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Granular Property Law

Recalibrating Optimal Standardization of Property Rights in the Internet of Things

Christoph Busch*

The numerus clausus principle, which limits both the number and content of property rights, has been explained by law and economics scholars as a device for reducing information costs. From this perspective, a more complex system of property rights can only be achieved at the price of less legal certainty or, in economic terms, higher information costs. However, advances of information technology could change this equation and make it possible to recalibrate the optimal standardization of property rights leading to a more granular property law. Starting from this premise, this article explores whether the emerging scholarship on "personalized law" could provide new perspectives on the future of the numerus clausus. In particular, it is examined to what extent standardization of information about idiosyncratic property rights could be an alternative to standardization of property rights in the Internet of Things.

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I. Introduction

For most European legal systems, the numerus clausus principle, which limits both the number and content of property rights, is a central pillar of property law.[1] On closer inspection, the picture becomes a bit more complex. While some legal systems have expressly enshrined the numerus clausus principle in their statutes, in other countries case law and jurisprudence derive it from the overall structure of the respective Civil Code. Differences also arise with regard to the numerous exemptions and relaxations of the numerus clausus principle. Such relaxations are found in particular in some Romanistic legal systems. In England, the principle applies seems to without restriction only in common law, but not in equity. Germany, in contast, is considered as one of the "core countries" of the numerus clausus.[2]

This article raises the question, whether the numerus clausus has a future and how it might look like. Will the limitations regarding the number and content of rights in rem also be necessary in the Internet of Things? Or does the numerus clausus lose its justification in a world full of smart objects? This article is organized as follows. Section 2 sets the scene by briefly outlining the importance of the numerus clausus principle and its two main aspects – type constraint and type fixation – under German law. Section 3 then takes a closer look at the common explanations for the numerus clausus in legal literature. Section 4 puts these explanations to a test from the perspective of German constitutional law. The result of this test reveals some initial doubts as to whether the current explanations of the numerus clausus will still be viable in the future. Finally, Section 5 argues that the wave of the future could be a "granular property law" in which the numerus clausus plays no role. In this perspective, the current standardization of property rights could be replaced by a standardization of *information* on property rights.

II. The numerus clausus principle in German property law

The limited catalogue of property rights is one of the "axiomatic foundations" of the German legal system and is firmly anchored in the minds of German lawyers.[3] The Motives for the German Civil Code (BGB) explains the function of the numerus clausus principle as follows: "The parties cannot be at liberty to confer the character of a right in rem to any right which relates to a thing. The principle of freedom of contract, which governs the law of obligations, does not apply to property law. Here, the opposite principle applies: the parties can only establish those rights permitted by the law. The number of rights in rem is therefore necessarily a limited one."[4]

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[1] For a comparative overview see Christian von Bar, Gemeineuropäisches Sachenrecht, Vol. I, 2015, para. 59 et seq.; see also Bram Akkermans, *The Principle of Numerus Clausus in European Property Law* (Intersentia 2008); Bram Akkermans, 'The numerus clausus of property rights' in Michele Graziadei and Lionell Smith (eds) *Comparative Property Law* (Elgar 2017) 100-120.

[2] Von Bar, supra note 1 at para. 64.

[3] Wolfgang Wiegand, 'Numerus clausus der dinglichen Rechte: Zur Entstehung und Bedeutung eines zentralen zivilrechtlichen Dogmas' in Gerhard Köbler (ed), *Wege europäischer Rechtsgeschichte* (Lang 1987) 623.

[4] Motive zu dem Entwurfe eines Bürgerlichen Gesetzbuches für das deutsche Reich [Motives for the Draft of a Civil Code for the German Empire], Vol. 3, 1888, 3.

