The Legal Regulation of Interoperability in an Oligopolistic Market

In Partial Completion of PhD

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Abstract

3D CAD (Computer Aided Design) software is widely used in engineering industries to design products and manage their lifecycles. It is crucial to the economy as it records vital design information and knowhow on all engineered products in the developed and developing worlds. The industry is oligopolistic with few suppliers and while efforts have been made to standardise data transfer formats by the promulgation of standards there are formidable interoperability issues. Once users have purchased a particular brand of software they are essentially "locked in" and the industry has all the elements associated with a lack of interoperability, namely network effects, lock-in, and proprietary software and interfaces.

Intellectual Property Rights in software are granted to incentivise innovation but cause a lack of interoperability. The ideas and principles which underlie software interfaces are not protected by copyright but there is no such exemption for patents. Interfaces are similar to standards and their indirect effect amplifies their impact and value and distorts the intended intellectual property protection. As the machine code which is distributed to users is not readable, reverse engineering is permitted to enable interoperability, subject to restrictions, including prohibiting the sharing of interface specifications, which is tantamount to making the information a statutory trade secret.

Using legal doctrinal research of primary and secondary materials including case law, previous research alongside industry documents and interviews with experts in the industry, this thesis makes original and significant contributions to knowledge. Firstly, the research provides an assessment of the legal regulation of lock-in in an oligopolistic market and identifies the inability of competition law to provide a remedy. It had previously been assumed that competition law would provide a remedy of last resort to require disclosure of interface information. Secondly, considering the indirect function of control of interfaces the justification for patents in interface standards is critically evaluated. Thirdly, with reference to the normative framework of balancing control and openness of interfaces, the ability of the studied market to achieve an optimum balance is evaluated, taking account of the impact of market conditions including the lock-in of the users' proprietary data, the software's functional nature and the need for data integrity. Fourthly, with reference to this research and intellectual property law principles and practice existing proposals are critically evaluated including the reduction of the term of protection which will harm vertical interoperability of complementary software. The argument that the time and cost of reverse engineering has a purpose in protecting first comers is countered and it is proposed that reverse engineering of interfaces should be easy and effective. Recommendations are made to improve the dissemination of interface information to allow markets to move towards an optimum balance with minimum regulatory interference.

The regulation of interoperability is a balancing act between control by rightsholders and openness of interfaces and this thesis builds on existing research to refine and expand the criteria that identifies the 'pivot'. Recommendations with least intervention and encouraging efficient market solutions are made with an emphasis on improving reverse engineering's effectiveness, particularly in the openness and dissemination of interface specifications.

Contents

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DECLARATION

To date the following journal article, report, impact case study and presentation directly related to the PhD have been published:

Firstly on copyright exceptions in interfaces in the Software Directive:

- Sally Weston, Software Interfaces: stuck in the middle. "The relationship between the law and software interfaces in regulating and encouraging interoperability" - International Review Intellectual Property and Competition Law (IIC) June 2012 (3*)

Secondly a report on Open Standards for interfaces for Government Software Procurement commissioned by the UK Cabinet Office

- Sally Weston (PI), Martin Kretschmer, Jennifer Piesse "Open Standards in Government IT: a Review of the Evidence" – UK Cabinet Office September 2012

Thirdly the work on Open Standards for the UK Cabinet Office formed part of an Impact Case Study for REF 2014 which was awarded 3* or 4*

Fourthly the findings of this research were presented at EPIP, Glasgow University in September 2015

CHAPTER 1. INTRODUCTION

1.1 Introduction

This is a law dissertation which considers the regulation of intellectual property rights (IPRs) in software interfaces and their effect on software interoperability. There is no exception to patent protection for the purpose of achieving interoperability and the exception to copyright protection only permits reverse engineering to achieve interoperability subject to specific conditions. Competition law has been invoked on a few occasions to require disclosure of interface information but this remedy is only available when the rights holder abuses a dominant position and is ex post and prone to error. Lack of interoperability persists in many industries including those that are oligopolistic in nature.

The legal and economic literature in this area highlights the balance that must be struck between IPRs - mainly copyright, patents and trade secrets, and the need for interoperability to create an expansion in use, enabling competition and encouraging innovation. Interoperability, or a lack of it, lies at the heart of the debate currently raging over the digital giants such as Google, Apple, Facebook and Amazon, and the rise of "platforms" that create "walled gardens" which make it hard for users to move content from one platform to another."[1]

The main regulatory tools - competition law and intellectual property, have the same goals – to maximise both allocative efficiency (cheaper products with less resources), and dynamic efficiency (superior products) – but there is conflict in the way they operate. Even regulation in the form of the exceptional circumstances test as applied in the Microsoft case has been criticised as a false negative which can harm incentives to innovate. A lack of interoperability is however also believed to harm innovation.

There has been debate and studies which have looked at the perspective of interoperability and its impact on network markets. This dissertation examines the present legal regime in the context of an oligopolistic market where the competition law remedy in the form of the exceptional circumstances test is not obviously available. Interoperability not only affects the well published cases of the internet platforms but is very prevalent in all industries that rely on software to construct and record their data. The case of *SAS Institute Inc v World Programming Ltd*[2] is one such example where the software user is locked into the software supplier because of a lack of compatibility with competing software. In order to establish that a real world problem exists the law will be considered in the context of the oligopolistic market of the 3D CAD industry. Through doctrinal analysis and the examination of case studies and the analysis of policies and practices in the industry, the thesis will illustrate the challenges posed by a lack of interoperability and investigate whether the existing legal regime provides solutions and seek to identify improvements.

1.2 Context and Perspective

The study examines the legal regulation of interoperability in the context of the 3D CAD market. 3D CAD software is crucial to the economy as it records vital design information and knowhow on all engineered products in the developed and developing world. Another vital role is facilitating rapid innovation, which enables the development of sophisticated products. The industry is easily identifiable as there are four main suppliers of 3D CAD software – Siemens, Autodesk, Dassault Systemes and Parametric Technologies – in an oligopolistic market.[3] Despite attempts to promulgate standards there are formidable interoperability issues and users are essentially “locked in” once they have purchased a particular brand of software. The industry experiences all the problems associated with a lack of interoperability, namely; network effects; lock-in; proprietary software; and intellectual property rights and practices restricting access to interfaces. The industry was identified in the 2013 Commission Staff Working Document as experiencing interoperability problems.[4] It could be considered a “worst case” scenario.

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[1] Editorial, ‘Survival of the Biggest’ *Economist* (London, 1 - 7 December 2012) 13

[2] Case C-406/10 *SAS Institute Inc v World Programming Ltd* [2012] Judgement of the General Court (Grand Chamber) (2012) 3 CMLR 4.

[3] Chapter 5 will evaluate the industry and conclude that it is oligopolistic in nature.

[4] Commission Staff Working Document, *Analysis of measures that could lead significant market players in the ICT sector to license interoperability information* SWD (2013) 209 final, 18 (‘Commission Staff Working Document’)

Interoperability requires two or more programs to exchange and use information.[5] It does not require the programs to use the same code or perform identical or similar functions, but they must be able to exchange and use essential information. The exchange of information between programs takes place through interfaces which can take various forms: application programming interfaces (APIs), protocols, and data file formats.

Interoperability is generally considered to promote socially desirable goals.[6] Intuitively it would seem that interoperability should create an expansion in use, enabling competition and encouraging innovation.[7] The innovations thus stimulated would be more likely to be of the "follow on" type rather than "breakthrough".[8] While there is no systematic body of empirical evidence of a link between interoperability and competition and innovation, the claim is often supported by illustrative examples.[9]

1.3 Broader Theoretical or Policy Relevance of the Inquiry

The underlying policy objectives of the Software Directive, the cases applying the exceptional circumstances test and the merger cases are to encourage innovation and increase consumer choice. Paradoxically, both strong IPR protection and maximum interoperability are thought to achieve these goals, but are also in conflict, so the balancing

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[5] Council Directive 2009/24/EC on the legal protection of computer programs, ('Software Directive' or 'Directive' as case requires) [2009] OJ L111/16, recital 10.

[6] Pamela Samuelson 'Are Patents on Interfaces Impeding Interoperability?' (2008) Berkeley Centre for Law & Technology 1. http://ssrn.com/abstract=1323838; Oracle America Inc. v Google Inc., Brief of Amici Curiae Intellectual Property Professors in Support of the Defendant-Cross Appellant and Affirmance 30 May 2013.; and Urs Gasser and John Palfrey 'When and how interoperability drives innovation' 31 October 2007. http://cyber.law.harvard.edu/sites/cyber.law.harvard.edu/files/interop-breaking-barriers_1.pdf

[7] Commentators including Mark Lemley 'Antitrust and the Internet Standardization Problem (1996) 28 Connecticut Law Review 1041, recognise the benefits of interoperability while others consider the position is more ambiguous, *see e.g.* Mario Gil-Moto 'Economic aspects of the Microsoft case: networks, interoperability and competition, in Luca Rubini , "*Microsoft on Trial*" 344 at 359 *et seq.* (Edward Elgar, Cheltenham, 2010).

[8] Follow on innovation is dynamic rather than static competition *e.g.* coming within the description of dynamic competition advocated by Gregory Sidak and David Teece 'Dynamic competition in antitrust law (2009) 5(4) Journal of Competition Law and Economics 581-631, 594 *et seq*.

[9] Urs Gasser and John Palfrey 'When and how interoperability drives innovation' (31 October 2007). http://cyber.law.harvard.edu/sites/cyber.law.harvard.edu/files/interop-breaking-barriers_1.pdf

act is far from straightforward. Owners of proprietary software claim strong IPRs are essential to justify investment in innovation, while others[10] favour the open systems model exemplified by open source software.

In Europe the Software Directive confirmed that ideas and principles which underlie interfaces are not protected by copyright under the Directive. The decision in *Sega Enterprises, Ltd v Accolade, Inc.*[11] gave a similar position in the USA by reining-in copyright and trade secret protection of interfaces in the USA. Since *Sega* there has been an increase in patent applications in the USA for software interfaces.[12] There are acknowledged drawbacks to software patents for interfaces, including insufficient rigour in the standard for non-obviousness and lack of adequate cost effective post grant review.[13] Patents are granted to incentivise innovation and in return for early publication of the invention. Software patents do not however have to disclose the source code or object code or even detailed descriptions of the patented program.[14] As patents can be narrower than the interface they do not necessarily require the revelation of all the "trade secrets" necessary for full compatibility.

When the Software Directive was being introduced there was intense lobbying by various factions of the industry, for and against reverse engineering and the open availability of

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[10] In addition to proponents of open source software governments are adopting open standards, see https://www.gov.uk/government/publications/open-standards-principles accessed 14 October 2015

[11] 977 F.2d 1510 (9th Cir. 1992)

[12] Pamela Samuelson 'Are Patents on Interfaces Impeding Interoperability? (2008) Berkeley Centre for Law & Technology 1, 13 – there may be many thousands of patents on interfaces; Lerner J, and Zhu F, 'What is the Impact of Software Patent Shifts?: Evidence from Lotus v Borland' (2005) NBER Working Paper 11168 http://www.nber.org/papers/w11168 provides empirical evidence of a surge in patenting of software dating from the mid-1990s.

[13] Pamela Samuelson 'Are Patents on Interfaces Impeding Interoperability?' (2008) Berkeley Centre for Law & Technology 1, 29

[14] James Bessen and Robert Hunt, 'An Empirical Look at Software Patents ' (2007) 16 Journal of Economics and Management Strategy 157, Courts in the USA have accepted high-level functional descriptions.

interfaces.[15] The compromise that was reached has lasted for over ten years but its success has not been quantified. Given the divergence of opinions expressed when the Directive was being drafted it could be assumed that the Directive was expected to have significant impact. Although the Directive was a focus of academic attention in 1991 no research has been undertaken with the object of examining its impact on an oligopolistic market. Though there have been studies considering the economics of lock-in and network effects[16] the only empirical study to examine the question of interoperability under the Directive from a legal perspective was a quantitative study conducted for the Commission Staff Working Document.[17] This thesis considers that work and builds on it by using qualitative data from a software industry to evaluate interoperability in the context of the legal framework, including the Software Directive and patent protection.

Nellie Kroes, when arguing for a potential future legislative proposal to require the publication ex ante of interoperability information, identified the absence of evidence on which to base decisions when assessing the best way to encourage ex ante interoperability.[18]

This thesis concentrates on the legal position in the EU however the development and practice of the law regarding IPR treatment of interfaces and competition law in the EU has been influenced by the legal position in the US. The relevant theories and legal provisions of US law as they impact the 3D CAD industry will be considered as part of this thesis.

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[15] Thomas Vinje '*The History of the EC Software Directive'* in M. Lehmann & C. Tapper *A Handbook of European Software Law (* Clarendon Press, Oxford, 1993) and Ashwin van Rooijen *The Software Interface between Copyright and Competition Law* (Kluwer Law International 2010)

[16] See for example Shane M. Greenstein, 'Lock-in and the Costs of Switching Mainframe Computer Vendors: What Do Buyers See?' (1997) 6 Industrial and Corporate Change and Ian Larkin, 'Bargains-then-Ripoffs: Innovation, Pricing and Lock-in in Enterprise Software' (2008) Academy of Management Annual Meeting Proceedings 1

[17] Noam Shemtov is unaware of empirical data on reverse engineering and decompilation, Noan Shemtov 'The Legal Regulation of Decompilation of Computer Programs: Excessive, Unjustified and in Need of Reform' (PhD Thesis QML 2013, 3

[18] N. Kroes, 'Speech 10/300' (Open Forum Europe 2010 Summit: Openness at the heart of the EU digital agenda Brussels)

1.4 Research Questions

The main aim of this thesis is to critically evaluate the existing legal regime, in the form of IPRs and competition law, which regulate the phenomenon of incompatibility of software in an oligopolistic market, such as the 3D CAD market, to construct a model of the law and policy to identify shortcomings in the existing legal regime and identify possible solutions. The thesis will illustrate the challenges posed by a lack of interoperability and investigate whether the existing legal regime provides solutions and seek to identify improvements.

The thesis has sought to answer the question of how the existing legal regime regulates the disclosure of interface information for the purposes of interoperability in an oligopolistic market such as the 3D CAD industry. It also seeks to answer what realistic amendments can be made to the current law.

The thesis evaluates how the existing regime responds to market failures that justify intervention. It considers whether competition law can provide a remedy in an oligopolistic market characterised by a lack of interoperability. The role of standards is evaluated and flaws are highlighted.

The thesis recommends modifications to the current law aimed at increasing access to interface information to help the market respond to the challenges presented by a lack of interoperability.

1.5 Contribution

Using legal doctrinal research of primary and secondary materials including case law, previous research alongside industry documents and interviews with experts in the industry, this thesis makes original and significant contributions to knowledge.

Firstly, the research provides an assessment of the legal regulation of lock-in in an oligopolistic market and identifies the inability of competition law to provide a remedy. It had previously been assumed that competition law would provide a remedy of last resort to require disclosure of interface information.

Secondly, considering the indirect function of control of interfaces the justification for patents in interfaces standards is critically evaluated.

Thirdly, with reference to the normative framework of balancing control and openness of interfaces the ability of the studied market to achieve an optimum balance is evaluated, taking account of the impact of market conditions including IPRs, the lock-in of the users' proprietary data, the software's functional nature and the need for data integrity.

Fourthly, with reference to this research and intellectual property law principles and practice existing proposals are critically evaluated including the reduction of the term of protection which will harm vertical interoperability of complementary software. The argument that the time and cost of reverse engineering has a purpose of protecting first comers is countered and it is proposed that reverse engineering of interfaces should be easy and effective. Recommendations are made to improve the dissemination of interface information to allow markets to move towards an optimum balance with minimum regulatory interference.

1.6 Structure and Overview of Thesis

This thesis analyses the phenomenon of interoperability, to make recommendations to improve interoperability, with minimum regulation or harm to vital aspects of the software industry, such as incentives to innovate. It has been structured to start with the introduction of the research methodology and the phenomenon.

The research methodology is primarily legal doctrinal research. The effectiveness of the main areas of law that are the subject, namely competition law and intellectual property law, are determined by economic as well as legal considerations. For this reason the research has included economic theory underpinning the relevant areas of law. The research has gone beyond the document based analysis and includes empirical qualitative research of experts in the 3D CAD industry. The research methodology behind this investigation concludes the second Chapter.

The third Chapter introduces the phenomenon of interoperability and the relevant legal and economic principles. The reader becomes acquainted with the conflict and balance between interoperability, innovation and the legal interventions of intellectual property rights and reverse engineering. The state of existing research is explored including relevant case studies and the normative framework balancing control by rightsholders and openness.

The fourth Chapter analyses the 3D CAD industry from its evolution over 50 years to its present oligopolistic structure dominated by proprietary software that gives it a controlled and closed nature. The rationale for selection is explained and the market defined. The competitive conditions in the industry are reviewed specifically to understand the implications for the regulation of interoperability by competition law and intellectual property rights. The Chapter concludes with a structural analysis based on Michael Porter's techniques for analysing industries and competitors but with a focus on the legal regulation of interoperability.

The fifth Chapter analyses competition law to determine whether a remedy is available in an oligopolistic market with no single dominant undertaking. After discussing the theoretical background to the rational of competition law interfering with IPR it is considered how far the exceptional circumstances test provides an adequate solution. As competition law is ex post and prone to error it is only a last resort to regulate interoperability by mandating disclosure of interface information. It can though have some flexibility for individual cases within the framework of the exceptional circumstances test. Because of the oligopolistic nature of the 3D CAD market there appears to be no single dominant entity but consideration is given to the impact of interoperability on the definition of the market and whether the concept of collective dominance could allow the exceptional circumstances test to apply to an oligopolistic market. It is concluded that while competition law can aid interoperability by controlling mergers the law as presently framed does not regulate oligopolies, particularly in the absence of economic links, and does not provide an effective deterrent.

Chapter 6 considers IPRs which provide ex ante regulation but apply similarly to all cases. This is most appropriate where the legal consequence of the regulation is foreseeable. The 3D CAD industry suffers from a lack of interoperability and while there are market solutions they are only partial. The amplifying effect of IPRs in interfaces provides the backdrop to a review of the present law on copyright, trade secrets and patents. Ideas and principles of interfaces do not have copyright protection and this applies to data formats because of their functional nature.[19] APIs have not yet received the specific attention of the CJEU but US case law has reinstated the importance of the sequence structure and organisation aspects of interfaces. Potentially decompilers who do not copy code will be uncertain about unintentional infringement of other elements of the interface. This could be resolved by reinforcing that under the Software Directive the functional nature of interfaces means that only the code amounts to the expression. Unfortunately the US Supreme Court refused to hear an appeal[20] that could have recognised that copyright should not be used to secure a monopoly for a system or method of operation where the rules and method of useful art have their final end in application.[21] A detailed analysis of the role of patents in interfaces evaluates the flawed concept and implementation of software patents and concludes that given the indirect effects of interfaces the economic justification for patent protection is doubtful.

The impact of patents on interfaces which are de facto and formal standards is considered further in Chapter 7 on standards. This Chapter starts to look at means to encourage and ensure adequate interoperability. The legal regulation of standards, much of which is to avoid abuse by patent holders is reviewed. It is recognised that standards in the 3D CAD industry provide only a partial functionality and that solution provided by standards is important but limited.

Chapter 8 reviews existing recommendations to improve interoperability including a proposed Interoperability Directive. The need to balance control and openness is sensible but considers the criteria to determine the positioning of the 'pivot' is not yet established. The 3D CAD market provides a core and critical function for its users and integrity of the users' proprietary data must be taken into account when adjusting the balance between control and openness. Any change must avoid market destruction. Mandatory disclosure of interface information is considered overly interventionist and probably unworkable as

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[19] Case C-406/10 *SAS Institute Inc v World Programming Ltd* [2012] Judgement of the General Court (Grand Chamber) (2012)3 CMLR 4

[20] Oracle America, Inc. v Google Inc. US District Court (31 May 2012, C10-03561 WHA)

[21] Baker v Selden 101 (11 Otto) U.S. 99 (1880) determined that systems and methods of operation (along with specific elements of expression that are "necessary incidents" to them) are not copyrightable.

interfaces are difficult to categorise. Reverse engineering is a vital tool to gain interoperability and as its purpose is limited there is no reason to protect the first comer. Efficient reverse engineering as permitted by the Software Directive should be encouraged. There are doctrinal and economic rationales for allowing interface specifications obtained by legitimate decompilation to be shared. This recommendation is discussed with mechanisms to implement, including a register, outlined and the benefits of copyright and patents having similar provisions discussed. The Chapter concludes with consideration of how this recommendation could work with the recommendations from the 2013 Commission Staff Working Document.

CHAPTER 2. RESEARCH METHODOLOGY

2.1 Introduction

This Chapter will describe the adopted research methodologies. The main methodology is doctrinal analysis. This is supported by empirical research in the form of interviews with industry experts. Following the overview of the research methodologies in this Chapter the legal doctrinal research will follow, particularly in Chapters 5 to 7 with summary of findings and recommendations in Chapter 8.

The findings of the interviews will be used throughout the thesis to corroborate the doctrinal literature research. They will also be a section evaluating the findings further in 4.11.

As the industry is small and interconnected the names of interviewees or details that identify the interviewees will be withheld. Footnote referencing to interview transcripts validate the evidence.

2.2 Doctrinal Research

As a law dissertation the principal methodology is doctrinal analysis into the law and legal concepts. It provides a systematic exposition of rules governing a particular legal category. It analyses the relationship between those rules, explaining areas of difficulty and recommending future developments.[22] The approach identifies a body of inter-related principles, including rules and guidelines, associated with a legal concept or principle. These core legal principles, embodied in statute and case law, are interpreted using a number of secondary sources including academic papers and consultation documents and applied to factual situations. The doctrinal approach has advantages, the most important of which are accuracy and availability. A large legal database is available, mainly in electronic format which is highly searchable. The doctrinal approach can be applied to the complex matrix of primary and secondary sources to analyse and study in depth the relevant areas of intellectual property law and competition law.

[22] Terry Hutchinson and Nigel Duncan 'Defining and describing what we do: doctrinal legal research' (2012) 17 (1) Deakin Law Review 83-119

The 3D CAD industry is based in the USA and Europe although the market is global. This dissertation will focus on the legal regime in Europe, considering the role of the Software Directive, patent law and European Competition Law. Because of the importance of the USA to the industry, comparison will be drawn with the treatment of software interfaces in the US, particularly the development of case law on copyright and patents and the approach adopted by the US Justice Department enforcing anti-trust laws.

Analysis of legal doctrines alone is not sufficient to obtain the objectives of this thesis and literature on relevant economic propositions will be reviewed. It is acknowledged that law research is not a clearly distinct methodology but an amalgam of elements including applied logic, economics and practices.[23] The purpose and rationale for intellectual property law and competition law are social and economic goals to maximise both allocative efficiency (cheaper products with less resources), and dynamic efficiency (superior products). However, there is conflict in the way they operate, and this special position has given rise to a large amount of literature in the field of economics which cannot be ignored. The literature deals with the economic rationale for intellectual property and competition law and with the effects of interoperability, standards and lock-in. This literature has been analysed in the context of a law thesis to form an understanding of the purpose of the legal regime regulating the 3D CAD market.

Building from the doctrinal analysis in the context of the 3D CAD market, a model of the legal regime will be developed, which will be evaluated to draw conclusions with a view to improving the regulation of interoperability.

2.3 Qualitative Empirical Research

The research started as a mixed method dissertation incorporating doctrinal research and a case study. What emerged is predominantly a law doctrinal dissertation though the thesis includes an element of empirical qualitative research. This allows the study to go beyond a document based analysis and investigate the reality in which the law operates.

[23] Richard Posner, 'Conventionalism: The Key to Law as an Autonomous Discipline' (1988) 38 University of Toronto Law Journal 333 "law is not a field with a distinct methodology, but an amalgam of applied logic, rhetoric, economics and familiarity with a specialized vocabulary and a particular body of texts, practices, and institutions .."

Although doctrinal research can be accurate, empirical research, while improving the understanding of reality and allowing elaboration on future developments with some level of probability, is more tentative and prone to changes driven by altering circumstances.[24] This is at odds with the fondness for legal certainty but nonetheless it has been accepted, especially by the legal realism movement, that empiricism has a role to play in the study of law.[25]

The aim of the research is first and foremost to analyse the legal regulation of the phenomenon of software interoperability. While this can best be achieved by doctrinal methodology, to help the research concentrate on real world problems, rather than abstract concepts, the analysis is being carried out in the context of the 3D CAD industry. As explained earlier this industry is intrinsically important and could be a "worst case scenario".

Research into the industry from industry documents, academic papers and interviews was carried out to inform and determine the existence and nature of the phenomenon of interoperability in the industry. Interviews were conducted to corroborate the desk based research into the industry. Analysis of the various sources identified the relevant converging lines of enquiry and convergence of conclusions. The theoretical propositions and hypothesis were identified and have informed data collecting and analysis. This allowed the law to be evaluated and analysed in a real world context and improved the relevance of the research.

In order to ensure that the evidence gathered by interviews was valid the interviews were selected and conducted in accordance with case study and empirical enquiry methodology.

A case study entails "the detailed and intensive analysis of a single case."[26] It is a holistic approach, attempting to "capture the totality of the phenomenon" and is "rich in description and understanding of the program, its complexity and its dynamic."[27]

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[24] W.C. Whitford, ''Critical Empricism' ' (1989) 14 Law and Society Inquiry 61

[25] Michael Heise, 'The Past, Present and Future of Empirical Legal Scholarship: Judicial Decision Making and the New Empiricism' [2002] University of Illinois Law Review 819

[26] Alan Bryman and Emma Bell, *Business Research Methods* (3rd edn, Oxford University Press 2011) 59

A case study is an empirical enquiry that:

- Investigates a contemporary phenomenon within its real-life context, especially when the boundaries between the phenomenon and context are not clearly evident.

- Copes with a technically distinctive situation in which there will be many more variables of interest than data points.

- Relies on multiple sources of evidence, with data needing to converge in a triangulating fashion.

- Benefits from the prior development of theoretical propositions to guide data collection and analysis.[28]

A case study methodology is used when there is a need to cover contextual issues, which are highly pertinent to the phenomenon under consideration.[29]

Although this is not first and foremost a case study, nevertheless when gathering and analysing interview data the four tests commonly used to establish the quality of empirical research were considered:

- Construct Validity: establishing correct operational measures for the concepts being studied.

- Internal Validity (for explanatory or causal studies only, and not for descriptive or explanatory studies): establishing a causal relationship, whereby certain conditions are shown to lead to other conditions, as distinguished from spurious relationships

- External validity: establishing the domain to which a study's findings can be generalised.

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[27] Janet Spirer, *The Case Study Method: Guidelines, Practices and Application for Vocational Education (*National Center Publications, The National Center for Research in Vocational Education 1980)

[28] Robert Yin, *Case Study Research Design and Method (* Sage, London*, 2009)*

[29] Ibid

- Reliability: demonstrating that the operations of study – such as the data collection procedures can be repeated, with the same results.[30]

To ensure construct validity multiple sources of evidence were used and a chain of evidence established. Although the importance of the 3D CAD market justifies the study, analytical generalisations arising from the study may justify external validity. The propositions posed and the detailed questions will form the basis of the data collected to ensure reliability.

2.4 Sampling Methodology

Within each sector a sample was selected by purposive screening[31] rather than random or non-probability sampling. The goal was to achieve a sample in a strategic way that was relevant to the research proposed and gave a good deal of variety with different key characteristics. While the sample was not random, it was not chosen for convenience but with research goals in mind. It was selected as relevant to an understanding of the social phenomenon.

The four key areas around recruitment were considered: initially finding a knowledgeable informant; getting a range of views; testing emerging themes with new interviewees; and choosing interviewees to extend results.[32] The interviewees could be considered elites, as they are experts in their field, and the best way to achieve access to elites can be through other elites. Therefore contact with the industry was established and introductions to potential interviewees did arise.[33]

It is recognised that actual recruitment may deviate from the planned method and can happen in an ad-hoc and chance basis while remaining valid reference criteria. "It is

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[30] L H Kidder and C M Judd, *Research methods in social relations* (5th edn, Holt, Rinehart and Winston 1986) 26

[31] Alan Bryman and Emma Bell, *Business Research Methods* (3rd edn, Oxford University Press 2011)

[32] Tim Rapley, 'Interviews' in G Gobo C Seale, JF Gubrium and D Silverman (ed), *Qualitative Research Practice* (Sage, London 2004) referring to H.J. and Rubin*, I.S., Qualitative Interviewing; The Art of Hearing Data. Thousand Oaks, CA: SAGE*

[33] See Alan Bryman and Emma Bell, *Business Research Methods* (3rd edn, Oxford University Press 2011) referring to Pettigrew, A. and McNulty,T. *'Power and Influence in and around the Boardroom' Human Relations, 48(8)(1995) 845-73*

important to try to get a range of views"[34] as these can produce 'radically different' or contrasting talk – often central to modifying theories. Above all, it is vital to take notes about the recruitment process and offer it in reports on research as questions of access and recruitment can be central to understanding the 'outcomes' of the research.

Four sectors of the industry were identified. If the purpose was to achieve a detailed and intensive analysis of the case of interoperability in the industry then all four sectors would have been interviewed. However as the purpose of the interviews was to provide context, focus and direction for the legal analysis the number of interviews were more limited and selective:

- Suppliers of 3D CAD systems
- Suppliers of complementary software
- Users
- Translators and standards setting bodies

The questions that interviewees were asked were based on concerns the literature analysis had identified as most relevant to the investigation of whether the existing legal regime is adequate and to identify potential improvements. The interviews were in a semi-structured form. All interviewees were asked a number of similar questions which give some standardisation and validity but also allowed for flexibility to respond to the direction the interviewee takes to allow for new emphases or even new issues to emerge in the course of the interview.[35] Questions were compiled to keep the interviewer on track and to give consistency. They gave structure to the inquiry but were not literal questions. They were generally in the form of level 2 questions which are asked of the industry rather than individual interviewees.[36] The form of questions were open questions to allow an unstructured approach to data collection to access the interviewee's perceptions, motives and attitudes towards interoperability in the 3D CAD market.

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[34] Tim Rapley, 'Interviews' in G Gobo C Seale, JF Gubrium and D Silverman (ed), *Qualitative Research Practice* (Sage, London 2004)

[35] Alan Bryman and Emma Bell, *Business Research Methods* (3rd edn, Oxford University Press 2011)

[36] Robert Yin, *Case Study Research Design and Method (* Sage, London*, 2009)*

Most interviews were recorded digitally but three of the interviewees declined to be recorded as they stated that they were working in a sensitive commercial environment. Interviews that were not recorded were conducted by the interviewer taking notes during and immediately after the interview in order to convey the course of the interview diligently as the standard of research requires.

2.5 Interview Sample

A total of nine face to face interviews were conducted from across the four sectors of the industry between May 2013 and November 2014. In addition there was email correspondence with industry observers and other experts based in the USA. Informal interviews and discussion also took place with design engineers and software engineers to explore technical and commercial issues concerning software interfaces.

Industry sector	No.interview	Description of role of interviewee
Suppliers of 3D CAD systems	2	Senior executives of two different suppliers. Both based in UK but operate across Europe
VAR for 3D CAD supplier	1	Senior executive of Value Added Reseller of 3D CAD software
Suppliers of ancillary and complementary software	2	Senior employees of two different suppliers of software where compatibility with 3D CAD software is essential
Translator and standard setting bodies	1	Senior member of the STEP committee
Users of 3D CAD software	2	2 formal interviews with design engineers with extensive knowledge of 3D CAD software as designers, software engineers and project managers and further informal conversations with other software and design engineers.

Industry Analyst	1	Senior industry analyst based in UK but frequently presenting at COFES[37]

2.6 Subject Areas Explored in the Interviews

Policy and practice on interoperability - As discussed in the previous Chapter the benefits of interoperability are complex and nuanced. It is presumed that proprietary software suppliers are opposed to interoperability.[38] In an oligopoly a lack of interoperability will mean that the market is stagnant as users are locked-in to suppliers and each supplier can retain their market share. This observation has been made of the 3D CAD market.[39] Conversely if one supplier wants to increase its market share it is thought necessary to increase interoperability.[40] The suppliers' responses may be constructed to present policy they wish to project rather than reality and for this reason comparison was made with data collected from other interviewees including the industry analyst.

Knowledge of the Legal Position - A major criticism of any attempt to reduce IPR protection is that it reduces the incentive to invest and innovate.[41] The knowledge the suppliers have of the legal position, particularly compulsory licencing and reverse engineering, is explored

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[37] See COFES 2015 The Congress on the Future of Engineering Software, Arizona http://cofes.com/Events/COFES-2015/Agenda.aspx [Accessed 12 August 2015]

[38] This was evidenced by the concerted opposition to the provisions of the Software Directive that were intended to encourage interoperability. See Thomas Vinje, "*The History of the EC Software Directive*" in M. Lehmann & C. Tapper *A Handbook of European Software Law (*Clarendon Press, Oxford, 1993)

[39] See Cyon Research "*EDS and PTC: Is there any substance to their interoperability agreement?"*(2002) Cyon Research Corporation. http://www.cyonresearch.com/Portals/0/files/whitepapers/interop040302.pdf [accessed 28 November 2015] *"*Most customers have made their decisions about which CAD system they are going to use, making wholesale migrations are rare. It's a zero-sum game: EDS, PTC and Dassault are each as likely to lose a seat of CAD software to a competitor as they are to gain one.*"*

[40] Ann Walsh, "*Microsoft v Commission*: interoperability, emerging standards and innovation in the software industry" in Rubini, L, (ed) *Microsoft on Trial* (Edward Elgar 2010)

[41] This was particularly stressed during *Microsoft* and in subsequent criticism. Alan Devlin, Michael Jacobs & Bruno Peixoto 'Success, Dominance, and Interoperability' (2009) 84 Indiana Law Journal, 1157- 1201; Richard A. Epstein 'Unilateral Practices and the Dominant Firm: The European Community and the United States' in Stephen Copp (ed) *The Legal Foundations of the Free Markets (*Institute of Economic Affairs, 2008)

to give a better understanding of the impact the legal regime may have on influencing behaviour ex ante.

Interfaces – As interfaces are the tools for achieving interoperability these questions examined in more depth the practice adopted in respect of interfaces. Issues that were explored included the practice on disclosing interface information. The extent to which suppliers write comprehensive interface specifications was also be explored as these were key documents to enabling interoperability.[42]

Reverse Engineering - Article 6 of the Software Directive which permits decompilation for the purposes of interoperability was one of the most contested provisions. The interviewees' views were sought on issues such as whether reverse engineering should be permitted to enable interoperability of competing products to see whether this is an outdated view. Reverse engineering is widely practiced but has severe shortcomings. The extent to which reverse engineering is used was explored, particularly in relation to translators and standards bodies.

Causes of Lock-in - A user can be locked-in by network effects or to a particular vendor. The causes of the lock-in differ and the phenomenon of lock-in in the industry was explored in the interview. Suppliers and users were also asked whether lock-in was foreseen and whether the price and other terms reflected this.[43]

Investment in R&D - The impact on R&D investment of interoperability and key aspects of the legal regime is explored by these questions. This category may have been addressed and exhausted in earlier questions.

Future Scenario - This looked at the interviewees' opinion on the trajectory for interoperability and whether the legal regime can influence this.

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[42] Specifications are the main method of communicating interface information. An interface specification comprised the core of the order made in *Microsoft* but Microsoft did not possess a specification at that time and was required to compile it. Any form of standard for an interface, be it an open standard or otherwise, is an interface specification.

[43] Ian Larkin, 'Bargains-then-Ripoffs: Innovation, Pricing and Lock-in in Enterprise Software' (2008) Academy of Management Annual Meeting Proceedings 1

2.7 Sample Questions and Answers

In Appendix 1 are sample questions and answers taken from the semi-structured[44] interview transcripts to give the reader a perception of interviews. They have been chosen as examples of answers that either corroborated the literature or otherwise useful in evaluating interoperability during the research.

The sample questions (with extracted answers in Appendix 1) are:

- Is lack of interoperability in 3D CAD Software a problem for manufacturing industry?
- How easily can interfaces be identified and documented? Are the interfaces clearly distinct?
- Should disclosure of interfaces be encouraged or even mandated?
- Should interface information obtained by decompilation be disclosed and shared?
- Are customers locked in to a particular 3D CAD System? What are the challenges for customers?
- Are market forces/customer demand driving interoperability and solving lock-in?
- Why is interoperability in 3D CAD software a technical challenge and why does STEP or another standard not provide a solution?
- How does interoperability affects policy and practice on R&D investment?

The findings of the interviews will be used throughout the thesis to corroborate or challenge the doctrinal literature research and most notably in sections 4.8 – 4.11 on the Industry, 8.2 Findings and the Appendix.

[44] Section 2.4 as semi-structured interviews asked a number of similar questions but also allowed flexibility to respond to interviewees initial responses.

CHAPTER 3. NATURE AND CONTEXT OF INTEROPERABILITY

3.1 Introduction

Before the concept of interoperability is considered in the context of the 3D CAD market interoperability and related concepts are introduced in a broader context. This Chapter establishes a foundation against which subsequent Chapters analyse the relevant law.

The Chapter starts with the legal and technology context for interoperability in software. The rationale for interoperability is then introduced with an analysis of the conflicting socially desirable goals of interoperability and IPRs. The consequences of network effects and lock-in are evaluated to assess whether these cause a failure in the market and whether this justifies further intervention. Lock-in is evaluated with a distinction drawn between market lock-in and supplier lock-in and consideration given to the implications for intervention. Existing case studies evidencing lock-in are reviewed as well as a normative approach to benchmarking the balance between openness and control in the legal framework. The Chapter concludes with summarising the general propositions concerning software interoperability and outlines the focus of the remaining thesis.

3.2 Interoperability

The Software Directive considers interoperability to be the functional interconnection and interaction between elements of software and hardware and "the ability to exchange information and mutually to use the information which has been exchanged."[45]

This requires something more than just the physical or logical interconnections and interactions of the interface. It involves not just the ability to exchange information, but that the information can be mutually used. This implies that interoperability is not just a technical matter. The information must be capable of being used, not just theoretically exchanged.

Interoperability can vary from the interface between computer programs operating on a single computer, to the exchange of data between large and complex organisations dependent on ICT systems such as government departments and health services. The interface between computer programs may only involve a machine-executable interface,

[45] Software Directive recital 10

whereas interoperability in a large complex ICT system involves human user interfaces and their ability to interpret and use the information.

The definition of interoperability, and the benchmarking of whether or not it has been achieved, is a wider issue than just the exchange of information. It has been defined by the RoadMap prepared by the Berkman Centre as "..the ability to efficiently transfer and use information uniformly across organisation, systems or components. It helps link systems, information and processes within and across enterprises"[46] and acknowledges that "frequently the main barriers to interoperability are not technical."[47]

This broad interpretation of interoperability implies that we are not just looking for a technical fix but must look at the humans and firms involved. For example, was it correct to say that iTunes was compatible with MP3 when the conversion was not straightforward, and the benefits did not justify most users expending the time to discover how to convert and then carrying out the process for a commodity worth only 99 cents?

How broadly interoperability will be construed at law is still uncertain. The degree of interoperability required by the Commission was considered at length in *Microsoft v Commission*.[48] While the determination was mainly influenced by competition law issues, the Court did pay heed to the Software Directive concept of interoperability.[49] In this case the degree of interoperability required was the extent necessary for competitors to remain viable in the market. This takes account of various factors appearing in the Roadmap.

The definition of interface and interoperability are linked. A more extensive expectation of interoperability could determine what parts of computer programs are considered interfaces. This is demonstrated by *Microsoft* where the Commission required Microsoft to

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[46] Jeff Kaplan 'Roadmap for Open ICT Ecosystems' *(2004)* Berkman Centre for Internet & Society at Harvard Law School, recognised this broader definition and that although technology is an enabler, interoperability is not only technology-driven. It "must respond to the needs and desired business outcomes of the communities that use, develop and maintain systems

[47] Ibid 5

[48] *Microsoft v Commission* [2007] 5 C.M.L.R. 11

[49] Ibid para 225 to 227

provide "specifications for protocols...including Windows domain controller services, Active Directory services and "group Policy" services".[50]

> "the complete and accurate specifications for all the protocols [that are] implemented in Windows work group server operating systems and that are used by Windows work group servers to deliver file and print services and group and user administration services, including the Windows domain controller services, Active Directory services and Group Policy services, to Windows work group networks".

Arguably not all this information was necessary to achieve full multivendor interoperability and if Microsoft's definition of interoperability had been accepted the extent of interfaces would have been more limited.

There is no single definitive definition of interoperability and while this thesis acknowledges the phenomenon and the need for interoperability it will not attempt to finalise a definition. The definition in the Software Directive which requires the ability to mutually use the information as well as the ability to exchange is however a reference point evidencing the legal requirement.

3.3 Interfaces

While interoperability requires two or more programs to exchange and use information it does not require the programs to use the same code or perform identical or similar functions. They must however be able to exchange and use the exchanged information. The exchange of information between programs takes place through interfaces which can take various forms: application programming interfaces (APIs), protocols, and data file formats.

APIs disclose to other developers the standard means of requesting the platform to carry out tasks for their application. Platforms provide APIs to encourage developers to write applications for their program to gain network effects. They are outward looking and do not reveal the details of how the task is accomplished. Protocols define and specify rules for exchanging information such as how to format and identify messages. Code compliant

[50] Ibid para 195 referring to Article 1(1) of the contested Commission decision where interoperability information is defined

with the protocols enables IT systems to work together. While APIs usually run on only one computer, protocols enable code to be written to work on two or more computers. The code should comply with the protocol but will not normally be written in an identical way. Data file formats specify how the data is encoded and stored in the files. Some of these are made public but many data file formats do not even have written specifications.

Each interface can exist in more than one form. The original form can be in source code which is then compiled into machine code. Many interfaces are then recorded as a specification in a word processed document. The intellectual property rights (IPRs) that have been used to protect these various forms include copyright, trade secrets and patents.

Interfaces are objectively defined as the rules by which data or instructions can be repetitively transferred between elements of a computer system.[51] Where such a transfer can occur, an interface exists; where it cannot occur, there is no interface. One cannot credibly claim that a portion of a program that is truly not an interface is one-or vice versa.[52] Almost any part of the program can be considered as an interface.[53]

The Software Directive defines interfaces as the parts of the computer program which provide for the "interconnection and interaction between elements of software and hardware".[54] The Directive encourages computer programs to function so that they can communicate and work with other systems and users. This requires logical interconnection and interaction between software and hardware and users so they can function in all the intended ways.[55] These interconnections and interactions are the interfaces. Interfaces are essential for computer programs to work with other elements and the ideas and principles

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[51] C Meyer and M Colombe, 'Interoperability still threatened by EC Software Directive: a status report' (1990) 12 European Intellectual Property Review 325, 328

[52] Ibid 328

[53] Robert J Hart 'Intefaces, Interoperability and maintenance (1991) EIPR 13 (4) 111-116, 112

[54] Software Directive, recital 10

[55] Software Directive, recital 10

underlying the interfaces are not protected by copyright in the Software Directive.[56] The CJEU has given directions on the relevance of this exemption in *SAS Institute Inc v World Programming Ltd*[57] which will be discussed in more detail later.

3.4 Intellectual Property Rights in Interfaces

Software is protected by copyright, trade secrets and patents. These IPRs prevent the code or function being copied, and control whether other software developers can design products which are compatible with and interoperate with each other. Depending on their business strategy, firms may be open and non-proprietary with interface information, as some may benefit from network effects for their systems. Developers of platforms have an incentive to allow other developers to create applications to work on their platforms but may not be open to potential rival platforms.[58] Others will have a proprietary closed approach. The plan can change over time and an interface is always vulnerable and could change and become unavailable unless it is adopted as a standard.[59]

Software interoperability is achieved through software interfaces, particularly the data formats but also APIs and protocols. Proprietary software interfaces are not readily available (because they are not published or even properly recorded) and are often protected by IPRs. Adopting standards for the interfaces helps to record and publish the interfaces but the adoption of standards incorporating IPRs raises several issues as to how the demands of both interests can be met. The main purpose of software standards is to increase interoperability.

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[56] Software Directive, recital 11 confirms the ideas and principles which underlie its interfaces are not protected by copyright under the Directive.

[57] *SAS Institute Inc v World Programming Ltd*, EWHC 3012, (Chancery Division High Court 22 November).

[58] Apple's strategy is normally for a closed proprietary system although it encourages applications to be written for its platform. Urs Gasser *and* John Palfrey "DRM-protected Music Interoperability and *e*Innovation" (November 2007) Berkman Publication Series. http://cyber.law.harvard.edu/interop

[59] For example when Microsoft first entered the work-group server operating systems market it disclosed interface information to enter, catch up and then dominate that market. It then introduced new software, Windows 2000, and did not disclose equivalent information. Case Microsoft (COMP/C-3/37.792) Commission Decision of 24 March 2004 relating to proceedings under Article 82 EC OJ L 32.23, para.780

In 1991 the Software Directive afforded copyright protection to computer programs as literary works, but the ideas and principles which underlie the computer program, including its interface, are not copyright protected.[60] In this way the Directive has provided protection from literal copying of the machine and source codes but does not protect the function of the program. Furthermore certain aspects of the interface, including the GUI[61] and specifications, are not copyright protected as literary works, which should assist interoperability. Computer programs must be able to interoperate with other programs and some exclusions, such as 'black box' analyses and 'reverse engineering' are permitted subject to certain conditions, including the limitation that any decompilation can only take place for the purpose of interoperability.[62] Although reverse engineering is commonplace, complex programs present significant difficulties as the process of reverse engineering is time consuming and can be thwarted by upgrades in the software being reverse engineered.[63] In many circumstances reverse engineering is not a good business model.

The manner in which the IPRs in interfaces are exercised has also been regulated by competition law. In 2004 the Commission ordered Microsoft to make certain information, including interface specifications, available to competitors in the work group server operating systems market.[64] Microsoft's refusal to make the information available voluntarily was held to be an abuse of its dominant position, which stifled innovation and diminished consumer choice by locking consumers into a homogeneous solution.[65] *Microsoft* was the most recent case to apply the 'exceptional circumstances' test to require

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[60] Software Directive, recital 11

[61] GUI, the graphic user interface is not copyright protected, see *Navitaire Inc. v easyJet Airline and Bulletproof Technologies Inc.* [2004] EWHC 1725

[62] Software Directive, Articles 5 & 6

[63] Samuelson and Suzanne Scotchmer 'The Law and Economics of Reverse Engineering' (2002) 111 The Yale Law Journal 1575, 1607

[64] *Microsoft* (Case COMP/C-3/37.792 Microsoft), Commission Decision of 24 March 2004 relating to proceedings under Article 82 EC OJ L 32.23

[65] Ibid Commission Decision at 782

the compulsory licensing of IPRs.[66] More recently the Commission required companies involved in acquisitions to licence interface information before clearance was granted.[67]

3.5 Interoperability and Innovation

As previously stated interoperability is considered to promote socially desirable goals and public benefit.[68] Interoperability encourages more use of resources and more competition which should stimulate innovation[69] which is likely to be of the "follow on" type rather than "breakthroughs".[70] While there is no systematic body of empirical evidence of a link between interoperability, and competition and innovation, the claim is often supported by illustrative examples.[71]

It is certain that lack of interoperability causes expense and wastage. The National Institute of Standards & Technology estimated that imperfect interoperability cost the US automotive supply chain at least $1 billion per year in 1999.[72] Incompatibility between two

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[66] Case T-201/04 *Microsoft v Commission* 5 C.M.L.R. 11 [2007].

[67] *Cisco Systems, Inc. And Tandberg ASA* (COMP/M.5669) Commission Decision of 29/03/2010 declaring a concentration to be compatible with the common market [2010] OJ L-2985 and Case COMP/M.5984 *Intel Corporation and McAfee, Inc.,* [2011] OJ C 98-1

[68] Pamela Samuelson 'Are Patents on Interfaces Impeding Interoperability?' (2008) Berkeley Centre for Law & Technology 1. http://ssrn.com/abstract=1323838, Oracle America Inc. v Google Inc., Brief of Amici Curiae Intellectual Property Professors in Support of the Defendane-Cross Appellant and Affirmance 30 May 2013.; and Urs Gasser and John Palfrey 'When and how interoperability drives innovation' (31 October 2007). http://cyber.law.harvard.edu/sites/cyber.law.harvard.edu/files/interop-breaking-barriers_1.pdf

[69] Commentators including Mark Lemley 'Antitrust and the Internet Standardization Problem' (1996) 28 Connecticut Law Review 1041, recognise the benefits of interoperability while others consider the position is more ambiguous, *see e.g.* Mario Gil-Moto 'Economic aspects of the Microsoft case: networks, interoperability and competition', in Luca Rubini , "*Microsoft on Trial*" 344 at 359 *et seq.* (Edward Elgar, Cheltenham, 2010).

[70] Follow on innovation is dynamic rather than static competition *e.g.* coming within the description of dynamic competition advocated by Gregory Sidak and David Teece, 'Dynamic competition in antitrust law' (2009) 5(4) Journal of Competition Law and Economics 581-631, 594 *et seq*.

[71] Urs Gasser and John Palfrey 'When and how interoperability drives innovation' (31 October 2007). http://cyber.law.harvard.edu/sites/cyber.law.harvard.edu/files/interop-breaking-barriers_1.pdf [accessed 15 October 2015]

[72] Smita Brunnermeier and Sheila Martin, Research Triangle Institute 'Interoperability Cost Analysis of the U.S. Automotive Supply Chain' Center for Economics Research for NIST (Final Report March 1999).

versions of Dassault Systemes' CATIA 3D CAD software delayed the delivery of the A380 and resulted in a $6 billion loss for Airbus.[73]

Perhaps the earliest and most notable impact of interoperability and open systems was the driving down of the quality adjusted price of the personal computer system when IBM, perhaps by accident, first introduced a personal computer using an open architecture.[74] The industry moved from the closed business systems adopted initially by IBM and Apple to a modular structure which encouraged specialisation and innovation. Innovation in components such as disk drives and modems as well as applications software proliferated. As IBM and Apple's market share declined the average price of computers fell by 40 per cent in 1992 alone.[75]

Interoperability has now been accepted as an essential virtue by most governments. The European Commission has accepted the benefits of interoperability in its competition law policy and policies for enterprise, industry and standardisation.[76]

Interoperability is regulated by IPRs and competition law and both aim to give incentives to encourage innovation and hence competition. The rationale for competition is that it gives efficient allocation of resources. Efficiency is an important concept in the relationship

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[73] Mel Duvall and Doug Bartholomew 'PLM: Boeing's Dream, Airbus' Nightmare' (2007) http://www.tgstech.com/releases/BoeingsDream_AirbusNightmare.pdf [accessed 10 April 2012]

[74] Joseph Farrell & Philip Weiser 'Modularity, Vertical Integration, and Open Access Policies: Toward a Convergence of Antitrust and Regulation in the Internet Age' (2003) 17 Harvard Journal of Law and Technology 85, also Richard Langlois 'Modularity in Technology and Organization' (2002) 49 Journal of Economic Behaviour and Organisation 19, 19. IBM was vertically integrated based around its mainframe computers. When it introduced personal computers it relied on Microsoft and Intel for key components including software and allowed them to license these to other computer makers. The specialisation that followed saw rapid innovation in chips, peripheral devices such as modems and software.

[75] David Angel and James Engstrom, 'Manufacturing Systems and Technological Change: The U.S. Personal Computer Industry' (1995) 71 Economic Geography 79, 81. IBM and Apple's market share fell from 52% to 21% between 1984 and 1992 to firms such as Compaq and low-cost system assemblers such as Dell who took advantage of the modularisation of the personal computer market.

[76] For example the ISA Interoperability Solutions for European Public Administration programme and decision in merger cases including Case COMP/M.5669, *Cisco Systems, Inc. And Tandberg ASA.,* [2010] OJ L-2985.

between IPRs and competition law.[77] Efficiency can mean "static efficiency", in which competition between existing technologies puts downward pressure on prices. In contrast "dynamic efficiency" is competition from new technology and products.[78]

This means that competition comes from new technologies rather than cost cutting. This requires substantial upfront investment in research and development and increased risk taking which must be recouped. Rational firms must expect sufficient profits to justify the investment. IPRs are essential to this process and are not separate from competition policy. IPRs are not protecting "their owners *from* competition ... but...should be seen as encouraging firms to engage in competition".[79] Nevertheless as a reward and incentive for innovation it might be acceptable for firms to enjoy "monopoly" profits for a period of time. Competition law does not prevent dominance, provided there is no abuse of that position.

Computer programs have low unit costs so the social benefit of the monopoly profits is to reward the firm for the "up front" investment and risk of entering the market and thereby encourage others to innovate and enter the market.[80] This pattern only works if barriers to entry are not permanent. IPRs give barriers to entry, with patents giving 20 years and software 50 years or longer. In practice in the new economy existing technology is often superseded by the next generation of technology within a much shorter space of time. This relies on IPRs only protecting copying and not substitutes so the new technology can enter the market.

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[77] Thomas Barnett 'Interoperability between antitrust and intellectual property' (2007) 14 Geo. Mason L. Rev. 859 - 870, 859.

[78]Dynamic efficiency was defined by Schumpeter as: competition from new technology, the new source of supply, the new type of organisation... competition which commands a decisive cost or quality advantage and which strikes not at the margins of the profits and the outputs of the existing firm but at their foundations and their very lives, Joseph Schumpeter, Capitalism, Socialism and Democracy (Allen and Unwin 5th ed. 1942)

[79] Thomas Barnett 'Interoperability between antitrust and intellectual property' 14 Geo. Mason L. Rev. (2007) 859, 860

[80] Richard A Posner 'Antitrust in the New Economy' (2001) 68 Antitrust LJ 925

3.6 Reverse Engineering

The Software Directive gives literary copyright protection to "the expression in any form of a computer program"[81] while recognising that the "function of a computer program is to communicate and work together with other components of a computer system and with users"[82]. For this to happen a particular piece of software must interoperate with other pieces of software. One way of achieving this is to "read" the interface of the software - however the software user cannot see the rules and codes of the software in the same way that the reader of a book can see the text of the book. To gain this information he needs to take steps which would otherwise be reserved to the rightholder.

The Directive has explicit exceptions to enable this to happen. These exceptions do not require the rightholder's consent and cannot be contracted out of. The exceptions include the right to make a back-up copy and "to observe, study or test the functioning of the program in order to determine the ideas and principles which underlie any element of the program".[83] This latter exception is known as "black box" analysis and is not limited to interoperability. When black box analysis is insufficient to achieve interoperability, reverse engineering is permitted if, in order to achieve interoperability of an independently created computer program with other programs, it is necessary to reproduce the code and translate its form.[84] This converts the machine readable object code, which is the version normally supplied to the public, back into a higher level language, resembling the original source code which can be read by humans.

This exception allows for the decompilation of the object code, in other words the user is allowed to look at and understand the basic building blocks of the program. This exception is subject to certain conditions which emphasise that the exception can only be used to

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[81] Software Directive, Article. 1(2)

[82] Ibid recital 10

[83] Ibid Article 5(3)

[84] Ibid Article 6

achieve interoperability, and not to create a computer program substantially similar in its expression,[85] or for any other act which infringes copyright.

The social welfare benefits of reverse engineering have been described as complicated and ambiguous.[86] Reverse engineering provisions did not appear in the first draft of the Software Directive and were only inserted after a battle between various factions of the software industry and user representatives.[87]

The Commission and Council's objective for including the reverse engineering provisions are said to give an incentive to both rightholders and potential decompilers to avoid reverse engineering. The rightholder can deter the reverse engineering of its software by making information available for interoperability which obviates the need for other developers to explore his program in detail. Those developers receive detailed and up to date information and do not need to incur the cost and risk of decompilation. The dialogue and co-operation should accelerate the progress to standard interfaces and open systems.[88]

Unfortunately the hard won provisions on reverse engineering have severe practical limitations, and they do not always give a complete answer to the problem of

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[85] Similar in expression prevents use of the same code but should not prevent the creation of a competing program. There has been no definite ruling on this point in Europe but in *Navitaire Inc v easyJet Airline Co Ltd.,* (No.3) EWHC 1725 (Ch) [2004] and *SAS Institute*, competing software emulating the "look and feel" was allowed under the Software Directive. See also the USA case of *Sega Enterprises Ltd. v. Accolade Inc*., 977 F.2d 1540 (9th Cir. 1992), where Accolade used reverse engineering to create a competing video game, an application, and *also Sony Computer Equipment Inc. v Connetix Corp., 203 F. 3d 596 (9th Cir 2000)* , concerned operating software. These exercises in reverse engineering were permitted under the US "fair use" exception.

[86] *See* Pamela Samuelson and Suzanne Scotchmer 'The Law and Economics of Reverse Engineering' 111 (2002)The Yale Law Journal 1575, 1621. Incentives to invest in platforms will be reduced as it allows unlicenced entry but this does not necessarily mean reverse engineering should be illegal. It probably increases the incentive to develop application software.

[87] Dominant American companies established a group called the Software Action Group for Europe (SAGE) which opposed reverse engineering while others promoted more interoperability through the European Committee for Interoperable Systems (ECIS), see Meyer C & Colombe M, 'Interoperability still threatened by EC Software Directive: a status report' (1990) 12 (9) E.I.P.R. 325 – 329, 327

[88] B Czarnota and R Hart *The Legal Protection of Computer Programs in Europe – A Guide to the EC Directive* (Butterworths 1991)

interoperability.[89] In its decision on *Microsoft,* the Commission found as a matter of fact that reverse engineering would not constitute a viable solution for companies wanting to compete in the work group server operating system market.[90] The volume of interfaces that would have to be reverse engineered in a program as large as Windows would require considerable effort with uncertain prospect of success. The viability of products developed using reverse engineering depends on the rightholder not altering its software so that it is no longer compatible with the new software developed by reverse engineering. Such alterations frequently occur when upgrades are issued. Reverse engineering is an inherently unstable basis for a business model. The Commission's decision referred to software developed by reverse engineering by the Samba group. More than two years after Windows 2000 had appeared on the market, the SAMBA software still had severe shortcomings.[91] Also, software developed by Novell to interface with Windows NT was not compatible with Windows 2000. Microsoft would not release vital interface information to Novell, but used the lack of interoperability to discourage customers from using Novell's product.[92] In the more recent decision on the merger of Intel Corporation and McAfee Inc.[93] the market investigation revealed that most respondents considered that reverse engineering Intel's CPUs would take months if not years, be prohibitively expensive, and still be incomplete and vulnerable to subsequent changes to the CPU.[94]

During the formation of the Directive there was recognition that while it is technically possible to decompile a program, doing so is lengthy, costly and inefficient.[95] However at

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[89] For a full account of how reverse engineering is essential but complex and time consuming see Andrew Johnson-Laird 'Software Reverse-Engineering in the Real World' (1994) 19 U Dayton L Rev 843

[90] *Microsoft* (Case COMP/C-3/37.792 Microsoft), Commission Decision of 24 March 2004 relating to proceedings under Article 82 EC, para 683 *et seq.*

[91] Ibid para 293 *et seq.*

[92] Ibid para 686

[93] Case COMP M.5984 Intel / MCAFEE [2011] OJ C 98 – 1

[94] Ibid para 145

[95] See also Pamela Samuelson and Suzanne Scotchmer 'The Law and Economics of Reverse Engineering' 111

the time it was said that "the problem of access to information may have to be addressed by other means which are outside the scope of the Directive."[96] One efficient solution is for the parties to voluntarily disclose information on agreed terms.

Despite the exceptions in the Software Directive to permit reverse engineering, full interoperability between programs has not been achieved. With certain types of complex software there appears to be a low level of interoperability. Compulsory disclosure of interface information under *Microsoft* is only available where the supplier is dominant, and the disclosure remedy is flawed as it is ex post and prone to error. Interoperability causes network effects as interoperability encourages users to adopt a network. Conversely, a lack of interoperability creates boundaries to the network and intensifies its effects. Users can become locked-in to the market, in that they must use software that is compatible with the *de facto* standard, and they can also be locked-in to particular software due to switching costs. It appears there are shortcomings to the extent of interoperability available under the Directive but other solutions have arisen, some of which appear to be caused by market effects. Interface information is frequently made available, particularly by operating systems software, to encourage the development of compatible application software. Commercial translators and standards have also been developed with varying levels of success.

One shortcoming of the reverse engineering provisions is the practical challenge of carrying out the process and keeping up with subsequent changes. Article 6 of the Software Directive prevents the decompiler giving the information obtained to others.[97] This means that all software developers must independently carry out the same process. In Chapter 8 the effects of this restriction will be explored and analysed to see if relaxation of this restriction will improve the effectiveness of reverse engineering and improve the access of software developers to interface information.

(2002)The Yale Law Journal 1575 - 1663, 1614 describing the considerable intellectual work and high costs involved in software reverse engineering and see also Andrew Johnson-Laird 'Software Reverse-Engineering in the Real World' (1994) 19 U Dayton L Rev 843 - 902, 843

[96] Proposal for a Council Directive on the legal protection of computer programs [1989] OJ C 91/4, para. 3.14

[97] Software Directive, Article 6. 2 (b)

Despite all these shortcomings reverse engineering of software is widely practiced. It is as standard in the software industry as it is in traditional engineering.[98] About one third of the respondents to a public web-based consultation use some form of reverse engineering to gain interoperability information as licensing. For reasons not explained, licensing is seen as more inconvenient. Small or medium-sized organisations or open source developers are more likely to reverse engineer than larger organisations who appear to prefer to license.[99]

Reverse engineering can be made more difficult by the deployment of Technology Protection Measures (TPMs) [100] but only 16% of respondents to the public web-based consultation had used any form of TPM to protect their software. [101] TPMs such as passwords and encryption systems can be deployed as a protective shell around software and need to be circumvented before decompilation can take place. They are protected by legislation but fortunately for reverse engineering the anti-circumvention regime in the Information Society Directive does not apply to the protection of computer programs.[102] The Software Directive does not prohibit the act of circumvention itself but only the act of trafficking in the circumvention tools which provisions are specifically stated to be without prejudice to Articles 5 and 6. Where technology protection measures applied to a

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[98] Samuelson & Scotchmer 'The Law and Economics of Reverse Engineering' 111 (2002) The Yale Law Journal 1575, 1607; Andrew Johnson-Laird 'Software Reverse-Engineering in the Real World' (1994) 19 U Dayton L Rev, 843

[99] Commission Staff Working Document (2103), Appendix 1, 19

[100] Directive 2001/29/EC on the harmonisation of certain aspects of copyright and related rights in the information society (2001) L167/10 (hereinafter the Information Society Directive'.

[101] Commission Staff Working Document (2103), Appendix 1, 19

[102] The Information Society Directive' Article 1 (2) (a). This is fortunate as there has been a degree of lack of harmonisation in implementing the Information Society Directive which has given rise to legal uncertainly. Guildbert, Study on the Implementation and Effect in Members States' Law of Directive 2001/29/EC on the Harmonisation of Certain Aspects of Copyright and Related Rights in the Information Society 2007, 75 http://ssrn.com/abstract=2006358

computer program circumvention of those measures is not restricted by the Software Directive.[103]

3.7 Breakthrough or Follow On Innovation

Interface information provides interoperability. Interoperability allows markets to exhibit network effects[104] and network effects magnify the benefits of interoperability. Developers of platforms encourage the development of applications to work on the platform which attracts more customers to the platform. This will encourage others to develop complementary products and generate an ever larger customer base – a virtuous cycle due to network effects.[105] What is less certain is the extent to which new technology in the new economy, including network markets, is prevented from entering the market by inadequate interoperability and what can be done to resolve it. Where network effects exist innovation, if it happens, may take the form of the "gale of creative destruction"[106] rather than evolution. Existing technologies would be replaced by new technologies in their entirety and so not need to be compatible with each other.

Arguably breakthrough technology is better than follow through technology as the new technology does not free ride on existing technology so incentives to innovate are preserved and encouraged. However follow on technology is acceptable in old markets and

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[103] In the US the Digital Millennium Copyrights Act (1998) 112 Stat 2860 'DMCA' gives unprecedented restrictions and inverts the rules on reverse engineering. The DMCA outlaws circumvention technologies and indirectly outlaws reverse engineering, subject to specific exceptions. This includes reverse engineering when necessary to achieve program to program interoperability. The information obtained by reverse engineering can only be disclosed for the sole purpose of accomplishing interoperability. There have been various instances of judges and commentators taking a position that would restrict the dissemination of information legitimately obtained. For example a journalists publication of information was thought to violate the DMCA even though legitimately obtained *Universal City Studios, Inc. v Reimerdes* 111 F. Supp. 2d 294 [103]

[104] Michael L. Katz & Carl Shapiro 'Systems Competition and Network Effects' (1994) 8 J ECON PERSP 94. The utility provided to each individual user of a specific platform or system increases with the total number of users, so the higher the number of users the higher the demand.

[105] Pamela Samuelson 'Are Patents on Interfaces Impeding Interoperability?' (2008) Berkeley Centre for Law & Technology 1, 7 http://ssrn.com/abstract=1323838

[106] Joseph Schumpeter, *Capitalism, Socialism, and Democracy* (George Allen, London, 1976) 81 *et seq*. (first published 1942).

the concept and reality of existing technology so complex that it cannot be certain that breakthrough technology will always give the greatest technical advance in all areas.

Markets with products that have incompatible standards tend, after a period of intense competition, to have one single firm emerge dominant. As one firm entices more developers and consumers to its standard the market may "tip".[107] It is argued that technological innovation in the new economy markets is so rapid that no market leader, even with strong network effects, can defend itself against new market entrants with "killer applications" meaning that "serial monopolies" are the norm with competition "for the market" rather than "within the market".[108] It is however possible that a firm may win the *de facto* standards battle, not on merit but with the help of a few "tactical antitrust violations",[109] and then hold the market for a long time.[110]

This "winner takes all" model means that entering the market is very risky. The new entrant has to secure strong economies of scale and network effects to enable it to "leapfrog" the former market leader. This makes investing in possible new entrants very risky and deters investment in potentially better products. The serial monopoly hypothesis claims that an innovator needs a period of monopoly in order to recoup its investment in innovation.[111] Strong IPRs are needed to attract investment in innovation where there are network barriers to entry.

The model of serial monopoly with strong IPRs and little competition law interference has attractions, as false positive errors are avoided. However, dominant companies can use lack of interoperability to leverage their position and attempt strategic foreclosure. In the

[107] *Katz & Shapirao '*Systems Competition and Network Effects' 8 J ECON PERSP 94*,* 106 (describing tipping as "the tendency of one system to pull away from its rival in popularity once it has gained an initial edge").

[108] Dan Wielsch 'Competition policy for information platform technology' (2004) 25 (2) ECLR 95 - 106, 102

[109] William Page. 'Microsoft and the limits of antitrust' (2010) 6 (1) JCL & E 35, 38; Mark Lemley 'Antitrust and the Internet Standardization Problem' (1996) 28 CONN L REV 1041.

[110] Ibid

[111] Dan Wielsch 'Ccompetition policy for information platform technology' (2004) 25 (2) ECLR.

Browser War[112] Microsoft leveraged its position in operating systems to ensure OEMs[113] preinstalled Internet Explorer in a prescribed manner. Microsoft protected its share of the browser market, but a more significant effect was that by damaging Netscape Navigator, which could run on several operating systems, Microsoft was able to protect its position as the dominant supplier of operating systems. The pace of competition law meant that judicial relief came too late for Netscape.[114]

Incumbents who have essential IPRs may attempt to steer innovation and the evolution of technologies, partly by innovating faster themselves (positive effects) but also by attempting to thwart innovation by potential competitors who may challenge their dominant position (negative effects)[115]. IPRs in interface information belonging to dominant companies can be used to prevent the emergence of superior technology which is not compliant with the de facto industry standard. This allows the dominant company to ratchet up its IPR protection.

The benefit of IPRs is that the owner can exclude others from using the protected subject matter, but this exclusivity is not an exemption from competition. It is only an instrument that compels the proprietor's competitors to compete by substitution as opposed to imitation.

3.8 Market Failure and Intervention

Because of the fast pace of innovation in the software industries it is advocated by some that the discipline of the market will give the optimum outcome and government intervention will only be inefficient. Many economists, mainly from the USA and drawing on free market theories originating in the Chicago School, argue against intervention on the

[112] *United States v Microsoft* 253 F.3d (D.C. Cir 2001)

[113] An OEM - Original Equipment Manufacture – makes the final product for the marketplace, examples are Ford for the car market and Apple for the computer market.

[114] Ian Brown and Christopher T Marsden *Regulating Code* (2013 The MIT Press), 166

[115] Liguo Zhang 'Refusal to license intellectual property rights under Article 82 EC in light of standardisation context' (2010) 32 (8) EIPR 402-411; Thomas A. Hemphill and Nicholas S. Vonortas 'U.S. Antitrust Policy, Interface Compatibility Standards, and Information Technology' (2005) 18 Knowledge, Technology & Policy, 134.

basis that the market is the best discipline. Lawyers from USA and Europe who analyse case law and rules with reference to the economic theories take a more pragmatic view of legal regulation and particularly competition law, especially concerning the new economies.[116] They see that in practice the law is not perfect so it is best to err on the side of caution as the market may well remedy any positive errors.[117] The theories of the Chicago School and the pragmatic views of Easterbrook[118] have dominated the debate on whether there is a case for intervention in the new economies.

Many US and European commentators are critical of the European Commission's approach in *Microsoft*. Not only was the case an undesirable extension of the 'essential circumstances' test but it failed to give an effective and timely remedy. The Commission was approaching the case with its ordo-liberal heritage having only recently adopted an economic effects based approach. The goal of innovation remains a policy priority and workable competition is seen as the best system for achieving an efficient market with the market as the best discipline for maintaining efficiency and encouraging innovation. Where however a lack of interoperability causes a failure in the market there may be a case for intervention to optimise innovation. IPRs are themselves an intervention in the market and if they give the wrong balance between protection for rightsholders and openness for interoperability the IPRs can themselves cause a failure in the market.

3.9 Network Effects and Market Failure

Network effects which can give rise to "network externalities" have been seen as causing a failure in the market. Network effects occur when the value of a product in a network will increase if more users subscribe to the network.[119] Network externalities are seen as a failure of the market, as the market is influenced by outside factors.

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[116] Richard A Posner 'Antitrust in the New Economy' (2001) 68 Antitrust LJ 925

[117] Frank H Easterbrook 'The Limits of Antitrust' (1984) 63 Tex L. Rev 1 1984-1985.

[118] Ibid

[119] Katz and Shapiro are attributed with defining network externalities in 1985: "There are many products for which the utility that a user derives from consumption of the good increases with the number of agents consuming the good. The utility that a given user derives from a good depends upon the number of other

While network effects are relevant to many computer programs, they are not as strong in the 3D CAD market. While it would be beneficial for the user if his 3D CAD system worked with others, it is not vital to the primary purpose of the system. Nevertheless network effects can cause or accentuate lock-in. Lock-in in network markets is normally the scenario where a technology wins a market because of network effects and the market is locked-in to a particular technology. The classic example of this is the Betamax v VHS battle. The market fails if the best technology does not win due to network externalities. Most of the literature argues that while dangers exist, intervention is not justified as government seldom succeeds in "picking winners".

Consumers as well as industrial users may be affected by interoperability issues. Once consumers have bought a platform or software they may be unable to move their data. They are "locked in",[120] and if they have not chosen the emergent *de facto* market standard they are faced with the additional costs of changing to the market standard and may lose the use of their expensively acquired data. This dilemma is apparent in the new market for e-readers. At least two of the e-readers are closed systems. Users who build up a library do not know whether they can transfer it to another platform. A study commissioned by the Book Industry Study Group identified the number one complaint among consumers about e-readers as "certain e-books [are] specific to certain e-readers." [121]

Distinctions are drawn between direct and indirect network externalities. Direct effects are physical connections such as those to a telephone network. Indirect effects are other effects such as software being more plentiful, increased availability of aftercare and lower prices. Katz and Shapiro recognise that systems markets with network effects may be inefficient, and theoretically government intervention could be justified. However there is

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users who are in the same network." Michael L Katz & Carl Shapiro 'Network Externalities, Competition, and Compatibility' (1985) 75 The American Economic Review 424

[120] Carl Shapiro and Hal Varian, *Information Rules - a strategic guide to the network economy, e.g.* 107 (Harvard Business School Press, Harvard, 1998).

[121] Dave Dickson 'EPUB, iPAD and Content Interoperability Digital Editions' http://blogs.adobe.com/digitaleditions/2010/01/epub_ipad_and_content_interope.html; [accessed 1 September 2010] on the Book Industry Study Group's, "Consumer Attitudes Toward E-book Reading" (2013) Book Industry Study Group (28, Jan. 2010).

evidence that private institutions may have solutions to the market and the problems can be resolved without government intervention. This is desirable as governments may not have all the information they need to intervene in a beneficial manner, the "picking winners" scenario.[122]

Liebowitz and Margolis refine Katz and Shapiro's work on network externalities distinguishing between network effects and externalities and claim that while "network effects are common and important, network externalities are theoretically fragile and empirically undocumented".[123] Network externalities were a specific type of network effect in which "the equilibrium exhibits unexploited gains from trade regarding network participation".[124] It was said this reflects the understanding of externalities as an instance of market failure. While network effects are common there is less evidence of network externalities and this reclassification plays down market failure and the need for intervention. They conclude that after looking at the Qwerty keyboard, the VHS tape and the internal combustion engine that they are not aware of any compelling examples of market failures and the wrong choice being made "..the a priori case of network externalities is treacherous and the empirical case is yet to be presented."[125]

Where a technology becomes the norm because of network effects causing technology lock-in, the markets may be able to guide the adoption of technology efficiently and intervention may be unnecessary and even harmful. Lock-in should not however be treated as a homogenous, simplified phenomenon by looking only at relatively trivial lock-in such as the iTunes and the Querty keyboard without attempting a comprehensive definition.[126] Most literature on lock-in is concerned with lock-in in the form of "path dependency" that

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[122] Michael L Katz and Carl Shapiro 'Systems Competition and Network Effects' (1994) 8 The Journal of Economic Perspectives 93

[123] SJ Liebowitz and Stephen Margolis ' Network Externalities: An Uncommon Tragedy' (1994) 8 (2) Journal of Economic Perspectives 133-150, 135

[124] Ibid 135

[125] Ibid 149

[126] Daniel Spulber 'Unlocking technology: antitrust and innovation' (2008) JCLE 4(4) 915 - 966

suppresses the feasibility, in principle, of improvements in the path[127] does not appear to consider the problem that exists when consumers are locked-in to a technology because of the high switching costs. Consumers can however become locked-in by a particular technology without strong network effects.

3.10 Supplier Lock-in

A lack of interoperability can result in users who have bought a platform or software being unable to join a network or to move their data and being "locked in".[128] There are two aspects to this lock-in: firstly "network" lock-in where, if they have not chosen the emergent market standard, users are faced with the additional costs of changing to the market standard, and secondly "vendor" or "supplier" lock-in which may cause users to lose the use of their expensively acquired data. Supplier lock-in is caused by incompatibility between the user's existing data and alternative forms of software, and is differentiated by the scale of switching costs per user and unquantifiable factors such as legacy issues and risk of undetected errors in data. A user locked-in to a supplier may also suffer from network lock-in where the supplier's software is the market leader but supplier lock-in can occur without network lock-in such as where the user's existing data is stored in the supplier's software and there are high switching costs. Supplier lock-in has existed for many decades when capital equipment was only physically compatible with the original supplier's equipment. This branch of lock-in can now be caused by lack of interoperability between computer programs.

