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A Model of Quantum-Technology Law for Understanding the Essence of Norms in Intellectual Property

1. Introduction

In legal scholarship, a *model* is usually defined as a conceptual representation of a given legal phenomenon devised for a specific research objective and built upon selective, simplifying elements and assumptions.[1] Such a representation operates as a tool for acquiring knowledge about the legal phenomenon under scrutiny. A model also provides an indirect means of apprehending particular legal norms while clarifying the principles used to interpret concrete legal provisions. Within legal research, models make it possible to determine whether the legal status *de jure* corresponds to its *de facto* application and to identify how any discrepancies might be remedied, for example through *de lege lata* critique or *de lege ferenda* proposals.[2]

This article evaluates the value of modelling in the legal sciences and explains how the term model differs semantically from *system*, *theory*, *postulate*, and *standard*. It then sets out the elements and research questions that a model of quantum-technology law in the field of intellectual property should address. Finally, it underscores the need to construct such a model and outlines the functions it could perform within the domain of intellectual property law.

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[1] T. Langer, "O pewnych aspektach stosowania modeli w prawoznawstwie," *Zeszyty Naukowe Wydziału Prawa i Administracji Uniwersytetu Gdańskiego* 1982, no. 5–6; *idem*, "O modelach i modelowaniu w naukach prawnych," *Państwo i Prawo* 1987, issue 9, p. 40; H. Wolska, *Model relacji pomiędzy krajowymi organami administracji publicznej a przedsiębiorcami*, Warszawa 2022, p. 11; J. Wróblewski, "Stosowanie prawa (model teoretyczny)," *Państwo i Prawo* 1967, issue 3, p. 377.

[2] See: H. Wolska, "Model jako forma poznania w naukach prawnych," *Forum Akademickie* 2024, vol. 31, no. 9, pp. 37–39.

2. Model Viewed Against Other Legal Terms

The term model appears in almost every sphere of human activity. In everyday language it is often equated with a standard of perfection – something that ought to exist, and to which one should aspire. It commonly denotes an ideal, a prototype, or an example. The word is also used to describe a theory structurally analogous to another theory, and sometimes to mark resemblances between systems, postulates, or a preliminary sketch.[3]

The Great Dictionary of the Polish Language defines model, *inter alia*, as "a pattern according to which something is or is to be made; a construction, scheme or description that shows the operation, structure, features or interdependencies of a phenomenon or object; or an object that is a copy of something, usually produced in smaller dimensions."[4] The Encyclopaedia of Management offers two cognate meanings: first, a set of assumptions adopted in a discipline to facilitate the solution of a research problem; and second, a hypothetical mental construct, a simplified image of a fragment of reality from which elements irrelevant to the scholarly aim are omitted.[5]

From the standpoint of legal studies, however, a model differs from the concepts system, theory, postulate, and standard. More specifically, model is semantically narrower than system of law. While a system of law comprises a full set of binding provisions, principles, rules, general clauses, and legal theories, a model captures only simplified and fragmentary legal constructs selected for analytical purposes. Consequently, a model ought to be regarded as just one constituent element of the broader legal system.

The chief distinction between a model and a theory lies in the level of abstraction. Legal models rely on simplifications, and sometimes on concepts detached from current doctrine, whereas theories consist of tightly and logically interconnected propositions grounded in detailed objectively observed laws and intended to reflect proven relationships in reality. A postulate is best understood as a proposal that points to the ways in which legal norms should be organised, interpreted, or created; in other words, it is a suggestion for possible future action within the legal order. A model, by contrast, offers a simplified portrayal of the properties of a concrete legal phenomenon, whether current or hypothetical. A postulate may, therefore, constitute just one element of a model (for instance, by indicating the need to amend or supplement a particular component), but it is never synonymous with the model in

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[3] H. Wolska, *Model relacji…*, pp. 13–14; M. Żytkow, "Pojęcie modeli w naukach formalnych i empirycznych," *Studia Filozoficzne* 1972, no. 7–8, p. 89.