Historically, the numerus clausus is closely related to the decision of the BGB in favour of undivided ownership.[5] The section from the Motives of the BGB quoted above is particularly opposed to the possibility of endowing any right with an effect in rem (ius ad rem), as was possible under the Prussian Civil Code, the *Allgemeines Landrecht* of 1794.[6] Some scholars have explained the decision of the BGB in favour of the numerus clausus principle as a an "overreaction" to the ius ad rem allowed by Prussian law.[7]

The numerus clausus principle has two dimensions: First, it limits the *number* of available property rights. In other words, only the forms provided by law are available to parties for the creation of rights in rem (*Typenzwang* or "type constraint").[8] Second, the *content* of the available rights in rem is determined by law. The parties are thus prevented from freely shaping the content (*Typenfixierung* or "type fixation"). It is important to note, however, that the numerus clausus principle only restricts private autonomy. In contrast, it does not prevent the creation of new property rights by the legislator or the courts, as illustrated by the creation of condominium ownership,[9] the land charge by way of security (§ 1192 (1a) BGB) and the recognition of the acquisition right (*Anwartschaftsrecht*).[10]

III. Explaining the numerus clausus principle

1. Protecting third parties

Different explanations for the numerus clausus of property rights have been offered.[11] The Motives of the BGB underline the autonomy of property law as opposed to the law of obligations and refer somewhat obscurely to the "essence of rights in rem".[12] Today, many scholars argue that the limitations regarding the number and content of property rights serves the purpose of protecting third parties.[13] Considering the erga omnes effect of property rights,

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[5] Alexander Hellgardt, *Regulierung und Privatrecht* (Mohr Siebeck 2016) 127; Wiegand supra note 3 at 623, 627 et seq.; Wolfang Wiegand, 'Die Entwicklung des Sachenrechts im Verhältnis zum Schuldrecht' (1990) 190 Archiv für die civilistische Praxis 112, 117.

[6] Christian Heinze, in *Staudinger*, BGB, 2018, Introduction to Property Law, para. 98; Jens Thomas Füller, *Eigenständiges Sachenrecht?* (Mohr Siebeck 2006) 373.

[7] Füller supra note 6 at 559.

[8] Heinze supra note 6 at para. 94.

[9] See Wohnungseigentumsgesetz [German Condominium Ownership Act] of 15 March 1951 (recast as of 12 January 2021), BGBl. I 34.

[10] Claus Wilhelm Canaris, Die Verdinglichung obligatorischer Rechte, in Horst Heinrich Jakobs et al. (eds) *Festschrift für Werner Flume zum 70. Geburtstag* (Schmidt 1978) Vol. I, 371, 376; Christian von Bar supra note 1 at para. 64; see also Akkermans (2008) supra note 1 at 214.

[11] See the overview at Heinze supra note 6 at para 97 et seq.; see also Holger Fleischer, 'Der numerus clausus der Sachenrechte im Spiegel der Rechtsökonomie' in: Thomas Eger et al. (eds) *Internationalization of the Law and its Economic Analysis* (Gabler 2008) 125, 127 ff; see also Bram Akkermans, *The Principle of Numerus Clausus in European Property Law* (Intersentia 2008) 436 et seq.

[12] Motive zu dem Entwurfe eines Bürgerlichen Gesetzbuches für das deutsche Reich [Motives for the Draft of a Civil Code for the German Empire], Vol. 3, 1888, 2

[13] Heinze supra note 6 at para. 99; see also Stadler in *Soergel*, BGB, 2002, Sachenrecht Einleitung [Introduction to Property Law] para. 42 (referring to legal certainty and legal clarity), Jürgen F. Baur and Rolf Stürner, *Sachenrecht* (18th edn, C.H.Beck 2009) Section 1 para. 9 (referring to the ease and security of legal transactions).

they argue, the catalogue of possible property rights must be limited and recognisable to everyone and the content of property rights must be clearly determined.[14]

Legal clarity and certainty with regard to property rights is not only necessary for parties interest in acquiring such rights. Similarly, for purposes of foreclosure proceedings and enforcement against movable property it is necessary that property rights are clearly recognisable.[15] The argumentative link between legal certainty and legal clarity also indicates that the numerus clausus principle is closely connected to the principle of the publicity of property rights.[16] From this perspective, the argument that the numerus clausus principle serves to protect third parties seems to conceal the deeper argument that the numerus clausus essentially serves to solve an information problem.

