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SYSTEMIC EFFICIENCIES IN COMPETITION LAW: EVIDENCE FROM THE ICT INDUSTRY

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ABSTRACT

This article introduces the concept of systemic efficiencies, traces its theoretical underpinnings in economics, management and technology, and applies it to recent high profile cases. Systemic efficiencies occur in large complex systems through the interaction of multiple distributed components, a process which is commonly coordinated by an entity that can exercise pervasive control over the system's components and their interactions. This type of extensive control can manifest itself as potentially anticompetitive practices, like tying, refusal to deal and full line forcing, causing the reaction of competition authorities. However, at the same time, systemic efficiencies can have significant benefits that cannot be generated by smaller scale, simpler, more isolated efficiencies, and are therefore of great interest to society, and of high redeeming value as antitrust defence to the introducing entities. To demonstrate how systemic efficiencies and their benefits materialize in practice this article also discusses two series of cases: the recent IBM mainframes cases in the US and the US, and the ongoing Google Android cases in the US and the EU. Both cases belong in the ICT industry, which is frequently said to consist of paradigmatic examples of large complex systems that can give rise to systemic efficiencies.

JEL: K21, L12, L22, L41, L52, L96, O31, O33

I. INTRODUCTION

In a series of ongoing and recent high-profile cases the EU and the US have launched investigations against large companies like Google and IBM for practices that allegedly hinder competition in their respective markets.[1] A common theme in all of these cases has been the potentially exclusionary effect of these companies' practices, namely that they may have prevented competitors from developing products and services that rely on inputs from these firms. As expected, Google and IBM have defended their behaviour by invoking, among others, efficiencies, which—they claim—turn out to the benefit of consumers.

For anyone studying competition law, it is fairly uncontroversial that proving and quantifying efficiencies is notoriously difficult. Indeed, there are hardly any EU cases that were saved on the grounds of efficiencies, and only a few in the US (with the exception perhaps of merger cases).[2] However, efficiencies play a key function in competition law since they highlight the value of progress and innovation even in the presence of anticompetitive effects, and provide competition authorities a means to make good policy by tolerating certain anticompetitive actions when these are offset by procompetitive effects.[3] This is even truer when the efficiency in question is substantial and can have far-reaching implications for the shape of the industry.

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[1] European Commission Press Release, Commission Sends Statement of Objections to Google on Comparison Shopping Service; Opens Separate Formal Investigation on Android (April 15, 2015); Case Comp/C-3/39692 IBM Maintenance Services, EC Decision 13.12.2011; Brent Kendall & Alistair Barr, *FTC Looking at Complaints Over Google's Android Control*, THE WALL STREET JOURNAL, September 25, 2015.

[2] For recent data see Hans Friederiszick & Linda Gratz, Hidden Efficiencies: The Relevance of Business Justifications in Abuse of Dominance Cases, 11 J. COMPET. LAW ECON. 671 (2015). See also United States v. Philadelphia National Bank, 374 U.S. 321 (1963); Derek C Bok, Section 7 of the Clayton Act and the Merging of Law and Economics, 74 HARV. LAW REV. 226 (1960). See also U.S. Department of Justice & Federal Trade Commission, Horizontal Merger Guidelines (2010).

[3] Maurice E Stucke, *Reconsidering Antitrust's Goals*, 53 BOST. COLL. LAW REV. 551 (2012); Kenneth G Elzinga, The Goals of Antitrust: Other Than Competition and Efficiency, What Else Counts?, UNIV. PA. LAW REV. 1191 (1977). See contra Albert Foer, On the Inefficiencies of Efficiency as the Single-minded Goal of Antitrust, 60 ANTITRUST BULL. 103 (2015).

Along those lines, this article aims to introduce a type of efficiencies—systemic efficiencies—which occur in large complex systems and which are qualitatively different from smaller scale, simpler, more isolated efficiencies, even if those are highly valuable or novel. The ICT industry is often brought as a paradigmatic example of an industry that exhibits the characteristics of large complex systems,[4] and it will provide herein many of the examples and cases that will illustrate the nature and value of systemic efficiencies. By introducing systemic efficiencies, tracing their characteristics as they emerge from a synthesis of economics, management and technology studies, and applying them to high-profile cases in the ICT sector, this article attempts to help authorities and regulators identify and assess the true dimensions of practices that can have sweeping effects in their respective industries.

Systemic efficiencies involve and affect multiple and dispersed parts of large complex systems whose components are intricately interconnected in a way that changes in one part may trigger readjustments in other parts (examples of such systems can be electronic communications networks and operating system ecosystems). Because they draw from multiple parts, they require a holistic overview of the system in which they are interwoven, which makes them harder to identify and appreciate. However, at the same time, the fact that they are so integrative and extensive means that they can bring about dramatic innovations in the industry, such that would not occur at a smaller scale or insular environments. Systemic efficiencies and innovations, therefore, generate unique value both to the introducing firm and to the industry as a whole, and deserve to be identified as a distinct type of efficiency.

Even when correctly identified, the challenge systemic efficiencies pose is that they often emerge through and because of pervasive control over the system. Control refers to firms' decisions as to how they shape their production process by defining boundaries, picking certain partners over others, and determining the architecture of the system. In that sense, control serves as the focusing mechanism that brings together the various parts (internal and external to the firm) implicated in the systemic efficiency. The problem is that to achieve this kind of pervasive control, the system architect may need to resort to potentially exclusionary practices, such as refusal to supply, tying, discrimination and others. While, these practices aim at creating the necessary conditions for the efficiency to materialize as they arguably ensure the involvement and proper interaction of only suitable parts, actors and components (according to the system architect), authorities and courts cannot ignore the dangers of pervasive control. However, this article argues, in the context of systemic efficiencies they should resist underestimating the indispensable role of control in achieving coordination and coherence, without which the attempted combination, novelty, innovation, readjustment or other efficiency might collapse under its own complexity. The necessity of control is best exemplified in the contrasting fates of the once most popular architecture for accessing the Internet on mobile phones, the i-mode, which was a monumental success in Japan, but a failure in Europe and the US, largely because of the degree of control different telecom companies could exert on the system.

The tension between the large benefits of systemic efficiencies and the large losses from otherwise potentially anti-competitive acts that may be necessary for systemic efficiencies to arise, make them an important and difficult topic to handle. Also, since the concept and implications of systemic efficiencies remain the same irrespective of jurisdiction, any lessons and conclusions drawn from their study are applicable universally. This becomes particularly relevant with regard to large international corporations considering that they can often be dominant or engage in far-reaching agreements, and therefore be the subject of antitrust investigations or regulation for the same behaviour in multiple jurisdictions. For example, this article discusses the recent influential cases of Google and IBM in both the US and the EU, where the invocation of systemic efficiencies can be (could have been) decisive for the outcome of the cases and the shape of their respective industry.

These issues will be addressed in sequence: Part II introduces the concept and function of systemic efficiencies, and explains why their attainment can be problematic for the reason of being linked to extensive control. It goes on to prove the necessity of pervasive control over the production process in achieving systemic efficiencies. Part III documents what the author sees as the main positive effects that can flow out of systemic efficiencies, which are unlikely to result from smaller scale, simpler or insular efficiencies. This is why systemic efficiencies are qualitatively different and deserve separate consideration and evaluation. The final part, Part IV, presents examples of how systemic efficiencies materialize in real cases. The point is not to exonerate the firms from wrongdoing, but rather to highlight offsetting benefits (i.e. the systemic efficiencies) that would otherwise

[4] See, e.g., Andrew Davies, Innovation in Large Technical Systems: The Case of Telecommunications, 5 IND. CORP. CHANG. 1143 (1996).

escape the attention of competition authorities and courts. The overall idea is to introduce systemic efficiencies as a distinct type of efficiency, raise awareness as to their importance, and help authorities and regulators assess them.

II. SYSTEMIC EFFICIENCIES AND THEIR FUNCTION IN COMPETITION LAW

A. The Concept of Systemic Efficiencies

Efficiencies as a justification for potentially anticompetitive firm conduct is a troubled concept, but one that can be of the utmost redeeming value to powerful firms. Efficiencies come at play as a mechanism to defend practices that competition authorities and courts would otherwise deem problematic in the market context and, absent any offsetting efficiencies, they may be condemned.

Proving efficiencies has been and remains notoriously elusive, which may explain why there have been few—if any indeed—cases where anticompetitive conduct was successfully justified on the grounds of efficiencies (with the exception of mergers).[5] That said, great progress has been made in understanding efficiencies, and we owe much of it to the formalization of antitrust analysis by the Chicago School during the second half of the previous century.[6] Unlike the Harvard School, which regarded the possibility of positive effects flowing out of seemingly anti-competitive acts with suspicion, the Chicago School offered a structured analysis in defence of exercising market power, which resulted in higher tolerance toward several practices that used to be considered on their face pernicious (per se illegal).[7]

There is no authoritative definition of efficiencies.[8] As a general matter, they can be economic, technical or of other nature as long as they are linked to either technical progress, or economization of resources, or enhancement of a product, service or production method.[9] Efficiencies are a relevant consideration in both agreements and unilateral conduct. In US case law efficiencies are mentioned in cases that involve both Section 1 and 2 of the Sherman Act, and while in the EU only Article 101(3) TFEU mentions technical progress explicitly, it is accepted that efficiencies are to be taken into account in 102 TFEU cases as well.[10] This makes sense: similarly to the underpinning rationale of Article 101(3), powerful firms may sometimes need to unilaterally resort to practices whose side effect is to potentially harm the competitive process, but such practices should be tolerated—even encouraged—if they can result in proportionate offsetting benefits to competition or consumers.[11]

Efficiencies can emerge anywhere in the value chain and can range from trivial localized enhancements to drastic extensive interventions. The latter is close to what can be called a systemic efficiency. Systemic efficiencies are those that involve and affect multiple and dispersed parts of a system, which are highly interconnected, so that changes in one component require substantial modifications in other components throughout the system or a readjustment of the whole system. Systemic efficiencies thus hint to a more integrative and less linear approach, which emphasizes the interdependence between components, rather than insular enhancements, no matter how significant.[12]

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[5] See supra note 2.
[6] HERBERT HOVENKAMP, FEDERAL ANTITRUST POLICY: THE LAW OF COMPETITION AND ITS PRACTICE 67 (3rd ed. 2005); William J Kolasky & Andrew R Dick, The Merger Guidelines and the Integration of Efficiencies into Antitrust Review of Horizontal Mergers, 71 ANTITRUST LAW J. 207 (2003).
[7] R H BORK, ANTITRUST PARADOX (1993); Richard A Posner, The Chicago School of Antitrust Analysis, UNIV. PA. LAW REV. 925 (1979); Daniel Sokol, The Transformation of Vertical Restraints: Per Se Illegality, the Rule of Reason and Per Se Legality, 79 ANTITRUST LAW J. 1003 (2014).
[8] Eleanor Fox, The Efficiency Paradox, in HOW THE CHICAGO SCHOOL OVERSHOT THE MARK: THE EFFECT OF CONSERVATIVE ECONOMIC ANALYSIS ON U.S. ANTITRUST 77, 81 (Robert Pitofsky ed., 2008).
[9] See Guidelines on the Application of Article 101(3) of the Treaty, OJ [2004] C 101/97. Art. 101(3) is to be applied "reasonably and flexibly" rather than mechanically. Ibid, paras 6, 11, 32, 33, 42. See also RICHARD WHISH & DAVID BAILEY, COMPETITION LAW 163 et seq. (2015).
[10] See, e.g., Case C-209/10 Post Danmark A/S v Konkurrencerådet [2010] EU:C:2012:172, paras 40-41; Guidance on the Commission's Enforcement Priorities in Applying Article 102 TFEU to Abusive Exclusionary Conduct by Dominant Undertakings OJ [2009] C 45/7, paras 28-31.
[11] WHISH & BAILEY, supra note 9, at 221-23.
[12] Thomas Horton, Efficiencies and Antitrust Reconsidered: An Evolutionary Perspective, 60 ANTITRUST BULL. 168, 174 (2015).

