

REAL ESTATE TRENDS: TITLE AND BLOCKCHAIN TECHNOLOGY

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This article discusses how blockchain technology could revolutionize real property title record-keeping, or not. It begins with a brief history of property transfers and title registry in the United States, followed by a basic overview of blockchain technology. Then it outlines how title is typically recorded today, including the role of traditional grantor-grantee indexes, plus less common tract indexes. It describes common title problems, often caused by human error, and exacerbated by an outdated system, together with an explanation of how blockchain and even tract indexes could eliminate or mitigate many title problems and simplify an antiquated system. The article shares various agencies' studies and experiences using blockchain for land transfers or title registry, and lessons learned. That leads to a broader discussion of blockchain benefits and drawbacks for title registries. It concludes that the costs associated with making a wholesale transition to blockchain does not presently justify such transition, even though blockchain has the potential to simplify indexing, enhance security, and reduce title errors. However, many problems could be avoided or resolved through uniform adoption of tract indexes which would require universal adoption of e-recording and digital documents.

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I. A BRIEF HISTORY OF THE UNITED STATES PROPERTY TRANSFER AND TITLE REGISTRY SYSTEM

To understand the problems examined in this article and how blockchain could present a potential solution, this Section starts with a history of property transfers and recording systems. The United States adopted much of its property law regime from England.¹ However, unlike England, which developed its land transfer and recording system in a somewhat haphazard fashion by tying transfers to grants from the Crown and feudal incidents,² processes for property acquisition and title registry were already in place by the time the United States was founded.³ A history of the Land Ordinance of 1785 noted that “[t]he colonial governments, proprietors and companies had several systems for disposing of land and methods by which legal title to the land was held.”⁴ For example, in New England, the “practice was to survey land in ordered blocks before settlement, then sell the blocks.”⁵

In the colonies, a purchaser presented a warrant to the official surveyor who inspected the land and if assured there were no prior claims, the surveyor conducted a metes and bounds survey then upon the claimant’s payment, issued and recorded a deed.⁶ In the south, land was also surveyed through metes and bounds, but also by reference to natural markers which

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1. Percy Bordwell, *English Property Reform and its American Aspects*, 37 *YALE L. J.* 1, 13–14 (1927); Francis R. Crane, *The Law of Real Property in England and the United States: Some Comparisons*, 36 *IND. L. J.* 282, 282 (1961); see Henry Upson Sims, Notes on Codifying Real Property Law in the United States, 36 *HARV. L. REV.* 987, 993–94 (1923).

2. W. W. Lucas, *The Crown and Private Rights*, 27 *JURID. REV.* 45, 68 (1915) (“[T]he onus of proving . . . title to land is thrown upon the Crown, as against a subject who has . . . [possessed the] land.”); see William E. Burby, *Handbook of the Law of Real Property* 1 (1965) (“The feudal system in England [created] a vast structure of land tenure in which the king was lord paramount.”). Notable differences in recording practices remain between England and the United States. For example, “[i]n the United States, except in the few registered title areas, recording is universal. . . . In England[,] recording of deeds has been confined to two counties, Middlesex (1705–1936 when it was replaced by registration of title) and Yorkshire (since 1705).” Crane, *supra* note 1, at 289–290.

3. See C. ALBERT WHITE, U.S. DEP’T OF THE INTERIOR, BUREAU OF LAND MGMT, A HISTORY OF THE RECTANGULAR SURVEY SYSTEM 5 (1983).

4. An Ordinance for Ascertaining the Mode of Disposing of Lands in the Western Territory (May 20, 1785); see generally WHITE, *supra* note 3.

5. SHARON M. HANES & RICHARD C. HANES, SHAPING OF AMERICA, 1783–1818: PRIMARY SOURCES 16 (Lawrence W. Baker Project ed., 2006); see also WHITE, *supra* note 3, at 8.

6. WHITE, *supra* note 3, at 9.

changed with time, thus creating uncertainty.⁷ Although not uniform, land transfer and recording systems were in place early in U.S. history.⁸ However, the hodgepodge of incompatible systems became increasingly problematic, and many were terminated after the American Revolution.⁹ Following the Revolutionary War, the Land Ordinance Act of 1785 formalized land surveying for the western territories.¹⁰ Even though it was limited to lands ceded to the United States, its system created uniformity, including how to establish townships.¹¹ Under the Act, surveyors created townships of six square miles, divided into thirty-six (36) one square mile sections.¹² Providing much needed consistency, “the Land Ordinance firmly established a system of land tenure, land acquisition and government. . . . For the most part, it ended the territorial and private boundary disputes, which alone would have made the effort all worthwhile.”¹³ While imperfect, it nonetheless established an orderly system for transferring land and recording property ownership and interests.

As the country developed, property matters became largely a matter of state, rather than federal concern.¹⁴ Utilizing their police power, states could delegate authority for real property transactions, including title registry, to counties.¹⁵ Fast forwarding to the present, two title indexing systems have emerged, with numerous variations among the over 3,243 counties in the United States.¹⁶ As noted, “the U.S. real property recording

7. See generally HANES & HANES, *supra* note 5 (“[B]uyers decided on the precise boundaries of the land they wanted and then had the land officially surveyed along those boundaries. Boundary points were natural markers such as trees and larger rocks.”).

8. See, e.g., WHITE, *supra* note 3, at 8–11. The systems admittedly were imprecise, resulting in numerous conflicting land claims. See generally HANES & HANES, *supra* note 5.