2. Reducing information costs

The informational dimension of the numerus clausus principle has also been emphasized by scholars from a law and economics perspective. In doing so, they combine the more traditional line of argument regarding the protection of third parties with arguments based on information economics. In this perspective, Merrill and Smith have pointed out that the numerus clausus helps to reduce information costs for third parties.[17] If the parties were free to establish novel and unusual property rights or "fancies", they argue, other market participants would have to go to great lengths to verify whether an object is encumbered with such an idiosyncratic right before acquiring it. The recognition of rights in rem created by parties at their own discretion thus leads to an information-related externality ("measurement-cost externalities").[18]

To illustrate their argument, Merrill and Smith famously discuss the hypothetical case of the owner of a watch granting another person a time-share in rem over the watch, allowing him to use the watch on any Monday ("Monday right"). The agreement between the parties would not only affect the specific watch concerned, but also all other watches. The purchaser of a watch would always have to check whether it is encumbered with a "Monday right" or another unusual right in rem (such as a "Tuesday right"). As a result, this increases the information costs for all parties and thus the transaction costs within the entire legal system.

In contrast, restricting rights in rem to a limited catalogue reduces information costs for other market participants and increases legal certainty. However, the price for this is a limitation of private autonomy. In this context, Merrill and Smith speak of "frustration costs" which have to be borne by the parties who are denied the creation of an idiosyncratic property right by the

[14] Heinze supra note 6 at para. 100; Jan Wilhelm, *Sachenrecht* (De Gruyter 2021), para. 13.
[15] Hellgardt supra note 5 at 132; Rüdiger Liebs, 'Die unbeschränkte Verfügungsbefugnis' (1975) 175 Archiv für die civilistische Praxis 1, 16.
[16] Christoph A. Kern, *Typizität als Strukturprinzip des Privatrechts* (Mohr Siebeck 2013) 453-54; Wilhelm supra note 14 at para. 33; J.H.M. van Erp, 'From classical to modern European property law' in Essays in Honour of Konstantinos D. Kerameus, (Bruylant 2009), Vol. I, 1517.
[17] Henry E. Merrill and Thomas W. Smith, Optimal Standardization in the Law of Property: The Numerus Clausus Principle' (2000) 111 Yale L. J. 1, 40.
[18] Merrill and Smith (2000) 111 Yale L. J. 1, 26.

legal system.[19] From this perspective, the numerus clausus principle, by limiting the number of possible property rights, seeks to strike a balance between information costs and frustration costs. The cost-benefit analysis must also take into account system costs that can arise from an excessive number of property rights.[20] For example, allowing new and unusual property rights regarding real property could overburden the land registry system and impair the clarity of the land registers.[21]

In summary, the numerus clausus marks a point of equilibrium where the advantages and disadvantages of standardizing property rights are balanced. The variations of the numerus clausus principle which have been identified by scholars of comparative property law, show that the exact location of this point of equilibrium may well vary from one legal system to another. Apparently, there is no consensus on what constitutes an "optimal standardization"[22] of property rights.

3. Preventing excessive fragmentation of property rights

Other scholars argue that the numerus clausus is primarily a means of avoiding excessive fragmentation of property rights.[23] This explanation, which also builds on an economic analysis of property law, starts from the premise that an excessive fragmentation of property rights can lead to welfare-reducing under-use of assets. If the number of persons with an entitlement is too large, a deadlock situation can easily occur, preventing the productive use of an asset. From this perspective, the numerus clausus seeks to prevent this problem, which Heller has described as the "tragedy of the anticommons".[24]