By nature, systemic efficiencies are associated with large complex systems that comprise several constituent parts and exhibit extensive interdependencies among them. These systems are most commonly referred to as large technical systems (LTS), namely large "coherent structures comprised of interacting, interconnected components,"[13] or complex products and systems (CoPS), a similar type that is characterized by a large number of specialized components and sub-systems, that are usually hierarchically organized and present a high degree of engineering intensity and technological novelty.[14]

Large complex systems can occur in various industries that exhibit the above-mentioned characteristics. Common examples include aircraft engines, electricity grids, intelligent buildings, railway systems, but also telecommunications and electronic network systems.[15] The organizational authority behind such systems can be a single firm, or a collection of actors, and a number of systems can coexist in a market. For example, we have more than one networks in the electronic communications market, each constituting a system of its own, but still interconnected with each other.

In such industries, the production function is often built around projects, which are necessary to organize the various assets and components as well as manage the extensive interactions throughout the system.[16] In such production processes improvements in isolated components are likely to have only limited impact on overall performance; true efficiencies occur at the level that involves the entire project network or at least a major part thereof.[17] By doing so, systemic efficiencies can best reflect and take advantage of the system's components, breadth of knowledge, skills, disparate technologies, and management across those elements.

What brings those elements together is a mechanism of control in the frames of the structure that is assumed by the system.[18] In that sense the various elements underpin the efficiency, but it is the control mechanism that enables it by orchestrating their interactions. While control is both necessary and beneficial in this context, it can raise competition concerns. Its role and implications are discussed right below.

B. Pervasive Control as a Prerequisite of Systemic Efficiencies and as a Source of Anticompetitive Concerns

If systemic efficiencies were purely beneficial, in the sense that in the process of introducing enhancements they did not negatively affect any competitors or the structure of the market, then a competition case would not arise at all, and systemic efficiencies would not need to be raised as an issue (in policy, regulatory or academic circles alike). The problem is that, often, for systemic efficiencies to emerge the introducing firm must exercise pervasive control over the production process and/or value chain, which in turn can affect the positioning of competitors in the market as well as the structure of the industry, and trigger the response of competition authorities or regulators. As will be shown in the following paragraphs this type of extensive control can be a prerequisite for the success of the systemic efficiency (and the project), and therefore, assuming that the systemic efficiency under scrutiny is desirable, it should be tolerated. But before we get to that part it is worth pausing for a moment to consider why pervasive control, as linked to efficiencies, may be a problem.

The most common manifestation of control/influence over the value chain is control of prices or output. This is also the most traditional source of worry for competition authorities. Indeed, the textbook reason to curb monopolists or dominant firms is their ability to price above marginal cost or to limit output.[19] But these are hardly the only ways by which a firm can shape the production process, value chain and ultimately the market to match its needs and strategy. Since the production of even the simplest product or service requires the bringing together

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[13] THOMAS HUGHES, NETWORKS OF POWER: ELECTRIFICATION IN WESTERN SOCIETY, 1880-1930 ix (1983); Bernward Joerges, Large Technical Systems: Concepts and Issues, in THE DEVELOPMENT OF LARGE TECHNICAL SYSTEMS 9, 23–24 (Renate Mayntz & Thomas Parke Hughes eds., 1988).
[14] Mike Hobday, Product Complextiy, Innovation and Industrial Organization, 26 RES. POLICY 689, 690–693 (1998).
[15] Id.; Joerges, supra note 13; Davies, supra note 4; Roger Miller et al., Innovation in Complex Systems Industries: The Case of Flight Simulation, 4 IND. CORP. CHANG. 363 (1995).
[16] ANDREW DAVIES & MIKE HOBDAY, THE BUSINESS OF PROJECTS: MANAGING INNOVATION IN COMPLEX PRODUCTS AND SYSTEMS 48–50 (2005).
[17] Id. at 48.
[18] Hobday, supra note 14, at 692.
[19] WHISH & BAILEY, supra note 9, at 6-8; W KIP VISCUSI, JOSEPH E HARRINGTON & JOHN M VERNON, ECONOMICS OF REGULATION AND ANTITRUST (4th ed. 2005).

of various assets (physical assets, capital, know-how etc.), a firm can affect the production chain by exercising control over inputs or distribution channels, which can be done in a variety of ways such as integration, refusal to deal,[20] tying, and exclusive dealing.[22] All of these practices define boundaries, partnerships, and competitors. They are a firm's way to choose desired partners, while excluding others, and while normally this is acceptable,[23] the exercise of control in the market can have multifarious repercussions, including raising rivals' costs,[24] foreclosure of competitors,[25] and raising entry barriers.[26] These can result in rival firms being completely or partly unable to access an essential input (product or service), distribution channel, or customers; being forced to exit the market; or being forced to turn to inferior or more costly alternatives.[27]

In all of those cases authorities and regulators might want to limit the reach of the dominant firm's control over inputs or the production process/chain. They can do so, for example, by mandating access or interoperability, which would force the dominant firm to share its products or services with competitors who could then compete on more equal grounds. But the important question here is whether weakening a firm's control over its own products, services or production process, would at the same time risk corrupting any efficiencies that emerge only through and because of strict control that excludes unwanted partners and arrangements.[28] If that is the case, then the benefits of facilitating rivals should be balanced against the benefits of enabling the efficiency. The stakes become higher when the efficiency in question is systemic, because, as will be discussed below,[29] they tend to be associated with significant payoffs. It is therefore essential to understand the necessity of control in the achievement of systemic efficiencies, both because it justifies its permissibility, and because it highlights the repercussions to systemic innovations of eliminating it. In this direction, systems organizations theory can provide valuable insights.

In systems organization theory, there are mainly two ways to structure a system: integral and modular.[30] Integral systems exhibit a formal structure of interdependence among components, which are customized to match each other in terms of physical and functional characteristics so that components are from the beginning designed to fit together as parts of a whole system whose structure and operation are known in advance.[31] This makes it hard for integral systems to accommodate change, scaling, and expansion. For the ICT sector in particular, these are important features, and therefore integral architectures are not preferable, especially for large systems.

Modular systems, on the other hand, comprise components that are independent from each other in the sense that they are (can be) developed without regard to other components as long as they adhere to standardized interface specifications.[32] They group similar or closely interdependent functions into modules (e.g. applications, hardware components), and then have modules communicate with each other through standardized interfaces (e.g. APIs, protocols).[33] The idea is that operations and complexity inside each module are invisible to other modules, and only the relevant information for other modules is passed along through the interfaces.

This organization facilitates structuring and management because it breaks down the system into smaller parts, isolates them from the overall complexity, and embeds the rules of operation into the system. Because the internal operation of each part is vested only in itself, local management and control can also be vested in each part individually. This allows control to be decentralized.[34] There can be many benefits to decentralized control, and indeed many systems of production have opted for the decentralized model in varying degrees; for example,

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[20] Id.
[22] VISCUSI, HARRINGTON, AND VERNON, supra note 19 at 258–66.
[23] United States c. Colgate and Co., 250 U.S. 300 (1919).
[24] Steven C Salop & David T Scheffman, *Raising Rivals' Co*sts, 73 AM. ECON. REV. 267 (1983).
[25] Patrick Rey & Jean Tirole, A Primer on Foreclosure, 3 in HANDBOOK OF IDUSTRIAL ORGANIZATION 2145 (2007).
[26] VISCUSI, HARRINGTON, AND VERNON, supra note 19 at 168–172.
[27] HERBERT J HOVENKAMP & PHILLIP E AREEDA, ANTITRUST LAW: AN ANALYSIS OF ANTITRUST PRINCIPLES AND THEIR APPLICATION (2006); VISCUSI, HARRINGTON, AND VERNON, supra note 19, 22, 26; EU Guidelines on the Assessment of Non-horizontal Mergers Under the Council Regulation on the Control of Concentrations Between Undertakings, (2008).
[28] Cf. DANIEL SPULBER & CHRISTOPHER YOO, NETWORKS IN TELECOMMUNICATIONS: ECONOMICS AND LAW 146–151 (2009).
[29] See infra Part I.III.
[30] Karl Ulrich, The Role of Product Architecture in the Manufacturing Firm, 24 RES. POLICY 419, 422 (1995).
[31] Ron Sanchez & Joseph T. Mahoney, Modularity, Flexibility, and Knowledge Management in Product and Organization Design, 17 STRATEG. MANAG. J. 63, 65–66 (1996).
[32] Id. See also Herbert A Simon, The Architecture of Complexity, 106 PROC. AM. PHILOS. SOC. 467, 474 (1962).
[33] CARLISS YOUNG BALDWIN & KIM B. CLARK, DESIGN RULES: THE POWER OF MODULARITY 64, 70 (2000). Carliss Baldwin & Kim Clark, Modularity in the Design of Complex Engineering Systems, in COMPLEX ENGINEERED SYSTEMS SE-9 175, 199 (Dan Braha, Ali A Minai, & Yaneer Bar-Yam eds., 2006).
[34] BALDWIN AND CLARK, DESIGN RULES, supra note 33 at 268–69.

in the ICT industry applications and operating systems can be independent and separately controlled modules, but they can still work together thanks to standardized interfaces.