Supplier lock-in can be caused by a variety of switching costs: damages due to contractual commitments, the cost of replacement equipment, loyalty programs, search costs, transaction costs and uncertainty about alternative suppliers, retraining and

[127] SJ Liebowitz and SE Margolis 'Path Dependence, Lock-In and History' (1995) 11 JL Econ & Org

[128] Carl Shapiro and Hal Varian, *Information Rules - a strategic guide to the network economy* (Harvard Business School Press, Harvard, 1998) 107. Björn Lundell describes various types of lock-in in 'Why do we need Open Standards?', M Orviska and K Jakobs (Eds) Proceedings 17th EURAS 2012 Annual Standardisation Conference 'Standards and Innovation' The EURAS Board Series, Aachen 227-240.

compatibility.[129] The costs of switching from one proprietary software program to another can include new hardware, software customisation, training and implementation. Training alone is significant, and business processes may have to be changed to meet the needs of the new software. Existing data may have to be converted with the risk that it is corrupted or even lost in the process. An industry estimate is that all of these costs are about eleven times the cost of the software itself.[130]

The 3D CAD market is affected by market lock-in as it is easier to transfer data using the same propriety system. This encourages the use of the more prevalent brands and OEMs often require their suppliers to use the same software. Supplier lock-in is however considered a stronger feature of the 3D CAD market due to high switching costs with the users' proprietary data stored in the proprietary software systems. Lock-in in the 3D CAD market is lock-in to the *supplier* rather than lock-in of the *market*. It is a question of degree. When a network *market* is locked in there will be switching costs but these can be low per user, and other issues such as inertia and lack of co-ordination are relevant. Lock-in in the 3D CAD market is caused by the scale of the costs to the user and unquantifiable factors such as legacy issues and risk of undetected errors in data. When a consumer is locked-in to a network *market* they can still individually enter the market, albeit at a cost, and the emphasis is on the market that is locked rather than the individual. With a user of 3D CAD the costs of re-entering the market can be large and this could effectively bar them from entering the market at all. For this reason there could be a failure in the market. Switching costs include new hardware, software customisation, training and implementation. Training alone is significant and business processes may have to be changed to meet the needs of the new software.

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[129] Types of lock-in and switching costs are suggested by Shapiro and Varian ibid and also by Paul Klemperer 'Competition when Consumers have Switching Costs: An Overview with Applications to Industrial Organizations, Macroeconomics, and International Trade' (1995) 62 (4) Review of Economic Studies 515-539.

[130] Hal Varian, Economics of Information Technology (2003) revision of Raffaele Mattioli Lecture, University, Milano, Italy, 15-16 November 2001 http://people.ischool.berkeley.edu/~hal/Papers/mattioli/mattioli.html; also Ian Larkin 'Bargain-then-Ripoffs: Innovation, Pricing and Lock-in in Enterprise Software' (2008) Academy of Management Annual Meeting Proceedings 1-6

92% of respondents to a public web-based consultation said they had encountered problems with a lack of interoperability information and 84% said this constrained their choice of subsequent acquisitions causing lock-in.[131] As well as experiencing problems with software from dominant suppliers interoperability problems were identified with suppliers who would not qualify as significant market players. Specifically issues were reported with different CAD systems as well as Enterprise Resource Planning 'ERP' systems offered by smaller suppliers.[132]

3.11 Supplier Lock-in, Market Failure and Intervention

In the case of market lock-in due to a prevalent technology there is an argument that users must bear some of the cost for letting the market arrive at the best innovative technology. Consumers must bear the switching costs. The need to encourage innovation may justify this as the most efficient approach. This would accord with Coase's Social Cost theory.[133]

The opinion that consumers' ability to switch to other search engines instantaneously and at no cost is said to constrain Google's ability and incentive to anti-competitive acts[134] was influential in the 2013 Federal Trade Commission's investigation into Google's alleged anti-competitive practices.[135] However where users are locked-in to a supplier with very high switching costs they are prevented from entering the market and arguably prevented from transacting an efficient resolution. The cost to the user is so substantial that it may not be justified as a social cost.

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131 Commission Staff Working Document SWD(2103) 209 final, 4

132 Commission Staff Working Document SWD(2103) 209 final, Appendix 1, 18

133 Robert H Coase 'The Problem of Social Cost' (1960) 3 JJ& ECON.

134 Robert H. Bork & J. Gregory Sidak, 'What does the Chicago School Teach about Internet Search and the Antitrust Treatment of Google?' (2012) http://www.aei.org/wp-content/uploads/2012/10/-what-does-the-chicago-school-teach-about-internet-search-and-the-antitrust-treatment-of-google_132249480630.pdf [accessed 26 December 2014]

135 Briefing Internet Monopolies 'Everybody wants to rule the world' The Economist (29 November 2014), 22 http://www.ftc.gov/news-events/press-releases/2013/01/google-agrees-change-its-business-practices-resolve-ftc

It is claimed that the evidence for technology lock-in is anecdotal and highly questionable[136] and does not justify intervention. There are however significant differences in the nature of lock-in and while it may be correct that *market* lock-in is best solved by the market there remains the possibility that different forms of lock-in need different solutions. Economists who looked at supplier lock-in are far less bullish about achieving a market solution. Farrell and Klemperer consider supplier lock-in due to switching costs binds customers to suppliers if products are incompatible, locking customers or even markets into early choices and giving suppliers lucrative ex post market power.[137] Firms "compete for the market" or "life-cycle competition", which can be fierce, but with incompatibility competition can involve direct efficiency losses and can magnify incumbents' advantages.[138]

Large switching costs occur when a buyer has made an initial purchase, and he is effectively locked-in to buying a series of goods such as upgrades or new modules of software. This can create ex post monopolies for which firms compete ex ante. "Ex ante competition often fails to compete away ex post rents: switching costs typically raise oligopoly profits".[139] At best ex post rents induce "bargain-then-ripoff" pricing (low to attract business, high to extract surplus) which distorts the market and gives consumers the wrong signals about whether to switch. Also switching costs "can segment an otherwise undifferentiated market as firms focus on their customers and do not compete aggressively for their rivals' buyers, letting oligopolists extract positive profits".[140] Farrell and Klemperer cautiously favour some intervention in the form of pro-compatibility public policy. Priority should be given to particular markets where incompatibility is strategically chosen rather than inevitable.

[136] Daniel Spulber referring to Qwerty key board and Betamax v VHS in 'Unlocking technology: antitrust and innovation' (2008) JCLE 4(4) 915 – 966, 954

[137] Joseph Farrell & Paul Klemperer 'Coordination and Lock-in: Competition with Switching Costs and Network Effects' in M Armstrong & R Porter (eds.) *Handbook of Industrial Organization* (Vol 3 Elsevier 2007).

[138] Idid

[139] Ibid, 1974

[140] Ibid

3.12 Case Studies Evidencing Lock-in

3.12.1 Mainframe Computers

An early study into switching costs associated with computer programs was conducted by Greenstein looking at lock-in and the cost of switching mainframe vendors.[141] The study looked at mainframe computers in Federal Government. From previous research it was known that anticipated lock-in induces fierce competition from suppliers for buyers which may reduce the impact of consequent monopoly rent. But not all monopoly rents were competed away for "technical uncertainty is asymmetrically resolved"[142] among competing suppliers. Suppliers will withdraw offerings while others are more innovative. Some buyers will be satisfied with their choice of supplier while others are not but continue with the supplier due to switching costs. Still others will be so dissatisfied they will change despite the switching costs.

There is a general presumption that buyers prefer a market with interoperability, where firms provide compatible 'mix-and-match' components, [143] for example IBM-compatible personal computers.[144] There is also a presumption of conflict of interests between proprietary suppliers and buyers with buyers preferring non-proprietary standards. Suppliers who have established a proprietary network will resist any movement towards a more competitive mix-and-match structure. Once buyers have bought into a system vendors have incentives to design incompatible systems to take advantage of switching costs[145] and may actively discourage interoperability.[146]

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[141] Shane M Greenstein 'Lock-in and the Costs of Switching Mainframe Computer Vendors: What Do Buyers See?' (1997) 6 Industrial and Corporate Change 247

[142] Ibid, 250.

[143] Carmen Matutes & Pierre Regibeau '"Mix and match": product compatability without network externalities' (1988) 19 RAND Journal of Economics (RAND Journal of Economics) 221

[144] Langlois R and Robertson P, 'Networks and innovation in a modular system: Lessons from the microcomputer and stereo component industries' (1992) 21 Research Policy 297

[145] Michael L Katz & Carl Shapiro 'Network Externalities, Competition, and Compatibility' (1985) 75 The American Economic Review 424 – 440

Greenstein found that buyers took a variety of actions in anticipation of lock-in due to switching costs and while these ameliorate the costs they did not eliminate them. Action to reduce the use of proprietary technology moved the industry towards mix-and match.[147] This was an early forerunner of the policy to encourage open source software in public institutions.

3.12.2 ERP Software

In 2008 Larkin conducted a survey of lock-in and switching costs of Enterprise Resource Planning (ERP) software, which is a sub-set of Enterprise Application Software.[148] Up until then "the few empirical studies that exist largely use aggregate measures of market share and pricing rather than actual contract by contract data".[149] Larkin surveyed a sales database of a leading enterprise software vendor to examine the strategy adopted by the suppliers and the customers' response to high switching costs. There was significant evidence of "bargain then rip-off" behaviour with new customers paying about 50% less than locked-in customers. Interestingly there was also evidence that "better" customers can avoid switching costs. Customers with strong IT departments take advantage of initial bargains and then choose not to upgrade and so avoid purchasing at the locked-in rate. Presumably the IT departments of these customers feel confident in their ability to maintain the software when they lose the benefit of vendor maintenance due to not upgrading the software. Also, customers with the strongest financial performance not only get initial bargains but are the most likely to switch, and get good prices again, rather than

[146] DW Carlton and J M Klamer 'The Need for Coordination among Firms, with Special Reference to Network Industries' (1983) 50 University of Chicago Law Review 446; Shane M. Greenstein, 'Lock-in and the Costs of Switching Mainframe Computer Vendors: What Do Buyers See?' (1997) 6 Industrial and Corporate Change 247 - 273, 250

[147] Shane M Greenstein 'Lock-in and the Costs of Switching Mainframe Computer Vendors: What Do Buyers See?' (1997) 6 Industrial and Corporate Change 247 – 273, 252

[148] *Oracle/Peoplesoft (COMP* M.3216) Merger Procedure Commission Decision 8 (2) 26/10/2004, para 18

[149] Ian Larkin 'Bargain-then-Ripoffs: Innovation, Pricing and Lock-in in Enterprise Software' (2008) Academy of Management Annual Meeting Proceedings 1-6, 2

upgrade at the locked-in rate.[150] While there is clear evidence of lock-in it appears that suppliers are not completely in control and buyer behaviour can ameliorate the effects of lock-in.

Purchase of ERP software such as Oracle Financial Systems and SAP has been described as a "one-way street"[151] when the purchase of a particular package effectively requires the purchaser to place future purchases with the same software family because the software has low compatibility with other packages. The purchaser is locked-in because the costs involved in switching to another package are prohibitively high. Once the initial decision to go with a system is made it becomes prohibitively expensive to switch.[152] Interoperability is important because of the long life expectancy of organisational data and the inability to change software without a common standard. The position is not fixed however with some suppliers seeing an advantage in changing the degree of interoperability with competing packages and some adding proprietary features and extensions which defeat otherwise open standards.[153] Software built around a standard that allows compatibility was an important factor along with price. One large manufacturer who attempted to change their ERP system to a competing ERP system at a better price abandoned the attempt after one year and reverted to their old ERP system.[154] Lock-in had been caused by non-technical issues with the skill set and knowledge base built around the former ERP system in practice inhibiting the switch.

[150] Ibid 3

[151] Jam Damsgaard and Jan Karlsbjerg 'Seven Principles for Selecting Software Packages' (August 2010) (53) 8 Communications of the ACM

[152] Ibid 67

[153] Ibid 67

[154] Ibid 71

3.12.3 3D CAD Software

A study of the Product Life-Cycle Management market was carried out by IDC Manufacturing Insights in 2011.[155] It distinguished between the 3D CAD market which it referred to as the visual design authoring and simulation applications (CAx) which includes CAD and FEA software and the PLM market which it described as collaborative product data management applications in industries such as automotive, aerospace and defence.

The study confirmed the vendors of CAD as Autodesk, Dassault Systemes, PTC and Siemens PLM. FEA vendor ANSYS was included in the CAx segment. In the PLM market competition is mainly between three of the four CAD vendors joined by SAP and Oracle. CAx is described as a mature market with little growth whose relevance is overlooked by enterprise. IDC however ranks this as the most important segment of the PLM market as there is potential growth in new applications. Competition is greater in the PLM market as the barrier to changing a supplier is much lower than with 3D CAD software. PLM users are more likely to nge their enterprise PLM products in coming years to take advantage of price cuts, consolidation and regional vendor preferences.[156]

End users seem to have a dilemma with the market with OEM end users struggling to choose between "an ERP-PLM portfolio that locks them in for years and best-of-the-breed products from different engineering software providers."[157] It can be inferred from the report that there is more competition and switching of suppliers in the PLM segment than the 3D CAD segment which has less interoperability and more lock-in. The 3D CAD Software market will be considered in more detail in Chapter 4.

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[155] S Pal and M Fauscette 'Worldwide Product Life-Cycle Management (PLM) Applications 2011 Vendor Assessment: CAx, Discrete, and Process PLM' (Excerpts) IDC Manufacturing Insights

[156] Ibid

[157] Ibid

3.12.4 iTunes, the iPod and DRM

The Apple iTunes and the iPod is one of the best known and most widely commented upon examples of lock-in that was used to leverage an adjacent market. It is a valuable case study as the lock-in was reduced firstly by demands of the market and then by new technology. The iTunes music service started in January 2001 but sales did not take off until April 2003 when the "third generation" of iPods was introduced. These were compatible with the USB 2.0 ports on PCs and had software available to offer compatibility with older iPod models. In June 2003 Apple sold its one-millionth iPod, and in September iTunes downloads passed the 10 millionth song mark.

But incompatibility remained due to digital rights management ("DRM") which is made possible due to TPMs.[158] iTune files could only be played on iPods and vice versa so consumers who built up a library of iTunes had to own an iPod. It appears that iPods could play non iTunes files but the extent to which iTune files can be re-recorded in MP3 format at that time is uncertain and obscured. What is certain is that due to DRM a first recording of a song downloaded from iTunes can only play on an Apple device. The result was that consumers who had built up a library of iTunes, which although individually cheap (99 cents per song) cumulatively had a significant value (at that time iPods carried up to 1000 song or $990 worth of downloaded files) and needed a relatively expensive iPod to listen to them. MP3 players can be bought for a tenth of the price of an iPod. Theoretically it might have been possible to convert files but law abiding consumers were effectively locked-in to the iPod because of the value of their library and the convenience it provided to use the iTunes service with the iPod.[159]

DRM allows IPR holders to diversify the way they offer their works more than they can in traditional markets, but DRM is a barrier to entry. While IPRs are "intangible barriers" and

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[158] DRM is a system made up of utechnical protection measure (TPM) that include passwords and encryption and effectively put a technical shell around copyrighted work. Legal protection against circumvention under Article 6 of the Information Society Directive does not apply to the protection of computer programs.

[159] Josh Bernoff *Forrester Research (*CNET News October 20, 2003) http://news.cnet.com/2030-1027-5093879.html [accessed 2 Nov 2011]

remedies are ex post, DRM is a "tangible barrier" composed of technology rather than rules and is ex ante.[160]

While reverse engineering might technically be possible, the exemption under Article 6 of the Software Directive would arguably not cover the purpose of designing compatible players.[161] The DMCA in the USA would also prevent reverse engineering as the music files are not likely to qualify as computer programs under the statute.[162]

"The iPod makes money. The iTunes Music Store doesn't."[163] If Apple's business model is to use relatively cheap iTunes downloads to tie customers to the iPod, using DRM to restrict interoperability and maximise sales of iPods at optimum price makes business sense[164]. The readily available iTunes service with seamless compatibility with the iPod and a variety of other services not available to other portable players gave an attractive integrated service. Apple could use this to maximise profits across its products and also to increase barriers to entry for the portable player market. While DRM might reduce the overall use of iTunes downloading service, making iTunes only compatible with the iPod allows Apple to price the iPod to maximise profits overall. Also by introducing more features that can be downloaded and thus increasing the complexity and variety of the integrated service Apple was again increasing the entry barriers.

This sort of pricing scheme has been seen with the manufacturers of razors and printers, with the cheap razor and expensive replacement blades or cheap printers and expensive

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[160] Paulo Magnani & Maria Lilla Montagnani 'Digital rights management systems and competition: what developments within the much debated interface between intellectual property and competition law?' (2008) 39 Intenational Review of Intellectual Property and Competition Law 83

[161] Urs Gasser et al. 'iTunes How Copyright, Contract and Technology Shape the Business of Digital Media - A Case Study' Berkman Center http://cyber.law.harvard.edu/media/uploads/53/GreenPaperiTunes03.04.pdf?q=itunes [accessed 29 July 2015]

[162] Ibid 42

[163] Phil Schiller, Apple Senior Vice President, Ina Fried 'Will iTunes Make Apple Shine?' *(CNET News* 16 Oct 2003) http://news.cnet.com/2100-1041_3-5092559.html [accessed 3 Nov 2011]

[164] See Ina Fried *Will iTunes Make Apple Shine?* CNET News 16 Oct 2003 http://news.cnet.com/2100-1041_3-5092559.html [accessed 3 Nov 2011]

replacement ink.[165] Commentators have criticised these comparisons arguing that the Apple model is for consumers to buy the expensive iPod first and then the option to use the iTunes software and buy the cheap iTunes songs.[166] However this is incorrect as the potential for lock-in occurs because of the value of the library built using iTunes which needs an Apple product to use.

Competition to DRM integrated iTunes/iPod model came from illegal downloads, which could be played on the iPod, evading the DRM to create copies playable on another portable player, or the few competitors, such as Dell that existed at that time.

In 2007 Apple's DRM not only tried to block music from competitors such as RealNetworks playing on iPods. If an iPod owner had managed to load music from another digital onto their iPod they would receive an error message telling them to restore their iPod to factory settings which then wiped non-iTunes music from the device.[167]

By the end of 2006 a total of 90 million iPods had been purchased and 2 billion songs downloaded from iTunes store. That gives an average of 22 songs per iPod. The most popular iPod at that time held 1000 songs and were normally full, meaning that only 3% of the songs had been downloaded from iTunes.[168] This also meant that only 3% of music was DRM protected with the remaining 97% unprotected and playable on any open format player. As Steve Jobs commented:

> It's hard to believe that just 3% of the music on the average iPod is enough to lock users into buying only iPods in the future. And since 97% of the music on the

[165] *Lexmark International, Inc v Static Control Components, Inc*. 02-CV-571. Feb. 27,2003

[166] Thomas Barnett 'Interoperability between antitrust and intellectual property' 14 Geo. Mason L. Rev. (2007) 859, 864

[167] http://www.bbc.co.uk/news/technology-30328309 This resulted in a class action suit representing 8 million iPod customers and 500 resellers claiming $350 million however in December 2014 a jury accepted Apple's argument that the upgrade to its iTunes 7.0 software substantially improved the user experience, and thus was not subject to anti-competitive violations http://www.bbc.co.uk/news/business-30507891

[168] Steve Jobs 'Thoughts on Music' *(Apple web site*, February 6, 2007) http://web.archive.org/web/20080517114107/http://www.apple.com/hotnews/thoughtsonmusic [accessed 30/10/2011]

average iPod was not purchased from the iTunes store, iPod users are clearly not locked-in to the iTunes store to acquire their music.[169]

3% is the average but the lawful consumer who downloads most of their songs from iTunes may feel locked-in to Apple. Consumers who mainly store illegal downloads or songs from CDs do not suffer the same inconvenience.

It would appear from this statement that the pressure to remove DRM did not come from consumers' dissatisfaction (although consumers did resent that downloads could not be copied in the same way as CDs) nor from the European competition authorities. From the statement made by Steve Jobs it would appear that what was uppermost in his mind was:

- Firstly a key provision of the agreements with the music companies that if the DRM system is compromised and their music becomes playable on unauthorized devices, Apple would only have a few weeks to fix the problem or the entire music catalogue could be withdrawn from the iTunes store.[170] With only 3% of songs coming from iTunes DRM was more of a threat to their business model than an asset.

- Secondly, while the four music companies required the music sold online to be DRM protected the CDs they sold were not protected. CDs could be copied directly onto iPods or uploaded to the Internet and (illegally) downloaded to iPods. This probably constituted a significant part of the 97% of songs on iPods.

Apple was competing with non DRM protected songs (In 2006, under 2 billion DRM-protected songs were sold worldwide by online stores, while over 20 billion songs were sold completely DRM-free and unprotected on CDs by the music companies themselves)[171] and Apple was exposed to the risk of the music companies withdrawing their licence if iTunes was not DRM protected.

[169] Ibid

[170] ibid

[171] Ibid

Steve Jobs set out a market solution to the problem of lack of interoperability and possible lock-in posed by the DRM system:

> At that time the overwhelming majority of the music companies' revenues came from selling CDs which must play in CD players that support no DRM system. So if the music companies are selling over 90 percent of their music DRM-free, what benefits do they get from selling the remaining small percentage of their music encumbered with a DRM system? There appear to be none. If anything, the technical expertise and overhead required to create, operate and update a DRM system has limited the number of participants selling DRM protected music. If such requirements were removed, the music industry might experience an influx of new companies willing to invest in innovative new stores and players. This can only be seen as a positive by the music companies.

In 2008 the music companies started to abandon DRM. Ironically a reason given for this was the threat they felt from Apple. As Apple refused to license its DRM version to rivals its best-selling iPod drove the iTunes store to become the third-largest music retailer in any form in the US and achieved more than 70% of the UK download market.[172] (This gives a very different picture to Steve Jobs claim that only 3% of songs on an iPod came from the iTunes store). The record companies[173] felt that Apple was in a position to dictate the economic terms and the business models. The music industry thought that one way of drawing people away from iTunes was to get rid of DRM.[174]

When the music companies freed Apple from the obligation to encode the files Apple increased the price per song and charged consumers for unlocking their existing library at

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[172] Ewan Kirk, 'Apple's iTunes digital rights management: "Fairplay" under the essential facilities doctrine' (2006) 11 (5) Comms Law 161.

[173] Universal, Sony BMG, Warner Music Group, and EMI.

[174] How Apple is changing DRM, The Guardian, Thursday 15 May 2008, http://www.guardian.co.uk/technology/2008/may/15/drm.apple [accessed 30/10/2010]

30 cents a song[175]. Apple offered tracks in its AAC format rather than MP3 – which still limited interoperability. Many popular devices such as the iRiver and Archos players and Creative's Zen did not support the AAC format and converting to a MP3 format was a time-consuming process.[176]

> The bottom line is that while Apple will allow the customer to use iTunes' DRM-free music on other players, it won't go out of its way to make it particularly easy to do so. Apple also revealed it will offer music videos without DRM protection, although it had no plans to do the same with films or TV shows.[177]

Apple’s use of DRM allowed it to raise barriers to entry in the portable player market and to maximise profits in that market. To its credit it provided a service that attracted people to pay for downloaded music and reduced the price of music, but was the business model potentially harmful to consumers? Using DRM to restrict interoperability imposes additional costs on consumers and hardware producers, particularly where there are competing DRMs which are not cross licensed. Economies of scale are foregone as “consumers are separated into different incompatible subgroups.”[178] The online music market has network effects and the use of DRM and lack of interoperability fragments the market, this is likely to decrease welfare and potential benefits as consumers do not enjoy being part of a larger network.[179] Ironically if reverse engineering were permitted it would increase the size of the legitimate network and with music at a lower price it would encourage more legal downloading, although this would arguably be at Apple’s expense.

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[175] John Lettice, ‘Apple iTunes Store goes '100% DRM-free' – allegedly’ *(the Register* 6th January 2009) http://www.theregister.co.uk/2009/01/06/macworld_itunes/ [accessed 30/10/2010]

[176] DRM Free Future, Music Week http://ehis.ebscohost.com/eds/pdfviewer/pdfviewer?vid=2&hid=20&sid=a7ab5a73-5b44-4f27-ab37-e78aa292aa78%40sessionmgr14 [accessed 30/10/2011]

[177] Ibid

[178] Urs Gasser et al., 'iTunes How Copyright, Contract and Technology Shape the Business of Digital Media - A Case Study'.44 http://cyber.law.harvard.edu/media/uploads/53/GreenPaperiTunes03.04.pdf?q=itunes [accessed 30 July 2015]

[179] Ibid 44

3.12.5 What can we learn from iTunes?

It is established that DRM can fragment existing markets and create new markets. One example is the division of the music market into the download market and the traditional market such as CDs.[180] DRM can also erect and strengthen barriers to entry which can be of concern when they are implemented, not for the purpose of protecting copyright but to prevent competition such as where there would otherwise be interoperability between competing complementary goods. Arguable DRM within the entertainments industry is less likely to have anti-competitive effects because it will be protecting unique goods which are often copyright protected. However the DRM protection can morph to protect goods that would otherwise be compatible. This was a concern in Sony/BMG joint venture. Sony could use its own DRM system to offer music in formats that would not be readable through equipment that adopted competitive DRM solutions.[181]

Even where DRM originally protects IPRs it can morph to protect physical products. DRM was ostensibly used to protect iTunes at the insistence of the record companies but was used by Apple to limit competition and raise barriers to entry in the portable player market.

In Chamberlain v Skylink[182] and Lexmark[183] DRM was applied to products to limit competition in the accessory or aftermarket. The cases were brought under the DMCA[184] alleging unlawful reverse engineering. While neither Court was asked to consider any matters of competition law both judgements considered that DRM should not be used to limit competition in the accessory market as this would reduce consumers' choice in the

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[180] *Sony/BMG* Comp/M.3333 (2007) Commission Decision 13/10/2007

[181] Paulo Magnani & Maria Lilla Montagnani 'Digital rights management systems and competition: what developments within the much debated interface between intellectual property and competition law?' (2008) 39 (1) Intenational Review of Intellectual Property and Competition Law 83, 93

[182] *Chamberlain Group, Inc. V Skylink Technologies Inc*., 281 F.3d 1178, 1183 (Fed. Cir. 2004)

[183] *Lexmark Intl., Inc. V Static Control Component Inc.,* 387 F. 3d 522,564 (6th Cir. 2004)

[184] Digital Millennium Copyright Act 1998

secondary market and reduce competition pressures that drive innovation.[185] These cases, where DRM solutions are used in connection with compatible goods, have highlighted the danger that DRM can be a tool to foreclose connected markets.[186]

In addition to the technical lock-in caused by DRM there was an element of lock-in due to switching costs. The switching costs per customer were not very significant but enough to lock customers into the Apple system. Switching costs were borne disproportionately by customers who paid for a library of songs from iTunes and then had to repay to convert them. The lock-in was in the form of market lock-in but there was also supplier lock-in as users had their data (songs) stored in the proprietary system.

It is not clear why Apple stopped using DRM. It appears to be a market driven decision.[187] Apple may have had genuine concerns that if the DRM was unencrypted it would risk action by the record companies; they had gained their market share thanks to DRM but it might have outlived its purpose and could backfire due to its unpopularity. Consumers were using non encrypted sources such as CDs and illegal downloads. Here an open system brought commercial pressure to bear on the closed systems.

Apple appears to have used DRM to leverage its market position. When the market changed DRM was removed. Apple still retained the AAC format which it did not licence and it remained a relatively incompatible system. Even taking into account Apple's preference for being vertically integrated and using exclusive proprietary software, the iTunes DRM scenario was a salutary tale for what to expect from the present trend for platform technologies in products and online services. However the latest chapter of the Apple iTunes saga is the decline of its preeminent position with the increase in the bandwidth available to consumers, enabling the rise of music streaming providers such as Spotify.

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[185] Paulo Magnani & Maria Lilla Montagnani 'Digital rights management systems and competition: what developments within the much debated interface between intellectual property and competition law?' (2008) (1) 39 Intenational Review of Intellectual Property and Competition Law 83, 96

[186] Ibid 105

[187] Ian Brown and Christopher Marsden, in *Regulating Code* (2013 The MIT Press), 89 consider consumer resistance caused the abandonment of TPM restrictions on most downloaded music.

3.13 Achieving the Right Balance

The background to software interoperability reviewed in this Chapter presents a picture of suppliers using various means including IPRs and TPMs to lock customers into their own software systems. It also displays examples of remedies that can come from customers' own action and from general market effects. The law can set a framework but it does not give all the solutions. These come from the ingenuity of the users and the commercial pressures acting on the suppliers. This however remains a rather haphazard picture of the present impact of interoperability and lock-in and does not enable the assessment of whether legal regulation is providing the optimum or even an acceptable framework.

The work on interoperability undertaken by van Rooijen makes a valuable contribution articulating a normative framework for evaluating interoperability. The normative framework takes account of the balance that must be struck between the rightsholders' need for control to incentivise innovation with the benefits of openness, again to enable competition and encourage innovation.[188] Striking the right balance is important for consumer welfare. It also recognises that the benefits and disadvantages of ex ante certain regulation and ex post flexible regulation must be considered.

Rooijen argues that control over interfaces can stimulate dynamic innovation[189] but factors such as the extent of supplier lock-in and the market being oligopolistic will affect dynamic innovation, particularly resulting from follow on innovation.

Van Rooijen proposes that control over interfaces has a dual function, the direct and the indirect function.[190] The direct function is similar to that of control over any technology which gives incentives to innovate, but as the investment in interfaces is normally recouped by licensing the main computer program, the incentives are barely necessary. The indirect function is the control over interoperability and control over access to competing and

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[188] Ashwin van Rooijen *The Software Interface between Copyright and Competition Law* (Kluwer Law International 2010), 43. Control enables the rightsholder to charge prices above marginal costs of production, which are negligible for software, to recoup the more substantial fixed costs of innovation.

[189] Ibid 44

[190] Ibid 45

complementary software, access to networks and access to consumers own data. As software industries are characterised by a substantial degree of interdependence the impact on competition and market power can be disproportionate.[191] Again a balance must be struck but this indirect control over interface specifications, and other technical standards, cause different effects and outcomes including on static and dynamic competition. The optimal balance for interfaces is different with more emphasis on openness than control. Competition law and copyright law were found to not fully recognise the indirect effects of control but to treat all subject matter similarly. This failed to recognise the effects of control over interface specifications on interoperability and its effect on competition and innovation.[192]

While the need to strike a balance is recognised and a 'middle ground between openness and control' advocated,[193] it is recognised that IPR regime determines the balance of control ex ante which gives certainty.[194] But an IPR regime is however unable to meet the requirements of specific cases and given the complex and widely differing nature of software available, it is desirable to have more substantive criteria to identify the location of the 'pivot' between control and openness.[195] Shemtov proposed a model that uses recoupment of R&D costs as a benchmark for licensing innovative software architecture to competitors when coupled with revenue generated on sales as sufficient incentive to continue and invest in original research and development.[196] Samuelson and Scotchmer

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[191] Ibid 196 et seq.

[192] Ibid 196 et seq.

[193] Ibid 234

[194] Ibid 46

[195] Noam Shemtov is unaware of empirical data on reverse engineering and decompilation, see Noan Shemtov 'The Legal Regulation of Decompilation of Computer Programs: Excessive, Unjustified and in Need of Reform' (PhD Thesis QML 2013) 44. Also Samuelson and Suzanne Scotchmer "The Law and Economics of Reverse Engineering" (2002) 111 The Yale Law Journal 1575; Rooijen ibid talks of 'middle ground between openness and control', 234

[196] Shemtov ibid 44

proposed four criteria to assess the social welfare effects of the law's recognition of a right to reverse engineer.[197]

This thesis uses the normative structure and the indirect effects proposition by applying it to oligopolistic markets and software patents. It is considered in the context of a specific software industry, the 3D CAD industry, which is characterised by supplier lock-in rather than predominantly network effects. This allows the framework to be applied to a clearly identified market and to evaluate how the market addresses the control and openness provided by the legal framework for software interoperability.

3.14 Summary

This Chapter has demonstrated that the relationship between interoperability, competition and innovation is not proven or clear cut, but is complex and nuanced.[198] Interoperability causes network effects as compatibility within a network is demarcated by the lack of interoperability on its boundaries and this can cause lock-in, restricting consumer choice and competition.[199] As interfaces are not accessible the IPR protection in computer programs protection may be stronger than intended[200] and the optimal balance between control and openness of interfaces is different with more emphasis on openness than for

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[197] Samuelson and Suzanne Scotchmer 'The Law and Economics of Reverse Engineering' 111 (2002) The Yale Law Journal 1575.

[198] Commentators, including Mark Lemley 'Antitrust and the Internet Standardization Problem' 28 CONN. L. REV. 1041 (1996) at page 31, recognise the benefits of interoperability while others consider the position is more ambiguous, *see e.g.* Mario Gil-Moto 'Economic aspects of the Microsoft case: networks, interoperability and competition', in Luca Rubini , "*Microsoft on Trial*" 344 at 359 *et seq.*l (Edward Elgar, Cheltenham, 2010). Studies have found anecdotal evidence sufficient to support the claim of a link between interoperability and innovation. See Urs Gasser & John Palfrey 'When and how interoperability drives innovation' (31 October 2007). http://cyber.law.harvard.edu/sites/cyber.law.harvard.edu/files/interop-breaking-barriers_1.pdf [accessed 30 July 2015].

[199] Michael L. Katz & Carl Shapiro 'Systems Competition and Network Effects' (Spring 1994) 8 J. Econ Persp. 94. The utility provided to each individual user of a specific platform or system increases with the total number of users, so the higher the number of users the higher the demand.

[200] Daniel J. Gifford, and Robert T. Kurdrie 'Antitrust approaches to dynamically competitive industries in the United States and the European Union' (2011) 7 (3) J C L & E 695-731 at 705 - 706. Gifford and Kurdie consider that the competition between differentiated products contemplated by copyright law does not work in network markets as the combination of copyright, trade secrets and the inaccessible code gives a much stronger protection than was probably intended by both the US and EC copyright initiatives

other software.[201] Software users are not necessarily passive victims of lock-in but can ameliorate the impact of lock-in.[202] Network effects and lock-in do not necessarily justify intervention[203] and forces in the market can bring pressure on suppliers to increase interoperability. To increase market share it may be necessary for the suppliers to make interfaces available.[204]

The Commission, CJEU and member states look favourably on interoperability, not only in the Software Directive but also in Article 102 and mergers.[205] Article 102 is however only available for dominant suppliers and is an unattractive remedy as ex post and prone to error.[206] There remains uncertainty about the legal status of interfaces although certain aspects amounting to ideas and method of operation are not copyright protected.[207] The Software Directive does not require suppliers to make interface information available although it permits reverse engineering including decompilation in certain circumstances.[208] Reverse engineering is essential and used frequently but is complex and time consuming

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[201] A van Rooijen, *The Software Interface Between Copyright and Competition Law* (Kluwer Law 2010)

[202] Ian Larkin 'Bargains-then-Ripoffs : Innovation, Pricing and Lock-In in the Enterprise Software' (2008) Academy of Management Annual Meeting Proceedings, 1-4

[203] Network effects are common but do not always involve externalities. S J Liebowitz & Stephen E. Margolis 'Network Externalities : An Uncommon Tragedy' (1994) 8 Journal of Economic Perspectives, 135. But compare Joseph Farrell & Paul Klemperer 'Coordination and Lock-in: Competition with Switching Costs and Network Effects' in M Armstrong & R Porter (eds.) *Handbook of Industrial Organization* (Vol 3, Elsevier 2007) who cautiously favour some intervention in the form of pro-compatibility public policy.

[204] Ann Walsh, '*Microsoft v Commission*: interoperability, emerging standards and innovation in the software industry' in Rubini, L, (ed) *Microsoft on Trial* (Edward Elgar 2010)

[205] It appears that the economic assessments carried out in *Microsoft* have influenced the Commission's opinion to look more favourably on interoperability than was apparent at the time the Software Directive was introduced.

[206] Frank H. Easterbrook '*The Limits of Antitrust'* 63 TEX. L. REV. 1 (1984)

[207] Art. 9(2) of TRIPS and Art. 2 of the WCT

[208] Art. 6 of the Software Directive

and a poor business plan.[209] Interface information obtained by reverse engineering cannot be disseminated although this restriction does not apply to information obtained by observation.[210]

The landscape is complex but a vital aspect is not just the interfaces or network of the software but the data that is created, collected and stored by the software. The emphasis should not be on the 'plumbing' of the software systems and their direct network effects but on the secondary or indirect effects caused by the data created by and stored in those systems. This data can include both information collected from users by the platform owners and the users' proprietary data stored in the software.

While it is possible that the dominance of Google's search engine may be eclipsed by a 'platform shift' what Google has, that others before it have not, is the ability to mine and accumulate data and "its unparalleled ability to exploit that data."[211]

It is the existence of users' proprietary data that is stored in the software's particular format that prevents the switching between platforms, such as in 3D CAD software. This causes the type of lock-in that may have a substantial effect on both static and dynamic competition and which it is said, may justify intervention.[212]

By contrast users of software have restricted access to information on interfaces and are unable to disseminate information obtained by decompilation even where it is not copyright protected. This lock-in means they are unable to access their own proprietary

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[209] For a full account of how reverse engineering is essential but complex and time consuming see Andrew Johnson-Laird 'Software Reverse-Engineering in the Real World' (1994) 19 U Dayton L Rev 843

[210] Art. 6 (2) (b) of the Software Directive

[211] Briefing Internet Monopolies 'Everybody wants to rule the world' *The Economist* (London 29 November 2014), 24

[212] Joseph Farrell & Paul Klemperer 'Coordination and Lock-in: Competition with Switching Costs and Network Effects' in M Armstrong & R Porter (eds.) *Handbook of Industrial Organization* (Vol 3, Elsevier 2007) who cautiously favour some intervention in the form of pro-compatibility public policy

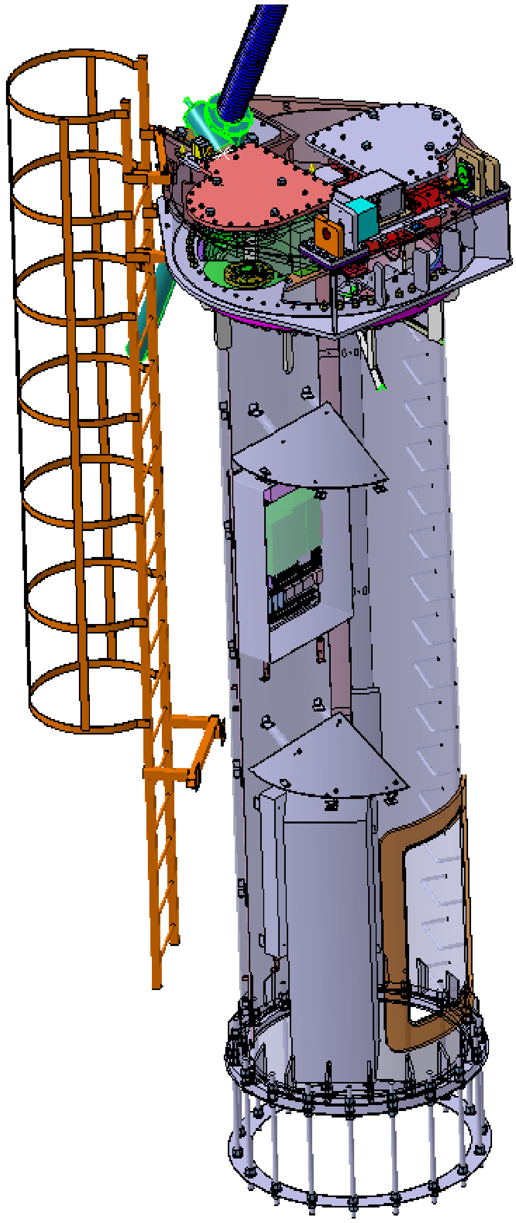
data that is stored in the software without the software rightholders permission. Due to this and other restrictions and costs, such as retraining, they are locked-in and competition in markets such as the 3D CAD industry is restricted. As the market is oligopolistic there is no effective competition law remedy. What is required is an improvement in the ex ante IPR regime to improve the access to interface information. This thesis explores the existing legal regime in the context of the 3D CAD industry, paying particular attention to the regulation of access to the interface information, and recommends improvements and methods of implementation.

CHAPTER 4. THE INDUSTRY

4.1 Introduction

This thesis is concerned with the specific topic of the regulation of interoperability. For this reason the analysis of the 3D CAD industry will not be a general competitive analysis but will focus on the issue of interoperability. It will consider the competitive conditions in the industry but with a view to analysing the implications for the legal regulation of intellectual property rather than developing a competitive strategy. The emphasis will be on the interplay between a lack of interoperability and its impact on the structure of the industry, and the role played by intellectual property rights and competition law.

The Chapter will start with an overview of the rationale for selecting the 3D CAD industry before defining the market using industry data and decisions by the European Commission. The evolution of the general software market and the 3D CAD industry will then be considered to provide context and illustrate the proprietary nature of the software that gives it its controlled and closed nature. The Chapter will conclude with a structural analysis drawing on Michael Porter's techniques for analysing industries and competitors. The focus on interoperability and legal regulation rather than a general competitive analysis is continued.



CATIA 3D CAD Model of 13.5 metre Satellite Earth Station Antenna Pedestal

4.2 Rationale for Selecting the Subject

3D CAD software is widely used in engineering industries to develop, design, and manage the lifecycle of products. The software is crucial to the economy as it records vital design information and knowhow on all engineered products in the developed and developing world. It has been said that "(f)or most companies, the most significant repository for their product-related intellectual capital are CAD data files".[213] Another vital role is facilitating rapid innovation, which enables the development of sophisticated products. 3D CAD technology reduces time to market and design and production costs.

There are four main suppliers of 3D CAD software – Siemens, Dassault Systemes, PTC and Autodesk. Efforts have been made to standardise data transfer formats by the promulgation of standards but there are formidable interoperability issues, and users are essentially "locked in" once they have purchased a particular brand of software. The industry has all the elements associated with the propositions to some extent, namely: a lack of interoperability; network effects; lock-in; interfaces and proprietary software. It was identified in the public consultation for the Commission Staff Working Document as software with which users experienced interoperability issues.[214]

3D CAD is relevant to the phenomenon for the following reasons:

- The 3D Computer Aided Design software market ('3D CAD') has been selected as it is known to be subject to a lack of interoperability. This is recognised and spoken about by suppliers and users but remains an unresolved issue.[215]
- There are four companies with a comparable market share, none of which are considered dominant. The market is oligopolistic but it appears competitive with four companies engaged in R&D[216] which strongly indicates dynamic competition.

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[213] Cyon Research 'Intellectual Capital and Interoperability' (2003) Cyon Research Corporation

[214] Commission Staff Working Document (2013), 18

[215] Ibid

[216] According to the published accounts of PTC, Dassault Systemes and Autodesk for the 2014 financial year the typically R&D spend exceeds 20% of revenue although this covers all PLM software not just 3D CAD software.

- The extent of network effects in the market has not been verified and the extent to which users select software based on network effects is unknown
- Users may be locked-in to their existing software but the extent and cause is not verified. This may be due to switching costs rather than network effects.
- The software is complex with frequent new releases so reverse engineering is challenging.
- Standards and translators have failed to provide an acceptable solution.[217]
- Incremental improvements in software but few new entrants.[218]
- The software is expensive and users have to pay regular maintenance fees to continue to use the software.
- Possible innovation mainly in rest of PLM market where customers are not locked in
- The kernels (package of algorithms) used by all 3D CAD suppliers as the mathematical basis of their software are all derived from 2 original kernels which have been cross licensed.

While industry studies have identified that interoperability is an issue[219] there has been no in-depth study which looks at the problem from the perspective of the legal framework.[220]

The selection of the 3D CAD industry was based on purposive sampling. It was chosen as relevant to understanding the social phenomenon of interoperability. The industry fulfils the strategic aim as it is relevant to the research question posed.[221]

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[217] Junhwan Kim et al 'Standardised data exchange of CAD models with desing intent' (2008) 40 Computer Aided Design

[218] Cyon Research, Intellectual Capital and Interoperability *(2003)* Cyon Research Corporation; one of the few market entrants has been SpaceClaim http://www.spaceclaim.com/en/default.aspx which is based on the ACIS modelling kernel licensed by Dassault Systemes but uses a solid modelling approach. See section 4.9.

[219] For example, Cyon Research 'Survey of Engineering Software Users' (2009) Cyon Research Corporation found that users ranked interoperability as one of the three most important selection criteria, along with total cost of ownership and improving product quality.

[220] Cyon Research and the survey by Chad Jackson and David Prawel 'The 2013 State of 3D Collaboration and Interoperability Report' Lifecycle Insights and Longview Advisors http://www.tetra4d.com/collateral/3D-Collaboration-Interoperability-Report.pdf [accessed 11 October 2014] are aimed at capturing the industry as it is and do not consider the impact of the legal regime or potential improvements.

4.3 Defining the 3D CAD Market

3D CAD has been categorised as a part of digital product development (DPD) which encompasses CAD, computer-aided engineering (CAE) and computer-aided manufacturing (CAM), digital manufacturing (DM), and product data management (PDM).[222]

The market is defined by the software's application and solutions. Prior to clearing the acquisition by Siemens of UGS in 2007, the Commission surveyed competitors, customers and information technology service providers. The respondents considered that the various software applications and solutions (i.e. DPD, CAD, CAE, CAM, DM, and PDM) were specific to the function they provide.[223]

3D CAD software was considered to be distinct from the wider PLM software but at the same time when combined it can form an integral part of an overall PLM solution. PLM software was also distinct from other kinds of software, such as the wider enterprise application software (EAS), because of its specific product characteristics that distinguish it from the more general EAS software. PLM software manages specific information about the products of the company whereas EAS addresses more general information about a company's resources such as personnel or finance.[224]

When the Commission considered the acquisition by Dassault Systemes of IBM's marketing operation of Dassault Systemes' PLM, the majority of respondents thought there could be a separate 3D segmentation for certain applications, particularly CAM & CAD where the 3D functionality is more relevant.[225] They also made a distinction between "high-end" and "low-end" PLM software depending on the types of PLM application, but opinions differed

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[221] Alan Bryman and Emma Bell *Business Research Methods* (OUP 2011)

[222] Dassault Systemes/IBM DS PLM Software business (COMP/M.57632010) Commission Decision of non-opposition to notified concentration [2010] OJ C 110/1, para 11

[223] *Siemens/UGS Corporation* (COMP M.4608) Commission Decision of non-opposition to notified concentration [2007] OJ C 113/03, para 10

[224] Ibid para 10

[225], Dassault Systemes/IBM DS PLM Software business (COMP/M.57632010) Commission Decision of non-opposition to notified concentration [2010] OJ C 110/1 para 19

as to the PLM applications for which the "high-end"/"low-end" distinction would be relevant.[226]

With regard to the geographic market the investigations by the Commission found that PLM solutions are traded homogeneously in most world regions or at least within the EEA. None of the competitors considered that their PLM solutions were specifically tailored for the EEA market.[227]

This thesis is concerned with the 3D CAD market and not the wider PLM market. The PLM market is broader and has different characteristics. There appears to be more interoperability between PLM software and the market is competitive.

4.3.1 Sub-markets within the 3D CAD Market

Two of the suppliers in the market, Siemens and Dassault Systemes, supply products that were formerly categorised as "high-end" but which now are more generally referred to as "specialist" software. Both these companies also market mid-range or mainstream systems that compete with software from two other suppliers, PTC and Autodesk. The features and functions of "mid-range" software are no longer considered to be inferior to the "high-end" systems[228].

Specialist software does have some differences:

- it meets certain specialised needs,[229] and continues "to develop valuable tools to meet the needs of a narrow band of very demanding customers".[230] For example, CATIA offers packages for ship hull and aerospace sheet metal design

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[226] Ibid 17

[227] *Siemens/UGS Corporation* (COMP M.4608) Commission Decision of non-opposition to notified concentration [2007] OJ C 113/03, 11

[228] Cyon Research 'Survey of Engineering Software Users' (2009) Cyon Research Corporation

[229] Examples given by Cyon Research 'A Fresh Look at the Value-Proposition of High-End MCAD' (2007) Cyon Research Corporation, are turbine blade optimisation or manufacturing design to account for spring-back in large-panel cold-press stamping.

[230] Ibid 12

- the price of the software is only a fraction of the overall price which will also include services such as training, customisation and implementation consulting
- it is sold directly, rather than through a VAR channel,[231] and focuses on large automotive and aerospace customers.

There has been convergence in the characteristics of the two categories of software.[232]

The high-end or specialist 3D CAD products primarily serve major OEMs[233] in traditional sectors such as the automotive and aerospace industries that require a high specification product. Second tier and sub-contractors may use high-end 3D CAD when specified by their OEM customer, or because their product has features which require more sophisticated capabilities that are only found in high-end 3D CAD systems.

Competitors in the high-end/specialist sector:

- Siemens PLM division of the Siemens Group with Siemens NX
- Dassault Systemes - CATIA
- Parametric Technologies Corporation (PTC)- Creo (formerly ProENGINEER)[234] -

Non high-end:

- Siemens PLM division - SolidEdge
- Dassault Systemes - SolidWorks
- Autodesk - Inventor

For this thesis both the high-end or specialist software market and the mid-range software will be considered. Distinction will be drawn between these two different sub-markets where relevant. They will be referred to as high-end and middle range.

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[231] Value Added Reseller who adds services, possibly selling the software as part of a system.

[232] Cyon Research 'A Fresh Look at the Value-Proposition of High-End MCAD' (2007) Cyon Research Corporation

[233] An OEM - Original Equipment Manufacture – makes the final product for the marketplace, examples are Ford for the car market and Apple for the computer market.

[234] As performance of the mid-range software increases PTC's Creo is seen increasingly as a mid-range product rather than high-end. This is recognised in PTC's financial statements.

4.4 Interoperability in the 3D CAD Market

There is abundant evidence that users of 3D CAD Software experience a lack of interoperability. All the interviewees acknowledged the problem. A report in 2013 on the state of 3D collaboration and interoperability found that about 30% of respondents had experienced significant project delays or ordered incorrect parts due to design data problems following the exchange of files. Almost half had engineers spending 4 hours per week fixing design data issues following exchange of files and 14% of engineers spent more than 24 hours per week, often working overtime. With 90% of respondents transferring 10 files per month and 16% transferring over 1,000 files per month this is seen as a serious issue for manufacturing industry.[235] These metrics portray "the highly publicised huge cost of poor interoperability"[236]

Interoperability is discussed openly at industry forums, for example at COFES the main industry conference:

> "Interoperability of CAD data, especially 3D data, remains one of the biggest unanswered and open-ended questions in the industry: "When will CAD data interoperate"? or "Why won't the CAD vendors make their file formats open and interoperable?" have been asked again and again at events like COFES (the Congress On the Future of Engineering Software.) And regardless of the brilliant minds in attendance, those questions have never been fully answered."[237]

It is also discussed in the press and other media where, for example, a blog highlights that while much has changed in the industry interoperability does not seem to be making much headway. Software providers enable their software to read competitor's products to encourage their customers to stay with them while using complementary software, but

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[235] Chad Jackson and David Prawel 'The 2013 State of 3D Collaboration and Interoperability Report' Lifecycle Insights and Longview Advisors http://www.tetra4d.com/collateral/3D-Collaboration-Interoperability-Report.pdf [accessed 11 October 2014]

[236] Ibid David Prawel, 8

[237] Rachael Dalton-Taggart '3D data interoperability vendors sound off' Engineering Automation Report (*Graphic Speak* 11 July 2007) at http://gfxspeak.com/2011/07/11/3d-data-interoperability-vendors-sound-off/ [accessed 1 August 2015]

suppliers do not make it easier to read their products with competitor's applications or systems.[238] One of the main suppliers spoke of exactly this model with the creation of a platform where data could be injected or ingested into the platform.[239]

4.5 Evolution and Interoperability of General Software Market

When computers were first introduced in the 1950s, software was bundled with the hardware and it was not until the early 1980s that IBM moved to supplying software on an object code only policy. By this time the cost of hardware had declined, while software became more valuable and in order to maintain revenue the source code was no longer disclosed.[240] Proprietary software companies such as Microsoft, Oracle and Computer Associates expanded rapidly from nascent software developers in the 1970s to public quoted companies in the 1980s, specialising almost exclusively in computer software. Alongside these companies were system suppliers such as IBM and ICL which provided both hardware and software solutions. The norm at that time was for there to be little compatibility between the software systems of the various proprietary suppliers.

Compatibility between proprietary software companies was poor and at the gift of the proprietary supplier. This has continued for decades as illustrated by the cases of *Microsoft* and *SAS Institute.* This incompatibility has given rise to "platforms" that create the "walled gardens" of the digital giants such as Google, Apple, Facebook and Amazon, which make it hard for users to move content from one platform to another."[241]

The 1980s also saw the introduction of the open source software licence. Open source software is defined by its collaborative development, accessibility of code and distribution models. In the academic software community that had pioneered the Internet, a belief

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[238] Chad Jackson, 'Where the Interoperability Movement Falls Flat' (*Engineering.com* 6 September 2012) http://www.engineering.com/DesignSoftware/DesignSoftwareArticles/ArticleID/4769/Where-the-Interoperability-Movement-Falls-Flat.aspx [accessed 16 October 2014]

[239] Interview with senior industry executive #3 (May 2014)

[240] Martin Campbell-Kelly and Daniel Garcia-Swartz, 'Pragmatism, not ideology: Historical perspectives on IBM's adoption of open-source software' (2009) 21 (3) Information Economics and Policy 229, 237-9.

[241] Editorial, 'Survival of the Biggest' *Economist* (London, 1 - 7 December 2012) 13

grew that commercial imperatives were destroying the cooperative environment in which programmers worked. As software increased in complexity (and higher level programming made use of obfuscation techniques), decompilation and reimplementation of a program from the binary object code (in which it is distributed and executed) became more difficult. In order to understand a program fully, access to the source code (including symbolic labels and annotations) was indispensable. Richard Stallman left MIT in 1984, and pioneered an open approach to software development and distribution in the GNU Project, launched to develop a complete Unix-like operating system. In 1988, Stallman issued the first version of the General Public License (GPL) forcing derivatives of GNU software to keep their source code free from proprietary claims. In a radical spirit, which has been described as the constitution of the Free Software/Open Source movement, copyright law was used to subvert itself.[242]

The GNU General Public License (GPL), as with all open source software, gives the user certain freedoms to run, copy, distribute, study, change and improve the software. To make this meaningful users must have access to the source code. It is these freedoms that give the software the prefix "free". Free software is a matter of liberty not price.[243] The GPL is a copyleft licence in that the copyright holder "leaves" what would otherwise be exclusive rights available to others. GPL v.2 contains a "liberty or death" clause making patent restrictions a breach of the licence and prohibiting further distribution of the software.[244] GPL v.3 more directly addresses patents, granting licences of software patents in added source code for downstream users.[245] Other open source software licences such as BSD, MIT and Apache are more "permissive". GPL v.2 is however the most widely used

[242] Martin Kretschmer, 'Software as Text and Machine', introduction to special issue on Software-related Inventions (2003) 1 Journal of Information, Law & Technology, 1-23. http://www2.warwick.ac.uk/fac/soc/law/elj/jilt/2003_1/kretschmer/

[243] 'What is free software' *Free Software Foundation* http://www.gnu.org/philosophy/free-sw.html [accessed 1 August 2015]

[244] GPL v.2, section 7

[245] GPL v.3, section 11

licence.[246] The most popular open source licences have a built-in termination clause that prevents distribution of the software if it is associated with any obligations such as patent licences that would not permit redistribution.[247] It does not mean that all software that reads on the OSS code must be royalty free (RF) but code that is licensed, for example under GPL, cannot be combined with an implementation of a FRAND standard without losing the ability to distribute the code.[248]

Incompatibility between proprietary software systems still exists but there have been some improvements in recent years. There has also been "commingling" with many software users and developers using both proprietary and open source software.[249] Both proprietary and open source software can be compatible with open standards. It has been said that open source can benefit the implementation of open standards, as adoption of an open standard under an open source development model can sometimes drive or accelerate standard adoption. Proprietary software remains prevalent but the combination of standards and open source and general expectation and market demand means that there is more openness and compatibility of software is now widespread. Nevertheless there are areas where a lack of interoperability remains and even in platforms which make APIs available interoperability can still be controlled by the rightsholder.

4.6 Evolution of 3D CAD Software

The roots of the 3D CAD industry can be found in the established practice of using drawings to record and communicate designs for the manufacture and use of products and the increasing use by large organisations of mainframe computers in the 1960s. The software is

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[246] http://osrc.blackducksoftware.com/data/licenses/ [accessed 1 August 2015]
GPL v.2 licence is used for roughly 40% of open source software projects and over 60% of all projects use GPL including the Linux project.

[247] Mikko Valimaki and Ville Oksanen, 'Patents on Compatibility Standards and Open Source – Do Patent Law Exceptions and Royalty Free Requirements Make Sense?' (Sept 2005) 2 (3) SCRIPT-ed. The latest versions of Apache license and Open Software License have similar clauses.

[248] Jay Kesan, 'The Fallacy of OSS Discrimination by FRAND Licensing: An Empirical Analysis' (2011) Illinois Public Law l Research Paper number 10-14. http://papers.ssrn.com/abstract=1767083

[249] Josh Lerner and Mark Schankerman, *The Comingled Code: Open Source and Economic Development* (MIT Press 2010)

overwhelmingly proprietary software produced by a small number of suppliers. While standards are widely used in the industry there is no evidence of open source software having any significant use or influence on interoperability. The study of the evolution of the software and the suppliers is a story of proprietary software.

4.6.1 Pen and Ink to CATIA V6

4.6.1.1 By Hand - The Drawing Board

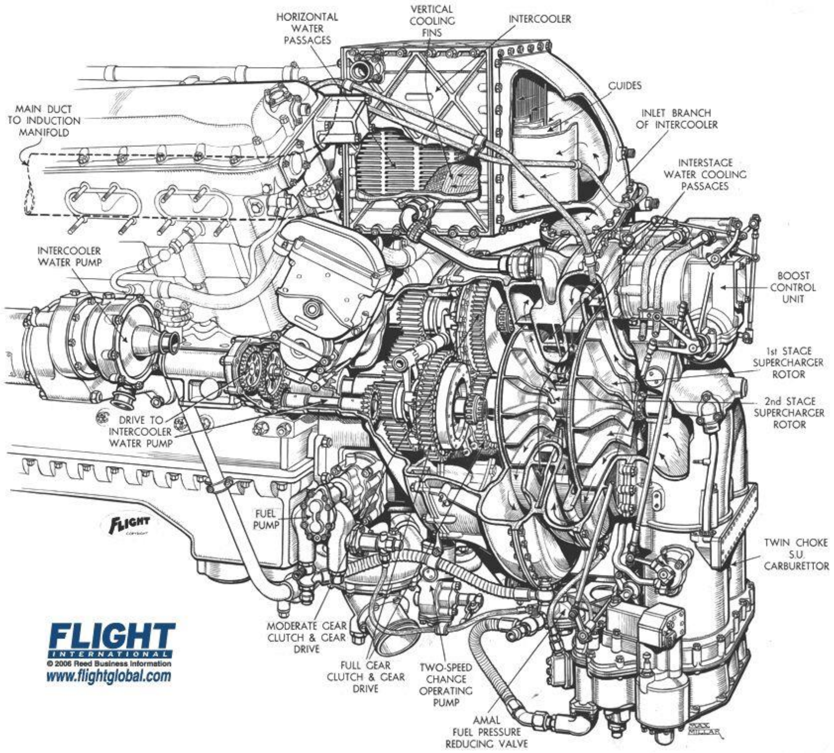
Since the industrial revolution, and probably before that, drawings have been used by engineering and manufacturing organisations to design products, to communicate designs to the factory floor, subcontractors and customers, and to store a considerable part of the organisation's intellectual property.

Traditionally, designs were produced by teams of draughtsmen working at drawing boards with pencils on large sheets of paper.

The Drawing Office of the Armstrong-Siddeley Company, Coventry

In the real world, products are three dimensional. To conceptualise a 3D product, and then to produce by hand a formal two dimensional (2D) drawing takes enormous skill, is extremely time consuming, and is prone to errors which have to be ironed out by manufacturing several prototypes.

The time consuming nature of manual drawing meant that detailed designs were often not produced for every part, leading to the requirement for high levels of craftsmanship on the shop floor, potentially incompatible parts, and uncertainty about capturing design changes as the product evolved over time.

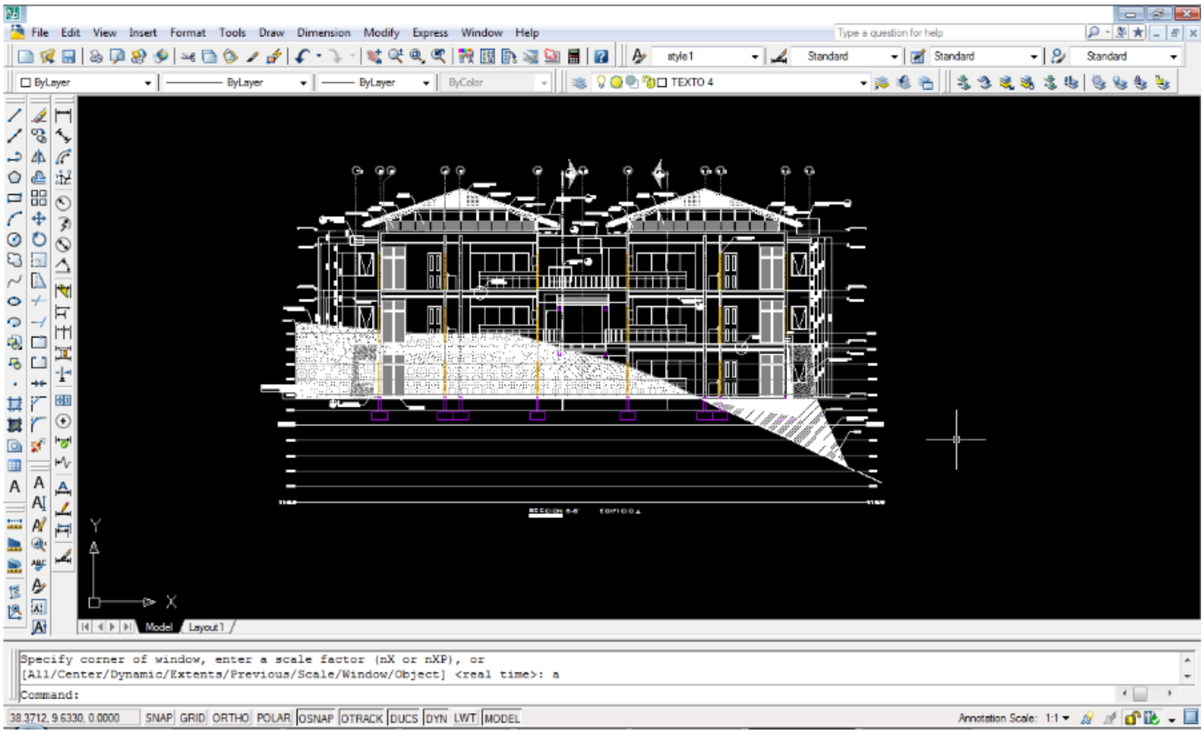


Hand Drawn Visualisation of Rolls Royce Merlin Engine Supercharger Arrangement

It is very time consuming and difficult to manually produce three dimensional (3D) images for manuals and publicity material. Design reviews and cooperative working are limited by the availability of paper drawings, and it is difficult to convey an idea of the proposed design to non-technical people. Stress analysis, often a vital part of the design process, has to be undertaken by hand, a difficult, time consuming and frequently inaccurate process, one which was frequently ignored by making designs heavier and hence more expensive than they really needed to be.

4.6.2 2-D Electronically - Keep Calm and Undo

With the advent of electronic computers, systems were designed which mimicked the operation of a drawing board and pen, by producing a 2D drawing on a screen which could be easily edited and subsequently printed. These Computer Aided Design (CAD) systems had considerable advantages over the traditional paper based approach, as they allowed the designer to produce drawings more accurately and quickly. As well as decreasing design time, CAD led to reduced manufacturing errors. It was said that the McDonnell Douglas MD11 airliner, designed with an early CAD system, was the first aircraft in which the carpets fitted first time without trimming. The advent of the IBM compatible PC (1983) and the introduction of Autodesk's AutoCAD software package (1988) meant that 2D CAD was within the reach of even modestly sized companies, and its use spread very quickly.



AutoCAD Screenshot

2D CAD systems were and are a considerable step forward, but they are really only improvements on the traditional drawing board – 2D solutions for a 3D world.

4.6.3 3D – Approaching the Real World

The ability to design components in 3D is a huge advantage, but presents formidable difficulties. The algorithms required to describe and represent 3D shapes and curves are complex, and they require enormous computing power to process and display. As the algorithms have become more ubiquitous and the cost of processing power has fallen, the use of 3D CAD has become very widespread. Even companies of modest size are able to use 3D CAD to design complex products accurately and quickly, and to analyse and predict the product's performance, as well as automatically building Bills of Material and keeping track of design iterations.

The 3D CAD market is a distinct market defined by the nature of the product. The market has been described as visual design authoring for product idea generation, visual collaboration and virtual simulation of products or processes - primarily for the design phase but also for planning and maintenance.[250]

It emerged as a market in the 1980s when CATIA, UGS and PRO/Engineer were first sold as 3D modellers. At that time there was a close link between the software suppliers and the hardware producers. The software was limited by the processing capabilities of the hardware and could only run on a limited range of hardware and operating systems. For example in the mid 1980s the UGS primary platforms were minicomputers from Data General and Digital. PTC designed PRO/Engineer to work on multiple platforms but focused on UNIX as its primary operating system. The hardware and software combined were very expensive – the price for a UGS system started at $250,000. Eventually 3D CAD systems moved to PCs running the Windows operating system. More recent entrants such as SolidWorks were designed from the start to run on PCs.

4.7 Industry Competitors

4.7.1 Introduction

Today there are four main players in the 3D CAD industry – Siemens, Dassault Systemes, PTC and Autodesk. To a considerable extent, the industry's history has been dominated by technological changes in computers, and the rise of new competitors able to exploit advances in hardware, as mainframes gave way to minicomputers, which in their turn were swept aside by the rise of the Windows PC.

The three companies in the high-end/specialised sector also supply complementary collaborative product data management software known as Product Life-Cycle Management (PLM). They tend to dominate this sector as well although there is competition from Oracle and SAP.

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[250] Worldwide Product Life-Cycle Management (PLM) Applications 2011 Vendor Assessment: CAx, Discrete, and Process PLM, (Excerpts) (February 2011) *IDC Manufacturing Insights* . https://www.plm.automation.siemens.com/en_us/Images/IDC-PLM-Marketscape-Siemens-excerpt-final-Mar11_tcm1023-122087.pdf [accessed 1 August 2015]

3D CAD products frequently include some integrated element of visual simulation or finite element analysis (FEA) and computational flow dynamics (CFD), and higher specification analysis software is available as an optional extra. CAD companies have generally gained access to FEA technology through acquisition. ANSYS is a major player in the FEA market, and until recently it did not produce 3D CAD software.

4.7.2 Siemens plm

4.7.2.1 McDonnell

Electronic digital computers were first developed during WW2. By the early 1960s, large corporations commonly possessed mainframes, and some of them realised that they could be used to assist in the design process. One example is the McDonnell aircraft company, which started its McAuto subsidiary to develop computer services. McAuto's 'CADD' software was used to design McDonnell and later McDonnell Douglas (MDC) aircraft, although there was reluctance to sell CADD to potential competitors in the aircraft industry, and potential customers were deterred by the $250,000 price tag.

By the mid-1970s minicomputers running UNIX operating systems had become much less expensive alternatives to mainframes, and MDC acquired United Computing, which had been founded in 1963 and had developed the Unigraphics (UGS) CAD program. By 1980 Unigraphics was 3D. In 1988 MDC acquired Shape Data which owned the solids modeller Romulus and the boundary representation or B-rep solid modeller Parasolid, which UGS adopted as its geometric modelling kernel.

4.7.2.2 GM and EDS

In 1991 UGS was sold to GM's EDS subsidiary for $400M, and in 1996 EDS was in turn spun off from GM. The mid-range software Solid Edge was acquired in 1997, and by 1998 Unigraphics was ported to Windows. In 2004 annual revenues were about $900 million and earnings just over $100 million. EDS sold UGS to private equity investors in 2004 for $2 billion.

4.7.2.3 Siemens

In 2007 Siemens AG acquired the UGS Corporation for US$3.515 billion from private equity firms. It now operates as a unit within Siemens' Automation and Drives (A&D) Group, a

€12.8 billion business unit headquartered in Nürnberg, Germany. UGS has customers in a variety of industries around the world, primarily automotive, aerospace and defence, consumer goods, high-tech electronics, and machinery. At the time of the acquisition UGS claimed more than 46,000 customers in 62 countries.

Siemens PLM Financial Information

As Siemens PLM is part of the Siemens group of companies separate financial information on the PLM division is not available. The latest financial information released to the stock market on UGS was in 2004 prior to the acquisition by private equity investors.

In 2004 annual revenues were $900 million and earnings just over $100 million. From interview it is understood that revenues have increased in the past 10 years in line with other 3D CAD Suppliers.

Siemens's PLM share in the overall PLM solutions market is approximately 10-20% worldwide, and slightly less at EEA-level. In sub-categories of PLM (i.e. DPD, CAD, CA E, CAM, DP, PDM), UGS' market share reaches a maximum of 10-20% in CAD and PDM while as regards DM software (the so-called "digital factory"), UGS enjoys a market share of approximately 30-40% worldwide and approximately 30-40% EEA-wide.[251]

Source of information: UGS K-10 for 2004 unless otherwise stated

4.7.3 Dassault Systemes

4.7.3.1 CATIA

Similar efforts were made in other large manufacturing companies to harness the power of their computers. The French aerospace company Avions Marcel Dassault leveraged pioneering work done by Pierre Bezier at Renault to develop the CATIA (Computer Aided Three-dimensional Interactive Application) 3D CAD program, and quickly realised its potential, spinning off Dassault Systems in 1981 to market the software, signing a non-

[251] Idid para 21

exclusive distribution agreement with IBM which proved to be very long lasting. CATIA's customer base widened to other industry segments including industrial equipment, high-tech, shipbuilding, energy and consumer goods, allowing customers to create digital mock-ups which lessened the need for physical prototypes, reducing costs and time to market.

Dassault Systemes, with headquarters near Paris, was listed in 1996 (Paris & Nasdaq), following which it entered a period of acquisition and innovation as it developed the PLM phenomenon, acquiring various companies with software products that became important brands in its PLM offering including SIMULIA and ENOVIA.

Dassault ported CATIA to Windows in 1998. Spatial, developers of the ACIS kernel was purchased in 2000, and in 2010 Dassault acquired IBM's CATIA distribution operation for $600 M.

4.7.3.2 SolidWorks

Using proceeds from gambling, John Hirschtick founded SolidWorks, developing a low cost but highly effective 3D CAD program for Windows based PCs. The software was aimed at SMEs, which generally still used 2D CAD. Sales of the software grew rapidly, often at the expense of Pro/Engineer, and the company was bought by Dassault Systemes in 1997, although the software continues to use the Parasolid kernel, now owned by Siemens.

Dassault Systems Financial Information for 2013

Dassault Systems had a turnover in the financial year 2013 of €2 Billion.

This was made up of 91% software products and 9% services with CATIA making up 39% of sales and SolidWorks 20%.

The majority of revenue, 73%, comes from recurring software rather than new licences or product development although there were 19,500 new customers in the year.

Operating Margin was 24%

The total number of employees is 10,685 with almost 5,000 engineers in the Research & Development department. Research & Development spend is more than 20% of revenue.

Revenue comes 27% from America, 40% from Europe, and 27% Asia

60% of its turnover comes from direct sales of CAD software of which Euro 1.1 billion is from CATIA and 0.5 billion from Solidworks.[252]

Turnover in 2010 was of 1.5B Euro with an operating income of 20% of revenue.[253]

Dassault Systemes' market share has been assessed at 25%[254], although some have estimated the market share, depending on how the market is defined (whether CAD/CAM is seen as separate from PLM) as high as 40%[255]

Source of information: Dassault Systems Annual Report 2013 unless otherwise stated[256]

4.7.4 PTC

The advance of lower cost 3D CAD software running on UNIX platforms commenced in earnest in 1985 when Samuel Giesberg started Parametric Technology Corporation to produce Pro/Engineer software. Pro/Engineer was first shipped in 1987. The company was profitable immediately and went public in 1989. This 3D system was a game changer, markedly less expensive than existing mainframe systems, and it expanded quickly, acquiring Computervision in 1997. Computervision had complementary design software and key accounts with Airbus, Rolls Royce Aircraft Engines, Fiat, PSA, GE & Raytheon. It also acquired Windchill, a smaller company, and the Windchill PLM software is now a major

[252] PLM analyst CIMdata as reported in *Engineering.com* (8 April 2014) http://www.engineering.com/PLMERP/ArticleID/7438/Inside-Daimler-Mercedes-Switch-from-Dassault-Systemes-to-Siemens-PLM-and-NX.aspx [accessed 11/10/14]

[253] Dassault Systems Annual Report 2010

[254] Dassault Systemes/IBM DS PLM Software business (COMP/M.57632010) Commission Decision of non-opposition to notified concentration [2010] OJ C 110/1

[255] Ibid 30

[256] Dassault Systems Annual Report 2013 http://www.3ds.com/fileadmin/COMPANY/Investors/Annual-Reports/PDF/2013-3DS-Annual-Report-EN-V2.pdf [accessed 16/10/14]

revenue stream for PTC. PTC's business now includes 3D CAD, renamed as Creo from Pro/Engineer, and PLM software.

Despite its markedly aggressive marketing techniques, Pro/Engineer suffered from competition from even lower cost Windows based software, and today inhabits a place in the market somewhere between the high and mid-range offerings from the other suppliers. During the interviews with senior executives and experts in the industry it was apparent that Dassault Systems and Siemens were seen as direct competitors in the high end/specialists software market and PTC was seen as the third player.

PTC Financial Information for 2013

PTC had revenue of $1.2 Billion of which $334 million came from licencing and the remainder from service and support. The CAD sector, CREO, amounted to $552M of income of which licences $150M, service $24M & support $378M

Research and Development costs were $221 million.[257]

PTC employees 6,000, including 2,000 in product development;

Americas accounted for 40%, Europe for 37% and Asia-Pacific for 23% of revenue

Most sales are made direct (70%) although 420 worldwide distributors account for 30% of sales.

PTC is estimated to have 10 to 20% of the worldwide market for PLM and up to 10% of the PLM market in Europe.[258] Its share in the engineering software market – CAD/CAM is probably higher.

Source of information: PTC K-10 for 2013 unless otherwise stated.[259]

[257] PTC Inc annual report fiscal year ended September 30, 2013, Form K-10, Appendix A

[258] *Siemens/UGS Corporation* (COMP M.4608) Commission Decision of non-opposition to notified concentration [2007] OJ C 113/03

[259] PTC Inc annual report fiscal year ended September 30, 2013, Form K-10, Appendix A

4.7.5 Autodesk

The story of the last of today's "Big Four", Autodesk, is straightforward. Autodesk developed its AutoCAD 2D package in 1985, specifically to run on PCs. Through a combination of a sound product, relatively low cost, an effective distribution network and elimination of competition, it soon had a near monopoly of 2D software, a position it has kept until today. Realising that 3D software was the wave of the future, Autodesk introduced its Inventor software in 1999. Although Inventor was initially a poor offering it has grown rapidly, due to improvements over time and the leveraging of the AutoCAD customer base.

Inventor is based on Spatial's ACIS kernel, but when Dassault Systems acquired Spatial, Autodesk developed its own geometric modelling software, ShapeManager, which was developed from an earlier permanent license of the ACIS kernel. Inventor mainly competes with SolidWorks and SolidEdge.

Autodesk Financial Information 2013

Autodesk has an annual income of $2.2 billion of which 65% comes from licences and 35% from maintenance contracts.

Gross Profit of 88% and a net profit of 13%

Research and development expenditures were $ 611.1 million or 27% of net revenue

Income came from Americas ($819M) Europe, Middle East and Africa ($852M) and Asia Pacific ($603M) with 15% of income from emerging economies

3D CAD system Inventor accounts for less than 25% of net revenue

Products licences and services provided primarily through indirect channels consisting of distributors and resellers.