However, as Merrill and Smith have pointed out, the numerus clausus does not necessarily lead to less fragmentation, since it limits the catalogue of possible property rights, but not the number of holders.[25] In this sense, the rules on co-ownership in §§ 1008 et seq. BGB do not limit the number of co-owners.[26] Furthermore, inefficient fragmentation of ownership can ultimately be remedied by buying up the partial rights and thus reunifying ownership. Under German law this solution is facilitated by granting each co-owner the right of ownership according to § 1008 BGB in conjunction with § 749(1) BGB.[27] In individual cases, however, such an efficient consolidation can be made more difficult by the strategic behaviour of a co-owner.[28]

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[19] Merrill and Smith (2000) 111 Yale L. J. 1, 35.
[20] Fleischer supra note 11 at 135.
[21] Martin Wolff and Ludwig Raiser, *Sachenrecht* (10th edn. Mohr Siebeck 1957) 9; see also Bavarian Supreme Regional Court, 3 February 1967, Case BReg. 2 Z 63/66, (1967) Neue Juristische Wochenschrift 1373, 1374.
[22] Merrill and Smith (2000) 111 Yale L. J. 1.
[23] Michael A. Heller, 'The Boundaries of Private Property' (1999) 108 Yale L. J. 1163, 1176 et seq.; see also Hellgardt supra note 5 at 131-32.
[24] Heller (1999) 111 Harvard L. Rev. 621, 624.
[25] Merrill and Smith (2000) 111 Yale L. J. 1, 51-52; Heinze supra note 6 at 106.
[26] Fleischer supra note 11 at 134.
[27] Id. at 135.
[28] Francesco Parisi, 'Freedom of Contract and the Laws of Entropy' (2003) 10 Supreme Court Economic Review 65, 70; Klaus Ulrich Schmolke, Das Servitutenrecht des BGB aus rechtsökonomischer Sicht (2010) Zeitschrift für Wirtschafts- und Bankrecht 740, 744.

IV. A constitutional perspective on the numerus clausus principle

1. Content and limitation of property rights

As the numerus clausus principle limits the number and content of possible rights in rem, it affects not only private property law but also constitutional property law. From this perspective, one could raise the question whether the numerus clausus is compatible with the constitutional guarantee of property. It seems that this constitutional dimension has been largely absent from the debate about the numerus clausus principle, which has mainly focused on issues of private law.

There are several ways of considering the relationship between constitutional property law and private property law. One the one hand, it could be argued that "constitutional property law takes premise over private law property law in such a way that constitutional principles influence the composition of private law property law".[29] On the other hand, one could argue that the constitutional guarantee of property only applies to property rights that have been acknowledged as such by private law.

This ambivalent relationship between constitutional property law and private property law is addressed in Article 14(1) of the German Constitution, according to which the "content and limitations" of property rights are determined by the law. From this perspective, the numerus clausus principle could be considered as a "limitation" that constitutes the content of private property in the first place.[30] Only the private property rights accepted by the private law legislator are protected by the constitutional guarantee of property.[31] However, in defining the limits of property rights, private law legislators is not entirely free, but they must observe the constitutional boundaries of private law.

The discretion of the private law legislator is limited in particular by the rule of fair consideration, i.e. the requirement that "the relevant interests of the parties involved are to be brought into a just balance and equitable relationship". [32] According to Article 14(2) sentence 2 of the German Constitution, the system of the property rights must also take into account public interests ("Gemeinwohl"). The objectives of ease of legal transactions, legal certainty and protection of third parties, which are usually cited as justification for the numerus clausus principle, are such public interest concerns.[33] Similarly, the prevention of an inefficient

[29] Bram Akkermans, 'A comparative overview of European, US and South African constitutional property law' (2018) 7 European Property Law Journal 108, 112.
[30] See Rudolf Wendt, *Eigentum und Gesetzgebung* (Heitmann 1985).
[31] Hans-Jürgen Papier and Foroud Shirvani, Commentary to Art. 14 GG, in Dürig/Herzog/Scholz (eds) *Grundgesetz* (94th edn, C.H.Beck 2021) para. 417; see also German Federal Constitutional Court, 18 December 1968, Case 1 BvR 638 et al., BVerfGE, Vol. 24, 367, 396; German Federal Constitutional Court, 15 July 1981, Case 1 BvL 77/78, BVerfGE, Vol. 58, 300, 336.
[32] German Federal Constitutional Court, 19 January 1969, Case 1 BvL 3/66, BVerfGE, Vol. 25, 112, 117 et seq.; see also Papier and Shirvani supra note 31 at para. 424.
[33] Matthias Ruffert, *Vorrang der Verfassung und Eigenständigkeit des Privatrechts* (C.H.Beck 2001) 384.

fragmentation of property, which is cited by parts of the literature as justification for the numerus clausus, is also likely to be among the concerns of the common good.