However, despite the option of decentralized control, sometimes firms choose to retain greater control even in modular systems, because it helps with the achievement of efficiencies through coherence, integration, strategy and appropriation.[35] As Brusoni has noted, even when the division of labour is such that can lead to a modular structure of the industry, "knowledge-integrating" firms might still be necessary to identify and solve more complex or generalized problems.[36]

Control can achieve several objectives. First, it allows the system manager to efficiently design the system and the overall modular structure in the first place by determining the boundaries of modules ("breaking points"), picking appropriate modules, excluding others, linking modules together, and generally defining module interactions.[37] This ensures a prima facie assurance that the system components will fit in well together and that work allocation has been performed optimally.

Second, to the extent that the system is not left completely stagnant, the system will require constant supervision and updating to keep up with new functionality and requirements. While some updates will be minor and will fall within the automated design process, others will require more extensive changes and perhaps the resolution of conflicts (see below IV.A), that are unable to take place without the intervention of the system designer.

Third, and perhaps most importantly, control allows system architects to bring together various elements that go beyond physical assets/modules. A long line of scholarship on firm structure and integration documents how innovations, efficiencies and the competitive advantage are not only the result of the combination of physical assets/modules that can be linked together through rules and interfaces, but also draw from complementarities and interactions among other elements such as knowledge, skills, objectives, vision,[38] managerial direction,[39] and human capital that cannot necessarily be reduced to substitutable parts that one can readily purchase from the market or put in a blueprint.[40] By exercising control over all those constituent parts system designers can ensure that they bind them together in a "team productive process."[41] This added value that comes with highly controlled (sometimes called closed) systems endows a system with a certain culture, a set of competencies and routines, which are not only transactional or organizational, but also technological (i.e. the particular selection or configuration of an organization's technological base), and serve as a unifying force that stitches together the system's resources and capabilities into a harmonious whole.[42]

With large complex systems the previously-mentioned conditions and effects are magnified, because the more parts a system of production involves the harder modularization becomes and the higher the risk of poor results. In such cases a controlling authority with system-wide reach can enhance the process of selection and combination of parts and resources to achieve what Schilling calls synergistic specificity, a state where resources optimally fit together and complement each other to maximize each other's functionality and utility.[43] Otherwise, some parts may behave individualistically, optimizing locally to the expense of the global optimum.

This trade-off between the prioritization of local and system-wide (global) efficiency is a well-known debate in the circles of technologists. As Skyttner notes "if each subsystem, regarded separately, is made to operate

[35] See, generally, Gregory Sidak, Debunking Predatory Innovation, 83 COLUMBIA LAW REV. 1121 (1983); Gregory Sidak, Is Structural Separation of Incumbent Local Exchange Carriers Necessary for Competition?, 19 YALE J. REGUL. 335 (2002). Teece and Chesbrough even suggest that full integration is the best way to achieve systemic efficiencies. Henry W Chesbrough & David J Teece, When Is Virtual Virtuous? Organizing for Innovation, 74 HARV. BUS. REV. 65 (1998).
[36] Stefano Brusoni, *The Limits to Specialization: Problem Solving and Coordination in "Modular Networks,"* 26 ORGAN. STUD. 1885 (2005).
[37] Richard N Langlois, Modularity in Technology and Organization, 49 J. ECON. BEHAV. ORGAN. 19, 26 (2002); BALDWIN AND CLARK, DESIGN RULES, supra note 33 at 260.
[38] George Richardson, The Organization of Industry, 82 ECON. J. 883, 895 (1972); MORRIS SILVER, ENTERPRISE AND THE SCOPE OF THE FIRM: THE ROLE OF VERTICAL INTEGRATION 17 (1984).
[39] Kathleen R Conner & Coimbatore K Prahalad, A Resource-Based Theory of the Firm: Knowledge Versus Opportunism, 7 ORGAN. SCI. 477, 485–86 (1996); Harold Demsetz, The Theory of the Firm Revisited, 4 J. LAW, ECON. ORGAN. 141, 157 (1988).
[40] Oliver E Williamson, The Vertical Integration of Production: Market Failure Considerations, 61 AM. ECON. REV. 112 (1971).
[41] Armen A Alchian & Harold Demsetz, Production, Information Costs, and Economic Organization, 62 AM. ECON. REV. 777, 778 (1972).
[42] EDITH TILTON PENROSE, THE THEORY OF THE GROWTH OF THE FIRM (1995); RICHARD NELSON & SIDNEY WINTER, AN EVOLUTIONARY THEORY OF ECONOMIC CHANGE (1982). See also Novak and Eppinger who find a strong positive correlation between the complexity of technological innovation and the performance of integrated firms. Sharon Novak & Steven D Eppinger, Sourcing by Design: Product Complexity and the Supply Chain, 47 MANAGE. SCI. 189 (2001).
[43] M. A. Schilling, Toward a General Modular Systems Theory and Its Application to Interfirm Product Modularity, 25 ACAD. MANAG. REV. 312, 320–23 (2000).

with maximum efficiency, the system as a whole will not operate with utmost efficiency." (emphasis added).[44] Large complex systems are prone to this kind of weakness because they are made up of several subsystems. While each subsystem may have been designed with its own internal architecture and efficiency rules, the system superstructure is largely dependent on the interactions of the subsystems with each other. This is why the element of a control authority, which can supervise the entire system and coordinate the subsystems to serve a common interest, is so prominent in large complex systems.[45] To ask that a measure in one part of a system be implemented without regard to collateral effects in other parts would perhaps solve a problem locally but jeopardize the health and efficiency of the system generally.[46]

These considerations highlight the link between systemic efficiencies and pervasive control that can potentially disadvantage rivals by excluding them from a system. One might reasonably ask whether pervasive control is always necessary to bring about systemic effects. Some scholars appear to cast doubt on that conclusion: for instance, de Laat suggests that the development of DVDs (which he sees as a systemic innovation—see infra Part III.A for the relationship between systemic efficiencies and systemic innovations) was the result of looser alliances rather than of a closely knit system,[47] while Robertson and Langlois note that the success of the personal computer architecture, which revolved around the Windows/DOS and Intel platforms, was attributable to the fact that no single firm controlled the development of the architecture.[48]

A closer look however, shows that in both cases, the element of control and coordination was present, just not vested in a single authority or at all times. In the DVD standard development control and coordination was exercised by the leader(s) of the rival alliances (Toshiba, and Philips and Sony),[49] and the personal computer architecture was chosen by IBM, which relied on Intel processors and Microsoft operating systems as the main components, later to be followed by Compaq.[50] It is therefore true that systemic efficiencies do not necessarily arise in the frames of a single unified firm or even conglomerate, but it seems that there is always a source of control that serves as the coordination and focusing mechanism for the project, at least until the product or service acquires its basic characteristics.[51]

A notable exception is the Internet, which has all the characteristics of a systemic innovation, but no single point of centralized control or direction. While the Internet clearly defies the theory laid down herein, its origins as a non-commercial innovation and its subsequent repurposing by a multitude of actors once it became public may explain the uniqueness of the case.

Furthermore, even in those rare cases that one can generate systemic effects in the absence of centralized control, it may be difficult to translate those qualities in a systemic efficiency that can successfully be commercialized, if there is no coordinating direction or control. Linux, for example, is a system with limited centralized authority (but not complete lack thereof—see infra Part III.B), which has been met with low desktop adoption even though it has been around for decades.[52] Part of the reason is that there are so many variants of it with so many different directions, features and priorities, that it is hard of any of them individually to build the critical mass and momentum necessary to earn the endorsement of OEMs, application developers, and ultimately users.[53]

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[44] LARS SKYTTNER, GENERAL SYSTEMS THEORY: IDEAS & APPLICATIONS 93 (2001).
[45] HUGHES, supra note 13. Davies, supra note 4.
[46] Cf. in the context of the Internet for instance Ian Wakeman et al., Is Layering Considered Harmful?, 6 IEEE NETW. 20 (1992); Randy Bush & David Meyer, REQUEST FOR COMMENTS 3439, SOME INTERNET ARCHITECTURAL GUIDELINES AND PHILOSOPHY (2002).
[47] Paul de Laat, Systemic Innovations and the Virtues of Going Virtual: The Case of the Digital Video Disc, 11 TECHNOL. ANAL. STRATEG. MANAG. 159 (1999).
[48] Paul L Robertson & Richard N Langlois, Innovation, Networks, and Vertical Integration, 24 RES. POLICY 543 (1995).
[49] De Laat, supra note 47.
[50] MARTIN CAMPBELL-KELLY, COMPUTER: A HISTORY OF THE INFORMATION MACHINE 232 et seq. (3rd ed. 2013). Apple had already enjoyed success in the personal computer market even before IBM, but the architecture around which the market revolved in the following decades was that of IBM, not Apple. In that sense, it was IBM which set the prevailing standard.
[51] There are several empirically backed theories that show the criticality of control especially in the early stages of a product's or service's development. See, e.g., MICHAEL PORTER, THE COMPETITIVE STRATEGY: TECHNIQUES FOR ANALYZING INDUSTRIES AND COMPETITORS 157 et seq. (2004); David J Teece, Profiting from Technological Innovation: Implications for Integration, Collaboration, Licensing and Public Policy, 15 RES. POLICY 285 (1986).
[52] See, e.g., Statcounter Global Stats, http://gs.statcounter.com/#desktop-os-ww-monthly-201506-201606.
[53] Bart Decrem, Desktop Linux: Where Art Thou?, ACM QUEUE, 2004, at 48; Adrian Kingsley-Hughes, Five Crucial Things the Linux *Community Doesn't Understand About the Average Computer User*, ZDNET, May 21, 2007. Similar observations have been made about Unix. See Melissa Schilling, Protecting or Diffusing a Technology Platform: Tradeoffs in Appropriability, Network Externalities, and Architectural Control, in PLATFORMS, MARKETS AND INNOVATION 203–4 (Annabelle Gawer ed., 2011).

The main point here is not to discredit open, decentralized systems with loose control mechanisms; their value and contribution to innovation and industry evolution are undisputed.[54] The goal was to show that for certain types of activities and objectives tight control is indeed indispensable. Acknowledging this is particularly crucial in systems that are otherwise open, because the exercise of control in an open system—especially if control is gradually expanding—may be seen as a threat to the inclusiveness of the system. The fear is that the system initially benefits from openness and expansion, but then once it is established, it expands control and its participants and components are locked in, and perhaps manipulated by the control mechanism. The analysis above suggests another (better?) strategic reason behind pervasive control. In the following part I move on to discuss how systemic efficiencies that emerge thanks to pervasive control materialize in concrete benefits not only for the introducing firm, but for society more generally.