[4] „Wzór, według którego coś jest lub ma być wykonywane; konstrukcja, schemat lub opis ukazujący działanie, budowę, cechy, zależności jakiegoś zjawiska lub obiektu; lub przedmiot będący kopią czegoś, wykonany zwykle w mniejszych rozmiarach" – *Wielki słownik języka polskiego PWN (h–n)*, ed. S. Dubisz, Warszawa 2018, p. 935. All quoted dictionary definitions are taken from Polish-language sources; unless otherwise indicated, the translations into English are the authors' own.

[5] A. Sulima, A. Wilczyńska, "Model" [in:] *Encyklopedia zarządzania*, mfiles.pl/pl/index.php/Model [accessed: 13.05.2025].

its entirety. Standards, for their part, refer to ideal or otherwise desired states of affairs, whereas models merely represent the phenomenon under study in a reduced form. Consequently, a model may fall within the ambit of a given standard or lie outside it, and standards can function as benchmarks or goals to be pursued.[6]

Despite these distinctions, the WSJP entries for model, postulate, theory, system and standard reveal a semantic kinship that explains why the terms are sometimes used interchangeably.[7] The dictionary defines postulate as "a thesis that requires no proof and serves as a starting point for proving other assertions;"[8] it defines theory as "a conception based on the cognition and understanding of the essential factors shaping a given sphere of reality;"[9] it defines system as "a set of interconnected elements, having a defined structure and constituting an ordered whole;"[10] and it defines standard as "an average norm, typical form or product that meets specified requirements."[11] These notions may therefore be regarded as near-synonyms belonging to the same family of meanings. Such a family is not "[…] a set of objects characterised by a group of features common to all elements of that set and only to them; rather, it is a series of subsets linked only by partial similarities that together form a family of subsets. That family corresponds to a family of meanings, which constitutes the sense of the concept. In the course of its development the range covered by a concept with a family of meanings may expand to include new subsets or conversely split into separate ranges that are subsequently assigned distinct terms."[12]

3. A Model of Quantum-Technology Law

The rapid development of quantum technologies has created an urgent need for guidance capable of addressing the distinctive challenges these technologies pose. Today, scholars of law, physics, and computer science, as well as legislators in many jurisdictions,[13] are grappling with the task of adapting existing legal frameworks to

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[6] H. Wolska, "Model jako forma poznania naukowego. Próba zdefiniowania," *Prawo i Więź* 2023, vol. 45, no. 2, pp. 57–58.

[7] The original Polish entries concern the terms: *model*, *postulat*, *teoria*, *system*, and *standard*.

[8] „Teza niewymagająca dowodu, stanowiąca punkt wyjścia i podstawę w dowodzeniu innych twierdzeń", *Wielki słownik języka polskiego PWN (o–q)*, ed. S. Dubisz, Warszawa 2018, p. 786.

[9] „Koncepcja oparta na poznaniu i zrozumieniu istotnych czynników kształtujących pewną sferę rzeczywistości", *Wielki słownik języka polskiego PWN (r–t)*, ed. S. Dubisz, Warszawa 2018, p. 833.

[10] „Układ powiązanych ze sobą elementów, mających określoną budowę i stanowiący uporządkowaną całość" – *ibid.*, p. 650.

[11] „Przeciętna norma, przeciętny typ, model, wyrób odpowiadający określonym wymogom" – *ibid.*, p. 540.

[12] M. Rodzynkiewicz, *Modelowanie pojęć w prawie karnym*, Kraków 1998, pp. 10–11; T. Pawłowski, *Tworzenie pojęć w naukach humanistycznych*, Warszawa 1986, p. 121.