2. Principle of proportionality

When implementing the above-mentioned objectives in the design of private property law, the legislator must respect the limits set by the principle of proportionality. Therefore, the application of the numerus clausus principle must be *suitable*, for attaining these objectives, and be necessary for achieving the goal, without being *excessive*. However, these general requirements of the proportionality test are somewhat relaxed as the legislator shapes the content and limitations of what constitutes a constitutionally protected property right.[34] As a consequence, the legislator has a rather wide discretion in defining the number and content of property rights.

Regarding the objective of preventing an inefficient fragmentation of property, it is already questionable whether the numerus clausus principle is at all *suitable* to serve this purpose. Since the numerus clausus only limits the number of available property rights, but not the number of possible beneficiaries, it cannot effectively limit a fragmentation of property rights. The restriction of the possible types of rights in rem could at best impose a brake on the – legally still possible – fragmentation of property rights.[35] Whether this alone is sufficient to justify the numerus clausus from a constitutional perspective seems doubtful. In contrast, justifying the numerus clausus as a tool for facilitating legal transactions, ensuring legal certainty and protecting third parties appears to be more viable. From this perspective, the decision of the private law legislator in favour of the numerus clausus principle in its current form seems to be justifiable from a constitutional point of view.[36]

3. Constitutional obligation to reassess the numerus clausus principle?

Whether the positive assessment of the constitutional admissibility of the numerus clausus principle outlined above can be upheld in the future depends on whether a limitation of the number and content of property rights will still be suitable and necessary in a world of connected and smart objects. In this respect, doubts are warranted. In particular, the explanatory model based on information economics could soon come under pressure. If the problem of "measurement-cost externalities" described by Merrill and Smith can be solved in a different way, this justification loses its persuasive power.[37] If it is true that the numerus clausus principle mainly serves as a tool for solving an information problem, technological solutions that make

[34] Ruffert supra note 33 at 385.
[35] See Merrill and Smith (2000) 111 Yale L. J. 1, 40 ("the numerus clausus imposes a brake on efforts by parties to proliferate new forms of property rights"); see also Alexander Peukert, *Güterzuordnung als Rechtsprinzip* (Mohr Siebeck 2008) 132.
[36] Thomas Regenfus, *Vorgaben des Grundgesetzes für die Lösung sachenrechtlicher Zuordnungs- und Nutzungskonflikte* (Duncker & Humblot 2013) 325; see also Dagmar Coester-Waltjen, 'Die Grundsätze der Vertragsfreiheit' (2006) Jura 436, 440.
[37] Parisi supra note 28 at 75 ("Most generally, information cost explanations lose most of their cogency as information technologies increase the possibility of real-time and inexpensive access to public records."); see also Lee Fennell, *Slices and Lumps: Division and Aggregation in Law and Live* (University of Chicago Press 2019) 101.

that make it possible to securely store and access digital information on property rights about connected objects could be a less intrusive regulatory tool. In a broader perspective, it must also be taken into consideration that the numerus clausus principle not only restricts private autonomy at the individual level, but also creates a barrier to legal innovations at the system level.[38]

These considerations raise doubts as to whether a mandatory limitation of property rights will continue to be necessary in the future to ensure the ease and security of legal transactions. From this perspective, it could be necessary to review the regulatory decision for the numerus clausus of property rights. To put it more pointedly, if technological innovation makes it no longer necessary to limit the number and content of property rights, there is a constitutional obligation to relax such restrictions on property rights. [39] In this sense, an autonomy-based private law should allow parties to "invent" their own property rights unless such arrangements entail negative external effects or affects individual rights of third parties.[40]