III. THE SIGNIFICANT BENEFITS OF SYSTEMIC EFFICIENCIES

As if efficiencies were not abstract enough and difficult to capture, prove or quantify, systemic efficiencies appear even more elusive. This begs the question of whether systemic efficiencies have indeed anything to contribute to the analysis of justifications for potentially anticompetitive behaviour. In answering positively, this part shows that systemic efficiencies should be seriously considered in assessing the overall effect of seemingly anticompetitive practices as they can advance goals that competition law cares about through ways that appear to be qualitatively different than what smaller scale or simpler efficiencies could contribute.

In that vein systemic efficiencies can be associated with two goals that competition law occupies itself with. First, they can generate systemic innovations—the kind that emerges only through the interaction of a large number of interconnected elements (including, as per above, capital, labour, human capital, and physical resources). Innovation, or in other words dynamic efficiency, is a well-established objective of competition law,[55] and systemic innovations as a distinct type contribute in that direction. Second, they can generate and maintain value in an ecosystem, which, is not confined to the introducing firm, but rather spills over to the entire ecosystem. In that sense the contribution of the efficiency is not value through progress enjoyed primarily by the introducing firm, but also (perhaps mainly) by the industry in which the firm belongs,[56] which raises total welfare—also an accepted goal of competition law.[57]

A. The Transformation of Systemic Efficiencies into Systemic Innovations

As mentioned, systemic efficiencies emerge through the interaction of a large number of elements and components dispersed across the organizational structure of a system. Similar to other efficiencies they can result in cost reduction or output expansion, but they become more relevant in the achievement of technical progress and the development of new products and services. In that direction they can result in localized innovations, but they can also account for a qualitatively different type of innovations, i.e. systemic innovations.

Systemic innovations have been dealt with in the economics and management literature under various names. They are commonly called systemic, architectural or generalized and are distinguished from their opposite autonomous, modular or local innovations. In systemic innovations changes in (at least) one component of a system cause the need for substantial modifications in other components throughout the system.[58] Henderson and Clark use the similar term architectural innovations, and define them as those where when the linkages between

[54] For a summary of pros and cons of open and proprietary systems see Schilling, id.
[55] See, e.g., Brodley Joseph, The Economic Goals of Antitrust: Efficiency, Consumer Welfare, and Technoclogical Progress, 62 NEW YORK UNIV. LAW REV. 1020 (1987).
[56] This is an important point because efficiencies should be objective, not just a private benefit to the introducing firm. See Case C-382/12 P Mastercard v. Commission, [2012] EU:C:2014:2201, para. 234.
[57] Robert Lande, *Chicago's False Foundation: Wealth Transfers (Not Just Ef*ficiency) Should Guide Antiturst, 58 ANTITRUST LAW J. 631, 638 et seq. (1989).
[58] David J Teece, Technological Change and the Nature of the Firm, in TECHNICAL CHANGE AND ECONOMIC THEORY (Giovanni Dosi et al. eds., 1988); Richard N Langlois, Economic Change and the Boundaries of the Firm, 44 J. INSTITUTIONAL THEOR. ECON. 635 (1988); Andrew Davies, The Life Cycle of a Complex Product System, 1 INT. J. INNOV. MANAG. 229 (1997).

components in a system change they cause an overall readjustment of the system.[59] These types of innovations are in contrast to simpler, more localized innovations that can be introduced in a system without modifying other components of the system or rearranging the links between components.

Since they affect a multitude of a system's parts, most often systemic innovations also represent a significant departure from the current state of the system or of the technological status quo, as components need to adapt and be rearranged to ensure compatibility and cooperation with the new technological structure.[60] They are therefore so to speak radical (also known as revolutionary, breakthrough, discontinuous, or disruptive), and are distinguished from incremental innovations (also known as evolutionary, continuous, or sustaining).[61] The main characteristic of radical innovations is that they "sweep away much of [an organization's] existing investment in technical skills and knowledge, designs, production technique, plant and equipment."[62] They are "game changers"[63] and can result in new technologies, products, services or even new markets.[64] This distinguishes them from incremental innovations which involve mere "adaptation, refinement, and enhancement of existing products and/or production and delivery systems."[65] Incremental innovations introduce minor changes, do not depart from the status quo and therefore often reinforce existing designs in products and services.[66]

Because systemic innovations involve a multitude of parts in a system, they often require an effective focusing mechanism to ensure their proper interaction and cooperation. The kind of pervasive control described previously is capable of bringing together those parts and nurture the proper conditions for their interaction, absent which the (systemic) innovation might not arise. In other words, the exercise of control is the catalytic element for bringing coordination, cohesion, management and asset interaction to the necessary efficiency levels to allow the systemic innovation to materialise. In lack thereof, components might be only loosely joint preventing the interactions from leading up to a confluence that will result in the systemic innovation.

This link between efficient control in a system and the systemic innovation that emerges thereof is beautifully exemplified in the contrasting fates of the development and success of i-mode in Japan and in Europe and the US. i-mode was the prevailing and a rather revolutionary architecture for accessing Internet content in the pre- and early 3G era, that was largely developed and sponsored by NTT DoCoMo, Japan's incumbent and flagship carrier.[67] It consisted of a collection of protocols, interfaces, compatible devices, servers, payment methods, and affiliated content providers, all designed together towards building a completely new ecosystem.[68] i-mode proved very successful in Japan, but failed to gain traction in other countries and particularly European countries and the US.[69]

Case studies that compared i-mode in Japan and in other countries uniformly show that a crucial reason why DoCoMo succeeded in creating an i-mode ecosystem is because it was more effective in putting together all of the i-mode components, and dictating an integrated mode of operation.[70] By doing so, DoCoMo managed to generate a widely adopted and innovative internet access architecture, where other operators failed. In the words of the managing director for i-mode's strategy "[t]he decisive difference is that neither the United States nor Europe has had a telecommunications provider like DoCoMo with the will to grow a new business and service

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[59] Rebecca M Henderson & Kim B Clark, Architectural Innovation: The Reconfiguration Of Existing Product Technologies and the Failure of Established Firms, 35 ADM. SCI. Q. 9 (1990).
[60] Stefanie Bröring, How Systemic Innovations Require Alterations Along the Entire Supply Chain: The Case of Animal-Derived Functional Foods, 8 J. CHAIN NETW. SCI. 107 (2008); John Taylor & Raymond Levitt, Understanding and Managing Systemic Innovation in Project-based Industries, in INNOVATIONS: PROJECT MANAGEMENT RESEARCH 2004 83 (Dennis Slevin, David Cleland, & Jeffrey Pinto eds., 2004).
[61] Rosanna Garcia & Roger Calantone, A Critical Look at Technological Innovation Typology and Innovativeness Terminology: A Literature Review, 19 J. PROD. INNOV. MANAG. 110 (2002).
[62] JAMES M UTTERBACK, MASTERING THE DYNAMICS OF INNOVATION 200 (1996); Henderson and Clark, supra note 59 at 13.
[63] Mark P Rice et al., Managing Discontinuous Innovation, 41 RES. MANAG. 52, 52 (1998).
[64] Gina Colarelli O'Connor, Market Learning and Radical Innovation: A Cross Case Comparison of Eight Radical Innovation Projects, 15 J. PROD. INNOV. MANAG. 151 (1998); X Michael Song & Mitzi M Montoya-Weiss, Critical Development Activities for Really New Versus Incremental Products, 15 J. PROD. INNOV. MANAG. 124 (1998).
[65] Id. at 126.
[66] Michael L Tushman & Philip Anderson, Technological Discontinuities and Organizational Environments, 31 ADM. SCI. Q. 439, 441 (1986).
[67] For an overview see TAKESHI NATSUNO, THE I-MODE WIRELESS ECOSYSTEM (2005); Jeffrey L Funk, The Mobile Internet Market: Lessons *from Japan's i*-mode System, in PROCEEDINGS OF THE E-BUSINESS TRANSFORMATION: SECTOR DEVELOPMENTS AND POLICY IMPLICATIONS (2000).
[68] Id.
[69] MARTIN FRANSMAN, TELECOMS IN THE INTERNET AGE: FROM BOOM TO BUST TO--? 235 et seq. (2002).
[70] Richard Tee & Annabelle Gawer, Industry Architecture as a Determinant of Successful Platform Strategies: A Case Study of the i-mode Mobile Internet Service, 6 EUR. MANAG. REV. 217 (2009); Jeffrey L Funk, Standards, Critical Mass, and the Formation of Complex Industries: A Case Study of the Mobile Internet, 28 J. ENG. TECHNOL. MANAG. 232 (2011); NATSUNO, supra note 67 at 17–19.

based on a comprehensive view of the ecosystem as a whole."[71] In Japan, the telecommunications industry was structured in a way that accorded a lot of power to the three main operators and especially DoCoMo as the largest operator, as opposed to Europe where power was more evenly divided between operators, device manufacturers and standard setting organizations.[72] The pan-European dominance of the GSM consortium and Nokia, in contrast with the fragmented national markets in which operators were confined, meant that operators lacked the power to direct and control the creation of the necessary standards, interfaces, protocols and devices that were essential to the operation of i-mode.

In contrast to Europe, DoCoMo was well positioned to make several technical decisions about the elements and components that made i-mode work: it excluded WAP from the initial version of i-mode and mandated the use of the more flexible cHTML (compact HTML) for content creation, it set the specifications for the handsets that would be sold as i-mode compatible (including the interfaces, menus and dedicated i-mode buttons) shutting out manufacturers that did not adhere to the strict requirements, and it developed and mandated the use of a specific micropayment system.[73] The result was that the elements that made up i-mode in Japan were much more integrated with each other and provided the much needed compatibility and reliability that both users and service/application/content creators needed in order to adopt it.

Bearing in mind the fates of the different implementations of i-mode one should note that absent the efficiencies generated by DoCoMo's pervasive control, the i-mode architecture would have likely never become successful. In that sense, it would never constitute an "innovation" at all, or at best it would be a failed innovation. It is a fine line to notice, but systemic efficiencies can be an indispensable driver behind the emergence and success of a systemic innovation.