[13] United States: National Quantum Initiative Act (Public Law No. 115–368, 21 December 2018); European Union: Quantum Manifesto for Quantum Technologies (10 March 2016; United Kingdom: National Quantum Strategy (15 March 2023); Australia: National Quantum Strategy (3 May 2023);

a new technological era, the so-called second quantum revolution, understood as the shift from observing quantum effects to engineering and controlling them for practical technologies.[14] Meeting that task requires a comprehensive yet flexible system of regulation, including in the field of intellectual property, one that accommodates the often-conflicting interests of diverse stakeholders. On the one hand, such a system must secure the rights of inventors and owners of quantum-technology solutions through the broadest possible protection of their intellectual assets; on the other, it should guarantee society wide access to cutting-edge technologies in a spirit of dissemination and public benefit.[15]

The proposed model must therefore lay down clear guidelines, principles and standards, including ethical ones, governing the operation of quantum technologies in an IP context. At present, no coherent legal concept of quantum-technology regulation exists in this domain. Any such model should rest on an interlocking set of elements shaped not only by technical factors (rooted in physics and informatics) but also by axiological, political, and normative considerations. Those elements will determine the web of relationships and dependencies that characterises research into intellectual property; their integration, in turn, will make it possible to articulate the salient features of a body of law designed for quantum technologies within the IP sphere.

The regulatory difficulty is not limited to missing rules. Quantum technologies are built on physical phenomena that have no straightforward analogue in classical engineering (for example, superposition, entanglement, and measurement disturbance).[16] This creates a knowledge gap between (i) the technical distinctions that determine how quantum systems actually work and (ii) the legal concepts used to classify, protect, and disclose innovations. In intellectual property law, that gap matters because doctrinal thresholds such as enablement, sufficiency of disclosure, inventiveness, and the patent-trade secret boundary are all sensitive to how an invention is described, reproduced, and scaled.[17]

Accordingly, the model must address both normative gaps (insufficient or ill-fitting legal rules) and epistemic gaps (insufficient legal-operational understanding of quantum technical concepts that determine how IP doctrines apply).

Canada: National Quantum Strategy (13 January 2023); Japan: Strategy of Quantum Future Industry Development (April 2023).

[14] I.H. Deutsch, "Harnessing the power of the second quantum revolution," *PRX Quantum* 2020, vol. 2, no. 1, 020101.

[15] D. Glaza-Jankowska, "Przegląd wybranych zagadnień prawnych związanych z rozwojem technologii kwantowych: wyzwania i aspekty regulacyjne," *Studia Prawa Publicznego* 2024, vol. 47, no. 3.

[16] E. Perrier, M. Aboy, "Quantum Information Technology and The Law," SRNN, 16 October 2025, https://ssrn.com/abstract=5616510 [accessed: 14.01.2026].

[17] G. Lenarczyk, T. Minssen, M. Aboy, "IP in Superposition: Patents, Trade Secrets and Open Innovation in Quantum Information Technology," SRNN, 22 July 2025, https://ssrn.com/abstract=5363171 [accessed: 14.01.2026].

A model of quantum-technology law for intellectual property ought, at minimum, to answer the following research questions:

RQ1: What legal gaps are present in the current corpus of law with respect to quantum technologies?
RQ2: Which guidelines, principles, and standards, including ethical ones, should condition the operation of quantum technologies? Should they follow the template of the Ethics Guidelines for Trustworthy Artificial Intelligence (8 April 2019)[18] or analogous instruments?
RQ3: How can quantum technology and its components be defined and described, for IP purposes, in language accessible to lawyers and legislators?
RQ4: What international legal frameworks may be required to govern the global impact of quantum technologies?
RQ5: In what ways can different jurisdictions co-operate to harmonise regulation of quantum technologies?
RQ6: Which forms of intellectual-property protection are appropriate for quantum-technology outputs?
RQ7: What patenting and licensing issues must be addressed in the quantum-technology sector?
RQ8: Which regime of trade-secret or know-how protection should apply to quantum technologies and their components?