V. Granular property law in the Internet of Things

1. "Personalization" of property law

Doubts about the necessity of a numerus clausus of property rights have recently also been expressed by proponents of a data-driven *personalized law*.[41] The emerging discourse about a data-driven personalization of the law has its origins in US law and economics literature, but is now also influencing legal discourse in Europe. [42] The core idea of the personalization project to replace template-like regulations and legal typifications with "granular legal norms"[43] that are more precisely tailored to the specific circumstances of the individual case. Proponents of a personalized law hope that the use of information technology could redefine the optimal complexity of legal rules and refine their content to a hitherto unachievable level of granularity. Personalized legal rules could take into account actor heterogeneity to a degree impersonal laws are unable to do. As a result, regulatory inaccuracies stemming form over- and underinclusive norms based on coarse-grained typifications could be reduced. Possible use cases that are being

[38] See Otto von Gierke, *Personengemeinschaften und Vermögensbegriffe in dem Entwurfe eines Bürgerlichen Gesetzbuches* (1889) 70 (expressing concerns about an ossification of property law if the law does not allow room for "creative action").
[39] Papier and Shirvani supra note 31 at 438; see also German Federal Constitutional Court, 18 December 1968, Case 1 BvL 5 et al., BVerfGE, Vol. 25, 1, 13; German Federal Constitutional Court, 1 March 1979, Case 1 BvR 532 et al., BVerfGE, Vol. 50, 290, 335.
[40] See Hanoch Dagan, *A Liberal Theory of Property* (CUP 2021) 110-12.
[41] Omri Ben-Shahar and Ariel Porat, *Personalized Law: Different Rules for Different People* (OUP 2021) 177-78.
[42] See, in particular, Ariel Porat and Lior Strahilevitz, 'Personalizing Default Rules and Disclosure with Big Data' (2014) 112 Mich. L. Rev. 1417; Omri Ben-Shahar and Ariel Porat, 'Personalizing Negligence Law' (2016) 91 NYU L. Rev. 627; see also Christoph Busch and Alberto De Franceschi (eds) *Algorithmic Regulation and Personalized Law* (Hart 2021).
[43] Christoph Busch and Alberto De Franceschi, 'Granular legal norms: big data and the personalization of private law', in Vanessa Mak, Eric Tjong Tjin Tai and Anna Berlee (eds) *Research Handbook in Data Science and Law* (Elgar 2018) 408.

discussed include the personalization of the standard of care in tort law,[44] information duties in consumer law,[45] as well as mandatory rules[46] and default rules[47] of contract law.

The debate on whether a data-based personalization of the law is possible and desirable is taking place against the backdrop of a general trend towards data-driven "granularization" in other areas, e.g. healthcare (personalized medicine), agriculture (precision farming) and marketing (targeted advertising). Similarly, a higher level of granularity could be made possible within the legal system with the help of new technologies that enable the analysis of large amounts of data (big data) for a more targeted regulation and individual justice. It goes without saying that such a personalized law (or granular law) raises numerous and complex legal questions regarding the relationship between individuality and equality before the law or the possible trade-offs between legal certainty, individual justice and the protection of privacy, which cannot be discussed here in detail.[48] So far, most of the debate about personalized law is about how the law should deal with the heterogeneity of persons, this approach can also be applied to the question how the law could manage the heterogeneity of objects and property rights. From this perspective, talking about a "personalization" of the law (or personalized law) is probably a bit misleading. Maybe, the term "granularization" (or granular law) is more appropriate with regard to property rights.