B. Raising Total Welfare Through Ecosystem Value Creation and Maintenance

Building and maintaining an ecosystem made up of numerous devices, services, infrastructure and other components is not an easy task. For instance, the ICT sector's recent history offers examples of platforms, around which a miscellany of actors and components revolved forming an ecosystem that emerged and faded in a matter of only a few years (e.g. Symbian, i-mode in Europe and US).

Without suggesting that it is the only reason behind an ecosystem's demise, the lack of coherence and coordination to ensure that all parts fit in well together, plays an instrumental role. As explained earlier, an elevated measure of control can be critical in achieving the required degree of cooperation, even if that means the occasional disadvantage of rivals. As an ecosystem's size or complexity increases, coordination becomes more challenging, and more drastic measures may need to be adopted in that direction. This part shows how such end-to-end control and the managing (read: limiting) of competition within the boundaries of ecosystems can help them generate and maintain value for the system sponsor and for the broader market alike.

Much like with the concept of efficiencies in general, it may sound paradoxical that restricting competition within a system can be positive for the broader market. But management and economics theories, including platform studies and compatibility theories, have well demonstrated how vesting control in a single entity that sits in the middle of a large complex system and manages competition can yield benefits for all other actors and ultimately consumers as well, even if some actors are individually harmed.

In their famous book, The Keystone Advantage, Iansity and Levien popularized the idea that certain firms in an ecosystem become more central than others, in that actors and value coalesce around them, and in that their behaviour can therefore have profound effects on the health of the entire network (examples the authors discuss include retailer Walmart and technology company Microsoft).[74] By nature of their central function, these keystones amass great power and exert great influence. Critical to the success of keystone firms and by extension of the ecosystem around them is that their "interests are aligned with those of the ecosystem as a whole."[75] Their

[71] Natsuno, id. at 19.
[72] Tee and Gawer, supra note 70 at 222–24; Funk, supra note 69 at 237.
[73] Supra note 72, and NATSUNO, supra note 67 at 5–6, 11–17, 19–22.
[74] MARCO IANSITI & ROY LEVIEN, THE KEYSTONE ADVANTAGE: WHAT THE NEW DYNAMICS OF BUSINESS ECOSYSTEMS MEAN FOR STRATEGY, INNOVATION, AND SUSTAINABILITY (2004); Horton, supra note 12 at 174–78.
[75] IANSITI AND LEVIEN, id. at 9.

actions are not animated by selfishness or greed; they are rather aimed at the general welfare of their ecosystem, because "the most direct way for a keystone to ensure its continued survival is to directly maintain the stability of its ecosystem."[76] And they can do this in a variety of ways including by removing actors or limiting their number in the ecosystem, by managing competition within the ecosystem and by providing a stable platform for the rest to build upon.[77] Under this light, the exercise of end-to-end control, the promotion of certain actors, links and behaviour, and the exclusion of others become a necessary and effective weapon in the keystone's arsenal.

In a way, keystones often act as benevolent dictators for life (BDFL), a term that was coined to describe leaders who retain the final say and ultimate authority even in systems that are otherwise open, inclusive, decentralized and non-hierarchical (e.g. open source software).[78] Such actors, who maintain central and overriding authority, either officially or de facto, can become indispensable for the overall health of the ecosystem, even if that means that their decisions and actions will harm some other players in the ecosystem.[79]

Iansiti and Levien's keystone theory reflects also insights from the platforms literature, which similarly identifies centres of gravity in platform ecosystems and the role the platform owner performs in that context.[80] In their highly influential work Baldwin and Woodard explain that in any given platform system and at any given time only a few parts and components will be those that define its general architectural shape.[81] These do not necessarily remain the same as the platform evolves, but there always seems to be a centre of gravity in platform ecosystems, which determines the overall direction, behaviour, and management of the key actors and components, and ultimately the ecosystem.[82]

One way whereby platform owners (or sponsors, designers, architects etc) attempt to maximize their chances of success is by exercising control on who gets access to the platform, and in technical systems they can do that by leveraging compatibility between actors and/or components.[83] There is rich literature on how managing (in)compatibility within and between platform systems can generate value and enhance competition, entry and innovation.[84] This is not to say that exclusion through incompatibility is always superior to compatibility,[85] but rather that, unlike popular belief, making a system highly selective by shutting out actors and components can also be the source of significant benefits.

Two reasons explain this: first, under incompatibility and before a standard has been selected by the market, potential candidates (actors, components, systems) compete against each other with the goal to become the de facto industry standard or model.[86] This type of competition where actors strive to dominate the market based on different models is characterized as competition for the market rather than competition in the market, and is recognized as a substantial form of competition.[87] A platform system that chooses to discriminate against or block rivals and their components may be doing so to establish itself as the paradigmatic system in the market, and this process of systems going against each other can still give rise to valuable effective competition.[88]

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[76] IANSITI AND LEVIEN, supra note at 70. See also Benjamin Edelman & Damien Geradin, Efficiencies and Regulatory Shortcuts: How Should We Regulate Companies like Airbnb and Uber?, 19 STANFORD TECHNOL. LAW REV. 293 (2016).

[77] IANSITI AND LEVIEN, supra note 74 at 20.

[78] Joseph M Reagle Jr, Do as I Do: Authorial Leadership in Wikipedia, in PROCEEDINGS OF THE 2007 INTERNATIONAL SYMPOSIUM ON WIKIS 143 (2007); Robinson Meyer, *On the Reign of "Benevolent Dictators for Life" in Software*, THE ATLANTIC, January 17, 2014.

[79] Reagle Jr, id. at 149.

[80] See generally ANNABELLE GAWER & MICHAEL A. CUSUMANO, PLATFORM LEADERSHIP: HOW INTEL, MICROSOFT, AND CISCO DRIVE INDUSTRY INNOVATION (2002).

[81] Carliss Young Baldwin & Jason C. Woodard, The Architecture of Platforms: A Unified View, in PLATFORMS, MARKETS AND INNOVATION 19, 24–25 (Annabelle Gawer ed., 2009).

[82] Pieter Ballon, Platform Types and Gatekeeper Roles: The Case of the Mobile Communications Industry, in DRUID SUMMER CONFERENCE, COPENHAGEN BUSINESS SCHOOL , 4 (2009). On the evolution of systems and the transition through various paradigms see generally James M Utterback & William J Abernathy, A Dynamic Model of Process and Product Innovation, 3 OMEGA 639 (1975); Giovanni Dosi, Sources, Procedures, and Microeconomic Effects of Innovation, 26 J. ECON. LIT. 1120 (1988).

[83] Joseph Farrell & Timothy Simcoe, Four Faths to Compatibility, in OXFORD HANDBOOK OF THE DIGITAL ECONOMY 34 (Martin Peitz & Joel Waldfogel eds., 2012).

[84] See infra footnotes 86-93 and accompanying text.

[85] On the trade-off see Jeffrey Church & Neil Gandal, Platform Competition in Telecommunications, in THE HANDBOOK OF TELECOMMUNICATIONS ECONOMICS (VOLUME 2) 119, 131 et seq. (Martin Cave, Sumit Kumar Majumdar, & Ingo Vogelsang eds., 2005); Esteve Almirall & Ramon Casadesus-Masanell, Open Versus Closed Innovation: A Model of Discovery and Divergence, 35 ACAD. MANAG. REV. 27 (2010); Joseph Farrell, Should Competition Policy Favor Compatibility, in STANDARDS AND PUBLIC POLICY 372 (Shane Greenstein & Victor Stango eds., 2007).

[86] Church and Gandal, id. at 127; RAMON CASADESUS-MASANELL & FRANCISCO RUIZ-ALISEDA, PLATFORM COMPETITION, COMPATIBILITY, AND SOCIAL EFFICIENCY COMPATIBILITY, AND SOCIAL EFFICIENCY (OCTOBER 1, 2008) .NET INSTITUTE WORKING PAPER 2 (2008).

[87] Id.

[88] Joseph Farrell, Hunter K Monroe & Garth Saloner, The Vertical Organization of Industry: Systems Competition Versus Component Competition, 7 J. ECON. MANAG. STRATEG. 143 (1998).

Second, under incompatibility, it is easier for components in each system (e.g. applications) to maintain relative market power, because they do not compete directly with those of rival systems only with those within the same system. This results in lower competitive intensity than if systems were compatible (in which case similar components from all systems would compete against each other), which in turn slows down the commoditization of competitors.[89] The softening of competition can be positively associated with higher innovation and entry: what today seems to be the predominant theory in the relationship between competition and innovation, is that competition is initially positively correlated to innovation, but that too much competition can be harmful for innovation rates, as the relationship between competition and innovation is not monotonic.[90] After a certain point, excessive competition may have an adverse effect on innovation as it leads to rapid depreciation of the innovation's value.[91] The prospect of not recouping the cost of developing and commercializing an innovation as other actors would quickly imitate or render the original innovation obsolete might act as a discouraging factor.[92] The friction between the two effects of competition results in an inverted U relationship where competition initially acts as the driving force of innovation, but when it gets too fierce it may hinder further entry.[93]

Taken together, what economics and management theories demonstrate is that in markets that are built as ecosystems, where actors interact instead of products and services trickling down from producer to consumer, the active management of relationships and competition can well be beneficial. This may sometimes appear counterintuitive because it implies a deviation from free unfettered competition, but as explained it aims to disadvantage the few to promote the well-being of the many.

IV. APPLICATION TO CASES

As mentioned, systemic efficiencies result from the interaction of multiple parts of a system, and in that sense, to be noticed, they require an overview of the entire system. Their subtlety may make them invisible to competition authorities and courts causing in turn certain firm behaviour to appear less justifiable than if the countervailing systemic efficiencies were readily observable. This part demonstrates how systemic efficiencies materialize in practice, and what potential pro-competitive effects authorities and courts could associate with them. The correct identification of systemic efficiencies can be decisive in the outcome of a case, and ultimately the shape and performance of the industry.

In that direction I discuss two high-profile sets of cases from the ICT industry: first, possible systemic efficiencies in the ongoing Google Android investigation opened by the European Commission in the EU and by the Federal Trade Commission in the US. Second, possible systemic efficiencies in the recent IBM mainframe cases also opened by the European Commission in the EU and the subject of multiple lawsuits in federal courts in the US.