Annual revenues in 2010 were $1.9 billion

Source of information: Autodesk K-10 for 2013 unless otherwise stated

4.7.6 Smaller 3D CAD Suppliers

3D CAD software provided by smaller companies is also available, including IronCAD, Think Design and Space Claim. IronCAD has been in the market at a low level for many years and the software is unique in that it uses both the Dassault Systemes ACIS and the Siemens Parasolid kernels. Space Claim was founded by Mike Payne, who was previously involved in the foundation of PTC and Solid Works. It has recently been bought by ANSYS which specialises in FEA software which must be compatible with 3D CAD Software of the main suppliers including Dassault Systems, PTC and Siemens. A recent development is the distribution through RS Components of a free cut down version of Space Claim, Designspark. There is limited information available on Think Design, a French company marketing several versions of 3D software. There is not much presence from open source software in the 3D CAD market. There are some exceptions in ancillary software such as OpenFOAM that does computational flow dynamics. Open source presently has a low market share and is not presently or in the foreseeable future a viable competitor to the four main suppliers.

4.7.7 Financial and Competitive Position of Suppliers in 3D CAD market

All the suppliers are enjoying continued growth with Dassault Systems growing over 6% per annum in the past 4 years. Profit margins are healthy in the region of 10% to 20%. The industry appears to be successful.

Dassault Systems has the largest volume of sales in 3D CAD but PTC and Autodesk are of a similar size with turnovers between $1.2 and $2.2 billion. The turnover of the Siemens PLM division is understood to be around $1.5 billion. Income is global with Asia and developing countries contributing to the increased revenues.

It appears that all the suppliers invest heavily in research and development spending in excess of 20% of net revenue on research and development. The main cost is software engineers. Dassault Systems say they have almost half their staff engaged in research and development. This indicates that while the challenge of interoperability and lock-in exists the suppliers are still driven to compete by innovation.

It is not possible to confirm by public information whether research and development is concentrated in the 3D CAD products or the wider PLM market. Interviews with the suppliers and industry commentators did not reveal any lack of complacency with innovation in 3D CAD.

> "Yes we put more money into [our 3D CAD software] today than we have ever done"…"we invest over 60% of our annual turnover R&D and we innovate faster than any other company in the world, even than Apple. We are the tenth most innovate company in the world by the global bench mark. That will not change. Regulation would not change that"[260]

> "Yes there is a huge amount of R&D going on and that is because the software has only just scratched the surface of what designers and engineers really do"[261]

Dassault Systemes in particular seem philosophically attached to innovation with the introduction of new concepts, the latest being '3D Experience'. There is certainly incremental development within the industry. Despite the barriers to entry that are presented by a lack of interoperability, innovation also comes from the small number of new entrants. The obvious examples of these are PTC in 1985 which developed new algorithms, Solidworks which made 3D CAD affordable for the masses and most recently SpaceClaim which produces 3D models using geometry rather than complete historical data.

The suppliers have similar market share and until the acquisition of UGS by Siemens were corporations of similar size concentrating primarily on engineering software.

Autodesk has the smallest market share in 3D CAD but has a very strong position in the 2D CAD market which makes it a serious contender for sales in the medium-range.

PTC has about 20% of the market for 3D CAD. While they can take market share from Siemens NX or CATIA they are increasing competing with mid-range software such as

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[260] Interview with senior industry executive #3 (May 2014) From later discussion it appears the 60% includes acquiring companies for their innovative software. The regulation referred to is from earlier discussion about compulsory disclosure of interface information.

[261] Interview with industry expert #1 (May 2014)

Solidworks and Inventor which they acknowledge in their annual report is their main competition.

Siemens NX has a maximum of 20% of the 3D CAD market in both high-end and mid-range. It can also leverage its controls and automation products to offer customers an integrated package of software and other production control equipment in the 'digital factory' where it has a larger market share up to 40%. This has the potential for disrupting the market but this is not yet apparent.

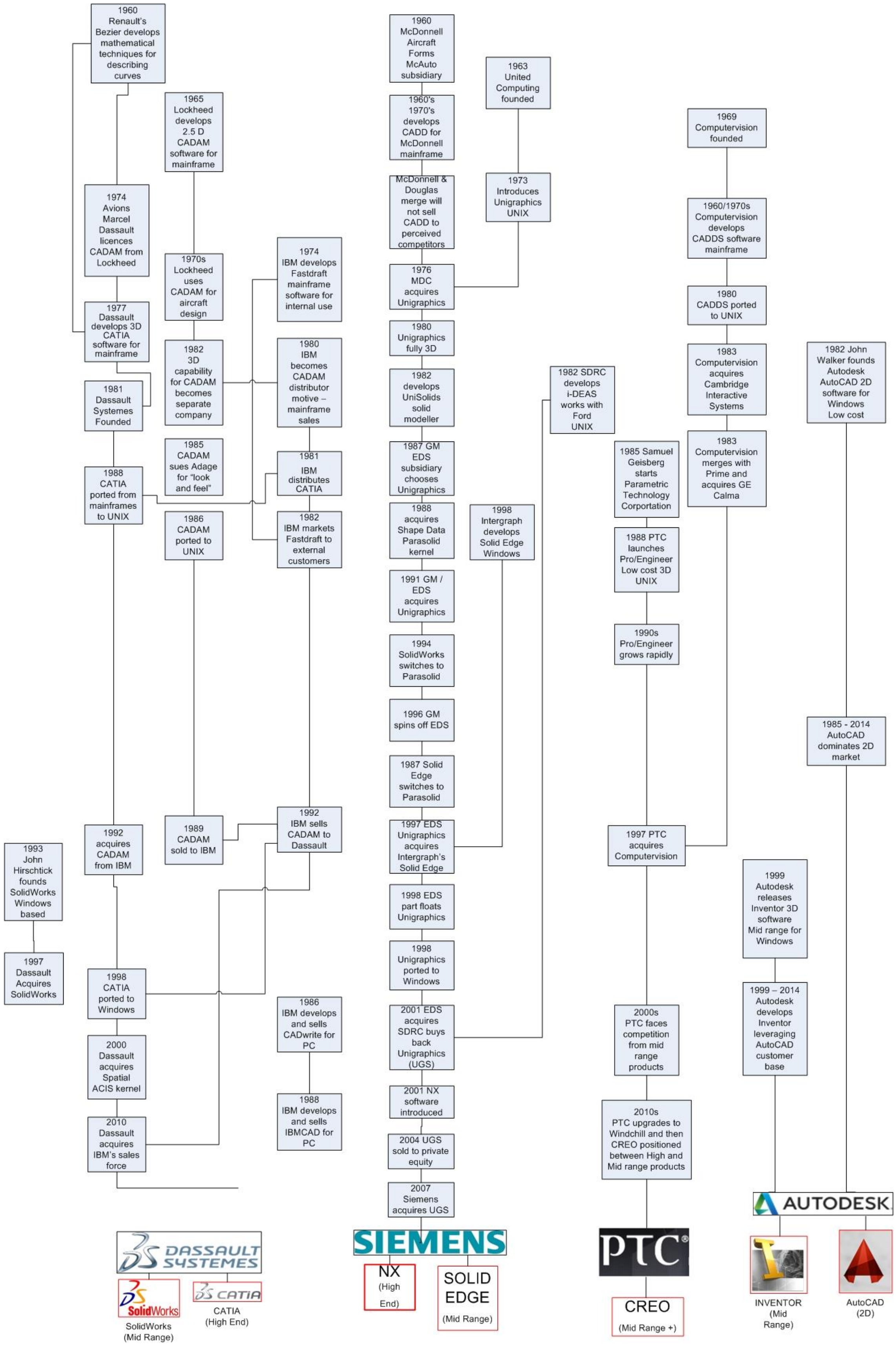
Dassault Systemes has between 25% and 40% of the market. 40% can be a threshold for considering companies to be dominant but other competitors' share is not significantly lower or dispersed.[262] A lack of interoperability is the main additional factor that is relevant to a determination of dominance as this reduces the effect of competition within the market and strengthens the legal barriers to entry to the market. The lack of interoperability and the impact on the definition of the market and dominance is considered further in Chapter 5.

The small number of competitors reflects the meaning of oligopoly 'sale by a few sellers'. There is a similarity in volume of sales and market share. The market certainly has the appearance of being oligopolistic[263] but whether it exhibits the economic and competition law issues associated with an oligopolistic market will be explored fully in Chapter 5.

[262] United Brands v Commission 27/76 [1976] ECR 207

[263] European Commission Guidelines (2004/C 31/03) on the assessment of horizontal mergers under the Council Regulation on the control of concentrations between undertakings [2004] OJ C 31/5 footnote 29 - an oligopolistic market refers to a market structure with a limited number of sizeable firms. Because the behaviour of one firm has an appreciable impact on the overall market condition, and thus indirectly on the situation of each of the other firms, oligopolistic firms are interdependent.

Simplified Industry Timeline



4.8 Structural Analysis of the 3D CAD Industry

Having defined the market and its evolution to provide context for the proprietary, controlled and closed nature of the software a structural analysis will be carried out drawing on Michael Porter's techniques for analysing industries and competitors. The focus on interoperability and legal regulation rather than a general competitive analysis is continued.

For several decades the four key suppliers in the 3D CAD Industry were of similar size with a turnover in the region of US one billion by 2007. As has been considered above there is some difference in the products and customers. For example Autodesk's background has been strong in 2D CAD while Dassault Systems has led in high end specialist software. There is a strong case that the 3D CAD industry comprises two markets, the high end specialist software and the rest. The market is global with all companies selling across the world.

Siemens purchase of UGS Corporation and its Unigraphics software in 2007 was a significant change in the nature of the suppliers. Siemens has "deep pockets" and can also leverage its business in controls and automation to offer customers the so-called "digital factory" where it enjoys a market share of 30-40% in the EU and worldwide.[264]

4.8.1 Threat of Entry

The intangible nature of the software and its lack of interoperability are key features that influence the structure of the 3D CAD Industry. The lack of interoperability makes buyers' switching costs a very strong barrier to entry.[265] Three of the main suppliers have been in the industry since its inception with only PTC entering directly later in 1987. Since then there has been no serious change in the structure of the suppliers as Siemens chose to enter the market by acquisition. There has however been some evolution mainly by the introduction of lower end 3D CAD Software such as Solidworks and Inventor. While these are now owned by existing suppliers incremental improvements in technology and their

[264] *Siemens/UGS Corporation* (COMP M.4608) Commission Decision of non-opposition to notified concentration [2007] OJ C 113/03, para 21

[265] Michael E Porter *Competitive Strategy* (Free Press 2004)

performance has seen them take market share from the high-end specialist software. Small and medium sized customers buying 3D CAD for the first time will now chose one of the middle-range systems which reduce the potential for market growth for the high-end specialist software.

While 3D CAD is intangible and can be easily delivered either by download or USB stick distribution channels still present a challenge when acquiring traction to enter markets. Dassault Systems overcame this with its successful relationship with IBM as its distributor. Interestingly the potential newcomer SpaceClaim has used RS Components to distribute a cut down version of its software. They are looking to benefit from the RS Components market reach and expertise in distribution. The majority of sales by Dassault Systems, Siemens PLM and PTC are now made direct, particularly to OEMs. VARS and distributors are employed to service other customers.

The most distinct cost disadvantage, independent of scale, that a potential entrant would incur is the existence of proprietary technology that is protected by intellectual property rights including copyright, patents and trade secrets. All the suppliers state their policy and practice is to protect intellectual property in their annual reports[266] and over one thousand patents have been registered by the four main suppliers to protect their software.[267]

Copyright does not prevent a competitor writing its own code but the difficulty accessing the interface presents challenges for new market entrants. If a market entrant overcame the problems of developing new 3D CAD software it would still be difficult to get customers to switch because of lock-in due to legacy issues, staff training and other switching costs. Access to interfaces is difficult because of the restrictions on reverse engineering in Article 6 of the Software Directive. This is discussed in more detail on Chapters 6 and 8.

Patent protection prevents a market entrant using the innovation contained in the claims but these will be narrow and do not prevent the use of alternative technology. Patents in interfaces will however prevent software interoperability making it difficult to supply

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[266] See eg PTC Inc annual report fiscal year ended September 30, 2013, Form K-10, 7 and further in Chapter 6.

[267] See further Section 6.12

software that buyers can switch to. Only when the interface is adopted as a standard is it possible to insist on a licence of the patent on FRAND terms.

The present government policy in the EU is to restrict the ability to reverse engineer[268] which means software interfaces are protected not only by copyright and patents but by a statutorily supported trade secret regime.[269]

4.8.2 Rivalry between firms

Interviews with senior industry executives gave a picture of intense rivalry between the existing suppliers.[270] However due to the problem of a lack of interoperability and switching costs there is less evidence of this affecting their respective market shares.

One headline exception to this is the switch by Daimler AG from Dassault Systems CATIA to Siemens PLM's NX announced in 2010. The migration will take 5 years to complete and involve retraining 6,000 employees. The reasons for the switch by Daimler include "compatibility issues between CAD and PDM software".[271] Daimler already uses a proprietary product database SMARAGD based on Siemen's PLM's Teamcenter which was incompatible with CATIA V6. Dassault Systems is very reliant on sales of its CAD software which makes up 60% of its turnover. It excels in pure Dassault environments but third party integration is a problem. It is more challenging for them "to operate smoothly in heterogeneous IT environments, which almost always is the situation in larger corporations".[272] The migration of Daimler to Siemens NX will mean the supply chain manufacturers will need to change to Siemens NX and has already created an "NX package

[268] Article 6 Software Directive

[269] See Section 6.11 and Chapter 8

[270] During the interviews of senior executives Dassault Systems and Siemens PLM clearly see themselves as rivals and the interviewees were not complimentary about their rival.

[271] Dr Peyman Merat, PLM project leader, Daimler AG as reported in *Engineering.com* (8 April 2014) http://www.engineering.com/PLMERP/ArticleID/7438/Inside-Daimler-Mercedes-Switch-from-Dassault-Systemes-to-Siemens-PLM-and-NX.aspx [accessed 11/10/14]

[272] Ibid, Engineering.com (8 April 2014) http://www.engineering.com/PLMERP/ArticleID/7438/Inside-Daimler-Mercedes-Switch-from-Dassault-Systemes-to-Siemens-PLM-and-NX.aspx [accessed 11 October 2014]

for subcontractors" and created a multi-CAD data model in their product database SMARAGD with an interface that solves the format problems.[273]

Daimler's announcement could be an illustration of the theory that a move to interoperability can allow supplier to increase their market share. However it is not certain that the move by Daimler to Siemens is about improved openness or even better compatibility. Siemens may present itself as being more open, for example by making their JT standard an ISO standard,[274] but this is only a small step away from the predominantly closed proprietary model. Improved openness is an uncertain strategy and while openness can be important to gain market share[275] the investment required and the uncertainty involved prevents any one of the four suppliers moving to an open and fully compatible business model.[276] The compatibility might earn them more market share but they could destabilise the existing model in the industry. It would be a dangerous gamble.

Possibly they could also face retaliation, although as established market players it is difficult to see how retaliation could be effective and not self-harming. The main danger of one supplier moving to a more open model is that others might be forced to follow which would damage the stability that has enabled them all to enjoy sustained growth and profitability. It is a common view in the industry and from interviews conducted that the 3D CAD suppliers are not interested in making their software more compatible. "Few CAD vendors

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[273] Ibid

[274] The Siemens JT data format makes it possible to view and share digital 3D product information and has been approved by the International Organization for Standardization (ISO) as an International Standard. Siemens said the adoption of the standard was a historic milestone for PLM open standards and further reinforces Siemens' overall commitment to an open business model that benefits the entire industry." Siemens Press Release 17 December 2012 http://www.plm.automation.siemens.com/en_gb/about_us/newsroom/press/press_release.cfm?Component=205727&ComponentTemplate=822

[275] Ann Walsh, '*Microsoft v Commission:* interoperability, emerging standards and innovation in the software industry' in Rubini L (ed) *Microsoft on Trial* (Edward Elgar 2010)

[276] Chad Jackson 'Where the Interoperability Movement Falls Flat'*Engineering.com* 6 September 2012 http://www.engineering.com/DesignSoftware/DesignSoftwareArticles/ArticleID/4769/Where-the-Interoperability-Movement-Falls-Flat.aspx [accessed 17 October 2014]

are interested in solving these CAD interoperability issues"[277] "Leaving interoperability to the primary CAD vendor would be like asking turkeys to organize a Thanksgiving dinner."[278]

4.8.3 Pressure from Substitute Products

Manufacturing industry has no substitute product for 3D CAD software. There is no other software that can perform the function of creating models to enable manufacturing industry to design new products and give instructions to the shop floor efficiently and to support the life of the product and keep a record of proprietary data.

"Most software or most IT is critical non-core to the customer's business. When we talk about PLM it is critical, core to their business. Their business processes are completely based on what we provide. That is quite unique in the IT industry."[279]

In addition to the strong element of customer lock-in due to legacy issues and high switching costs, the 3D CAD industry is marked by the lack of substitute products that can perform the same function, particularly for manufacturing industry.

Rivalry from substitute products does exist to some extent however. Competition for high-end specialist software comes from the improved performance of cheaper middle-range software which is taking market from the high-end/specialist software. As software such as SolidWorks and Inventor improve their performance some customers who do not have specialist requirements will move from CATIA or NX. It is also the case that new customers such as start-ups and companies in the developing world will increasingly find their needs are met by the middle-range software as the performance of that type of software improves.

Another change the 3D CAD industry is starting to experience is the move to Software as a Service (SAAS) with a subscription pay as you go package which can include services and

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[277] Todd Reade, CEO of Transmagic in Rachael Dalton-Taggart '3D data interoperability vendors sound off' Engineering Automation Report (*Graphic Speak* 11 July 2007) at http://gfxspeak.com/2011/07/11/3d-data-interoperability-vendors-sound-off/ [accessed 1 August 2015]

[278] Dicken of Delcam, ibid

[279] Interview with senior industry executive #3 (May 2014)

storage on the cloud. Interviews revealed that this was being considered by the suppliers as an alternative business model.[280]

Dassault Systems, Siemens, and PTC experience more competition in other areas of their business such as the wider PLM software but the competition still comes from alternative software rather than substitute products.

4.8.4 Bargaining Power of Buyers

Customers for 3D CAD software cover the full range of manufacturing industry. They have different needs and bargaining positions. The major OEMS[281] in the Aerospace and Automotive industries are larger organisations than most of the 3D CAD suppliers and have significant bargaining power. Not only do they purchase high volumes of software but also impose the same software on their supply chain.

> "Interestingly the higher up you go in the supply chain towards an OEM the more reliant they are to a single platform……the closer you are to the OEM the more likely you are to be standardised on a platform"[282]

If the OEMS and other major customers do not insist on interoperability the 3D CAD suppliers will not do anything voluntarily. The OEM's could specify openness as part of a Request for Tender to change software applications or systems but they are more concerned with integrity of data and keeping costs down, not only of the software but also in the entire supply chain.[283] This contrasts with the practice in other industries

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[280] Software as a Service could reduce the ability to reverse engineer software if it is delivered in certain file formats. However to save the supplier's server space and costs they will probably want the user to have some of the application software on the user's computer rather than running solely on the supplier's server which would allow reserve engineering to take place. Conversations with software and design engineers 2014 - 2015

[281] An OEM - Original Equipment Manufacture – makes the final product for the marketplace, examples are Ford for the car market and Apple for the computer market. Tier one suppliers supply direct to OEMs while tier two supply to tier one suppliers.

[282] Interview with senior industry executive #3 (May 2014)

[283] Interview with senior industry executive #3 (May 2014) and Chad Jackson, 'Where the Interoperability Movement Falls Flat'*Engineering.com* 6 September 2012 http://www.engineering.com/DesignSoftware/DesignSoftwareArticles/ArticleID/4769/Where-the-Interoperability-Movement-Falls-Flat.aspx [accessed 17 October 2014]

particularly where the customer is a public authority when openness and open standards are an important requirement in any Request for Tender.

The OEM's choice of software can influence the entire supply chain.

> "As you move away from the OEM to the tier one, tier two, tier three suppliers, they will use the platform of choice of the OEM. So firms lower down in the supply chain and in the indirect sales channel may have a Siemens platform and a Dassault Systems platform because that is what they provide to the OEMs."[284]

Daimler's move from CATIA to Siemens NX will mean the change of 6,000 CAD licenses at Daimler. The German automotive industry is seen as one of the world's most important market clusters for PLM software, including 3D CAD software. If Daimler wants the supply chain to use NX rather than CATIA it will be a driver to further change.[285]

The OEMs feed the software down the supply chain "..that is driven by the OEM.. .. this is very much driven by the OEMs"[286]

The major OEM accounts have considerable bargaining power not only because of their own purchasing power but also because of their influence on the tier suppliers. Because of their size and 'deep pockets' they have the ability to cope with a lack of interoperability.

> With the big customers, such as the OEMs, "the number one, absolute sacrosanct priority is total integrity of their data and the functions they think they have bought for their designers and engineers to use"… "the customer believes that if the vendor controls the entire environment they are responsible for it and must fix it….if the vendor controls the environment that side is a plus because of the data integrity"… OEMs and other large customers can control the suppliers in another way such as buying 80% of the software from one supplier but keeping 20% from another. "That

[284] Interview with senior industry executive #3 (May 2014)

[285] Verdi Ogewell 'Inside Daimler Mercedes switch from Dassault Systemes to Siemens PLM and NX' *Engineering.com* (8 April 2014) http://www.engineering.com/PLMERP/ArticleID/7438/Inside-Daimler-Mercedes-Switch-from-Dassault-Systemes-to-Siemens-PLM-and-NX.aspx [accessed 11 October 2014]

[286] Interview with senior industry executive #3 (May 2014)

> is common practice in the supply chain generally and all of the customers do have more than one system and they occasionally prove they can change despite the huge upheavals it potentially implies." [287]

The interviewee acknowledged that large customers manage the risk with a commercial solution rather than a technical one such as open standards. It was noted that these customers would have the money to handle the transition if they wanted to change supplier.

Cyon Research's 2009 Survey of Engineering Software Users identified some differences in users' attitude to interoperability with certain respondents ranking interoperability higher than others.[288] CATIA V4 users and shipbuilders gave a high priority to interoperability with former systems than did other sectors such as the Energy sector. Respondents from firms with $200 to $300 million in revenue rank interoperability higher than do those from smaller or larger firms. Other groups that ranked interoperability more highly are those who procure from VARs rather than local dealers, and those with no plans to reduce technology acquisition spending despite the recession.[289] While there was some variation in ranking, overall users ranked interoperability as one of the three most important selection criteria, along with total cost of ownership and improving product quality.[290] Of course this does not mean they achieve compatibility. Interoperability is better in the wider PLM market than in the 3D CAD software. We "have given up on CAD interoperability" but expect interoperability from PLM.[291]

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[287] Interview with industry expert #1 (May 2014)

[288] The question asked by Cyon Research was 'Interoperability with data from former systems'. This only refers to backward compatibility and not to any form of open system. http://cyonresearch.com/Portals/0/files/whitepapers/Cyon%20Research%202009%20User%20Survey.pdf [accessed 1 August 2015]

[289] Ibid 20 -22

[290] Ibid 19

[291] Jim Brown 'Has Parker Hannafin found the key to living with heterogeneous systems?' *Tech Clarity* (19 April 2010) http://tech-clarity.com/parker-hannifin-heterogeneous-engineering-systems/767 [accessed 1 August 2015

Customers other than major OEMS, including 1st and 2nd tier suppliers, have far less bargaining power or choice of supplier. They are faced with only two or three choices in either the high-end or middle-range software and that choice may be determined by their customers wanting them to use the same software system. Some suppliers may have to support two or more software systems which not only duplicates software purchase but may require them to employ more engineers to ensure they have the requisite expertise.

There are various sales structures depending on the customers' size, software requirements and position in the supply chain. The major OEM accounts are looked after directly by the suppliers. Some of the other customers are serviced by Value Added Distributors (VARs) and other distribution channels.

The 3D CAD suppliers are more concentrated than the industry it sells to. They are oligopolistic and most of their customers are locked-in to the software due to high switching costs and legacy issues. The software is critical, core to most customers.

4.8.5 Bargaining Power of Suppliers

The intangible nature of 3D CAD software means that the suppliers of 3D CAD do not have the cost of trading in physical goods. There are upfront costs of R&D which require highly skilled software engineers, after that there are very low unit costs. Aftersales services in the form of maintenance and upgrades provide an important income stream but again this is not reliant on trading physical goods.

There are however certain essential inputs to developing and marketing 3D CAD which will be considered in this section and include: IPRs in the 3D CAD software; complementary CAE software - FEA and computational flow dynamics; and standards and translation software

The four main 3D CAD companies: Siemens PLM, Dassault Systemes, PTC and Autodesk all have proprietary software which is protected by copyright, patents, trade secrets and contractual restrictions. They also use trademarks as part of their marketing strategy.[292] Most of the software has been designed in-house or acquired through acquisition of other

[292] See for example Dassault Systemes Annual Report 2013, 22

software companies. One aspect of the software is however cross licensed - there are only two leading software kernels or underlying algorithms which are owned by two of the companies, Siemens and Dassault Systems and licensed to competitors, Parasolid[293] and ACIS.[294] The practice of licencing the kernels was established before Siemens and Dassault Systems acquired them and continues on "a level play field basis"[295] to a large number of CAD companies, many of whom are not direct competitors.[296] Any industry is somewhat mutually reliant and ending licensing the kernel could result negatively for Siemens or Dassault Systems, possibly with claims of abuse for failure to supply. A significant reason though is that with few kernels available the licensing is almost certainly profitable.[297]

Parasolid is the 3D solid geometric modeling component originally developed by Shape Data, and used as the foundation of Siemens PLM's NX and Solid Edge products. Siemens licenses Parasolid to independent software vendors to develop Parasolid-based applications in the product design and analysis market space, for example Parasolid is used as the geometry kernel for Dassault Systemes' SolidWorks software. It is said that Solidworks has been trying to move from the Parasolid kernel owned by Siemens to the ACIS kernel owned by its parent company, Dassault Systems for several years but so far without success.[298]

ACIS is the kernel developed by Spatial, which was acquired by Dassault Systemes in 2000. It is claimed it is no longer openly published. A development of ACIS, Convergence

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[293] "Parasolid is the world's leading 3D solid modeling component software used as the foundation of Siemens PLM's NX and Solid Edge products. Parasolid is also licensed to many of the leading independent software vendors (ISVs) on a level play field basis. These ISVs develop hundreds of Parasolid-based applications in the product design and analysis market space"
http://www.plm.automation.siemens.com/en_gb/products/open/parasolid/

[294] http://www.spatial.com/company/about-us

[295] Ibid

[296] Parasolid is the world's most widely used geometric modeling kernel with leading customers in all aspects of design, analysis and manufacturing software. Parasolid customers also include those in non-traditional PLM markets, such as architecture, engineering and construction (AEC).
http://www.plm.automation.siemens.com/en_gb/products/open/parasolid/customers/index.shtml

[297] Conversations with software and design engineers 2014 - 2015

[298] Interview with senior industry executive #4 (July 2013)

Geometric Modeler (CGM), said to be the industry's first commercial 3D geometry kernel, is used as the basis of CATIA V5 and V6. Autodesk's Inventor 3D CAD software uses Shape Manager, a kernel derived from ACIS.

4.9 Complementary Software

3D CAD suppliers have a complex relationship with suppliers of complementary software. While lack of interoperability can lock-in customers it can affect sales when customers want to use complementary software, particularly software they already use and in which their data is stored. The lack of compatibility between CATIA and Daimler's PLM software is cited as a reason for change.

There are also various third party engineering software that is used to test and evaluate models created in 3D CAD, such as FEA which is a form of CAE. For example, Siemens offers NX NASTRAN FEA software, which will operate with other 3D CAD programs, but requires the user to output a STEP or IGES file from the CAD for input into NX NASTRAN. While 3D CAD suppliers have an interest in disclosing information to some of these companies so that the software can interoperate, conflict can arise when the 3D CAD supplier has its own proprietary CAE software. ANSYS was formerly tightly integrated with Inventor, but this is no longer the case since Inventor included some FEA capability.

ANSYS is the largest supplier of CAE that is not a major supplier of 3D CAD. It has however recently bought SpaceClaim which is a specialist form of 3D CAD that works on geometry alone and does not use the historical data on the models. It works as a form of interface taking the geometry data which is needed to carry out FEA but leaving the other data which only slows the process down. SpaceClaim was created by engineers who were also involved in the founding of PTC and SolidWorks. It appears to work with all 3D CAD software systems and for that reason is used as an interface to extract data for analysis. It is unclear how this interoperability has been achieved although at least one interviewee considered reverse engineering was the most likely method.[299]

Some commentators consider SpaceClaim could change the flow of engineering design bringing simulation right to the front of the whole process. SpaceClaim allows for the

[299] Interview with industry expert #9 (June 2014)

metaphorical sketch on the back of the envelope type model allowing for simulation to start with the simplest form of model. This information can then be used from the beginning of the design. Up till now it has been necessary to make a more detailed design before it can be analysed.

SpaceClaim is particularly useful to suppliers of ancillary software such as ANSYS CAE as their software is sometimes unable to operate with the latest releases of CAD software. 3D CAD suppliers usually issue an annual upgrade. This is made available to ancillary software suppliers at the time it is available to their customers and not before. This means there is a time lag, often of several months during which the two software systems will not work together. ANSYS and other ancillary software suppliers have to study the upgraded software to identify what is different and then work to ensure compatibility.[300] Only then will the two software products work together again. When native to native translation does not work SpaceClaim may provide an interim solution.

D-Cubed is part of Siemens but sells Constraint Management Software (CMS) to other 3D CAD suppliers. It provides documented information on the interfaces to allow the D-Cubed software to work with different 3D CAD software. Customers are mainly the 3D CAD suppliers who will sell a software package of 3D CAD incorporating CMS software. Here the interoperability is essential to sell the CMS and driven by commercial pressures. The software function is more limited than the 3D CAD software but the interfaces need to be generic enough to work with the different kernels. Documenting the interfaces takes time but it is “not what they spend most of their time doing.”[301]

4.10 Standards and Translation Software

Interoperability can be achieved by the 3D CAD suppliers’ own proprietary software, a standard such as STEP or by third party translation software. Using a standard such as IGES or STEP has severe limitations as information and features are lost in translation. Standards such as STEP and IGES transfer most, if not all, of the data on the model. Most of the time this level of data is required and it is only for certain functions that the geometry solution

[300] Ibid

[301] Interview with industry expert #2 (May 2014)

provided by SpaceClaim is appropriate. The role of standards in the industry is considered further in Chapter 7.

The translation software can often do a better job than standards. The lack of interoperability in the 3D CAD market has generated a small industry with companies whose main purpose is to supply software to enable one brand of 3D CAD software to translate to another form, for example Transmagic, Elysium and Theorem.

The market for software providing interoperability solutions for 3D CAD software was estimated in 2007 to be $300 million to $500 million in annual revenues.[302] However it can be appreciated that relying on translation software to ensure that the organisation's design data is not rendered partly or wholly useless may represent a significant gamble.[303] Some examples of suppliers of translation software are given below:

TransMagic, based in Colorado, USA, was founded in 2001 to supply software for CAD incompatibility and 3D multi-CAD data exchange problems. The software offers native and neutral 3D CAD translation and product data interoperability. It combines 3D CAD translation, geometry repair, 3D model viewing and collaboration technologies to create a unique line of 3D CAD interoperability tools. They claim strategic partnership with Dassault Systemes, Autodesk, and Siemens PLM[304]

Elysium Inc develops interoperability software for 3D CAD and PLM. It was founded in 1984 with headquarters in Hamamatsu, Japan with 95 employees and offices in USA and Europe and an international network of partners and distributors. The company claims to have

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[302] Rachael Dalton-Taggart '3D data interoperability vendors sound off' Engineering Automation Report (*Graphic Speak* 11 July 2007) at http://gfxspeak.com/2011/07/11/3d-data-interoperability-vendors-sound-off/ [accessed 1 August 2015]

[303] Users are risking their core proprietary data to a third party and will suffer if their data is corrupted or lost. Translation software is not suitable for legacy storage as users want to ensure the data format will be available in decades to come. This is why STEP or JT, an ISO standard is used.

[304] Transmagic website http://www.transmagic.com/community/partners [accessed 6 December 2013]

long-term strategic relationships with major CAD vendors such as Siemens, Dassault Systemes, PTC and Autodesk.[305]

Spatial, owned by Dassault Systemes, has an interoperability product - 3D InterOp Spatial which imports from ACIS, CGM and Parasolid but its claims for export are more limited, mainly to CATIA V5 and V6 and standards such as STEP. It appears to not export to competing software such as Siemens' NX, Pro/E or Inventor among others

Suppliers of complementary software and translation software are clearly finding ways to interface with the 3D CAD software. How this is done in less clear. The interviewees were unsure whether reverse engineering was used but considered it possible.[306] Theorem Solutions, a UK based translator, relies on its relationship with the 3D CAD suppliers to use APIs provide by and supported and maintained by the suppliers to convert native data and to use visualisation formats. By using APIs supported by the suppliers they avoid spending time in reverse engineering when new revisions or new version of applications come out. This avoids the time delay as Theorem can keep pace with change quickly and efficiently for their customers.[307] The advantage of translators which are third party specialists is that they are driven to solve market needs unlike the 3D CAD suppliers which want to maintain or capture market share for their CAD product.[308]

Standards and translators introduce an element of openness to the industry. They enable customers to mitigate the effects of lock-in. They also enable customers to retrieve their proprietary data and to store it securely in a neutral format.

It appears the 3D CAD suppliers licence their APIs to suppliers of certain complementary software. It has not been possible to establish how widespread this practice is and on what

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[305] Elysium website http://www.elysiuminc.com/Products/ [accessed 6 December 2013]

[306] Interview with industry expert #9 (June 2014)

[307] Trevor Leeson, Theorem Solutions, MCADCafe interview 2014 PTC http://www10.mcadcafe.com/video/Theorem-Solutions-Trevor-Leeson-Principal-Consultant-Tech.-Director-Major-Accounts/43971/media.html [accessed 17/10/14]

[308] Rachael Dalton-Taggart '3D data interoperability vendors sound off' Engineering Automation Report (*Graphic Speak* 11 July 2007) at http://gfxspeak.com/2011/07/11/3d-data-interoperability-vendors-sound-off/ [accessed 1 August 2015]

criteria the 3D CAD suppliers determine to whom they will licence the APIs. None of the interviewees knew definite information but it appears from the interviews that some software developers have to rely on reverse engineering which puts them at a disadvantage. The 3D CAD suppliers release new software each year and it can take several months before the complementary software is modified to work properly with the new version.[309] While the 3D CAD suppliers are making interfaces available they are still very much in control and determine who has access to this information.

4.11 Synopsis of Industry Interviews

The interviews corroborated many of the findings on the industry set out in this Chapter. Some of these findings have already been commented on in the text where relevant but the following is a concluding synopsis. It uses example questions from the interviews.

Is lack of interoperability in 3D CAD Software a problem for manufacturing industry?

The interviews confirmed that lack of interoperability was a serious problem for the industry. It increased costs and created legacy issues.[310] It was thought however, that particularly for the OEMs, the issue of compatibility had to be traded against the need to ensure integrity of the data as 3D CAD is critical core to their business.[311]

Are customers locked in to a particular 3D CAD System?

There was little doubt that customers were locked in to suppliers due to a lack of interoperability. The suppliers claimed this mattered less to the OEMs who valued the integrity of their data and the competitive edge given by enhanced features.[312] Tier one, two and three suppliers were more disadvantaged particularly as the software system was dictated to them not only by lock-in to the Supplier but also by the OEM.

Are there market forces/customer demand driving interoperability and avoiding lock-in?

There is some evidence of customer demand influencing decision. One example is Siemens' JT standard adopted as the world's first International Standard for viewing and sharing

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[309] Interview with industry expert #9 (June 2014) and see section 3.6 for the difficulties of reverse engineering.

[310] Interview with industry expert #5 (September 2014)

[311] Interview with senior industry executive #3 (May 2014)

[312] Interview with senior industry executive #3 (May 2014)

lightweight 3D product information.[313] Siemens allowed this to be adopted as an ISO due to customer demand to protect legacy data.[314] Siemens was generally considered more open with one interviewee commenting that they would "see Siemens as a clear leader among the big players as having structure within which to put software that supports open standards and a kind of commitment to doing that."[315] It was "harder to point to other major players and really say yes at a software level they are sharing components." Siemens appears to recognise that openness brought benefits to their business, for example "Siemens has been very public in stating that they support open standards in order to support [D Cubed]. And I suppose they have done the same with JT in the format they use for moving data around between systems."[316] The openness appears pragmatic however in response to particular narrow needs rather than a broader philosophical approach. Another supplier perceived compatibility as allowing data to be ingested into their platform and considered the Apple model to be open.[317] Also that by making their software read competitor's products they encourage customers to stay with them while also using complementary software. There is less incentive to open their products and make them easier to read with competitor's applications.

Examples of openness are distinguished by their rarity and go against the normal pattern of a closed proprietary software system. The industry has a long way to go to achieve open compatibility. There is little evidence of market forces and the lower tier suppliers are divided and unable to exert pressure.

Why is interoperability in 3D CAD a technical challenge and why does STEP or another standard not provide a solution?

The technical complexity of the software was seen as the main reason the STEP standard gives only limited interoperability. The desire of the suppliers to bend the standard to be

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[313] http://www.plm.automation.siemens.com/en_us/products/open/jtopen/ [accessed 12 August 2015]

[314] Interview with senior industry executive #4 (July 2013) and Interview with industry expert #5 (September 2014)

[315] Interview with industry expert #1 (May 2014)

[316] Interview with industry expert #1 (May 2014)

[317] Interview with senior industry executive #3 (May 2014)

closest to their proprietary capability was recognised but generally averted as STEP is driven by an industry consortium.[318]

Suppliers of complementary and ancillary software were confident they could distinguish and document their interfaces. It is essential for these companies that interfaces are available to interoperate with the 3D CAD software and they are highly focused on this. Even for these people though the ambiguity as to what constitutes an interface existed with comments such as "The software is basically interfaces."[319]

The knowledge of the law was varied with one supplier being aware of clean room procedures but most of the interviewees being surprised that decompilation was permitted.

Should interface information obtained by decompilation be disclosed and shared?

The response to proposals that interfaces should be disclosed either by compulsion or sharing of reverse engineered was mixed. Most spoke positively of balancing the disclosure of interface information while protecting the kernel. One common view heard during all interviews is that the kernel of the software programs is sacrosanct and would not be open "the kernel that is something we would never, we would never go to that level. That is literally too far the other way."[320] The same interviewee was more relaxed about interfaces and did not have a fundamental problem with the sharing of interface information. This dichotomy was reflected in all interviews. This unconsciously reflects the position that interfaces are different to the main computer program. The interviewees may not be consciously considering the issues of indirect function or control of interoperability but they all perceive the interface as subject to a different optimal balance and of less intrinsic value.

The strongest criticism was the fear it could rise to competing standards.[321] Whether this potential confusion and inefficiency would arise and whether it would justify suppressed of information is beyond the scope of this research but is considered in recommendations for

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[318] Interview with industry expert #5 (September 2014)

[319] Interview with industry expert #2 (May 2014)

[320] Interview with senior industry executive #3 (May 2014)

[321] Interview with industry expert #5 (September 2014)

further research. Data from the interviews will be referred to in the doctrinal analysis in the next Chapters 5 to 7 and will be further evaluated when considering recommendations in Chapter 8.

Unfortunately it seems that key customers such as the major OEMs do not drive the pressure to more openness.[322] This contrasts with industries who sell to government authorities and bodies where interoperability and open standards are a requirement of the tender.[323] The tier suppliers maybe required by the OEMs to use the software but are too dispersed to have bargaining power. The forecast is that while there may be pockets of openness this will remain under the control of the 3D CAD suppliers and this will not change for the foreseeable future.[324]

4.12 Summary

The 3D CAD industry was selected as relevant to the social phenomenon of interoperability and is relevant to the research question posed.[325] Interoperability has been identified as an issue[326] but there has not been an in-depth study looking at the problem from the perspective of the legal framework.[327]

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[322] Interview with industry expert #1 (May 2014)

[323] Interview with industry expert #7 (May 2013) and see UK Government Policy on Open Standards, *Standards Hub* http://standards.data.gov.uk/ [accessed 10 December 2014]

[324] Chad Jackson comments that none of the current players are willing to place bets in terms of resources that openness will differentiate them although this could be the opportunity a start-up could leverage. The other way openness could come about is if a major OEM made it part of the request for tender but is uncertain this is a high priority particularly over price. Chad Jackson, 'Where the Interoperability Movement Falls Flat' *Engineering.com* 6 September 2012 http://www.engineering.com/DesignSoftware/DesignSoftwareArticles/ArticleID/4769/Where-the-Interoperability-Movement-Falls-Flat.aspx [accessed 16/10/14]

[325] See section 4.2

[326] For example, Cyon Research 'Survey of Engineering Software Users' Cyon Research Corporation 2009 found that users ranked interoperability as one of the three most important selection criteria, along with total cost of ownership and improving product quality. http://cyonresearch.com/Portals/0/files/whitepapers/Cyon%20Research%202009%20User%20Survey.pdf [accessed 1 August 2015]

[327] Cyon Research and the survey by Chad Jackson and David Prawel 'The 2013 State of 3D Collaboration and Interoperability Report' Lifecycle Insights and Longview Advisors http://www.tetra4d.com/collateral/3D-

The 3D CAD industry is doing very nicely. The suppliers are profitable and expanding. The business they work closely with, namely the OEMs and suppliers of complementary software such as FEA and translators also appear to benefit. There are occasional disruptions to the status quo and some of them are significant including Daimler's change of supplier, Airbus €6 billion losses[328] and the appearance into the industry from nowhere of PTC and Solidworks. The fact they are significant but have not yet disrupted the model of incompatible software systems is all the more remarkable. There appears to be little effective market pressure on the suppliers to improve interoperability.

3D CAD is highly complex software. It is not just an operating system, a platform to allow Apps to run but is a modular system that performs a highly sophisticated function. It is designed to enable users to create, edit, use and store what, for many users, is their most valuable data. While users would like their software to be compatible, integrity of data is vital, not least for the OEMs whose investment in current production and future models is entirely dependent on the software. The software's highly functional nature, it's critical, core role in the users business, and that it stores the users' own proprietary data, means that any disruptive change to the 3D CAD industry could be harmful to the users as well as the competing suppliers. Any amendments to the legal regime must take account of the users' needs, not just as consumers wanting competitive pricing but also to protect the existence and use of their own proprietary data.

On the face of it innovation appears to be thriving with the suppliers continuing to invest in R&D. The software can be developed further but whether this would have happened faster if compatible systems were subject to more competition is a counter-factual. The suppliers have though produced something of great value to society. Relying on breakthrough innovation could result in the waste of some past investment and innovation, as well as disruption to users, while follow on innovation could be more efficient and beneficial.

Collaboration-Interoperability-Report.pdf [accessed 11 October 2014] are aimed at capturing the industry as it is and do not consider the impact of the legal regime or potential improvements.

[328] Airbus lost €6 billion due to late delivery of the Airbus A380 resulting from problems because CATIA V4 and V5 were not fully interoperable.

The importance of the user's proprietary data and the impact users' pressure can achieve is illustrated by the insistence that Siemens' JT data format is adopted as an ISO standard. The JT standard is now suitable for legacy storage as the data format will be maintained which was not assured if it remained proprietary. Users now have a standard interface and improved data integrity. Without that pressure though the four suppliers' professed approach to openness is to make their own software able to 'ingest' data from other suppliers' systems. They want to make their own software able to read competitor's products to encourage customer to stay with them.

The suppliers are far less interested in making their interfaces available to allow their products to work on a competitor's platform. Interfaces, APIs and data formats, are though available and provided to translators and other complementary software suppliers. D-Cubed, although not a 3D CAD system, is still complex software, and it manages to make interfaces available to ensure its software can work with all the different CAD systems. On the face of it the 3D CAD suppliers have interfaces available that if they were mandated to make available could improve interoperability. While this appears attractive there are several shortcomings. The 3D CAD industry is established and easily identifiable but the impact and practicalities of mandating disclosure of interfaces for all software are unknown and challenging. Even within the 3D CAD industry, while the definition of APIs remains with the suppliers, there is uncertainty as to whether those APIs will give the optimum or even adequate interoperability. The problems associated with defining and enforcing mandatory disclosure will be discussed further in Chapter 8, but even if these were overcome, because of the complexity of 3D CAD software it is not certain whether it is technically possible for all four systems to achieve full functional compatibility. Interviewees do however consider that more interoperability can be achieved. The next Chapters will look in more detail at the legal regime before discussing recommendations to achieve a greater degree of openness

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CHAPTER 5. COMPETITION LAW

5.1 Introduction

Competition law is a tool that can regulate market economies to increase allocative efficiency and innovation. Competition law is in conflict with IPRs, for while they both have the goals of encouraging innovation IPRs do this by giving limited exclusivity which is antipathetic to competition law. To give an optimum outcome a balance must be struck. Chapter 3 introduced the role of competition law in regulating software industries in the new economy and the challenge of determining when intervention is beneficial. In this Chapter the role of competition law in regulating interfaces will be explored to evaluate whether it can provide an effective remedy in an oligopolistic market.

Competition law is justified by economic theories and the theoretical background will be explored at the start of the Chapter. This will underpin evaluation in this and subsequent Chapters as to whether regulation and intervention is justified and beneficial. Contributing to that evaluation is a normative evaluation of ex post intervention by competition law as opposed to ex ante regulation depending on whether the circumstances are structural and foreseeable.[329]

This is followed by an overview of the development and main features of the exceptional circumstances test, particularly the new product test that is required where intellectual property rights are involved. An analysis of the *Microsoft* case will consider its legal and practical implications and its legacy, particularly on the handling of merger cases where interoperability was a material concern for post-merger competition.

The 3D CAD industry is oligopolistic and characterised by supplier lock-in, and the impact of these features on the effectiveness of competition law will be considered. This starts with an assessment of the impact of interoperability and market and supplier lock-in on the definition of the relevant market. This is followed by an analysis of the challenges posed to

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[329] Ashwin van Rooijen *The Software Interface between Copyright and Competition Law* (Kluwer Law International 2010)

competition law enforcement by oligopolies, in the absence of regulation aimed at oligopolies and in the context of failure to provide interface information.

In conclusion it will be noted that the most effective competition law remedy to encourage interoperability is in merger cases. In those instances the remedy is effectively ex ante, providing both flexibility and legal certainty. *Microsoft* is the cause of this apparent success as the Commission realised the importance of interoperability to innovation. It also sent a message that dominant undertakings could be made to disclose interface information. However in the absence of co-ordination, because of the complexity of the tests that need to be met, it is very doubtful that it will extend to refusal to supply interface information to alleviate a lack of interoperability and lock-in in an oligopolistic market.

5.2 Theoretical background to the Current Problem of 'Interfering with' IPRs

This Chapter considers the phenomena of interoperability in an oligopolistic industry in a market economy where resources are allocated predominantly by supply and demand in free markets rather than directed by government regulation and intervention. To improve the evaluation of the impact that a lack of interoperability can have on the competitive process, the development of the economic theories underpinning competition law have been reviewed.

The rationale underpinning market economies is that they give allocative efficiency as goods are produced in the quantities valued by society. In a perfectly competitive market production is expanded to the point where market price and marginal cost[330] coincide and everyone who is willing and able to purchase at the cost of production will do so. The market is in equilibrium and in a state of 'Pareto optimal' as no one can be better off without someone being made worse off. [331] Other optimal efficiencies are productive

[330] Marginal cost includes 'normal' profit as all the factors of production are taken into account when computing the cost, including capital.

[331] Alison Jones and Brenda Sufrin, *EC Competition Law* (5th edn, OUP 2010) 8

efficiency – downward pressure on costs which are passed on to the consumer, and dynamic efficiencies – the delivery of innovation and technical progress.[332]

Perfect competition is a theoretical model, where there are a large number of buyers and sellers of homogeneous products, with no barriers to entry and all with perfect information. Each seller is insignificant and 'price-takers' not 'price-makers'. In reality 'workable' competition is the best that can be expected. Oligopolies, in which a few leading firms know each other's identity and recognise they are mutually affected by output and pricing decisions are typified by markets which may have allocative and productive inefficiencies.[333] The persistent quandary is whether by intervening, the state can improve allocative and productive efficiency. An additional dimension is the extent to which the state should take back that which it has granted by way of IPRs. While IPRs are intangible, state generated property, reducing the IPR holder's rights may also harm the incentive to innovate and hence damage dynamic efficiency. With interfaces there is yet another issue as they are generally of low innovative value but as *de facto* standards can give disproportionate control over access to proprietary software and even networks.[334]

An influential approach to the challenge of achieving optimum control by competition law comes from the economic analysis of law, in which economic concepts are used to explain the effects of laws and to assess the economic efficiency of legal rules. Leading proponents of this field are Ronald Coase,[335] Frank Easterbrook[336] and Richard Posner.[337] Concepts that have common currency in assessing the economic efficiency of legal rules include Pareto efficiency and game theory. The increase in importance of economics in competition law is

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[332] Ibid 8

[333] Ibid 11

[334] Ashwin van Rooijen *The Software Interface between Copyright and Competition Law* (Kluwer Law International 2010) 132

[335] Robert H Coase, 'The Problem of Social Cost' (1960) 3 JJ& ECON

[336] Frank H Easterbrook*, 'The Limits of Antitrust'* (1984) 63 Tex L Rev 1

[337] Richard A. Posner, *The Economics of Justice* (Cambridge: Harvard University Press 1983)

marked with adoption of the effects based approach in the modernisation of Article101 and 102 as well as merger control. This new approach was seen in *Microsoft*, although Microsoft failed to fully develop the efficiency argument.

Precursors to the economic analysis of law were the Progressives and American Realists. The Progressive school of thought in the USA at the fin de siècle believed that while the rise of corporations was socially and economically beneficial to the economy, opportunities for abuse of that power clearly existed. Progressives such as Richard Ely and John Commons believed the government should regulate in areas of potential abuse. They were particularly in favour of regulation of oligopolistic industries and antitrust enforcement more generally.[338] Progressives believed in the existence of rational bases for ethical and political values and that these could be rationally justified, but believed that law and public policy were inseparable and hence justified the need for intervention. The American Legal Realists built on this case for a regulatory state, but were more sceptical about the rational foundations of legal, moral, and political values.[339] The most "important common denominator between the two political-intellectual movements was said to be their attack on legal orthodoxy, the crucial characteristic of which was an understanding of law as politically neutral."[340]

According to the American Legal Realists, the free market was a system of coercive power, and the legal system and the market were interdependent. Effective policy decisions concerning resource allocation required analysis of how the legal system itself distributes coercive power. Robert Hale considered property rights not to be defensive - a means to protect oneself from unwanted interferences from others or the state, but offensive - the basis for coercing others to do something that the owner wishes.[341] Taking this further it

[338] Gregory S Alexander, 'Comparing the Two Legal Realisms - American and Scandinavian' (2002) 50 The Americal Journal of Comparative Law 154

[339] Morton J. Horwitz, *The Transformation of American Law,1870-1960* (OUP 1992)

[340] Ibid 170 - 171

[341] Robert L Hale, 'Coercion and Distribution in a Supposedly Non-Coercive State' [1923] Political Science Quarterly 470

was thought that a government which limits the right of large land-holders limits the rights of property and yet may promote real freedom. Property owners, like individuals, are members of a community and must subordinate their ambition to the larger whole of which they are a part.[342] This notion that private property rights are nothing more or less than state-sanctioned coercion was echoed by the Scandinavian Realists who, though less concerned than the American Realists with the notion of property,[343] considered ownership to amount to a state guarantee to certain protection in possession, and that in the typical lawsuit over possession both sides believe they are lawfully entitled to possession. Ultimately the legal idea of a property right is reliant only on legal machinery and has no basis in reality and therefore can only have a metaphysical basis.[344] This idea is epitomised in IPRs which are intangible and legal constructs.

The Sherman Act 1890 is described as the first modern system of competition law. Its introduction was a protectionist measure in response to farmers, small businesses and those wanting to stop the transfer of wealth from consumers to big business.[345] It was not until the 1950s and the emergence of the Chicago School did the theories of allocative efficiency come to dominate the economics and law of competition. Between the introduction of the Sherman Act and the Chicago School, and against the backdrop of an industrial revolution, the Depression and the New Deal, came the Harvard School's paradigm that the structure of the market determines the firm's conduct and market performance. Barriers to entry were thought to be widespread while economies of scale were not valued and monopoly pricing, associated with oligopolies, were thought to occur

[342] Morris Cohen, 'Property and Sovereignty' (1927) 8 Cornell LQ

[343] Gregory S Alexander, 'Comparing the Two Legal Realisms - American and Scandinavian' (2002) 50 The Americal Journal of Comparative Law 154

[344] Axel Hagerstrom, *Inquiries into the Nature of Law and Morals* (Karl Olivecrona ed, C.D. Broad trans. 1953)

[345] Alison Jones and Brenda Sufrin, *EC Competition Law* (5th edn, OUP 2010), 20

at relatively low levels of concentration. This resulted in an interventionist antitrust enforcement policy in the USA.[346]

The Chicago School criticised the Harvard's School's empirical study and from the 1950s introduced its own theoretical model of economic efficiency as the exclusive goal of antitrust. The Chicago School's adherents thought that most markets are competitive even with a small number of sellers. They considered 'natural' barriers to entry more imagined than real, and economies of scale pervasive. Monopolies will tend to be self-correcting and antitrust enforcement should be tolerant of efficient behaviour and be less interventionist.[347] For the Chicago School efficiency is the sole purpose of competition law. Policies such as distributive goals should be the subject of other laws rather than competition law.[348] The Chicago School has been criticised, among other reasons, for its belief that barriers to entry are rare, and that their market efficiency model is too simple to account for or predict business behaviour in the real world.[349]

Game theory has influenced the approach to oligopolies as part of the 'new industrial economics' or 'post-Chicago approach'. Whereas traditional models such as Cournot's model examine oligopolies in a static manner, game theory looks at the behaviour of the undertakings rather than concentrating on the static structure.[350] It is based on infinitely or finitely repeated interactions, and models strategic interactions between firms including their cooperation and conduct. It recognises that the interdependence and the risk of mutual retaliation can encourage tacit cooperation to joint profit maximisation.[351]

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[346] Ibid 22

[347] H Hovenkamp, 'Antitrust Policy after Chicago ' (1985) 213 Univ Mich LR 226

[348] R H Bork, *The Antitrust Paradox: A Policy at War with Itself* (Basic Books, reprinted 1993, 1978)

[349] Alison Jones and Brenda Sufrin, *EC Competition Law* (5th edn, OUP 2010),30

[350] Heiko Haupt, 'Collective dominance under Article 82 E.C. and E.C. merger control in the light of the Airtours judgment' (2002) 23 ECLR 434, 435

[351] Ibid

Meanwhile in Europe the Austrian School embraced free markets beyond the theories promoted by Schumpeter, with a belief that markets could prevent long-run exploitation of monopoly power. The Austrian School opposed intervention in the competitive process including against cartels. By contrast Ordoliberals considered that the law could create and protect the conditions of competition. As well as efficiency they had notions of fairness and considered small and medium sized enterprises to be important to consumer welfare and worth protecting against excessive market power. The Ordoliberals had some influence on the development of Article 102 TFEU but the modernisation of Article 102 with the adoption of the effects based approach to Article 102 has moved away from the Ordoliberal stance to one that places the most importance on efficient allocation of resources and dynamic competition. The interests of the consumer are important but not the competitor, indeed the courts will examine claims put forward by dominant undertakings that their conduct is justified on efficiency grounds.

5.3 Application of Theories to IPRs

Against this backdrop of seemingly contrary theories the tools of competition law and IPRs need to be balanced to achieve the mutual aim of encouraging innovation. In Chapter 3 the debate on reconciling the conflict was introduced and the important case of *Microsoft* has been the focus for commentators in the debate on whether competition law should dictate licensing of IPRs. The anti-interventionists appear to be in the majority, particularly in the USA. Devlin, Jacobs and Peixoto are an example of writers favouring the free market approach that has its origins in the Chicago School.[352] They argue in favour of breakthrough innovation for network markets referring to Katz & Shapiro and Liebowitz & Margolis. Their analysis of lock-in is limited to market lock-in and they do not consider the situation where customers are locked-in due to switching costs. They do however recognise that there could still be room for competition law remedies in the new economies when the Schumpeterian process of creative destruction is thwarted. This could occur when lack of interoperability is used to foreclose the means of access. They consider this may have

[352] Alan Devlin, Michael Jacobs and Bruno Peixoto, 'Success, Dominance and Interoperability' (2009) 84 (4) Indiana Law Journal Article 4

occurred in *United States v Microsoft*[353] where Microsoft blocked Netscape Navigator's and Sun Microsystems' bids to gain market access thus threatening Microsoft's position in the operating systems market. Even in that case they point out that Microsoft did "not violate the antitrust laws simply by developing a product that is incompatible with those of its rivals".[354] The difference is between "interoperability as a remedy to antitrust violation and exclusivity as an antitrust offence in itself."[355] Devlin et al say that Europe should take note of this. However Microsoft's practice of using interoperability information to gain market share and then to withhold it from competitors has similarities with both the US *Microsoft* case and also with *Aspen* where the unilateral termination of a voluntary course of dealings suggested a willingness to forsake short-term gains to achieve an anticompetitive end.[356]

There are some commentators, who while recognising the need to incentivise innovation, do not yet accept that the case is closed.[357] Simon Genevez argues that IPRs as property rights should not be treated differently to other property and criticises giving quasi-immunity to IPRs in exclusion cases advocating that it is not justified by dynamic efficiency arguments.[358] He cites Ayers and Klemperer's research that restrictions on patentees' market power are efficient as the loss of incentives is negligible relative to the increase in social welfare. This is however industry dependant and is also dependent on the degree of

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[353] *United States v Microsoft*., 253 F.3d 34, 53 (D.C. Cir. 2001).

[354] Ibid para 75

[355] Alan Devlin, Michael Jacobs and Bruno Peixoto, 'Success, Dominance and Interoperability' (2009) 84 (4) Indiana Law Journal Article 4, 1200

[356] *Aspen Skiing Co v Aspen Highlands Skiing Corp*, 472 U.S. 585 (1985)

[357] Kathryn McMahon, 'Interoperability: Indispensability and Special Responsibility in High Technology Markets' (2007) 9 Tul J Tech & Intell Prop 123

[358] Simon Genevaz 'Against Immunity For Unilateral Refusals To Deal In Intellectual Property: Why Antitrust Law Should Not Distinguish Between Up And Other Property Rights' (2004) 19 Berkeley Technology Law Journal 741

price elasticity.[359] Genevez refers to a study conducted by Scherer at Harvard in 1977 which showed that compulsory licensing did not discourage innovation.[360] However explanations again were industry specific and industries with an innate high level of R&D or where substitutes were the norm were not deterred from innovating by compulsory licencing. Genevez argues that while the judgement in *Trinko* did not confirm the essential facility doctrine, it did not rule out judicial control where IPRs protection was abused.[361] Provided the door is left open Genevez considers the rule of reason can be used to prevent actions taken solely to foreclose markets while preserving the incentive to innovate.

In this complex landscape the Commission and the European Courts, and their counterparts in the USA, had to develop an approach to ex post regulation of interface information. Review by competition law on an ex post basis should have the advantage that it can give consideration on a more flexible case-by-case basis. Theoretically this review should be better placed to determine the correct balance between openness or control of interface specifications and which is more likely to advance innovation. An ex post review in this manner can however result in uncertainty which in itself is damaging to investment and innovation. The uncertainty can be ameliorated by the Courts adopting a predictable, but possibly rigid analytical framework but at the expense of flexibility. This is contrasted with the ex ante regulation of intellectual property law which grants exclusivity with exceptions and is more rigid. There is the danger of striking a suboptimal balance between control and openness and static and dynamic efficiency.[362]

One analysis of the tension between competition law and IPRs has proposed that the balance of regulation by ex ante legislation or ex post competition law intervention is

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[359] Ian Ayres and Paul Klemperer, 'Limiting Patentees' Market Power Without Reducing Innovation Incentives: The Perverse Benefits of Uncertainty and Non-Injunctive Remedies' (1999) 97 Michigan Law Review 985

[360] Frederic M Scherer, *The Economic Effects of Compulsory Patent Licensing* (New York University 1977)

[361] *Verizon Communications Inc v Trinko LLP* 124 S.Ct. 872

[362] Ashwin van Rooijen, *The Software Interface between Copyright and Competition Law* (Kluwer Law International 2010) 197

determined by a parameter of structural foreseeability.[363] Circumstances that are considered structural and foreseeable are best addressed by ex ante legislation, for example by IPRs or exceptions. It is only where for some reason circumstances that might have been foreseeable were not anticipated on a particular occasion that competition law should step in on a one off basis. The legislation should be amended as similar cases should now be foreseeable. Only unforeseeable or non structural circumstances are best dealt with by competition intervention, and this should be in exceptional circumstances where the balance of static and dynamic efficiency is less than optimal and is not structural and cannot be foreseen.[364] Arguably the use of competition law to intervene in the disclosure of interface information is a case which has been foreseen by the reverse engineering provisions of the Software Directive. Applying these parameters it could be said that the *Microsoft* case, where intervention corrected IPRs that were considered too broad, would signal either that intervention should not have happened or that the consequences were not fully foreseen and anticipated. The courts must assess not only whether the suboptimal balance was anticipated by the relevant IPR but also what the ex post optimal balance should be. It is said that the courts often neglected the first element and the second is an economic evaluation.[365] The Federal Circuit of the United States favours the per se rule where IPRs are nearly always lawful which means the second part of the analysis is overlooked. The test of the European Courts is the exceptional circumstances test, which will be looked at in detail in the following section, incorporates a new product test which stands as a poor proxy for both parts of the analysis.[366] IPRs protect certain aspects of

[363] Josef Drexl, 'Abuse of Dominace in Licensing and Refusals to License A "More Economic Approach" to Competition by Imitation and to Competition by Substitution', in: Claus Dieter Ehlermann & Isabela Atanasiu, *European Competition Law Annual 2005: The Interaction between Competition Law and IP Law*, Oxford: Hart Publishing 2006, pp 647-664

[364] Ibid

[365] Ashwin van Rooijen, *The Software Interface between Copyright and Competition Law* (Kluwer Law International 2010), 111

[366] Ibid

technology or expression and new product development can be foreseeable and anticipated.

The application of the exceptional circumstances test to the refusal to supply IPRs is more concerned with structural ownership issues resulting from the ex ante allocation of rights rather than from behaviour which is patently abusive. The structural and foreseeable nature of the problem indicates that an ex ante solution in the IPR regime is better than ex post competition law. There have however been aggravating circumstances in some of the cases, including in *Microsoft* where interface information was originally disclosed before withdrawing it when the benefits of network effects had been achieved and were available to exploit on a more exclusive basis.

5.4 Exceptional Circumstances Test

Competition law recognises that IPRs are important in encouraging innovation which is beneficial to consumers but IPRs are not immune to control by competition law and in exceptional circumstances owners of IPRs have been ordered to grant compulsory licences to competitors. The exceptional circumstances test is as a variant of the essential facilities doctrine which originated in US law[367] where it was seen as an exception to the principle that a trader is free to decide who he should deal with. The legal basis for the exceptional circumstances test in Europe is Article102 TFEU paragraphs (b) and (c). The concept that refusal to supply amounts to an abuse which limits markets to the prejudice of customers and discrimination which might in the end eliminate competition from the relevant market.[368] It is also said to be a development of the existence/exercise doctrine that was developed by the CJEU to avoid Article 345 TFEU preventing rules set by Member States

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[367] *Sealink/B&I Holyhead: Interim Measures* [1992] 5 CMLR 255 in which the Commission first used the expression "essential facilities"

[368] Article 102 TFEU paragraphs (b) and (c) Case 27/76, (b) limiting production, markets or technical development to the prejudice of consumers; (c) applying dissimilar conditions to equivalent transactions with other trading parties, thereby placing them at a competitive disadvantage; *United Brands v Commission* (27/76) [1978] ECR 207, [1978] 1 CMLR 429.

that prejudice the system of property ownership.[369] The Commission has built on the exceptional circumstances test in its Guidance on Enforcement Priorities.[370]

One of the earliest cases concerning refusal to supply an IPR was *Volvo AB v Erik Veng* (*UK) Ltd* which determined that refusal to licence IPRs by a dominant company was not an abuse *per se.* *Volvo* held that refusal might amount to an abuse in certain circumstances, such as the arbitrary refusal to supply spare parts to repairers or fixing exorbitant prices. The cases which developed the exceptional circumstances test, namely *Magill*[371]*, IMS Health*[372] and *Microsoft*[373] to some extent concerned the attempt by the dominant entity to exceed the scope that the IPR regime was intended to protect.[374] IPRs are not identical for although they all aim to provide a form of limited exclusivity they have different types of subject matter and are subject to different defences and exceptions.[375] Relatively weak IPRs allowed the use of a dominant position to leverage the position on, or block a secondary market. In *Magill* the IPR was considered to be a subspecies of copyright, blocking the information rather than the expression. In *IMS Health* the copyrights were combined with a

[369] It is arguable that Article 345 does not apply to IPRs as it was introduced to control public ownership of coal and steel enterprises and also should not apply to harmonised IPRs such as the Software Directive which are not defined by national legislators. See Ashwin van Rooijen, *The Software Interface between Copyright and Competition Law* (Kluwer Law International 2010) 97 - 98

[370] Guidance on the Commission's enforcement priorities in applying Article 82 of the EC Treaty to abusive exclusionary conduct by dominant undertakings [2009] OJ C 45/02

[371] Joined Cases C-241/91 P and C-242/91 *Radion Telefis Eirann (RTE) and Independent Television Publications (ITP) , Commission (Magill),* [1995] ECR I-743 [1995] 4CMLR 718

[372] Case C-418/01 *IMS Health v NDC Health* [2004] ECR I-5039

[373] L Zhang 'Refusal to license intellectual property rights under Article 82 EC in light of standardisation context' (2010) EIPR 32 (8) 402-411

[374] Liguo Zhang, 'Refusal to license intellectual property rights under Article 82 EC in light of standardisation context' (2010) 32 (8) EIPR 402-411; Ann Walsh, '*Microsoft v Commission*: interoperability, emerging standards and innovation in the software industry' in Rubini, L, (ed) *Microsoft on Trial* (Edward Elgar 2010)

[375] For example some aim to protect "look and feel" while others protect function *Volvo AB v Erik Veng (UK) Ltd* (238/87) [1989] 4 CMLR 122 concern a registered design right which protects appearance rather than technical function. Nevertheless the question referred to the CJEU was on the basis the body panels were not replaceable by body parts or any other design. The "must fit/match exemption was not discussed)

dominant industry standard which excluded competition. In *Microsoft* the level of IPR protection is unclear and some of Microsoft's IPRs may have originated from the public domain.[376]

These variations in the characteristics of IPRs are relevant to the way in which the exceptional circumstances test is applied. Rather than seeing the test as an erosion of IPRs, it could be considered an *ex post* exception to IPRs comparable to existing ex ante exceptions such as the exception for interfaces under the Software Directive. *Ex post* exceptions have the advantage of providing flexible, case-by-case scrutiny but this can reduce certainty.

With the exception of *Oscar Bronner,*[377] the cases decided using the exceptional circumstances test concern a refusal to licence material protected by copyright.   *Oscar Bronner* did not concern IPRs but the CJEU discussed the exceptional circumstances test and expanded on certain areas including the issue of indispensability.

The most recent case to use the exceptional circumstances case was *Microsoft,* where the circumstances that may be considered exceptional are where the refusal:

- Relates to a product or service indispensable to the exercise of a particular activity on a neighbouring market.
- Is of a kind as to exclude any effective competition in that neighbouring market.
- Prevents the appearance of a new product for which there is a potential consumer demand.[378]

The new product test only applies where the exceptional circumstances involves IPRs. In those cases the circumstances were arguably foreseeable and even anticipated. This

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[376] Ibid Walsh 286

[377] *Oscar Bronner GmbH & Co Kg v Mediaprint Seitungs-und Keitschriftenverlag GmbH & Co Kg and others* (C-7/97), 26 November 1998, [1998] ECR I-7817 [1999] 4 CMLR 112

[378] *Microsoft v Commission* CMLR Court of First Instance of the European Communities para. 332

indicates that the use of the exceptional circumstances test was correcting unsatisfactory shortcomings in the IPR regime and is not the optimum method for achieving interoperability.[379]

The exceptional circumstance test only applies where one party is dominant. The 3D CAD market is an oligopolistic market.[380] It would therefore be necessary to establish collective dominance to secure a remedy under Article102. As will be discussed later the 3D CAD market does not meet the criteria for collective dominance. Nevertheless in order to analyse whether the exceptional circumstances test could apply to the 3D CAD industry the test, as formulated by case law and the Commission's Guidance, this thesis has carried out an analysis. The comments below summarise key aspects as well as highlighting uncertainty and inconsistencies:

- **Separate Upstream Market.** The separation between the upstream and downstream markets only needs to be potential or hypothetical.[381] The creation of interfaces and their specifications could be seen as a separate market.[382] The extent of IPR protection in interfaces will be considered in Chapter 6. There is a trade in interface specifications separate from the interface itself, for example translator companies in the 3D CAD industry, and this will be considered further in Chapter 8.

- **Previous Trade in Input.** It is not necessary for the input to have been traded before, though this may be relevant in assessing whether the input is indispensable, the efficiency claim or even the risk to competition. There may be cases where the interface information has been previously available but is then withdrawn or changed, as occurred in the *Microsoft* case but it is not essential for there to have been any discernible trade in interfaces.

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[379] Ashwin van Rooijen *The Software Interface between Copyright and Competition Law* (Kluwer Law International 2010) 112

[380] See Chapter 4 sections 4.2 and 4.3

[381] *IMS Health*

[382] Ashwin van Rooijen *The Software Interface between Copyright and Competition Law* (Kluwer Law International 2010, 130 and see further discussion on interface specifications in Chapter 8

- **Indispensable**. There appears to be consensus that the input must be indispensable to competition in the downstream market. What is less clear is the degree of evidence required to satisfy this test. While the test has been developed, the decisions in the cases are deeply rooted in their findings of facts. It has been said that *Oscar Bronner* drew back the limits of the test but arguably the facts of that case were not such as to satisfy the test of being indispensable.[383]

- **Elimination of Competition.** The General Court in *Microsoft* stated that the test should be whether the refusal is liable or likely to eliminate all effective competition.[384] Article 102 is concerned more with proof of conduct that *could possibly* produce effects than proof of effects.[385] This approach is continued in the Commission's Guidance.[386] Early cases including *Commercial Solvents* and *Volvo* looked at the exclusion of competition from the particular claimant, while in later cases both the Court and the Commission speak of the elimination of competition in the whole of the downstream market. This could mean either that a dominant undertaking could avoid the abuse by licensing to a less efficient competitor,[387] or that the dominant undertaking would be required to licence to all competitors and potential competitors in the downstream market. This would be a development of the exceptional circumstances test, but might be appropriate in certain areas such

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383 *Oscar Bronner,* CJEU judgement para 41 – 47 The argument that not economically viable to create second home-delivery scheme was not made out as other methods to distribute daily newspapers including post, shops and kiosks exist even if less advantageous.

384 *Microsoft,* 563

385 *Instituto Chemioterapico Italiano SpA and Commercial Solvents Corp v Commission* (6 & 7/73, 6 March 1974, [1974] ECR 223, [1974] CMLR 309

386 The Commission will normally intervene ...where on the basis of cogent and convincing evidence, the allegedly abusive conduct is likely to lead to anti-competitive foreclosure. See Guidance on the Commission's enforcement priorities in applying Article 82 of the EC Treaty to abusive exclusionary conduct by dominant undertakings [2009] OJ C 45/02

387 Valentive Korah 'The Interface between Intellectual Property Rights and Competition in Developed Countries' *(2005) Vol 2:4* Script-ed

as the licensing of interface information to enable interoperability of software and platforms.

- **Consumer Harm/New Product**. Case law and the Commission's Guidance identify consumer harm as the prevention of the development of new products.[388] In *Microsoft* the Court noted that the requirement for a new product is found only in the case of the exercising of IPRs.[389] The aim of allowing competition in the downstream market is to encourage follow on innovation rather than just to introduce price competition as this could prevent the owner making a return and harm future incentive to invest in innovation. The aim appears to be to avoid consumers missing out on new or improved goods or services for which there is a potential consumer demand. In *Magill* there was a new product. *IMS* required that an undertaking requesting a license does not intend essentially to duplicate the goods or services already offered but intends to produce new ones not offered by the IPR owner for which there is a potential consumer demand.[390] *Microsoft* lowered the bar, and required only technical developments. It was further stated that evidence that the alternative systems had distinguishing features would be relevant in establishing potential consumer harm, but the new product rule is not the only parameter to be considered in determining whether the refusal is capable of causing prejudice to consumers, as Article 102(b) TFEU includes limiting production, markets or technical development to the detriment of the consumer.[391] The new product test may be justified for some IPRs but it could be inappropriate

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[388] *Magill;* European Commission Guidance (2009/C 45/02) on the Commission's enforcement priorities in applying Article 82 of the EC Treaty to abusive exclusionary conduct by dominant undertakings [2009] OJ C 45/7, para 5

[389] *Microsoft v Commission, para 334* The Commission's Guidance Ibid adopts a similar test for refusal to supply generally, not just IPRs, but it does not include the new product requirement. Traditional cases of refusal to supply, not involving IPRs, did not require evidence of a new product.

[390] See Case C-418/01 *IMS Health v NDC Health* [2004] ECR I-5039, para 49

[391] *Microsoft, para* 647 It is not clear to the author whether the exceptional circumstances test must be limited to Article 102 (b) and (c). If unfair prices could harm consumers in a downstream market could the exceptional circumstances be used? That could be a slippery slope but is the limitation to Article 102 (b) and (c) inviolable?

for interfaces which have become a *de facto* standard. This was effectively the case in *IMS Health* and *Microsoft*. It has also been questioned whether the new product test gives a valid defining factor to differentiate between foreseeable and exceptional cases.[392]

5.4.1 The New Product Test and Interfaces

The new product test may also fail to optimise innovation. Applying the new product test assumes the benefit of new product development outweighs the negative effects caused by the actual or threatened disclosure of interface information or licence of IPRs on the dominant competitor. It is said that from an economic perspective the real question is not what consumers might like but what they are willing to pay for. The willingness to pay for innovation is best left to the markets not the courts on the basis that firms will innovate if they think customers will pay.[393] However if a customer is locked-in to a software supplier he is not able to move to the innovation, which prevents the market operating to reward innovation, and the existence of lock-in may justify intervention.

The innovative value of interfaces is generally low but the incentive for innovation comes from the prospect of extracting value from a platform's substantial network benefits. The incentive comes from the plan to gain market power from network effects.[394] This is substantially the same argument as competition for the market where there are some consumer advantages. Network effects are however caused by interoperability which is in turn caused by intervention in the market by IPRs. Platforms are not a naturally occurring feature in the market. They come about because of IPR restrictions on interfaces where the level of innovation can be low. As proprietary network effects happen because of this intervention the argument that they are better left to market forces is not proven.