A more granular property law that enables parties to create customized rights in rem could serve as a catalyst for new business models. Examples of possible use cases could be in rem rights regarding data collection in the Internet of Things[49] or usage rights in rem for business models of the sharing economy.[50] Other use cases could also include new forms of custom-tailored conservation rights[51] and in rem rights regarding conservation measures in the context of urban planning.[52] Allowing a numerus apertus of property rights will not necessarily lead to a boundless expansion of new types of property rights. It is rather likely that a more flexible

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[44] Ben-Shahar and Porat (2016) 91 NYU L. Rev. 627; see also the critical comment by Christian von Bar, 'Personalization of Tort Law?' in Christoph Busch and Alberto De Franceschi (eds), *Algorithmic Regulation and Personalized Law* (Hart 2021) 236.

[45] Porat and Strahilevitz (2014) 112 Mich. L. Rev. 1417; see also Christoph Busch, 'The Future of Pre-Contractual Information Duties: From Behavioural Insights to Big Data', in Christian Twigg-Flesner (ed), *Research Handbook on EU Consumer and Contract Law* (Elgar 2016) 157; Christoph Busch, 'Implementing Personalized Law: Personalized Disclosures in Consumer Law and Data Privacy Law' (2019) 86 U. Chi. L. Rev. 309 (2019); Philipp Hacker, 'Personalizing EU Private Law: From Disclosures to Nudges and Mandates' (2017) 25 Eur. Rev. Priv. L. 651.

[46] Ben-Shahar and Porat, 'Personalizing Mandatory Rules in Contract Law' (2019) 86 U. Chi. L. Rev. 225.

[47] Porat and Strahilevitz (2014) 112 Mich. L. Rev. 1417; see also the critical comment by Philip Maximilian Bender, Grenzen der Personalisierung des dispositiven Rechts, in Elena Beyer et al. (eds) *Privatrecht 2050 – Blick in die digitale Zukunft, Jahrbuch Junge Zivilrechtswissenschaft 2019* (Nomos 2020) 33.

[48] Christoph Grigoleit and Philip Maximilian Bender, 'The Law between Generality and Particularity: Chances and Limits of Personalized Law' in Christoph Busch and Alberto De Franceschi (eds) *Algorithmic Regulation and Personalized Law* (Hart 2021) 115; Marietta Auer, 'Granular Norms and the Concept of Law: A Critique', in Christoph Busch and Alberto De Franceschi (eds) *Algorithmic Regulation and Personalized Law* (Hart 2021) 155.

[49] See Benjamin Raue, 'Die Rechte des Sacheigentümers bei der Erhebung von Daten' (2019) Neue Juristische Wochenschrift 2425.

[50] See Shelly Kreiczer-Levy, *Destabilized Property: Property Law in the Sharing Economy* (CUP 2019) 134.

[51] Jaime Ubilla, 'The conservation right: a new property right for sustainability' (International Union for Conservation of Nature, 11 February 2019) <https://www.iucn.org/news/world-commission-environmental-law/201902/conservation-right-a-new-property-right-sustainability> accessed 8 March 2022.

[52] See Herbert Grziwotz, 'Die Sicherung von naturschutzrechtlichen Ausgleichsmaßnahmen' (2008) Kommunaljurist 288.

private standardization of property rights will emerge in the market in place of the legally fixed catalogue of property rights.[53]

2. Digital Twins and NFTs

A more granular property law could be made possible by technologies that are already being used today for predictive maintenance of technical systems. Predictive maintenance involves the continuous collection of machine data through the use of sensor technology in order to create a "digital twin" of a technical system, e.g. a construction vehicle. By analysing the machine data it is possible to replace standardized maintenance intervals with individual maintenance intervals for each single piece of machinery. In a certain sense, each machine is treated as a technical "individual".

Such an individualization of connected objects could also take place from a legal perspective. This would require that the digital twin of a connected object (e.g. a construction vehicle) not only stores information on the maintenance status, but also data on the property law status of the object. Accessing the data profile of the object would enable a prospective buyer to find out whether a machine is encumbered with an idiosyncratic right in rem.