Besides demonstrating how systemic efficiencies play out in practice, the cases discussed below will hopefully also help readers understand what systemic efficiencies are not. This is important because not all efficiencies that occur in the context of complex technical systems are systemic, and distinguishing real systemic efficiencies from "standard" efficiencies is instrumental in preventing abuse of the concept. The Microsoft cases are helpful here. In the EU case, Microsoft claimed that tying Windows Media Player to the Windows operating system lowered transaction costs for users, and helped developers make use of media services by providing them with a media platform to which they could place calls through APIs.[94] Regardless of whether these are indeed real efficiencies to begin with (the Commission rejected them),[95] they definitely do not seem to be systemic: they

[89] Farrell, supra note 85 at 375.
[90] This conclusion is contested but at the same time it is the one that has garnered the most support. See Wesley M. Cohen & Richard C. Levin, Empirical Studies on Innovation and Market Structure, in HANDBOOK OF IDUSTRIAL ORGANIZATION 1059, 1074–1078 (Richard Schmalensee & Robert D. Willig eds., 1989); Richard Gilbert, Looking for Mr. Schumpeter: Where Are We in the Competition-Innovation Debate?, in INNOVATION POLICY AND THE ECONOMY, VOLUME 6 159 (Adam B. Jaffe, Josh Lerner, & Scott Stern eds., 2006).
[91] MORTON I KAMIEN & NANCY L SCHWARTZ, MARKET STRUCTURE AND INNOVATION 24–31 (1982). This view is traced back to Schumpeter. JOSEPH SCHUMPETER, CAPITALISM, SOCIALISM, AND DEMOCRACY (1942).
[92] Philippe Aghion et al., Competition, Imitation and Growth with Step-by-Step Innovation, 68 REV. ECON. STUD. 467 (2001).
[93] Philippe Aghion et al., Competition and Innovation: an Inverted-U Relationship, 120 Q. J. ECON. 701 (2005).
[94] See Commission Decision of 24.03.2004 relating to a proceeding under Article 82 of the EC Treaty (Case COMP/C-3/37.792 Microsoft), paras 956, 962.
[95] Id. paras 956 et seq., 962 et seq.

involve only few components, which are in fact localized, and changing their relationship or behaviour would not affect the operation of the system, whether that is defined to be the Windows operating system software, or the Windows ecosystem more broadly. Similarly, in the US case, Microsoft claimed that integrating Internet Explorer into Windows and using it as the default browser even overriding user preferences, was necessary to allow certain features of Windows Help and Windows Update.[96] While the Court of Appeals upheld this defence,[97] it should, again, be clear that this was not a systemic efficiency: the IE integration affected only specific software functionality in a limited number of cases, which did not have crucial influence on the architecture (technical or other) of the system as a whole.

On the other hand, one should also be cautious when correctly identifying a systemic efficiency. The case studies below should not be read to mean that systemic efficiencies justify any and all business behaviour. They are meant to highlight the role of systemic efficiencies in the balancing test undertaken by authorities and courts to assist in the appreciation of practices that may appear anti-competitive but which in essence have far reaching effect, not immediately obvious. In that sense, firm conduct can still be found to be in violation of competition law if the anticompetitive effect outweighs the benefits of the systemic efficiency.

A. The Google Android Cases in the EU and the US

Google has recently been the subject of multiple monopolization/abuse of dominance investigations regarding its business practices. These include the company's search operations, which came under scrutiny both by the Federal Trade Commission in the US and by the European Commission in the EU,[98] but also the company's Android and mobile apps strategy, which prompted a separate investigation by the EC and (at the time of writing) an unofficial probe by the FTC.[99] This latter set of practices provides a good base for discussion on how the acknowledgement of systemic efficiencies can affect our understanding of the legitimacy of seemingly anti-competitive practices. Google's practices, of course, may still be found illegal if potential anti-competitive effects overshadow the benefits of (systemic) efficiencies.

In April 2015 the EC confirmed that it opened formal proceedings against Google to determine whether "Google has illegally hindered the development and market access of rival mobile operating systems, mobile communication applications and services in the European Economic Area."[100] The EC suggested that Google might have done so by "requiring or incentivising smartphone and tablet manufacturers to exclusively pre-install Google's own applications or services," by "prevent[ing] smartphone and tablet manufacturers who wish to install Google's applications and services on some of their Android devices from developing and marketing modified and potentially competing versions of Android," and by "tying or bundling certain Google applications and services distributed on Android devices with other Google applications, services and/or application programming interfaces of Google."[101] These limitations are imposed through Android's licences, namely the Anti-fragmentation Agreement (AFA) and the Mobile Application Distribution Agreement (MADA). These (voluntary) agreements ask manufacturers to adhere to a set of compatibility requirements, to refrain from developing competing Android-based operating systems, and to install certain Google Apps (alongside other apps).[102]

These practices have something in common: they potentially prevent competing manufacturers of mobile operating systems and mobile applications from offering their products on fully equal grounds with those of

[96] United States v. Microsoft Corp., 253 F.3d 34 (2001), para 30.
[97] Id.
[98] Statement of the Federal Trade Commission Regarding Google's Search Practices, In the Matter of Google Inc., FTC File Number 111-0163 (January 3, 2013); European Commission Press Release, Commission Sends Statement of Objections to Google on Comparison Shopping Service; Opens Separate Formal Investigation on Android (April 15, 2015).
[99] Id. Kendall and Barr, supra note 1.
[100] European Commission Fact Sheet, Antitrust: Commission Opens Formal Investigation Against Google in Relation to Android Mobile Operating System (April 15, 2015).
[101] Id.
[102] Sample MADA contracts are available at: http://www.benedelman.org/docs/htc-mada.pdf (between Google and HTC), and at https://www.sec.gov/Archives/edgar/containers/fix380/1495569/000119312510271362/dex1012.htm (between Google and Motorola). See also http://www.sec.gov/Archives/edgar/containers/fix380/1495569/000119312510271362/dex1012.htm, and Ron Amadeo, *Google's Iron* Grip on Android: Controlling Open Source by Any Means Necessary, ARS TECHNICA, October 21, 2013.

Google when they rely on the Android platform.[103] But they cannot be said to be anti-competitive in the abstract. Rather, it must be proven that Google is dominant in the relevant markets, that it has abused its dominance (or monopolized or attempted to monopolize the relevant markets), and that no good justifications exist for such conduct. This last part is precisely where systemic efficiencies come in.

Android comes in varying degrees of openness, from the fully open Android Open Source Project version, which anyone can modify and install on a mobile device, to the version sponsored by Google which comes with the limitations of the AFA and MADA mentioned before. Many manufacturers use Android as the operating system on their devices, with some estimates placing them in the range of 24,000 devices from 1,300 brands.[104] Compare that to the number of devices that run, for instance, Apple's iOS, which is fewer than fifty, and all controlled by the same company. Android's success, as evidenced by its wide base of adoption, came with the high cost of extensive fragmentation. With such a large number of devices the complexity and heterogeneity of the Android ecosystem are not only hard to manage,[105] they also threaten the very success of the ecosystem if they hinder its stability and—above all—evolution.[106] In such situations a focusing mechanism that enhances cohesion can prove decisive in maintaining the health of the ecosystem for the reasons explained previously. Looking at it as a large complex system, the suggestion here is that Android necessitates Google's steering to prevent degeneration into a loose collection of interacting yet uncoordinated nodes.[107]

For the layman, the cost of fragmentation is not readily visible. The average user interacts only with his own device oblivious to the multitude of other devices that belong in the same ecosystem and to the "backstage" of his end user experience. But competition authorities and courts should be able to appreciate that the management of fragmentation in the Android ecosystem is essential and requires constant supervision of at least three aspects: updates, security, and user experience. These aspects involve several parts in the ecosystem including the Android operating system, the applications that run on top, the applications distribution platform (e.g. Google Play), the hardware of the device on which the operating system and applications are installed and run, and the mobile network on which devices connect (hence the systemic element).[108] Keeping fragmentation under control has to take into account the effects and implications of actions (re updates, security, and user experience) across all those loci; an update or a security feature that fails at any of these stages is not an update or feature at all. Collectively, the successful management of these aspects, spread over the various parts of the ecosystem, result in the systemic efficiencies of the system's maintenance and evolution. In turn, this is what will allow the system to innovate and stay ahead of competition, a welcome development from a competition law perspective.

To pull this process together, as suggested by systems organization theory presented above,[109] the system manager (i.e. Google) may need to exercise an elevated measure of control, which manifests itself, inter alia, through the very actions that competition authorities are scrutinizing.[110] While these actions may create obstacles for competitors, they also aim to create a minimum standard of uniformity, cohesion, stability and evolution, as they ensure that the pieces of the Android ecosystem fit in optimally together, not only statically but dynamically as well.[111]

Let us first focus on updates. In a static view of the Android ecosystem we can assume that all parts and components fit in well and perform optimally (something that in itself requires planning and will be discussed shortly below). But when a component changes—a common occurrence in the fast-paced environment of mobile communications—seamless interoperation with the rest of the system must be ensured, otherwise functionality will be broken. Localized insular updates (e.g. user interface of an application) are easy in that regard, because they do not interfere significantly with the operation of other parts. But more extensive updates, such as those that

[103] Benjamin Edelman, Does Google Leverage Market Power Through Tying and Bundling?, 11 J. COMPET. LAW ECON. 365 (2015).
[104] Android Fragmentation Visualized, OPEN SIGNAL (2015).
[105] GREG NUDELMAN, ANDROID DESIGN PATTERNS: INTERACTION DESIGN SOLUTIONS FOR DEVELOPERS 41 et seq. (2013).
[106] Dan Han et al., Understanding Android Fragmentation with Topic Analysis of Vendor-Specific Bugs, in 2012 19TH WORKING CONFERENCE ON REVERSE ENGINEERING 83 (2012); TORSTEN KOERBER, LET'S TALK ABOUT ANDROID – OBSERVATIONS ON COMPETITION IN THE FIELD OF MOBILE OPERATING SYSTEMS 6–9 (2014), http://papers.ssrn.com/abstract=2462393 (last visited Dec 21, 2015).
[107] Gregory Sidak, Do Free Mobile Apps Harm Consumers?, 52 SAN DIEGO LAW REV. 619 (2015).
[108] Je-Ho Park, Young Bom Park & Hyung Kil Ham, Fragmentation Problem in Android, in 2013 INTERNATIONAL CONFERENCE ON INFORMATION SCIENCE AND APPLICATIONS (ICISA) 1–2 (2013).
[109] See supra Part II.B.
[110] See supra note 100 and accompanying text.
[111] United States v. Microsoft Corp., 253 F.3d 34 (2001); Caldera, Inc. v. Microsoft Corp., 72 F. Supp. 2d 1295 (1999).