To date, legal doctrine has not attempted to construct a specific model of quantum-technology law, still less to specify its features in the field of intellectual property. Yet the second quantum revolution is highlighted with increasing frequency at international conferences. At the European Quantum Technology Conference in Hanover (16–20 October 2023), organisers and speakers noted the striking progress made since 2021. Professor Dr Michèle Heurs, co-chair of the EQTC organising committee and head of the Quantum Control group at Leibniz University in Hannover, observed that "not only is basic research in quantum technologies flourishing, but first approaches and prototypes are already being tested worldwide […] This field already matters greatly to our everyday lives – and its impact may soar in future." Dr Gustav Kalbe, acting director for Digital Excellence and Scientific Infrastructure at the European Commission's DG CONNECT, added: "Quantum is a game-changer for Europe."[19]

A well-constructed model of quantum-technology law could therefore inaugurate a process of legal standardisation through which international and domestic jurisdictions shape rules for the quantum domain. In the intellectual-property context such a model must be developed through sustained dialogue between lawyers and quantum physicists.

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[18] European Commission, *High-Level Expert Group on Artificial Intelligence. Ethics Guidelines for Trustworthy AI*, Brussels, 8 April 2019, https://ec.europa.eu/newsroom/dae/document.cfm?doc_id=60419 [accessed: 21.05.2025].

[19] Quantum Flagship, *EQTC 2023: Europe's Quantum Sector to Showcase Research & Business Successes and Its Roadmap to Global Leadership*, 12 October 2023, https://qt.eu/news/2023/2023-10-12_EQTC2023-press-release [accessed: 18.05.2025].

4. Functions of a Model of Quantum-Technology Law

In scholarly work, models serve a range of purposes, most notably explanatory, heuristic, and representational ones. The explanatory function consists in interpreting reality and identifying the causes of observed phenomena. Models devised by researchers help elucidate how various mechanisms operate, including those of a legal nature. They likewise act as cognitive tools – useful, for instance, in grasping legal norms – which gives them considerable didactic value, for they offer a synthetic portrayal of the current state of knowledge about a given subject and the rules that govern it. The explanatory role also manifests itself in the possibility of drawing analogies between different groups of phenomena, a process that, in turn, facilitates the discovery of their internal structure.[20] This belongs to the realm of indirect cognition, in which the objects analysed (legal phenomena) are not identical but share common features.[21] Finally, academic models can yield, by means of deductive reasoning, findings that would otherwise remain out of reach because of data gaps, insufficient legal regulation, or limitations in theoretical insight.[22]

In the quantum-technology context, the explanatory function of a model can illuminate how every stratum of the intellectual-property ecosystem is being reshaped.[23] By charting the sharp rise in quantum-computing patents such models expose where trade-secret protection is giving way to disclosure and where future patent thickets may emerge. A recent landscape analysis records a ten-fold growth in quantum-related grants since 2001, with more than half of all current applications now embedding quantum concepts in their independent claims.[24] In parallel, the looming reality of Shor-enabled decryption forces lawmakers to revisit the equilibrium between exclusivity and diffusion, turning post-quantum cryptography from a technical preference into a regulatory necessity.[25] An explanatory model therefore helps forecast doctrinal shifts, such as a possible recalibration of the inventive-step threshold for quantum algorithms or the creation of targeted carve-outs for quantum-

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20 Z. Hajduk, "Pojęcie i funkcja modelu," *Roczniki Filozoficzne* 1972, vol. 20, issue 3, p. 111.

21 P. Sztompka, "O pojęciu modelu w socjologii," *Studia Socjologiczne* 1968, no. 1, p. 40.

22 H. Wolska, *Model relacji*…, p. 11.

23 In this article, "the intellectual-property ecosystem" refers to the interacting set of IP entitlements (patents, trade secrets/know-how, copyright and related rights), institutions (patent offices, courts, standard-setting bodies), and market practices (licensing, defensive publication, standardisation) through which technological knowledge is appropriated, disclosed, transferred, and diffused. Using an ecosystem framing helps connect legal norms at different levels, namely hard-law rules, interpretive principles (for example, disclosure and inventive-step standards), and soft-law commitments (for example, standard-setting licensing undertakings), which together shape innovation incentives and access.