For reasons of legal certainty, it would be necessary to ensure that the information on the status of the connected object is protected from manipulation. Such a secure data storage could be achieved by using non-fungible tokens (NFTs) based on blockchain technology. In simplified terms, an NFTs is a record or entry in a distributed distributed ledger representing an asset or a certain legal entitlement. [54] Such an NFT can also store information on whether idiosyncratic property rights exist in an off-ledger object – for example, in a machine represented by the NFT. To be clear, in the model outlined here, the NFT does not convey a property right in the object represented by the token, but merely documents it in a tamper-proof manner. In other words, the NFT only fulfils a register function.[55] In this respect, the approach described here differs somewhat from even more far-reaching considerations for a tokenization of assets and a "tokenized" private law.[56]

In order to protect the interests of third parties, it is not only necessary to protect information about property rights against manipulation. The ease of transactions and legal certainty also require that the information about the property law status of connected objects is available in a

[53] See Merrill and Smith (2000) 111 Yale L. J. 1, 45 et seq.; but see Kern supra note 16 at 508 (doubting the efficiency of market-based governance).
[54] Jonathan Tobler, 'Non-fungible Tokens – Einsatzmöglichkeiten aus Sicht des deutschen Rechts' in Jürgen Taeger (ed) Tagungsband Herbstakademie 2021, Deutsche Stiftung für Recht und Informatik (OlWiR 2021) 251, 252 et seq. (on technical aspects of NFTs).
[55] See Tobler supra note 53 at 262 et seq. Another use case that is currently being examined as part of a pilot project by the German Federal Chamber of Notaries in cooperation with the Bavarian Ministry of Justice and the Fraunhofer Institute concerns the a blockchain-based register for notarial powers of attorney and certificates of inheritance. For more information see the press release of the Bavarian State Ministry of Justice of 26 May 2020 available at: https://www.justiz.bayern.de/presse-und-medien/pressemitteilungen/archiv/2020/42.php.
[56] See Julia von Buttlar and Sebastian Omlor, 'Tokenisierung von Eigentums-, Benutzungs-, Zutritts- und Pfandrechten' (2021) Zeitschrift für Rechtspolitik 169; see also Sebastian Omlor, 'Elektronische Wertpapiere nach dem eWpG' (2021) Recht Digital 371.

digital and standardized format. In this sense, the standardization of property rights, stipulated by the numerus clausus principle, would have to be replaced by a standardization of information about property rights. This could be achieved by defining legal requirements for the content of digital twin NFTs. A possible model is provided by Section 17 of the German Electronic Securities Act, which contains specifications for information stored in the crypto securities register.[57] As an alternative, the creation of a technical standard for property law-related information in cryptographic registers could be considered.[58]

VI. Summary

1. The numerus clausus principle, which limits the number and content of property rights, is in need of justification as it restricts private autonomy. For many property law scholars, the numerus clausus is mainly based on legal-economic reasons. From this perspective, the standardization of property rights primarily serves to reduce the complexity of the property law system and contributes to lowering information costs.

2. The digital transformation creates new possibilities for collecting and processing data regarding property rights in connected objects. In the Internet of Things, the commonly used justification for the standardization of property rights based on information economics loses its persuasive power. If the numerus clausus no longer proves to be necessary and appropriate for the protecting third parties against prohibitively high information costs, the legislative decision in favour of a closed list of property rights needs to be reviewed.

3. In the near future, "digital twins" could make it possible to securely store and easily access information about idiosyncratic property rights in connected objects. This could make it possible to abandon the numerus clausus in the Internet of Things in favour of a "granular property law". For the benefit of legal certainty and the ease of transactions, the standardization of property rights could be replaced by a standardization of information about property rights.

[57] See Matthias Lehmann, 'Das Gesetz zur Einführung von elektronischen Wertpapieren' (2021) Neue Juristische Wochenschrift 2318, 2322 et seq.; see also Omlor supra note 55 at 374 et seq.
[58] The Ethereum standard ERC-721 for NFTs could serve as a model (https://eips.ethereum.org/EIPS/eip-721). A similar standard could also be developed within the framework of ISO/TC 307 (Blockchain and distributed ledger technologies).