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[392] Ashwin van Rooijen *The Software Interface between Copyright and Competition Law* (Kluwer Law International 2010), 131

[393] François Lévêque, 'Innovation, Leveraging and Essential Facilities: Interoperability Licensing in the EU Microsoft Case' (2005) 28 World Competition 71-91 (2005)

[394] Ashwin van Rooijen *The Software Interface between Copyright and Competition Law* (Kluwer Law International 2010),144

The situation is even more complex with interfaces which are de facto standards. Competitors are not always looking to introduce a new product but to use the interface to compete horizontally. In *IMS Health* the copyrighted brick structure was a de facto standard and the value came from its network effects. The new product test was inappropriate as follow-on innovation was not feasible because of the incentive for standardisation. The new product test did not give sensible criteria for intervening to improve the competitive position and encourage innovation. It failed to stimulate dynamic efficiency and risked impeding static efficiency.[395] In *Microsoft,* Sun Microsystems needed their operating system to interoperate and compete with Microsoft on an 'equal footing.' Sun's software had some features that Microsoft's did not but it was not a new product and the Court settled for requiring technical development. The Court and Commission considered the interface to be basic information and in some cases variants on public domain interfaces. The relatively low value of the interface specifications resulted in the Court concluding that a duty to share the information could not result in a substantial impediment to incentives to innovate. Further consideration of Microsoft's incentive to innovate was analysed under objective justification where the burden of proof was with Microsoft. Microsoft failed to present a full argument merely relying on the existence of its IPRs and the opportunity to analyse the impact on its incentive to innovate was missed.[396] The new product test may be too high a threshold for refusal to licence IPRs that amount to standards, but the impact this will have on the incentives to innovate due to losing the higher value network effects has not been fully analysed. The new product test is a poor proxy for the more complex question of whether firms have sufficient incentives to innovate and the control of interface specifications should not be treated on an equal footing with other subject matter.

[395] Josef Drexl 'Intellectual Property and Antitrust Law – IMS Health and Trinko – Antirust Placebo for Consumers Instead of Sound Economics in Refusal-to-Deal Cases' (2004) IIC 788 (2004), 803

[396] Ashwin van Rooijen *The Software Interface between Copyright and Competition Law* (Kluwer Law International 2010), 145 and *Microsoft,* para 710-712

5.4.2 Economic Efficiency and Effects Based Approach

Objective justification has been a defence to Article102 for many years, but the *Microsoft* case was the first instance of the defence being considered by the courts since the Commission's review of Article102. Microsoft did not put up a strong case and did not succeed in its arguments that licensing would harm investment and innovation. The defence is not a balancing act but a legalistic assessment.[397] One of the main issues would be incentives to innovate both of the dominant undertaking and competitors. The requirements are now set out in Section III D of the Commission's Guidance.

The Commission's Guidance on the exclusionary abuse of refusal to supply has incorporated much of the exceptional circumstances test.[398] The test is not however the only condition that will determine whether behaviour is abusive. The Commission has adopted an "effects based" approach to foreclosure that could lead to consumer harm. In Section III B of its Guidance, the Commission requires the identification of consumer harm by appropriate qualitative or quantative evidence and outlines seven factors that are relevant in determining "on the basis of cogent and convincing evidence" whether the alleged abusive conduct is likely to lead to anti-competitive foreclosure. [399] The factors relevant to the assessment include the conditions in the relevant market, the existence of network effects and whether conduct may allow the dominant undertaking to "tip" a network market in its favour to further entrench its position.[400]

This further economic analysis is important to ensure the correct application of the exceptional circumstances test. In particular the analysis should ensure that the input is indispensable and that there is consumer harm. The analysis will take into account all of

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[397] The party charged with abuse must establish that their behaviour is necessary to meet the economic efficiency requirements in line with the Commission's Guidance on enforcement priorities in apply Article 82 Guidance on the Commission's enforcement priorities in applying Article 82 of the EC Treaty to abusive exclusionary conduct by dominant undertakings [2009] OJ C 45/02 and must satisfy that criteria. It is not just a matter of balancing the impact of the abuser with the impact on the abused. *Microsoft,* para 710

[398] Ibid para 75 to 88

[399] Ibid para 19 & 20

[400] Ibid para 20

the facts of the case with a view to ensuring that the alleged abusive conduct will lead to an anti-competitive foreclosure that will harm consumers. It is not enough just to 'tick the boxes' of the essential circumstances test. Further analysis of the facts, including the nature of the IPRs and the particular market should be taken into account.

It could be argued that the CJEU adopted a formalistic tick box approach in *IMS,*[401] and that such an approach might give rise to false positive errors. In *Microsoft* the CJEU attempted an effects based approach incorporating economic analysis although there has been criticism that the *Microsoft* judgement did not include adequate economic analysis. The crucial point is that the CJEU did more than just tick the boxes of the exceptional circumstances test. The exceptional circumstances test should now be considered a form of filter to identify markets and behaviour which should then be subject to closer scrutiny to determine whether there is abusive conduct leading to anti-competitive foreclosure.

In this way it is possible that there can be some differentiation between interface information and other IPRs. While they may all pass through the same filter of the exceptional circumstances test, the interface information, operating in markets characterised by network effects and lock-in, will not be treated in the same way as all other IPRs.

Two of the factors that the Commission's Guidance requires to be considered in the further analysis include the position of the dominant undertaking and the conditions on the relevant market.[402] In *Microsoft* the General Court stated: "Microsoft impaired the effective competitive structure on the work-group server operating systems market by acquiring a significant market share on that market".[403] The statement has been criticised

[401] Valentive Korah considers the CJEU delivered a formalistic judgement in *IMS* based mainly on the wording of the judgement in *Magill* with neither AG Tizzano or the CJEU being interested in policy. Valentine Korah 'The Interface Between Intellectual Property Rights and Competition in Developed Countries'*(2005)* Vol 2:4 SCRIPT-ed.

[402] Guidance on the Commission's enforcement priorities in applying Article 82 of the EC Treaty to abusive exclusionary conduct by dominant undertakings [2009] OJ C 45/02, para 20

[403] *Microsoft,* para 664

as making the holding of a market share illegal. It has been considered a return to an interventionist ordoliberal stance which attempts to impact the structure of the market.[404] This is at odds with the effects based approach.

The relevance of the significant market share in the *Microsoft* case is an example of a factor that is very relevant to interface information but that may not have a bearing on other applications of the exceptional circumstances test. When interface information is involved the market will often be affected by network effects which present high barriers to entry. In those circumstances, while there may be substitute products available in the market, the users cannot select them as they are locked-in to the dominant standard. In markets without network effects, where users are not locked-in, they can switch to substitute products. If for example a dominant supplier has a 90% market share, users can still switch to one of the smaller suppliers without the detrimental effects felt in markets where there are network effects. Inability to change suppliers can also arise from supplier lock-in caused by lack of interface information and high switching costs prevent changing suppliers even in the absence of strong network effects. For this reason the issue of market share on the existence of abuse is more relevant to interface information than the refusal to licence other IPRs. Where other IPRs are concerned, consumers who may not be able to get the dominant company's product elsewhere can switch to substitute products without being locked in by non-interoperable software.

Various economists including Katz & Shapiro and Liebowitz & Margolis acknowledge that there can be inefficiencies in network markets with externalities, but do not advocate intervention preferring an unregulated market outcome. The benefits of intervention may be different when supplier lock-in prevents consumers switching products.[405] These

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[404] Philip Marsden 'Microsoft v Commission With great power comes great responsibility' (23 October 2007) 8 Competition Law Insight 3-5,4

[405] Network effects are common but do not always involve externalities. See S J Liebowitz & Stephen E Margolis Network Externalities: An Uncommon Tragedy, (1994) 8 Journal of Economic Perspectives 135 but compare Joseph Farrell and Paul Klemper 'Coordination and Lock-in: Competition with Switching Costs and Network Effects' M Armstrong and R Porter (eds) 3 *Handbook of Industrial Organisation* (Elsevier 1989) who cautiously favour some intervention in the form of pro-compatibility public policy

economic arguments and whether different forms of lock-in may alter this position was considered in more detail in Chapter 3.

5.4.3 Microsoft and Intellectual Property Rights and Remedies

Microsoft's European case occurred before the rulings in *Bezpečnostní* and *SAS Institute* which gave software interfaces an exemption. *Microsoft* illustrates the relationship between Article102 and the Software Directive, and how this may be influenced by the status of interfaces. Unfortunately it is not possible to draw a definitive picture of the relationship, as neither the Commission nor the General Court determined what IPRs existed in the information Microsoft was ordered to disclose. They said they did not need to as Microsoft had abused its dominant position and met the exceptional circumstances test which justified the disclosure. The Court sidestepped the issue of whether the interface information was copyright protected. While noting that the contested decision "does not take a position as to whether Microsoft's [IPRs] are affected or not"[406] it proceeded on the presumption that the protocols in question, or the specifications of those protocols, are covered by IPRs. Compulsory disclosure was justified by the abuse of a dominant position and the exceptional circumstances test following the cases of *Magill* and *IMS Heath.*

The decision in *Microsoft* has been criticised for being a false positive, penalising success in the absence of abuse, which will reduce incentives to innovate and dynamic competition.[407] There are also claims that the "exceptional circumstances" test was distorted by the

[406] *Microsoft*, para 287

[407] Alan Devlin, Michael Jacobs and Bruno Peixoto, 'Success, Dominance and Interoperability' (2009) 84 (4) Indiana Law Journal, 1157 – 1201, 1177

interpretation of the "indispensability" requirement[408] and the expansions of the new product test in a secondary market to technical development as discussed earlier.[409]

Microsoft claimed the interfaces were protected by patents, copyright and trade secrets. However the Commission said the considerations associated with patent protection did not justify the refusal, indeed Microsoft took some time to even identify a single patent.[410] The Commission was also not impressed with the trade secret argument as the protection afforded to trade secrets can be more limited than copyright or patent protections, and they exist as a result of a unilateral business decision dependant on its facts and the interests at stake. Here the value of the secret was not its innovative nature but the fact that it belonged to a dominant undertaking.[411] Also, subject to certain conditions, reverse engineering can legitimately disclose information for the purpose of interoperability, and this would defeat any attempt to protect interface information as trade secrets.[412]

When considering the question of copyright the Commission commented that while specifications may be copyright their implementation is not necessarily a copy but may result in new work. The order in *Microsoft* was for the disclosure of "complete and accurate specifications for the protocols". The use of the term "specifications" did not require Microsoft to disclose how it implemented the specifications in the source code. The term "protocol" related to "the rules of interconnection and interaction".[413] The wording of the order resembles the wording in recital 10 of the Software Directive defining

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[408] Microsoft argued that reverse-engineering provided the less advantageous yet "actual and potential alternative". This standard of alternative to the input defeated the claim that the input was indispensable, see Case C-7/97 *Oscar Bronner* [1998] ECR I-7791

[409] The abuse in *Magill, IMS Health* and *Microsoft* all fall within the same category of abuse in Article 105 (b) TFEU "limiting production, markets or technical development to the prejudice of consumers;"

[410] *Microsoft*, para 278

[411] *Microsoft*, para 280

[412] See also Samuelson 'Are Patents on Interfaces Impeding Interoperability?' (2008) Berkeley Centre for Law & Technology 1, 1620, if reverse engineering is both lawful and feasible, trade secrecy protection for platform APIs is vulnerable.

[413] *Microsoft* Commission Decision, para Order 6.1.1.1 (999)

interfaces as parts which provide “interconnection and interaction” to enable software to work “in all the ways they are intended to function”[414]. While the full meaning of these phrases has not been judicially determined, in *Microsoft* two-way operability was required and presumably an objective test would be applied.

Microsoft argued that the information disclosed went further than was necessary for interoperability arguing that the information would allow for “plug-replaceablity”, “cloning” and arguing that “the replication of the Global Catalog features of the Active Directory do not bear on interoperability”.[415] The Commission refuted these arguments and set out details of why Microsoft’s “one-way” interpretation of interoperability was incorrect.[416] The Court considered Microsoft had not cast doubt on these assertions.[417] It considered the concept of interoperability adopted in the order namely “the capacity for them to exchange information and to use that information mutually in order to allow each of those software products to function in all the ways envisaged” as consistent with the Software Directive.[418] Nevertheless Article102 was held to rank higher than the Directive, and the level of interoperability ordered was necessary to enable competitors to remain viable on the market.[419] Microsoft’s assertions that aspects of the information to be disclosed did not relate to interoperability and could amount to cloning were rejected. The General Court dealt with many points including that Microsoft would not be required to disclose the source code and only give a general description of the algorithms, leaving it to its competitors to develop their own implementation of it.[420]

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[414] Software Directive, Recital No 10

[415] *Microsoft*, para 212 and 253

[416] Commission Decision in *Microsoft*, 749-763

[417] *Microsoft,* para 224

[418] Ibid para 225

[419] Ibid paras 227 – 228

[420] Ibid para 265

On the face of it the information Microsoft was ordered to disclose: "Complete and accurate specifications for the protocols", was interface information for interoperability and hence not copyright protected.[421] The main problem was that the information arguably went beyond interoperability into the "internal make up of Windows server operating systems"[422] which Microsoft claimed could compromise the internal integrity and security of the system. The argument was not accepted by the Commission and it is debatable whether a dominant undertaking should be entitled to cite security risks to justify non-disclosure of information when that is dependent on its own architectural design decisions.[423] Another issue was the requirement to provide an algorithm's "general description", which can amount to a most valuable but unprotected aspect of software[424] demonstrating the misfit of copyright protection for software.[425]

It has been pointed out that the only example of reduced interoperability present at the trial was that some users needed to log on twice and that the fines and extra work imposed on Microsoft seem disproportionate.[426] The judgement meant Microsoft had to employ 210 software engineers and spent tens of thousands of hours to write the required specification.[427] On the other hand it was relevant to the abuse that Microsoft had

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[421] Daniel J. Gifford, and Robert T. Kurdrie, 'Antitrust approaches to dynamically competitive industries in the United States and the European Union' (2011) 7 (3) J C L & E 695-731 at 705 – 706, 708. Under US law the APIs in the Windows operating system are "systems of operation" which are denied protection under Sec. 102(b) of the Copyright Act 17 A.S.C., so Microsoft sought to protect them as trade secrets.

[422] Commission Decision in *Microsoft,* para 201

[423] Ann Walsh, '*Microsoft v Commission*: interoperability, emerging standards and innovation in the software industry' in Rubini, L, (ed) *Microsoft on Trial* (Edward Elgar 2010)

[424] *Microsoft,* para 265

[425] Algorithms are excluded from copyright protection. While there are many ways to write code to perform a given task, the algorithms would vary less and protecting them would amount to protecting the function. This is more appropriate to patent protection. See the opinion of the Advocate General in *SAS Institute*, para 56

[426] Ian S. Forrester, 'Victa lacet mihi causa: the compulsory licensing part of the Microsoft case' in Rubini, L, (ed) *Microsoft on Trial* (Edward Elgar 2010), 97-98.

[427] Ibid

formerly disclosed interface information to enter, catch up and then dominate the market, before introducing new software, Windows 2000, and not disclosing equivalent information. Also the new software was built on industry standard access protocols and open source software, LDAP and Kerbos, that was not developed by Microsoft, but to which Microsoft had added private unilateral extensions.[428] Microsoft's behaviour in that period appeared to be intended to protect and exploit its dominant position[429] in the PC operating systems market, whether from Netscape and Java or other competing platforms such as a rival server operating system.[430]

5.4.4 Microsoft's Legacy

Although commitments concerning interoperability had occurred before, for example in 1984 IBM gave an undertaking to the Commission to provide interface information for its System 370, there seems, post *Microsoft,* to be an acceleration in the number of decisions by the Commission in which it has imposed interoperability. These have occurred in merger cases and voluntary commitments under Article 9 of the Antitrust Regulation 1/2003. In recent merger cases the Commission appears to have accepted the position that a lack of interoperability has an adverse effect on competition, particularly in network markets.[431] This could be seen as the Commission using *Microsoft* to strengthen its arm in negotiations and furthering a culture of interoperability.

In December 2009 Oracle's acquisition of Sun Microsystems was cleared following Oracle's public commitment which included addressing licensing and copyright issues relevant to

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[428] Commission decision in *Microsoft,* para 244 *also see* Colin Jackson, 'The basic technology issues at stake' *Microsoft on Trial* ibid, 23. Kerberos had been developed by MIT and the specification for this protocol was in the public domain but Microsoft added a proprietary extension to the public standard.

[429] Microsoft had 93 percent share of the PC operating system market and 60 percent of the work group server operating system market. Windows was described not only as dominant but as the "de facto standard". See *Microsoft,* paras 31 – 33.

[430] *See Mirosoft*, para 1349 on interoperability leveraging quoting Bill Gates, "What we are trying to do is use our server control to do new protocols and lock out Sun and Oracle specifically... Now, I don't know if we'll get to that or not, but that's what we are trying to do".

[431] The Commission's position may have been informed by analysis in the *Microsoft* decision.

third-party developers of open source software, MySQL storage engines, promising to maintain the openness and flexibility of MySQL's Pluggable Storage Engine Architecture and not to require commercial licenses to use the storage engine APIs.

In the decision on Cisco's acquisition of Tandberg,[432] the lack of interoperability was seen as a barrier to entry to the market for high-end video conferencing systems. The question in that merger was whether the market would impose interoperability or whether intervention was required. Perhaps unsurprisingly, the competitors favoured intervention. End customers, distributors and industry analysts however thought that the market would impose interoperability and that a standard would develop.[433] The market investigation revealed that network effects meant there was a strong case for interoperability. It confirmed that interoperability was the way forward for the industry, but the merged entity could have an increased incentive to strategically restrict interoperability with new entrants or less important competitors.[434] Cisco was required to divest the copyright and management of its TIP protocol to an industry body before the merger was approved.[435]

The acquisition of the security software vendor McAfee by Intel raised concerns as competing security software vendors would continue to need good interface information post merger, information which is essential to ensure that their software was not disadvantaged with regard to performance and power consumption, as that would significantly increase workload on the CPU and affect performance of the computer.[436] There was concern that after the acquisition Intel would lose the incentive to disclose

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[432] *Cisco Sytems Inc and Tandberg ASA* (Case COMP/M5669) Commission Decision [2010] OJ L-2985

[433] Ibid para 71 One important distributor (AT&T) said that Cisco, in acquiring Tandberg, would achieve better interoperability and if interoperability was made more difficult it would diminish the value of the new combined entity.

[434] Ibid para 81

[435] *Ibid para 146-160* Cisco also undertook to make the source code of the TIP protocol available on an open source licence, ensure backward compatibility and support TIP for at least three years after the industry accepts a recognized standard.

[436] *Intel/McAfee* Case (COMP M5984) Commission Decision [2011] OJ C 98 -1, para 18

information to competing security software vendors and this would foreclose the market. Given Intel's large market share, customers would not be in a position to exert pressure on Intel to restore interoperability and reverse engineering was not "commercially viable or technically feasible."[437] This would have a significant adverse effect on the market, acting as a technical tie and foreclosing the market. Intel committed to give equal access to "Instruction, Interoperability and Optimization" information.[438] The Commission co-operated closely with the U.S. Federal Trade Commission throughout the review.[439]

5.4.5 Does the Exceptional Circumstances Test Provide an Adequate Solution?

The central purpose of competition law is to "speed up the arrival of the long run" (so that firms lose market power faster).[440] Lock-in due to lack of interoperability is a drag on this process and it is possible that intervention by competition law could give net benefits.[441] The willingness to intervene to promote interoperability in *Microsoft* and more recent merger cases indicates that the Commission has been convinced by the competitive virtues of interoperability. Arguably, the outcome of *Microsoft* has strengthened the Commission's bargaining position in negotiations intended to maintain interoperability post-merger and Article 9 commitments.

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[437] *Ibid* para, 160

[438] Ibid 62 The information seems to extend beyond interoperability to include information necessary to develop and optimise functionality in the Intel microprocessors and chipsets.

[439] Press release Mergers: Commission clears Intel's proposed acquisition of McAfee subject to conditions, IP/11/70, 26/01/2011; Daniel J. Gifford, and Robert T. Kurdrie, 'Antitrust approaches to dynamically competitive industries in the United States and the European Union' (2011) 7 (3) J C L & E 695-731 where the appointment of Carl Shapiro's appointment as Deputy Attorney General in the Obama Administration is discussed and that subsequent action concerning Intel may indicate that the Federal Trade Commission sees no special antitrust status for the new economy.

[440] Frank H. Easterbrook 'The Limits of Antitrust' (1984) 63 Tex L Rev 1

[441] Opponents to any form of intervention for fear of dampening the incentive to innovate remain and criticise the exceptional circumstances test as applied in *Microsoft.*

Interface specifications have been considered an exception under the Software Directive and not covered by copyright.[442] This would not overturn or invalidate all criticism of *Microsoft* but arguably *Microsoft* is not a full frontal attack on the sanctity of IPRs but a step towards a more nuanced and pragmatic approach to interoperability and lock-in.

Interface information has distinct features which mean that it may require different treatment to other IPRs. While the Commission's Guidance conflates the two in Section III D, objective necessities and efficiencies, it can be argued that in Section III B the Guidance calls for sufficient analysis for the Commission and courts to differentiate between them in practice. This may mean that the law will develop so that undertakings dealing in software and platforms are able to assess when they have to disclose interface information, although this process is likely to be very slow and fraught with difficulties.

The Software Directive permits block box analysis and reverse engineering, but it does not require suppliers to disclose interface information in any form. However, following *Microsoft*, once a supplier becomes dominant it may have to compile and disclose such information. We are faced with two levels of interoperability, in which the level of interoperability that can be required of dominant companies will be at a higher level than for other suppliers. This may be justified given the impact of network effects, but the very existence of the remedy implies that the interface information available under the Software Directive is inadequate for interoperability.[443] There will continue to be prospective suppliers unable to achieve interoperability for their software, and users locked in to incumbent suppliers. *SAS Institute* is just the tip of the iceberg and software in the 3D CAD industry is another example. It could be argued that the cumulative effect of this does not affect the market and is inappropriate for a remedy under competition law, but it is a serious problem for the user and a cost to the economy and should be addressed as part of the IPR regime.

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[442] *SAS Institute*

[443] The level of interoperability required from Intel and Cisco before their respective mergers were cleared was certainly more than could be achieved by reverse-engineering. *See e.g.* M.5984 *Intel/ McAfee, para 145.*

In *Microsoft* the Court considered that competitors would not want to replicate exactly the same work-group server operating systems as Microsoft, but to offer something innovative and different. This supports the requirement under the "essential facilities test" for a secondary market with a new product or an advance in technical development. By contrast in *Navitaire* and *SAS Institute* the aim was to produce software with the same "look and feel", to help users swap to the new supplier. It is ironic that a competitor has to establish a new product or technological advance to interoperate with a dominant company but can emulate the software of any other competitor.

The benefits of using competition law as an ex post regulation of IPRs is that it should provide a flexible solution after analysis on a case by case basis. This allows for the balance between openness and control to be struck. However it is said the exceptional circumstances test has developed to provide a rigid framework which is neither flexible nor appropriate for the particular factors relevant to interoperability and standardisation.[444] The considerations relevant to standards and interface information include that firms may be competing for the market rather than within the market. Competition for the market is arguably not harmful to consumer welfare per se but has different considerations which may not fit within a rigid application of the exceptional circumstances test. The IPRs in interfaces are often of a low innovative value, but give control to network markets, locking in customers and shutting out competitors. When balancing the incentive to innovate it may be incorrect to focus solely on the value of the interface innovation but to consider the innovation incentive that can flow from the resulting control.[445]

The merger and Article 9 Commitments post *Microsoft* have seen competition law turning into an ex ante remedy. This is appropriate as the problems that are being remedied are structural and foreseeable. Competition law is therefore playing a valid and important role on a case-by-case basis to provide a flexible remedy that will encourage interoperability and competition.

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[444] Ashwin van Rooijen *The Software Interface between Copyright and Competition Law* (Kluwer Law International 2010, 132-133

[445] Ibid

Competition law as an effective remedy is limited to merger and Article 9 Commitments. The disadvantages of the exceptional circumstances test have been analysed above. The 3D CAD industry has additional hurdles to overcome before the exceptional circumstances test could be applied to the undertakings. The industry is oligopolistic with 3 or arguably only 2 suppliers in the high end of the industry. On the surface there appears to be competition in the industry although users suffer from supplier lock-in. Before the issue of failure to supply interface information could be challenged it would be necessary to show either that the supplier was individually dominant or two or more suppliers were collectively dominant. The lack of interoperability would be very relevant to this determination. It has been argued that Amazon's Kindle and Kindle e-books are a distinct market due to Amazon's restrictive e-book format which because of DRM protection features could until recently only be read on Amazon's devices.[446] If the market for 3D CAD could be defined at the individual supplier level because of interoperability the evaluation of dominance and abuse for failure to supply interface information could be applied. Alternatively the industry, as a tight oligopoly, could be considered collectively dominant and then subject to review under the exceptional circumstances test. This Chapter will continue with an analysis as to whether the products of individual suppliers in the 3D CAD industry could be considered distinct markets, or whether the industry is collectively dominant.

5.5 Market Definition

In the software industry, dominance has been defined narrowly. Software maintenance and software updates of Digital computers were considered to be separate markets from non-branded systems.[447] Software and services for branded proprietary systems could not be replaced by other suppliers' systems and customers were locked-in, unable to switch to

[446] Angela Daly, 'E-book monopolies and the law' (2013) 18 Media & Arts Law Review 350

[447] Vincent Pickering and Maurits Dolmans 'The 1997 Digital Undertaking' *(1998)19 (2)* ECLR *108- 115, 109* The Commission based its position on the arguments that software and services for branded proprietary systems could not be replaced by software and services for other vendors' systems (absence of substitutability of demand), and that customers could not switch to other vendors' systems if the service fees for their systems were increased ("customer lock-in"). Digital arguments that customers' can calculate the total cost of ownership and software updates and patches were separately available at a reasonable price so customers could use suppliers other than OEMs were not accepted.

other suppliers' systems if Digital increased the service fees. When accepting Digital's undertaking the Commission[448] was relying on the narrow market definition approach adopted in cases such as *Hugin v Commission*[449] and *Hilti v Commission.*[450] The same reasoning could apply to numerous suppliers in the software industry. Complex software available for functions such as Enterprise Resource Management or 3D CAD does not usually interoperate fully with systems from other suppliers.[451] After a customer has made the initial decision to buy from one supplier he is locked-in to that supplier for upgrades, add on modules, maintenance and service. The lack of interoperability means that following the reasoning in the *Digital Undertaking*, or the cases of *Hugin* and *Hilti,* each supplier could be considered to be in a separate market and dominant with a high market share. Rather than being oligopolistic the market would then be made up of the software system of individual suppliers. The deliberate non-disclosure of software interface information by a car manufacturer has however been considered an abuse of superior bargaining position but does not necessarily delineate the manufacturer into a separate market where it could be considered dominant[452]

[448] The European Commission accepts an undertaking from Digital concerning its supply and pricing practices in the field of computer maintenance services, press release Brussels (10th October 1997) IP/97/868 http://europa.eu/rapid/press-release_IP-97-868_en.htm [accessed 10 December 2014]

[449] Case 22/78 [1979] 3 CMLR 345 although Hugin has been said to be a case of economic dependence rather than dominance Ioannis Kokkoris *A Gap in the Enforcement of Article 82*(BIICL 2009), 24; Louis Vogel 'Competition law and buying power: the case for a new approach in Europe' (1998) 19(1) ECLR 4, 5

[450] [1994] E.C.R. I-667 [8] CJEU referring to the General Court ruling that the case law of the Court of Justice (see Case 6/72, Europemballage and Continental Can v. E.C. Commission) the relevant product market is defined as the market for those products which, in relation to their characteristics, are apt to satisfy an inelastic need and are interchangeable only to a limited extent with other products. The General Court [1991] E.C.R. II-1439;para 66 took the view that nail guns, cartridge strips and nails constitute three specific markets. Since cartridge strips and nails are specifically manufactured, and purchased by users, for a single brand of gun, it must be concluded that there are separate markets for Hilti-compatible cartridge strips and nails.

[451] Commission Staff Working Document (2013) 18

[452] ICN 'Report on Abuse of Superior Bargaining Position' *(* ICN Conference Kyoto 2008) ASBP, 21

5.5.1 Commission Guidance

A relevant product market is defined as all those products which are regarded as interchangeable or substitutable by the consumer, by reason of the products' characteristics, prices and intended use.[453] Price is a key factor for measuring demand and supply side interchangeability[454] but in markets characterised by a lack of interoperability and network effects, market prices may not be an accurate sufficient parameter for the relevant market as lock-in, network benefits and standardisation may cause markets to be less sensitive to price increases.[455] The Commission's 2002 Guidelines on market analysis and the assessment of significant market power in the telecoms industries[456] considers that switching costs can influence whether consumers will change products or services even when there is a significant lasting price increase. Having invested in one system they will be unwilling to incur additional costs involved in switching to an otherwise substitutable service or product. Customers may be 'locked in' by the prohibitively high switching costs. The Guidelines say that in a situation where end users face significant switching costs in order to substitute product A for product B, these two products should not be included in the same relevant market.[457]

If lack of interoperability is relevant to market definition, more firms could be held dominant and the exceptional circumstances test could be used to force the disclosure of

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[453] Commission Notice on the definition of relevant market for the purposes of Community competition law [1997] OJ C 372/03

[454] Ibid, para 17 which take of a hypothetical small (in the range 5 % to 10 %) but permanent relative price increase

[455] When applying the SSNIP test evidence relevant to the likelihood of product substitution by customers in response to a SSNIP includes the time and costs required to switch products, as high switching costs relative to the value of a product tend to make substitution less likely. ICN Recommended Practices for Merger Analysis, Part II http://www.internationalcompetitionnetwork.org/uploads/library/doc316.pdf [accessed 25 October 2015]

[456] The Commission Guidelines on market analysis and the assessment of significant market power under the Community regulatory framework for electronic communications networks and services [2002] OJ C 165/6

[457] Ibid

interface information.[458] Software competitors who withhold interface information to cause a lack of interoperability may do so in an attempt to compete for rather than within the market. This form of competition is thought to incentivise investment as the winner takes all. Of concern is that if the products of such companies were defined as a separate market the narrow definition could be seen to apply to successful companies before they even achieved the level of market power normally associated with dominant firms. This could exacerbate the arguments that intervention reduces incentives to innovate.

Furthermore, with fast innovation cycles, consideration should be given to include future market conditions. The Commission's 2002 Guidance on market definition considers that:

> ...high barriers to entry may become less relevant with regard to markets characterised by on-going technological progress. In electronic communications markets, competitive constraints may come from innovative threats from potential competitors that are not currently in the market. In such markets, the competitive assessment should be based on a prospective, forward-looking approach.[459]

While software is generally perceived as a highly innovative industry, the lack of interface information and customer lock-in will complicate scrutiny of entry barriers. Lack of interoperability can present entry barriers constraining the market to existing technology rather than potential innovation. What can result is the construction of various platforms in an oligopolistic market where customers are locked into suppliers which impacts the nature of competition.

5.5.2 Microsoft/Apple/Amazon

In *Microsoft* the Commission enquired whether the possibility of reverse engineering under the Software Directive could lower entry barriers and curtail Microsoft's *present* market

[458] See earlier Section 5.4

[459] The Commission Guidelines on market analysis and the assessment of significant market power under the Community regulatory framework for electronic communications networks and services [2002] OJ C 165/6, para 80

power.[460] Entry barriers, including a lack of interoperability and network effects are also taken into account when considering the sustainability of market share. These entry barriers are considered as a confirmation of market power rather than in defining the market itself. In *Microsoft* network effects were considered a factor in sustaining Microsoft's market share and the Commission Guidance recognises that network effects may be a significant barrier to entry.[461]

The question of market definition and dominance raised its head when DRM was used to make iTunes compatible only with iPods,[462] but the complaints were discontinued. It has been considered again with the Kindle's leading position in the market for e-readers. Amazon's Kindle uses a proprietary format AZW/KF8 and DRM rather than the open EPUB format. This encourages Kindle users to buy from the Amazon store to get compatible books. Network effects encourage the purchase of Kindles as they give easy access to Amazon's extensive library of books which encourages authors and publishers to make their books available on Amazon. Amazon is said to have 60% of the e-book market in the USA and 90% in the UK.[463] Amazon has recently introduced a free Amazon app to allow Kindle books to be read on non-Kindle devices. This move could cause the market definition to be broader than purely Amazon Kindles.[464]

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[460] *Microsoft* Decision, para 5.2.1.3

[461] Guidance on the Commission's enforcement priorities in applying Article 82 of the EC Treaty to abusive exclusionary conduct by dominant undertakings[2009] OJ C 45/02

[462] Ewan Kirk, 'Apple's iTunes digital rights management: "Fairplay" under the essential facilities doctrine' (2006) 11 (5) Comms Law 161.

[463] Jeremy Greenfield "Kindle Most Popular Device For Ebooks, Beating Out iPad; Tablets On The Rise" (*Forbes.com* 13 October 2013) http://www.forbes.com/sites/jeremygreenfield/2013/10/30/kindle-most-popular-device-for-ebooks-beating-out-ipad-tablets-on-the-rise/ [accessed 17 November 2014]

[464] Angela Daly, 'E-book monopolies and the law' (2013) 18 Media & Arts Law Review 350, 354

5.5.3 Oracle/Peoplesoft

In the acquisition of UGS by Siemens, the Commission referred to previous decisions such as Oracle/Peoplesoft[465] where it had taken a "broad approach" in software markets.[466] In Oracle/Peoplesoft it had recognised that there could be separate product markets within enterprise application software ('EAS') and further categorised the markets into high function financial management ('FMS') and human resource ('HR') solutions, to serve the needs of large enterprises with complex functional needs, and midmarket FMS and HR solutions. Interoperability did not feature in the market analysis other than comments that the high function solutions would have complex proprietary APIs which, it was assumed would give better integration.

Mid-market solutions tend to have simple (i.e. batch export/import) interfaces, or simple application programming interfaces (APIs) making them easy to integrate in a simple way with other mid-market software and other smaller scale solutions, but allowing little scope for adding directly to the functionality of the software. High-function software tends to have complex and proprietary APIs which allow full and complex integration with other large scale software solutions and additional functionality to be added to customize the solutions. The number of data interfaces needed in order to integrate all major external data sources in HR and FMS solutions are also fewer and simpler for mid-market solutions than for large enterprises with complex functional needs.[467]

Subsequent research has highlighted: that competition in a market such as EAS can be affected by the importance of the software to the users and the risks of switching, including interoperability problems[468] and the lack of compatibility of ERP software, a subset of EAS,

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[465] *Oracle/Peoplesoft (COMP* M.3216) Merger Procedure Commission Decision 8 (2) 26/10/2004

[466] *Siemens/UGS Corporation* (COMP M.4608) Commission Decision of non-opposition to notified concentration [2007] OJ C 113/03, para 21

[467] *Oracle/Peoplesoft (COMP* M.3216) Merger Procedure Commission Decision 8 (2) 26/10/2004, papa 78 and what was considered important was (i) functionality (breadth and depth); (ii) scalability, reliability and quality; (iii) technology; (iv) industry coverage; (v) international scope; (vi) brand reputation, sale and service, para 85

[468] Ioannis Kokkoris *Merger Control in Europe* (2001 Routledge) 127

means that customers can be locked-in following an initial purchase due to the costs involved of switching.[469] Had the merger occurred after the introduction of the SIEC test, which allows the Commission to consider post- merger non-coordinated effects in an oligopolistic market, the merger may not have been approved.[470]

5.5.4 3D CAD and Siemens/UGS

There is generally more interoperability in the EAS software industry than the 3D CAD industry but even for enterprise application software 'EAS', high-function software was considered a distinct market.[471] This would however support a definition of high end 3D CAD software being a distinct market. The suppliers would be Dassault Systems with CATIA, Siemens with Siemens NX and possibly PTC Creo.[472] The question is whether legacy issues and other causes of supplier lock-in would prevent customers switching to the other supplier even if there was a significant non-transitory increase in price in their existing system. This increase in price could apply to upgrades, maintenance or the purchase of additional modules. The Commission accepted in *Microsoft* and various merger cases that interoperability impacts competition, and iTunes and the Kindle demonstrate recognition that it could also influence the definition of the market. If the Commission was required to determine the definition of the 3D CAD market, the question of interoperability would be a very relevant factor. What is less clear is the level of incompatibility that would be required. The interoperability between Amazon's Kindle books and Apple may be sufficient to widen the market definition. Would the STEP Standard, even with its limitations, and translator software be considered to give a solution that would define the market wider than the individual supplier?

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[469] Jam Damsgaard and Jan Karlsbjerg 'Seven Principles for Selecting Software Packages' (August 2010) (53) 8 Communications of the ACM, 67 and see Section 3.12.2. In the Commission's Decision it was recorded that Oracle Software would only run on Oracle database, para 189, footnote 99.

[470] Ioannis Kokkoris *Merger Control in Europe* (2001 Routledge) 129 and *Oracle/Peoplesoft (COMP* M.3216) Merger Procedure Commission Decision 8 (2) 26/10/2004, 187.

[471] *Oracle/Peoplesoft (COMP* M.3216) Merger Procedure Commission Decision 8 (2) 26/10/2004, 171

The Commission considered a definition of the 3D CAD market when Siemens acquired UGS Limited in 2007.[473] Interoperability was considered by the Commission but the focus was on the interoperability of automation and control products as this was a market that Siemens and UGS were both active in before the acquisition. Only UGS was active in the PLM and 3D CAD market.

The market was defined as the PLM software market rather than the wider enterprise application software as it manages specific information about the products of the company rather than financial and more general business information. When distinguishing CAD from other products many respondents to the consultation viewed the 'individual application product as specific to the function it provides'[474] while also being integral to the overall PLM solution.

There was no consideration given to defining the market more narrowly due to lack of interoperability to include only software supplied by Siemens. The Commission considered the precise delineation of the product market could be left open as it thought that even with a narrower definition, separating CAD from PLM, no serious competition concerns arose from the proposed acquisition.

The Commission relied on industry analyst reports to define market shares.[475] UGS' market share for PLM and CAD was assessed at 10 -20% with Dassault Systems the only named competitor for CAD software. The Commission did not appear to draw any distinction between high and low end software but considered that given the presence of a number of strong competitors the proposed concentration would not lead to a significant impediment of effective competition in the supply of PLM solutions.

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[472] See discussion on the industry in Chapter 4 sections 4.3 and 4.3.1

[473] *Siemens/UGS Corporation* (COMP M.4608) Commission Decision of non-opposition to notified concentration [2007] OJ C 113/03 Celex No 307M4608

[474] Ibid para 10

5.5.5 Summary

Market definition is a 'highly sophisticated economic and econometric analysis'[476] and a definitive position on defining the market for 3D CAD is beyond the scope of this legal thesis. The outcome of the analysis, including the SSNIP test cannot be fully prejudged but limiting the market to single suppliers is exceptional. The availability of standards and translators as well as the incidences of changing suppliers such as by Daimler AG's from Dassault Systems CATIA to Siemens PLM's NX may be sufficient to categorise the software market as high-end or middle-range rather than restricting the definition to a single supplier.

5.6 Oligopoly and Collective Dominance

If the supplier of software is not dominant and in the absence of a cartel, or market investigation, the only solution provided by competition law to a refusal to supply interface information is the concept of collective dominance under Article 102. The purpose of evaluating whether the market for 3D CAD could be considered oligopolistic is to find a solution to lock-in and other problems associated with a lack of interoperability. Collective dominance would allow the refusal to supply interface information to be subjected to the exceptional circumstances test to determine whether it is an abuse of a dominant position.[477]

The "oligopoly problem" is said to be one of the chief concerns of EU competition policy as oligopolies do not have an express Treaty provision to regulate their unique structure and intrinsic behaviour.[478] This is seen as a "lacuna" in EU law [479] which the European Commission and Courts have sought to address in recent years. Caution has rightly been

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[475] Ibid para 21

[476] Richard Whish and David Bailey *Competition Law (8th Ed OUP 2015) 27*

[477] The exceptional circumstances test is considered in Section 5.4

[478] Craig Callery 'Considering the oligopoly problem' (2011) 32 ECLR 142, 142

[479] Jephcott M and Withers c, 'Where to go now for EC oligopoly control? ' (2001) 22 European Competition Law Review 295, 300

shown to avoid penalising the innate structure of the oligopolistic market unless there is behaviour that goes beyond rational responses to that market. But this has proven to be a very thin line to draw.[480] There is said to be an "oligopoly gap", where subcompetitive performance is not adequately addressed by legal provisions to control anti-competitive abusive behaviour.[481]

Oligopoly is defined as 'sale by a few sellers'. It is a phenomenon occurring somewhere on the continuum between monopoly and perfect competition. 'Oligo' means few while 'mono' means one and 'polypoly' means many.[482] "Because there are only a few firms each firm can affect the market price and hence its rivals' profit....a firm must consider rival firms' behaviour to determine its own policy".[483]

Not all oligopolistic markets are a problem and there are economic models of oligopolists competing on price or output.[484] The main argument against oligopolies is that, because there are only a few competitors in an oligopolistic market, they are very aware of each other's presence and behaviour and are interdependent. They are bound to match and follow each other's marketing strategy and price competition will be minimal or non-existent. They produce non-competitive stability.[485] This view is supported by the literature on 'game-theory' and 'the Prisoner's Dilemma'.[486] The interdependence can be used by the oligopolists for their own self-interest if they match each other's conduct to

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[480] K Middleton, *Cases & Materials on UK & EC Competition Law* (2nd edn, OUP 2009), 211

[481] Ionnis Kokkoris *Merger Control in Europe (Routledge 2011);* Barry Hawk and Giorgio Motta, 'Oligopolies and Collective Dominance: A Solution in Search of a Problem' Treviso Conference on Antitrust Between EC Law and National Law, Eighth Edition; Fordham Law Legal Studies Research Paper No. 1301693. Available at SSRN: http://ssrn.com/abstract=1301693

[482] Richard Whish and David Bailey, *Competition Law* (8th edn, Oxford University Press 2015), 595

[483] Dennis W. Carlton and Jeremy M. Perloff, *Modern Industrial Organization* ((4th Edition) edn, 2005), 157

[484]Richard Whish and David Bailey, *Competition Law* (8th edn, Oxford University Press 2015), 595

[485] Ibid 596

[486] Ibid 596

charge profit-maximising prices at a supra-competitive level. They do this by relying on the structure of the market and mutual self-awareness rather than actual communication.[487]

There is debate as to whether the market structure itself produces the problem. There is empirical evidence to support the structuralist theory that there is a direct correlation with profits being higher in oligopoly markets than in less concentrated markets.[488] Later empirical studies failed to find a simple link between profits and concentration in a wide range of industries and higher profits seemed better explained by efficiencies.[489] This led to a more agnostic view of oligopolies where efficiency was seen as a benefit and there was also an appreciation that coordination in oligopoly markets was more difficult to achieve than originally thought.[490] According to the Cournot model[491] oligopolistic interdependence exists in any market with few firms and output is often lower than in perfect competition but this does not always mean firms are maximising joint profits by tacit collusion. In an oligopoly anything can happen and oligopolistic interdependence is not enough to justify intervention without joint profit maximisation through tacit collusion.[492] The market structure is important but is not the only cause and structural remedies to deconcentrate the market are not the only solution. The market can adopt a non-co-operative equilibrium in which profits can only be increased by co-ordinating behaviour.   Stable co-operation

[487] Ibid 596

[488] Joe Bain, 'Relation of Profit Rate to Industry Concentration, American Manufacturing" 1936-1940' (1951) 65 Q J Econ 293

[489] H Demsetz, 'Two Systems of Belief About Monopoly' in H Goldschmid, H Mann and J Weston (eds), *Industrial Concentration: The New Learning* (Little Brown 1974)

[490] Barry Hawk and Giorgio Motta, 'Oligopolies and Collective Dominance: A Solution in Search of a Problem' Treviso Conference on Antitrust Between EC Law and National Law, Eighth Edition; Fordham Law Legal Studies Research Paper No. 1301693. Available at SSRN: http://ssrn.com/abstract=1301693,61

[491] The Cournot model describes an industry structure where companies making homogeneous products who have market power to affect the price of goods compete on output and do not collude.

[492] Gunnar Niels, 'Collective dominance: more than just oligopolisitic interdependence' (2001) 22 ECLR 168, 172

may occur if it is more profitable than cheating which depends on the extent and nature of available market information.[493]

The theory of oligopolistic interdependence is not without its critics who challenge the central proposition that oligopolies can earn supra-competitive profits without explicitly colluding. The theory of oligopoly relies on a simplistic picture of markets which in reality are more varied and complex with different costs, goods, levels of barrier to entry so markets differ considerably and make it difficult to have one theory for them all. Oligopolies are not as interdependent as theory claims, for example one firm may benefit from cutting prices and there can be intense competition in some oligopolistic markets if not for price then for quality, after sales and other aspects. Further, the oligopolistic structure might result from efficiencies and be subject to competitive pressures. If supra-competitive profits are achieved new firms will enter and barriers may be illusionary.

Game theory has attempted to provide a reference model to describe the rational behaviour of undertakings in an oligopolistic market. Rather than merely identifying structural conditions the impact of certain aspects are examined including whether they allow repeated interaction between oligopolists; create barriers to entry; encourage mutually acceptable market equilibrium; facilitate monitoring and detection of cheating and allow for immediate effective retaliation. Barriers to entry, which are particularly relevant when there is a lack of interoperability, are considered to be a particularly significant factor supporting collusion.

Undertakings in the 3D CAD industry appear to be a tight oligopoly, indeed they could be said to be a perfect oligopoly with a tight market structure and with each undertaking enjoying a significant market share.[494]

A tight oligopoly is said to have two essential features:

[493] Ibid 171

[494] Craig Callery 'Considering the oligopoly problem' (2011) 32 ECLR 143, 146

- Some factors that makes for easy price comparison and alignment, such as a small number of sellers, homogeneous products, high market transparency. Members of the oligopoly can monitor each other and coordinate actions including responding if one of them lowers their prices. The 3D CAD industry has "very complex pricing"[495] but the numbers of suppliers is very small and with similar products.[496]

- Some factors, such as high barriers to entry or lack of buyer market power, which allow prices to be raised without risk of losing market share.[497] A lack of interoperable interfaces would certainly increase barriers to entry and lock-in can reduce the buyer's bargaining position.

5.7 Competition Law Enforcement of Oligopolies

The legal tools that are potentially available to address subcompetitive performance in oligopolies are Article 101 and Article 102 for agreements, concerted practice or collective dominance; the European Union Merger Regulations[498] and regulatory procedures such as market investigation.[499]

The appropriate legal tool depends on whether the oligopoly problem is seen as structural or behavioural. If it is accepted that oligopolies are always bad leading to inevitable non-collusive price parallelism then a structural approach would be the sensible solution. The Merger Regulations are a tool to prevent the formation of oligopolies and Article 7 of Regulation 1/2003 gives a structural remedy on breach of Article 101 or 102. There is a potential structural solution in the market investigation regime on a national basis such as under the Enterprise Act 2002, or by the Commission under Regulation 1/2003, Article 17

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[495] Interview with senior industry executive #3 (May 2014)

[496] Interview with senior industry executive #4 (July 2013) – there was only about a 10% difference in the various 3D CAD modules.

[497] Giorgio Monti, 'The Scope of Collective Dominance under Articles 82 EC' (2001) 38 Common Market Law Review 131, 135

[498] Council Regulation (EC) No 139/2004 of 20 January 2004 on the control of concentrations between undertakings OJ L 24/1 (Merger Regulation)

[499] In the UK, market investigations can be brought under the Enterprise Act 2002

but investigations and structural remedies are rare and only used in exceptional cases. They have the benefit of a less prosecutorial process recognising that the market may have arrived at a 'bad' equilibrium rather than necessarily finding wrong doing.[500] A regulatory approach, which attempts to control prices or impose practices, is a counsel of despair and last resort, and the State could look at barriers to entry and ensure they are not themselves the cause through restrictive licensing, regulation or legislation.[501]

Article 101 and 102 are primarily concerned with behaviour and do not assume that oligopolies are intrinsically harmful. Article 101 will be considered first as it would outlaw cartel behaviour such as agreements not to disclose interface information. Its role in regulating the disclosure of interface information is important but more straightforward. The role of the merger regulations will then be considered as it has already been used pre-merger to protect interoperability post-merger and it has been important in developing the law on collective dominance. The merger regulations are only available for a concentration, while Article 102 should provide a remedy to distorted existing markets. For this reason it will be discussed at more length even though its role in regulating oligopolies is undeveloped and the rules incoherent which hinders its purpose.

5.7.1 Article 101 TFEU

An agreement or concerted practice between oligopolists to restrict interoperability will be caught by Article 101 and will be void and unlawful, unless it comes within Article 101(3). An agreement or concerted practice by undertakings to withhold software interface information from customers, or from each other, could have the purpose or effect of restricting competition by directly or indirectly fixing trading conditions, or limiting or controlling markets or technical development and be contrary to Article 101 (1).[502]

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[500] Barry Hawk and Giorgio Motta, 'Oligopolies and Collective Dominance: A Solution in Search of a Problem' Treviso Conference on Antitrust Between EC Law and National Law, Eighth Edition; Fordham Law Legal Studies Research Paper No. 1301693. Available at SSRN: http://ssrn.com/abstract=1301693, 66

[501] Richard Whish and David Bailey, *Competition Law* (8th edn, Oxford University Press 2015), 602

[502] Commission Decision in *Microsoft, para 782,* where the Commission concluded that the refusal to supply interface information stifled innovation and diminished consumer choice by locking them into the

While such an agreement could be unlawful it is difficult to distinguish between concerted practice and behaviour which appears parallel but is not coordinated. Certain market structures allow for coordination which is to the disadvantage of customers and consumers but that does not amount to an agreement or concerted practice. This has been described by economists as ‘tacit collusion’ but for lawyers, collusion connotes the concept of concerted practice and even conspiracy. An alternative expression is ‘conscious parallelism’ or ‘tacit coordination’. [503] Parallel behaviour may not of itself be identified with a concerted practice[504] but competition in an oligopolistic market might be muted as firms react to one another’s behaviour and for this reason:

> ..although parallel behaviour may not of itself be identified with a concerted practice, it may however amount to strong evidence of such a practice if it leads to conditions of competition which do not respond to the normal conditions of the market, having regard to the nature of the products, the size and number of undertakings and the volume of the said market.[505]

There may be situations where firms take into account their rival’s likely responses but an intelligent response to competitor’s behaviour or ‘barometric price leadership’ in an oligopoly may not amount to a concerted practice.[506] While competitors are not entitled to coordinate their behaviour the Commission has the burden to prove a concerted practice which can be difficult when the evidence is limited solely to behaviour in the market rather than contact or other concertation. The oligopolistic tendencies of a particular market

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homogeneous Microsoft solution which was in particular inconsistent with Article 102 (b) TFEU - limiting production, markets or technical development to the prejudice of consumers

[503] Lawyers are uncomfortable with the terminology ‘tacit collusion’ as collusion implies some form of conspiracy which should be caught by Article 101(1) and if not worthy of punishment should not then be caught by Article 102. An alternative expression of tacit coordination has been suggested as avoiding the pejorative phrase collusion and ‘coordinated effects’ are already part of the vocabulary of merger controls. Richard Whish and David Bailey, *Competition Law* (8th edn, Oxford University Press 2015), 597

[504] 48/69 *ICI v Commission (Dyestuffs)* [1972] ECR 619

[505] Ibid para 65 and 66

[506] 172/80 *Zucher v Bayerische Vereinsbank AG* [1981] ECR 2021

could justify legitimate price parallelism[507] but in appropriate cases parallelism could be evidence of a concerted practice where there is no plausible alternative explanation.[508] Where competition in an oligopolistic market is already restricted the firms should be vigilant to ensure that behaviour such as price leadership does not restrict any competition that does exist.[509]

The concern that oligopolies create an environment in which cartels can succeed without apparently leaving evidence of an agreement or concerted practice is known as the "unproved cartel gap". There is however doubt the gap is significant and could be narrowing. Cartels need organising which creates a likelihood of evidence of agreement[510] and leniency programmes have increased detection and instability of cartels. It is questioned whether any significant cartel gap exists to justify intervention, "at least through ill-fitting and inchoate doctrines such as collective dominance".[511]

In the absence of a concerted practice, or an agreement, to maintain low levels of interoperability, Article 101 does not have a role to play in ensuring competition in the oligopolistic 3D CAD industry.

5.7.2 Merger Regulations

Prior to 2004 there was a perceived gap in the Merger Regulation 2004 of non-collusive oligopolies. In *Airtours/FirstChoice*[512] the Commission considered the three firms remaining

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[507] Lorna McGregor 'The future for the control of oligopolies following Compagnie Maritime Belge' (2001) 22 ECLR 434, 435

[508] Cases C-89 104,114,116-17, and 125-9/85 *Re Wood Pulp Cartel:Ahlstrom Oy v. Commission (Wood Pulp II)* [1993] ECR I-1307[1993] 4 CMLR 407

[509] L 76/1 *British Sugar* OJ [1999] 4 CMLR 1316

[510] M Levenstein and V Suslow, 'What Determines Cartel Success?' (March 2006) 54 Journal of Economic Literature

[511] Barry Hawk and Giorgio Motta, 'Oligopolies and Collective Dominance: A Solution in Search of a Problem' Treviso Conference on Antitrust Between EC Law and National Law, Eighth Edition; Fordham Law Legal Studies Research Paper No. 1301693. Available at SSRN: http://ssrn.com/abstract=1301693,74

[512] *Airtours/First Choice* (Case IV/M.1524) Commission Decision [2000] OJ 93/1

on the market after the merger could act as a tight oligopoly to unilaterally exercise market power without any need to act in a coordinated manner.[513] The General Court annulled the Commission's decision adopting an approach that associated collective dominance with coordinated effects. The undertakings might be able to exercise more market power on an individual basis because of the increased concentration in an oligopolistic market but it did not create a single dominant entity.

Proposals for reform looked at the UK test of whether the merger will 'substantially lessen competition'[514] but the dominance concept was well established in EU law and had generally worked well. The Merger Regulations addressed the gap by amending Articles 2(2) and 2(3) so that the test is now whether a merger would lead to an Significant Impediment to Effective Competition (SIEC), *in particular* by creating or strengthening a *dominant position* (emphasis added) rather than whether the merger would create or strengthen a dominant position thereby leading to an SIEC. In this way the pre-eminence of the dominance test remains intact, giving continuity, while allowing the Commission to prohibit or require modifications of mergers that 'significantly impede effective competition' without creating a dominant entity. Recital 25 of the Merger Regulations confirm that the amendment is intended to apply to an oligopolistic market and extend beyond the concept of dominance, where the anti-competitive effects of a concentration result from the non-coordinated behaviour of undertakings. This has improved the quality and predictability of decision making by the Commission.[515]

The Merger Guidelines have identified two ways in which mergers can significantly impede effective competition by creating or strengthening a collective dominant position. [516] Firstly, non-coordinated effects where competitive constraints are removed to give

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[513] Richard Whish and David Bailey, *Competition Law* (8th edn, Oxford University Press 2015), 907

[514] Enterprise Act 2002 see also OFT Merger Assessment Guidelines CC2 Revised (1254) September 2010

[515] Ioannis Kokkoris *Merger Control in Europe*(2011 Routledge) 264

[516] Guidelines on the assessment of horizontal mergers under the Council Regulation on the control of concentrations between undertakings [2004] OJ C 31/3, para 24 (Merger Guidelines)

increased market power. This normally applies to a single entity which gains a larger market share post-merger but can also apply to oligopolistic markets where despite the reduction in competition there is little likelihood of coordination.[517] Secondly, parallel and coordinated behaviour, which requires a certain level of transparency in the market to enable the firms to know what others are doing in respect of price and output. The transparency allows the firms to monitor the behaviour of others to notice any deviation and impose some form of sanction such as a price war. To be sustainable it must not be susceptible to pressure from competitors, customers and consumers.[518]

The Merger Guidelines list non-exhaustive and non-cumulative factors relevant to a determination of whether non-coordinated effects might occur. The factors particularly relevant to an oligopoly characterised by a lack of interoperability include the degree of substitutability between the products of the merging firms and those supplied by rival producers. This includes where customers of the merging parties have difficulties switching to other suppliers because of substantial switching costs as these customers are particularly vulnerable to price increases. Of particular relevance are the comments concerning interoperability between different infrastructures or platforms, such as telecommunications and other communications industries,[519] as this can give the merged entity the ability and incentive to raise the costs or decrease the quality of service of its rivals.[520]

Recent merger cases have seen the Commission recognise that a lack of interoperability has an adverse effect on competition. Cisco's acquisition of Tandberg[521] and the acquisition of

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[517] Ibid para 24 & 25

[518] Ibid para 41 and see Case T-342/99 *Airtours Plc v Commission* [2002] ECR II-2585 CFI The three points appear in the General Court's judgment (i) firms must be able to monitor others (ii) credible deterrent mechanism to maintain stability (iii) no outside constraints to destabilise or jeopardise expected results.

[519] Ibid (Merger Guidelines) para 36 and footnote 50

[520] Merger Guidelines, paras 28 - 36

[521] Case COMP/M.5669, *Cisco Systems, Inc. And Tandberg ASA.,* [2010] OJ L-2985 and see section 5.4.4

the security software vendor McAfee by Intel, discussed above,[522] have seen Commission decisions and commitments to ensure an acceptable level of interoperability post merger.

The acquisition by Siemens of UGS Limited in 2007 was declared compatible by the Commission.[523] Interoperability was considered by the Commission but the focus was on the interoperability of automation and control products (A&C) as this was a market that Siemens and UGS were both active in before the acquisition. Only UGS was active in the PLM and 3D CAD market.[524] The software market was defined as the PLM software market of which UGS' market share for PLM and CAD was assessed at 10 -20% with Dassault Systems the only named competitor for CAD software.

Interoperability featured several times in the decision with the Commission noting that Siemens proposed a new product that would have an open interface with some A&C solutions from both Siemens and some of its competitors. The focus was on interoperability of A&C solutions as the area with some overlap in activity by Siemens and UGS. Open standardised interfaces appear to be common feature of the A&C industry with organisations such as the OPC Foundation (www.opcfoundation.org). There were concerns that a focus on solutions that fully integrated PLM and A&C would create the incentive and ability for Siemens to drive the standard-setting process favouring its own products.[525] One competitor raised the concern that proprietary data interfaces between both PLM and A&C solutions would close the market to participants on either side. A few customers were concerned they would become locked-in to the merging parties' products as a switch to alternative suppliers would involve high integration and transaction costs. Some competitors also feared that they would be prevented from effectively addressing the converging PLM and A&C markets in the future. In response the Commission noted that

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[522] See Section 5.4.4

[523] *Siemens/UGS Corporation* (COMP M.4608) Commission Decision of non-opposition to notified concentration [2007] OJ C 113/03

[524] Ibid para 20

[525] Ibid para 28

Siemens and UGS had been promoting and developing open and standardised interfaces to facilitate data exchange between PLM & A&C products from different vendors. There would also be pressure from customers to keep interfaces open as while entirely new installations of PLM or automation products are uncommon customers prefer to 'cherry-pick' the best product for their needs and they often have a multiple source policy. There would be an incentive to move away from the stated present approach of 'open and standard' as this would involve re-engineering product interfaces to proprietary interfaces with consequent time and investment which would not suit the customers' purchasing patterns and could put Siemens at a disadvantage. Also the combined market share of the merging parties for the converging product market, PLM & A&C, was not large and did not make credible the foreclosure claims on either side of the PLM or A&C market.[526]

The considerations of interoperability focused on the relationship between PLM and A&C as this was a developing trend and both Siemens and UGS were active in this area to some extent. There appears to be an existing level of openness and standardisation in the A&C interfaces. What was not considered was the interoperability of PLM itself or its constituent parts such as 3D CAD. In this way the Merger Regulations played a limited ex ante role to promote open interface information but did not address wider competition law issues. There was no consideration of the closed nature of the 3D CAD industry with only 2 kernels and 2 competitors in the high end software – UGS and Dassault Systems. While the Commission did consider possible consequences of integration of PLM and A&C solutions it did not consider what impact acquisition by Siemens could have on the constituent distinct product market. As Siemens was not active in this market this was not considered necessary. To some extent the Commission's decision left the status quo unaltered although it has helped Siemens have the ability to sell a production line and 'give away the 3D CAD software'.[527] This gives Siemens a further advantage to attract and then lock customers into its 3D CAD software.

[526] Ibid para 29

[527] Interview with senior industry executive #3 (May 2014)

The Commission did not require increased openness when Siemens entered the 3D CAD market. The decisions in the Cisco merger and the Intel and McAfee merger illustrate however that competition law can provide an ex ante solution rather than an ex post remedy by acting to ensure disclosure of interface information and promote interoperability. The Merger Regulations are considering circumstances that are structural and foreseeable and are suitable for an ex ante approach. They are even able to consider mergers on a case-by-case basis which appears to give the optimal approach – the best of all worlds. The Merger Regulations can promote interoperability where IPRs or other aspects of competition law fail to do so. The 3D CAD industry could be looked at both for coordinated and non-coordinated behaviour but in the absence of a merger, acquisition or other concentration they do not provide an immediate remedy. The Merger Regulations may have a role in preventing future exploitation of a lack of interoperability or closing of markets but will not provide a remedy to existing closed proprietary interfaces.

5.7.3 Article 102 TFEU

Article 102 is concerned with undertakings that have substantial market power which allows them to act to an appreciable extent independently of competitors, customers and consumers.[528] This will allow them to have power over price or other factors such as quality, service, and innovation. A second form of market power is the "power to exclude" with behaviour such as loyalty rebates, refusal to supply and predatory pricing.[529] Article 102 is considered to be an important last resort to prevent the worst excesses of a lack of interoperability but is only available where there is dominance. In an oligopolistic market collective dominance is needed which has been a very difficult concept to establish.

The law that has developed to determine the concept of collective dominance has been applied both to existing oligopolies and to mergers but there are inherent differences between the two as oligopolies are unpredictable, "anything can happen"[530] and regulation

[528] 27/76 *United Brands v Commission* [1978] ECR 207, para 65

[529] Damien Geradin and others, 'The Concept of Dominance in EC Competition Law' [2005] Global Competition Law Centre, Research Paper on the Modernisation of Article 82 EC, 6

[530] Craig Callery 'Considering the oligopoly problem' (2011) 32 ECLR 142, 142

is ex post whereas mergers are assessed ex ante but are predictable "tangible" events.[531] The scrutiny of ex post conduct, under Article 102, has been problematic and the cases and resultant judicial policy is perplexing and still requires development.[532] What has emerged is said to be a three part test, where before the question of dominance and abuse are addressed, an assessment must be made as to whether the undertakings constitute a collective entity vis-a-vis their competitors, trading partners and consumers?[533] Before the questions of dominance and abuse are addressed it is necessary to establish whether the undertakings are a collective entity. This means whether they present themselves on the market as a single entity. Perhaps the most important factor is whether they have a common marketing strategy. This however is not particularly helpful to industries characterised by a lack of interoperability and lock-in as the effect of any common policy on interface information would be to compartmentalise the market rather than make it common and homogenous.

To amount to a collective entity they must, from an economic point of view "present themselves or act together on a particular market as a collective entity."[534] There must also be sufficient transparency to enable entities to monitor each other's behaviour, a threat of retaliation for deviation and to be sustainable it must not be susceptible to pressure from competitors, customers and consumers.[535] The various judgements have spoken of "economic links" which could be an agreement, however legal links have been

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[531] Lorna McGregor, 'The future for the control of oligopolies following Compagnie Maritime Belge' (2001) 22 ECLR 434, 438

[532] Craig Callery 'Considering the oligopoly problem' (2011) 32 ECLR 142, 143

[533] Barry Hawk and Giorgio Motta, 'Oligopolies and Collective Dominance: A Solution in Search of a Problem' Treviso Conference on Antitrust Between EC Law and National Law, Eighth Edition; Fordham Law Legal Studies Research Paper No. 1301693. Available at SSRN: http://ssrn.com/abstract=1301693, 76

[534] Cases C-259 & 396/96 P *Compagnie Maritime Belge Transports and Others v Commission (CEWAL II)* [2000] ECR I-1365, para 36

[535] Case T-342/99 *Airtours Plc v Commission* [2002] ECR II-2585 CFI The three points appear in the General Court's judgment (i) firms must be able to monitor others (ii) credible deterrent mechanism to maintain stability (iii) no outside constraints to destabilise or jeopardise expected results.

said not to be indispensable to a finding of a collective entity.[536] There has been debate as to whether the links that exist in a tight oligopoly could amount to economic links, however in the only cases that have been successfully brought under Article102, in which the undertakings were held to be abusing a collective dominant position, all had an existing legal agreement. They mainly concern liner conferences where Article 102 was used because a block exemption made a case under Article101 uncertain.

We certainly should not condemn all oligopolistic interdependence as this would be tantamount to condemning oligopolies per se. Many oligopolies are naturally drawn to align their conduct because of market conditions. The Court has approved of behaviour that allows undertakings to "adapt themselves intelligently to the existing and anticipated conduct of competitors."[537] There is a line to draw between tacit collusion and mere innocent parallel conduct on one hand and between tacit collusion and a concerted practice which is caught by Article 101(1). To use interdependence as a link risks censuring the innocent. The ECMR has permitted a finding of tacit collusion as leading to collective dominance and *Piau*[538] seems to say the same criteria will apply to Article 102 cases.

The 3D CAD industry has no known legal links between undertakings although there are licences of the software kernels.[539] The absence of legal links means that, based on past decisions, Article 102 is not a viable means of regulating anti-competitive behaviour such as the refusal to supply interface information. The criteria to determine collective dominance is not settled. The importance and nature of economic links is uncertain and the case law in general is undeveloped. To evaluate whether Article 102 could provide a remedy to abuse in the 3D CAD industry the background to collective dominance will be explored to see

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[536] Ibid 45

[537] 40/73 *Cooperatieve Vereniging Suiker Unie UA v Commission* [1975] ECR 1663; [1976] 1 CMLR 295, 174

[538] T-193/02 *Laurent Piau v Commission*[2005] ECR II-209

[539] The 3D CAD Software suppliers licence certain software to each other, most notable the software kernels. This appears to be done at arms-length, see section 4.8.5

whether it can provide a remedy to achieve the correct balance between openness and control in the 3D CAD software industry.

5.7.3.1 Economic Links

The General Court confirmed the principle of collective dominance in its judgment in the case known as *Italian Flat Glass* that:

> There is nothing in principle, to prevent two or more independent economic entities from being, on a specific market, united by such economic links that, by virtue of that fact, together they hold a dominant position vis-á-vis the other operators on the same market.[540]

In the *Italian Flat Glass* case the General Court countered the position taken in *Hoffman-La Roche* that dominance is applicable only to independent undertakings and that a dominant position must be distinguished from parallel courses of conduct which are peculiar to oligopolies.[541] The Court did however consider Article 101 and 102 conceptually independent of one another and overruled the Commission for merely 'recycling the facts' from Article 101 to Article 102. The judgement did not expand on what behaviour might be required, or the concept 'economic links' but left this to subsequent cases.[542]

The next cases to come before the European Courts concerned 'liner conferences' where agreements existed.[543] The cases contained material abuses of Article 101 which detracted

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[540] Joined Cases T-68/89 & T-78/89 *Societa Italiana Vetro SpA v Commission* [1992] ECRII-1403, para 358

[541] 85/76 *Hoffmann-La Roche & Co AG v Commission* [1979] ECR 461, para 39

[542] The Court did however give an example of what are really legal links "..agreements or licences, a technological lead affording them the power to behave to an a appreciable extent independently of their competitor, the customer and ultimately of their consumers." *Societa Italiana Vetro SpA v Commission,* para 358

[543] *French-West African Shipowners' Committees decision* OJ [1992] L 134/1 [1993] 5 CMLR 446; T-191/98 *Atlantic Container Line v Commission*[2003] ECR II-3275, [2005] CMLR 1283

from the understanding as to how Article 102 should operate.[544] The conduct in both cases amounted to "overt collusion" with an explicit agreement.[545]

One important point to come out of one of the liner conference cases, *TACA,* was that for the purposes of establishing the existence of a dominant position, it is not required that no competition exists between the undertakings. This raises the possibility that oligopolies which compete on price could be caught for aligning other policies.[546] This would allow enforcement proceedings to be brought where there is alignment on interface information even though price competition exists. However given the conservative approach adopted by the Commission it is conceivable that any enforcement under Article 102 will be prioritised to focus on markets where there is a lack of effective competition on a large range of parameters.[547] The issue of supplier lock-in is unlikely to be high priority for competition law enforcement save in cases that rival the *Microsoft* case for prominence and widespread impact.

There has been much debate about the nature of 'economic links' and the term remains ill-defined. One model suggests the links can take the form of "links in law" which include the 'liner conference' agreements seen in *TACA* and *CEWAL* as well as structural links such as cross shareholdings in the *Irish Sugar*[548] case. These economic links involve overt collusion allowing firms to substitute coordination for competition. The cases where there was some form of agreement also involved possible infringements of Article 101 but as the agreement could benefit from a form of block exemption the Commission's decision has also included infringement of Article 102.

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[544] Craig Callery "Considering the oligopoly problem" (2011) 32 ECLR 142, 145

[545] Felix Mezzanotte, 'Tacit collusion as economic links in article 82 EC revisited' (2009) 30 ECLR 137,139

[546] Craig Callery 'Considering the oligopoly problem' (2011) 32 ECLR 142, 145

[547] Damien Geradin and others, 'The Concept of Dominance in EC Competition Law' [2005] Global Competition Law Centre, Research Paper on the Modernisation of Article 82 EC, 31

[548] T-228/97 *Irish Sugar plc v Commission*[1999] ECR II-2969

In the merger case of *Gencor* brought under the ECMR, the Court, after referring to *Flat Glass* asserted that '[T]here is no reason whatsoever in legal or economic terms to exclude from the notion of economic links the relationship of interdependence existing between the parties to a tight oligopoly.'[549] In *Gencor* the General Court implied that links of oligopolistic interdependence may be sufficient to establish joint dominance, at least, under the merger regulations, as well as the links of ownership or agreement.[550] The decision by the General Court in *Gencor* indicated a more interventionist approach to oligopolies[551] and was tacitly[552] endorsed by the CJEU in *Compagnie Maritime Belge.* [553] *Piau* also supports the approach that tacit collusion or interdependence can apply under Article102 as well as the ECMR.[554] But it must be difficult to distinguish undertakings which have aligned conduct due to market conditions rather than silent coordination. It is a fine line and certainly not yet a bright-line distinction and there is a risk the approach creates uncertainty and censures the innocent.[555]

5.7.3.2 Compagnie Maritime and Other Criteria

In the Article 102 case of *Compagnie Maritime*, where the case before the CJEU was also known as *CEWAL II,* the CJEU suggested a broader interpretation of economic links, beyond the need for links in law. 'The existence of an agreement or of other links in law is not indispensable to the finding of a collective dominant position; such a finding may be based

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[549] T-102/96 *Gencor v Commission*[1999] ECR II-753, [1999] 4 C.M.L.R. 971, paras 273 - 276,

[550] Ibid paras 273 to 276; Valentive Korah, 'Gencor v Commission: collective dominance' (1999) 20 ECLR 337

[551] Albertina Albors-Llorens, 'Collective Dominance: a mechanism for the control of oligopolistic markets?' (2000) 59 Cambridge Law Journal 253, 257

[552] Steven Preece, 'Compagnie Maritime Belge: missing the boat?' (2000) 21 ECLR 388, 389 the CJEU did not explicitly refer to the CFI's judgement in Gencor,

[553] C-395/96 Compaigne Maritime Belge Transports SA v Commission [2000] ECR I-1365 (*CEWAL II);* Albors-Llorens, 'Collective Dominance: a mechanism for the control of oligopolistic markets?' (2000) 59 Cambridge Law Journal 253

[554] T-193/02 *Laurent Piau v Commission*[2005] ECR II-209, para 111

[555] Craig Callery 'Considering the oligopoly problem' (2011) 32 ECLR 142, 147

on other connecting factors and would depend on an economic assessment and, in particular, on an assessment of the structure of the market in question.'[556] This has been interpreted as amounting to tacit collusion by independent actions and without communicating with each other.[557] Tacit collusion exists where the market enables firms to coordinate their behaviour without entering an agreement or concerted practice in the sense of Article 101(1). Such behaviour advantages them at the expense of their customers and consumers. It is not defined by the conduct itself, which could take various forms. It is defined by the structure of the market which allows the behaviour to have a particular relevance and consequence.

An alternative interpretation is of parallel conduct but without tacit collusion necessarily explaining the parallelism.[558] Another label placed on the conduct is 'oligopolistic interdependence'. They both amount to analogous conduct of undertakings but without communication. Any attempt to distinguish interdependence behaviour which included communication would probably bring us into the realm of Article 101(1), rather than collective dominance.

In *Compagnie* the Court having introduced the possibility that links in law are indispensable spoke of an economic assessment and that a dominant position may be held by two or more economic entities legally independent of each other, 'provided that from an economic point of view they present themselves or act together on a particular market as a collective entity'[559]… 'vis-a-vis their competitors, their trading partners and consumers'[560] This concept of presentation on the market as a single collective entity is arguably now the most

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[556] *CEWAL II, para 45*

[557] Felix Mezzanotte, 'Tacit collusion as economic links in article 82 EC revisited' (2009) 30 ECLR 137, 139

[558] Steven Preece, 'Compagnie Maritime Belge: missing the boat?' (2000) 21 ECLR 388

[559] *CEWAL II,* para *36*

[560] *CEWAL II, para 39*

predominant criterion or approach to establish a collective dominance, rather than the more troublesome concept of links.[561]

The CJEU spoke of a three stage test as it is only where the first question of collective entity is answered in the affirmative that it is appropriate to consider whether that collective entity actually holds a dominant position and whether its conduct constitutes abuse.[562] The economic links or factors are examined for the purpose of establishing the existence of the collective entity as defined above. Do the economic links between the undertakings enable them to act together independently of their competitors, customers and consumers?[563] This looks at the results of, rather than the nature of the links, an approach taken by Advocate General Fennelly in *Compagnie* [564] which is an effects based approach to collective dominance.[565]

In *Compagnie* the Court did not clarify the extent to which competition in any form could exist within collective dominance. Advocate General Fennelly considered that competition could exist based on parameters such as quality of service[566] and the Commission considered that the existence of a "possible degree of competition between the parties"[567] does not rule out the finding of a collective dominance.[568] Undertakings may, for example, act as a single unit on price while competing on other factors, such as quality. While some

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[561] Barry Hawk and Giorgio Motta, 'Oligopolies and Collective Dominance: A Solution in Search of a Problem' Treviso Conference on Antitrust Between EC Law and National Law, Eighth Edition; Fordham Law Legal Studies Research Paper No. 1301693. Available at SSRN: http://ssrn.com/abstract=1301693, 76

[562] Ibid 39

[563] Ibid 42

[564] AG Fennelly opinion para 28

[565] Giorgio Monti, 'The Scope of Collective Dominance under Articles 82 EC' (2001) 38 Common Market Law Review 131, 131 - 133

[566] *CEWAL II, 34*

[567] *Transatlantic Conference Agreement Decision (TACA)* OJ 1999, L 95/93, point 522

[568] Steven Preece, 'Compagnie Maritime Belge: missing the boat?' (2000) 21 ECLR 388, 390

competition may not be fatal to the test it is unclear whether tacit collusion such as withholding of interface information could satisfy the test, even if its impact was aggravated by lock-in or network effects, if there was a degree of competition on price.

There is no one model of an oligopolistic market. Undertakings in an oligopoly may have different cost levels, their products will have some differentiation, there may be some customer loyalty and market shares may not be exactly equal.[569] The ruling in *Compagnie* did not clarify the position for oligopolies falling short of the model oligopoly.[570]

The following catalogue of market factors which contribute to conscious parallelism were adapted from the CJEU ruling in Compagnie and the writings of Patrick Ryan.[571] The general factors are set out in bold followed by the specific relevance to the 3D CAD industry:

Limited Competition - f**ew competitors control the market for a given product.** There are four main suppliers of 3D CAD and only two or arguably three in the high-end market.

Similar Products - products are homogenous or readily interchangeable. The 3D CAD products are homogeneous. One commentator suggested there was only a 10% difference in the systems.[572] They are not however interchangeable. The nature of interoperability is that even similar products are not interchangeable. There is ambiguity as to whether the suggested criteria requires products to be homogenous *or* readily interchangeable, or *and* interchangeable. Interchangeable may be used in the sense of substitutable i.e. similar or substitutable. In any event a lack of interoperability in the 3D CAD market means that products which are similar cannot be interchanged or substituted. It would be ironic if this feature which is central to any conscious parallelism prevents them from being considered collectively dominant.