24 M. Aboy, T. Minssen, M. Kop, "Mapping the Patent Landscape of Quantum Technologies: Patenting Trends, Innovation and Policy Implications," *IIC – International Review of Intellectual Property and Competition Law* 2022, vol. 53, no. 6, pp. 853–882.

25 K. Balarabe, "Quantum Computing and the Law: Navigating the Legal Implications of a Quantum Leap," *European Journal of Risk Regulation* 2025, vol. 16, no. 2, pp. 1–20.

safe encryption, before market practice hardens. And, by analogy with the digital revolution, the model enables cross-temporal comparison: just as semiconductor miniaturisation spurred new IP doctrines around software and chip-layout rights,[26] quantum error-correction and entanglement may demand *sui generis* protection or revised disclosure norms. In short, a robust explanatory model does more than describe; it anticipates the legal adaptations essential for safeguarding innovation and competition in the quantum era.

The heuristic function of a model concerns the discovery of new facts and the relationships that bind them together. A well-grounded model serves as a cognitive instrument for analysing legal phenomena and, at the same time, as a source of knowledge about those phenomena.[27] In this capacity, models assist the practical deployment of theory: they enable researchers to test whether underlying premises and resulting propositions are mutually consistent, to decide whether the chosen assumptions are both necessary and sufficient, and to arrange propositions according to their degree of generality. When a theory proves too intricate to be applied directly to a particular class of phenomena, scholars frequently turn to a model derived from that theory.[28]

Quantum technologies are advancing at such speed that a heuristic model of quantum-technology law would assist in spotting emergent IP questions before they harden into problems. Foremost among these is whether core patent doctrines – the definition of invention, thresholds of novelty, and an inventive step – may need adjustment for quantum outputs whose inventive concept rests on phenomena (superposition, entanglement) that have no classical counterpart. A heuristic model lets policymakers run what-if simulations: for example, whether narrowing the enablement standard for quantum error-correction claims would still comply with the Trade-Related Aspects of Intellectual Property Rights (TRIPS) article 27's technology-neutral mandate[29] and evaluate knock-on effects for disclosure incentives, venture financing, and open science. It could likewise expose regulatory frictions at the edges of IP: export-control rules that already treat certain qubit architectures as dual-use goods, or data-protection statutes that must integrate post-quantum cryptography timelines.[30] By iterating such hypothetical scenarios, the model not only enriches the fact base but guides doctrinal fine-tuning while quantum innovation is still malleable.

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[26] See: Council Directive 87/54/EEC of 16 December 1986 on the legal protection of topographies of semiconductor products (OJ L 24, 27.1.1987, p. 36), creating an EU-wide layout-design right.

[27] Z. Hajduk, "Pojęcie i funkcja modelu…," p. 113.

[28] M. Mazurek, "Modele teoretyczne," *Filozofia i Nauka. Studia Filozoficzne i Interdyscyplinarne* 2015, vol. 3, p. 151.

[29] See: TRIPS Article 27(1): "patents shall be available for any inventions, whether products or processes, in all fields of technology, provided that they are new, involve an inventive step and are capable of industrial application." Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS), 15 April 1994.

[30] M. Aboy, T. Minssen, M. Kop, "Mapping the Patent Landscape…," note 23.