involve the operating system or the hardware require more holistic planning because it must be determined whether the change should be performed at the module level, at the group of modules (subsystem) level, or at the system level, and any conflicts and interdependencies (a process that is commonly done using the so called Design Structure Matrix) must be resolved.[112] This requires a degree of coordination between and control over the implicated modules if the management mechanism deems that selective updates in one regard or part without corresponding updates to another will not bring about the goal and purpose of the update.[113] Apple, for example, integrates the hardware (iPhone), with the operating system (iOS) and the distribution platform (App Store) to achieve a consistent and reliable product as well as effective implementation and commercialization of innovations. Google only partially has this kind of pervasive control: for instance, the requirement of pre-installing the complete Google app suite, which can potentially exclude developers of similar and competing applications, applies only to manufacturers that sign the (optional) MADA; the rest are free to release Android compatible devices with other non-Google applications pre-installed. One of the reasons for the full line strategy is to ensure that the essential set of applications that Google promotes (which in themselves are modules) evolve hand in hand, and that an update in one module (including the operating system) is reflected in updates to the rest of the set without discontinuities in functionality.[114]

Further, a systemic analysis of the Android ecosystem suggests that it can derive significant benefits from greater homogenization through the wider adoption of an "official" version of Android or highly compatible versions of Android. Along those lines Google has invited scrutiny for forcing "compatible" versions of Android onto manufacturers to the expense of independent forks (e.g. Amazon's Fire fork). While the potential anti-competitive harms here are easy to see (i.e. foreclosure), it is worth considering the more subtle systemic benefits as well: a unified update process speeds up dissemination of new features and facilitates testing and error detection. Today, when Google releases an update to the Android core, the various manufacturers have to separately test every update to make sure it is compatible with a variety of different phone configurations, and with their own implementation of Android.[115] Subsequently, network operators have to further test it for compatibility with their networks as new features can present stability or security threats to the highly managed cellular networks.[116] These tests add significant delays to the evolution of the Android ecosystem, create an overhead of testing requirements to ensure compatibility, and pull the operating system in multiple directions.[117] Apple, on the contrary, having internalized the process can afford to skip many of those tests, saving it time, creating consistency, and allowing for the undistracted planning and execution of the company's iOS strategy (Microsoft mutatis mutandis). [118]

Similar justifications explain why placing some restrictions around the formation of the end user experience can be effective to counter Android's fragmentation. One of the common reasons why the iPhone has been so successful is that it "simply works" meaning that the out-of-the box experience of iPhone users is smooth, consistent and lacking the need for customization.[119] Similarly, the MADA, by maintaining a list of minimum applications and default home screen layouts, aims at offering a uniform and familiar end user experience free from potential breaking points. What is most important here is not so much the likelihood that third parties may actually break the system, but rather that Google's strategy appeals also to those users that do not even want to have to assess this possibility themselves. By picking the Android experience those users would like to forego the transaction costs of verifying the quality of the product and instead opt for an off-the-shelf end product/service that has taken care of all issues of compatibility, cross-functionality and interoperation for them.[120]

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[112] BALDWIN AND CLARK, supra note 33 at 221 et seq.; Baldwin and Clark, supra note 33 at 175 et seq.

[113] In the famous Jerrold Electronics case the US Supreme Court accepted that modifying a system in a way that is not approved by its manufacturer can harm cohesion and quality, but noted that this justification must persist through time, and not only be valid during the inception of the system. United States v. Jerrold Electronics Corp., 187 F. Supp. 545 (1961).

[114] The different update rates of the various parts of the Android ecosystem is a common problem. See T McDonnell, B Ray & Miryung Kim, An Empirical Study of API Stability and Adoption in the Android Ecosystem, SOFTW. MAINT. (ICSM), 2013 29TH IEEE INT. CONF. 70 (2013).

[115] Brent Rose, Why Android Updates Are So Slow, GIZMODO, March 19, 2013.

[116] David Meyer, Hold off Updating Your iPhone 4S to iOS 6.1, European Carriers Warn Customers, GIGAOM, February 11, 2013, https://gigaom.com/2013/02/11/hold-off-updating-your-iphone-4s-to-ios-6-1-european-carriers-warn-customers/; Rose, supra note.

[117] Brent Rose, *What's the Point of Android Skins*, GIZMODO, December 5, 2013; Rose, supra note 115; Meyer, id.

[118] Chris Hoffman, Why Do Carriers Delay Updates for Android But Not iPhone?, HOW-TO GEEK, March 25, 2013.

[119] Felix Cuadrado & Juan Duenas, Mobile Application Stores: Success Factors, Existing Approaches, and Future Developments, 50 IEEE COMMUN. MAG. 160 (2012); Michael A Cusumano, Technology Strategy and Management Platforms and Services: Understanding the Resurgence of Apple., 53 COMMUN. ACM 22–24 (2010), 10.1145/1831407.1831418.

[120] On how customizability serves as a source of transaction cost see Park Chung-Hoon & Kim Young-Gul, Identifying Key Factors Affecting Consumer Purchase Behavior in an Online Shopping Context, 31 INT. J. RETAIL DISTRIB. MANAG. 16 (2003).

For instance, one of the requirements of the MADA is that manufacturers have to pre-install an entire suite of Google apps; they cannot pick and choose. Two of those applications are Gmail and Google Drive, and their complementarity is obvious: the integration of Google Drive with Gmail allows users to easily attach files to their emails and save attachments from their emails. It is not that this function cannot be performed by any other combination of applications, but the ready availability of such functionality increases Android's usefulness and user-friendliness, and therefore value. If one extrapolates from this example, it is easy to see how the restrictions placed by the MADA comprehensively help shape an environment that meets certain minimum standards but is still customizable and open to third parties, so that it can compete with the more integrated approach followed by Android's main competitors, including iOS and Windows Phone.

Lastly, fragmentation takes its toll on the security aspects of the Android ecosystem as well. While all mobile operating systems have security flaws, Android's position is worsened by additional factors that could be resolved by a controlling authority with the power to filter out customizations that constitute a risk factor. However, this might be a problem for competition authorities, if one is to judge by the European Commission's suspicion that Google prevents manufacturers from developing competing versions of Android.

As already mentioned, Google allows a very large margin of customization of Android, but it still reserves Google Play for manufacturers that have signed the MADA and have accepted Google's full app line. One of the benefits of using Google Play is that Google is generally good at policing it for malware. Once it detects a harmful app, it removes it thereby protecting Android users and the Android ecosystem as a whole. However, malware can survive in less protected app distribution platforms, of which there are many, and while Google Play users will not be affected, the overall quality of the Android ecosystem is indeed harmed. [122] Indeed, evidence suggests that Google Play is more secure than other Android application distribution platforms.[123] In turn, a more robust app distribution platform layer not only enhances security in the ecosystem built around Google Play, but creates positive externalities for the entire Android ecosystem as well, because it enhances its reputation and the perception users and developers have about it generally.

Moreover, Android forks can expose users to vulnerabilities by failing to prevent apps and malware from accessing unauthorized functions.[124] Android is a layered operating system consisting of an app layer, a framework layer, and the Linux kernel layer. To take advantage of a device's hardware features (e.g. GPS, camera, microphone etc) an app has to interface with the Linux kernel. To avoid exploitation of functions and features both the apps and the layers have to be protected from unauthorized uses. Badly designed layers can open the door for apps to compromise user security and privacy, and this is a common concern with modified versions of Android.[125] The small time window manufacturers have to work on their own version of Android and the challenges the updating process presents described previously become a liability for the Android ecosystem because they expose it to security and privacy violations.[126] In this context, promoting a more uniform version of Android which adheres to the standards Google sets through its licensing system, can help ameliorate these concerns.

In all, the recognition of systemic efficiencies should allow authorities and courts to appreciate that Google's restrictions taken together are not necessarily (only) about protecting individual components of the Android system (e.g. Play, Search), but about the well-being and evolution of the system and its relationship with users as a whole. This realization does not automatically mean that Google's behaviour is overall pro-competitive, but it does illuminate a certain value in and rationale behind it that could otherwise remain hidden. The opportunity for a genuine appreciation of systemic efficiencies is reminiscent of the opportunity the Court of Appeals had and seized in the US Microsoft case, to recognize tying efficiencies in platform markets as different from those in non-platform markets, which led the court to move the tying standard from per se illegal to rule of reason analysis.[127] The court did not say that tying in platforms is always justified, but it did point out that tying in platform markets

[122] Steve Mansfield-Devine, Android Architecture: Attacking the Weak Points, NETW. SECUR. 5–12 (2012). The quality of platform derives from offering good quality content, but also from excluding bad quality content. See David Evans, Governing Bad Behavior By Users of Multi-Sided Platforms, 27 BERKELEY TECHNOL. LAW J. 1201 (2012).
[123] James Vincent, Google Says It Scans Six Billion Android Apps Daily for Security Threats, THE VERGE, April 19, 2016.
[124] Xiaoyong Zhou et al., The Peril of Fragmentation: Security Hazards in Android Device Driver Customizations, in 2014 IEEE SYMPOSIUM ON SECURITY AND PRIVACY 409 (2014).
[125] Lei Wu et al., The Impact of Vendor Customizations on Android Security, in PROCEEDINGS OF THE 2013 ACM SIGSAC CONFERENCE ON COMPUTER & COMMUNICATIONS SECURITY 623 (2013).
[126] Zhou et al., supra note 124.
[127] United States v. Microsoft Corporation, 253 F.3d 34 (D.C. Cir. 2001).

generates broader benefits that accrue not only to the firm that performs the tying, but also to third parties and therefore a more moderate rule of reason approach was in order.[128] The idea here is that the systemic effect of Google's restrictions taken together should be separately valued too, for what they offer to the Android ecosystem (including developers and consumers). Whether the added value (on top of the separate value of each contractual arrangement) is enough to make Google's behaviour pro-competitive overall is a conclusion that a court or authority can only reach after assessing potential harms too. But this exercise is beyond the scope of this article.

B. The IBM Mainframe Cases in the EU and the US

As expected for large technology companies, IBM has not escaped antitrust scrutiny either. A series of recent EU and US cases that involved the company's mainframe computers highlighted again the fine line between acceptable business practices and anticompetitive exclusion, but bypassed an opportunity to show how exclusionary practices in the universe of large complex systems and firms can be linked to types of efficiencies that do not occur in smaller scale or more insular environments. Had they done so they would have provided a fuller understanding and appreciation of IBM's practices and the industry's needs and structure.