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[569] Richard Whish, *Competition Law* (8th edn, Butterworth 2015), 595-6

[570] Lorna McGregor 'The future for the control of oligopolies following Compagnie Maritime Belge' (2001) 22 ECLR 434, 436

[571] Patrick Ryan, 'European Competition Law, Joint Dominance, and the Wireless Oligopoly Problem' (2004-2005) 11 Columbia Journal of European Law 355

[572] Interview with senior industry executive #4 (July 2013)

Competitive Price Structures – due to the pricing structure of the market, competing companies are almost immediately sensitive to price changes. Pricing in the industry is very complex and particularly in the high-end market will be tailored to the customers' requirements using "value pricing".[573] Although suppliers have similar 3D CAD products there is a distinction in marketing approach and other products and value they can supply. Pricing is not transparent and there will be a delay in responding to a price change. In any event lack of interoperability will hinder customers changing unless there was a drastic price cut.

Comparable Production Costs - the production costs of the participants are similar as there are few raw materials or other tangibles involved. The main costs are wages, marketing and establishment costs. All the suppliers are based in America or Europe with international offices. They certainly have the opportunity to have similar costs.

Long- Standing Associations – The lack of interoperability means customers are locked-in to suppliers and the market is characterised by long-term relationships between user and supplier. There have also been long standing associations within the industry such as the cross-licensing of the kernels and the marketing arrangement between Dassault Systemes and IBM.

Sufficient Market Share – the market is well established and firms are satisfied with their current market share. This is difficult to assess. The suppliers have an obligation to their shareholders to maximise profits which normally is an incentive to increase market share unless higher profits can be achieved by coordination. The technical challenges of interoperability may however make it difficult to gain new customers even in the absence of coordination. Switching to new suppliers is uncommon in the industry.[574] Suppliers may accept the current market share in 3D CAD and look to other products in the PLM range where there is more interoperability and they can compete more easily for market share. Lack of interoperability in the 3D CAD products means there are high barriers to entry so

[573] Interview with senior industry executive #3 (May 2014) The high-end 3D CAD market does not have transparent pricing. It would be easier to follow the pricing in the mid-range which uses price lists but discounts would obscure the picture, see *Airtours.*

[574] Case COMP/M.4608, Siemens AG and UGS Capital Corp. Celex No 307M4608, para 28

entry to the market is difficult. There have recently been some changes in major OEMs switching providers including Daimler.[575]

The 3D CAD market meets all but two of the criteria namely transparent pricing and interchangeable products. The failure to offer interchangeable products is caused by the lack of interoperability which could be caused by conscious parallelism.

5.7.3.3 Airtours & Impala

Following the judgement in *Compagnie* it is recognised that a threefold test exists to establish abuse of collective dominance, namely: first establish collective entity and then dominance and then the abuse. The Commission decisions on collective dominance under Article 102 had a predominantly static analytical approach based on market structure, but Article 102 is designed to handle 'conduct related retrospective' abusive *behaviour.*[576] In merger proceedings the Commission considered more dynamic, prospective structure related criteria including cheating incentives and the possibility of retaliation when determining the stability of any collusion. In the important judgement of *Airtours*[577] a forward looking analytical approach was displayed and attention paid to the economic rationality of tacit co-operation and whether the conditions existed for its lasting sustainability.[578] Examination of cheating incentives, monitoring of deterrence and sanctioning any deviation from a common policy indicates a trend towards a conduct-related analytical approach.[579] When *Airtours* came before the ECMR a further threefold test was introduced to determine the first part of the *Compagnie* test, namely whether the undertakings are a "collective entity".

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[575] See section 4.8.2

[576] Heiko Haupt, 'Collective dominance under Article 82 E.C. and E.C. merger control in the light of the Airtours judgment' (2002) 23 ECLR 434, 437

[577] Case T-342/99 Airtours v Commission [2002] ECR II-2585

[578] Heiko Haupt, 'Collective dominance under Article 82 E.C. and E.C. merger control in the light of the Airtours judgment' (2002) 23 ECLR 434, 444

[579] Ibid 444

The three elements of the *Airtours* test:

- The market must be sufficiently transparent for the undertakings which co-ordinate their conduct to be able to monitor sufficiently whether the rules of co-ordination are being observed.
- There must be a form of deterrent mechanism in the event of deviant conduct
- The restrictions on current and future competitors and the reactions of customers should not be able to jeopardise the results expected from the co-ordination.[580]

The *Airtours* criteria have been adopted in the Guidelines on Horizontal Mergers to determine whether the coordination could be sustainable. [581] The word transparency replaced by the need to "monitor to a sufficient degree whether the terms of coordination are being adhered to".[582] This combined with the credible deterrent mechanism and the inability of customers to jeopardise the results are considered necessary if the coordination is to last long enough to have a significant impact on competition in the market.[583]

Economic theory is that cartels are unstable and liable to defections without the risks of retaliation. Retaliation includes the return to competition. Collusion also requires that neither competitors nor customers can jeopardise the expected results of coordination.[584] In addition to transparency the oligopoly must be relatively easy to monitor, sell homogenous goods and be stable. Transparency was particularly important in *Airtours* and while there were publically available list prices the type of discount available undermined the transparency. The CJEU also said it must be clear at what level co-ordination is

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[580] *Airtours Plc v Commission*

[581] Merger guidelines, art 41

[582] Ibid art 41

[583] *Airtours Plc v Commission* and Marilena Filippelli, 'Collective dominance in the Italian mobile telecommunications market' (2010) 31 European Competition Law Review 81, 82

[584] Marilena Filippelli, 'Collective dominance in the Italian mobile telecommunications market' (2010) 31 European Competition Law Review 81, 82

occurring and how it can be monitored.[585] Stability requires transparency and effective deterrents, such as the threat of price wars or poaching key personnel. Without transparency firms cannot decode rivals signals to behave in a certain way. For tacit collusion to occur essential data must be available from which to be able to infer all that is needed for collusion.

The high-end 3D CAD suppliers had complex pricing and the mid-range had published price lists against which they give discounts.[586] The discount information may not be publically available. In *Airtours* the discounts meant the market was not transparent. Price does not have to be the main area of coordination. Supplier's policies on disclosure of interface information may appear to be public but could be complex and uncertain. The perception of the industry is that while there is poor interoperability across the industry the suppliers appear to have a slightly different attitude. Some emphasise they can meet all of their customers' needs and give data integrity while others appear to appreciate that openness and standards can have marketing benefits, but the difference in attitude is small compared to the level of incompatibility in the industry. [587]

An absence of competitive constraints or external force which can undermine the constituent undertakings strategy will make the oligopoly stable. The present lack of interoperability means there are restrictions on competitors and customers as customers are locked-in to the software but it is difficult to predict on an individual basis the extent of the restriction. Criteria, other than transparency are not applied so strictly, for example retaliation may just take the form of uncertainty about the effect a deviation may have on profits.[588] The deterrent mechanism may be viewed as the incentive to go on with the status quo. When the equilibrium depends on a refusal to deal even a single defection

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[585] Jane Golding, 'The Impala case: a quiet conclustion but a lasting legacy' (2010) 31 European Competition Law Review 261, 265

[586] Interview with senior industry executive #3 (May 2014) and Interview with industry expert #6 (June 2014)

[587] Siemens is perceived to be more open than Dassault Systemes but the examples given are very minor in relation to the apparent problem. Industry Interviews # 1, 2, 3 & 4.

[588] Marilena Filippeli, 'Collective dominance in the Italian mobile telecommunications market' (2010) 31 European Competition Law Review 81, 83

could destroy the collusion with no going back. A downstream market could be opened up which would affect the collusive profits. These could prevent cheating without the need for menacing retaliation.[589] One supplier adopting a policy to disclose interface information or moving to an effective open standard would mean there was no going back as customers' expectations would require other suppliers to disclose interface information.

By contrast symmetry between undertakings is less crucial in a tight oligopoly.[590] Small and large firms may have different incentives and defection and retaliation depend on an increase in supply and the capacity of the firm. This favours bigger firms which normally gives them an incentive to undercut and increase output while retaliation by small firms is a weaker deterrent threat. However in a tight oligopoly with high barriers to entry bigger firms may prefer to give price leadership rather than expand. This may optimise profits for all. Asymmetry may be relevant when the competition concerns are price collusion as size and capacity are more relevant but with a joint refusal to deal, because the power does not depend on size alone, the field may be more level.[591] Prior to Siemens acquisition of USG the suppliers were of similar size. Siemens has acquired major OEM accounts but there is no evidence of any significant change in pricing or openness in the industry.[592]

The General Court in *Impala*[593] applied the *Airtours* criteria but also considered the *Airtours* criteria might:

> "be established indirectly on the basis of what may be a very *mixed series of indicia and items relating to the signs, manifestations and phenomena inherent* in the presence of a collective dominant position" and "[A] finding of *a common policy over a long period*, together with the *presence of a series of other factors*

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[589] Ibid 84

[590] Ibid 83

[591] Ibid 84

[592] Industry Interviews # 1, 3 & 4.

[593] Case - T 464/04 *Impala v Commission* [2006] ECR II-2289 (emphasis added)

characteristic of a collective dominant position, might, in certain circumstances and in the absence of an alternative explanation, suffice to demonstrate the existence of a dominant position, as opposed to the creation of such a position, *without it being necessary to positively establish market transparency*."[594]

The *Airtours* criteria were therefore considered not the only way to establish collective dominance. The essential element appears to be a common policy over a long period. Applied to Article 102 and interoperability this would mean that collective dominance could be established either by the *Airtours* three point test, which would require a transparent market, or by establishing a common policy by other means including 'indicia, signs and manifestations and other factors' which cannot otherwise be explained. The judgement in *Impala* considered there would also have to be a series of other factors characteristic of a collective dominant position which do not have an alternative explanation.[595] One common policy could be the practice of not disclosing interface information. Other factors would be prices maintained at a stable and unexplained high level, another could be stability of market share.

When the *Impala* case was appealed to the CJEU the Court applied the *Airtours* criteria but it did not criticise the alternative proposed by the General Court.[596] The CJEU also said the existence of an agreement or of other links in law are not essential to a finding of collective dominance "Such a finding may be based on other connecting factors and would depend on an economic assessment and, in particular, on an assessment of the structure of the market in question."[597]

The Court then spoke of correlative factors which allowed for the adoption of a common policy to profit from a situation of collective economic strength, without actual or potential

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[594] Ibid para 251 -254

[595] Ibid para 251 -252

[596] Alison Jones and Brenda Sufrin *UK Competition Law* (5th Ed OUP 2014) 1208

[597] Case C- 413/06 *P Bertelsmann and Sony Corporation of America v Commission "Impala"* [2008] ECR I-4951, [2008] 5 CMLR 17, para 119

competitors, customers or consumers who could react effectively.[598] The correlative factors were said to *include* parties to a tight oligopoly in a transparent, homogenous market who can anticipate and align behaviour or face retaliation[599] – effectively meet the *Airtours* test.

The CJEU appears to consider that the *Airtours* criteria are not exhaustive factors required for collective dominance. This is corroborated by the statement by the CJEU that the *Airtours* test is not *incompatible* with the criteria set out in the General Court in its judgement (the *Impala* criteria).[600] The CJEU listed examples of the conduct that could be aligned, and presumably also constituted the abuse, as increasing prices, reducing output, the choice or quality of goods and services, diminishing innovation or otherwise influencing the parameters of competition. The willingness to include a wide variety of potential abuse raises the potential to include the refusal to supply interface information. However if there are IPRs in the information, the exceptional circumstances test would also have to be satisfied before the refusal would be unlawful and a remedy available.

The CJEU then considered how the co-ordination might work. It was observed that a lack of shared *tacit* understanding of the terms of co-ordination might result in the parties resorting to tactics that would be caught by Article 101.[601] It was also considered important that the common policy was sustainable.[602] The temptation to depart from the tacit co-ordination to achieve short term profits must be countered by the ability to monitor adherence which requires a market sufficiently transparent for each undertaking to be aware, sufficiently precisely and quickly of each other and of how the co-ordination is evolving. There must also be a credible deterrent mechanism while the anticipated results

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[598] Ibid para 120

[599] Ibid para 121 [emphasis added]

[600] Ibid para 124

[601] Impala, para 123 [emphasis added]

[602] The need for the common policy to be lasting and sustainable was stated in para, 122, 123 and 126 of the Impala CJEU judgement.

of the common policy should not be jeopardised by current or future competitors or the reaction of customers. The need for sustainability could be said to equate with the need for market share to not be transient in order to achieve market power.[603]

The *Impala* criteria could be summarised as a common policy on a market due to correlative factors such as market concentration, transparency and product homogeneity, that allows conduct maximising profits to be aligned and sustained which is to a significant extent independent of their competitors, customers and consumers.[604] The CJEU considered that the criteria should not be applied in a mechanical approach and each aspect of the criteria should not be looked at in isolation. It should be carried out using the mechanism of a hypothetical tacit co-ordination as a basis.[605]

Airtours concerned proceedings under the Merger Regulations where the Commission has to predict whether a merger will result in tacit co-ordination. *Laurent Piau* confirmed that the same criteria should apply to Article 102 cases.[606] Enforcement under Article 102 is ex post and it is reasonable to expect a higher standard of proof[607] to avoid falling the wrong side of the thin line and a false positive decision. An example of this is the application of the second *Airtours* criteria where the Commission was only required to show that a *potential* retaliatory mechanism was present rather than evidence of the existence of a *specific* retaliatory mechanism.

Regardless of what has been said in *Airtours* and *Impala* it must be remembered that collective dominance was only found to exist in Article102 proceedings where there was some agreement of a contractual nature or participation in an industry association such as the liner conference arrangements. National cases have accepted the ruling in *Laurent Piau*

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[603] Ibid 123

[604] Impala, para 123

[605] Impala, para, 125 - 126

[606] T-193/02 *Laurent Piau v Commission*[2005] ECR II-209

[607] Damien Geradin and others, 'The Concept of Dominance in EC Competition Law' [2005] Global Competition Law Centre, Research Paper on the Modernisation of Article 82 EC, 28

extending the *Airtours* criteria to Article 102 but did eventually dismiss the claims either for failure to establish abuse, because of insufficient evidence or because of market characteristics incompatible with a finding of collective dominance.[608] In one case it was said that in the absence of structural links the finding of collective abuse was subject to a stricter burden of proof which required consistent evidence of a stable convergence of commercial policies leading to an impairment of competition.[609]

5.7.4 Collective Dominance in the Telecommunications Framework

Collective dominance in the telecommunications industry is addressed in the Commission's Guidance on the regulatory framework for electronic communications networks and services.[610] The Guidelines summarise the jurisprudence of the General Court and CJEU and refer to the Framework Directive[611] and sets out a shorter list of the appropriate characteristics most relevant to an assessment of joint dominance in the context of electronic communications: low elasticity of demand, similar market shares, high legal or economic barriers to entry, vertical integration with collective refusal to supply, lack of countervailing buyer power, and lack of potential competition. The list is a non-exhaustive and non-cumulative list of market characteristics which in addition to market concentration and transparency would illustrate the sort of evidence that would support an assertion of collective dominance by tacit coordination. The Guidance goes on to emphasise that an overall assessment is required rather than a mechanistic 'check list' approach and that although links are not a prerequisite they can be useful with other factors to establish

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[608] Alfonso Lamadrid de Pablo 'Oligopolistic collective dominance: the BCA's Telefonica decision' (March 2010) commenting on Decision No. 17131 (August 3, 2007) A357 Tele2 v. Tim/Vodafone/Wind Bolletino No. 29, 2007 'http://chillingcompetition.com/2010/03/25/oligopolistic-collective-dominance-the-bcas-telefonica-decision/.[accessed 24 November 2015]

[609] Ibid

[610] Commission guidelines on market analysis and the assessment of significant market power under the Community regulatory framework for electronic communications networks and services 2002 OJ C 165/6

[611] Directive 2009/140/EC amending Directives 2002/21/EC on a common regulatory framework for electronic communications networks and services, 2002/19/EC on access to, and interconnection of, electronic communications networks and associated facilities, and 2002/20/EC on the authorisation of electronic communications networks and services (25 November 2009) OJ L 337/37

collective dominance and a strong incentive to converge to a coordinated market outcome rather than rely on competition.

Copyright's impediment to interoperability is caused by a scope of protection that is too broad when it protects the software interface, particularly as it restricts access. There are useful comparisons to be drawn between the telecommunications industry and software industries such as the 3D CAD industry. Legislators and regulators have had several decades of experience trying to ensure horizontal interconnection by telecoms operators which is essential to ensure competition and investment. The result is a system of sector specific ex ante regulation that is a trade-off between the flexibility *o*f ex post competition law and the certainty of ex ante legislation.[612]

There are however structural and technology differences. The origins of the telecoms industry was as a public utility and state monopoly. There are simpler, physical interconnections with less IPRs. Network effects remain paramount, the infrastructure complex and standards common. Regulation has worked to ensure the incumbents allow access to newcomers to encourage competition. The software industry by contrast is far more varied, almost chaotic, and requires less investment in infrastructure. Suppliers have grown from entrepreneurial creativity rather than the break-up of state monopolies with open source a disparate but successful community.

One aspect of the horizontal regulation of the telecommunications industry has focused on an ex ante approach to reallocate rights, that are foreseeable and structurally harmful to competition, away from incumbents who already have a significant market share. The problem is very much structural in nature requiring an ex ante approach rather than a competition law approach under Article 102 which focuses on abusive behaviour. As the cause of the problem is historical and structural it would be wrong to identify that behaviour as abusive.[613] The historical structural problem is overcome by specific national regulatory bodies which initiate a complex analysis to assess whether an operator has

[612] A van Rooijen, *The Software Interface Between Copyright and Competition Law* (Wolters Kluwer 2010), 170

[613] Ibid 177

significant market power and impose ex ante access duties on them but only temporarily to allow competition to develop. Subsequent review is ex post by general competition law. Part of the analysis of significant market power is the assessment of collective dominance under the Guidelines discussed above. This would allow regulation ex ante. The similarities between telecommunications and software indicate the Commission might be open to consideration of collective dominance in software industries.

Another role for regulators is the more permanent horizontal interconnection between networks which apply even in the absence of significant market power.[614] This role is particularly relevant to the public utility nature of the telecommunications industry where users need to have safeguards that ensure any-to-any connectivity. The regulations remove the need to satisfy the exceptional circumstances test and the high test for indispensability set in *Bronner* which would otherwise require operators to invest in their own network. The Access Directive[615] promotes commercial negotiations between operators to achieve interconnections which is similar to reverse engineering of software in that it provides an instrument for access but does not guarantee the outcome. The national regulatory body may intervene to ensure that interconnection is achieved. Relying on its' own analysis and expertise it can impose ex ante forward looking obligations. This intervention does not require a finding of collective dominance. It is more akin to the role of exclusions to IPRs such as reverse engineering and comparison of this mechanism will be considered later in Chapter 8 when considering recommendations and remedies to achieve interoperability.[616]

[614] Pierre Larouche 'The Basis of EC Telecommunications Law after Liberalization' (PhD thesis Universiteit Maastricht 2000).

[615] Directive 2002/19/EC on access to, and interconnection of, electronic communications networks and associated facilities and see L 337/37 Directive 2009/140/EC amending the Directive.

[616] See Sections 8.3 and 8.4

5.7.5 Abuse

In *Compagnie* the CJEU spent little time on the concept of abuse.[617] Citing *Michelin v Commission,*[618] the CJEU considered there was a breach of the special responsibility on dominant undertakings not to allow their conduct to impair genuine undistorted competition.[619] They ignored the argument that the parties were reacting intelligently to the market. They also ignored the argument that predatory pricing had not taken place as prices had remained above cost.[620]

Dominance of itself is not unlawful but constructing the concept of collective dominance necessitates filling the gaps in legal rules that were not designed with oligopolies in mind. By the time the tests are all met the step between establishing collective dominance and proving abuse appears much smaller. This could imply that it is the structure of the oligopolistic market which constitutes the abuse, rather than the behaviour of the undertakings. The corollary of this is however that firms in an oligopolistic market could be under an obligation not to react intelligently to the market to avoid committing an abuse which works against the nature of competition and takes intervention to an antithetical extreme.[621]

The case law on what amounts to abuse by collective dominant entities is under-developed.[622] It has been asserted that a causal link between dominance and the abuse is not necessary so the anti-competitive effects need not result from the dominance. Presumably this argument would mean the same behaviour does not have to be

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[617] Lorna McGregor, 'The future for the control of oligopolies following Compagnie Maritime Belge' (2001) 22 ECLR 434, 437

[618] Case 322/81 *Michelin v Commission*[1983] ECR 3461; [1985] 1 CMLR 282

[619] *CEWAL II, 85*

[620] Case 62/86 *AKZO v Commission* [1991] ECR I-3359; [1993] 5 CMLR 215

[621] Lorna McGregor, 'The future for the control of oligopolies following Compagnie Maritime Belge' (2001) 22 ECLR 434, 437

[622] Richard Whish and David Bailey, *Competition Law* (8th edn, Oxford University Press 2015) 615

responsible for satisfying three elements of the test in *Compaignie.*[623] This could mean that where the abuse is the refusal to supply interface information it is not essential to show that a lack of interoperability was relevant to establishing a collective entity and dominance, or indeed vice versa.

Behaviour such as refusing to supply an undertaking or targeting new entrants to a market is difficult to explain without some element of collusive behaviour.[624] It is by no means certain that refusal to supply would amount to an abuse of collective dominance. Where however a lack of interoperability is a significant feature in an industry, it is feasible that refusing to disclose interface information could amount to abuse. The same could also apply to non-collusive parallel behaviour reducing innovation or maintaining inefficiencies.[625]

The abuse does not have to be the action of all the undertakings. Undertakings occupying a joint dominant position may engage in joint or individual abusive conduct.[626] This raises questions as to how this fits with the requirement "to present themselves or act together ... as a collective entity." It may also be difficult to apply the concept where some undertakings in the collective entity have smaller market share and behaviour could be more about keeping pace with the market leader.

The only defence to a claim of abuse is to show that the welfare effects of the actions are pro rather than anti-competitive. Following *Oscar Bronner* in the context of refusal to supply, *t*he Commission must assess the competitive impact rather than rely on the

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[623] See also the all elements of the "three prong" test to establish collective entity before establishing the dominance and the abuse, as advocated by Barry Hawk and Giorgio Motta, 'Oligopolies and Collective Dominance: A Solution in Search of a Problem' Treviso Conference on Antitrust Between EC Law and National Law, Eighth Edition; Fordham Law Legal Studies Research Paper No. 1301693. Available at SSRN: http://ssrn.com/abstract=1301693, 76

[624] Alison Jones and Brenda Sufrin, *EC Competition Law* (5th edn, OUP 2014), 724

[625] Ibid 932. The 3 D CAD industry's investment in Research and Development indicates no policy of reducing innovation – see Chapter 4 eg 4.7.3.2 Dassault Systemes spend more than 20% of revenue on R&D

[626] *Irish Sugar plc v Commission,* para 66

proportionality standard. This requires complex and expensive economic analysis where economic evidence is often ambiguous. The alternative proportionality standard, under which an undertaking could demonstrate the actions are the method by which then can try to compete is not appropriate for the effects-based concept of abuse and welfare analysis is more appropriate.[627]

5.7.6 Remedies

A fundamental problem with the logic of using collective dominance to control oligopolies is that undertakings could be penalised for economically rational behaviour. The CJEU has said that undertakings have the "right to adapt themselves intelligently to the existing and anticipated conduct of their competitors".[628] If Article 102 is used to penalise behaviour of this nature, when Article 101 could not be used to penalise the economically rational reactions of oligopolists, as confirmed by the decision in *Wood Pulp,* the parties' legitimate expectations are infringed.[629]

There is also the issue that where the abuse amounts to an intelligent adaption to the market, how can intervention provide an effective remedy to the alleged abuse without distorting the market? A fine is unlikely to stop them reacting to each other's behaviour and could distort the market irrationally and is tantamount to a tax on structure.[630] Ordering parties to stop "agreeing" by tacit price coordination amounts to compelling marginal cost pricing and the competition authority or court becomes a price control body.[631] A behavioural remedy not to respond to each other is little better and difficult to

[627]Giorgio Monti, 'The Scope of Collective Dominance under Articles 82 EC' (2001) 38 Common Market Law Review 131, 151

[628] *Cooperatieve Vereniging Suiker Unie UA v Commission, 174*

[629] Giorgio Monti, 'The Scope of Collective Dominance under Articles 82 EC' (2001) 38 Common Market Law Review 131, 145

[630] Ibid 145 and Alison Jones and Brenda Sufrin, *EC Competition Law* (5th edn, OUP 2014), 727

[631] Barry Hawk and Giorgio Motta, 'Oligopolies and Collective Dominance: A Solution in Search of a Problem' Treviso Conference on Antitrust Between EC Law and National Law, Eighth Edition; Fordham Law Legal Studies Research Paper No. 1301693. Available at SSRN: http://ssrn.com/abstract=1301693, 64

enforce. A structural order of divesture is complex and may go against the efficient order of the market.[632]

Fortunately however where a lack of interoperability is a cause or a factor in the collective dominance, or the abuse, an order for disclosure of interface information could, on one level, provide an effective remedy. An order requiring disclosure of interface information would be a direct response to the issue, more so than a fine, and less interventionist than remedies such as divestiture. This would meet the limited approach and criteria of *remediability* where oligopoly behaviour is only interfered with when the Commission can prescribe a remedy. In the same way that advanced price announcements and most-favoured-nation clauses which can facilitate price coordination in a tight oligopoly have been remedied, the disclosure of interface information can also be remedied by this limited approach.[633] However *Microsoft* revealed the expense and complexity of an order to disclose interface information. There was considerable uncertainty about what information Microsoft was required to disclose and Microsoft had to employ 210 software engineers and spent tens of thousands of hours to write the required specification.[634] In many instances it will not be a cheap remedy and an inefficient one as it creates considerable work which may need to be repeated each time a new version of software is released. There is also the recurrent issue of whether disclosing interface information which can include IPRs has a negative effect on incentives to invest although the indirect effect of controlling the interface information reduces the strength of this argument.[635]

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[632] Giorgio Monti, 'The Scope of Collective Dominance under Articles 82 EC' (2001) 38 Common Market Law Review 131, 146 the benefits may not outweigh the risks, eg where they damage a large minimum efficient scale, reduce productivity and increase prices.

[633] Ibid 147

[634] Ian S. Forrester, 'Victa lacet mihi causa: the compulsory licensing part of the Microsoft case ' in Luca Rubini (ed), *Microsoft on Trial* (Edward Elgar, Cheltenham 2010), 97-98

[635] See A van Rooijen, *The Software Interface Between Copyright and Competition Law* (Wolters Kluwer 2010) and Section 3.13 and Chapter 8

5.8 Alternative Methods under Competition Law

The Commission has power which can be exercised widely to conduct sector inquiries under Article 17, Regulation 1/2003 to collect information but not to impose remedies. The Commission would have to use powers such as under Article 102 if breaches of competition law were identified. A number of enquiries have taken place since 2004 into large strategic market areas including telecommunications, energy and pharmaceuticals.[636] An enquiry into the more niche 3D CAD industry is not expected, even though the issue of interoperability has been recognised to some extent by the Commission.[637] An inquiry has the advantage that it can disclose information without attributing fault, at least initially. A disadvantage to using this power is that while it would only improve interoperability in a single industry. The outcome could however send clear signals to suppliers in other industries afflicted by a lack of interoperability. The concept of lack of interoperability is now foreseeable and an ex ante change to IPRs could be more universal and appropriate.

An oligopolistic market will not have a dominant supplier unless there is collective dominance. The complexity of establishing collective dominance removes its effectiveness. Members States can have rules that are more stringent than Article 102[638] and several have the concept of dominant bargaining position or abuse of economic dependence. This applies where a definition of the market leaves no incumbent dominant undertaking but abuse occurs in the incidence of contractual relations between firms or towards customers.[639] Germany identified conduct that could amount to abuse of a dominant bargaining position under their national legislation as the deliberate non-disclosure of interface information in the software sector by a car-manufacturer.[640] Laws in six other

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[636] http://ec.europa.eu/competition/antitrust/sector_inquiries.html [accessed 24 October 2015]

[637] Commission Staff Working Document, 18

[638] Council Regulation 1/2003 of 16 December 2002 on the implementation of the rules on competition laid down in Articles 81 and 82 of the Treaty [2003] OJ L1/1 recital 8 & 9

[639] Ioannis Kokkoris *A Gap in the Enforcement of Article 82* (BIICL 2009) 3 et seq.

[640] ICN 'Report on Abuse of Superior Bargaining Position'*(*ICN Conference Kyoto, ASBP 2008), 21; Ioannis Kokkoris *A Gap in the Enforcement of Article 82* (BIICL 2009) 29 & 62-63 *Adam Opel AG/Software DMS* (2006)

countries can also sanction abuse of dominant bargaining position or economic dependence in some form[641] Suppliers of translation or complementary software such as CAE software, faced with discrimination or a change in the practice of disclosure or interface information, could conceivably bring a claim against one of the 3D CAD suppliers under national law to force the disclosure of interface information. With a market that is Europe wide or global this would be a tactical and hostile move carrying risks for the complainant. Interfaces as standards have an amplifying effect which justifies distinct consideration under the exceptional circumstance test and competition conditions more generally.[642] The lack of interoperability causes lock-in and high switching costs which differentiates the software with barriers to entry.[643] A move away from a structural approach to dominance, with the present focuses on market share, to assessing the ability to behave independently of competitors, customers and consumers[644] could allow for a more dynamic analysis[645] of the 3D CAD industry. However In the absence of wholesale change, or software being made a special case, Article 102 will not provide a solution and as the lack of interoperability is foreseeable an ex ante change to IPRs may be more appropriate[646] and achievable.[647]

5.9 Summary: Does Competition Law Provide an Effective Solution?

Lack of interoperability reduces the interchangeability of otherwise homogenous goods and causes lock-in due to switching costs. Whether this will definitively reduce market definition to single suppliers rather than high-end or middle range software is beyond the

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[641] Germany, Japan and Korea include provisions in their competition law while In France it is a restrictive practice as a tort under their commercial code

[642] See Section 3.13 and Chapter 8

[643] Ioannis Kokkoris *A Gap in the Enforcement of Article 82* (BIICL 2009) 57

[644] Case 27/76 United Brands v Commission [1978] ECR I-207.

[645] Ioannis Kokkoris *A Gap in the Enforcement of Article 82* (BIICL 2009) 84 et seq.

[646] Abuse of dominant bargaining position still carries connotations of wrong doing. There was no evidence in the interviews that the suppliers would pursue a policy, for example to withhold interface information that was unlawful

[647] See proposals for modest reform of the Software Directive in chapter 8 sections 8.3 and 8.4

scope of this thesis. In all likelihood though, neither dominance nor dominant bargaining position, will provide imminent relief to users of 3D CAD software.

The 3D CAD market is a tight oligopoly but the lack of pricing transparency or interchangeable products probably prevents the suppliers presenting themselves or acting together from an economic perspective as a collective entity.[648] With a small number of suppliers they can monitor each other but pricing and the products themselves are complex and opaque. No evidence has been discovered of price coordination and research and development infers no plan to limit innovation.[649] The industry does not therefore meet the *Airtours* test. There are also no legal or economic links in the nature of *Compagnie Maritime.*[650] The Commission has been very cautious about using Article 102 to outlaw parallel behaviour. It appears to prefer to use merger control or sector-specific legislation to address the oligopoly problem. Of the few collective dominance decisions of the Commission, there have been none under Article 102 where oligopolistic interdependence was held to be a sufficient connecting element to justify a dominant position. In most cases some legal or similar links existed and the Commission's use of Article 102 could be explained by the need to circumvent Article 101(3) exemptions or immunity from fines.[651] There are many differences between Article 102 cases and merger control and the required standard of proof. The standard of proof under Article 102 should be more stringent not least because of the backward looking nature of the Article. The use of merger control to regulate interoperability is not however a full answer to the problems posed by a lack of interoperability.

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[648] The *Airtours* test

[649] The industry invests in research and development, see chapter 4. Whether this is reduced by a lack of interoperability is a counterfactual

[650] The suppliers cross licence the kernels but this appears to be done on an arm's length basis.

[651] Damien Geradin and others, 'The Concept of Dominance in EC Competition Law' [2005] Global Competition Law Centre, Research Paper on the Modernisation of Article 82 EC, 27

Interfaces can contain copyright, patents and trade secrets. While certain aspects of the interface may be excluded from copyright[652] due to the complex nature of software, there may be cases where in order to give sufficient information to achieve effective interoperability code or other information protected by copyright or patents must be supplied. In *Microsoft* the General Court proceeded on an assumption that IPRs existed. With that approach, where the abuse is the refusal to supply interface information the exceptional circumstances test must also be met. This presents another hurdle increasing the complexity of the remedy and reducing the effectiveness of the deterrent.

Interoperability does have a remedy in the disclosure of interface information, which is not the case for most abuses of collective dominance. The weakness is in the nature of the tests that have to be met and the complexity of the procedure before the remedy can be achieved. There are too many hoops to jump through particularly as there has not yet been an Article 102 remedy that did not have economic links, for example in the form of contracts.

Competition law should be reserved for exceptional circumstances where the imbalance between openness and control are not anticipated by the ex ante intellectual property approach. In the case of software the need for exceptions for interface information is structural and anticipated.[653] The potential for competition law intervention creating uncertainty for suppliers and the possibility of false positives reduces the effectiveness of competition law even as a remedy of last resort.

Competition law does not provide effective regulation, even of last resort, for oligopolistic suppliers of complex 3D CAD software. The suppliers are however aware that as an oligopoly competition is susceptible to scrutiny under competition law and certain practices may be considered an abuse.[654] The existence of competition law remedies may

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[652] *SAS Institute*

[653] A van Rooijen, *The Software Interface Between Copyright and Competition Law* (Wolters Kluwer 2010) 108-110

[654] Interview with senior industry executive #3 (May 2014) and Interview with senior industry executive #4 (July 2013)

concentrate the minds of the suppliers to deter them from substituting competition for coordinated behaviour. However the nebulous, uncertain nature of collective dominance means that it will almost certainly fail to create an effective incentive for informed suppliers to make their interface information available voluntarily. It is an ex post remedy which is so unlikely to succeed that the risk of violation is small. Abuse of collective dominance under Article 102 does not provide a realistic sanction to any parallelism in the refusal to supply interface information and does not promote progress to a more open environment in the 3D CAD industry.

CHAPTER 6. INTELLECTUAL PROPERTY PROTECTION OF INTERFACES

6.1 Introduction

The aim of literary copyright is to protect creativity rather than functionality, whereas the value of computer programs lies in their functionality and their algorithms, and not the more prosaic code used to achieve that functionality. There is a fundamental mismatch, and suppliers turn to protecting their interface information because of the lack of protection for parts of the program which truly merit protection.[655] This is exacerbated by the fact this is one of the rare occurrences when an IPR is not disclosed. Whatever the copyright status of the interface, the situation remains that the user cannot readily see the rules and codes of the software. Disclosure is the price usually paid for IPRs, but here there is no such requirement and this hampers competition by substitution or follow on technology. Network effects are reinforced as the boundaries of the network are established by poor interface information causing a lack of interoperability. The market has to rely on breakthrough technology, which, as seen in *Microsoft*, has to contend with sophisticated behaviour to protect interfaces.

Restrictions on reverse engineering under the Software Directive give additional protection akin to trade secrets, and suppliers also file patents to give protection to functional aspects of the software. This and subsequent Chapters will consider the impact of these IPRs and the legal consequences of copyright protecting functionality and hidden interfaces.

6.2 Intellectual Property Rights in Interfaces

Proprietary software companies in the 3D CAD industry protect their software by copyright, trade secrets and patents.

Stated policies of the suppliers include:

> "We maintain an active program to legally protect our investment in technology through intellectual property rights. We protect our intellectual property through a

[655] Ann Walsh '*Microsoft v Commission*: interoperability, emerging standards and innovation in the software industry' in Rubini, L, (ed) *Microsoft on Trial* (Edward Elgar 2010), 313, quoting J. Farrell, 'Standardization and Intellectual Property' (1989) 35 Jurametrics Journal, 47

combination of patent, copyright, trademark and trade secret protections, confidentiality procedures and contractual provisions."[656]

"Our software products and related technical know-how, along with our trademarks, including our company names, product names and logos, are proprietary. We protect our intellectual property rights in these items by relying on copyrights, trademarks, patents and common law safeguards, including trade secret protection.[657]

These IPRs prevent the code or function being copied, and give the suppliers control over whether other suppliers can design products which are compatible with and interoperate with each other. In some industries firms may adopt a business strategy with open and non-proprietary interface information, as they benefit from network effects for their systems. Developers of platforms have an incentive to allow other developers to create applications to work on their platforms but may not be open to potential rival platforms.[658] The 3D CAD industry has almost always adopted a proprietary closed approach.[659] Even where an open approach is adopted this can change over time and an interface is always vulnerable and could change and become unavailable unless it is adopted as a standard.[660]

The main purpose of software standards is to increase interoperability. Software interoperability is achieved through software interfaces, particularly the data formats but also APIs and protocols. Proprietary software interfaces are not readily available (because they are not published or even properly recorded) and are often protected by IPRs.

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[656] Autodesk Annual Report fiscal year 2014, Form K-10, 11

[657] PTC Inc Annual Report fiscal year ended September 30, 2013, Form K-10, 7

[658] Apple's strategy is normally for a closed proprietary system although it encourages applications to be written for its platform. Urs Gasser *and* John Palfrey 'DRM-protected Music Interoperability and *e*Innovation' (Berkman Publication Series, November 2007). http://cyber.law.harvard.edu/interop [accessed 5 August 2015]

[659] Industry interviews confirmed the proprietary closed approach adopted by the 3D CAD industry.

[660] When Microsoft first entered the work-group server operating systems market it disclosed interface information to enter, catch up and then dominate that market. It then introduced new software, Windows 2000, and did not disclose equivalent information. Case COMP/C-3/37.792 Microsoft, Commission Decision of 24 March 2004 relating to proceedings under Art 82 EC, para.780. Customer pressure to use the Siemens JT

Adopting standards for the interfaces helps to record and publish the interfaces but the adoption of standards incorporating IPRs raises several issues as to how the demands of both interests can be met.

6.3 Economic Rationale behind for Copyright Exemption for Interfaces

Copyright endows the creator with exclusive rights over its original creations for a period of time. This is done to raise the supply of works closer to a socially desirable level. The economic rationale for copyright law is to give an incentive to produce creative work and avoid ‘underproduction.’ There is a trade-off between the interests of producers and consumers.[661] Higher prices and access costs naturally result from the copyright monopoly and consumers that value the work at more than the marginal cost may not pay the higher price resulting in ‘under-utilisation’. The higher prices can also deter innovation by other creators who would otherwise have built on the prior work.[662] The value of interfaces relies on their indirect effects rather that their intrinsic innovation.[663] Overprotection of interfaces, which results in a failure to differentiate between the prices and access costs for interface and the more valuable subject matter, may result in under-utilisation. At the same time lack of access to interface information can harm follow on competition and cause underproduction.

Copyright is a form of intervention in a public good for works that are non-rival.[664] For software, copyright law is not effective at solving the public-good problem in the way

format for archival purposes made Siemens adopt the JT as an ISO standard. Interviews with industry expert #1 (May 2014) and senior industry executives #4 (July 2013) and #5 (September 2014)

[661] Josef Drexl (ed) *Research Handbook on Intellectual Property and Competition* (Edward Elgar 2008) 375-376

[662] Ibid 375-376

[663] Ashwin van Rooijen *The Software Interface between Copyright and Competition Law* (Kluwer Law International 2010)

[664] Kenneth Arrow argued that information goods are public goods and that non-rivalry demands free access on grounds of economic efficiency, Arrow, K J ‘Economic Welfare and the Allocation of Resources for Invention’, in National Bureau of Economic Research (ed.) *The Rate and Direction of Incentive Activity,* (Princeton: Princeton University Press, 1962) p 609, and William Landes and Richard Posner, “An Economic Analysis of Copyright Law, 18 (1989) Journal of Legal Studies 325, reject copyright law is justified on the ‘Tragedy of the Commons’ argument that there is no incentive to invest in common property, as copyright is non-rival.

normally addressed by IPRs as copyright targets the portion of the good that in itself has no value, namely the writing.[665] The law should minimise transaction costs, which include the costs of contracting and protecting property rights, to avoid inefficiencies.[666] The costs involved in administering and enforcing the copyright regime are 'deadweight loss' as they use resources without adding value.[667] A market can fail to develop when transaction costs exceed the value of copies to individual users.[668]

Welfare economics recognises the costs and benefits of copyright to society. Interfaces can bring network effects and network externalities which benefit social welfare and as consumers benefit from the network externalities they can be willing to pay a higher price for the benefits while producers make higher revenues.[669] The case for IPRs in computer programs is to improve the creation, innovation and dissemination of knowledge to enable a competitive and prosperous software market.[670] However as information is a public good that has been privatised by the creation of copyright only a second-best solution can be achieved.[671] Pareto optimality is not achievable and the cost-benefit analysis is only credible if measured empirically.[672] This supports the challenge of identifying the correct

[665] Gustavo Ghidini and Emanuela Arezzo 'One, none, or a hundred thousand: how many layers of protection for software innovations?' in Josef Drexl (ed) *Research Handbook on Intellectual Property and Competition Law* (Edward Elgar 2008)

[666] Ibid Drexl 384. This supports the 'Coase theorem' that subject to transaction costs property rights traded in a free market are allocated to the most valuable use.

[667] Josef Drexl (ed) *Research Handbook on Intellectual Property and Competition* (Edward Elgar 2008) 375-376

[668] Gordon, WJ 'Fair Use as Market Failure': A Structural and Economic Analysis of the Betamax Case and its Predecessors' (1982) 82 Col. L. Rev. 1600

[669] Takayama, L 'The Welfare Implications of Unauthorised Reproduction of Intellectual Property in Presence of Demand Network Externalities' (1994) 42(2) J. Ind. Econ. 155

[670] N Shemtov, 'The Legal Regulation of Decompilation of Computer Programs: Excessive, Unjustified and in Need of Refrom' (PhD Thesis QML 2012). Discussing the legal systems justifications for granting the entitlement of copyright for computer software.

[671] Ruth Towse and Rudi Holzhauer in the introduction to *Economics of Intellectual Property* (Edward Elgar 2002)

[672] Josef Drexl (ed) *Research Handbook on Intellectual Property and Competition* (Edward Elgar 2008), 383

balance between openness and control.[673] Nevertheless since Landes and Posner's maximisation of economic welfare thesis, which has been built on by subsequent commentators, it is accepted that the balance must be struck.[674] Overly strong protection with no exemptions raises transactions costs, transferring rents to suppliers from users. An excessively weak regime which gives insufficient incentives reduces costs, earnings and also incentives.[675] Copyright is not unconditional but there must be trade-offs with other objectives and values. The law attempts to strike a balance between protecting the creator and the costs imposed on other creators, such as the cost of obtaining permission to use copyright protected work.[676] Legal exceptions have arisen for these socially desirable purposes, for example to enable interoperability.

6.4 Is there Copyright in Software Interfaces?

The Software Directive gave copyright protection to computer programs, but interfaces are considered an exception.[677] The status and limits of the exception have not yet been finally and comprehensively established, but a case before the CJEU ruled that the format of data files did not constitute expression.[678] The judgement has justifiably been criticised as being "at times, disappointingly compressed, if not obscure."[679] The Advocate General's opinion also had failings as it did not answer the questions referred directly but he did say that the Directive "does not exclude interfaces from copyright protection", merely the ideas and

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[673] Cross reference earlier discussion Section 3.13 and Chapter 8

[674] Samuelson P, Vinje TC and Cornish WR, 'Does Copyright Protection Under the EU Software Directive Extend to Computer Program Behaviour, Languages and Interfaces?' (2011) EIPR 34(3) 158; Rooijen A van, *The Software Interface between Copyright and Competition Law* (Kluwer Law International 2010)

[675] William Landes and Richard Posner, 'An Economic Analysis of Copyright Law' 18 (1989) Journal of Legal Studies 325

[676] Christian Handke, 'The Economics of Copyright and Digitisation' (2010) (03) UK Strategic Advisory Board for Intellectual Property Policy (SABIP)

[677] See 3.3 for an explanation of what constitutes an interface.

[678] Case C-406/10 *SAS Institute Inc. v World Programming Ltd* [2012] Judgement of the Court (Grand Chamber) (2012) CMLR 4. And see also *SAS Institute Inc v World Programming Ltd* [2013] EWCA Civ 1482 Court of Appeal

[679] *SAS Institute* Court of Appeal, para 4

principles underlying the interface.[680] The CJEU ruled that as the format of data files is used to exploit certain functions they do not constitute a form of expression and, as such, are not protected by copyright.[681] So while the source code and machine code of interfaces may not *per se* be outside the protection of copyright, there are certain aspects, such as specifications and protocols (the aspects relevant to standards) which are not expressions but ideas and principles and thus not copyright protected. When interpreting the Software Directive the CJEU must take account of TRIPS which gives copyright protection to expressions but not to "ideas, procedures, *methods of operation* or mathematical concepts as such" (emphasis added). Interfaces have been interpreted as methods of operation[682] and hence not copyright protected.

Copyright is a weak protection intended for literary and artistic expression that is normally exposed to numerous competing expressions. Unlike a work of art or the words of a book, the copyright protected material in software is not normally visible or readable. The supplier usually only distributes the program in machine code and not in human readable source code.[683] This gives a much stronger protection than is normally associated with copyright protection and creates a unique form of IPR.[684] Not only is the source code not distributed but the supplier may also claim to protect it as a trade secret. This means that while the interface may not be copyright protected it is inaccessible, and thus interoperability is hindered.

The Software Directive attempts to address this by permitting certain acts that would normally contravene copyright. One such act is to decompile machine code to re-create a

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[680] Case C-406/10 *SAS Institute Inc. v World Programming Ltd* [2011] ECR I -1, Opinion of AG Bot.

[681] Case C-406/10 *SAS Institute Inc. v World Programming Ltd* [2012] Judgement of the Court (Grand Chamber) (2012) CMLR 4

[682] *Sega Enterprises, Ltd v Accolade*, 977 F.2d 1510 (9th Cir. 1992).

[683] This is not the case for open source software where the source code is normally available.

[684] Decompilation can only be used to access interface information so "in essence, the Council made copyright law into a super-strong trade secrecy law as to every aspect of program internals – except interfaces" Pamela Samuelson, "Are Patents on Interfaces Impeding Interoperability?" (2008) Berkeley Centre for Law & Technology 1 21 -22.

higher level, human readable language. This form of reverse engineering is only permitted to obtain information for the purpose of interoperability. Subject to such restrictions in the Directive, reverse engineering is permitted even though the supplier claims trade secrets in the source code. Reverse engineering is common and often an effective means of achieving compatibility. While it is not a complete remedy, as software systems are complex and interfaces can change when new versions are released, it is difficult to see how a supplier could justify royalty payment on interfaces based on trade secrets when there is a lawful way to discover the information.[685] Indeed it has been found that copyright is rarely claimed in standards.[686]

Although the United States and the European Union have taken different legal paths they have grappled with the same issues including the expression/ideas dichotomy and functionality to analyse and converge on the key questions of whether interfaces are unprotectable by copyright law and reverse engineering.[687] The provisions finally adopted in the Software Directive were influenced by the status of US law at that time and fierce lobbying by large US software companies.[688] Consideration of the approach adopted by the Courts in the US is essential and informative.

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[685] In Case T- 201/04 *Microsoft v Commission* 5 C.M.L.R. 11 [2007] neither the Commission nor the CJEU were impressed by the trade secret argument as the protection afforded to trade secrets can be more limited than copyright or patent protections, and they exist as a result of a unilateral business decision dependant on its facts and the interests at stake. Here the value of the secret was not its innovative nature but the fact that it belonged to a dominant undertaking. *See* also Pamela Samuelson and Suzanne Scotchmer "The Law and Economics of Reverse Engineering" (2002) 111 The Yale Law Journal 1575, 1620, if reverse engineering is both lawful and feasible, trade secrecy protection for platform APIs is vulnerable.

[686] Knut Blind and others, 'Study on the Interplay between Standards and Intellectual Property Rights' (OJEU S136 of 18/07/2009) Final Report, 11.

[687] Pamela Samuelson 'The Past, Present and Future of Software Copyright Interoperability Rules in the European Union and United States' Keynote Speech 21st Anniversary of the European Committee for Interoperable Systems (ECIS) 1 December 2011, Brussels.

[688] Thomas Vinje, The History of the EC Software Directive' in M. Lehmann & C. Tapper *A Handbook of European Software Law (*Clarendon Press Oxford 1993) and Noan Shemtov 'The Legal Regulation of Decompilation of Computer Programs: Excessive, Unjustified and in Need of Reform' (PhD thesis QML 2013)

In 1992 the decision in *Sega Enterprises, Ltd v Accolade, Inc.*[689] reined-in copyright and trade secret protection of interfaces in the USA. Interfaces were spoken of as "functional requirements for achieving compatibility with other programs"[690] and so excluded from copyright protection. Copying code when reverse engineering for the purpose of extracting interface information for interoperability amounted to fair use and did not infringe copyright.[691] To enjoy a lawful monopoly over the idea or functional principle underlying a work, the creator must meet the more stringent test required for patent protection.[692] Following *Sega*, developers are unable to protect interfaces in the USA by copyright.[693] The case also approved decompilation of code to extract interface information, and so put trade secrets at risk. This approach was followed by the District Court in the dispute between Google and Oracle where the Java APIs were held not to be copyrightable, as when there is only one way to express an idea or function everyone is free to do so (although this was expressly limited to the facts of the case).[694] The ruling was overturned by the Federal Appeal Court and will be discussed later. Since *Sega* there has been an increase in patent applications in the USA for software interfaces,[695] as although being first to market may be an incentive to innovate, particularly where there are switching costs, without some form of protection software is by its nature easy to copy, either by outright pirating or by copying the code into new products, which eliminates the first mover benefit.

[689] 977 F.2d 1510 (9th Cir. 1992)

[690] Ibid 1525-26

[691] Ibid 1527-28

[692] Ibid 1525

[693] Suppliers can prevent licensee in the USA from reverse engineering under the terms of the licence. Article 8 of the Software Directive makes a contractual provision excluding reverse engineering void.

[694] Oracle America, Inc. v Google Inc. US District Court (31 May 2012, C10-03561 WHA)

[695] Pamela Samuelson 'Are Patents on Interfaces Impeding Interoperability?' (2008) Berkeley Centre for Law & Technology 1, 13 – there may be many thousands of patents on interfaces; Lerner J, and Zhu F, 'What is the Impact of Software Patent Shifts?: Evidence from Lotus v Borland' (2005) NBER Working Paper 11168 http://www.nber.org/papers/w11168 provides empirical evidence of a surge in patenting of software dating from the mid-1990s.

6.5 The Software Directive

Although the Software Directive grants copyright protection to the expression in any form of a computer program, "ideas and principles which underlie any element of a computer program, including those which underlie its *interface,* are not protected."[696] This is stated "for the avoidance of doubt" in the recitals and in the operative part of the Directive.[697] The Directive also acknowledges that the *function* of a computer program is to communicate and work with other components of a computer system and with users.[698] To achieve this interconnection and interaction it is required "to permit all elements of software and hardware to work with other software and hardware and with users in *all the ways in which they are intended to function*. The parts of the *program* which provide for such interconnection and interaction are generally known as *'interfaces'*."[699]

The *functional* interconnection and interaction is what is generally known as 'interoperability': defined as the "ability to exchange information and mutually to use the information which has been exchanged".[700]

The repeated reference to the function of the computer and the interface echoes the "functional requirements for achieving compatibility with other programmes" that was important in excluding copyright protection in *Sega Enterprises, Ltd v Accolade, Inc.*

Interfaces comprise not only the code that implements them but also the ideas, rules or principles in the specification of the interface. The specification can be used by a programmer to create an independent implementation of the interface which uses different code.[701] As the specification amounts to ideas and principles it is not subject to copyright. The phrase "where the specification of interfaces constitutes ideas and

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[696] Software Directive, Article 1 (2)

[697] Ibid Article 1 (2) and recital 11

[698] Ibid recital 10

[699] Ibid recital 10. (*emphasis* added).

[700] Ibid recital 10

[701] See section 8.4.6 for further discussion of interface specifications and the 'clean room' procedure

principles which underlie the program, those ideas and principles are not copyrightable subject matter" appeared in the original proposal but was removed from the final Directive. It was criticised for being so obvious that it would introduce the suggestion that this may not always be so.[702] It was also objected to by members of the software industry who claimed that excluding specifications from copyright protection would facilitate 'piracy'.[703]

The effect of the Software Directive is not just to protect "a" single, certain configuration of a program but also the rights of the holder in reproductions, translations, transformations, changes, improvements etc that in themselves constitute original works.[704] The right to control the use and the access to the program information combined with copyright gives a protection over functionality that is similar to patent rights and amounts to overprotectionism.[705] Decompilation is permitted in Article 6 of the Software Directive to obtain information on functional behaviour of a computer program. Copyright protection is not available for this functional behaviour.[706] The restrictions in Article 6 though give the rightsholder the protection of a subject or benefit that without it will not be protected by copyright. This subject or benefit includes but may not be limited to the specification for the interface needed for interoperability which, although it may not be protected by either copyright or patent, may have been a trade secret and is now prevented from disclosure by Art 6 of the Software Directive.[707] Giving the equivalent of copyright protection to

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[702] William R. Cornish, 'Interoperable systems and copyright' (1989) 11 EIPR 391-393, 391

[703] American companies formed the Software Action Group for Europe (SAGE) and lobbied strenuously against Articles. 1 (3) of the draft Directive; C Meyer and M Colombe, 'Interoperability still threatened by EC Software Directive: a status report' (1990) 12 (9) EIPR 325, 326 & 327

[704] Begona Gonzalez Otero, 'Compelling to Disclose Software Interoperable Information' (2013) Vol. 16, no 1-2 The Journal of World Intellectual Property 5

[705] Ibid 5

[706] *SAS Institute* C-406/10, para 39

[707] Begona Gonzalez Otero, 'Compelling to Disclose Software Interoperable Information' (2013) Vol. 16, no 1-2 The Journal of World Intellectual Property, 10

functionality can lead to a thicket of IP barriers which can deprive markets of the benefits of competition.[708]

We therefore have a scenario where at least some aspects of interfaces do not have copyright protection but even so the interfaces are not readable without reverse engineering.

6.6 International Conventions and US Case Law

Art. 9(2) of TRIPS and Art. 2 of the WCT state that copyright protection shall extend to expressions and not to "ideas, procedures, methods of operation or mathematical concepts as such". Neither domestic UK law nor the Software Directive expressly contain the exclusions that copyright does not extend to "... procedure, method of operation, or mathematical concepts as such". Nevertheless domestic and European law must now be interpreted in conformity with TRIPS and Art.2 of the WCT.[709] [710]

By contrast Sec.102(b) of Title 17 of the United States Code was amended in 1980, in line with TRIPS, to deny copyright protection to any "idea, procedure, process, system, method of operation, concept, principle, or discovery.."[711] At the time the Software Directive was being debated and introduced in Europe the US case of *Whelan v Jaslow*[712] gave a conservative interpretation that only the purpose or function was the idea and everything else was the expression. This meant that interfaces could be swept up in the broad concept of structure, sequence and organisation, as being copyright protected. In 1992, after the Software Directive had been adopted in Europe, the US position shifted. The case of *Computer Associates v Altai*[713] applied "the abstraction-filtration-comparison test"[714] and

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[708] Samuelson, Vinje & Cornish 'Does Copyright Protection Under the EU Software Directive Extend to Computer Program Behaviour, Languages and Interfaces?' 34(3) EIPR 158-66

[709] Arnold J in *SAS Institute* High Court Judgement, para 205. The WCT entered into force with respect to the European Union and the United Kingdom on 14 March 2010

[711] Title 17 U.S.C. §102(b) (1982)

[712] *Whelan Associates Inc. v. Jaslow Dental Laboratory, Inc*., et al, 797 F.2d 1222 (3rd Cir. 1986)

[713] *Computer Associates Int. Inc. v Altai Inc.,* 982 F. 2d 693 (2nd Cir. 1992)

[714] Applies the levels of abstraction approach in *Nichols v Universal Pictures Corp*., 45 F. 2d 119 (2nd Cir. 1930)

filtered out in the second stage those facets that are dictated by external constraints, such as compatibility with other programs, as not copyright protected. In the same year reverse engineering was considered fair use, in *Sega Enterprises Ltd. v. Accolade Inc*., for if disassembly was per se unfair this would give a de facto monopoly over the functional aspects.[715] A monopoly over ideas or function must satisfy the more stringent test imposed by patent law.[716] This case is important not only because it condoned reverse engineering but also because it described the interface information as functional aspects.[717]

In *Lotus v Borland*[718], Lotus' menu command hierarchy, including macros, were considered to be methods of operation and excluded from copyright protection under Sec.102. Borland wanted to emulate the Lotus software, not by copying the underlying code, but by copying the Lotus menu command hierarchy such as the "copy" and "print" commands. These commands explained and presented functional capabilities to the user, and were the method by which the program was operated and controlled. They were essential to operation and the Court considered it was not necessary to determine whether they could have been designed differently. Compatibility strengthened the argument that the menu command hierarchy was a "method of operation" as otherwise, in order to use other software, the user would have to learn many different operating methods. The Court found this notion "absurd".[719] That there are different ways to operate computer programs, and different ways to arrange hierarchically command terms, does not make the actual method chosen copyrightable. It functions as a method of operating the computer and is uncopyrightable. "The "expressive" choices of what to name the command terms and how

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[715] *Sega Enterprises Ltd. v. Accolade Inc*., 977 F.2d (9th Cir. 1510). See also *Atari Games Corp v Nintendo of America Inc*. 977 F 2d 1510 (9th Cir. 1992)

[716] Ibid para 1527

[717] Functional aspects were considered not to have copyright protection by Arnold J and AG Bolt in *SAS Institute* but the status of the interfaces was less clear.

[718] *Lotus Development Corp. v. Borland International Inc*., 49 F.3d 807 (1st Cir. 1995)

[719] Ibid 818

to arrange them did not magically change the uncopyrightable menu command hierarchy into copyrightable subject matter."[720]

The US law has applied the methods of operation exclusion to some forms of interface. Thanks to TRIPS and the WIPO Copyright Treaty, the methods of operation exclusion will now apply to domestic and European law.

6.7 UK and European Case Law

Against this backdrop there have now been a number of cases in Europe where software has been consciously emulated so that the user interface bears similarities to existing software. These cases have provided an interpretation of the copyright protection afforded to user interfaces by the Software Directive.

6.7.1 Navataire

In *Navataire Inc v easyJet Airline Co Ltd.,*[721] Pumfrey J considered VT100 screens were literary in character. However they were "ideas which underlie its interface" in the sense used in Art.1(2) of the Directive: "they provide the static framework for the display of the dynamic data which it is the task of the software to produce".[722] By contrast graphical user interface ("GUI") screens were artistic and outside the scope of the Software Directive.

In *Navataire* the source code had not been copied and there was no reverse engineering, but the new system was substantially indistinguishable from the original system in respect of its "user interface". In addition to the question of whether copyright subsisted in the interface Pumfrey J also considered whether the copying of commands amounted to a substantial proportion, and whether copying the "business logic" aka "non-textual copying", or copying without access to the thing copied, directly or indirectly, infringed the copyright in the source code. Pumfrey rejected the claims saying:

[720] Ibid 816

[721] *Navitaire Inc v easyJet Airline Co Ltd.,* (No.3) EWHC 1725 (Ch) [2004].

[722] Ibid para 96

If it is the policy of the Software Directive to exclude both computer languages and the underlying ideas of the interfaces from protection, then it should not be possible to circumvent these exclusions by seeking to identify some overall function or functions that it is the sole purpose of the interface to invoke and relying on those instead.[723]

6.7.2 Bezpečnostní

In the case of *Bezpečnostní softwarová asociace*[724] the CJEU was asked to determine whether for the purposes of Art. 1(2) of the Software Directive the phrase "the expression in any form of a computer program", includes the graphical user interface of the computer program or part thereof.

Here again the interface in question is the graphical user interface ("GUI") rather than a pure software interface. The Advocate General said the question was whether the GUI "which is the *result,* on screen, of a computer program constitutes an expression".[725] The GUI is not seen as part of the code but only as a result of the code. The GUI, also referred to as the "look and feel" enables communication and interaction between the user and the program.

The CJEU considered that the GUI interface did not constitute a form of expression of a computer program as the GUI does not enable the reproduction of that computer program. It is only one element which allows the user to use the features of the program. The CJEU referred to the Advocate General's opinion that "the form of expression of a computer program must be protected from the moment when its reproduction would engender the reproduction of the computer program itself, thus enabling the computer to perform its task".[726] Copying the code, including into another language, would cause the computer to perform its task. Presumably some forms of incomplete copying would also come within

[723] Ibid para 130

[724] Case C-393/09 *Bezpečnostní softwarová asociace - Svaz softwarová ochrany v Ministerstvo kultury (2010) [2011] ECDR 3*

[725] Ibid para AG52 (emphasis added)

[726] Ibid para 38

the Advocate General's test, so the code does not have to be reproduced exactly, provided the computer performs the task expected. Copying the GUI would not however enable the reproduction of the program.

In *Bezpečnostní* the CJEU confirmed that aspects of certain interfaces, GUIs in particular, are not expressions and are not copyright protected. The case does not directly address whether the code creating the interface is protected by copyright or not. It also does not consider other forms of interface, namely data formats, protocols and APIs although it can be inferred from the Advocate General's test that the idea/expression dichotomy will vary depending on the nature of the interface involved.

6.7.3 SAS Institute Inc v World Programming Ltd

The case of *SAS Institute Inc v World Programming Ltd*[727] was referred to the CJEU on a number of points. The case illustrates the problems that lack of interoperability poses for users and competitors. SAS Institute Inc ("SAS") is a major supplier of sophisticated analysis software using its own SAS language. Customers may have written thousands of application programs in the SAS language and while "there are other suppliers of analytical software which compete with SAS Institute, a customer who wanted to change over to another supplier's software would be faced with re-writing its existing application programs in a different language."[728] Customers were locked-in to the SAS software and had to continue to buy an annual licence. This case illustrates the problems faced by users of 3D CAD software who experience similar lock-in of their own proprietary data and legacy issues. They either have to pay for annual licences or maintenance contracts or incur the costs associated with moving to a different CAD system.

World Programming Ltd ("WPL") sought to provide an alternative, cheaper[729] software to

[727] *SAS Institute*

[728] Ibid para 2

[729] Press release 'World Programming Secures High Court Victory Against SAS David slays Goliath as 30 year monopoly is ended'. High Court says that WPS is lawful clone of SAS system. http://www.teamwpc.co.uk/press/world_programming_secures_high_court_victory_against_SAS [accessed 21 October 2011]

enable users who had programs written in the SAS language to have a choice of software. WPL sought to emulate much of the functionality, to ensure the same inputs would produce the same outputs, and to ensure customer's application programs ran in the same manner on WPS and SAS components.

WPL did not have access to the source code nor did it decompile the software.[730] The source code for the WPL software was mainly written using the SAS manuals and observing the operation of a Learning Edition of the SAS software. The method WPL used to create the interface was characterised by observation of the format of data files to enable WPL to write source code which read and wrote data files in the same format.[731] SAS claimed that WPL had infringed the copyright in its manuals, and thereby indirectly the copyright in the programs, and breached the terms of the licence of the Learning Edition of the SAS software. The facts are similar to *Navitaire* but involve interfaces between the software and data files rather than the user interface.

Many provisions of the Software Directive, as transposed into English Law, were analysed by Arnold J in the High Court decision. Aspects of the SAS software were considered to be a language or aspects of functionality and therefore excluded from copyright protection.[732]

Arnold J then considered whether interfaces are protected by copyright in a computer program. He was faced with the situation where WPL had not decompiled the interface and at no time had they been able to see and copy the source code. In these respects the facts were similar to *Navitaire*. In *SAS Institute* the interface information had been obtained by examining the SAS System in operation to work out enough of the format of the SAS7BDAT data file to write a new source code which reads and writes data files in that

[730] *SAS Institute,* para 69 where Arnold J. found that WPS had never had access to the source code of the SAS System and there was no suggestion that WPL had decompiled any of the SAS object code or even attempted to.

[731] Ibid para 129

[732] Ibid para 217 where Arnold J. agrees with the ruling of Pumfrey J in *Navitaire* that computer languages are not copyright protected although the expression of a program in a particular language may be protected. See *Navitaire*, para 88

format.[733] The element of the interface that was in question, arguably, was akin to the ideas, rules or principles by which the interface was specified. Arnold J recognised that methods of operation were also excluded from copyright.[734]

The original proposal for the Directive, referred to by counsel for WPL, clearly stated that these rules or principles by which interfaces are specified are not copyright protected. If a specification is used to write new code to achieve interoperability then that does not infringe copyright. But what of the code that actually constitutes the interface? This is the expression, and would appear still to be copyright protected. The original proposal says competitors are free to build on the identical idea (the specification) but may not use the same expression as that of protected programs (the code). It also proposes that similarities in the code which implemented the ideas, rules or principles due to the inevitability of certain forms of expression, where constraints of the interface are such that different implementation is impossible, will not infringe copyright as the idea and expression are said to merge.[735]

Arnold J, agreeing with Pumfrey J in *Navitaire,* concluded that interfaces were not protected by copyright. He considered that the legislative history supported this and the inclusion of reverse engineering in the later version of the Directive was not counter to that interpretation. The purpose was to entitle third parties to obtain information about interfaces in one or more ways. This he concluded meant that once the information is obtained it was intended that "competitors would be free to copy the interface anyway."[736]

The question is: What constitutes copying the interface? If it is using the specification to produce new code, then that would equate to using the ideas and principles which underlie the interface. This is in line with the wording of the Directive. Copying the code itself is something else. The only reference to this is in the Directive's original proposal where it

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733 Ibid para 129

734 Ibid para 205

735 Proposal for a Council Directive on the legal protection of computer programs [1989] OJ C 91/4, para 3.12 - 3.13.

736 *SAS Institute* para 226

speaks of the form of expression being constrained where the idea and expression may merge.[737] The courts should however consider whether the interfaces amount to methods of operation and are therefore exempted from protection.

Arnold J then considered what aspects of the SAS software amounted to an interface. The syntax of the SAS Language was part of the programming language rather than an interface, but as such is still unprotected by copyright. The SAS data file formats were considered "precisely the kind of information which is required by third parties in order to access data stored in those formats for the purposes of interoperability"[738] and thus were interfaces. WPS could read and write files in the SAS data file format but this did not amount to an infringement of the copyrights in the SAS components. There is no evidence that WPS reproduced a substantial, or indeed any, part of the SAS source code. Instead they had examined the system in operation and worked out enough of the format of SAS7BDAT data files to write their own code.

When Advocate General Bot referred to his own reasoning in *Bezpečnostní* about what constitutes expression, he said that the protection of a computer program is not confined to the literal elements, to the source code and object code, but extends to any other element expressing the creativity of the author.[739] He acknowledged the impact of the WCT and that not only are ideas excluded from copyright but also procedures, methods of operation and mathematical concepts.[740] He then explained that he considered the functionalities and language of a computer program are not capable, as such, of being protected by copyright. To determine whether copyright exists, account should be taken not of the time and work or level of skill, but the degree of originality.[741] He said that the language is a functional element lacking any originality and drew a comparison with the

[737] Proposal for a Council Directive on the legal protection of computer programs [1989] OJ C 91/4 para 3.13

[738] *SAS Institute* Arnold J para 248

[739] Opinion of AG in *SAS Institute* para 50

[740] Ibid paras 43 & 109

[741] Ibid para 66

language used by the author of a novel. This does not stop code written in the language from copyright protection as this would amount to the expression.[742] It will be for the national courts to examine whether reproducing functionalities has also reproduced "a substantial part" of the elements of components "which are the expression of the intellectual creation of the author of those components".[743] The opinion supported the distinction between ideas and expression in respect of functionality and language.

The opinion is less helpful on the question directly concerning the program interface and whether reading and writing files in the same format is making use of the interface's idea, principle, methods of operation or its expression. Advocate General Bot rephrases the question to ask whether copyright has been infringed by "deciphering" the format of the SAS data files to write a new source code. Arguably deciphering the format can be done either by observation or by some form of translation. Only if translation is involved does it amount to decompilation under the Directive. As stated earlier, it was found as a matter of fact that decompilation did not take place. WPL had observed the format files. They had not translated or altered SAS' code in the way that would amount to reverse engineering, as described in Art. 4 (b). The Advocate General's Opinion however focuses on Art 6 of the Directive which deals with reverse engineering. It says Art. 6 should be interpreted strictly, decompilation should be an exceptional act, and the licensee will have to demonstrate the "absolute necessity" of its actions.[744] This language is even more restrictive than the language of the Directive and may not help the cause of interoperability. It is worth noting at this point that in the subsequent CJEU judgement it was emphasised that WPL did not have access to the source code which differentiated their ruling from AG Bot's imprecise view and "neutralised" the implication that reverse engineering is only permitted when absolutely necessary rather than the somewhat more permissive conditions in the Software Directive.[745]

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[742] Ibid para 71

[743] Ibid para 67

[744] Ibid para 87

[745] Simonetta Vezzoso 'Copyright, Interfaces and a possible Atlantic Divide' (2012) 3 JIPITEC 153, para 23

Arnold J stated that "interfaces as described in recital [15] of the Software Directive are not protected by the copyright in a computer program." The Advocate General's opinion states that the Directive "does not exclude interfaces from copyright protection", merely the ideas and principles underlying the interface. There may be less difference in these statements than meets the eye. Interfaces are not per se outside the protection of copyright. Source code and machine code interfaces may be copyright protected but there are certain aspects, such as specifications and protocols which are not expressions but ideas and principles and thus not copyright protected.

The CJEU ruled that "the format of data files used in a computer program in order to exploit certain of its functions" are not a form of expression for the purposes of the Software Directive.[746] This does not say that data files are never copyright protected. If code didn't perform a function then copyright might apply. It does mean that when the purpose of data files is functional, as they invariably are, including for interoperability, they are not copyright protected under the software directive. The CJEU did not define copyright but Advocate General Bot defined it as "the set of possibilities offered by a computer system, the actions specific to that program. In other words, the functionality of a computer program is the service which the user expects from it."[747] More specifically the CJEU referred to the reading and writing of data in specific format as being a means by which users exploit certain functions.[748] As the functionality of a computer program is dictated by a specific and limited purpose there is similarity to ideas and it is legitimate for other programs to exist offering the same functions.

When to achieve that functionality there is a choice amounting to intellectual creativity in the program code, design work and "the way in which all of these elements are arranged"[749] there can be no direct copying and new code or designs must be written to achieve the same function. But an element of choice due to a combination of several

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[746] *SAS Institute* CJEU para 39

[747] Ibid AG Bot para 52

[748] *SAS Institute* CJEU para 42

[749] Ibid *SAS Institute* AG Bot para 55

functions or the skill and judgement in devising the functionality did not stop it falling on the ideas side of the line.

The CJEU expressed a policy rationale for this approach that accepting protection of functionality akin to patent protection would amount to monopolising ideas which would be harmful to technological and industrial progress. The CJEU appears to be justifying the use of copyright protection for software over patent protection as it refers to the rationale of only protecting the expression and leaving the desired latitude to create similar or identical works provided there is no copying.[750]

The Court kept open the possibility that the content of the format of the data files could be protected by the Information Society Directive 2001/29. As in the case of *BSA* the GUI could contain other intellectual property rights. This would however only extend to the reproduction of the *expression* of intellectual creation.[751] Excluding the format of data files which have a functional purpose allows for the reproduction of the functionality, even when there are elements of choice, provided the code or design of data formats is not copied verbatim.[752]

The rulings in *SAS Institute* have affirmed that functional behaviour was not protectable expression under the Software Directive as it embodied methods of operation[753] Functional behaviour in computer programs do not form literary expression and copyright protection is not available.[754] The legal issues and decisions in *SAS Institute* aligned with

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[750] *SAS Institute* CJEU para 41 referring to the Proposal for Directive 91/250 [COM (88) 816]

[751] *SAS Institute* CofA decision [2103] EWCA civ 1482 Judge Lord Lewison. The High Court also doubted the data file formats are the "author's own intellectual creation" as there was little room for personal choice as elements dictated purely by technical function be disregarded; Yin Harn Lee, UK Copyright Decisions 2013 International Review of Intellectual Property and Competition Law (2014) 45 (2) IIC 206-211

[752] *SAS Institute* CJEU para 39 but note the Court of Appeal's ruling in *SAS Institute* noted that functionality was not considered protected by the Information Society Directive para 74

[753] Pamela Samuelson, 'The Past, Present and Future of Software Copyright Interoperability Rules in the European Union and United States' article derived from Keynote speech to celebrate 21st anniversary of European Committee for Interoperable Systems (ECIS) 1 December 2011, Brussels.

[754] Samuelson, Vinje and Cornish 'Does Copyright Protection for Programs under the EU Software Directive Extend to Functional Behaviour, Languages and Interfaces?' [2012] 34 EIPR 158, 160-161

the legal issues and outcome in *Lotus v Borland.* Both the data formats and the macro commands were functional with little element of choice for the author. Europe had considered the position of the GUI and data formats. Consideration of APIs would take place in the USA with a clash of giants.

The decision to remove functionality from copyright protection contrasts with the approach taken by the Federal Court of Appeal in the most recent decision in *Oracle America Inc. v Google Inc*.[755] when considering the copyright in APIs. There the Court considered that if it accepted that a computer program is uncopyrightable simply because it carries out pre-assigned functions then no computer program is protectable. The Court required a more extensive abstraction-filtration- approach and assigned the function of interoperability to the fair use exception.

6.8 Back in the USA - Oracle v Google

While data formats were being considered in *SAS Institute* by the CJEU and the courts in England the legal status of copyright in APIs was being considered in the USA. In *Oracle v Google* the District Court ruled that the code and the structure, sequence and organisation of Java API packages were not copyrightable. The District Judge ruled that the declaring code, which Google had reused rather than rewritten, was not copyrightable as there was only one way to write it and the merger doctrine stopped Oracle claiming copyright ownership. The overall structure of API packages is a command structure and a system or method of operation and is therefore not entitled to copyright protection under S102(b) of the Copyright Act.[756]

On appeal, while it was accepted that Google wrote its own implementing code it was not disputed that Google copied 7,000 lines of code and generally replicated the overall structure, sequence and organisation of 37 Java API packages.[757] Google had copied the Java shorthand commands, whose specific format - java.package.Class.method (input)

[755] *Oracle America, Inc. v Google Inc* Court of Appeal Federal Circuit (May 9, 2014) 2013-1021, - 1022

[756] 17 U.S.C. § 102.; *Oracle America, Inc. v Google Inc* Judge William Alsup, District Court for the Northern District of California No. 10- CV - 3561 - "In no case does copyright protection for an original work of authorship extend to any idea, procedure, process, system, method of operation, concept, principle, or discovery, regardless of the form in which it is described, explained, illustrated, or embodied in such work".

[757] *Oracle v Google* Court of Appeal Federal District, 15

reflects the software's structure, which was indirect copying of the sequence, structure and organisation. For the shorthand commands to work on the Android platform the method headers, also known as declarations, must be replicated precisely as Android and Java *must be* identical when it comes to those particular lines of code.[758] So Google directly copied the code. This would amount to literal copying of the code and non-literal copying of the sequence, structure and organisation.