The representational role of a model is to mirror a given legal system, relying on structural similarity between the model and the phenomenon under study.[31] Scholarship distinguishes two variants: the model may act as a close approximation of reality, or as an idealised construct that simplifies a complex legal architecture.[32] Applied to quantum technologies, a representational model can map the lattice of relationships linking patents, trade secrets, copyright (for quantum-control software), defensive publications, and Standards-Essential Patents (SEPs) to the varying levels of disclosure demanded by quantum R&D. For example, a model that traces how increasing qubit fidelity shifts the optimal point from secrecy to patenting, or how SEPs and associated Fair, Reasonable, and Non-Discriminatory (FRAND) commitments, that is, commitments to licence on fair, reasonable and non-discriminatory terms, interact with export-control licences, offers regulators a concise, systems-level dashboard. Such a model also clarifies where classical precedents continue to be valid and where quantum-specific carve-outs may be needed. In this sense the model functions as an economic representation of the law/technology interface, capable of being rendered as flow-charts or dependency diagrams that decision-makers can manipulate when drafting legislation or negotiating international standards.

To sum up, intellectual property law employs models to deepen understanding (an explanatory function), to uncover new regulatory frontiers (a heuristic function), and to depict intricate protection systems (a representational function). In the quantum-technology context, such a model would help analyse how these breakthrough technologies shape the architecture and effectiveness of IP-protection mechanisms.

5. Concluding Remarks

Quantum technologies have quickly become one of the most formidable challenges facing contemporary legal systems, above all in the domain of intellectual-property protection. Their advance calls for fresh approaches to norm-creation and, in many cases, a re-definition of existing legal institutions. Against that background, a well-designed model of quantum-technology law can play a pivotal role: it is a tool for understanding, analysing, and ultimately shaping the applicable rules. By systematising an otherwise highly interdisciplinary field, the model makes it easier to identify gaps in current regulation, to propose coherent guidelines for future law-making, and to formulate *de lege ferenda* recommendations.

Such a model would combine explanatory, heuristic, and representational functions. It would aid interpretation of new phenomena, set the agenda for further research, and map the structural interdependencies within the intellectual-property system. By factoring in the distinctive features of quantum technologies – their impact

[31] P. Sztompka, "O pojęciu modelu…," p. 42; W. Ławniczak, *O różnych pojęciach modelu*, Poznań 2011, p. 63.

[32] W. Ławniczak, *O różnych pojęciach modelu*…, p. 118.

on patents, trade-secret practice, or information-processing methods – the model would support the construction of a consistent body of doctrine that recognises the global reach of such technology.

In light of the foregoing, developing a model of quantum-technology law for intellectual property is not merely desirable; it is essential. It can serve as a springboard for future legislative work, facilitate international harmonisation, and foster a constructive dialogue among the legal, scientific, and technological communities. Only on the basis of such an interdisciplinary approach can we secure effective, equitable, and proportionate protection for quantum technologies, ultimately to the benefit of both innovators and society at large.

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Summary

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A Model of Quantum-Technology Law for Understanding the Essence of Norms in Intellectual Property

The accelerating second quantum revolution is transforming encryption, sensing, and computation. There exists, however, no coherent legal framework for the intellectual-property (IP) issues it raises. This article proposes a model of quantum-technology law as a structured method for analysing and, ultimately, guiding regulatory responses. It first clarifies model in jurisprudence, separating it from related terms, such as system, theory, postulate and standard. Whereas a system of law covers the full body of binding norms, a model is a selective, simplified representation designed for research, sometimes containing postulates but never reducible to them, and capable of sitting within or outside prevailing standards.

Drawing on that conceptual groundwork, the article sketches an abstract model tailored to quantum technologies in the IP domain. It identifies eight core research questions spanning doctrinal gaps, definitional challenges, cross-border harmonisation, and the calibration of patent, trade-secret, and licensing rules. The model is deliberately interdisciplinary, weaving together technical, axiological, political, and normative factors, so as to capture the web of dependencies that characterise quantum innovation.

The analysis then turns to the three classic functions a model can perform, showing how each gains quantum-specific relevance. Explanatory modelling traces empirical trends – such as a ten-fold rise in quantum-computing patents since 2001 – and flags pressure points like post-quantum cryptography. Heuristic modelling enables what-if simulations to test whether core patent doctrines might need recalibration for inventions based on superposition or entanglement and reveals frictions at the edges of IP, from export-control rules to data-protection timelines. Representational modelling maps the lattice that links patents, trade secrets, copy-

right, standards-essential patents, and disclosure obligations, giving regulators a systems-level overview and indicating when quantum-specific carve-outs – safe harbours for error-rate data, for instance – could be warranted.