The cases covered a range of offenses but the exclusion part is common to all. In the EU, the Commission accused IBM of tying the sale of its mainframe computers with maintenance services thereby shutting out competition in the secondary market.[129] In the US the case involved the refusal of IBM to extend interoperability between its products and those of rival firms making it impossible for them to offer competing solutions to companies that were using IBM's mainframes.[130] The EU case was settled, and so we are lacking the details on the Commission's thinking regarding possible justifications for IBM's behaviour.[131] The district court in the US upheld the established norm that in principle firms are free to partner with whomever they wish, and accepted that IBM's refusal to supply and tying practices (which partly materialized through IBM's refusal to support its older S/390 mainframe series, and the tying of its new mainframe hardware to the z/OS software) were justified by IBM's interest to protect its investments in its new "z" mainframe series.

It is at this point that the court could and should have considered IBM's (potentially anti-competitive) policies as part of IBM's broader innovation cycles in its mainframe line of business, and not just as an isolated incident. This would highlight that the current mainframe line is part of a larger system from which it has evolved and which it extends, and it cannot be appreciated out of that context.

The z mainframe model is not an insular product; it is the latest model in a long line of mainframe computers, which over the years became so successful that the IBM's brand name became almost synonymous with the market itself. It would not be a hyperbole to say that IBM created and maintained the market for mainframe computers for over 50 years through continuous innovations generating tremendous value and technical progress for the industry and society (and quite evidently IBM itself).[132] Throughout this period IBM's business practices were not necessarily geared towards shielding IBM from competition, but also served to maintain and evolve a mainframe system through the years, not just a single model, but a whole line of them through recurrent innovations one drawing from the success of the previous ones. Under this light, to fully capture the rationale and effect of IBM's current practices, one has to regard them in perspective as part of the system in which they are born, namely the mainframe system in its historical dimension.

IBM's mainframe line was launched in 1964 with the S/360 model, which has been described as a $5 billion gamble, and was the biggest corporate project investment at the time.[133] The reason why the S/360 project was so risky and revolutionary was twofold: first, it was the first modular mainframe architecture, meaning that its various components (and peripherals) could be recombined throughout IBM's product line, unlike standard

[128] Id. at 90. See also Art Jean-Yves & Gregory McCurdy, *The European Commission's Media Player Remedy in Its Microsoft Decision:* Compulsory Code Removal Despite the Absence of Tying or Foreclosure, 25 EUR. COMPET. LAW REV. 694 (2004).
[129] European Commission Press Release, Commission Initiates Formal Investigations Against IBM in Two Cases of Suspected Abuse of Dominant Market Position (July 26, 2010). Case Comp/C-3/39692 IBM Maintenance Services, EC Decision 13.12.2011.
[130] IBM v. Platform Solutions, Inc., 658 F. Supp. 2d 603 (2009). See also Neon Enter. Software, LLC v. IBM, WL 830737 (2011).
[131] Although the Commission briefly touches upon them in para. 40.
[132] Timothy Bresnahan, Shane Greenstein & Rebecca Henderson, Schumpetarian Competition and Diseconomies of Scope, in THE RATE AND DIRECTION OF INVENTIVE ACTIVITY REVISITED 203, 217 (Josh Lerner & Scott Stern eds., 2012).
[133] Matthew Sparkes, *IBM's $5bn Gamble: Revolutionary Computer Turns 50*, THE TELEGRAPH, April 7, 2014.

practice which was to manufacture integrated machines. Second, while some hardware components were available in the market, IBM chose to develop and produce its own, to ensure maximum compatibility and reliability.[134]

The S/360 was a complete departure from the then established technology, and IBM had to get systemic compatibility and reliability right, not only because the architecture of the S/360 was experimental and innovative (and thusly risky, untested, and potentially unstable), but also because its customers consisted of large corporations, institutions and government agencies with low tolerance for glitches and internal incompatibilities. This is why IBM chose to forego off-the-shelf hardware and keep its architecture closed. To ask that IBM open up its architecture to third parties (including hardware, software, training, and maintenance), as regulators and competitors unsuccessfully did,[135] would risk the project's core design, as well as IBM's survival, reputation, and, as the keystone player in the mainframes market, the fate of the industry altogether. Indeed, the S/360 system sustained an entire ecosystem of other independent players in the industry, and it is telling that some commentators identify the ecosystem's enduring success as one of the factors why IBM found it challenging to push out the next wave of innovation after the S/360.[136]

IBM obviously had an interest in safeguarding its system and the market it created around it,[137] but it was also in the long-run interest of the industry to allow IBM to create a new market through this revolutionary machine, even though in the short-run competitors would rather chip away IBM's profits by free-riding on its R&D and efforts to build the market.[138] Indeed, IBM's strategy resulted in a product line that defined computer architecture for the next decades to such an extent that the mainframe market comprising IBM and other smaller rivals was sneeringly referred to as "IBM and the seven dwarves."[139] For instance, motivated by the success of the S/360 system and hoping for its continuation, IBM designed and invested in the so called Future System project (FS). FS ultimately turned out to be a strategic failure, mainly because it was too ambitious and revolutionary for its time.[140] But despite its failure, the project paved the way for far-reaching innovations (such as the use of integrated chips, the full separation of software and hardware, and the idea that computers should become adaptable to every and any operational environment), that were gradually integrated into the next generations of mainframe computers over the next decade, including models S/370 and S/390,[141] the latter of which came out in 1990 and included fiber optics integration and, for the first time, open source software support.

What is important to note here is that IBM decided to go forward with FS and the evolutions of the S/ series precisely because the S/360 succeeded in creating and locking in a market that justified taking immense business risks and making the necessary investments. Subsequent innovations maintained this trend. Around the time that S/390 came out in the early 90s some industry experts felt that mainframes are a thing of the past (one analyst wrote "I predict that the last mainframe will be unplugged on March 15, 1996.").[142] Not only did that not happen but two decades later, the mainframe industry is still active even during the cloud era when for many maintaining centralized computer power seems backwards and inefficient, and IBM continues to be a frontrunner.

It would be wrong to say that IBM's continuous innovation waves are the result of just the sheer size of its business span or IBM's "bullying" practices. While there is some truth to that,[143] IBM's protective practices allow it to compete on innovation because they are interwoven with IBM's corporate culture on innovation.[144] IBM is not the typical "idle" monopolist who enjoys "the quiet life" once it has successfully commercialized an innovation. Five decades after the revolution of the S/360 it continues to take evolutionary steps each bringing together new hardware and software, and—combined—a whole ecosystem of mainframe computing. The systemic element here becomes obvious when one takes a higher level look from each particular mainframe model

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[134] CHARLES FERGUSON & CHARLES MORRIS, COMPUTER WARS: HOW THE WEST CAN WIN IN A POST-IBM WORLD 8–9, 14 (1993).
[135] Lawrence Sullivan, Monopolization: Corporate Strategy, the IBM Cases, and the Transformation of the Law, 60 TEX. LAW REV. 587 (1982).
[136] CAMPBELL-KELLY, supra note 50 at 130–133.
[137] FERGUSON AND MORRIS, supra note 134 at 8.
[138] MARTIN CAMPBELL-KELLY & DANIEL GARCIA-SCHWARTZ, FROM MAINFRAMES TO SMARTPHONES: A HISTORY OF THE INTERNATIONAL COMPUTER INDUSTRY 57–58, 63–67 (2015).
[139] JOHN SUTTON, TECHNOLOGY AND MARKET STRUCTURE 398 (1998).
[140] FERGUSON AND MORRIS, supra note 134 at 31 et seq. (the FS aspired to make computers adaptable to every environment).
[141] CAMPBELL-KELLY AND GARCIA-SCHWARTZ, supra note 138 at 75 et seq.
[142] IBM Archives, available at https://www-03.ibm.com/ibm/history/exhibits/mainframe/mainframe_intro4.html.
[143] Russell Pittman, Predatory Investment, U.S. vs. IBM, 2 INT. J. IND. ORGAN. 341 (1984); FERGUSON AND MORRIS, supra note 134 at 14–15.
[144] John Lopatka, United States v. IBM: A Monument to Arrogance, 68 ANTITRUST LAW J. 145, 158 (2000).

and the software and hardware that developed around it to the uninterrupted progress and maintenance of the mainframe industry over a course of several decades through a series of IBM-controlled innovations.

This combined effect and contribution, can well be greater than the individual innovations themselves, and should be separately appreciated by anyone that studies (or attempts to regulate) IBM's strategy in the market. Just by means of an example, the persistent success of IBM's products in many European markets (on top of the American one) was a main driving force behind the creation of national programs to inhibit IBM's domination.[145] By threating over a sustained period of time to become a foreign force domestically in a sensitive industry whereon governments relied on IBM prompted them to intensify their own home-grown computer programs. This kind of spill-over effects stemming from taking a broader look at a system's evolution and continuous success and innovations, are essential in accurately evaluating new products, services, or innovations, when considering imposing restraints as to how the company behind them is allowed to manage them.

My purpose here is not to extol IBM's corporate culture or strategy. It is rather to show that IBM's product and strategy choices have generated innovations and efficiencies that, put in a continuum, form part of a system, i.e. the mainframe computer and all its evolutions, and should not be seen separately just as individual products, services or functions, because doing so would overlook the added synergistic value they have contributed to the industry by establishing and maintaining it. For this reason IBM's choices as a reflection of the company's product and institutional philosophy, should be coated with the additional element of systemic efficiencies and innovations.

V. CONCLUSION

A number of points were made in this article in hopes of assisting regulators, competition authorities and courts better assess certain practices that may appear anti-competitive if one does not account for a distinct type of efficiencies, namely systemic efficiencies. The article traced the characteristics of systemic innovations, explained why they may pose anti-competitive dangers, presented the distinctive benefits they generate which justify why they should be tolerated, and showed how they can be applied to high profile cases.

While this article hopefully made a worthwhile attempt to demonstrate the value of systemic efficiencies in competition law analysis, it also acknowledges that systemic efficiencies are in tension with the tendency of courts and authorities to require efficiencies to be specific, likely, and provable. This is a fair requirement considering that firms have a reputation for making overbroad statements regarding alleged efficiencies. However, efficiencies, in all their fuzziness, have traditionally been at the forefront of pushing the boundaries of antitrust theory and practice. As we gain a better understanding of systems and their peculiar properties due their internal complexity, we should allow these insights to be reflected in antitrust theory and practice, for otherwise we are risking banning pro-competitive strategies, the same way we did half a century ago when efficiencies were first being discovered.

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[145] CAMPBELL-KELLY AND GARCIA-SCHWARTZ, supra note 138 at 88–98.