This case therefore is not a complete step back for reverse engineering[759] as the extent of literal copying of the code would distinguish the case from standard reverse engineering. Had Google reversed engineered the API packages and then written their own code Oracle would have no remedy under copyright. However as the Java method headers had become the de facto industry standard the structure needed to be copied to ensure interoperability. Crucially it was considered that the method headers were a method of operation and excluded from copyright under a subject matter approach to Section 102(b).[760]

Google accepted that there were similarities in the wording of the 'declaring' code but also pointed to differences and denied that its documentation was a copy. Google also said the similarities were largely the result of the fact that each API carries out the same function in both systems.[761] The similarities are not because of a simple cut-and-paste exercise but because it is inevitable that declaration of the functions of an API are going to be similar and even nearly indistinguishable.[762]

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[758] Ibid 29

[759] Ibid 48

[760] Ibid 38

[761] *Oracle v Google* Final Charge To The Jury (Phase One) And Special Verdict Form No. C 10-03561 WHA http://docs.justia.com/cases/federal/district-ourts/california/candce/3:2010cv03561/231846/1018/0.pdf [accessed 7 September 2014]

[762] Bradley Kuhn *Federal Appeals Court Decision in Oracle v. Google* *http://ebb.org/bkuhn/blog/2014/05/10/oracle-google.html [accessed 7 September 2014]*

Federal Courts vary in their approach. Some circuits deny copyright protection to all systems or methods of operation[763] while others grant copyright protection to essentially all elements of an original and creative computer program (including systems and methods of operation). The circuit of the Federal Appeal Court in the Oracle and Google case apply the abstraction/ filtration/ comparison test.[764]

The Federal Appeal's Court considered that merely being embodied in a method of operation does not extinguish particular expression from copyright protection. Section 102(b) only reflects the dichotomy between ideas and expressions and method of operations are copyrightable if the creator could have designed them in different ways.[765] It was not accepted the declaring code as a system or method of operation was not copyright protected. Rather than apply the function test to subject matter approach the Court looked on the matter from the tradition approach and to determine the ideas/dichotomy question applied an abstraction-filtration-comparison test. Applying this test to the APIs was necessary to identify whether any of the expression merged with ideas because they were constrained by efficiency or other external requirements.

The Federal Appeals Court was almost scathing of the functional approach[766] and ruled that to avoid copyright Google would need to rely on the fair use exception. It appears to have refined and narrowed the opportunities for claiming exemption from copyright for interfaces. It has renewed an emphasis on structure, sequence and organisation and non-literal copying which must be determined by the abstraction-filtration-comparison test rather than excluding automatically if it amounts to a system or method of operation.

Rather than relying on the natural meaning of Section 102(b) it said the two sub-sections of 102 had to be considered collectively and certain expressions are subject to greater

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[763] *Lotus Development Corp. v. Borland International, Inc.*, 516 U.S. 233 (1996), where the Federal Appeals Court and the Supreme Court held, but in divided opinions, that methods of operation embodied in computer programs are not entitled to copyright protection.

[764] *Oracle v Google* Court of Appeal Federal Circuit, 40

[765] *See, e.g.*, *Whelan Assocs., Inc. v. Jaslow Dental Lab., Inc.*, 797 F.2d 1222, 1234 (3d Cir. 1986), 1234

[766] *Oracle v Google* Court of Appeal Federal Circuit, 42

scrutiny. It did not however explain the origin or criteria for the test or even appear to apply it but simply held that because Sun could have written the method headers in different ways, they were copyrightable. [767]

The Court considered the question of compatibility and whether the Java method headers had become the de facto industry standard was irrelevant to copyright but factors to balance in the fair-use defence.[768]

The Federal Appeal Court determined that the District Court wrongly applied *Lotus v Borland.* In that case the defendant did not copy the underlying code but did copy the menu command hierarchy "Copy" "Print" and "Quit". But these commands were not creative, unlike the code and structure, sequence and organisation of the Java API packages. Also the commands in *Lotus* were essential to operating the system whereas Google did not need to copy the structure, sequence and organisation of the Java API packages to write programs in Java language. While these points distinguished *Lotus,* what will have more implications for the legal standing of interfaces is the disapproval of the importance of functionality. Several rationales and authorities were cited for the propositions that although an element may be a method of operation or system it may contain separable expression that is eligible for copyright protection.[769] The point was also made that merger and Scenes a Faire are evaluated and determined when the original work is created and hence discredited the argument that subsequent code or structure, sequence and organisation had to follow the original.[770] The District Judge was criticised from looking "at externalities from the eyes of the plagiarists, not the eyes of the program's creator".[771] Once a program is created a defendant's desire to achieve "total compatibility

[767]Ibid 31

[768]Ibid 51

[769] Ibid 37 – 43

[770] Ibid 35 - 37

[771] Ibid 50

…is a commercial and competitive objective which does not enter into the … issue of whether particular ideas and expressions have merged."[772]

The District Judge had justified characterising the structure, sequence and organisation of the Java API Packages as a "method of operation" on interoperability grounds as duplication of the command structure is necessary for interoperability.[773] The District Court had relied on *Sega Enterprise v Accolade* and *Sony Computer Entertainment, Inc v Connectix Corp*[774] although these were predominantly fair use cases. The Federal Appeal Court held that, while those cases recognized that software contained unprotected functional elements, it is not the same as denying the existence of separate creative expression or the existence of any copyright protection.[775] *Sega* and *Sony* were distinguishable as intermediate copies were made to understand the functional aspects of the copyrighted works and the new products were created with new code written. The District Court should have conducted the abstraction-filtration-comparison test to separate the expression from the underlying function and filter out the ideas and elements "dictated by consideration of efficiency, so as to be necessarily incidental to that idea; required by factors external to the program itself."[776] While some elements may be unprotected as functional it is not the same thing as saying the entire work loses copyright protection.

The Federal Appeals Court was also not convinced by Google's argument that it had to copy the packages so that an app written in Java could run on Android as there was no evidence of any Java apps that could run on the Android platform. The Court considered that compatibility was sought not with the Java platform but rather to capitalise on the fact the software developers were already trained and experience in the use of Java API packages. Google wanted to leverage Java for its existing base of developers. This competitive

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772 Ibid 50; *Apple Computer* 714 F.2d at 1253 (Fed Ct P 50)

773 Ibid 45 and Copyrightability Decision 872 F. Supp. 2nd at 977

774 Ibid *Oracle v Google Court of Appeal Federal Circuit,* 46; *Sony Computer Entertainment, Inc. v Connectix,* Corp., F.3d 596 (9th Cir. 2000)

775 Ibid *Oracle v Google* 47 – 48; *Altai (982 F.2d at 707)*

776 Ibid 24

objective could be relevant to fair use but not to whether the code and structure, sequence and organisation were copyrightable in the first place.[777]

The decision in *Oracle v Google* has tempered the notion that any code or organisation that is used as an interface is divested of copyright protection either because it is functional or because of merger of the idea with the expression. Common sense supports this view for interfaces are not absolute. The software developer which owns the copyright might identify one aspect as an interface while another software developer might select another interface by reverse engineering. It would be impossible to categorically identify and delineate which code or organisation had copyright protection and which did not.

The decision is not a complete reversal but it will make the determination of what is legitimate interoperability more refined. As the ruling stands it will create uncertainty for the industry and those developers wanting to create interoperable programs. It sends a clear signal that the structure, sequence and organisation cannot be copied with impunity and that code has to be written from scratch. Where however is the line drawn between commands that can be copied such as “copy” and those that are original? When can the programmer be certain that efficiency and other external constraints are acceptable? Will it require them to analyse the constraints on the ‘original’ code, such as to meet the requirements of a common platform, before deciding what code can be reused?

The Federal Appeals Court ruling in *Oracle v Google* is a clear reminder that software must comply with the principles of copyright law even where the functional aspects of the medium strain the application of those principles. It brings interfaces back within the scope of copyright protection subject to the fair use defence which has been referred back to the District Court. The Federal Appeal Court set out its opinion on the fair use defence to guide the District Court on a clear and appropriate picture it should give to the jury.[778] Google appealed on the question of “whether copyright protection extends to all elements of an original work of computer software, including a system or method of operation, that an

[777] Ibid 51

[778] Ibid 53-62

author could have written in more than one way?"[779] Google appealed to the Supreme Court which was said to be justified on the basis that the Federal circuit is in disarray about the application of Section 102(b) to software, and the ruling conflicts with the statutory section and the Supreme Court's precedent.[780] The Supreme Court refused to hear the appeal.

Two comments are pertinent to the issue of program's functionality. Firstly one of four factors that must be taken into account when considering the fair use defence is the nature of the copyrighted work.[781] This should recognise that computer programs have functional as well as expressive components. The necessity of copying the expressive elements of code in order to perform the function could support a finding of fair use. Secondly, although when determining whether the Java API packages had copyright, the Federal Appeal Court overruled the trial Court's undue reliance on functional aspects of the packages and Google's desire to achieve interoperability, these factors could be relevant to a fair use analysis. The Federal Appeal Court referred to the process in *Sega* of breaking down a computer program into its component subroutines and sub-subroutines and then identifying the idea or core functional element of each – essentially the filtration analysis.[782] The Court found this particularly true of the core packages which anyone may need to copy if they are to write programs in the Java language and said there may be others which are essential components of any Java language-based program.

The Federal Appeal Court appears to be saying that merger or functionality will not prevent copyright protection where the original software code or structure, sequence and organisation is not determined by efficiency or external factors, such as the need to interoperate with a pre-existing standard platform. The filtration test should be used to see whether there are elements that could meet the merger or functionality test. Where

[779] *Google v Oracle*, Petition for a Writ of Certiorari to the United States Court of Appeals for the Federal Circuit, October 6, 2014

[780] Ibid 30-31 and *Baker v Selden*

[781] *Oracle v Google* Court of Appeal Federal Circuit, 58

[782] Ibid 61

however the original software is not so constrained then subsequent software designed to interoperate would have to rely on the fair use test.

6.9 Is there an Atlantic Divide?

What then are the present similarities and differences between the EU and the USA approach to copyright protection of interfaces and encouragement of interoperability? US law has developed primarily by case law with some codification of exception such as ideas, and methods of operation in section 102 (b) of the Copyright Act. The position in the EU by contrast is influenced by the Software Directive which while not expressly stating copyright protection is unavailable for interfaces in various recitals and articles does more or less explicitly promote interoperability.[783] In both *SAS Institute* and *Oracle v Google* the judges at first instance, who both ruled the interfaces had no copyright protection, arguably took an approach that was overly simplistic while the CJEU and Federal Appeal Court took a more discerning approach.[784]

The CJEU was faced with a case where the defendants genuinely wanted to interoperate to increase competition. As there was no reverse engineering by decompilation there was no need to consider whether code had been copied or the conditions in Article 6. This made the case more straightforward. The pertinent part of the CJEU ruling is that the format of data files used to exploit certain of its functions is not a form of expression.[785] The CJEU acknowledged that the Software Directive chose copyright as the median for protection, which protects the copying of individual expression and avoids the monopolisation of ideas. Functionality was defined by AG Bot "as the service the user expects". It was not clarified

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[783] Pamela Samuelson, Thomas Vinje and William Cornish 'Does Copyright Protection Under the EU Software Directive Extend to Program Behaviour, Language and Interfaces?' (2011) 34 European Intellectual Property Review, 156, 163

[784] In *SAS Institute*, para 226 Arnold J seemed to think that once an aspect of a program was identified as an interface, it was unprotectable by copyright and see Samuelson, Vinje and Cornish 'Does Copyright Protection for Programs under the EU Software Directive Extend to Functional Behaviour, Languages and Interfaces@' [2010] 34 EIPR 158, 163 who considered the Software Directive requires a more nuanced interpretation.

[785] *SAS Institute* CJEU, para 39

whether functionality had to align with exemption such as ideas, procedures or methods of operation in the US Copyright Act or TRIPS and WIPO, or whether it was a merger of ideas and expression. This may cause future problems for courts analysing functionality in future cases."[786] The functionality applies to the code and as the Software Directive specifically includes preparatory design material it also applies to the sequence, structure and organisation provided it engenders reproduction of the program.[787] The CJEU appears to be introducing a test for the Software Directive that assumes a distinction can be made between performing a function, such as interoperability, and the copying of the detailed way in which the code and probably the structure, sequence and organisation is written.[788] No consideration of efficiency or factors external to the original program were required or made. No abstraction- filtration-comparison test made, although this could be done by the national court. Provided there was no copying, functionality permitted WPL's actions. The grey area is the notion that copyright protection may still be found in data format, presumably in the absence of functionality, if they meet the test of being the author's own intellectual creation.[789] This reflects the CJEU ruling in *BSA* that other forms of copyright could exist in the GUI.

The Federal Appeal Court in *Oracle v Google* did not accept that functionality automatically removed copyright as they considered all software to be functional.[790] They did not distinguish between the aim of the program and the manner of its detailed expression in the code. The Court was looking at APIs rather than data formats which were the subject of *SAS Institute*. While arguably more creativity and time went into writing the APIs than the

[786] The CJEU judgement was criticised by Lewison LJ for being "at times, disappointingly compressed, if not obscure, *SAS Institute* CA decision, para 4

[787] In *SAS Institute* Arnold J, para 232 refers to sequence, structure and organisation and AG Bot refers to reproduction of code

[788] In *SAS Institute* the CJEU refers to the choice, sequence and combination of the keywords, sytax and commands of the SAS Manuals, see also Simonetta Vezzosa, Copyright, Interfaces and a Possible Atlantic Devide, 3 (2012) JIPITEC 153, para 47

[789] *SAS Institute* CJEU, para 45

[790] *Oracle v Google* Court of Appeal Federal Circuit, 42

data formats both have a clear functional purpose. There are other more significant factual difference between the two cases. Google had copied source code, namely the Java declaring code, and the API's structure, sequence and organisation. It did so not for straightforward interoperability but to "capitalize on the fact that software developers were already trained and experienced"[791] in using the particular Java packages. While this could be considered semantic rather than technical interoperability it has been considered valid in such cases as the GUI cases of *Navataire* and *Bezpečnostní* and in *Lotus v Borland.*

While the facts might justify a difference in outcome between the two cases the legal argument and rationale behind the rulings does reveal a divergence. The CJEU by referring to copyright protecting only the individual expression and leaving other authors latitude to create similar of even identical programs provided they refrain from copying[792] is saying that new code written or structure, sequence and organisation designed to implement the same function, namely interoperability, will not breach copyright. This position is not completely at odds with the Federal Appeal Courts decision in *Oracle v Google.* There the Court was not convinced by the argument that Google had to use the identical Java declaring code or structure, sequence and organisation. The Court denied an interoperability exception in previous case law and ruled that even if software contained functional elements it did not mean associated work lost copyright protection. The Court should filter out elements including those constrained by external factors, seen from the eyes of the program creator. If there was a need to copy what remained subject to copyright to achieve interoperability, the defence of fair use was the appropriate means to determine whether the copying of the code or structure, sequence and organisation was legitimate.[793]

The Federal Appeal Court's approach was in line with the traditional idea/expression approach rather than the subject matter approach. A compelling need for exact duplication

[791] Ibid 51

[792] *SAS Institute* CJEU, para 41

[793] *Oracle v Google* Court of Appeal Federal Circuit, 53

of expression does not normally arise if the purpose is only to duplicate functionality.[794] The Court commented that to exclude functionality per se would exclude copyright protection for software and ruled against Google's copying of the code. The Software Directive adopts the traditional idea/expression approach in Article 1(2) where it refers to ideas and principles underlying computer programs and its interfaces not being copyright protected by the Directive. There are echoes of the subject matter approach in the 11th recital that "logic, algorithms and programming languages" are not protected by the Directive. It is uncertain what is meant by a "system" "process" or "method" and how non-functional expression needs to be to benefit from copyright protection.[795] The functional approach is potentially much broader than just excluding the interface specification from copyrightable subject matter. It could mean computer programs being excluded from copyright protection which is against the intention of the Software Directive.[796]

The traditional idea/expression approach was adopted by the Courts in both *SAS Institute* and *Oracle v Google.* In *SAS Institute*, where the code was not copied, there was no infringement and in *Google v Oracle,* where the code was copied, there was infringement. The material difference in approach is dictated by the wording and structure of the law.

As well as promoting interoperability the Software Directive explicitly refers to the functionality of computer programs and in particular the function of working together with other computer systems.[797] While TRIPS, which refers to methods of operation, was considered in *SAS Institute* the CJEU was not limited to TRIPS interpretation of the idea/expression dichotomy and could consider the broader purpose of the Directive. With

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[794] Ashwin van Rooijen *The Software Interface between Copyright and Competition Law* (Kluwer Law International 2010, 211 considering the two interpretations of S102(b). In *Baker v Selden* the bookkeeping system was function and not copyrighted but the question of whether the forms were protected was not answered as they had not been copied directly.

[795] Ibid Rooijen 213

[796] Ibid Rooijen 213, and Pamela Samuelson argues computer programs would be excluded "Questioning Copyright in Standards" 48 Boston College Law Review 193-224 (2007)

[797] Software Directive, functionality is mentioned three times in recital 10 and also in 13, 16 and Article 5 (3) and interoperability nine times.

the definitions in the recital and the strong emphasis on interfaces and interoperability it is fair to conclude the Software Directive was "intended to promote reuses of interfaces essential to interoperability"[798]

While European law has the purposive interpretation of the Software Directive it does not have the safety valve of the fair use doctrine. Everything relies on how the idea/expression dichotomy is applied to the challenging environment of software with its high level of functionality. The Software Directive singles out the function of interoperability.[799] The Courts have relied on the Directive to introduce an evolution of the idea/expression dichotomy so that interface functionality for interoperability is an idea. While it has not been categorised as a procedure or method of operation, any implementation of the interface which does not involve direct copying of the code (and other forms of expression such as preparatory design work) will not infringe copyright under the Directive. In the US by contrast the courts do not have to rely solely on the idea/expression dichotomy. They can use the more subtle test of fair use to achieve the balance between IPR protection and the public interest in interoperability.

Competition law had a comparable situation until 2004.[800] Europe had a very formalistic competition law regime and in the absence of the US rule of reason regime the CFEU had on occasions to bend over backwards to avoid findings of anti-competitive behaviour where, on an economic evaluation, the benefits would outweigh the disadvantages. The US Justice Department by contrast could find the elements of anti-competitive behaviour but apply an economic rule of reason test to avoid censure. The two regimes may end up in the same place but arrive there by different means and routes.

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[798] Pamela Samuelson 'The Past, Present and Future of Software Copyright Interoperability Rules in the European Union and United States' (2010) 34 (3) European Intellectual Property Review 229 - 236

[799] Software Directive, Recital 10

[800] Regulation 1/2003, on the implementation of the rules on competition laid down in Articles 81 and 82 of the Treaty (2003) OJ L1/1

6.10 Summary

The CJEU ruling in *SAS Institute* has given some guidance on the position and should enable more developers to legitimately obtain interoperability. *Oracle v Google,* where the Court gave far less weight to the functional nature of interfaces, has raised some doubts about the status of APIs. That case however involved the 'verbatim' copy of the declaring code and the sequence, structure and organisation, combined with Google's ambiguous stance on interoperability means that the message to come from that case is complex. Reverse engineering that writes new code is acceptable but doubts have been raised again about the status of sequence, structure and organisation and whether it can be copied. Although *Oracle v Google* does not directly affect Europe the US case of *Whelan v Jaslow* where the sequence, structure and organisation of an interface was protected, was not helpful to advocates for open interfaces when the Software Directive was negotiated. It will not help the future of interoperability if the advances made in *SAS Institute* and the cases following from C*omputer Associates v Altai* are lost. Over protection of the sequence, structure and organisation of interfaces does not recognise the "essentially utilitarian" nature of computer programs.[801]

The Software Directive and the CJEU ruling in SAS Institute do give an important element of openness which is beneficial for interoperability. Although the legal position has benefited there are still technical and commercial challenges particularly the challenge of gaining access to the interface remains. The Software Directive allows for black box analysis and decompilation, but the effectiveness of these exceptions is limited by the complex nature of the software and the ability to alter interfaces with upgrades.

In the 3D CAD industry data formats and APIs are used for the purpose of interoperability. The STEP standard is a data format that enables models to be transferred between software systems. It only gives limited interoperability as data required to edit the model is not transferred. The APIs are disclosed to translators, who provide software and a service to users of 3D CAD to convert their data between the different proprietary software systems, and other complementary software providers, but not all as some must rely on

[801] *Altai* 982 F. 2d 693, 704 (2bd Cir. 1992) and referring to *Baker v Selden* 101 U.S. 99 (1879)

reverse engineering. The present legal position allows for elements of reverse engineering and voluntary disclosure of interface information but it fails to give a complete answer.

Copyright is not a good fit for software, because of its functional nature, and suppliers feel their valuable core areas are vulnerable, and compensate by attempting to overprotect interfaces. The situation could be improved by the introduction of a *sui generis* form of protection and exceptions, but short of that and to avoid undesirable regulation another option would be a change to the Software Directive to allow for the dissemination of interface information obtained by reverse engineering. The Directive currently prevents the disclosure of any interoperability information obtained by decompilation,[802] and this forces each supplier to repeat the painstaking exercise for itself. Lifting this restriction would remove duplication of effort and allow firms to specialise in providing interoperability information to other vendors, or innovating in the knowledge that an interface is available.[803] This would create a market for interface information which could encourage, but not oblige, suppliers to make their own interface information available to ensure its quality, and could also bolster the use of standard interfaces. This market response will no doubt be resisted by many in the software industry with the same vehemence displayed when the Software Directive was introduced. This option will be discussed more fully in Chapter 8.

6.11 Trade Secrets

For copyright to prevent the copying of software there must be a copying of the manner of expression. Using the ideas and other information contained in the software is insufficient. It is the ideas and other information however that may be the most valuable element of the software requiring the most investment and innovation. This is reinforced by the difficulty in observing the machine code or reconstructing the source code. Both software suppliers

[802] Software Directive Article 6 (2) (b) although this restriction does not appear to apply to information gained by black box analysis under Article 5.

[803] Ann Walsh '*Microsoft v Commission*: interoperability, emerging standards and innovation in the software industry' in L Rubini (ed) *Microsoft on Trial* (Edward Elgar 2010) 296- 297

and users consider aspects of software to be trade secrets.[804] As software has to be supplied, generally in machine code, some of its know-how is also supplied and unrestricted decompilation could make it possible for competitors to take and use the know-how in their own programs.[805]

Microsoft claimed their interfaces were protected by trade secrets in addition to patents and copyright.[806] The Commission was not impressed with the trade secret argument as the protection afforded to trade secrets can be more limited than copyright or patent protections, and they exist as a result of a unilateral business decision dependant on its facts and the interests at stake. Here the value of the secret was not its innovative nature but the fact that it belonged to a dominant undertaking.[807] Also, subject to certain conditions, reverse engineering can legitimately disclose information for the purpose of interoperability, and this would defeat any attempt to protect interface information as trade secrets.[808]

Software products are not intrinsically protected as trade secrets. Reverse engineering or analysis of a product including the electronic content of digitised material, such as an encrypted program implanted in a vending machine, without special conditions will not generally be treated as protected as a trade secret.[809] Reverse engineering of even an encrypted computer program may not be a breach of trade secrets law. The mere existence of technical obstacles to access does not classify the computer program as a trade

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[804] 5% of respondents considered the interoperability information in their products amounted to trade secrets Public Consultation on the Access to Interoperability Information of Digital Products and Services in the Commission Staff Working Document SWD (2013) 209 final Q 3.6 (Commission Staff Working Document)

[805] Samuelson, P R Davis, M.D. Kapor and JH Reichman 'A Manifesto Concerning the Legal Protection of Computer Programs' (1994) 94 Columbia Law Review 2308 - 2431

[806] *Microsoft* para 278. However the Commission said the considerations associated with patent protection did not justify the refusal, indeed Microsoft took some time to even identify a single patent.

[807] Ibid para 280

[808] Pamela Samuelson 'Are Patents on Interfaces Impeding Interoperability?' (2008) 93 Minn L Rev 1943, 1955 if reverse engineering is both lawful and feasible, trade secrecy protection for platform APIs is vulnerable.

[809] *Mars v Teknowledge* [2002] EDCR 77

secret. The starting point is that trade secret protection cannot be invoked against the use of interoperability information obtained through reverse engineering.[810] The position with software that is password protected or licenced on terms expressing its status as a trade secret is less certain.[811]

Clauses imposing trade secret obligations and restricting the right to reverse engineer are common in the USA where they can be valid and effective. In Europe Article 8 of the Software Directive makes void any contract clause attempting to restrict the reverse engineering provisions of Article 6. However licence terms have attempted to require that information *resulting* from decompilation must be treated as a trade secret. This does not prevent the reverse engineering of the interface but purports to restrict the use of the resulting information even where there is no copyright protection. Article 6 does not give any express right to use the reverse engineered information so arguable a clause preventing its use may not fall foul of Article 8 which also says that the provisions of the Directive are without prejudice to the rules on trade secrets.[812]

The Software Directive prohibits reverse engineering other than for the purposes of interoperability. The Software Directive also prohibits the dissemination of information obtained by legitimate reverse engineering.[813] A situation is created where know-how in

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[810] Inge Graef 'How can Software Interoperability be achieved under European Competition Law and Related Regimes?' (2014) 5(1) Journal of European Competition Law & Practice 17; W Cornish et al *Intellectual Property: Patents, Copyright, Trade Marks and Allied Rights* (Sweet & Maxwell 2013) 326 - no action lies for secrets embodied in physical objects which are available on the open marker which can be analysed to find out its secret content.

[811] *Imerman v Tchenguiz & Ors* [2009] EWHC 2024 (QB) Eady J suggested that information stored on a computer with password protection was a strong case for saying that it should be regarded as confidential irrespective of its content .

[812] Noam Shemtov 'The Legal Regulation of Decompilation of Computer Programs: Excessive, Unjustified and in Need of Reform' (PhD Thesis QML 2013) 228 analysing contract clauses in Quaalcomm's 'Eudora EMSAPI License Agreement'

[813] Software Directive Article 6 2 (b)

the software which is not protected by copyright is protected as though it were a trade secret. It is akin to creating a statutory trade secret.

Article 39(2) of the TRIPS Agreement has three conditions for trade secret protection: (1) The information must be secret in that it is not generally known among or readily accessible to persons within the circles that normally deal with the information in question; (2) The secrecy gives it commercial value and (3) the rightful owner must have taken reasonable steps to keep the information secret. According to TRIPS, persons who have secret information lawfully in their control can prevent its unauthorised disclosure, acquisition or use "in a manner contrary to honest commercial practices." [814]

While the use of information protected by IPRs retrieved by reverse engineering can be unlawful[815] the act of reverse engineering itself is not usually considered to be contrary to honest commercial practices. [816] By preventing reverse engineering of software other than in very restricted circumstances the Software Directive arguably goes further than required by TRIPS. Even where the Software Directive permits reverse engineer it prohibits the dissemination of this information.[817] Here information such as interface specifications are not protected by the supplier's IPRs and the restriction is again beyond that required by TRIPS.[818]

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[814] Article 39 TRIPS and Article 10 Paris Convention (1967) see also W Cornish et al *Intellectual Property: Patents, Copyright, Trade Marks and Allied Rights* (Sweet & Maxwell 2013) As liability arises "in the course of ensuring effective protection against unfair competition" international obligations are limited to trade secrets between competitors.

[815] *British Leyland Motor Corp v Armstrong Patents* [1986] RPC 279

[816] Article 39(2) TRIPS Agreement. Note 10 of the TRIPS Agreement explains: 'For the purpose of this provision, "a manner contrary to honest commercial practices" shall mean at least practices such as breach of contract, breach of confidence and inducement to breach, and includes the acquisition of undisclosed information by third parties who knew, or ought to were grossly negligent in failing to know, that such practices were involved in the acquisition.'

[817] Software Directive Article 6 (2) (b)

[818] Article 39 of TRIPS addresses information lawfully within the control of the owner from being disclosed to, acquired by, or used by others. Distributing the software by sale or licence can amount to losing control which removes the obligation under TRIPS to provide protection from disclosure.

Copyright protection for computer programs is effectively a *sui generis* protection and the focus lies on protecting access to valuable know-how in the source code rather than the use of the expression.[819] This is emphasised by the decompilation rights in Article 6 with permit access to the interface but not the software's architecture. The Software Directive therefore gives statutory protection to trade secrets which protects the functionality of the software without the inventive rigour or disclosure requirements of patents. Not only is this unique protection afforded to the specific subject matter of the software but access and use of the interfaces is also controlled and restricted. The indirect effect of controlling these interfaces impacts competition and innovation.[820] This form of trade secrets law adds another layer of IPR protection which was not anticipated. It has significant anti-competitive effects for firms which need interoperability to sell products either working with or competing with the protected program.[821] For interoperability to be achieved, access to information on the code matters, and the present provisions for reverse engineering do not provide the access that is required.

6.12 Patents

Since the case of *Sega* there has been an increase in patent applications in the USA for software interfaces.[822] Although being first to market may be an incentive to innovate, particularly where there are switching costs, software without some form of protection is by its nature easy to copy, either by outright pirating or by copying the code into new products, which eliminates the first mover benefit.

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[819] Ashwin van Rooijen *The Software Interface between Copyright and Competition Law* (Kluwer Law International 2010, 203

[820] Ibid 203

[821] Gustavo Ghidini and Emanuela Arezzo 'One, none, or a hundred thousand: how many layers of protection for software innovations?' in Josef Drexl (ed) *Research Handbook on Intellectual Property and Competition* (Edward Elgar 2008), 363

[822] Pamela Samuelson, 'Are Patents on Interfaces Impeding Interoperability?' (2008) 93 Minn L Rev 1943, 1960 there may be many thousands of patents on interfaces; J Lerner and F Zhu 'What is the Impact of Software Patent Shifts?: Evidence from Lotus v Borland' (2005) NBER Working Paper 11168 http://www.nber.org/papers/w11168 provides empirical evidence of a surge in patenting of software dating from the mid-1990s.

The CAD industry has made use of patents since the 1980s[823] with Dassault Systemes holding 188 patents, Autodesk 669 and PTC 37. Siemens also has about 250 patents with reference to computer aided design or CAD. It has not been established that all of these Siemens patents relate to software but software is the only product of Dassault Systemes, Autodesk & PTC.

The rate of increase of patents filed by Europe based Dassault Systems has increased steadily over the past 15 years from 9 in 2000 to 30 in 2013, and 27 patents to October 2014. In comparison the rate of patenting at Autodesk has not shown an overall increase. With a rate of patenting varying from 16 to 63 patents per year, patent filing peaked in 2007 (63 patents filed) compared to any subsequent year but still averages 41 patents filed a year.

The 3D CAD suppliers use patents to protect their proprietary software. There is no evidence of any policy to avoid patent protection of interfaces. Interfaces are objectively defined by the occurrence of transferring data or instructions repetitively between elements of a computer system.[824] They are not defined solely or exhaustively by the supplier. There is a real probability that patents exist in interfaces of 3D CAD software.

Of respondents to a public consultation as part of the Commission Staff Working Document in 2013[825], less than 5% of owners protected their interoperability information by patents, while 25% of users said the needed interoperability information was protected by

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[823] In *Viacom's Application* [1987] OJ EPO 14 the Board of Appeal considered a program developed for computer-aided design of engineering products and accepted claims for uses which started with computerised image, rather than the less specific methods of using an algorithm. The claims went to the general functioning of the computer and were "sufficiently directed to a technical purpose." The decision was important in developing "technical effect" as reason for granting patent protection and the importance of CAD is thought to have influenced the decision. W Cornish et al *Intellectual Property: Patents, Copyright, Trade Marks and Allied Rights* (Sweet & Maxwell 8th Ed 2013), 837

[824] Caroline Meyer and Michel Colombe 'Interoperability still threatened by EC Software Directive: a status report' (1990) 12 (9) EIPR 325, 328 and C Meyer and M Colombe 'Seeking interoperability: an industry response' (1990) 12 (3) EIPR 79-93

[825] Commission Staff Working Document Appendix 2 'Public Consultation on the Access to Interoperability Information of Digital Products and Services'

patents.[826] The cause of the discrepancy is unclear. It could be due to patents being concentrated in interfaces or to the users' misconception about the incidence of patents. While the extent of patents in interfaces in 3D CAD software cannot be quantified there is strong evidence that they exist.

6.13 Software patents in the USA and UK

Following *Diamond v Diehr*[827] there was an increase in the number of software patents issued by the USPTO and while no one can be sure of the number it may be hundreds of thousands.[828] The US Supreme Court ruled in *Bilski v Kappos*[829] in 2010 that the claims were too abstract. By doing so they risked pre-empting all uses of the method even if the inventor had not foreseen them. Unfortunately there was little guidance in the judgement to help determine when ideas are too abstract. They were not as supportive as the earlier Federal Appeal Court decision of the machine or transformation test where for a method to be patentable it must either be carried out by a machine or transform something from one state to another. The test was considered useful but not exclusive. In *Bilski* the patent did not mention any machine in the claims nor did it transform anything. In a latter case of *CLS Bank International v Alice Corp*[830] the Supreme Court determined that claims were ineligible as they were nothing more than an instruction to apply abstract ideas using a generic computer. Again the abstract principle was relied on rather than the machine or transform test which is less useful for software though the decision does not exclude per se software or business methods nor imposes any special eligibility on software or business methods.[831]

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[826] Public Consultation on the Access to Interoperability Information of Digital Products and Services in the Commission Staff Working Document. Q 2.3 and 3.1

[827] *Diamond v Diehr* 450 U.S. 175 (1981)

[828] Pamela Samuelson 'Legally Speaking Is Software Patentable?' (Nov 2013) Vol 56 No11 Communications of the ACM

[829] *Bilski v Kappos* 561 U.S. 2010 WL 2555192 (28 June 2010)

[830] *Alice Corp Pty Ltd v CLS Bank International* 573 US, 134 (2014)

[831] USPTO Memorandum 25 June 2014

Software, along with mathematical and business methods, is not patentable "as such" under the European Patent Convention and the Patents Act 1977. To be patentable it has to have a "technical contribution" which is new and non-obvious, and which is generally referred to as a computer implemented invention.[832] Various interpretations and applications of the phrase "as such"[833] have resulted in the granting of software patents. In 1985 the approach adopted by the European Patent Office was to permit software inventions that had a "technical effect" allowing software to be patented as part of a concrete apparatus such as a mobile phone. By 1990 as a result of decisions of the EPO's Board of Appeal the approach had evolved to allow for the patenting of "technical software" that was decoupled from actual devices. This is believed to have increased further the number of software patents in Europe although the quality of these patents may have been no higher than the US counterparts. The notoriously controversial attempt to adopt a Software Patent Directive that would have formalised software patents while exempting interfaces was dropped in 2005 leaving the EPO and member states to attempt to rationalise the case law of the Board of Appeal and national courts. Board of Appeal cases that strengthened the test for "inventive step" which tightened the criteria for granting software patents and is thought to reduce the number of bad patents. Nationally countries including Germany and the UK are attempting to rein in and refine the patenting of software[834] In *Symbian*[835] the meaning of technical was considered and while an

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[832] The UKIPO adopted a four-step test first applied in *Aerotel Ltd v Telco Holdings Ltd, Macrossan's Patent Application* EWCA Civ [2006] 1371. The proposed patent directive was intended to provide that interfaces essential to interoperability are "ideas" or "principles" should be unpatentable. The proposed Article 6a "MS shall ensure that wherever the use of a patented technique is needed for the sole purpose of ensuring conversion of the conventions used in two different computer systems or networks so as to allow communication and exchange of data content between them, such use is not considered to be patent infringement." See Robert Bray 'The European Union Software Patents Directive: What is it? Where is it? Where are we now?' (2005) 11 Duke Law & Technology Review 28 but there may be some difficulty justifying an interoperability exception under TRIPS because normal exploitation of patents includes licensing them, Pamela Samuelson, 'Are Patents on Interfaces Impeding Interoperability?' (2008) Berkeley Centre for Law & Technology, 26

[833] Patent Cooperation Treaty (PCT)

[834] Pamela Samuelson 'Legally Speaking Is Software Patentable?' Communications of the ACM Nov 2013 Vol 56 No11 The German legislature recently passed a resolution calling for the cessation of patenting for most software-related innovations.

invention involving a computer is undoubtedly “technical”, in law the mere presence of conventional computing hardware does not of itself mean an invention makes a technical contribution and so avoids the computer program exclusion. This approach contrasted with that of the European Patent Office.

The notion of interoperability information can be wider than computer programs, for example covering protocols and hardware-software interfaces which are not excluded from patentability.[836] The USPTO has required a useful, concrete and tangible result[837] even if only on the computer screen, but with no “as such” statutory exclusion the “enablement” requirement for software inventions has been eliminated. Software patents now make up 15% of all patents granted in the USA, where about 20,000 software patents are granted each year.[838] The propensity to apply for software patents increased by 16% per annum in the 20 years to 1996 while spending on R&D grew by only 4.4%. The reason for the low relative growth in R&D spending is not clear and it may be due to R&D being more efficient and taking place in promising and expanding fields rather than a fall in innovation.[839]

6.14 Can the Purpose and Benefits of Patents be Reconciled with Software Interoperability?

6.14.1 Innovation and Interoperability

The rationale for patents is to encourage innovation by excluding others. This would appear to be at odds with the aims of interoperability and competition to encourage innovation. The professed link between patents and innovation is the justification for

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835 Court of Appeal in *Symbian Ltd v Comptroller General of Patents, Designs and Trade Marks* [2008] EWCA Civ 1066; [2009] Bus LR 607

836 Commission Staff Working Document

837 In *re Alappa* (33 F. 3d 1526, (1994).

838 James Bessen and Robert Hunt, ‘An Empirical Look at Software Patents’ (2007) 16 (1) Journal of Economics and Management Strategy 157-189, 158-160.

839 Ibid 173

granting exclusivity in a similar way to copyright protection. Patents protect ideas and function, unlike copyright which just protects the expression of those ideas.

The literature gives a stated justification for patent protection as the desire to stop others appropriating the work of an innovator, as this would prevent the innovator recouping a return on his R&D costs.[840] The use of patents to stop others appropriating innovations in software has three potential economic consequences - monopolies, rent seeking and favouring current over future innovation. The right to try to exclude others may result in market power which is considered a social cost that is necessary to stimulate innovation and provide a return on R&D expenditures. Debatably, although patents rarely give monopolies in any economic market and patent doctrines can avoid unnecessary rent seeking,[841] there is an acknowledged impact on competition caused by a lack of interoperability and lock-in in software markets.[842] One of the solutions to a lack of interoperability or lock-in is the use of standards. There can however be a lack of choice in patents in standards where a distinction is drawn between patents in 'similarity' standards and patents in 'compatibility' standards as they have a different economic impact. FRAND rules are appropriate for similarity standards where the user can choose whether to take advantage of the patented technology. Where compatibility standards define interfaces, all who wish to use the system must pay for the patent without any decision on their part about the value of the patent to them. This is seen as an unplanned expansion of the patent system that greatly impacts the rights of others and which should be recognised and

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[840] Kenneth Dam, 'Some Economic Considerations in the Intellectual Property Protection of Software' (1995) 24 Journal of Legal Studies 321

[841] Ibid 337 – economic rent is in one sense the incentive accorded to the innovator by IPR which should not be excessive. Copyright does not exclude independently created works and various patent doctrines reduce the extent of any economic rent for most technologies and see also Kenneth Dam, 'The Economic Underpinnings of Patent Law' (1995) 23 Journal of Legal Studies 247, 253.

[842] In *Microsoft v Commission* Microsoft enjoyed a dominant (quasi-monopoly) on the pc operating systems market and used the lack of interoperability to leverage an increasing market share of the work group server operating system market. The impact of lack of interoperability was also recognised in merger cases such as Intel and McAfee, COMP/M.5984 *Intel Corporation and McAfee, Inc.,* [2011] OJ L. Copyright doctrine does not give protection to interfaces but there appears to be a trend to seek patent protection of interfaces.

addressed.[843] The STEP standard is a compatibility standard and while there are only a small number of patents in the standard, interviews indicate they give a disproportionate level of concern.[844]

The desire to generate a stream of innovation over time means that it can be counterproductive to raise the level of protection too high. Inventors and creators want to benefit from previous works. While failure to give any protection might be a disincentive to R&D, the pace of technological change and progress could be slowed if the appropriate balance is not achieved.[845] The software sector is one where innovation tends to be cumulative and therefore the impact of patents can be negative for innovation. While patents reduce the prospects of imitation in a static world, software development is dynamic and sequential and patent protection may inhibit complementary innovation.[846] This may explain why, as patent protection of software became accepted,[847] firms in the computer and electronics hardware industries, which obtained the most software patents,

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[843] Ken Krechmer, 'Open Standards: A Call for Change' (2009) May IEEE Communications Magazine 88, 90-91

[844] Interview with industry expert #5 (September 2014)

[845] William Landes and Richard Posner, 'An Economic Analysis of Copyright Law' 18 (1989) Journal of Legal Studies 325 at 332 "From an ex ante viewpoint, every author is both an author from whom a later author might want to borrow material and the later author himself." Copyright protection of software can be stronger than other forms of literary copyright as the source code is normally not available and the machine code cannot be read as the words of a book. Patents are disclosed to encourage later follow on innovation but do not reveal all of the know-how, Pamela Samuelson, 'Are Patents on Interfaces Impeding Interoperability?' (2008) Berkeley Centre for Law & Technology 1, 28

[846] James Bessen and Eric Maskin, 'Sequential innovation, patents, and imitation' (2009) (4) RAND Journal of Economics, Winter, 611-635 – explain "sequential," as successive invention builds on the preceding one eg Microsoft's Excel built on Lotus, and "complementary," means each potential innovator takes a different research line which increases the overall probability that a particular goal is reached within a given time e.g the many different approaches taken to voice-recognition software hastened the availability of commercially viable packages. They consider that "when innovation is sequential and complementary, standard conclusions about patents and imitation may get turned on their heads. Imitation becomes a *spur* to innovation, whereas strong patents become an *impediment*."

[847] The line of cases following the ruling of the Supreme Court in the case of *Diamond v Diehr* (450 US 175) 1981.

actually reduced their R&D spend relative to sales.[848] Most software patents in the USA were obtained by manufacturing firms, especially in the electronics and machinery industries (which include computers), with only 5% in the hands of software publishers and other software service firms, excluding IBM which accounted for an additional 2%. Patents tend to benefit the larger firms more as they have the resources to apply for, maintain and defend patents. Smaller firms are ambiguous about the advantages of patents. Although some find patents are strategically important and can help secure finance[849] they can be deterred because of expense and the fear of patent disputes with wealthier firms.[850] There has been an increase in patenting by large firms such as Adobe, Microsoft and Oracle, while most software firms hold no patents.[851] Although large firms may engage in patent portfolio races it has been concluded that software patentability has "no particular positive impact on software innovation *per se*".[852]

The lack of exemption in patent law for decompilation to achieve interoperability could have a dampening effect on interoperability, as when embarking on decompilation it is difficult to know what will be found and whether a patent is present.[853] Reverse

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[848] James Bessen and Eric Maskin 'Sequential innovation, patents, and imitation' (2009) (4) RAND Journal of Economics, Winter, 611-635

[849] Andrés Guadamuz González**,** 'The software patent debate' (2006) 1 (3) Journal of Intellectual Property Law and Practice 196, at 203-4 – venture capitalists favour firms with IPRs; Ronald Mann, 'Do Patents Facilitate Financing in the Software Industry?' (2005) 83 (4) Texas Law Review 961. In email correspondence with the authors (29 August 2012) Jacques Crémer and Mark Schankerman make the case that some small firms place huge emphasis on patents both to protect their inventions from expropriation and for access to finance.

[850] Ibid Gonzalez 203-204 and Mann, 1009; Puay Tang, John Adams, and Daniel Pare, 'Patent Protection of Computer Programmes' (2001, INNO-99-04) European Commission Report.

[851] Bronwyn Hall and Dietmar Harhoff, 'Recent Review on the Economics of Patents', (2012) National Bureau of Economic Research, Working Paper 17773.

[852] Ibid 24

[853] For a discussion on the economic justification for patent protection see Kenneth Dam, 'Some Economic Considerations in the Intellectual Property Protection of Software' (1995) 24 Journal of Legal Studies

engineering is important in preserving competition and compatibility between products particularly in markets characterised by network effects.[854]

> "reverse engineering promotes the fundamental patent policies of disclosure and enablement, ensures that patents will not be leveraged to protect unprotectable components of software, preserves the balance sought by intellectual property systems as a whole, and also helps patentees enforce their rights".[855]

Patent protection for a single software component could prevent the 'making' or 'using' of the whole of a complex program including the temporary uses required for decompilation.[856] Conversely, as European patent law requires a specific technical invention with a technical character, and protection is limited to the claims and specific applications, decompiling aspects of the program such as its architecture and aspects of interfaces may not amount to 'making' or 'using' the patented invention.[857] Analogies have been drawn between reverse engineering and exemptions permitting research concerning the claimed invention. [858] In Europe this defence extends to commercially sponsored research although not to commercialisation of the results. As patent protection is broad, prohibiting independent development and different ways of carrying out the invention, a strong case is made for revising the research exemption to cover those activities carried out to analyse software for interoperability purposes.[859]

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[854] Julie E Cohen & Mark A Lemley 'Patent Scope and Innovation in the Software Industry' (2001) 89 Cal L Rev 1, 21

[855] Ibid 22

[856] Ibid 21

[857] N Shemtov, 'The Legal Regulation of Decompilation of Computer Programs: Excessive, Unjustified and in Need of Refrom' (PhS Thesis QML 2012). T0208/84 *Vicom/Computer related invention* [1987] EPOR 74.

[858] Cornish, Llewelyn & Aplin *Intellectual Property: Patents, Copyright, Trade Marks and Allied Rights* (Sweet & Maxwell 2103) after looking at the US patent law's experimental defence, exhaustion of rights, implied licence and misuse; Julie E Cohen & Mark A Lemley 'Patent Scope and Innovation in the Software Industry' (2001) 89 Cal L Rev 1, 6 consider policies underlying exhaustion of rights and implied licence doctrine could allow courts to develop a reverse engineering exemption.

[859] Ibid

6.14.1 Implementation

Patents granted on technologies that were already known or were obvious, means the resulting patents cause social costs without offsetting benefits.[860] A serious criticism of software patents is not the concept but its "abysmal implementation."[861] Particularly in the USA, patents are being granted for processes and ideas that are obvious and not inventive.[862] In the 1980s and 1990s insufficient familiarity with software technology and inadequate access to appropriate databases to ensure vigorous examinations resulted in the USPTO granting patents on processes that programmers claimed had been known and used for decades.[863] This problem is recognised and there have been calls to reinvigorate the non-obviousness standard for obtaining patent protection for software interfaces.[864] Following these concerns internal procedures were revised and a relatively cheaper administrative challenge introduced to allow third parties to challenge the issuance of patents without resort to court litigation. Despite this the present software environment is said to be "polluted by bad software patents" which have a particular effect on open source developers who lack the resources to challenge a patent's validity or defend themselves against allegations of infringement.[865] The broad and often imprecise language in software

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860 Mark Lemley and Carl Shapiro, 'Probabilistic Patents' (2005) 19 (2) Journal of Economic Perspectives, Spring, 75-98 – they note that roughly half of all litigated patents (less than 1% of all patents granted) are found to be invalid.

861 A Jaffe and J Lerner, 'Innovation and its discontents' (2004) 202 referred to by Andrés Guadamuz González**,** "The software patent debate" (2006) 1 (3) Journal of Intellectual Property Law and Practice 196, 205.

862 Ibid Gonzalez, 205 provides a quote that as much as 95% of software patents may be invalid due to the existence of prior art; Pamela Samuelson, "Are Patents on Interfaces Impeding Interoperability?" (2008) Berkeley Centre for Law & Technology 1

863 Jonathan Band and Masanobu Katoh *Interfaces on Trial 2.0 (*MIT Press 2011)

864 Pamela Samuelson, 'Are Patents on Interfaces Impeding Interoperability?' (2008) Berkeley Centre for Law & Technology 1, 28-29; David Evans and Anne Layne-Farrar 'Software Patents and Open Source' (2004) 9(10) Virginia Journal of Law & Technology, also call for reforms but consider abolishing patents for software altogether is too drastic a step.

865 by Andrés Guadamuz González 'The software patent debate' (2006) 1 (3) Journal of Intellectual Property Law and Practice 196 205; Pamela Samuelson, 'Are Patents on Interfaces Impeding Interoperability?' (2008)

claims increases the likelihood that a software developer has no idea a patent applies until they receive a cease-and-desist letter. Reform is uncertain as patent legislation remains controversial and poor quality patents remain a potential threat to interoperability.[866]

Patents are granted on a national basis and there is variance in the legal position. It cannot be certain that the problems at the USPTO have affected Europe and the UK patent practice but criticism exists of European patents, and examples that are not innovative and where prior art exists have been identified.[867] The patent system may be national, but 3D CAD software is international as are standards in software interfaces. A policy on patents and on standards cannot assume that Europe is isolated from these problems.

The acknowledged drawbacks to software patents for interfaces, including insufficient rigour in the standard for non-obviousness and lack of adequate cost effective post grant review,[868] has made organisations such as OASIS and W3C sufficiently wary of patents to adopt royalty free policies to avoid patent hold ups.[869]

In addition to incentivising innovation, patents are granted in return for early publication of the invention. Software patents do not however have to disclose the source code or object code or even detailed descriptions of the patented program.[870] As patents can be narrower than the interface they do not necessarily require the revelation of all the "trade secrets" necessary for full compatibility. Patent protection can be available in addition to trade secret protection, but as the patentable element of software is often not visible, other than by reverse engineering, trade secrecy is an alternative to patenting. As patenting requires

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Berkeley Centre for Law & Technology 1, 29 believes a more cost effective way to challenge invalid patents is needed than the current litigation and re-examination procedures.

[866] Jonathan Band and Masanobu Katoh *Interfaces on Trial 2.0 (*MIT Press 2011), 189

[867] Andrés Guadamuz González, 'The software patent debate' (2006) 1 (3) Journal of Intellectual Property Law and Practice 196, 205 and see: http://eupat.ffii.org/patents/samples/index.en.html

[868] Pamela Samuelson 'Are Patents on Interfaces Impeding Interoperability?' (2008) Berkeley Centre for Law & Technology 1, 29

[869] OASIS has also adopted a FRAND option.

[870] James Bessen and Robert Hunt, 'An Empirical Look at Software Patents ' (2007) 16 Journal of Economics and Management Strategy 157, Courts in the USA have accepted high-level functional descriptions.

some disclosure it is feared that adverse selection may occur where more innovative ideas are kept secret and only the obvious ideas are there for all to see.[871]

6.14.2 Potential Abuse of Patent System

In the Guidelines on Horizontal Agreements,[872] firms were categorised by their use and ownership of patents which would affect their interests in the outcome of the standard setting process.[873] There were the upstream-only companies that only develop and market IPR, and their incentive is to maximise royalties. There are the downstream-only companies which make or supply services based on IPR owned by others and which want to minimise royalties. The third group is made up of vertically integrated companies which both own IPR and make goods or supply services and have mixed incentives. There is a concern that RF standards could foreclose the business for the upstream-only firms. This business model of non-practicing entities (NPEs) includes universities and research centres and patent "trolls".[874]

NPEs acquire patents in order to license them to others, although some also conduct research themselves. NPEs are very active in software patents[875] as software patents can be vague. NPEs are said to account for about 41% of patent litigation involving software patents.[876] The loss to defendants as a result of this litigation has been assessed at half a

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[871] Christian Koboldt, 'Much Pain for Little Gain? A Critical View of Software Patents' (2003) (1) Journal of Information Law and Technology

[872] Commission Guidelines on the applicability of Article 101 of the TFEU to Horizontal Co-operation Agreements OJ [2011] C 11/1.

[873] Ibid para 267

[874] Tom Ewing and Robin Feldman, 'The Giants Among Us' (2012) Stanford Technology Law Review 1 – in a little more than five years, the largest of the NPEs have accumulated 30,000-60,000 patents worldwide, which would make it the 5th largest patent portfolio of any domestic US company and the 15th largest of any company in the world. http://stlr.stanford.edu/pdf/feldman-giants-among-us.pdf but see also Damien Geradin "What's wrong with royalties in high technology industries?" (December 2009) TILC Discussion Paper DP 2009-045 who presents the case for royalties for upstream only firms

[875] While NPEs are not specifically active just in interfaces or standards they are attractive to NPEs as it is easier to identify infringements

[876] James Bessen, 'The Private and Social Costs of Patent Trolls' (2011) Regulation, Winter, 26 - 35, 34.

trillion dollars while the benefit to the original patent inventor was only 2 percent of that amount.[877] The threat of this litigation, which for software is often for an inadvertent infringement, can be a disincentive to innovate.[878] There is concern that the incentive flow to small inventors does not offset the very much larger disincentive imposed on technology firms. This shortfall is considered a social cost of NPEs.

The aim of preventing imitation is the traditional patent motive, but there is evidence of other strategic motives. These include blocking competitors by patenting in adjoining fields with no intention of exploiting the patent, and for the purpose of exchanging and cross licensing.[879] "Patent thickets" are cited as a disadvantage of patenting of software as they may require complex cross-licensing to allow newcomers to enter the market, but patent thickets are said not to effect research and development spending.[880]

6.15 Patents and Interfaces and Standards

Patents in standards are said to aid investment in and diffusion of the standard as well as encouraging patents to be committed to a standard.[881] Further, while patents may not be well suited to software inventions, there is said to presently be insufficient empirical evidence that patents are such a major impediment to interoperability that the exclusion of interfaces from patent protection is justified.[882] There are however several examples of established firms with strong market positions taking patents on interfaces, possibly with the aim of controlling the development of competing and complementary products.[883]

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[877] Ibid 31-32

[878] Ibid 33

[879] Knut Blind, 'Motives to patent: Empirical evidence from Germany' (2006) Research Policy 35, 655-672.

[880] Ronald Mann, 'Do Patents Facilitate Financing in the Software Industry?' (2005) 83 (4) Texas Law Review 961 - 1030, 999-1004.

[881] Knut Blind 'Motives to patent: Empirical evidence from Germany' (2006) Research Policy 35, 655-672

[882] Pamela Samuelson 'Are Patents on Interfaces Impeding Interoperability?' (2008) Berkeley Centre for Law & Technology 1, 48 reached this conclusion after talking at length to industry experts and being surprised at the lack of examples of patents as an impediment to interoperability.

[883] Ibid 19

Patents are considered most threatening to competition when they are held by established firms with market power which may use them to leverage their dominant position in one market into an adjacent market.[884]

The exclusionary power of patents in interfaces is considered strong[885] as infringements are easier to detect than other software patent infringements and as patents protect the function and not just the way the code is written, thus potentially making it impossible to work around the patent.[886] In the absence of a Standard Setting Organisation 'SSO'[887] imposing a FRAND or RF obligation, firms can often charge higher royalty rates for licensing interface patents than other patents, regardless of the intrinsic degree of innovation.[888] This practice known as "patent hold up" should be alleviated where the SSO successfully adopts a FRAND or RF policy.[889]

Patent ambushes are another potential problem in standards where members of SSOs are deceptive and only assert their patents after the standard is set. A similar risk comes from non-members who subsequently assert patents without any FRAND obligation. These incidences are not common but significant when they do occur. Standards in some parts of the ICT industry have also suffered from royalty stacking where multiple royalties impose a burden that is inefficient or even obstructive as individual rights holders do not take account of the negative effect on downstream sales. Again it is argued that excessive

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884 Ibid 3

885 Maureen O' Rourke 'Towards a Doctrine of Fair Use in Patent Law' (2000) 100 Columbia Law Review 1117, 1218 – noting that many interfaces are arbitrary, obvious and /or of low intrinsic value.

886 Mark Lemley and Carl Shapiro 'Patent Holdup and Royalty Stacking', (2007) 85 Texas Law Review 1991, 2016.

887 Standard Setting Organisation (hereafter SSO)

888 Maureen O' Rourke 'Towards a Doctrine of Fair Use in Patent Law' (2000) 100 Columbia Law Review 1117, 1218.

889 Damien Geradin 'Reverse Hold-ups: The (Often Ignored) Risks Faced by Innovators in Standardized Area' The Pros and Cons of Standard Setting, 2010 Konkurrensverket, Swedish Competition Authority, in which it is argued that the risk of patent hold-ups is exaggerated and the real risk is of under compensation for patent holders.

cumulative royalties are uncommon and whether royalties are passed downstream to end customers depends on a number of market factors.[890]

A further concern is that the royalty that can be imposed may be due to the nature of the standard rather than the value in the IPR. The IPR holder may try to profit from the standard's strategic position and extract excessive rents.[891]

Participants in the process of adopting a new interface standard tend to accept the IPR of others if its own IPR is also accepted. Although the participants benefit, this is unfair to those who do not participate and to the end user who ultimately bears the cost.[892]

Patents may not be the only IPR in interfaces, but patents appear more likely to attract licence fees than other IPRs. Following the *Microsoft* case and the settlement in 2009, Microsoft still continued to charge royalties for its interface patents but not for non-patented interface information.[893] Microsoft's willingness to license protocols including to SAMBA on GPL-friendly terms may not have occurred but for the Commission's enforcement action.[894]

6.16 How do SSOs Approach IPR?

While the terms adopted by SSOs vary, the majority require or encourage members to disclose essential patents, and sometimes all IPRs of which they are aware. It is not usually required for participants to disclose pending patents or to conduct searches. Some SSOs do not require disclosure provided the patent holder is willing to commit to licence on FRAND or RF terms. An empirical study found that mandating RF licensing is negatively associated

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[890] Damien Geradin, 'What's wrong with royalties in high technology industries?' (December 2009) TILEC Discussion Paper DP 2009-043. http://ssrn.com/abstract=1104315

[891] Knut Blind and others 'Study on the Interplay between Standards and Intellectual Property Rights' (OJEU S136 of 18/07/2009) Final Report

[892] Ken Krechmer 'Open Standards: A Call for Change' (2009) May IEEE Communications Magazine 88, 91

[893] http://www.microsoft.com/openspecifications/en/us/programs/default.aspx[accessed 20 December 2014]

[894] William Page and Seldon Childers 'Bargaining in the Shadow of the European Microsoft Decision: The Microsoft-Samba Protocol License' (2008) 102 Northwestern University Law Review 332 – 354.

with a disclosure requirement, but that FRAND is strongly associated with such a requirement.[895]

The W3C requires patents necessary for interoperability to be licensed RF, although there is a procedure for getting an exclusion from RF.[896] OASIS adopted RF licensing options but also allows for some licensing of patented technologies for standards on RAND terms. Apparently the RF terms have proved more popular and the overwhelming majority have adopted RF policies for application and web services approved by OASIS.[897]

Patents remain enforceable even where an RF policy for interface patents is adopted, but it is thought that this policy reduces their leverage and economic value. This will dampen incentives to acquire patents. Even so, some open source developers do not agree with W3C and similar RF policies as the license may still include restrictions that are not acceptable to some members of the open source community.[898]

When a sample of SSOs policies was reviewed in 2002,[899] the majority adopted standards which included IPRs, but two SSOs prohibited the continued ownership of any IPRs adopted by a standard, and one required members to give up patent rights. The policy of at least one of those SSOs, the ISO, which validates the STEP standard, has changed and members can now continue to own patents with a policy of disclosure and licence of patents on RF or RAND terms.[900] Four SSOs permitted members to own the patents but only if they licensed

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[895] Benjamin Chiao, Josh Lerner, and Jean Tirole 'The Rules of Standard Setting Organizations: An Empirical Analysis'(February 9, 2005) http://www.people.hbs.edu/jlerner/ssoempirical.pdf

[896] http://www.w3.org/2004/10/patents-standards-innovation.html

[897] Pamela Samuelson 'Are Patents on Interfaces Impeding Interoperability?' (2008) Berkeley Centre for Law & Technology 1, 43. http://www.oasis-open.org/standards Carl Mair in correspondence with the authors (1 October 2012) points out that software standards adopted under FRAND are uncommon and there is a move towards more Web-based applications that use RF standards, such as W3C.

[898] Ibid Samuelson, 43

[899] M Lemley 'Antitrust Intellectual Property and Standard Setting Organisation' (2002) 90 California Law Review 1889, 1902, the rules of 43 different SSOs setting standards in telecommunications and computer-networking industries were surveyed in 2002.

[900] The ISO policy, along with the ITU and IES was changed in 2007, see http://isotc.iso.org/livelink/livelink/fetch/2000/2122/3770791/Common_Policy.htm and http://www.iso.org/iso/newsandmedia/pressrelease.htm?refid=Ref1052

them RF.[901] A further survey recorded in 2005 found a majority of SSOs (63%) used RAND in the patent licensing rules and only 9% used RF rules.[902] More recently there are signs of a shift towards RF licensing as Google and Web standards bring competitive pressure to adopt RF licensing models.[903]

One thing most SSOs have in common is that while they may require patents to be licensed on FRAND terms, the negotiations on converting that principle into actual figures and words must take place between the parties. The 2005 survey found that only 9% of organizations have a dispute resolution mechanism. Most SSOs are not involved in agreeing what may constitute a reasonable fee or other terms.[904] Interviews confirmed that the ISO was not involved in setting fees for the use of the STEP standard.[905]

6.17 Remedies for Breach of Patents

Not only is the existence of poor quality patents harmful to interoperability but the nature of the remedies, particularly the granting of injunctions, can exacerbate the position. This is especially the case in the ICT industry where they can be thousands of patents in one product. Patent trolls[906] are particularly active in the software industry with software

The ISO members can make a declaration whether they will license on RF/RAND or just RAND terms, or not at all. If they do not agree to license on RAND/RF terms then the patent should not be included in the standard. ANSI and ETSI have similar policies.

[901] (I20 SIG, RosettaNet, MWIF and Wired for Management). Allowing them to keep the patent but license on royalty free basis allows them to use the patent to challenge infringement which is not related to the standard.

[902] Benjamin Chiao, Josh Lerner, and Jean Tirole 'The Rules of Standard Setting Organizations: An Empirical Analysis'(February 9, 2005) http://www.people.hbs.edu/jlerner/ssoempirical.pdf, 19

[903] Carl Mair, 'Openness, Intellectual Property and Standardization in the European ICT Sector' (2012) 2 (2) IP Theory, Indiana University.

[904] See eg the ISO/ITU/IEC policy that "negotiations are left to the parties concerned and are performed outside ITU-T/ITU-R/ISO/IEC", http://isotc.iso.org/livelink/livelink/fetch/2000/2122/3770791/Common_Policy.htm

[905] Interview with industry expert #5 (September 2014)

[906] Also known as non-practicing entities

patents ten times more likely to be asserted than other patents[907] The threat of injunction and damages and legal costs is a recognised problem.[908] Under TRIPS, injunctions should be available for patent infringement but can be subject to certain requirements[909]

There is an argument that the patent system is "self-correcting" which was demonstrated in the US Supreme Court decision in *eBay v MercExchange* which disapprove of granting injunctions as the "general rule" as "a right to exclude" referred to the nature of the rights and not the nature of the remedy.[910] The threat of an injunction is a strong bargaining tool employed by patent trolls to charge exorbitant fees and to leverage negotiations where a patent only covers a component of a larger product.[911] The decision in *eBay* favours interoperability as a reasonable royalty rate will normally make the patentee whole[912] and the public interest favours competition.[913]

Damages and even royalties can themselves be harmful to interoperability. Damages payments are usually aimed at compensating the claimant rather than penalising the wrongdoer. Damages could equate to the royalties that could have been paid or where a licence would not have been granted to compensation for anticipated profits. An account for profits, which is based on actual diverted profit rather than notional damages is

[907] Mark Lemley and Douglas Melamed 'Missing the Forest for the Trolls' (2013) 113 Columbia Law Review 2117-2189, 2123

[908] Patent Trolls are calculated to cost society about $30 billion per year see Mark Lemley and Douglas Melamed 'Missing the Forest for the Trolls' (2013) 113 Columbia Law Review 2117-2189 quoting James Bessen & Michael J Meurer 'The Direct Costs from NPE Disputes, 99 Cornell Law Review (2014) forthcoming.

[909] TRIPS Agreement, articles 44 – 46. In the UK injunctions are at the discretion of the court and the claimant must establish that damages are not an adequate remedy. For an interim injunction he must also show that there is a serious question to be tried and the balance of convenience. *American Cyanamid Co v Ethicon Ltd* [1975] RPC 513

[910] eBay, Inc. V MerExchange, LLC 547 US 388 (2002)

[911] eBay, Inc. V MerExchange, LLC 547 US 388 (2002), 396

[912] Patent Damages 35 USC § 284

[913] Pamela Samuelson 'Are Patents on Interfaces Impeding Interoperability' (2008) Berkeley Centre for Law & Technology 1

available but not as an automatic alternative.[914] Exemplary damages are rare although the EU Directive on IP enforcement sets out when damages are payable for economic and moral harm.[915] In the US in addition to lost profits or reasonable royalty awards, in the event of a wilful infringement, which is found in the majority of cases, the award can increase three fold.[916]

Large damages have negative consequences encouraging litigation rather than licensing, as even a settlement can result in higher licences fees. This "royalty burden" falls on innovative companies and encourages patent trolls. Failure to apportion damages results in damage awards for prior art in the public domain and technology patented by third parties over compensates plaintiffs unjustly.[917] Post 2000 there has been a shift away from lost profit awards to reasonable royalty awards. As lost profits are available only where the patent holder could have made a sale the rise in royalty awards reflects the increase in ownership by companies who do not manufacture or distribute.[918] The basis for calculating lost profits or the reasonable royalty can be either a portion of revenue credited to invention or entire market value. If the reasonable royalty is based only on the value of the infringed interfaces, rather than on the value of the entire interoperable product, it will encourage the development of interoperable products by reducing the risk of draconian damages.[919]

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[914] Cornish, Llewelyn and Aplin *Intellectual Property: Patents, Copyright, Trade Marks and Allied Rights* (8th Ed Sweet & Maxwell 2013)

[915] Directive 2004/45 of 29 April 2004 on the Enforcement of Intellectual Property Rights OJ L157/45

[916] Jonathan Band and Masanobu Katoh *Interfaces on Trial 2.0 (*MIT Press 2011), 196

[917] Patent Reform of 2007: Hearing HR 1908 Before the H. Subcom. On Courts, the Internet, and Intellectual Property of the H Comm. on Judiciary 110th Cong. 65 (2007) (statement of John R. Thomas, Georgetown University Law Center)

[918] PricewaterhouseCoopers, Patent and Trademarks Damages Study 22, 2007 http://www.pwc.com/us/en/forensic-services/publications/assets/2007-patent-study.pdf [accessed 20 October 2015]

[919] Jonathan Band and Masanobu Katoh *Interfaces on Trial 2.0 (*MIT Press 2011), 204

Even if interfaces are free of copyright and can be reverse engineered, a patent on the interface can frustrate interoperability. This is particularly the case when the patent holder does not participate directly in the market for the program or related products but is purely seeking to maximise revenue without any incentive to cross license their own technology.[920] For this reason patent quality and damages are crucial to improving the interoperability of 3D CAD software.

6.18 Is There a Failure in the Market due to IPRs in Interfaces and Standards?

Most commentators agree that there should be a market for standards with minimal government interference in interfaces both for de facto and formal standards. IPRs are however by their nature interference, as they give exclusive rights of self-interest in return for benefits that give public economic welfare in the form of incentives to innovate and publication of past innovations. IPRs are granted in the expectation that the deadweight loss caused by the grant of exclusivity is lower than the value of increased inventiveness that follows.

Market failures are not limited to actual failures of markets to appear, but also occur when markets fail to align private and social economic welfare and arguably socio-economic goals.[921] Market failure also occurs due to asymmetric information. Software systems are sufficiently complex that, while the producer may have an advanced understanding of the system, the user does not, until it is too late.

Lerner and Schankerman acknowledge that there are shortcomings in both patent policy and the functioning of SSOs with externalities due to network effects and a lack of information about the market, particularly open source software. They do not however consider that governments should intervene for example by exploiting their purchasing power to compensate for distortions, and change the nature of the market. They propose that market failure in the form of abuse of network dominance should be addressed by

[920] Ibid 204

[921] Wendy Gordon, 'Fair Use as Market Failure: A Structural and Economic Analysis of the Betamax Case and its Predecessors' (1982) 82 Columbia Law Review 1600-1657; and 'Market Failure and Intellectual Property: A Response to Professor Lunney' (2002) 82 Boston University Law Review 1031-2002.

competition law.[922] A lack of interoperability, lock-in and high switching costs do not always justify intervention, even when the results are strong network effects. Innovation can still happen in other ways, such as the "gale of creative destruction" or the "killer app" rather than evolution.[923]

In some software markets there appears to be a dominant supplier. It is claimed that the desktop PCs of Europe's governments are completely locked in to a single proprietary software vendor due to high switching costs.[924] The market is tipped "towards a certain technology or standard, not necessarily the one offering the highest user benefits, creating a monopoly position for the seller of that technology."[925]

Competition law provides an ex post remedy and while it can be flexible it should only apply to exceptional cases which are not structural and which have not been anticipated by an *ex ante* regime. Identifying in advance which cases are anticipated rather than exceptional can be difficult. This was attempted in the Software Directive[926] in Europe and considered in *Trinko*[927] In telecommunications law and design protection law ex ante exemptions are in

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[922] Josh Lerner and Mark Schankerman, *The Comingled Code: Open Source and Economic Development* (MIT Press 2010). In email correspondence with the authors (29 August 2012) Jacques Crémer and Mark Schankerman propose that procurement power should not be used to address any perceived market failure which should be addressed instead by competition law or by drafting exceptions to patent protection into patent law.

[923] Joseph Schumpeter, *Capitalism, Socialism, and Democracy* (George Allen, London, 1976) first published 1942, 81 *et seq*

[924] It is said that less than ten thousand of Europe's civil servants use a desktop system that does not depend on this proprietary software vendor which equates to one fifteen-hundredth (0.0007) of the total of fifteen million desktops; Gijs Hillenius, 'Governments could save millions by reducing their dependence on a single desktop PC software vendor' (11 March 2011) European Journal of ePractice, www.epracticejournal.eu.

[925] Michiel Bijlsma, Paul De Bijl, and Viktoria Kocsis 'Competition, innovation and intellectual property rights in software markets' (CPB Netherlands Bureau for Economic Policy Analysis No 181 March 2009) 55-74

[926] Thomas Vinje 'The History of the EC Software Directive' in M. Lehmann & C. Tapper *A Handbook of European Software Law*, Clarendon Press Oxford 1993; Ashwin van Rooijen *The Software Interface between Copyright and Competition Law* (Kluwer Law International 2010), 202

[927] *Trinko* (US Supreme Court 2004) 411, there was no duty to deal by the telecommunications operator Verizon under competition law as there was already a duty under telecommunications law.

place which remove the need to resort to competition law to correct for structural and foreseeable. Design protection laws exempt control over interconnecting and replacement parts in secondary markets. The telecommunications industry has a pro-active regulator to address refusals by operators to interconnect.

The IPR regime for software, which is arguably not fit for purpose, gives an additional barrier to entry by giving monopoly rights that may not efficiently incentivise innovation. For competition law to intervene there must be both dominance and evidence of abuse, and the remedy invariably gives only a slow *ex-post* remedy. But due to lack of interoperability and the resulting lock-in and high switching costs there can be little competition in some software markets even where there is no obvious monopoly.[928] Lack of interoperability means the market is not contestable, but as there is no single dominant supplier a normal remedy under competition law is unavailable.

Chapter 5 demonstrated that competition law will not address failures in oligopolistic markets, such as the 3D CAD industry, caused by a lack of interoperability. Where a market such as the 3D CAD industry suffers from large switching costs which can create ex post monopolies and segment an otherwise undifferentiated market allowing firms to focus on customers rather than compete with rival buyers and extracting oligopolistic profits, some intervention in the form of pro-compatibility public policy may be justified, particularly where incompatibility is chosen rather than inevitable.[929]

Market power is usually closely linked to the subject matter protected by intellectual property rights. An example is a patent which protects the precisely claimed subject matter but not the entire product containing the protected subject matter. Traditionally copyright protects the original expression of the novel. The position is not the same for interface specifications as their demand can be driven not by their subject matter but by the demand

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[928] An example is the 3D computer aided design market see Cyon Research 'Intellectual Capital and Interoperability' Cyon Research Corporation, 2003. The supply of IT to the UK Government has been described as an oligopoly with evidence of barriers to entry and lock-in. Public Administration Committee *Government and IT- "A Recipe For Rip-Offs": Time For A New Approach Twelfth Report,* (HC) March 2011, 715-II.

[929] Joseph Farrell & Paul Klemperer 'Coordination and Lock-in: Competition with Switching Costs and Network Effects' in M Armstrong & R Porter (eds) *Handbook of Industrial Organization* (Vol 3, Elsevier 2007).

for the computer program or platform that relies on the interface. This can be magnified by network effects and lock-in. This arguably gives control over more than the subject matter which is disproportionate and undesirable.[930]

Interfaces are essentially de facto or formal standards. It is generally difficult to anticipate in advance which subject matter will evolve into a standard. Interfaces specifications are more easily identifiable as standards. The case for an *ex ante* approach to control of interface specifications is stronger than for standards generally. It is more feasible to achieve an *ex ante* approach which gives more certainty to software developers which should encourage competition and innovation. This is not however reflected in the Software Directive which has too little openness of interface information particularly in the overly restrictive provision on reverse analysis in Article 6.[931]

Vendor lock-in and high switching costs are said to give a first-mover advantage leading to higher prices and entry barriers for suppliers of new software products. "In software markets, the implication is not necessarily that production by a single firm is the most efficient outcome."[932] "The resulting high monopoly price creates a deadweight loss, that is, a loss in welfare that occurs when demand is reduced due to a mark-up in the price."[933] By "welfare", economists mean consumer and producer surplus.[934]

[930] Ashwin van Rooijen *The Software Interface between Copyright and Competition Law* (Kluwer Law International 2010, who also argues that copyright protection of code bears little relationship to the market power conferred as it is caused by the demand for functionality of the program which copyright should not protect.

[931] Ibid 202

[932] Michiel Bijlsma, Paul de Bijl and Viktória Kocsis 'Competition, innovation and intellectual property rights in software markets' (CPB Netherlands Bureau for Economic Policy Analysis No 181 March 2009) 32

[933] Ibid 31

[934] Gijs Hillenius, 'Governments could save millions by reducing their dependence on a single desktop PC software vendor' (11 March 2011) European Journal of ePractice, www.epracticejournal.eu.

The dependence on a single IT vendor by public bodies has been described as "a waste of public money that public bodies can no longer afford",[935] a waste not only of public money but also of the private money of the citizen who has to use a specific product (rather than any product compliant with an applicable standard), to use a public service. Policies encouraging public bodies to purchase compatible software by specifying open standards can bring pressure on the market to remedy lock-in and reduce cost.[936] With the exception of the JT standard, there is little evidence of this sort of pressure being brought to bear on the 3D CAD market as OEMs appear to value data integrity over openness of software systems.[937] While the software is protected by IPRs and there is little effective market pressure to increase openness interoperability will continue to cause huge cost to users.[938]

6.19 Summary

The 3D CAD suppliers all use copyright, trade secrets and patents to protect the intellectual property in their computer programs. These regulations allow the suppliers to protect the innovation created by their research and development activities. The rationale for the IPRs is to incentivise innovation by giving a defined monopoly.

The law has recognised that software interfaces should be exempted from copyright protection. In the US there is uncertainty as to how far functionality will exclude either direct or indirect copying of code and other expression but ideas and principles underlying the interface are exempt. In Europe the format of data files used to exploit functions has

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[935] Neelie Kroes Address at Open Forum Europe 2010 Summit: 'Openness at the heart of the EU Digital Agenda' Brussels 10th June 2010. http://europa.eu/rapid/pressReleasesAction.do?reference=SPEECH/10/300&format=HTML&aged=0&language=EN&guiLanguage=en

[936] Sally Weston and others 'Open Standards in Government IT: a Review of the Evidence' (UK Cabinet Office September 2012)

[937] Interview with senior industry executive and industry experts # 1,3 & 6

[938] David Prawel in Chad Jackson and David Prawel 'The 2013 State of 3D Collaboration and Interoperability Report' Lifecycle Insights and Longview Advisors http://www.tetra4d.com/collateral/3D-Collaboration-Interoperability-Report.pdf [accessed 11 October 2014], 8

been held to justify exclusion from copyright protection.[939] Interfaces that are written in new code from specifications obtained by reverse engineering are not copyright protected under the Software Directive.