The article concludes that developing a quantum-technology-law model is not merely desirable but essential. Such a model would act as a springboard for legislation, ease international alignment, and sustain dialogue among the legal, scientific, and technological communities, ensuring that IP protection remains effective, equitable, and proportionate as quantum technologies mature.

Keywords: model, system, theory, postulate, standard, quantum technology, intellectual property.

Streszczenie

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Model prawa technologii kwantowej służący zrozumieniu istoty norm dotyczących własności intelektualnej

Druga rewolucja kwantowa stawia współczesne systemy prawne, a zwłaszcza prawo własności intelektualnej (IP), przed wyzwaniami, których nie da się rozwiązać w ramach dotychczasowych konstrukcji dogmatycznych. W artykule przedstawiono koncepcję modelu prawa technologii kwantowych jako narzędzia systematyzującego badania nad regulacjami IP w tej dziedzinie. W pierwszej kolejności wyjaśniono znaczenie pojęcia „model" w naukach prawnych i odróżniono je od bliskoznacznych terminów, takich jak: „system", „teoria", „postulat" oraz „standard". Model określono jako uproszczoną, celową reprezentację zjawiska prawnego, która może obejmować postulaty, lecz nie sprowadza się do nich i może funkcjonować zarówno wewnątrz, jak i poza obowiązującymi standardami normatywnymi.

Następnie zaproponowano abstrakcyjny model odnoszący się do technologii kwantowych w sferze IP oraz sformułowano osiem kluczowych pytań badawczych, obejmujących luki dogmatyczne, problemy definicyjne, harmonizację transgraniczną oraz dostosowanie różnych mechanizmów ochrony (patentów, tajemnicy przedsiębiorstwa, *know how*). Konstrukcja modelu ma charakter interdyscyplinarny: łączy czynniki techniczne (fizyka, informatyka), aksjologiczne, polityczne i normatywne, aby uchwycić złożoną sieć zależności determinujących innowacje kwantowe.

W dalszej części omówiono trzy klasyczne funkcje modelu i ich szczególne znaczenie w kontekście kwantowym. Funkcja wyjaśniająca pozwala analizować trendy empiryczne – m.in. dziesięciokrotny wzrost liczby patentów kwantowych od 2001 r. – oraz identyfikować newralgiczne punkty, takie jak kryptografia post-kwantowa. Funkcja heurystyczna umożliwia symulacje służące ocenie, czy definicje stosowane w prawie własności przemysłowej należy dostosować do wynalazków opartych na superpozycji lub splątaniu, a także ujawnia napięcia na styku IP i takich obszarów, jak regulacja kontroli eksportu czy ochrona danych. Funkcja reprezentująca odzwierciedla relacje między patentami, patentami koniecznymi do spełnienia normy (SEP), tajemnicą przedsiębiorstwa, prawami autorskimi a poziomem ujawnienia wiedzy, oferując decydentom klarowny obraz wzajemnych zależności w systemie i wskazując, kiedy celowe może być wpro-

wadzenie szczególnych odstępstw – np. ustanowienie „bezpiecznej przystani" (*safe harbour*) dla udostępniania danych o współczynnikach błędów.

Autorki konkludują, że wypracowanie modelu prawa technologii kwantowych w obszarze własności intelektualnej jest zasadne i niezbędne. Model ten może stać się punktem wyjścia dla przyszłej legislacji, ułatwić międzynarodową harmonizację oraz zainicjować trwały dialog między środowiskami prawniczymi, naukowymi i technologicznymi, zapewniając skuteczną, sprawiedliwą i adekwatną ochronę innowacji kwantowych.

Słowa kluczowe: model, system, teoria, postulat, standard, technologie kwantowe, własność intelektualna.