The law on software patents has developed separately and there is generally no exemption for interfaces. There is evidence that the concept and implementation of software patents is flawed, does not incentivise innovation and could restrict the operation of standards and interoperability. This raises the question of whether there is any economic justification in encouraging patent protection of interfaces. The case is certainly doubtful and intellectual property has failed to adequately address the indirect effects of control over interface specifications on interoperability. This failure can impact competition and innovation.[940]

It raises the question whether there is a failure of the market with overprotection of interfaces which cannot be rectified by reverse engineering or by conventional competition law, particularly in an oligopolistic market.[941] Lack of interoperability is conventionally overcome by the use of standards. The 3D CAD industry has several standards including the most widely used STEP standard but this provides limited compatibility. Standards that are compatibility standards cannot be avoided and consequently give an unplanned expansion of the protection for both copyright and patents. The hidden nature of the code also extends the protection usually secured by trade secrets. Standards, including the role of IPRs, will be considered in the next Chapter.

[939] *SAS Institute* CJEU, para 39

[940] Ashwin van Rooijen 'The Software Interface between Copyright and Competition Law' (Kluwer Law International 2010), 198

[941] Competition law is not able to provide an alternative suitable remedy as it is ex post and as considered in Chapter 5 relies on a definition of dominance which does not take account of a lack of interoperability in its criteria and hence is unavailable in oligopolistic markets.

CHAPTER 7. STANDARDS

7.1 Introduction

Standards are sets of voluntary technical and quality criteria for products, services and production processes. They help businesses in working together which ultimately saves money for the consumer. They are a set of technical specifications that provide a common design for some product or process. One aspect is the technical specifications for markets where compatibility and interoperability with other products or systems is essential.[942] This includes software to software interoperability. Available and accessible standards can reduce market or supplier lock-in. Software built around open standards can interoperate and avoid users being unintentionally locked-in for decades to particular IT solutions.[943]

Standardisation can lead to economic efficiency and substantial consumer benefits.[944] In addition to providing information to encourage interoperability standards can encourage the development of new and improved products or markets, improve quality and supply conditions which normally increase competition and lower output and sales costs, benefiting the economy as a whole.[945] Knowing the requisite standard reduces risk of market entry and can speed up market adoption of new products and technologies. Competitors know the common baseline. Standards can also increase substitutability, thus increasing competition and lowering prices.[946]

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[942] Commission Guidelines on the applicability of Article 101 of the TFEU to Horizontal Co-operation Agreements OJ [2011] C 11/1 (the Guidelines on Horizontal Agreements or the Guidelines)

[943] Digital Agenda for Europe – Interoperability and Standards Pillar**,** Action 23: Provide guidance on ICT standardisation and public procurement

[944] M Lemley ‘Antitrust Intellectual Property and Standard Setting Organisation’ (2002) 90 California Law Review 1889

[945] Commission Guidelines on the applicability of Article 101 of the TFEU to Horizontal Co-operation Agreements OJ [2011] C 11/1

[946] Marcus Glader 'Open Standards: Public Policy Aspects And Competition Law Requirements' (2010) 6 European Competition Journal 611

There are however dangers with standards and they can impact competition in three main ways. They can reduce price competition, can foreclose innovative technologies and they can exclude or discriminate against certain companies by prevention of effective access to the standard.[947]

Standards in interfaces include standard document formats and protocol specifications. These may include IPRs in the form of copyright and patents. De facto standards are normally proprietary interfaces that have become standards due to the market share enjoyed by the proprietary software. An example is Microsoft's ".doc" document format. Open Standards by contrast are created by standard-setting organisations (SSOs) which can be either formal standards bodies such as the International Standards Organisation (ISO) or consortia such as the Internet Engineering Task Force (IETF) or World Wide Web Consortium (W3C). It is estimated that other consortia and fora are the origin of about 60 per cent of standards in the ICT sector. Examples include HTTP, HTML, Wifi and XML.[948]

In this Chapter the benefits, disadvantages and shortcomings of standards will be analysed in the context of the 3D CAD market. This will consider not only activity and practice by the industry to adopt standards but also the legal framework including competition law and licencing of IPRs on FRAND or RF terms.

[947] Commission Guidelines on the applicability of Article 101 of the TFEU to Horizontal Co-operation Agreements OJ [2011] C 11/1

[948] The Commission, recognising the importance of the less formal standard setting bodies, issued a White Paper to modernise ICT standardisation policy. Commission White Paper, 'Modernising ICT Standardisation in the EU – The Way Forward', COM(2009) 324 final 2. See also 'EU Study on the specific policy needs for ICT standardisation' (Final Report, July 2007) http://ec.europa.eu/enterprise/sectors/ict/files/full_report_en.pdf [accessed 6 August 2015] One of the key aims is to identify attributes that all standard setting organisation should have, whether formal, open or restricted.

7.2 Standards and 3D CAD

Standards are used in the 3D CAD industry to provide various levels of interoperability. The two most widely used formal standards are ISO 10303 (STEP) and IGES[949] which are both file formats that allow the digital exchange of information between 3D CAD systems.[950]

STEP has been the most serious and continuing attempt to develop an international standard for data exchange of CAD models. The standard has been limited to transferring geometry but is incapable of handling the additional process information needed to amend the model. Only a "dumb" shape model is transferred with essential information on construction history and constraint parameters missing.[951] Proof of concept tests on enhancements to ISO 10303 find that "the coverage of geometry and design intent achieved is only a subset of what is necessary for full practical translators and not all problems encountered have been fully overcome".[952] The APIs of commercial CAD systems are not primarily intended as an interface for model exchange which may prevent the transfer of all design intent information.

STEP allows design engineers to save a 3D module in a 'non-native' format such as an 'STP' file. The file can then be sent to others including suppliers and designers outside their firm. The recipient can see the 3D model but will not have all the design history and will be unable to edit the module. For some applications this is adequate and can have advantages as less information is transferred. Incomplete transfers are however common and data

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[949] IGES, Initial Graphics Exchange Specification, is an ANSI standard first published in 1980. It is said that interest in IGES declined after the first release of STEP (ISO 1030) in 1994 and the last release of IGES was version 5.3 in 1996. IGES is still used but is less supported and appears to be less popular than STEP.

[950] Of respondents to the 2013 State of 3D Collaboration and Interoperability Report, Lifecycle & Longview, 79% of respondents said they use 79% STEP and 58% IGES http://ptccreo.files.wordpress.com/2013/05/2013-collaboration-and-interoperability-study-ptc.pdf [accessed 9 November 2014]

[951] Conversations between author and software design engineers 2014 - 2015

[952] Junhwan Kim et al. 'Standardised data exchange of CAD models with desing intent' (2008) 40 Computer Aided Design. The essential elements of lost information include: construction history – the procedures used to construct the model; parameters, variables associated with dimensions and other values; constraints relationships between parameter values and geometry and features such as shape configurations.

cleansing including those which involve factoring the data back in again drive up errors and errors cost money.[953] As only incomplete information is transferred from one proprietary software system to another, or even between different versions, it does not provide a remedy to lock-in.

STEP and IGES converters are normally supplied by the 3D CAD suppliers, incorporated into the modules in which their own proprietary software is supplied. The standards are also used by developers of complementary software such as Eurostep to create innovate solutions to data exchange.[954]

The lack of adequate standards has encouraged the development of software companies which specialise in software to provide interoperability, but the companies' success in providing a technical solution or being affordable to all users is mixed. Less than 33% of engineering companies surveyed used a third party translator and of those only 45% indicate that they get the results they want with these applications better than 75% of the time.[955] "The translators are based on the same underlying principle as the standard that instead of doing multiple point to point you work through some neutral format. Essentially they have their own proprietary neutral format but that means you have to buy all your translation requirements from them."[956] As they are not an ISO standard they are not as suitable for archival purposes.[957] They can provide some relief to lock-in when used to migrate data between systems.[958] As the process is complex and expensive it only provides a limited solution in limited circumstances.

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953 Interview with industry expert #5 (September 2014)

954 Eurostep Group AB supplies 'Share-A–space' based on STEP for collaborative sharing of information in a 'hub' rather than exchanging information with suppliers, most commonly by email, which reduces time and cost and improves the quality of the data http://player.vimeo.com/video/95489634

955 Longview Advisors, Inc. 'Collaboration & Interoperability Market Report' 2008 http://www.proficiency.com/downloads/3DMarketReport2008.pdf [accessed 12 November 2010]

956 Interview with industry expert #5 (September 2014)

957 Interview with industry expert #5 (September 2014)

958 BAE Systems, *Data Migration Case Study – CAD Data Exchange Automation and Workflow Optimization,* Theorem Solutions, is an account of migrating tens of thousands of PTC CADDS 5 to CATIA. Manually

Siemens has recently allowed the JT data format to become adopted as an ISO standard.[959] This is said to be driven by customer demand although the process may have been started by UGS before its acquisition by Siemens.[960] It is seen by others in the industry as support and commitment for open standards in response to what the customers want.[961] "A big company would only make their data format a standard if they believed that being able to say that we support open standards is good in the market place".[962] The JT file is less than a tenth of the size of a normal CAD file which allows not only for visualization but also transferring the model more efficiently. JT is also used to support collaborating as part of a digital 'mock up' and data-sharing standard for the PLM industry and as a long-term data archival format.[963]

> The acquisition of SpaceClaim by ANSYS not only provides customers with a powerful but intuitive 3D direct modeling software that allows for computer simulation of failures at earlier stages of design but as SpaceClaim works on geometry and is 'CAD-neutral' it allows users to modify geometries regardless of the system in which they were created.[964] This creates a de-facto standard allowing

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monitoring and auditing made the project unfeasible due to cost of manpower. After a three month pilot to ensure the translations met required quality standards the translation was automated with an exception report indicating to operators where there might be issues in particular model or drawing.

[959] Industrial automation systems and integration -- JT file format specification for 3D visualization ISO 14306:2012

[960] Interview with senior industry executive #4 (July 2013)

[961] Interview with industry expert #1 (May 2014); Interview with industry expert #6 (June 2014)

[962] Interview with industry expert #1 (May 2014)

[963] Conversations between author and software design engineers 2014 - 2015

[964] ANSYS Acquires SpaceClaim Corporation, A Leading Provider Of 3-D Modeling Software, 1 May 2014, http://otp.investis.com/clients/us/ansys/usn/usnews-story.aspx?cid=806&newsid=16276 [accessed 9 November 2014]

designers to transfer their models to SpaceClaim for analysis by ANSYS and other computer simulation software.[965]

A main concern for the users of 3D CAD is that the standard will be available in the future to ensure access to legacy data. Users will have a commercial and often a legal requirement to maintain access to the data for several decades. They do not want to be locked-in to a standard which then becomes unavailable because the rules and procedures on which it was adopted were unlawful or unenforceable.[966] International standards such as STEP and JT have advantages over de facto proprietary standards for archival data.

One potential disadvantage of software becoming an official or even de facto standard is that it creates an on-going commitment to support it and makes it harder to modify where necessary to support future needs. Suppliers of complementary software must disclose interface information to encourage the use of their products with 3D CAD software. Suppliers express concern however about disclosing information in other layers of software which would remove freedom to change things and would lock down the behaviour of all the layers.[967]

The 3D CAD industry utilises standards in a number of ways. Official standards provide a partial solution to industry needs such as the transfer of geometry and archiving but do not provide a solution to lock-in. There has been a market response to the shortcomings in the official standards with translators and de-facto standards but these address specific solutions and their business model relies on a lack of interoperability and lock-in. Patents in the official standards present challenges and all the de-facto standards rely on proprietary software.

[965] Interview with industry expert #9 (June 2014)

[966] To keep an aircraft certified the certification data has to last 30 years so the basic design data has to last 30 years but is on a CAD system that has a life of 10 years. Industry Interview # 5

[967] Interview with industry expert #2 (May 2014)

Standards in the 3D CAD industry appear to respond to market opportunities. They must however do so within the regulatory framework to prevent restricting or distorting competition and optimising the opportunity for continued innovation.

7.3 Standards and Innovation

Standards are the accepted method of providing compatibility in traditional engineering, and in recent decades software standards have been developed to enable software interoperability. Standards have well recognised benefits such as improving economic efficiency and promoting growth.[968] Several studies have found that standards contribute nearly one percentage point per year in productivity and growth in some developed economies.[969] The relationship between standards and innovation is more nuanced. Standards can aid innovation by reducing time to market and codifying and disseminating the state of the art technology.[970] It appears that standards can increase product variety by increasing the number of value-added combinations and this is seen as more valuable than their impact on procurement or production costs. There is also a perception that standards do not level the playing field but may favour dominant firms.[971] Standards play an important role in network industries as they help the adoption of new technologies by enabling forward and backward compatibility.[972] There are concerns however that "over-standardisation" can restrict product differentiation and can decrease competition and

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[968] Marcus Glader, 'Open Standards: Public Policy Aspects and Competition Law Requirements' (2010) 6(3) European Competition Journal 611–643; GMP Swann "The Economics of Standardisation" Report for the UK Department of Business, Innovation and Skills (BIS) by Innovative Economics Ltd The Economics of Standardization: An Update, G.M.P. Swann [accessed 6 August 2015], and Mark Lemley "Intellectual Property Rights and Standard-Setting Organizations" (2002) 90 California Law Review 1889, 1889

[969] Ibid studies reported in Swann, 4-6.

[970] Ibid Swann, 9 -12; Knut Blind, 'Standardisation: A Catalyst for Innovation' (August 2009) Inaugural Address, Rotterdam School of Management, Erasmus Universiteit. http://repub.eur.nl/res/pub/17558/EIA-2009-039-LIS.pdf

[971] Knut Blind, Stephen Gauch and Richard Hawkins 'How stakeholders view the impact of international ICT standards' (2010) 34 Telecommunications Policy 162-174.

[972] Knut Blind 'Standardisation: A Catalyst for Innovation' (August 2009) Inaugural Address, Rotterdam School of Management, Erasmus Universiteit. http://repub.eur.nl/res/pub/17558/EIA-2009-039-LIS.pdf, 30

innovation.[973] The level of constraint appears to vary with the nature of the standard and its user. There may be more constraint with old standards, associated with lock-in to legacy systems, rather than with new standards, although early standardisation may constrain innovation.[974] Some standards mainly codify knowledge and are informative and more likely to have a direct benefit to innovation than constraining standards concerned with such matters as health and safety. The perception of the user also varies, with more innovative users taking knowledge from the standard and then pushing the boundaries of innovation so that innovation is not prevented.[975] Standards in software must cope with lock-in, network effects and arguably a less than optimal IPR regime but overall can offer advantages for improved interoperability.

If standards overreach or define more than necessary they can reduce product differentiation and even exclude new technologies from entering the market. An advance in technology may be deterred from entering the market if it does not comply with the existing standard. When a standard is being developed alternative technologies can complete for inclusion in the standard but once a standard is set it can become a barrier to entry excluding advances in technology from the market. Over-standardisation can limit competition and product variety. Competition authorities and courts tend to focus on the process of adopting the standard rather than the technical merits which they are less well placed to determine.[976]

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[973] Marcus Glader 'Open Standards: Public Policy Aspects And Competition Law Requirements' (2010) 6 European Competition Journal 611, 615

[974] 'The Empirical Economics of Standards' (June 2005) DTI Economics Paper 12, Department of Trade and Industry. www.bis.gov.uk/files/file9655.pdf

[975] GMP Swann 'The Economics of Standardisation' Report for the UK Department of Business, Innovation and Skills (BIS) by Innovative Economics Ltd referring to Peter Swann and RJ Lambert 'Why do Standards Enable and Constrain Innovation?' unpublished paper, Nottingham University Business School April (2010).

[976] Marcus Glader 'Open Standards: Public Policy Aspects And Competition Law Requirements' (2010) 6 European Competition Journal 611

7.4 Open and Closed Standards

Standards can be used to improve interoperability and the openness of interfaces and systems. Standards themselves are considered to be open or closed depending primarily on their treatment of IPRs in the standards.

There are many definitions of open and closed standards. On the one hand "closed" standards have no regulation of ownership or licensing of intellectual property rights IPRs. This could be a de facto standard[977] or where one member of an SSO owns the IPR and effectively controls the standard. On the other hand "open" standards have been defined as those in which the members provide their IPR so that anyone is free to use it.[978] Krechmer suggests 10 criteria for assessing the openness of standards including requirements that all stakeholders may participate and that there are low or no charges for IPR.[979] In fact most SSOs occupy a middle ground somewhere between these open and closed standard definitions, permitting their members to own IPRs but requiring the licensing of the IPR on specified terms.[980] They are open in that the standard can be used, but proprietary in that the IPR holder may demand some form of payment which is said to offer a "third way", where the IPR has some value but does not obstruct the standard.[981]

Both open and closed standards can increase interoperability and reduce lock-in. The intention is to achieve a more diverse and competitive market, enabling IT to interoperate and share information to achieve more economic efficiency in the delivery of IT. Projects

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[977] An example of a de facto standard is ".doc".

[978] The Internet is an open, non-proprietary standard as the SSO which controls the TCP and IP protocols the (IETF) had a policy of not adopting proprietary standards. The policy is now to prefer technologies with no known IPR claims or, for technologies with IPR claims, to offer a royalty-free licence. Memo on best practice on IPR in IETF Technology from S Brader to Network Working Group (March 2005). http://www.ietf.org/rfc/rfc3979.txt

[979] Ken Krechmer 'Open Standards: A Call for Change'(2009) May IEEE Communications Magazine 88. For further discussion on the definition of openness see Concurrences N° 1-2010 I Tendances I Open Standards & Antitrust; and G Bird 'The Business Benefits of Standards' Standards View (1998) 6(2) 76-80.

[980] Mark Lemley 'Intellectual Property Rights and Standard-Setting Organizations' (2002) 90 California Law Review 1889, 1902.

[981] Ibid

can be smaller and more manageable, and may be reused to avoid duplicating the commissioning of new solutions where one already exists. Standardisation of data and document formats should give customers and businesses a choice in the software they use when accessing information.

The STEP standard has few patents but the conclusion gathered from industry interviews is that patents raise challenges requiring attention and careful consideration.[982]

7.5 Guidelines on Horizontal Agreements

Setting of standards creates an exclusive market position which can easily be abused. The co-operation between competitors and the setting of detailed specifications can exclude competing technologies.[983] For this reason the behaviour of firms participating in standard setting can infringe Art 101 and 102, competition law provisions of the TFEU.

The benefits of standards are well recognised as improving economic efficiency and promoting growth[984] and for this reason are encouraged despite the possible restriction on competition. For a standard to be beneficial, it must not only have technical merit, but the rules, process and procedures of adoption on which it is available for implementation must also be sound and in particular must not infringe competition law. The Commission has issued guidance in the form of the "Guidelines on Horizontal Agreements" to assist SSOs and other interested parties in shaping the standard setting process, to comply with European competition law.[985]

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[982] Interview with senior industry executive #4 (July 2013) Interview with industry expert #5 (September 2014) The question of patents in standards was discussed in interviews and took up a proportionally long time considering the relatively few patents involved in the standards.

[983] Sven Sattler 'Standardisation under EU competition rules – the Commission's new horizontal guidelines' (2011) 32 (7) European Competition Law Review 343-349.

[984] Marcus Glader 'Open Standards: Public Policy Aspects And Competition Law Requirements' (2010) 6 European Competition Journal 611, 611; GMP Swann 'The Economics of Standardisation' Report for the UK Department of Business, Innovation and Skills (BIS) by Innovative Economics Ltd Swann; Mark Lemley 'Intellectual Property Rights and Standard-Setting Organizations' (2002) 90 California Law Review 1889

[985] Commission Guidelines on the applicability of Article 101 of the TFEU to Horizontal Co-operation Agreements OJ [2011] C 11/1

The Guidelines cover all standards, but this document is concerned with standardisation agreements covering technical specifications in the 3D CAD market where compatibility and interoperability with other products or systems is essential.[986]

In the past decade the level of essential IPRs in standards has increased.[987] The Commission has dealt with some high profile disputes including *Rambus,* a "patent ambush" case, where Rambus did not reveal an essential patent until the industry was locked-in.[988] It has been said that attention has shifted in recent years from concerns about collusion between participants, where the aim is to exclude competitors, to focus on preventing "hold up" problems. This change of emphasis is a result of the increase in the incidence of patents in standards.[989]

The Guidelines acknowledge that standardisation agreements may encourage new and improved products, increase competition, reduce costs and ensure interoperability.[990] In specific circumstances however standard setting can potentially reduce competition by restricting price competition, foreclosing technologies and discrimination by preventing access to the standard for example by using IPRs to "hold-up" users after the standard has

[986] Ibid

[987] Sven Sattler 'Standardisation under EU competition rules – the Commission's new horizontal guidelines' (2011) 32 (7) European Competition Law Review 343-349, 344; Anna Emanulson 'Standardisation agreements in the context of the new Horizontal Guidelines' (2012) 33 (2) European Competition Law Review 69-76, 70

[988] COMP/C-3/38.636 – Commitment Decision by Rambus in response to the Commission's claim that Rambus had breached Article 102 TFEU by not disclosing an essential patent before leaving the SSO and trying to charge above FRAND prices. Rambus committed to put a cap on its royalty rates for products compliant with the standards for five years. Rambus also agreed to charge zero royalties for certain chip standards in combination with a maximum royalty rate of 1.5% for the later generations of standards. http://europa.eu/rapid/pressReleasesAction.do?reference=IP/09/1897&format=HTML&aged=0&language=EN&guiLanguage=en [accessed 6 August 2015]

[989] Anna Emanulson 'Standardisation agreements in the context of the new Horizontal Guidelines' (2012) 33 (2) European Competition Law Review 69-76, 70

[990] Commission Guidelines on the applicability of Article 101 of the TFEU to Horizontal Co-operation Agreements OJ [2011] C 11/1, para 263 – the Guidelines say these benefits should increase value for consumers.

been adopted.[991] The Guidelines recognise that SSOs have different rules and procedures, but also provide a limited "safe harbour" for SSOs meeting certain criteria based on unrestricted but non compulsory participation, a transparent procedure and access on FRAND terms.[992] FRAND can also cover RF licensing.[993] It is thought that SSOs with an RF standards policy would meet the safe harbour requirements without having to disclose IPRs.[994] Variation from these terms does not necessarily invalidate the standard but the rules and procedures must satisfy an effects-based assessment, contain only essential restrictions, and display efficiency gains which are passed on to customers. Efficiency gains include technical interoperability and compatibility as they often encourage competition and prevent lock-in.[995]

The aim of competition law and the Guidelines is to avoid competition being distorted by the setting of standards. To avoid collusion a transparent process must give unrestricted rights for all competitors to be involved, non-discriminatory allocation of voting rights and objective criteria for selecting the technology.[996] Participants are required to make good faith disclosure of any IPRs so that an informed decision can be made on whether to include the technology in the standard. Perhaps of most importance though is the requirement in the Guidelines that once a standard is adopted there is an irrevocable written commitment to make essential IPR available on FRAND terms.

FRAND can range from RF to a price that is reasonable *ex ante,* before the industry has been locked-in to the market. The participants, not the SSO, must assess whether licence terms

[991] Ibid, para 264-269 – Standardisation agreement that have the object of restricting competition are unlawful para 273

[992] The safe harbour is only limited: the Guidelines ibid say such agreements will *normally* not restrict competition, para 280.

[993] Ibid para 285

[994] Anna Emanulson 'Standardisation agreements in the context of the new Horizontal Guidelines' (2012) 33 (2) European Competition Law Review 69-76, 75

[995] Commission Guidelines on the applicability of Article 101 of the TFEU to Horizontal Co-operation Agreements OJ [2011] C 11/1, para 308

[996] Ibid para 281

are FRAND.[997] This may well result in each firm wishing to use a standard negotiated separately with the patent holder. The Guidelines say the fees should bear a reasonable relationship with the economic value of the IPR rather than a cost-based method as it would be difficult to attribute development costs to particular patents. Comparisons with *ex ante* pricing by the company for relevant patents is one possibility. Another is an independent expert assessment of the "objective centrality and essentiality to the standard at issue of the relevant IPR portfolio."[998] Again comparisons can be drawn with other relevant *ex ante* prices. The Guidelines are not exhaustive and no mechanism is provided to resolve disputes. It is recognised that the courts are still the only final arbiters if a reasonable royalty cannot be agreed.[999]

The Guidelines try to block a loophole by which the FRAND obligation could be sidestepped. Not only must participants give irrevocable commitments in writing to licence any essential IPRs that are adopted by the standard on FRAND terms, but also, in order to ensure the effectiveness of the commitment, ensure that when they transfer the IPR any transferee is also bound by that commitment, for example by a contractual clause.[1000] This is aimed at preventing a recurrence of the problems that arose when IPCom acquired standard-essential patents from Bosch and the FRAND commitment did not automatically follow suit.[1001] The Commission stepped in again, and IPCom relented before the opening of

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[997] Ibid Guidelines, para 288

[998] Ibid para 290

[999] The Commission has taken proceedings against Qualcomm for failure to licence on FRAND terms but there Qualcomm was allegedly dominant and proceedings were under Article102 TFEU see press release - Antitrust: Commission initiates formal proceedings against Qualcomm. http://europa.eu/rapid/pressReleasesAction.do?reference=MEMO/07/389&format=HTML&aged=1&language=EN&guiLanguage=en [accessed 6 August 2015]

[1000] Commission Guidelines on the applicability of Article 101 of the TFEU to Horizontal Co-operation Agreements OJ [2011] C 11/1, para 285. This was highlighted as a potential problem in Knut Blind and others, 'Study on the Interplay between Standards and Intellectual Property Rights' (OJEU S136 of 18/07/2009) Final Report

[1001] Commission, Press release 'Antitrust: Commission welcomes IPCom's public FRAND declaration' (December 10, 2009) MEMO/09/549.

formal proceedings. By doing so the Commission recognised that the unrestricted access to essential patents on FRAND terms for all third parties safeguards the pro-competitive economic effects of standard setting.

The main aim of the Guidelines is to shape the standardisation process in accordance with competition law. By doing so they fortunately also help to reduce costs and lock-in by introducing open standards. The common aim of safeguarding proprietary technology on FRAND terms for all third parties is of mutual benefit. The Commission's principle of "prevention is better than cure" of identifying IPRs before the industry is locked-in is another benefit.[1002]

Remaining perils include: The Guidelines allow participants to disclose *ex ante* their most restrictive licensing terms.[1003] The Guidelines do not allow participants to negotiate an aggregate royalty rate for a standard,[1004] so although the individual royalty may seem reasonable, the aggregate cost for all the essential patents in a standard could be undesirably high, and potentially amount to royalty stacking. Without the ability to discuss, in theory each licence has to be negotiated separately which slows and complicates the process and can lead to secret informal discussions. These arrangements are inefficient and inconsistent with the system of patent pooling[1005] where the parties can discuss and agree

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http://europa.eu/rapid/pressReleasesAction.do?reference=MEMO/09/549&format=HTML&aged=0&language=EN [accessed 6 August 2015]

[1002] Sven Sattler 'Standardisation under EU competition rules – the Commission's new horizontal guidelines' (2011) 32 (7) European Competition Law Review 343-349, 349

[1003] Commission Guidelines on the applicability of Article 101 of the TFEU to Horizontal Co-operation Agreements OJ [2011] C 11/1, para 299. The Commission may have hoped that reasonable ex ante rates would be disclosed but parties are more likely to disclose a high maximum which could raise aggregate royalties rather than lower them, John Temple Lang 'Patent pools and agreements on standards' (2011) 36 (6) European Law Review 887-895, at 891.

[1004] This can give rise to an abuse of monopsony power by the oligopsonists in the SSO, Knut Blind and others, 'Study on the Interplay between Standards and Intellectual Property Rights' (OJEU S136 of 18/07/2009) Final Report

[1005] John Temple Lang 'Patent pools and agreements on standards' (2011) 36 (6) European Law Review 887-895 and see Guidelines on the Application of Article 81 of the EC Treaty to Technology Transfer Agreements [2004] OJ C-101/2; The practice of setting royalty terms with the supplier was set out in email correspondence between Jacques Crémer and Mark Schankerman and the authors (29 August 2012). Carl Mair in an affordable aggregate royalty rate. In practice royalty terms are often set between the patent owner and the supplier of technology using the standard. The end user is not involved although the cost will normally be passed on to them. The Guidelines only apply to standards that have market power.[1006] It could therefore be possible to adopt a standard which is not subject to the Guidelines. Before adopting a standard the terms of the SSO must be checked rather than assuming FRAND applies.

The legal framework is complicated but can support a policy of open standards. The Guidelines have helped when adopting standards but the SSOs are not responsible for agreeing FRAND terms and this remains an area of uncertainty.

7.6 Limitations of Standards Policy

The STEP and IGES standards are not alone in providing limited interoperability. There are several practical limiting factors in standards that need to be recognised as they will reduce the potential benefits of standards. Standards do not guarantee interoperability. The study by Shah and Kesan on compatibility between ODF, OOXML and DOC revealed examples of poor compatibility varying from formatting problems to loss of information in pictures, footnotes, comments, tracking changes and tables. Less than 100% interoperability may significantly reduce the value of these document formats for some applications such as the archiving of information.[1007]

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correspondence with the authors (1 October 2012) points out that once a standard has been adopted a patent pool can be established and the Horizontal Guidelines will no longer apply and the terms of the Technology Transfer Guidelines will be controlling.

[1006] Commission Guidelines on the applicability of Article 101 of the TFEU to Horizontal Co-operation Agreements OJ [2011] C 11/1, para 277, market power is not defined.

[1007] Rajiv Shah and Jay Kesan 'Lost in Translation: Interoperability Issues for Open Standards' (September 2008) Illinois Law and Economics Research Paper series No. LE08-026. http://papers.ssrn.com/abstract=1201708

Another consideration is whether a single standard should be adopted, and if so which one.[1008] There are several standards in the 3D CAD industry.[1009] Not all standards are successful and it appears that only a few generate most of the impact in a "winner takes all" scenario. Standards that are likely to have a high impact can be recognised at the development stage: they are more likely to have more participants and more divisive debates. This can result in longer standards,[1010] so more complexity and more words can indicate a standard with more impact.[1011] It is said that little research has been done on the impact of competing (functionally equivalent) open standards on such matters as interoperability, innovation, and the environment.[1012] Egyedi considers that selecting two or more functionally equivalent standards is inadvisable as this may reduce market transparency, decrease overall interoperability, decrease network externalities, decrease ease of use, fragment the market and possibly lead to forms of lock-in and increase transaction costs, for example the costs of converters.[1013] To benefit from network effects it is best to adopt a successful standard. Early adoption of a standard can reduce conversion costs, but ensuring adoption of the right standard at the right time is undoubtedly easier said than done.

Kesan and Shah, analysing Massachusetts' adoption of ODF when it was an immature standard, promote a policy of "multiple independent interoperable implementations" or

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[1008] Development of IGES stopped with the introduction of STEP but both standards are in common use. The number of standardisation serving the 3D CAD Systems is in single figures. They have emerged from different environments eg visualisation has given rise to the JT ISO standard.

[1009] Ibid

[1010] The STEP standard is one of the longest standards and has significant impact but does not provide full interoperability.

[1011] Rajiv Shah and Jay Kesan 'An Empirical Study of Open Standards' TPRC Conference Proceedings 23 Research Conference on Communications, Information and Internet Policy, Sept. 28-30, 2007.

[1012] Tineke Egyedi 'To select or not? Dealing with Competing Standards in Public IT Procurement' (2012) Delft University final version.

[1013] Ibid

"running code" to avoid users being locked-in to an open standard.[1014] Sieverding warns against mandating a particular path to interoperability which would include adopting a specific standard, open or otherwise, particularly if the open standard is immature and unproven. Doing so may reduce flexibility and foreclose other opportunities of benefiting from advances in interoperability and so be ineffective and costly.[1015] Swann also warns against standardisation taking place too early in the development cycle which can then exclude alternative and possibly superior technology.[1016] Conversely, standardising too late can involve high transition costs. There appears to be a proportional relationship between the number of standards and their positive effect on the process of innovation, which is reversed when the number of standards rise above a certain number.[1017]

7.7 Can RF Standards Avoid the Patent Problem?

RAND and RF terms for standards were evaluated by the US Department of Justice and the Federal Trade Commission in 2007. Opinions varied from those who considered RAND to be effective and had no complaints with RAND terms,[1018] to those who considered RAND was not a sufficient safeguard against the abuse of a patent that is essential to a standard.[1019] One of the reasons RAND may be inadequate is because terms such as

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[1014] Jay Kesan and Rajiv Shah 'Running Code as Part of an Open Standards Policy' (2009) 6 (14) University of Illinois Research Paper 08-38 http://ssrn.com/abstract=1416115.

[1015] McLean Sieverding 'Choice in Government Software Procurement: A Winning Strategy' (2008) 8 Journal of Public Procurement 70 - 97, 86

[1016] The concern was expressed in the interviews for example Interview with industry expert #2 (May 2014)

[1017] Ramona Apostol 'Formal European standards in public procurement: a strategic tool to support innovation' (2010) 2 Public Procurement Law Review 57-72 commenting on Peter Swann 'Do Standards Enable or Constrain' DTI Economics Paper No.3, 2005 published as part of the 'The Empirical Economics of Standards' (June 2005) DTI Economics Paper 12, Department of Trade and Industry www.bis.gov.uk/files/file9655.pdf

[1018] US Dep't of Justice & Fed. Trade Comm'n , Antitrust Enforcement and Intellectual Property Rights: Promoting Innovation and Competition (2007) 46, see Paul Vishny, referring to the experiences of the Telecommunications Industry Association of which he is the General Counsel and of other standard development organisations such as IEEE and ANSI. (Nov. 6 Tr. At 22-23)

[1019] For example the Federal Trade Commission ibid with Scott Peterson, Corporate Counsel for IP, Hewlett-Packard Company and Chair American National Standards Institute, Patent Committee, 46 ‘reasonable’ and ‘non-discriminatory’ are not well defined. Commentators considered ‘reasonable’ to be so vague that it did not amount to anything,[1020] and RAND to be an empty term.[1021] SSOs give little explanation or guidance on what RAND means and there has not been much judicial guidance.[1022]

Additionally, SSOs do not want to become involved in complaints about RAND licensing terms. The absence of a good forum for resolving disputes about RAND licensing terms has contributed to problems including patent hold ups.[1023]

There is doubt as to whether the requirement to licence on FRAND terms is even legally enforceable, and this may vary from one jurisdiction to another. There is no agreement as to the terms or mechanism to objectively determine the terms, which amount to a “recipe for litigation”.[1024] It should be assessed on the value before adoption as an essential standard.[1025] It may not be possible to compel the granting of FRAND licences in private law

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[1020] Ibid Carl Shapiro (Nov. 6 Tr. at 63), 47

[1021] Ibid, Earle Thompson, Senior Counsel Texas Instrument; Vishny “‘The people who are negotiating for the establishment...of a standard don’t know what [RAND] mean(s).” (Nov. 6 Tr. at 64) 47

[1022] Ibid, Daniel G Swanson, Gibson, Dunn and Crutcher LLP (Apr. 18 Tr. At 286-87), 47; Mark Lemley “Intellectual Property Rights and Standard-Setting Organizations” (2002) 90 California Law Review 1889, 1906 and 1954 n 272. The case of *Georgia-Pacific v United States Plywood*, 318 F. Supp. 1116 (S.D.N.Y., 1970) set out a “15 factors test” but uncertainty remains. In Case n° 39247 *Texas Instruments v Qualcomm* [2009] the complainants argued that licensing terms are FRAND when royalties are proportional to the number of essential patents included in the standard (so-called “numeric proportionality test”)

[1023] US Dep’t of Justice & Fed. Trade Comm’n , Antitrust Enforcement and Intellectual Property Rights: Promoting Innovation and Competition (2007) Joseph Farrell (Nov. 6 Tr. At 27-28), 47

[1024] Iain Mitchell QC and Stephen Mason ‘Compatibility of the Licensing of Embedded Patents with Open Source Licensing Terms’ (2010) International Free and Open Source Software Law Review 3(1) 25-58. An example of litigation involving FRAND can be seen in the patent dispute between Apple and Samsung where Samsung claims a 2.4% royalty on the entire selling price of Apple’s technology employing an ETSI standard which based on the average selling price of the iPhone would equal $14.40 per unit, or more than 100% of the price of a baseband chipset which was the only component of Apple’s products that employed the patented technology. http://docs.justia.com/cases/federal/district-courts/california/candce/5:2011cv01846/239768/1323/0.pdf?ts=1343373719

[1025] “The proper method of computing a FRAND royalty starts with what the cost to the licensee would have been of obtaining, just before the patented invention was declared essential to compliance with the industry standard, a license for the function performed by the patent. That cost would be a measure of the value of the patent. But once a patent becomes essential to a standard, the patentee’s bargaining power surges because a and any remedy that may exist under competition law is cumbersome and ex post. This does of course look at the worst case scenario and the industry appears to operate and muddle through although it is questionable whether this is adequate when so much depends on reliable standards.

The Horizontal Guidelines give little further guidance on how FRAND should be assessed although it is said that the fees should not be excessive or prevent or make it difficult to implement the standard.[1026] It is for the participants not the SSO to assess whether the fee fulfils the FRAND commitment. The Guidelines permit *ex ante* disclosure of the most restrictive licensing terms which may provide a model for license fees to be capped in advance.[1027]

The most recognised and certain interpretation of RF is of a standard that *requires* all participants to make essential patent claims available on a RF basis. There are however said to be other interpretations which are more difficult to monitor.[1028]

Only a small minority (4 out of 43) of SSOs that were the subject of a study required RF licensing of patents incorporated in standards.[1029]

RF could be the best means to limit licensing hold-up, but it does not obviously benefit the patent owner. Arguably there could be a first mover advantage which could favour the IPR holder's complementary technologies.[1030]

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prospective licensee has no alternative to licensing the patent; he is at the patentee's mercy." (*Apple, Inc. and Next Software Inc., v. Motorola, Inc. and Motorola Mobility, Inc.,* June 22, 2012, Case No. 1:11-cv-08540, 18)

[1026] Josh Lerner and Jean Tirole 'Standard-Essential Patents' (March 13, 2014) w19664 National Bureau of Economic Research, identify inefficiencies in the lack of price commitment and suggest policy reform to restore the ex-ante competition. They show that price commitments are unlikely to emerge in the absence of regulation.

[1027] As discussed in email correspondence between Valerio Torti and author (24 August 2012), also Valerio Torti 'IPRs, Competition and Standard Setting: in Search of a Model to Address Hold-Up' (2012) 33(9) *European Competition Law Review* 387-397.

[1028] Steve Mutkoski 'Defining Open Standards: A Comparison of Policy and Practice' (October 17, 2011). http://ssrn.com/abstract=1945252

[1029] Mark Lemley 'Intellectual Property Rights and Standard-Setting Organizations' (2002) 90 California Law Review 1889

There is concern that RF does not provide an efficient incentive to innovate. Intellectual property protection is the means by which those who invest in R&D have an expectation of achieving a return that is greater than zero.[1031] The alleged connection between software patents and innovation has been discussed in Chapter 6. The indirect effect of IPRs in interfaces is exacerbated if the interface is a standard and the justification for the closed IPR protection in interfaces which become standards is much weaker than for other aspects of the software.

As well as removing the incentive to invest there is concern that mandating RF licences, by removing the licensor's ability to earn a return from its investment in R&D through its intellectual property, is a disincentive to joining the standard. RF raises the technology monopsony concern much more sharply than *ex ante* negotiation of RAND.[1032] It may be possible to resolve the problem if members are not committed to licensing their technology at the outset, but are only obliged to do so if they want to take advantage of getting a RF license from the other members by agreeing to a reciprocal RF license.[1033] This gives choice rather than a monopsony, but with some organisations there is a commitment on entering to licence all patents, and there can be asymmetry where some patents are more valuable than others.[1034] RF is implemented in many different ways.[1035] RF may be appropriate in certain technologies, particularly ones less populated by patents or at least few essential patents, where there might be unpatented alternatives, and in which case the licensor may

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[1030] David Teece and Edward Sherry 'Standards Setting and Antitrust' (2003) 87 Minnesota Law Review 1913, 1954 propose that licensing patents royalty free is most likely to occur where the patent holder has complementary capabilities that allows them to profit from its innovation other than from royalties.

[1031] US Dep't of Justice & Fed. Trade Comm'n , Antitrust Enforcement and Intellectual Property Rights: Promoting Innovation and Competition (2007) Swanson (Apr. 18 Tr. 289).

[1032] Ibid Joseph Farrell (Nov. 6Tr. At 66-67) 48

[1033] Ibid Joseph Kattan (Nov. 6 Tr. At 67-68) 48

[1034] Ibid Joseph Farrell (Nov. 6 Tr. At 66-67) 48 and Carl Shapiro (6Tr. At 66-67)

[1035] Ibid Galbreath and Peterson (Nov 6 Tr. At 70) be willing to accept RF.[1036] Reciprocal or cross-licensing is of less value in standards than in some patent pools as patents in standards may not be useful in the licensee's income generating technology. While there is evidence that RF licensing can be preferred even by IPR holders, there is little incentive for pure IPR companies, such as NPEs, to participate in RF licensing. The grant of an RF license, even with a non-assertion clause, does not prevent claims by patent holders outside the SSO. The remedies of defensive patenting, competition law and challenging the validity of the patent are expensive and not a complete solution. This should not justify abandoning the policy of RF but it does mean that an open standard policy that adopts RF does not immediately lose the problems of claims by patent holders that are normally associated with FRAND.[1037]

The European Interoperability Framework v.2 which is aimed at promoting interoperability in the public sector opted for a principle of openness that requires IPRs to be licensed on FRAND terms or on an RF basis in a way that allows implementation in both proprietary and open source software.[1038] This is intended to foster competition between the business models. While EIF2 includes RF within FRAND it has been said that a policy that prefers RF does not align with the first recommendation of EIF2 to align interoperability frameworks to take into account the European dimension of public service delivery and contravenes the duty of sincere cooperation contrary to the TFEU. The EU does not have treaty competence in the area of organisation and delivery of public services, outside the remit of procurement, and cannot legislate in the area of interoperability systems for provision of public services. For this reason a Commission Communication was used which is said to have intellectual and moral authority but is not directly legally enforceable.[1039] If the public

[1036] Ibid Peterson (Nov 6 Tr. At 71)

[1037] Carl Mair 'Openness, Intellectual Property and Standardization in the European ICT Sector' (2012) 2 (2) IP Theory, Indiana University in which Carl Mair makes the case that there is a risk that RF standards could be less open than FRAND based standards in the long run due to less participation by pure upstream companies and NPEs which stay outside the SSOs.

[1038] COM (2010) 744 final Communication – Towards interoperability for European public services – European Interoperability Framework for European Public Services v.2, para 5.2.1.

[1039] The point that a policy preferring RF may not align with EIF2 and contravene the duty of sincere co-operation was made in email discussion between Elisabetta Rotondo of Kemp Little LLP and the author (30 sector insist on open standards when purchasing software this may spill over and influence software suppliers in other markets to increase their openness and interoperability. An example is the Army 2020 initiative looking at standards based common interfaces to achieve interoperability. It is a key demand to be able to achieve operational effect with the limited resources.[1040]

The consultation on Modernising Standards in the EU revealed that IPRs are perceived as one of the most critical issues in IT standardisation. Most of the respondents to the consultation supported FRAND policies although several felt more clarity, transparency and predictability was required. Of those supporting FRAND, the majority also supported the inclusion of RF approaches as well. They recognised that business models, other than charging royalties on standards, could support further R&D.[1041] Disadvantages to the FRAND model included the time spent negotiating licensing arrangements. This was seen as out of step with the speed of innovation and evolution in the IT domain where the increase in the number of patents had dramatically increased the complexity of monitoring the implementation of IPR policies.[1042]

There are issues however with the inclusion of a FRAND option. In markets where competing software is implemented by small firms or individuals without significant funds, the economic effect of open standards may only be achieved on RF terms. If several standards exist in one product the amount of royalties that have to be paid, even under FRAND terms, could harm some competitors.[1043] Basing standards on RF terms, rather than

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August 2012), also Kemp Little LLP "UK government's Open Standards Consultation – a step in the wrong direction?" (2012). http://www.kemplittle.com/publications/item.aspx?ListName=KL%20Bytes&ID=76
On legal standing see Iain Mitchell QC and Stephen Mason 'Compatibility of the Licensing of Embedded Patents with Open Source Licensing Terms' (2010) International Free and Open Source Software Law Review 3(1) 25-58, 27 - 28

[1040] 5 Interview with industry expert #5 (September 2014)

[1041] Modernising ICT Standardisation in the EU – The Way Forward – overview of the results of the public consultation on the White Paper (December 2009) DG Enterprise and Industry D/4 (2009) DB/AL/pm D (2009) 40002, section 8

[1042] Ibid

[1043] Rishab Ghosh 'An Economic Basis for Open Standards' University of Maastricht, December 2005 http://www.intgovforum.org/Substantive_1st_IGF/openstandards-IGF.pdf [accessed 21 October 2012], 8

FRAND or other commercial terms, is said to reduce the risk that data will become unavailable over time.[1044]

Some open source licences, such as GNU v.2 and v.3 are considered incompatible with FRAND and royalty payments on patents.[1045] Arguably this is a choice taken by the open source software developer[1046] and should not of itself prohibit a policy of using both FRAND and RF software or even preferring RF. Nevertheless, the existence of this legal incompatibility may be relevant where the main existing or potential competitor to proprietary software is open source software. It can be argued that the open standard should be compatible with the development and distribution of the open source software's licence terms.[1047]

The incompatibility of FRAND licencing and open source software arose when Microsoft was ordered by the Commission to licence interoperability information in the form of protocol specifications on RAND terms including remuneration charged. When setting the charge Microsoft had to disregard its market power and not impose any restriction that could create disincentives to compete or unnecessarily restrain innovation.[1048]

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which draws comparison to the GSM standards where compared to the capital requirements for manufacturing telecommunications hardware the licensing and royalty rates are relatively undemanding.

[1044] Björn Lundell and other 'Exploring Tool Support for Long-term Maintenance of Digital Assets: a Case Study' in Fomin, V & Jakobs, K (Eds) Proceedings: 16th EURAS Annual Standardization Conference 2011, European Academy of Standardisation, The EURAS Board 207-217

[1045] Even RF may not be compatible with GPL 2 and GPL 3 terms as restrictions may still exist preventing the automatic downstream cascade of patent rights. Iain Mitchell QC and Stephen Mason (n 188) 54. 'Restriction Free' may give better solutions than royalty free. But not all FOSS licences are incompatible with FRAND, see eg Stephen Mutkoski 'Government Procurement Policy, Patent Royalties and the Myth of "Discrimination" against Free and Open Source Software Developers'. http://ssrn.com/abstract=1949832.

[1046] For a discussion on this see Jay Kesan 'The Fallacy of OSS Discrimination by FRAND Licensing: An Empirical Analysis' (2011) Illinois Public Law l Research Paper number 10-14. http://papers.ssrn.com/abstract=1767083Jay Kesan

[1047] Rishab Ghosh 'An Economic Basis for Open Standards' University of Maastricht, December 2005 http://www.intgovforum.org/Substantive_1st_IGF/openstandards-IGF.pdf [accessed 21 October 2012]

[1048] *Microsoft* (Case COMP/C-3/37.792) Commission Decision of 24 March 2004 relating to proceedings under Article 82 EC.

Microsoft ended up with at least two forms of licence. A 'No-Patent Agreement' at a flat rate royalty fee of €10,000 that was compatible with open source models[1049] and a 'Patent Agreement' at 0.4 per cent of licensee's product revenues.[1050] One version of the 'No-Patent Agreement', negotiated by SAMBA, amounted to a non-disclosure agreement between Microsoft and the Protocol Freedom Information Foundation (PFIF) on behalf of open source developers. In return for a one off fixed fee of €10,000 the agreement enabled the PFIF to licence the protocol information for free to 'subcontracting' open source developers.[1051] The agreement does not include a licence of any patents. Instead it contains a list of patents to inform the PFIF and the wider open source community of Microsoft's patents related to WSPP.[1052] The subcontractors then know what is patented and hence what to avoid. In return Microsoft agrees not to assert any patents that are not notified in the agreement and, crucially for the open source ethos, this non assertion undertaking covers all open source developers involved in WSPP protocols. This form of agreement was compatible with the GPL licence.[1053]

Adopting a policy which mandates RF standards could reduce choice as the vast majority of SSOs have at least one option that allows patent holders to charge on a RAND basis. This could limit the pool of standards available.

[1049] Nicholas Economides and Ioannis Lianos 'The quest for appropriate remedies in the EC Microsoft cases: a comparative appraisal' in Luca Rubini (ed) *Microsoft on Trial (*Edward Elgar 2010)

[1050] Ibid, 423 Microsoft initially tried to charge a royalty between 7 and 5.95 percent.

[1051] http://www.samba.org/samba/PFIF/PFIF_history.html [accessed 16 March 2012]

[1052] Workgroup Server Protocol Program.

[1053] http://www.samba.org/samba/PFIF/PFIF_agreement.html [accessed 16 March 2012] In email correspondence with the authors (27 September 2012) Björn Lundell claims the SAMBA case should not be presented as an argument for the compatibility of GPL and FRAND licensed standards. The case concerns a Microsoft proprietary specification rather than a standard controlled by an SSO. Björn Lundell asserts that over time the integrity of the specifications cannot be assured and the arrangement for patents may be challenged.

7.8 Impact of Standards on 3D CAD Industry

Standards, principally the STEP and IGES standards, provide a means of transferring featureless models, although the transfer often has errors.[1054] This allows manufacturing industry to share files with suppliers and customers for the purpose of their manufacturing business. The standards and the JT file also give a safer format for archiving data.[1055] They do not however provide a good answer to users who are locked-in to one of the proprietary 3D CAD systems. The users cannot use the standards to convert their own proprietary data to a different system in which they have an acceptable level of editing. Translator companies have however seen the market opportunity and using a combination of standards, APIs and reverse engineering, developed software that can assist with the process of transferring data between proprietary 3D CAD systems. This is not however an easier process and can take months if not years to complete.[1056] Standards also allow 3D CAD suppliers to 'ingest' data from other 3D CAD systems into their own proprietary system.[1057] This is a popular method by which the 3D CAD suppliers can enable the user to have some limited interoperability while still maintaining control.

The industry has more than one standard, such as the IGES and STEP standard. There has been more investment in the STEP standard[1058] but some users still prefer the IGES standard. There does not appear to be any conflict in their use although neither gives a complete answer.

The STEP standard relies on proprietary data from the 3D CAD suppliers and while there are only a small number of patents in the main standards of STEP and JT it was apparent they

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[1054] Interview with senior industry executive #4 (July 2013) and conversations between author and software design engineers 2014 - 2015

[1055] Interview with industry expert #5 (September 2014)

[1056] BAE Systems, *Data Migration Case Study – CAD Data Exchange Automation and Workflow Optimization,* Theorem Solutions, migration from PTC CADDS 5 to CATIA involved a three month pilot to ensure the translations met required quality standards. http://www.theorem.com/casestudy/Data_Migration.pdf [accessed 30 October 2015]

[1057] Interview with senior industry executive #3 (May 2014) Interview with senior industry executive #4 (July 2013)

[1058] Interview with industry expert #5 (September 2014)

did present some challenges. There were also some challenges identifying the limits of the interface and the extent of information that was needed to be disclosed.[1059] The SSO gives an established framework within which these issues can be addressed and the STEP standard is very valuable to users. The impression gained though was that there was no determination to improve the standard to give full interoperability. While the standard is clearly going to be maintained and advanced it is not in its present guise going to give a solution to 3D CAD users.

The SSO did not provide assistance with setting royalties on any patents, which is the normal practice. While the patents in the standards have given some issues there was no evidence that securing FRAND agreements had caused a problem. The argument that claiming royalties in interface standards incentivises innovation is nuanced and has certainly not been made convincingly. However it does not appear that with the existing state of standards in the 3D CAD industry that FRAND rather than RF standards is having any present impact on the industry. This may however change should more interface information and de facto standards increase in number. As the information available becomes more dynamic negotiating FRAND licenses could be a drag on innovation. However with the existing rather static arrangement of standards, RF licensing does not appear to be the main cause of incompatibility in the industry.

[1059] Interview with industry expert #5 (September 2014)

CHAPTER 8. SUMMARY OF FINDINGS AND RECOMMENDATIONS

8.1 Introduction

The object of the research was to evaluate how the existing legal regime regulates the disclosure of interface information for the purposes of interoperability in the 3D CAD industry.

This Chapter will start with a summary of the findings of the legal analysis and empirical research from previous Chapters. Building on those findings realistic amendments will be proposed that can be made to the current law to improve interoperability. To this end proposals for reform made by various commentators will be considered to identify which proposal could improve openness in the 3D CAD market without damaging innovation. The proposals allow for additional exceptions to IPR protection and improved access to information. A new proposal will then be recommended that requires minimum intervention, balancing the control and access requirements of industry and users and which is centred on improving access to information In particular improvements in the rules on sharing of information obtained by reverse engineering will be explored.

8.2 Summary of Findings

8.2.1 Competitive Pressures on 3D CAD Industry to Improve Interoperability

This thesis has established that the 3D CAD industry is oligopolistic, made up of four suppliers who are profitable and successful.[1060] The 3D CAD software is proprietary, protected by copyright, trade secrets and patents.[1061] There is evidence from several sources that lack of interoperability causes a problem for users and results in expense, waste, reduced efficiency and lock-in which affects competition. Suppliers with a "significant" part of the market may benefit from lock-in effects and may not want to license interoperability information for their product.[1062]

[1060] Chapter 4

[1061] Sections 6.2 and 6.12

[1062] Commission Staff Working Document, 7

There appears to be little effective market pressure on the suppliers to improve interoperability. Their most important customers are the OEMs[1063] which value integrity of data as highly as interoperability.[1064] The suppliers' concept of openness is to make their own software able to 'ingest' data from other suppliers' systems to encourage customers to stay with them.[1065] Despite the lack of pressure there has been a market response.[1066] This has not always come from the suppliers of 3D CAD but from other firms such as translators[1067] which supply specialised software to enable models in competing 3D CAD software to interoperate to some extent. This response is however only partial and often limited as standards and translation software provide only a partial solution.[1068]

While there is presently little pressure on suppliers to disclose interfaces they do provide APIs and data formats to suppliers of translation software and other complementary software.[1069] It would appear that interfaces can be made available and mandating their disclosure could aid interoperability. However given the complex nature of the software it may still require the specialist knowledge of the translators to achieve effective compatibility and it is not certain whether it is technically possible for all four systems to achieve full functional compatibility.

Chapter 5 introduced the debate about whether intervention is justified, in this instance by competition law restricting IPRs to mandate disclosure of interface information. IPRs are

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[1063] The OEMs have the largest accounts and often dictate what software the tier suppliers use.

[1064] Section 4.8.3

[1065] Section 4.4

[1066] The industry does respond to market demand and continues to innovate. Whether there would be more innovation if there was more interoperability is a counterfactual.

[1067] For example Theorem Solutions http://www.theorem.com/Company/overview.htm and Tansmagic. These companies use a variety of methods including APIs and reverse engineering to provide translators to enable the direct exchange of native CAD files. See Chapter 4

[1068] Section 4.10 For example the translation software supplied with 3D CAD packages allows for one direction translation only - Interview with senior industry executive #3 (May 2014)

[1069] Section 4.10

themselves a form of intervention but are seen by many as an almost inviolable right to encourage innovation. Supplier lock-in may justify intervention[1070] and it may be necessary to strike a balance between control by the rightsholder to incentivise innovation and openness of interfaces to achieve interoperability. This can be achieved either ex ante by IPRs or ex post by competition law.[1071] It was also proposed that as interfaces have indirect effects where their value comes from being a standard the balance may favour openness more than for other subject matter in the computer program. Industry interviews supported this differentiation in purpose and importance.

To achieve more openness and interoperability disclosure of interface information is needed and competition law can give a remedy in exceptional circumstances.[1072] This remedy is only available where there is an abuse of a dominant position, but the 3D CAD industry is oligopolistic with no single dominant supplier. The remedy of disclosure of information under competition law is not available in oligopolistic markets.[1073] Interoperability is unlikely to narrow the definition of the market to a single supplier and it is also unlikely that the suppliers will be considered collectively dominant.[1074] The argument that has been made that competition law makes amendment to IPRs unnecessary[1075] is disproved because in oligopolistic markets, where users are locked-in to suppliers due to a lack of interoperability, competition is affected but no remedy is available.

[1070] Market lock-in and supplier lock-in were distinguished as in the later the cost of entering the market is prohibitive while in the former customers can afford to bear some of the cost and the market can rely on market forces and if necessary ‘creative destruction’ to change a dominant supplier in the market. See section 3.10 and 3.11

[1071] The merger regulation is able to provide an ex ante control of interoperability which is also flexible as it takes the individual circumstances into account. See section 5.7.2

[1072] Section 5.4

[1073] Section 5.7.3

[1074] Section 5.5

[1075] Josh Lerner and Mark Schankerman, *The Comingled Code: Open Source and Economic Development* (MIT Press 2010) – and Chapter 5

8.2.2 Openness and Standardisation of Interfaces in 3D CAD Software

Chapter 6 analysed the control of interfaces by IPRs and the extent to which they are open and accessible. The Software Directive has enabled the CJEU when considering data formats to exclude ideas and principles which underlie the interfaces as not expression and not copyright protected.[1076] Emphasis has been placed on the interface functionality which aligns with the method of operation and subject matter approach adopted in the US. This means that an interface specification written by analysis of a program without copying the expressive code can avoid infringing copyright.[1077] APIs were considered in the US case of *Oracle v Google* where the District Appeal Court was not persuaded by the functional, subject matter approach, to determine the ideas/expression dichotomy. In addition to direct copying of the code, indirect copying of the sequence, structure and organisation had taken place which needed to be determined using the abstraction, filtration, comparison test. The US can take a traditional approach to ideas/expression and then implement the fair use exception.[1078] In Europe the CJEU gave a purposive interpretation of the Software Directives so that the functionality of interfaces should not restrict interoperability.[1079]

To improve interoperability to generate follow on innovation it is necessary to have access to and use of interface information. Reverse engineering to create interface specifications occurs even though access to the software is restricted but there is little evidence that reverse engineering presently provides a significant answer or incentive to suppliers in the 3D CAD industry to disclose interface information. Even where the interface specifications contain no copyright belonging to the software rightsholder the decompiler is not allowed to share that information. The rightsholder cannot use trade secret law to prevent

[1076] *SAS Institute*

[1077] Section 6.7.3

[1078] Section 6.8

[1079] Section 6.9

decompilation but the Software Directive creates a statutory trade secret law.[1080] Recommendations to improve this position to encourage access and dissemination of interface information will be made in this Chapter.

Even where there is no copyright in the interface specification the software's rightsholder may have protected the interface through patent protection. The 3D CAD suppliers have been granted numerous patents.[1081] With the exception of the Unified Patent, there is no exemption from patent protection for the purpose of interoperability. The concept and implementation of software patents is flawed, does not incentivise innovation and could restrict the operation of standards and interoperability.[1082] Patent protection fails to adequately address the indirect effect of control over interface specifications on interoperability and it is seriously doubted whether patent protection of interfaces can be economically justified.[1083] There may be a failure of the market with overprotection of interfaces which cannot be rectified by reverse engineering or by conventional competition law in an oligopolistic market.[1084] Because interfaces are standards and have an indirect effect they give an unplanned expansion of IPR rules both for copyright and patents. The hidden nature of the code giving protection equivalent to a statutory trade secret also overprotects the interfaces.

Standards are one means of improving interoperability. The 3D CAD industry has more than one formal standard including the most widely used STEP standard but they all only provide limited compatibility. Standards, particularly compatibility standards which cannot be avoided, give an unplanned expansion of the protection for both copyright and patents. Patents in standards must be licensed on FRAND terms which have to be agreed between the parties without the Standard Setting Organisation's 'SSO' assistance. Various issues

[1080] Section 6.11

[1081] Section 6.12

[1082] Section 6.14.1 and 6.14.2

[1083] Section 6.15

[1084] Section 6.18

with patents and FRAND licensing are discussed in Chapter 7 although there is no evidence this has caused a problem for STEP and it does not appear that FRAND rather than RF has an impact on the industry although this may change if interface availability and informal standards become more prevalent.[1085] As the information available becomes more dynamic negotiating FRAND licenses could be a drag on innovation. The argument that claiming royalties in interface standards incentivises innovation is nuanced and has certainly not been made convincingly.[1086]

Translator software companies have seen a market opportunity, and using standards, APIs and reverse engineering, they have developed software to assist the process of transferring data between proprietary 3D CAD systems. While this gives some relief from lock-in it is a costly and complex process which can take months to complete. The 3D CAD suppliers also use standards to 'ingest' data from other 3D CAD systems into their own proprietary system[1087] which gives limited interoperability while encouraging customers to remain with their system.

The existing legal regime only provides a low level of interoperability. A main legal tool for improving interoperability, competition law, is not available. Reverse engineering also does not make a significant impact, certainly not sufficient enough to encourage suppliers to make disclosure of interface information. Some market solutions in the form of translation software companies have emerged but generally there appears to be little drive in the industry towards improving interoperability.

8.2.3 Welfare Benefits of 3D CAD Software

Despite the lack of interoperability the 3D CAD software provides a good welfare benefit as it improves the ability to develop goods quickly and to manage related data efficiently. 3D CAD is sophisticated modular software developed over several decades and it is more than

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[1085] Section 7.8

[1086] Ibid

[1087] Interview with senior industry executive #3 (May 2014) Interview with senior industry executive #4 (July 2013) just a platform.[1088] Industry interviews have shown that OEMs and other customers value integrity of data as highly if not more so than openness and full interoperability.[1089] OEMs and other users rely on 3D CAD software to create, edit, use and store what is probably their most valuable data. The software is highly complex and functional and has a 'critical core'[1090] function in the users business, particularly as it stores their own proprietary data. The lack of interoperability would prevent them switching to another supplier immediately and result in lost data. It is important the problem of interoperability is solved without disrupting the market. The disruption to the music industry caused by digital downloads did not directly harm the user as music became more available.[1091] Disruption to the 3D CAD industry and to the supply of proprietary software in which users' data is stored could be very harmful to the user and to society generally as manufacturing industry would suffer as vital know-how and legacy data could be lost.

Continuing follow on innovation would appear to have more welfare benefit than some form of creative destruction which could destroy the existing software and replace it with a new platform. 3D CAD suppliers have invested heavily in designing sophisticated software and a model that just replaces it with something else seems unlikely and undesirable. Interoperability helps follow on innovation. Not only does the software have intrinsic value but the users' proprietary data is extremely valuable. It is important to the user that they can access their data now and in the future. Interoperability allows this to happen but any changes to the legal regime should not destabilise the industry as it is necessary to ensure that users can continue to use the format of the software their own proprietary data is stored in. Changes must also take into account users' needs, not only as consumers seeking competitive prices, but also to protect the integrity and access to their own proprietary data. The functional nature of the software is relevant not only to determining the IPRs

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[1088] See Chapter 4

[1089]Section 4.11

[1090] Interview with senior industry executive #3 (May 2014)

[1091] It is uncertain what indirect effects, such as reduction in choice of artists, the disruption to music industry had on the consumer but the availability of music generally increased with introduction of digital media and iTunes, file sharing and streaming.

status of the interface but also to ensuring the legal regime balances the need for interoperability with the need for data integrity.

8.2.4 3D CAD Software Interfaces as De Facto Standards

In addition to taking into account the impact, not only on the suppliers' incentive to innovate, but also any harm that could be done to the integrity and continuity of access to the users' data, software interfaces require different considerations and treatment to other subject matter in a computer program. This is because, not only do software interfaces directly affect interoperability, but also because of their indirect effects as standards. Interfaces have an indirect function of controlling interoperability and access, not only in competing software and networks but also in complementary software and access to the users existing own data. Their impact and value is amplified solely because of their role as standards and this extends and distorts the IPR protection they enjoy to the detriment of competitors, suppliers of complementary software, and users. Interfaces will have a different optimal balance than the core subject matter with more openness to counteract the amplifying effect that control over standards has on market power.[1092] The concept that software interfaces require different treatment has been recognised in previous research[1093] and in copyright case law.[1094] This thesis has developed this concept beyond copyright to demonstrate that the law applied to patents and standards also justifies and supports the unique treatment of software interfaces. This is further supported by the case study of the 3D CAD industry which suffers from a lack of interoperability but the status and openness of interfaces is recognised as distinctive from the protection afforded to other aspects of the software.

8.2.5 Striking the Balance to Improve Interoperability

It is necessary to strike a balance between IPR protection which gives control, and the need for access and use of interface information which gives openness. This will also achieve the

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[1092] Ashwin van Rooijen *The Software Interface between Copyright and Competition Law* (Kluwer Law International 2010), 197

[1093] Ibid

[1094] *SAS Institute* CJEU

economic goals of increasing incentives to innovate and promote efficient allocation of resources.[1095] The economic rationale for copyright law and its exemptions was considered in section 6.3. The central economic problem is said to be that copyright protection of software conflicts with the desire for information, particularly interface information, to be disseminated. Overprotection favours present innovation over future innovation.[1096] Future innovation can be improved by allowing a degree of copying of interfaces.[1097] The reverse engineering provisions in Article 6 of the Software Directive is an attempt to strike a balance. They were however formed more by lobbying than by economic Pareto optimality or empirical evidence.[1098] The introduction of the Software Directive was influenced by lobbying from US trade representatives and negotiators and *Computer Associates v Altai* and *Sega Enterprise Ltd v Accolade Inc.,* which held that decompilation to achieve interoperability was 'fair use' were not decided until after the Software Directive had been enacted.[1099]

The Commission appears to consider that as the Directive and in particular the decompilation provisions "were the result of intensive debate among all interested circles…the balance found then appears to be still valid today" although maintaining the status quo is influenced by not wanting "to reopen the floodgate of debate".[1100] In 2013

[1095] W M Landes and R A Posner 'An Economic Analysis of Copyright Law' (1989) 18 J Leg Stud 325

[1096] Roger Van den Bergh 'The role and social justification of copyright: a "law and economics" approach' (1998) 1 Intellectual Property Quarterly 17-34, 28

[1097] Kenneth Dam advocates copying of operating system interfaces to write new application programmes and where follow-on innovation adds substantial surplus value. 'Some Economic Considerations in the Intellectual Property Protection of Software' (1995) 24 Journal of Legal Studies 321

[1098] Ian Brown and Christopher T. Marsden in *Regulating Code* (2013 the MIT Press), 87 give another example of policy making that are "less the product of a rational decision-making process than of lobbying by stakeholders".

[1099] N Shemtov 'The Legal Regulation of Decompilation of Computer Programs: Excessive, Unjustified and in Need of Reform' (PhD thesis QML 2013), 138 - 139. The case of *Whelan v Jaslow* had been decided and opponents to decompilation asserted that even interface information could be part of the program's SSO and protected as copyright law in the US.

[1100] Commission Report 2000/199 on the implementation and effects of Directive 91/250/EEC on the legal protection of computer programs [2000] COM 199 final, 21 however a Commission Staff Working Document looked at measures that would lead to the licensing of interoperability information. They considered that *"copyright does not offer control over the information per se embodied in a work; only the expression is protected of that information where it constitutes the author's intellectual creation."* Because software is distributed in machine code even where interoperability information is not copyrightable there is no guarantee of effective access to the necessary protocols for developers.[1101] The Software Directive also gives control over the information obtained by reverse engineering even when it does not include expression as there are restrictions on sharing the information.[1102] While the ideas behind software interfaces are not copyright protected more freedom to access and share the information is needed to improve interoperability.

The Commission Staff Working Document is one of several proposals to achieve a balancing interest. This Chapter will consider those proposals but this thesis considers that it has not yet been determined how bests to identify and obtain the correct balance. Neither the correct, optimum balance nor the criteria for identifying it, have yet been identified.[1103] While the need for balance is reinforced by the proposals there has been less progress on establishing criteria for identifying the 'pivot' between control and openness.[1104] This means it is difficult to put these principles into practice.

[1101] Inge Graef 'How can Software Interoperability be achieved under European Competition Law and Related Regimes?' (2014) 5(1)' Journal of European Competition Law & Practice 6 - 19, 15

[1102] Software Directive Article 6.2 (b)

[1103] N Shemtov, 'The Legal Regulation of Decompilation of Computer Programs: Excessive, Unjustified and in Need of Reform' (PhD Thesis QML, 2012) proposed a model using recoupment of R&D costs as a benchmark for licensing innovative software architecture to competitors when coupled with revenue generated on sales as sufficient incentive to continue and invest in original research and development, 44. See also four criteria to assess the social welfare effects of the law's recognition of a right to reverse engineer in Pamela Samuelson and Suzanne Scotchmer 'The Law and Economics of Reverse Engineering' (2002) 111 The Yale Law Journal 1575

[1104] Ibid Shemtov, 44 proposed a model using recoupment of R&D costs as a benchmark for licensing innovative software architecture to competitors when coupled with revenue generated on sales as sufficient incentive to continue and invest in original research and development. See also four criteria to assess the social welfare effects of the law's recognition of a right to reverse engineer in Samuelson and Suzanne Scotchmer ibid. Rooijen talks of 'middle ground between openness and control', 234 see also Section 8.4

It is proposed in this Chapter that the correct approach is to start with changes that cause least intervention and only increase intervention if after evaluation and reflection there is insufficient improvement in interoperability. To be effective any changes would need to be made across the EU and the first evaluation will be the recent proposals for an interoperability directive.

The proposals will be considered in reverse order, starting with those that are most interventionist and moving towards those that need the least change to the existing law to give more freedom to the market to use information that does not have IPR protection.

8.3 Review of Current Proposals

8.3.1 An Interoperability Directive

An 'Interoperability Directive' has been seen as a way to ensure a common approach across Europe to enforce disclosure of interface information and other remedies. A Directive is a mechanism or wrapper that could include various rules to implement changes aimed to prevent IPRs being used to exclude competition without resorting to ex-post competition law or to find a deliberate strategy of exclusion to justify intervention.[1105] Dominant suppliers, particularly of network or application infrastructure in software based internet services, such as software as a service, would be prevented from 'locking in' certain segments of the market which is said to happen when providing services across different platforms is costly.[1106] This would strengthen competition between software based internet providers and platform owners and the increased interoperability should reduce training costs and encourage new entrants to markets.[1107]

An Interoperability Directive, including trade secrets and patent licences, was discussed in the Commission Staff Working Document in 2013 with Article 114 TFEU as the legal basis.

[1105] Pierre Audoin Consultants 'Economic Social Impact of Software and Software-Based Services' Final Report August 2010 Smart 2009/0041, 208 http://cordis.europa.eu/fp7/ict/ssai/docs/study-sw-report-final.pdf [accessed 16 December 2014]

[1106] Ibid 207

[1107] Ibid 208

Proposals included a mandatory license of right on FRAND terms or an interoperability exception to mirror Article 6 of the Software Directive.

The Agreement on a Unified Patent Court[1108] provides that the rights conferred by European patents with unitary effect will not extend to the use of information obtained under Articles 5 and 6 of the Software Directive.[1109] On establishment of the unitary patent and Unified European Patent Court patent holders will not be able to invoke patents against products implementing interface information obtained by black box or decompilation reverse analysis. This is similar to the provision in the doomed Software Patent Directive. In 2002 the European Commission proposed a Directive on software patentability. The European Parliament proposed an amendment that the use for the purposes of achieving interoperability would not be considered a patent infringement. The Directive was defeated by a vote in the European Parliament in 2005 and has been dropped.[1110] As the exemption in the unitary patent does not however apply to classical European patents, or national patents which contain no such exemption, they will continue to stand in the way of using interface information.[1111]

The Commission Staff Working Document considered a proposal extending the exemption in unitary patents to all European or national patents which would prevent them being invoked against the use of information obtained from reverse engineering for interoperability purposes. No royalty fee would be payable under this interoperability exception. The exception removes the risk from developers who rely on Articles 5 and 6 of the Software Directive to reverse engineer interoperability information that they would risk infringing patent rights, perhaps unknowingly.[1112] An alternative option was for patent

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[1108] http://www.epo.org/law-practice/unitary/patent-court.html

[1109] Article 27(k) of the Agreement on Unified Patent Court (11 January 2013) document 16351/12.

[1110] COM(2002) 92 final — 2002/0047(COD) Proposal for a Directive of the European Parliament and of the Council on the patentability of computer-implemented inventions *OJ C 151E*

[1111] Inge Graef 'How can Software Interoperability be achieved under European Competition Law and Related Regimes?' (2014) 5(1), Journal of European Competition Law & Practice 6 – 19, 16

[1112] Commission Staff Working Document, 11

claims which relate to interoperability information to be subject to an automatic license of right on FRAND terms similar to the arrangements for essential patents in standards.[1113]

A further approach is to licence both patents and trade secrets information on a case by case basis giving individual consideration rather than a general application of an exception or the right to licence regime. This would be modelled on the Framework and Access Directives for access to and interconnection of electronic communications networks.[1114] Obligations to licence would be imposed on undertakings with significant market power which would require new bodies in each national regulatory authority to carry out ex ante analysis of the market to identify those suppliers who had significant market power.[1115] If the definition of significant market power is equivalent to dominance under European competition law[1116] it would not apply to oligopolies such as the suppliers in the 3D CAD market and so would not provide a remedy to lack of interoperability and lock-in in oligopolistic markets. The consultation carried out as part of the Commission Staff Working Document identified that interoperability problems existed with suppliers that would not qualify as significant market players and gave the example of interoperability issues between different CAD systems.[1117]

After raising these initiatives the Commission Staff Working Document concluded that an Interoperability Directive should not proceed. Even if effective, establishing the new bodies would be costly, and the analogy with the electronic communications networks breaks down. Software industries, such as 3D CAD, do not have identifiable market bottleneck

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[1113] Commission Staff Working Document, 11

[1114] Directives 2002/21EC on a common regulatory framework for electronic communications networks and services, 2002/19/EC on access to, and interconnection of, electronic communications networks and associated facilities (as amended by Directive 2009/140/EC OJ L337/37) (the Framework Directive).

[1115] Commission Staff Working Document, 12 Safeguards would need to be in place including a framework explaining the principles to follow to ensure alignment between regulatory actions and the breach of interoperability principles as well as avoiding the disclose of information that reveals the technology and functionality implemented by a device or a system beyond its interfaces.

[1116] Framework Directive, recital 25

[1117] Commission Staff Working Document, 17 – 18 assets.[1118] They also have a different territorial scope as the electronic communications networks are primarily national whereas software markets generally cover the whole of the EU which makes implementation by national regulatory authorities inappropriate and ineffective. It could also introduce a public law approach adding a third dimension to intellectual property law and competition law.[1119]

Introducing automatic licences of right, other than just for the unified patent, would entail a revision of legislation in all member states, which presumably the Commission Staff Working Document did not consider feasible. It was also doubted whether the provisions could use Article 114 TFEU as a valid legal basis or meet the principles of proportionality.

It was assumed that implementation would be costly but the new bodies would only be necessary if action was limited to undertakings with significant market power. Automatic rights and interoperability exception for patents would, after amendment to the law, leave implementation and enforcement to the parties.

The Commission Staff Working Document preferred the introduction of non-legislative measures to lower transaction costs and foster a culture of licensing through the use of model licences and guidelines on valuing interoperability to help parties agree royalty rates.[1120]

8.3.2 Compulsory Disclosure and Mandatory Licenses of Right

Proposals to amend the existing legal position often consider some form of compulsory or mandatory disclosure of interface information.[1121] Article 102 provided such a mandatory licence remedy in *Microsoft.* The effectiveness of the remedy is limited as it is ex post and takes years to provide relief by which time the market may have moved on. Compulsory

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[1118] Commission Staff Working Document, 14-15

[1119] Ashwin van Rooijen *The Software Interface between Copyright and Competition Law* (Kluwer Law International 2010), 234

[1120] Commission Staff Working Document, 15-16

[1121] For example requiring dominant social network systems such as Facebook to provide APIs and other interoperability obligations, see Ian Brown and Christopher T. Marsden *Regulating Code* (2013 The MIT Press), 190 disclosure through some form of regulation is rare in copyright.[1122] Regulation has serious drawbacks including the cost burden of the regulator and regulated and can stem the innovation it intended to create.

Patent holders can already volunteer licences of right, normally in return for a reduction in licence fees. This allows all patent holders the opportunity of licencing the technology on reasonable royalty terms. As discussed earlier the Commission Staff Working Document considered converting this to mandatory licenses of right for patent claims covering interoperability information.[1123] Patent holders would be required to offer licences on FRAND terms, similar to the commitments in standard setting organisations. However as this would require changing the legislation of all Member States the Commission considers implementing automatic mandatory licenses of right would be 'very difficult'.[1124]

The Software Directive imposes a trade secret regime for computer programs[1125] which conflicts with a requirement for disclosure of any code but particularly the source code. Mandatory disclosure arrangements, including registration of the source code, could give copyright protection only in return for disclosure of the subject matter.[1126] But the source code is the 'crown jewels' and their disclosure is unlikely to strike the right balance between revealing interface information and the 'thin' protection of copyright granted to the valuable and functional know-how in the source code.[1127]

A more direct and proportionate approach is a registration requirement by the rightsholder of the interface specification. A disclosure requirement limited to the interface would not relate to the source code itself but only to the interface specification. Disclosure of

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[1122] Begona Gonzalez Otero 'Compelling to Disclose Software Interoperable Information' (2013) 16 The Journal of World Intellectual Property 2 - 14, 8

[1123] Commission Staff Working Document, 11

[1124] Commission Staff Working Document, 14 and 16-17

[1125] Ashwin van Rooijen *The Software Interface between Copyright and Competition Law* (Kluwer Law International 2010), 236

[1126] Ibid 235

[1127] Ibid 235

interfaces safeguards the public domain by limiting copyright protection to the computer program rather than the interfaces and “domain of interoperable programs”[1128] This would protect the rightholder’s control with less detriment to incentives to innovate. It would also limit transaction costs as it removes the need for third parties to invest substantially and without certainty of success in reverse engineering. The interoperability information is offered for free without competitors having to get a license from the copyright owner or to determine the royalty rate. The cost of preparing the information rests on the rightholder which is probably the most cost effective solution but these costs may be substantial[1129] and may be a disproportionate burden on small developers.[1130] Also it is possible that what the rightsholder makes available is not the optimum information. This could involve the rightsholder in work that is of little benefit to the consumer. It is effectively imposing a command economy on interface information rather than a demand economy which is achieved by reverse engineering.[1131] If however the rightsholder disclosed information in response to the threat of reverse engineering it is more likely the information that is disclosed more closely maps onto the information that is required by the market which should be more efficient.

Even where copyright protection is conditional upon full disclosure of interfaces, monitoring and enforcement remains problematic. It is difficult to define the point at which adequate disclosure has taken place to ensure the body of the computer program has copyright protection.[1132] For example, what level of disclosure or incomplete disclosure

[1128] Ibid 237

[1129] See for example Microsoft costs to comply with the Commissions interface disclosure requirement, Ian S. Forrester '"Victa lacet mihi causa: the compulsory licensing part of the Microsoft case” ’ in Luca Rubini (ed), *Microsoft on Trial* (Edward Elgar, Cheltenham 2010), 97-98

[1130] The “cheapest cost informer” is the original developer and owner of the software, Dieter Schmidtchen and Christian Koboldt ‘A Pacemaker That Stops Halfway: The Decompilation Rule in the EED Directive on the Legal Protection of Computer Programs’ (1993) 13 International Review of Law and Economics 413-429

[1131] Section 8.4

[1132] Inge Graef ‘How can Software Interoperability be achieved under European Competition Law and Related Regimes’ (2014) 5 (1) Journal of European Competition Law & Practice 5(1) is required and does the copyright owner have the say on where the interfaces are and how many? As discussed earlier, interfaces can be objectively defined as the rules by which data or instructions can be repetitively transferred between elements of a computer system.[1133] Interfaces exist where such transfers occur, making it difficult to categorise which portion of a program is truly an interface.[1134] As almost any part of the program can be considered as an interface[1135] it would be difficult to establish conclusively what constitutes an interface and to say whether full disclosure has taken place, particularly as the source code would not be available. This introduces a high level of legal uncertainty. This level of uncertainty combined with the degree of intervention required to enforce the rightsholder to compile and disclose information means this option is not recommended.

8.3.3 Reducing the Term of IPR Protection

The fifty years minimum term protection required by the Berne Convention for literary works far exceeds the useful life of the software. Shortening the term is not however easy. The difficulty of fixing a single appropriate term meant that approach was rejected for replacement parts under design protection law. [1136] "Attempting to influence the dynamics of platform software competition by identifying a single, fixed term of protection for interface specifications similarly appears too detailed an instrument to be effective."[1137] Reducing the term of protection for all software does not improve the position for interoperability but could adversely damage incentives to innovate. As interfaces have indirect effects as de facto standards reducing protection for interfaces alone to a shorter term is theoretically appropriate. This could be based on the time it would take to reverse

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[1133] Section 3.3

[1134] Ibid; C Meyer and M Colombe 'Interoperability still threatened by EC Software Directive: a status report' (1990) 12 European Intellectual Property Review 325, 317

[1135] Robert J Hart 'Intefaces, Interoperability and maintenance' (1991) EIPR 13 (4) 111-116

[1136] A single shorter term of protection was rejected for design protection laws, Ashwin van Rooijen *The Software Interface between Copyright and Competition Law* (Kluwer Law International 2010) 162 & 221 and could conflict with the Berne Convention but see Rooijen, 221 ft 1036

[1137] Ibid Rooijen, 221

engineer the relevant specifications. Given that interfaces can be subjectively identified and defined it would be difficult to operate a two tier regime for interfaces and other software. A two tier approach could imply that these specifications are protected which is not the case.[1138] Rather than having to determine the nature of interfaces under the ideas/expression dichotomy the courts would be deciding whether code was an interface to determine its duration of protection.

Introducing a shorter term of protection that is applicable to interfaces would be detrimental to vertical interoperability.[1139] Users of complementary software could be put in a worse position than they are now. While voluntary data exchange does take place within the 3D CAD industry not all suppliers of complementary software have advanced access to APIs and their software might stop working each time a new version of the operating or platform software is released.[1140] Many users would suffer disruption to interoperability between existing complementary software and new versions of operating or platform software. Users of complementary software for 3D CAD systems such as ANSYS and translation software do experience problems when new versions of the 3D CAD software are released and their complementary software may stop working for weeks or months.[1141] The suppliers of complementary software generally find APIs are not available before the release, or frequently not at all and have to rely on reverse engineering.[1142] Even if the copyright term was reduced to a matter of months, control would still remain

[1138] *SAS Institute*

[1139] Vertical interoperability is complementary systems which create new functionality as opposed to horizontal interoperability for systems with similar or overlapping functionality. Commission Staff Working Document, 6

[1140] For example interoperability data is exchanged between Dassault Systemes' CATIA design software and ANSYS's FEA (Finite Elements Analysis) software. Even here problems occur. When CATIA is upgraded ANSYS may not receive the information in advance and there may be a period when the programs are not compatible. Making the interface information available is in the gift of the 3D CAD supplier. If Dassault Systemes decided to introduce its own FEA software they could stop making interface information available.

[1141] Conversations between author and software design engineers 2014 – 2015, the 3D CAD suppliers may have a competing version of the complementary software application, for example FEA analysis, so there is no incentive to release APIs to ensure compatibility.

[1142] Interview with industry expert #9 (June 2014) with the operating or platform supplier. If interfaces were given a short term of protection rather than excluded under the present regime the position for suppliers and users of complementary software could be worse.

8.3.4 Specific Exclusion for Interface Information

The Software Directive and case law in the CJEU has categorised interface information amounting to ideas and principles as not being copyright subject matter.[1143] Case law has given guidance on what effectively amounts to an exclusion for those elements of software which are not concrete elements of expression.[1144] While the ideas and principles behind the interface, which can be extracted by reverse engineering, are not protected the code itself can still not be copied. A proposal for a specific exclusion would go further than the existing legal position by excluding the code in the interface from copyright protection. While interfaces can be subjectively identified and defined, the proposal is considered feasible as although many parts of a computer program could be named an 'interface', an interface specification is distinguishable from its implementation.[1145] It is only the lines of code that constitute the specification that would be excluded from protection which is only a small part of the interface.[1146] In practice this would be limited to the machine code as the source code would not usually be available to the decompiler, only their interpretation of the source code achieved by decompilation.

An exclusion removing code in interfaces from copyright protection would not entirely remove control as access to the software's code would remain limited to the purposes of interoperability. When however software is reverse engineered under Article 6 the decompiler would have a right to use the code for the permitted purposes. There is a need and benefit in copying the exact expression as it is an efficient way to achieve interoperability and can achieve the benefits of standardisation. Such an *ex ante* approach

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[1143] *SAS Institute*

[1144] *SAS Institute, Oracle v Google*

[1145] Ashwin van Rooijen *The Software Interface between Copyright and Competition Law* (Kluwer Law International 2010), 218

[1146] Ibid 219

could give certainty. The courts have not gone as far, relying on the expression/idea dichotomy to provide a remedy that falls short of this proposed exclusion. If however the information includes code, as that is part of the expression, it is probably copyright protected even though its originality may be subordinate to its purpose.[1147] Dissemination of the code, in addition to the interface specification, could economically be a very sensible re-use of the code as it would reduce waste and cost. If it was limited to code implementing interfaces, rationally, it should not reduce incentives to innovate.[1148] This implementation does though require amendment to the Software Directive in a way that redefines the copyright protection given to software rather than just changing the arrangements for access to those parts of the code that are not copyright protected. For this reason it is recommended that these amendments should not proceed unless the following recommendation for sharing interface specifications, excluding code, does not achieve a balance that improves interoperability.

8.4 Recommendation

8.4.1 Access to Interface Information by Reverse Engineering

The above proposals concerned imposing obligations on rightsholders and changes to IPRs themselves. The following recommendations concern only access to the interface information which is not copyright protected. They are intended to improve access to information needed to achieve interoperability without imposing any positive obligation on the rightsholder.

The Software Directive employs copyright to protect trade secrets. It gives software companies the enviable position that they can license their products to the world while still protecting the trade secrets contained in those products without the need to get patent protection for functional elements. If there was no need for the software to be compatible that position could be acceptable, however the strong protection of copyright and trade secret skews the balance to be overly closed.

[1147] *Oracle v Google* refuted arguments that interfaces code was not copyright protected just because it had to be compatible, 42

[1148] The originality of code in interfaces is normally limited by its function and the value in interfaces comes from their indirect effects rather than their intrinsic innovation

No other general principle of intellectual property law exempts the ideas underlying products from study by those wishing to create competing products.[1149] The law of trade secrets and confidentiality permits the study of ideas by reverse analysis.[1150] Trade secrets once learned by another are theirs to use. The ideas contained in cookery books can be studied to develop competing recipes provided the expression is not copied.[1151] What is considered here is redressing the anomaly that ideas and other non-copyright protected aspects of software are not visible and that they are also restrictions on disseminating any information obtained from decompilation.

Decompilation and reconstruction in a higher level language can result in the exposure of some vital knowhow that would otherwise remain protected as a trade secret. It will reveal code which is copyrightable expression. As the location of the code that is essential for interoperability may not be identified without an analysis of the wider program even the conscientious engineer may discover more than is essential for interoperability. It is for these reasons the Article 6 was so contentious and drafted restrictively.[1152] However reverse engineering even of the entire program will not of itself reveal all of the secrets of its design and development.

> Software reverse engineering does not lay bare a program's inner secrets. Indeed, it *cannot*. The inner secrets of a program, the real crown jewels, are embodied in the higher level of abstraction material such as the source code commentary and the

[1149] Maurizio Borghi and Stavroula Karapapa *Copyright and Mass Digitization* (OUP 2013); Caroline Meyer and Michel Colombe 'Interoperability still threatened by ED Software Directive: a status report' (1990) EIPR 12(9) 325-329, 327

[1150] Pamela Samuelson and Suzanne Scotchmer *The Law and Economics of Reverse Engineering (2002) 3* The Yale Law Journal 1575

[1151] Caroline Meyer and Michel Colombe 'Interoperability still threatened by ED Software Directive: a status report' (1990) EIPR 12(9), 325-329, 328

[1152] Article 6 is more restrictive than the common law approach as under fair dealing exceptions certain circumstances will justify the performance of otherwise restricted acts, regardless of whether other means exist to accomplish the same objective. Article 6 presume and requires the decompiler to have reviewed all other means to achieve the same end and found them to be inadequate. B Czarnota and R Hart *Legal Protection of Computer Programs in Europe - A Guide to the EC Directive* (Butterworths 1991) 76

> specification. This material never survives the process of being converted to object code.[1153]

As the Explanatory Memorandum to the Initial Proposal for the Software Directive states "Although it is technically possible to decompile a program in order to find out information concerning access protocols and interfaces this is a lengthy, costly and inefficient procedure."[1154] It would not give any benefit to the pirates who have other shortcuts to produce illegal copies of programs. Decompilation is not a preferred technique as it is difficult and expensive but sometimes it is the only feasible means of obtaining the interface information.[1155] The justification for preventing the disclosure of the interface specification obtained by reverse engineering has not been made out.

> If a pirate wanted to copy a program they would do just that – copy the available object code. *Attempting to recreate an entire program after it is compiled would be as sensible – and as economically efficient – as trying to unscramble an egg.* Also the product if used for commercial purposes would infringe copyright as a 'translation' of the original program.[1156]

Reverse engineering is intended to act as a safety valve to enable a second program maker to develop an interoperable program when an existing program is not available.[1157] It is also intended to encourage the copyright holder to disclose the interface information voluntarily,[1158] although its success in this is mixed. In the public consultation of the Commission Staff Working Document, only 24% of respondents considered the possibility of

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[1153] Andrew Johnson-Laird 'Software Reverse-Engineering in the Real World' (1994) 19 U Dayton L Rev 843, 896

[1154] Explanatory Memorandum to the Initial Proposal for the Software Directive, 8, para. 3. 15.

[1155] Alan Palmer and Thomas Vinje 'The EC Directive on the Legal Protection of Computer Software: New Law Governing Software Development' (1992) 2 Duke Journal of Comparative & International Law 65, 82

[1156] Caroline Meyer and Michel Colombe 'Seeking interoperability: an industry response' (1990) EIPR 12 (3) 79-93, 82

[1157] B Czarnota and R Hart *The Legal Protection of Computer Programs in Europe – A Guide to the EC Directive* (Butterworths 1991), 76

[1158] Ashwin van Rooijen *The Software Interface between Copyright and Competition Law* (Kluwer Law International 2010) reverse engineering interoperability information by third parties represented an incentive to license interoperability information while 21% considered it did not.[1159] Industry executives and experts were either unaware of the possibility of reverse engineering or did not consider it important to their decision making.[1160] This indicates that reverse engineering is not considered a strategic issue in the 3D CAD industry and is therefore not a significant driver for interoperability.

8.4.2 Economic Rationale for Reverse Engineering

Permitting reverse engineering is thought to be economically sound as the innovator is protected by the costliness of reverse engineering and the lead time due to the technical challenge of reverse engineering[1161] Costs and lead time allow the original innovator to recoup its investment and protect incentives to innovate. However the welfare benefits of allowing reverse engineering of interfaces differ from those of reverse engineering the software's core subject matter. In manufacturing industries reverse engineering is done to make directly competing stand-alone products.[1162] Copyright law prevents direct copying of software and interfaces are reversed engineered to improve interoperability of both complementary as well as competing programs. Interfaces also have a different, indirect and magnified effect on interoperability and hence on competition and innovation.[1163] Interfaces are standards and different considerations should apply to the treatment of IPRs, if any, present in the interface information.[1164] IPRs in interface could be used to leverage

[1159] Public Consultation on the Access to Interoperability Information of Digital Products and Services in the Commission Staff Working Document. Q 3.6 Half those surveyed consider that the question was 'not applicable' so the 24% may actually be higher among relevant constituents but still gives a very incomplete solution to the problem of interoperability

[1160] Interview with senior industry executive #3 (May 2014)

[1161] Samuelson and Suzanne Scotchmer 'The Law and Economics of Reverse Engineering' (2002) 111 The Yale Law Journal 1575

[1162] Ibid 1613

[1163] Ashwin van Rooijen *The Software Interface between Copyright and Competition Law* (Kluwer Law International 2010), 198

[1164] See Chapter 6

market power in a way that was unintended as a matter of intellectual property law.[1165] The interface's value comes predominantly from this interdependence rather than intrinsic innovation. Decompiling interfaces is not a market-destructive means of reverse engineering even in the absence of costs and technical challenges.[1166] The 3D CAD suppliers certainly distinguished between protection of the interfaces and the inviolable kernels.[1167] The logic that to be economically sound reverse engineering needs to be costly and difficult does not apply to interfaces. With respect to interfaces, cost and difficulty is only a waste and economically undesirable. There is no rationale for protecting the first comer. The Software Directive already specifies that decompilation can only be done for interoperability which restricts software reverse engineering more than in traditional manufactured items.[1168] Reverse engineering is legitimised by its purpose,[1169] and when restricted to interfaces, difficulty or cost, does not give any welfare benefit. The goal should be to make reverse engineering of interfaces as efficient as possible. This will aid both horizontal and vertical compatibility.

The Software Directive prevents access to ideas and other non-copyright protected aspects of software. Noam Shemtov argues that the purpose of reverse engineering should not be limited to interoperability. He makes the case that not only is this justified on the doctrinal grounds of the ideas and expression dichotomy but also by economic efficiency considerations. The relaxation of the restrictions on decompilation would not cause a loss of incentives to create and develop but result in a more balanced system properly

[1165] Pamela Samuelson and Suzanne Scotchmer 'The Law and Economics of Reverse Engineering' (2002) 111 The Yale Law Journal 1575, 1575

[1166] Ibid 1653

[1167] Interview with senior industry executive #3 (May 2014)

[1168] Pamela Samuelson and Suzanne Scotchmer 'The Law and Economics of Reverse Engineering' (2002) 111 The Yale Law Journal 1575, 1655

[1169] Ibid 1655

addressing the unique properties of software products.[1170] The US 'fair use' doctrine is not restricted solely to interoperability and is said to be more flexible than Article 6 of the Software Directive. The Software Directive does however make null and void any contractual provision attempting to prevent reverse engineering.[1171] There is no such statutory provision in the US and contractual provisions in software licences prohibiting reverse engineering are common and the enforceability of restrictions on reverse engineering has been highly contentious.[1172] While decompilation in the US is not specifically limited to interoperability there must be a legitimate reason,[1173] the most prominent of which is for the purposes of interoperability.

8.4.3 Art of the Possible

It is highly unlikely the climate in Europe has changed significantly to allow for a major change in the hard won provisions of Article 6. The Commission has looked at the Software Directive and the question of interoperability on at least two occasions since the introduction of the Software Directive and on both occasions has shied away from making any changes.[1174] There appears to be little appetite for legislative amendments in any form[1175] and certainly not on the psychological scale that would be required to permit decompilation of all software even with an *ex-post* review by the courts as envisaged by

[1170] N Shemtov, 'The Legal Regulation of Decompilation of Computer Programs: Excessive, Unjustified and in Need of Refrom' (PhD Thesis QML 2012), 45

[1171] Software Directive Article 8(1)

[1172] Pamela Samuelson and Suzanne Scotchmer 'The Law and Economics of Reverse Engineering' (2002) 111 The Yale Law Journal 1575

[1173] *Sega*, 977 F.2d at 1518

[1174] Report from the Commission to the Council, the European Parliament and the Economic and Social Committee on the implementation and effects of Directive 91/250/EEC on the legal protection of computer programs COM (2000) 199 final and the Commission Staff Working Document Analysis of Measures that could lead significant market players in the ICT sector to license interoperability information SWD (2013) 209 final.

[1175] Ibid, the Community Institutions have been urged "not to re-open the floodgate of debate on this Directive", 21

Shemtov.[1176] While there may be doctrinal validity in allowing access to non-copyright protected aspects of software the effect on the required balance and the economic consequences have not been established to the extent that a convincing case could be made to a hostile audience.[1177] Interviews in the 3D CAD industry reveal a clear distinction between allowing access to interfaces with a strong resistance to any dilution in control of what were considered core aspects of the computer program.[1178] The need to strike a balance between control and openness is recognised[1179] but the means of converting this recognition into a reliable model to identify the pivot's position is not yet available. Rather than taking the purist approach, which might be doctrinally correct but which would meet with over-riding resistance, the guiding principle should be the art of the possible. It would be best to take a step approach starting with the minimum intervention and evaluating its impact.

A form of step approach was advocated by Rooijen in the form of a regulator with rulemaking, dispute resolution and monitory powers. To achieve the middle ground between openness and control would require the use of levers such as lifting the ban on sharing decompiled code or shift the burden of proof for availability of the interface information to the rightsholder.[1180] The regulator would not be called upon to carry out any market-specific analysis.[1181] Regulators are used in some Member States to regulate

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[1176] N Shemtov, 'The Legal Regulation of Decompilation of Computer Programs: Excessive, Unjustified and in Need of Refrom' (PhD Thesis QML 2012), 152 – 161

[1177] See Thomas Vinje 'The Legislative History of the EC Software Directive' in Tapper C and Lehmann M (eds), *Handbook of European Software Law* (OUP 1993)

[1178] Interview with senior industry executive #3 (May 2014) Interview with senior industry executive #4 (July 2013)

[1179] Pamela Samuelson and Suzanne Scotchmer 'The Law and Economics of Reverse Engineering' (2002) 111 The Yale Law Journal 1575

[1180] Ashwin van Rooijen *The Software Interface between Copyright and Competition Law* (Kluwer Law International 2010), 226-233

[1181] Ibid 233

Technology Protection Measures (TPMs) under the InfoSoc Directive[1182] and telecommunications.[1183] As a form of step by step approach, where the impact of the change can be monitored to achieve the optimum balance, the approach has advantages but it is unclear how it would be implemented. Divulging to the regulator powers to vary the rules would involve a wholesale change to highly contentious provisions of Article 6 of the Software Directive and could lead to uncertainty if the regulator changes the rules too often. It is unclear whether any execution of the rulemaking task would be effective at Europe wide level or only national or even specific case level. Nevertheless the approach has merit and similarly to the proposal for a specific exclusion for code in interfaces[1184] it should be considered if the following proposal to permit sharing of interface specifications does not achieve the required balance and improve interoperability.

8.4.4 Restrictions on Sharing Information

Article 6 of the Software Directive permits decompilation where it is indispensable to achieve interoperability of an independently created computer program provided *inter alia* the information obtained is not "to be given to others, except when necessary for the interoperability of the independently created computer program".[1185]

Article 6 (2) (b) was submitted by the French delegation in April 1990 and considered by the Council working group.[1186] It was adopted in the final directive and prevents the dissemination of information obtained from reverse analysis even when that information is not covered by copyright. The literature on the adoption of the Software Directive makes little mention of this provision and it does not appear to have met with opposition.

[1182] Directive 2001/29/EC on the harmonisation of certain aspects of copyright and related rights in the information society (2001) L167/10

[1183] Directive 2002/19/EC on access to, and interconnection of, electronic communications networks and associated facilities and see L 337/37 Directive 2009/140/EC amending the Directive.

[1184] Section 8.3.4

[1185] Software Directive Art 6 (2) (b)

[1186] Thomas Vinje 'The History of the EC Software Directive' in M. Lehmann & C. Tapper *A Handbook of European Software Law*, Clarendon Press Oxford 1993

Energies were perhaps understandably concentrated on resisting other proposals such as preventing reverse engineering interface information being used to develop a competing program. When making the point that decompilation should be permitted to produce non-infringing programs regardless of whether they compete with the decompiled program, ECIS said that to do otherwise would be contrary to the fundamental copyright tenet that the ideas and principles underlying a copyrighted work are dedicated to the public.[1187] To apply that principle to the non-sharing provision begs the question that if the work is dedicated to the public why should the decompiler be prevented from sharing it?

Decompilation is limited to 'code' and cannot reconstitute other preparatory material. Underlying ideas and principles derived from reverse engineering may be used only so far as the provisions of the Directive permit.[1188] The non-sharing clause prevents dissemination of those ideas and principles obtained by decompilation. By contrast under Article 5.3 ideas and principles derived from "black box" engineering, namely observation, study or testing by loading, displaying, running, transmitting or storing the program, has no restriction on the sharing of the ideas and principles. It is only the information, including the interface specification, that remains protected as though it were a trade secret.

The separation of Article 6 into two parts corresponds to separate possible violations of the author's rights. Article 6.1 concerns decompiling the original program and 6.2 producing an infringing program based on the results of decompilation.[1189] The Directive does not explain the nature of the obligation imposed on the decompiler in 6.2 and as most Member States merely duplicated the article no insight is given on their understanding of the obligation.

> It has been argued by some commentators that the use made of 'information' is not a copyright issue. However, the access to the information contained in the program

[1187] ECIS: 'Why Interoperability Must Be Defined To include Competing Products' and Caroline Meyer and Michel Colombe "Interoperability still threatened by ED Software Directive: a status report" (1990) 12(9) EIPR 325-329, 327

[1188] B Czarnota and R Hart *Legal Protection of Computer Programs in Europe - A Guide to the EC Directive* (Butterworths 1991), 77

[1189] Ibid 81

> cannot be given without a change in the *normal* rules of copyright. Therefore, it is necessary to ensure that the removal of that 'copyright barrier' to access does not lead to abuses which undermine the very protection which the Directive seeks to give.[1190]

This ignores certain realities. Firstly copyright protects expression which by implication means it protects something that is visible, audible or otherwise communicated to the public. It is not intended as a means to protect trade secrets. Secondly, the restricted acts under Article 4 are basically reproduction, adaptation and distribution. These are the normal acts which if undertaken with the rightholder's consent will reveal the underlying ideas and principles. The difference with computer programs is that, unlike most works that have copyright protection, the ideas and principles are not necessarily revealed when there is a legitimate reproduction, adaption or distribution of the software. The problem is that acting within the '*normal* rules of copyright' does not reveal these ideas and principles and something more and *sui generis* needs to happen. It is a secondary consequence that the expression does not reveal all the ideas and principles of the copyrighted work.[1191]

Thirdly, it is not a 'copyright barrier' that has to be removed but a technical hurdle that needs to be overcome to enable copyright to work in its normal manner to give a balance between protecting the expression while not giving a monopoly on the underlying ideas and principles. To restrict the purposes for which the program may be reproduced, as imposed by the Software Directive, is restricting rights beyond that normally enjoyed.[1192]

[1190] Ibid 81

[1191] W R Cornish 'Inter-operable systems and copyright' (1989) 11 (11) European Intellectual Property Review 391-393

[1192] Ibid, examples given are that the reader of a book or the viewer of a painting is perfectly free to analyse and create; but because of the nature of software, he has first to obtain a version of the text in order to get the picture. Making an analysis for one's own experimental purposes, is just the kind that would be allowed in respect of patentable invention. Engaging in an act of reproduction (or its equivalent) for the sole purpose of evaluation, analysis, research or teaching, which by common consent is a necessary freedom when it comes to the protection of semiconductor chip topographies.

Not only is software and the Software Directive unique in keeping ideas underlying products exempt from study[1193] but normally copyright law does not prevent the use of or dissemination of ideas or other non-copyright protected information.[1194] The Software Directive however restricts the use of information, such as the interface specification, to only achieving interoperability of the independently created computer program and prevents the information being given to others except when necessary for the interoperability of the independently created computer program. To deny access to the ideas and principles underlying a computer program that are inaccessible without reverse engineering is analogous to saying that copyright protection of a book prevented the purchaser from reading it. According to the Turner Report this is inherently wrong and would have a serious restrictive effect on innovation and competition.[1195]

8.4.5 Interface Specifications

The Turner Report referred to the 'clean room' procedure where analysis of competitors' programs to write an interface specification is kept separate from the writing of the code to implement the specification which prevents the copying of the expression. Interface specifications are created by the decompiler. The machine code is decompiled to a higher level language which can be read by the decompiler. Using the higher level information, a specification is written setting out the characteristics of the interface. 3D CAD suppliers were aware of this practice and thought it would be used in their company for reverse analysis.[1196]

The subject of the interface specification can be an API or data file. The document is the decompiler's interpretation of the requirements of the interface and does not include

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[1193] Caroline Meyer and Michel Colombe 'Interoperability still threatened by ED Software Directive: a status report' (1990) 12 (9) EIPR 325-329

[1194] Thomas Dreier and P. Bernt Hugenholtz Eds *Concise European Copyright Law* (Kluwer Law International 2006)

[1195] prepared by Amedée Turner QC, one of the Parliamentary rapporteurs ,Eur. Parl. Doc. 136.025 (fin.) Annex II, DOC EN/RR/91422 (Nov. 1989) (the 'Turner Report')

[1196] Interview with industry expert #1 (May 2014) Interview with industry expert #2 (May 2014) either the machine or original source code.[1197] The interface specification is the work of reverse engineering and does not contain either machine or source code. It comprises the ideas and principles of the software's interface and hence does not contain copyright of the software's rightsholder. Despite the fact that the interface specification is normally free of copyright material, other than copyright belonging to the decompiler, the decompiler is restricted by the Software Directive in their ability to share the interface specification.

Limiting the use of the information obtained by reverse engineering is not understandable from an economic standpoint.[1198] That information has the nature of a public good and welfare consideration requires that once produced there should not be exclusions of possible users from that information.[1199] If firms could sell the interface information they have obtained by reverse engineering they could recoup the costs of reverse engineering.[1200] This would create a market for interface specifications which would reduce waste and increase efficiency in the process. It could encourage start-up firms that specialise in this sort of information.[1201] While the "cheapest cost informer"[1202] is the original developer and owner of the software if other firms could share the interface specifications they acquire by reverse engineering this would also be efficient. By stopping multiple competitors from collaborating on their reverse engineered efforts it leaves reverse engineering as a viable option only to the large developers. This makes it harder for

[1197] Interview with industry expert #2 (May 2014)

[1198] Dieter Schmidtchen and Christian Koboldt 'A Pacemaker That Stops Halfway: The Decompilation Rule in the EED Directive on the Legal Protection of Computer Programs' (1993) 13 International Review of Law and Economics 413-429

[1199] Ibid 425

[1200] Ibid 425 the cost of decompilation should be as small as possible

[1201] Van Den Bergh 'The Role of Social Justification of Copyright: A "Law and Economics" Approach' (1998) Intellectual Property Quarterly 17-34

[1202] Dieter Schmidtchen and Christian Koboldt 'A Pacemaker That Stops Halfway: The Decompilation Rule in the EED Directive on the Legal Protection of Computer Programs' (1993) 13 International Review of Law and Economics 413-429 smaller firms to enter and compete in the market.[1203] The pressure group SAGE[1204] recognised that an exception permitting research and analysis could disadvantage small companies which could not afford to conduct reverse engineering.[1205]

8.4.6 Compliance with the Berne Convention

The Berne Convention is specifically referred to in Article 6 of the Software Directive.[1206] Article 6 of the Software Directive is considered to comply with Article 9(2) of the Berne convention as the exemption is specific as it "relates to a unique characteristic of novel subject matter among literary works",[1207] namely that machine code does not reveal its ideas to the human eye without reproduction, which is the reason for the exemption. Further the elements are not sought in order to produce a program that is similar in its expression but to access the unprotected elements, namely interface specifications. For this reason the exception is a 'special case'.[1208]

As the exemption allows reproduction for a transitory purpose, not to write a program which infringes as it does not take the expression of the analysed program, but to access the ideas, it does not conflict with the normal exploitation of the work. The dissemination of that non-protected work would also not infringe the work's normal exploitation.

[1203] Ashwin van Rooijen *The Software Interface between Copyright and Competition Law* (Kluwer Law International 2010), 90

[1204] Dominant American software companies established a group called the Software Action Group for Europe (SAGE)

[1205] Thomas Vinje 'The History of the EC Software Directive' in M. Lehmann & C. Tapper *A Handbook of European Software Law*, Clarendon Press Oxford 1993, 51

[1206] There was debate as to whether computer programs came with the Convention, see W R Cornish "Computer program copyright and the Berne Convention" (1990) 12(4) EIPR 129-132, 130 but its express inclusion in Article 6 requires the exemption to be interpreted in accordance with Article 9(2) of the Convention. The Berne Convention permits exemptions to Article 9 (1), which requires Union countries to give authors exclusive rights to the reproduction of their literary and artistic works, only (1) in certain special cases, (2) provided that such reproduction does not conflict with a normal exploitation of the work and (3) does not unreasonably prejudice the legitimate interests of the author.

[1207] W R Cornish 'Computer program copyright and the Berne Convention' (1990) 12(4) EIPR 129-132, 130

[1208] Ibid

Copyright is not concerned with keeping ideas secret and Article 9(2) of the Berne convention is not concerned with protecting trade secrets.[1209]

The third requirement of not unreasonably prejudicing the legitimate interests of the author was used to claim reverse analysis should not be allowed as it could be employed as a tactic by those wanting to copy the expression. The same could be said of sharing the interface specification. The argument that a limitation should not be allowed because it cannot be distinguished from conduct not within the limitation is not acceptable. To allow such an argument would prevent exemptions such as private study or private use.[1210] Indeed the converse is true and protection would be illegitimate. The investigation is an act which basic copyright theory regards as beyond the scope of protection. It would give control over non-copyright material that could restrict the products of competitors and other software developers without achieving the standards required for patent protection.[1211]

8.4.7 Sharing of Interface Specifications

The change that is recommended is to amend the Software Directive to allow for the dissemination of interface information obtained by reverse engineering. This would normally be in the form of an interface specification which is compiled from information obtained by reverse engineering. The interface specification would not contain information protected by the software supplier's copyright.[1212]

The Directive presently prevents the disclosure of any interoperability information obtained by reverse engineering[1213] and this forces each supplier to repeat the painstaking decompilation for itself. Lifting this restriction would remove duplication of effort and

[1209] Ibid

[1210] Ibid

[1211] Ibid

[1212] *SAS Institute* and Interview with industry expert #8 (June 2014) and technical discussions and conversations between author and software design engineers 2014 - 2015 and see section 8.5.6

[1213] Software Directive, Article6 (2) (b) although this restriction does not appear to apply to information gained by black box analysis under Article 5 avoid waste. It would allow firms to specialise in providing interoperability information to other vendors and other firms could innovate secure in the knowledge that an interface is available.[1214] This would encourage decompilation by the most efficient and specialised firms.[1215] It would create a market for interface information which could encourage, but not oblige, suppliers to make their own interface information available to ensure its quality, and could also bolster the use of standard interfaces. This market response will no doubt be resisted by many in the software industry with the same vehemence displayed when the Software Directive was introduced. There is concern that:

> The sharing of interface specifications could evolve into a complex pattern of unmanageable (sub) licencing arrangements. It could be prohibitively difficult for the rightsholder to ascertain whether use of his or her interoperability information by a third party stems from a valid (sub)license or whether it was obtained in a different manner and, therefore, possibly constitutes an infringement"[1216]

Properly decompiled interface specifications do not contain code or other copyright material belonging to the software rightsholder. There is no doctrinal justification for the rightsholder being able to prevent its dissemination. Conduct cannot be avoided just because it is difficult to distinguish from illegitimate conduct.[1217] As will be seen the proposal provides for a conservative step approach and encourages registration which could allow the rightsholder some element of monitoring of its interfaces. This limited modification of Article 6 is intended to move a moderate step towards more openness. It is also hoped the increase in access to interface specifications will challenge software rightsholders to make the interface information available themselves.

[1214] Ann Walsh '*Microsoft v Commission*: interoperability, emerging standards and innovation in the software industry' in Rubini, L, (ed) *Microsoft on Trial* (Edward Elgar 2010), 296- 297

[1215] Ashwin van Rooijen *The Software Interface between Copyright and Competition Law* (Kluwer Law International 2010), 230

[1216] Ibid 221

[1217] It is the same reason for reverse analysis not infringing the third requirement of the Berne Convention to not unreasonably prejudice the legitimate interests of the author. See section 8.5.7

The safeguards that have been imposed by Article 6 (1) can remain unaltered.[1218] Allowing the sharing of interface specifications obtained by reverse engineering would not require any dilution of these restrictions. The original compiler would still be required to have a licence or other permission, to ensure the information was not already available and to limit the reverse analysis to only what was necessary for interoperability. Indeed the dissemination of interface specifications could reduce the need for reverse engineering as more information would be available. This could reduce the opportunity or excuse for looking at parts of programs wider than the interfaces.

With regard to Article 6(2) reverse analysis could still be limited to cases where the original decompiler has an independently created computer program but the original decompiler could then make the interface specification available to others. Ideally however the requirement for an independently created computer program would be removed to allow for software engineers to carry out decompilation purely to write the interface specification. This certainly happens in the software community[1219] and encouraging the practice would help disseminate interface information. The restriction, that information should not be "used for the development, production or marketing of a computer program substantially similar in its expression, or for any other act which infringes copyright" would remain valid. The statement is really superfluous anyway as nothing in Article 6 or elsewhere permits the use of copyright material.[1220]

[1218] Article 6 (1) requires that decompilation is carried out by someone who has a license or other right to use a copy of the program; the information necessary to achieve the interoperability has not previously been readily available; and the acts are confined to parts of the original program which are necessary to achieve interoperability.

[1219] Interview with industry expert #2 (May 2014) Interview with industry expert #8 (June 2014). Many software engineers already decompile and share interface information unaware the sharing of the information is unlawful. They realise they are not using the code but information they have discovered and recorded themselves and do not understand the justification for them not being able to use that information as they wish.

[1220] Article 6 does not even give an express right for the decompiler to use decompiled information.

Some decompilers may not want to share the interface specifications as they may want to retain the competitive advantage the information gives them.[1221] The possibility of sharing interface specifications was discussed during industry interviews and several interviewees expressed interest in the possibility.[1222] Some also expressed surprise that it was not already permitted as they know of interface specifications being shared in the software community.[1223] In practice interfaces of individual computer programs would only have to be completely decompiled once. When new versions appear the decompilation could be limited to those aspects that appear from running and observing the program to be novel. If interface specifications from the original decompilation were continually and widely available, updating would be less time consuming and expensive.[1224]

The wider software industry does have a pattern of sharing information, not least in the open source community. If there was a market for the interface information it would be possible for smaller developers to buy the interface information which would remove the burden of reverse analysis. This could allow smaller developers to enter and compete in the industry. A market for interface specifications minimises 'deadweight loss' of administration and potentially enforcement. The availability of the information would mean there was less need to embark on reverse analysis and it would not even be permitted because of Article 6 1(b). Permitting the sharing of interface specifications is a form of 'prosumer law'[1225] which allows the user of the internet, or in this instance the computer

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[1221] Samuelson & Scotchmer (2002), 1658 who considered that reverse engineers typically keep the resulting know-how secret for competitive advantage.

[1222] Interview with industry expert #2 (May 2014) Interview with industry expert #9 (June 2014)

[1223] Interview with industry expert #8 (June 2014) Interview with industry expert #9 (June 2014)

[1224] Interview with industry expert #8 (June 2014) Interview with industry expert #9 (June 2014)

[1225] The term 'prosumer' refers to the online creator who is not just a consumer Ian Brown and Christopher T. Marsden *Regulating Code* (2013 The MIT Press), 184 program, to have an active role to obtain interoperability including the ability to exit with their data.[1226]

The rationale behind Article 6 was said to be to encourage the rightsholder to voluntarily disclose the interface specification but this does not appear to have had a significant impact.[1227] If however decompilers can make that information available then this can either relieve the rightsholder of the burden of preparing the information for disclosure, or may encourage them to disclose the information themselves as they may feel more in control of the situation.

8.4.8 Specific Amendments to Article 6

No amendment is required to Article 6.1 which can remain unaltered.

While Article 6.1 (b) can remain unaltered it has been criticised as it is uncertain when information is 'readily available'. Is it legitimate to charge for the information and if so how much and how complete must the information be? Shemtov proposes inserting the words 'readily available under fair and reasonable terms'.[1228] This would be a sensible amendment but not essential to the working of these proposed changes. Article 6.1 (c) has been criticised as until decompilation takes place it is not possible to know exactly what part of the code makes up the interface and needs to be decompiled. It is likely that some extraneous code could be decompiled. Again inserting the word reasonable to read 'acts are performed to the extent *reasonably* necessary to achieve interoperability of the independently created computer program.' However this amendment is not essential to this proposed outcome. To implement this proposal no amendment would be needed to Article 6.1.

[1226] Ibid 185. Here the prosumer could choose to exit if they were not locked-in to the supplier's software.

[1227] Only 24% of respondents to the Commission Staff Working Document consultation thought the possibility of reverse engineering of their software represented an incentive to license interoperability information. No evidence of any incentive was revealed in 3D CAD industry interviews.

[1228] N Shemtov 'The Legal Regulation of Decompilation of Computer Programs: Excessive, Unjustified and in Need of Reform' (PhD thesis QML 2013), 150

Article 6.2 amended to read:

*2. The provisions of paragraph 1 shall not permit the information obtained through its application to be used for goals other than to achieve the interoperability of **an** independently created computer program.*

Article 6.1 refers to the interoperability of ***an*** independently created computer program while Article 6.2 refers to the interoperability of ***the*** independently created computer program. Replacing *the* with *an* in Article 6.2 removes the requirement for the decompiler to have already developed a specific computer program. This would allow for decompilation by software engineers with the aim of licensing or otherwise distributing the interface specifications they have created. Because of the difficulty of reverse engineering there is unlikely to be a rush of independent decompilers. However some interest was expressed during industry interviews for this model, although not from the 3D CAD suppliers themselves. The model could prove an efficient way of making the interface information available[1229] although some concern was also expressed that this could create competitive standards which would not be efficient.[1230]

Article 6.2(b) would be deleted in its entirety

This would remove the restriction on the sharing of the interface specification.

Article 6.2 c does not appear to add anything but can be included to avoid the doubt that the rest of Article 6 in some way gives an implied licence to infringe the copyright in the decompiled software.

These amendments would allow for dissemination of the non-copyright protected information. They do not relieve the restrictions that exist in Article 6.1 that limit decompilation to interoperability nor do they give any right under the Software Directive or other legal provision to infringe another parties intellectual property rights, other than the existing right to reproduce or translate software for the purpose of interoperability.

[1229] Interview with industry expert #8 (June 2014) Interview with industry expert #9 (June 2014)

[1230] Interview with industry expert #5 (September 2014)

8.4.9 Registration of Interface Specifications

A registry of interface specifications is proposed with the aims of: encouraging decompilers to make their information available; improving knowledge as to what interface information is available, informing rightsholders when their interfaces have publically available specifications.

Interfaces of computer programs do not normally change substantially, although when new versions are released there will be some changes. Once a version of the interface is registered and available the specification can be re-used, and combined with decompilation of changes to the latest version to give a current interface, without repeating the original work.[1231]

8.4.9.1 Safe Harbour

Registration is not compulsory, but to encourage the use of the registry, decompilers who notify the registrar that they have created the interface will be relieved of normal liability for infringement of copyright. Where the decompiler complies in good faith[1232] with the provisions of Article 6 the rightsholder will not be entitled to an injunction nor to damages. To meet this requirement decompilers will be expected to keep, and when required disclose, records of the decompilation process. The only remedy that will be available to the rightsholder is to claim a royalty on a FRAND basis for any copyright that might have unwittingly been included in the interface specification.

Ideally the changes to copyright law in the Software Directive would be accompanied by the introduction of a patent interoperability exception. This exception would state that, where the results of decompilation or other reverse engineering for interoperability cannot be used because they are covered by a patent, such patents could not be invoked against

[1231] Interview with industry expert #8 (June 2014) Interview with industry expert #9 (June 2014)

[1232] Good faith is used for while there is no general principle of good faith in English law there are judicial interpretations of the concept and it's meaning is more established in other European Union member states. The concept is used in the safe harbour provision of competition law, see for example Commission Notice on agreements of minor importance which do not appreciably restrict competition under Article 81(1) of the Treaty establishing the European Community (deminimis) (1) (2001/C 368/07) products implementing the information.[1233] Alternatively the patent holder's right would be to claim a royalty based on FRAND terms.[1234] As this arrangement only applies to interfaces and is intended to improve interoperability with minimum cost and regulation, a royalty free arrangement is preferable. This would avoid the cost and delay of parties negotiating royalties on prices valued prior to the code becoming a standard interface. This is considered to be difficult to achieve in the absence of further regulation.[1235] It is envisaged that the right to claim any FRAND royalties will be normally be invoked only when the interface specification infringes a patent right. Interface specifications will generally not include copyright protected material such as code and there is little evidence of royalty claims for copyright in standards.[1236] This may also apply to interfaces as they are de facto standards.[1237] The patent exception is not essential to this proposal but it would remove the concern that, while responsible decompilation and dissemination of interface specifications avoids liability for copyright, it could still face claims of patent infringement.

8.4.9.2 Publication of Interface Specifications

The registry would publish sufficient information on the interface specification to allow anyone searching the registry to identify the software interface that had been decompiled. The decompiler registering the interface specification would have the option not to publish it for at least twelve months after registration. This would enable the decompiler which had registered the specification to charge a fee for release of the information to recoup its investment.[1238] There would be no charge or only a very minimal charge for registering the

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[1233] Section 6.14 above and Commission Staff Working Document, 11

[1234] Section 6.16 and 7.5 - 7.7 above and Commission Staff Working Document, 11

[1235] Josh Lerner and Jean Tirole *Standard-Essential Patents (2014)* Working Paper IDEI-803, 3

[1236] Following the *Microsoft* case and the settlement in 2009, Microsoft still continued to charge royalties for its interface patents but not for non-patented interface information. http://www.microsoft.com/openspecifications/en/us/programs/default.aspx[accessed 20 December 2014]

[1237] Knut Blind and others 'Study on the Interplay between Standards and Intellectual Property Rights' (OJEU S136 of 18/07/2009) Final Report, 11

[1238] This would of course be subject to other decompilers making the same interfaces available so there could be competitive versions of the interface available on the register.

information. If the decompiler wanted to continue to charge for the release of the interface specification they would have to pay an annual fee to the registrar otherwise the interface specification would be published twelve months after first registration. The interface specification would have to be published after a maximum term which is proposed as ten years. In practice most software specifications will be redundant before ten years and the decompiler would stop paying the annual fee and the information could be publically available for free. The situation could arise where two specifications are registered for the same software. In that case each decompiler could charge for the information but would compete and need to offer other benefits such as easier distribution and clarity of information.[1239]

The rationale for the reverse engineering provisions in Article 6 was to encourage rightsholders to make interface information available. The dissemination of interface specifications would be further pressure on the rightsholders to this end. Indeed there is no reason why rightsholders should not avail themselves of the register. This would give notice that the interface information was available. It would address the difficulty identified in the Commission Staff Working Document of how to find and obtain interface information.[1240] It would also help further one of the non-legislatives measures recommended by the Working Document to improve advertising of the availability of interoperability information.[1241]

8.4.9.3 Patents

If a patent exemption could be brought into the regime a further amendment could not only encourage rightsholders to disclose interfaces on the register but also deter litigation by patent trolls. It would provide that if the rightsholder make interface information on their own software available through the register and it subsequently transpires the interface infringes a third party patent the safe harbour against normal intellectual property claims could protect the registering party. This would make the rightsholder liable at worst

[1239] These are the added values with which internet suppliers compete the most successful of which is Amazon.

[1240] Commission Staff Working Document, 17

[1241] Commission Staff Working Document, 15

for FRAND royalties. This would help protect registered rightsholders from claims by patent trolls. Patent trolls are attracted to de facto software standards as infringement is easier to identify.[1242] If the rightsholder registered the interface the trolls would not be able to threaten injunctions or high damages claims so convincingly and would have to settle for a FRAND royalty.[1243]

8.4.9.4 Contractual Preference for Registered Interfaces

Another benefit that would flow from the introduction of the registry of interface specifications is that industry could prefer software where the interfaces are registered. This could be specified in contracts, including industry standard form contracts.[1244] This would start to bring the pressure to increase openness that is seen by procurement practices of public authorities[1245] into the private commercial environment. This aspect could be more influential than any other aspect of the proposal. It is clear from industry interviews that pubic authorities specify open standards and will give preference to bids that will improve compatibility. This requirement influences the behaviour of their suppliers to design their products using open standards.[1246] However public authorities are able to share information and collaborate to improve their knowledge and practices on using open standards. As commercial enterprises conventionally compete, collaborating on open standards is harder. By defining open standard software in contracts as including

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[1242] Nicholas Saunders 'Litigation of patents essential to technical standards – what is the future for patent trolls?' CIPPM Spring Lecture 25 April 2013

[1243] As 3D CAD Software is sold globally the jurisdictional issues of the protection would need to be considered. Patent trolls might be able to avoid the protection of the safe harbour by issuing proceedings outside the protected jurisdiction.

[1244] For example use in the IMechE and Institution of Engineering and Technology, Model Form of Contract for the design, supply and installation of electrical, electronic and mechanical plant, MF/1 (Rev 6)

[1245] Interview with industry expert #7 (May 2013) and for procurement practice of public authorities see http://standards.data.gov.uk/ From conversations it appears that construction contracts often specify the architectural design software that will be used by contractors and sub-contractors to ensure interoperability. This would enable those contracts to specify software with registered open interfaces.

[1246] Interview with industry expert #7 (May 2013) and conversations with software design engineers 2014 - 2015 software whose interfaces are registered and available either for free or on FRAND terms, commercial enterprises can increase the use of compatible software in an efficient and effective manner.

8.4.10 Registration Platforms

Interface specifications could be posted on a register similar to the European Federated Interoperability Repository (EFIR)[1247] which has the Joinup platform that is a catalogue to enable Member States and the European Commission to document and share their solutions to interoperability.[1248] These initiatives are presently focused on public administration but the concept could be available to allow for recording and sharing of interface specifications for all commercial software. This could be done, preferably by extending the existing repository, as some software has uses in both the public and private sphere, or a separate register for software used by the commercial sector. This has the attraction of a one stop shop across Europe.

However as it is proposed that registration will have the legal implications of relieving some liability it may be more appropriate for registration to be with the intellectual property offices. These offices already have in place systems to record when registration takes place and to ensure the integrity of the data. There would be no need to inspect or examine the information that is registered. The register's purpose is to publicise the existence of the interface information and provide a safe harbour to the registering party. All negotiations and transactions concerning the information will be done directly between whoever registered the information and the prospective licensee. A disadvantage of using intellectual property offices is that they are mainly nationally based and individual searches would need to be undertaken of each register. However this could be overcome if a common service such as Espacenet is used.[1249]

[1247] http://ec.europa.eu/isa/documents/actions/more-about-action-4.2.4_en.pdf [accessed 5 December 2014]

[1248] This is part of the Interoperability Solutions for European Public Administrations (ISA) programme. http://ec.europa.eu/isa/documents/publications/efir-publisher-leaflets-v02_en.pdf [accessed 5 December 2014]

[1249] Espacenet offers free access to more than 80 million patent documents worldwide.

The register would increase access to interface information and improve interoperability without the cost of repeated decompilation of interfaces. Conventional reverse engineering is tolerated as it is costly and time consuming which protects the rightsholder. This rationale does not apply to software interfaces as their value is indirect, coming from their ability to control interoperability and networks rather than their intrinsic innovation.[1250] There is less need to protect first comers as they should recoup their research and development investment from other aspects of the software rather than from the interface. Making the reverse engineering process any harder is wasteful and without welfare benefit.[1251]

All that is required is a system of registering certain information and publishing it in an ordered way. Several systems are available and could be modified appropriately. The increased dissemination of the interface information in this relatively low cost but efficient manner would help to reduce under- utilisation of the information and increase follow on completion. Copyright is a public good and overprotection of the interface, which is the portion of the good that normally has less innovative, has no welfare benefit.

This proposal to disseminate interface specifications through a public register avoids costs such as the setting up of a new public body. It is expected that efficient dissemination of interoperability information can avoid the need to make disclosure compulsory which will save the cost and deadweight of enforcement. Transaction costs are instead borne by the prospective licensor and licensee which should be efficient and minimised, particularly if implemented alongside the soft measures recommended in the Commission Staff Working Document. The recommended model licences could be made available on the same website as the register of interfaces which could encourage uptake. The methodology or guidelines for assessing the value of the interoperability information will also help parties to minimise transaction costs and avoid deadweight loss.

[1250] Section 3.13

[1251] 8.4.2

8.5 Summary

The proposal to allow dissemination of interoperability information which does not contain the software rightsholder's copyright is doctrinally appropriate and is a modest step. Combined with the soft measures recommended by the Commission Staff Working Document it would achieve more compatibility with minimum regulation and cost. Monitoring the impact of the initiative will inform whether the regulation is in the right place to balance control and openness over the correct pivot. If not, and more openness is required, then other recommendations such as allowing reuse of interface code should be considered.

The value of interfaces comes mainly from their interdependence rather than any intrinsic innovation and reverse engineering of software interfaces should be made as efficient as possible. Interfaces have an indirect function of controlling interoperability and access, not only of competing software and networks but also of complementary software and access to the consumers' own data. It is not rational to protect the first comer and making access more difficult is not only inefficient but harms the consumer. The Software Directive already restricts decompilation to the purpose of interoperability which limits software reverse engineering more than in other fields.[1252] Reverse engineering is legitimised by its purpose,[1253] and is restricted to interfaces. Making it difficulty or costly has no welfare benefit.

The disclosure of interface information requires less amendment or monitoring. The only changes required to Article 6 of the Software Directive address the question of access rather than substantive copyright protection. While the proposal could be effective in isolation, ideally it should be accompanied by an exception to patents allowing preferably free use or failing that, FRAND licensing of patents in interfaces which have been decompiled and registered.

[1252] Samuelson and Suzanne Scotchmer 'The Law and Economics of Reverse Engineering' (2002) 111 The Yale Law Journal 1575, 1655

[1253] Ibid 1655

The register would help inform the software industry of the existence of the interface information. This will remove the need to repeat the decompilation and it is hoped encourage rightsholders to make the information available themselves. If the legislation could go further and provide a safe harbour for rightsholders who register their interfaces this could not only increase awareness of the information but also reduce action by patent trolls.

Software with interfaces available through the register can be specified in contracts which will help commercial enterprises follow the lead set by public authorities in stipulating open standards. These initiatives combined with the 'soft' measures of model licenses and guidance on setting royalties are a practical and measured step towards increased interoperability.

Whether they will achieve a significant increase in interoperability in the 3D CAD market is unknown. 3D CAD software is highly complex and technical. It is possible that interoperability is feasible only through the services of specialised translators supplying translation software and services. Even if that is the case the outcome may be that an increase in interface information allows the translators to become more efficient and to provide more effective services which of itself would be beneficial. While these recommendations build on the knowledge gained from examining the 3D CAD industry they are suited to other industries experiencing problems with interoperability. Lack of interoperability is not limited to software industries but includes all products which have a software component.[1254]

This thesis is a legal analysis of interoperability in the context of an oligopolistic industry. Approaching this case study from the legal perspective has identified realistic proposals to change the existing legal regime. To refine the knowledge and advance these

[1254] Industries that have a need for software to be compatible include cars, traffic control systems, construction industry, defence and many more.

recommendations the benefit of a multidisciplinary examination of code and law is acknowledged.[1255] Potential areas of further relevant research are how best to develop the system of registration and safe harbour and whether the more permissive dissemination of information could result in competing standards and whether that is less advantageous than cultivating a single standard. It is important that any further research can include economics, computer science and political analysis which would give a more holistic approach to this complex legal, technical and commercial problem.

[1255] Ian Brown and Christopher T. Marsden *Regulating Code* (2013 The MIT Press), 200

CONCLUSION

This thesis has combined legal doctrinal analysis and empirical qualitative data to carry out a comprehensive and detailed evaluation as to how the existing legal regime regulates the disclosure of interface information for the purposes of interoperability in the 3D CAD industry. The 3D CAD industry can be seen as a 'worst case scenario' and has been singled out by the Commission Staff Working Document. Concentrating on this case study has enabled consideration of new aspects of the interoperability phenomenon including implications for an oligopolistic market and supplier lock-in.

The key phenomena associated with interoperability including lock-in were introduced and evaluated and this enabled a focused analysis of the 3D CAD industry and the control and closed nature of its proprietary software. A structural analysis drawing on Michael Porter's techniques for analysing industries and competitors again focused on interoperability and legal regulation. It was clearly demonstrated that there is a marked lack of interoperability in the 3D CAD industry but the suppliers are profitable and R&D and innovation is thriving. Apart from isolated examples of the suppliers responding to customer pressure to standardise software and make interface information available to translators there is little evidence of market pressure increasing openness. OEMs are the key customers, especially at the high-end, and the OEMs value integrity of data as much as interoperability as the software holds vital proprietary operating data. Having established a model of the industry, including its oligopolistic nature, the thesis analysed the industry against competition law as one area of law regulating interoperability.

The economic rationale behind IPRs and competition law are considered throughout the thesis and it is submitted that conditions such as supplier lock-in may justify intervention to improve the market. This thesis illustrated, using case law, commentaries and Commission Guidance and Decisions concerning the 3D CAD industry, that the exceptional circumstances test is not an effective method for ensuring adequate disclosure of interface information. It was demonstrated that even the lack of interoperability is not expected to reduce the market definition to single suppliers. It was also argued that the oligopolistic 3D CAD industry does not meet the criteria of collective dominance for the exceptional circumstances test to apply as the industry is not sufficiently transparent nor does it enjoy legal or economic links. While merger regulations may provide an ex ante control it was established that competition law does not provide an effective deterrent or remedy. This is the first evaluation of the concept of supplier lock-in due to a lack of interoperability of an oligopolistic market and dispels the previously held belief that competition law would provide a remedy of last resort to require disclosure of interface information.

This thesis then developed the understanding of the copyright status of interfaces by a comparison of the treatment of functional/subject matter approach to data formats under the Software Directive and a more traditional approach to the idea/expression dichotomy for APIs in the USA. The case was made that IPRs provide a better ex ante remedy for foreseeable situations but IPRs should take account that the indirect amplifying effects of interfaces as standards distorts the expected IPR protection. The optimal balance for interfaces is different from other subject matter in software with more emphasis on openness than control. These propositions were considered for the first time in the context not only of copyright but also trade secrets and patent protection. It was argued that the Software Directive gives statutory trade secret protection by restricting access and use of interfaces and protecting the functionality of the software without the inventive rigour or disclosure requirements of patents. This form of trade secrets law adds another layer of IPR protection which was not anticipated.

The law on software patents developed separately with no exemption for interfaces. Evidence established that the concept and implementation of software patents is flawed, does not incentivise innovation and could restrict the operation of standards and interoperability. This raises the question of whether there is any economic justification in encouraging patent protection of interfaces particularly given the indirect effect of control over interface specifications on interoperability. The question was raised of a failure of the market with overprotection of interfaces which cannot be rectified by reverse engineering or by conventional competition law, particularly in an oligopolistic market. Incompatibility is conventionally overcome by standards and there are several standards in the 3D CAD industry but none give a full solution. Interfaces are also standards and compatibility standards that cannot be avoided give an unplanned expansion of the protection for both copyright and patents. This research has made a significant contribution to the debate on whether open standards must be patent and royalty free and concluded that the argument that royalties in interface standards incentivises innovation is nuanced and has certainly not been made convincingly. While there are many patents in 3D CAD software the STEP standard has few patents and it does not appear that with the existing state of standards in the 3D CAD industry that FRAND rather than RF standards is having any present impact on the industry. This may however change should more interface information and de facto standards increase in number. The information available will become more dynamic and negotiating FRAND licenses could be a drag on innovation.

The thesis submits a summary of the findings of the research upon which existing proposals for reform are evaluated. Central to this evaluation is the premise that due to indirect effects the balance of openness and control for interfaces is different from other subject matter but this is not fully achieved by competition law and IPRs. This has resulted in less than optimal market conditions including significant lack of interoperability causing lock-in of the users' proprietary data and an apparent failure of the market. While law and research recognise the need to strike a balance the criteria for determining the positioning of the 'pivot' is not yet established. 3D CAD software is core and critical and the integrity of the users' proprietary data must be preserved when adjusting the balance between control and openness. Supplier lock-in favours follow on innovation rather than market destruction. It is submitted that proposals such as an Interoperability Directive and mandatory disclosure of interface information are overly interventionist, potentially unworkable as interfaces are difficult to categorise, and politically unrealistic. Reducing the term of protection will harm vertical interoperability of complementary software. Extending the exclusion for interfaces to include the code as well as the specification obtained by reverse engineering has advantages but this thesis promotes the least interventionist approach of expanding dissemination of interfaces specifications secured by decompilation. The doctrinal and economic rationale for allowing interface specifications obtained by legitimate decompilation to be shared is made and the argument that the time and cost of reverse engineering has a purpose in protecting first comers is countered. Recommendations are made to make minor alterations to Article 6 of the Software

Directive without changing the copyright protection of software. Also platforms for registering interface specifications and safe harbour provisions, to improve the dissemination of interface information are made to allow markets to move towards an optimum balance with minimum regulatory interference. This approach would support the recommendations of the 2013 Commission Staff Working Document.

APPENDIX

Sample Interview Questions and Answers

Is lack of interoperability in 3D CAD Software a problem for manufacturing industry?

"Interoperability has always been a major issue for the users of CAD systems and 3D systems. I think in the early days the demand was entirely.... the users wanted all the applications together and in a funny sort of way they got that in the 2D arena, not because of interoperability but dominance of AutoDesk with AutoCad format, the way data was communicated around the industry. Now that could have happened I suppose with 3D but it didn't. Why was that? In my opinion because there was no (single) vendor who as the 3D CAD industry got started – there were multiple vendors who all made progress in parallel and nobody got the kind of dominant position that Autodesk achieved with the 2D format."[1256]

"In order to keep an aircraft certified the certification data has to last 30 years so the basic design data has to last 30 years so we put it on a CAD system that has life of 10 years running on an operating system that changes every few months."[1257]

"If you don't solve the interoperability problem you are actually driving cost in rather than taking it out and IT becomes the problem"[1258]

Are customers locked in to a particular 3D CAD System?

"It is quite difficult to get your data out of the system and into a different application."[1259]

"Information that is managed and generated by the software is … difficult to move around"[1260]

[1256] Interview with industry expert #1 (May 2014)

[1257] Interview with industry expert #5 (September 2014)

[1258] Interview with industry expert #5 (September 2014)

[1259] Interview with industry expert #2 (May 2014)

"Interestingly the higher up you go in the supply chain towards an OEM the more reliant they are to a single platform. A single provider." "…..but as you move down from the OEM to the tier one, tier two, tier three suppliers they are obviously bidding for work with multiple OEMs or tier two, tier ones, and therefore they will utilise the platform of choice of the OEM."…."(feeding the software down the supply chain) "is drive by the OEMs" [1261]

They (the tier two and three suppliers) are more vulnerable. They all complain anyway because they want their software vendors to do more on interoperability and they always will. As they demand more from the vendors the interoperability problem gets worse. If you go to some segments (the construction world). I maybe being a bit cruel but the absence of interoperability is built into the business model.[1262]

How easily can interfaces be identified and documented? Are the interfaces clearly distinct?

"It is fairly fundamental to what we produce that you are able to integrate it to know what the interfaces are not only from the point of view of the description of how to hook up the software but also how it will perform when you do particular operations with it. So we have documentation which describes how to use the components interface descriptions, descriptions of behaviours. So from our view interoperability is part of what we provide"[1263]

"It is clear to anyone who looks at it and understand the structure of what we are providing, what the interface is as opposed to what is the internal detail. I think anyone who is familiar with the type of software we are providing and the way it is

[1260] Interview with industry expert #2 (May 2014)

[1261] Interview with senior industry executive #3 (May 2014)

[1262] Interview with industry expert #1 (May 2014)

[1263] Interview with industry expert #2 (May 2014)

normally done would recognise the difference between the interface and the core."[1264]

"The software is basically interfaces."[1265]

Should disclosure of interfaces be encouraged or even mandated?

I think it is a question of balance I mean we look at how far and how much we would go. In the question of CAD system, is it the kernel? That is something we would never, we would never go to that level. That is literally too far the other way (but) the scope is wide enough I think to be able to protect the company and to allow the customer the ability to utilise the aspect. Every customer we work with there will always be competition, not direct competition but there will always be other data that will need to be utilised. ..we moved to……. a platform and any data can be injected into the platform. So really promoting a loop of how data works together data gets ingested into the platform from the source and then works the computation within the platform. So that's an interesting approach. It very much follows an approach that say Apple takes so that people can develop interfaces into the platform … it's very much about how you make your data available.[1266]

"its an interesting journey we are on now and it does have an enormous amount of traction. Its a difficult question because I think its scope is wide enough to allow the customers freedom and us protection. It does mean there has to be integration of data models to allow that to happen and the future journey that we are now on is the creation of a platform that allows the ingestation of data or indeed any data pushed back down."[1267]

"But if we were obliged to document everything that was in theory contained within the software, again vector and matrix stuff in there, if there was an obligation on us to document that in the same way we document the interfaces we want people to

[1264] Interview with industry expert #2 (May 2014)

[1265] Interview with industry expert #2 (May 2014)

[1266] Interview with senior industry executive #3 (May 2014)

[1267] Interview with senior industry executive #3 (May 2014)

use then there are lots of those interfaces in there and that would be. I mean at some level they are documented because we have to be able for internal developers to call those and use those interfaces but reorganising that into a form that is suitable for an external customer would be considerable work. And then the killer would be any obligation to maintain those interfaces. So yeah that would be difficult to do that."[1268]

Should interface information obtained by decompilation be disclosed and shared?

"If someone was to reverse engineer all of our interfaces then in theory that could be used as a blue print to write what we have done again. The software is basically interfaces. So that an argument that it allows people to copy what you have done. If that reverse engineering is legitimate then I suppose well my feeling it is not something we would want the customers to be doing. It creates for reasons of future compatibility issues and worries for us because we would be concerned about the future impact on customers. So in that sense the more it is done the more I would worry about it so if there is a barrier to actually doing that then that feels like it is a way of discouraging everyone to do it just because they can do it."[1269]

"That then comes back to what is our core competence and is it the way we do things or is it what we do with what we have. Our value is in what we do with what we have which makes us unique. How we do it and how we structure our data base to do that is fairly, I wouldn't say irrelevant, but I would say lower end. I would suggest as a personal opinion rather a corporate opinion that I can't see why we would have a problem. If it was able to be done and everybody could do it and we had to give access to do it, I don't think we would have a fundamental problem with that being shared. But again that is personal thoughts because as I say our core

[1268] Interview with industry expert #2 (May 2014)

[1269] Interview with industry expert #2 (May 2014)

competency is…..why couldn't they work together to get more benefit out of the platform. That would make absolute sense commercially"[1270]

Would it? Yes it would (encourage disclosure of interface information by the suppliers) I think but I would be facing those two alternatives wouldn't I. Thinking do I want to invest to control that interface? I suppose that if I had customers who seemed to want to do that then I probably would invest. But it is not because of the threat of reverse engineering it would be because the customers want it. And then I would, because I would go along and say here is the interface and I take responsibility for the data. And that would have to be a very strictly controlled interface indeed you know you suddenly if you are the supplier say you take responsibility for the resulting data in the existing environment the software is going through your process, isn't it. So you are managing all the updates sequences with review meetings and trainings of software developers and goodness knows what. The moment you provide an interface with third parties actually that has to be a very strictly controlled interface because you are not in control of the procedures they use or their quality checks or anything.[1271]

"My concern with that is that if you are licencing proprietary models you are opening up a market for people doing multiple different interfaces so your interoperability problem doesn't go away it just gets worse…essentially that sets up the opportunity for multiple competing standards which means that rather than 15 proprietary systems you have 15 proprietary standards i.e. 30, so that would cause a degree of proliferation. It also kind of renders the standards work irrelevant allowing everyone to do their own thing and it wouldn't solve the issues of the supply chain."[1272]

[1270] Interview with senior industry executive #3 (May 2014)

[1271] Interview with industry expert #1 (May 2014)

[1272] Interview with industry expert #5 (September 2014)

Are market forces/customer demand driving interoperability and solving lock-in

> We strongly believe that customers that we call our partners, because we work with them on their business challenges is why they choose to work with us, not where we see them as a cash cow where we have locked them in and they have to pay us. All of our big tier one customers globally work with *us* because of the value of working together. Not because they are locked into it….the value is in the long term relationship with *us* because they can steer the direction of the product. I think there is something else interesting in that. Most software or most IT is critical non-core to the customer's business. When we talk about PLM it is critical core to their business. Their business processes are completely based on what we provide. That is quite unique in the IT industry. The enablement that, the ability to work at a senior level in that customer in terms of their vision and our vision and alignment of innovation cycles, efficiency gains, that is what I believe is our partnership value, because we work with them to ensure they achieve their goals for their stakeholders, their shareholders, which from my experience in IT is unique. Everybody else is providing critical non-core, not core, functionality.[1273]

> If a big customer has to say where are the big priorities here. The number one, absolute sacrosanct priority is total integrity of their data and the functions they think they have bought for their designers and engineers to use.[1274]

> Just going through my mind is the Apple and Android in the mobile sphere. Apple has this walled garden and controls everything. In that walled garden everything works well together. Android isn't like that, they allow all sorts of people to play in their garden and put additions in a do things. So you have naturally I think consumers have different expectations because of those two things. I think it is the same for big business. If a software vendor controls the environment that side is a plus because of the data integrity. Do you need open standards in that environment? If you a CEO then no you don't because you control your suppliers in

[1273] Interview with senior industry executive #3 (May 2014)

[1274] Interview with industry expert #1 (May 2014)

big business in a different way. I am going to be spending £10 million a year on this software. £8 million will go to my main supplier. £2 million of it will go to my back-up supplier. And you tell everyone this up front. You say you are my main supplier but if anything goes wrong I have these other people who say they are ready to step into your shoes. From the users point of view of a big business that would be - you would probably feel more confident with that set of contracts in terms of dare I say in terms of interoperability than your supplier having all open standards.[1275]

(data integrity and interoperability) "… are both important because of the nature of the supply chain. The ten thousand suppliers, even with the drive to get it down to a thousand contractors to make it easier you need to ensure that your data is of as good a quality as possible and you have got to have interoperability otherwise you have got costs. And those costs arise not only from the translation process but also from the data cleansing. Incomplete translation including those which involve factoring the data back in again drive up errors and errors cost money….. Looking back over nearly 40 years of this stuff I think at this moment we are at an un-paralleled time for driving interoperability as more people have got it now than I have ever seen before. They are starting to see the issues and benefits and they are starting to value their data which very soon takes them on to the interoperability issue."[1276]

Why is interoperability in 3D CAD a technical challenge and why does STEP or another standard not provide a solution?

"..the different kernels thinking about the Parasolid, ACI and other kernels have slightly different rules about what constitutes a valid shape…just because something is valid in one system does not mean it is going to be valid in another system. Just because you bring it across with no loss of information and there is always the possibility of losing information … and there is always the possibility of losing information when you write something out to file and then writing it back in again,

[1275] Interview with industry expert #1 (May 2014)

[1276] Interview with industry expert #5 (September 2014)

reinterpreting it… it is already difficult to transfer the physical shape across (but if) ...you can get that information across … what it doesn't have is how the thing will behave when you modify these. Capturing that is much harder."[1277]

"I think the ability to manipulate models is important so therefore should there be a standard to do that? I don't know I am afraid that's a very difficult question. I can only see it from our approach to how we cope with there not being a standard means that we invest in how we ingest other data models from other providers to enable our software to utilise that model and be able to, to make best use of it. So we spend a lot of time in implementation of a new customer ensuring data transfer. Should it be standardised, what would we lose and what would we not have today? I don't readily know the answer because I can only see it from my perspective."[1278]

"The big challenge with the software vendors is they want to bend the standard to be closest to their proprietary capability as that gives them a degree of efficiency but in many cases the users are saying, no we do not want, we cannot risk our business on you owning our data. Because if you cannot get data out from a vendor system, who owns it?"[1279]

"one of the great things about a standard is that in this area they are not driven by the software vendors, they are driven very much by the industry and industry consortia who come together for their mutual interest"[1280]

How interoperability affects policy and practice on R&D investment

"There are some aspects we don't publish partly because if we publish something then we are in it for the long term. Our customers dont want things to change and as soon as we publish something then we have an ongoing commitment almost to support it. So if we publish all of the details of what is happening in all the layers of

[1277] Interview with industry expert #2 (May 2014)

[1278] Interview with senior industry executive #3 (May 2014)

[1279] Interview with industry expert #5 (September 2014)

[1280] Interview with industry expert #5 (September 2014)

our software then we would be basically locking down the behaviour for all those layers. And we dont want to do that we want freedom to be able to tweak things to modify things where necessary in order to support the needs we have. So if a customer who has a legitimate right to use the component where to reverse engineer what we provide in order to gain access to that lower level information, or any information, not in our published interfaces. That is not something we would want to happen. It is not necessarily a lot of IP contained in that it is really the on-going commitment to have to support it."[1281]

"Today the way the company is structured is what does an industry value most and how we can develop our capability for that industry? If that industry is driven by openness and interoperability then the solutions that we provide into it will be limited by that but also developed against that. …. Through spending many months with our key customers … they were most interested in how do they win a tender…..how early in the lifecycle of development can you create collateral to be able to win a tender without having to build the product which costs billions of pounds. So we focused on that, how do you win a tender"[1282]

[1281] Interview with industry expert #2 (May 2014)

[1282] Interview with industry expert #2 (May 2014)

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GLOSSARY

3D CAD	Three Dimensional Computer Aided Design
ACIS	A geometric modeling kernel developed by Spatial Corporation, part of Dassault Systemes.
ANSI	American National Standard Institute
ANSYS	Supplier of Finite Element Analysis software
APIs	Application Programming Interfaces
CAE	Computer Aided Engineering
CAM	Computer Aided Manufacturing
CATIA	3D CAD software developed and sold by Dassault Systemes SA
COFES	Congress on the Future of Engineering Software - a conference for the 3D CAD industry
Creo	3D CAD software supplied by PTC
DM	Digital Manufacturing
DPD	Digital Product Development which encompasses CAD, DAE, CAM, DM and PDM
DRM	Digital rights management, a form of technology protection measure (TPM) to control the use of copyrighted work
EAS	Enterprise Application Software
FEA	Finite Element Analysis
FMS	Financial Management Software
FRAND	Fair, Reasonable And Non-Discriminatory – terms on which IPRs may be licenced
GPL	General Public License – a form of open sources license
ICT	Information Communication Technology
IETF	Internet Engineering Task Force
IGES (ANSI)	Initial Graphic Exchange Specification – an American National Standard
IPR	Intellectual Property Rights
ISO	International Standards Organisation
JT	Data format developed by UGS and Siemens and now an official ISO standard
NPE	Non-Practicing Entities also known as patent trolls
ODF	Open Document Format
OEM	Original Equipment Manufacturer

Parasolid	Geometric modelling kernel developed by Shape Data and now owned by Siemens
PDM	Product Data Management
PLM	Product Lifecycle Management software which includes 3D CAD software
PTC	Parametric Technologies Corporation a supplier of 3D CAD software
R&D	Research and Development
RAND	Reasonable And Non-Discriminatory – terms on which IPRs may be licenced
RF	Royalty Free licencing of IPRs
SAP	Systems, Applications & Products in Data Processing - a large German supplier of enterprise software
SSO	Standard Setting Organisation
STEP	Standard for the Exchange of Product model data - an ISO standard (ISO 10303) for the representation and exchange of product manufacturing information
TPM	Technology Protection Measure to control use of copyrighted work
TRIPS	Agreement on Trade-Related Aspects of Intellectual Property Rights
UGS	Unigraphics CAD software acquired by Siemens in 2007 and now sold as Siemens NX
VAR	Value Added Reseller – a distributor that adds features or services to an existing product before reselling to users
W3C	World Wide Web Consortium
WIPO	World Intellectual Property Organization Copyright Treaty (WIPO Copyright Treaty or WCT)
WTO	World Trade Organisation