9. See WHITE, *supra* note 3, at 5.

10. See generally PAUL W. GATES, HISTORY OF PUBLIC LAND LAW DEVELOPMENT 51–55, 61–63 (1968).

11. See An Ordinance for Ascertaining the Mode of Disposing of Lands in the Western Territory, *supra* note 4.

12. See *id.* Four lots per township were reserved for the United States to sell in the future, and one central lot was reserved for public school purposes. WHITE, *supra* note 3, at 15.

13. WHITE, *supra* note 3, at 16.

14. See, e.g., JOHN G. SPRANKLING & RAYMOND R. COLETTA, PROPERTY: A CONTEMPORARY APPROACH 22 (5th ed. 2021) (“Under our federal system of government, state law generally determines what constitutes property. . . . subject, of course, to various exceptions; for example, federal law governs copyrights and patents . . .”).

15. See Brian W. Ohm, *Some Modern Day Musings on the Police Power*, 47 URB. LAW. 625, 635 (2015) (“A significant body of state court case law began to develop during the early 1900s involving local government actions under enabling laws enacted by state legislatures. The enabling laws delegated various police power programs to local governments, such as zoning. Local governments became key actors in the expanded use of the police powers.” (footnote omitted)).

16. *States with the Most Counties 2022*, WORLD POPULATION REVIEW, <https://worldpopulationreview.com/state-rankings/states-with-the-most-counties> [<https://perma.cc/9JUL-7PMH>] [hereinafter WORLD POPULATION] (“This [number] includes 136 county-equivalents

system is disconnected and decentralized because each state government and each local government has a role in local real estate ownership and has latitude to create its own laws, recording requirements and fee structures.”¹⁷ Even with thousands of discrete local agencies, all counties rely primarily on either grantor-grantee indexes (majority) or tract indexes (minority), which are described in Section III. But first, the remainder of this Section provides an overview of typical real estate transfers to contextualize the complexity of even the most straightforward deal, typical parties, and the extensive documentation involved.¹⁸ Although this article focuses on title, it is difficult to understand modern systems’ shortcomings without being familiar with the framework in which title registry exists.

Property owners (“sellers”) typically enter into contracts with brokers to sell their property, which is documented through a listing agreement.¹⁹ When a potential purchaser (“buyer”) makes an offer, if the seller and buyer agree to terms, it is documented through a purchase contract.²⁰ The buyer then makes a good faith deposit, and the escrow process begins.²¹ Escrow instructions are issued and often amended multiple times, generating several documents.²² Sometimes escrow and title are handled by the same company, but they are often separate companies working together.²³

The buyer may have been pre-approved for financing but if not, will start the process of obtaining a loan to be secured by the real estate.²⁴ This is probably the most document-intensive part of a purchase as it includes a loan application, plus supporting documentation for income, expenses, tax returns, and anything else a lender may require to satisfy itself that a borrower can repay the loan.²⁵ The lender hires an appraiser who prepares a valuation

in the 50 U.S. states and the District of Columbia and 100 county-equivalents in U.S. territories.”); *see* SPRANKLING & COLETTA, *supra* note 14, at 560.

17. *See* S.H. Spencer Compton & Diane Schottenstein, *Questions and Answers About Using Blockchain Technology in Real Estate Practice*, 33 No. 5 Prac. Real Est. Law. 5, 6 (Sept. 2017).

18. This article describes real estate practices in California for this example.

19. *See generally* CAL. DEP’T OF REAL EST., REFERENCE BOOK: INFORMATION RELATING TO REAL ESTATE PRACTICE, LICENSING AND EXAMINATIONS 103–104 (2010).

20. ORANGE COAST TITLE COMPANY, CALIFORNIA BUYER & SELLER GUIDE TO TITLE & ESCROW 5 (2016) [hereinafter ORANGE COAST]; *see* CAL. DEP’T OF REAL EST., *supra* note 19, at 103.

21. WAYNE S. BELL & SUMMER B. BAKOTICH, SURVIVING THE REAL ESTATE “ESCROW” PROCESS IN CALIFORNIA: IMPORTANT THINGS AND TIPS YOU SHOULD KNOW AND MISTAKES TO AVOID 11 (2010).

22. *See id.* at 25, 27.

23. *See* CAL. DEP’T OF REAL EST., *supra* note 19, at 119; *cf.* *Title insurance*, CAL. DEP’T OF INS., <http://www.insurance.ca.gov/01-consumers/105-type/95-guides/03-res/Title-Insurance.cfm> [<https://perma.cc/FG44-6GMB>] (explaining that whether title and escrow are handled by the same company varies by region).

24. *See* ORANGE COAST, *supra* note 20, at 8, 14; *see also* CAL. DEP’T OF REAL EST., *supra* note 19, at 318 (defining preapproval and prequalification).

25. *See* CAL. DEP’T OF REAL EST., *supra* note 19, at 276–78.

report based on factors like the property's condition, location, size, and comparable sales.²⁶

While the buyer is engaged in the loan application process, the seller provides the buyer with required disclosures, documented by standard forms that comply with a given state's disclosure requirements.²⁷ A prudent buyer will also order a property inspection, resulting in a report detailing the condition of the property.²⁸ After receiving the seller's disclosures and reviewing the inspection report, the buyer has a contractually defined period to proceed with the transaction, negotiate for repairs or a credit before removing the disclosure contingency, or terminate the deal without penalty.²⁹

During this same period, the seller provides the buyer with a preliminary title report issued by a title company which shows any recorded interests against the property.³⁰ The buyer has a contractually defined period to accept the report, negotiate for removal of items on the report, or terminate the deal without penalty.³¹ If the deal closes, the title company will issue an owner's title policy to the buyer, and a lender's policy to the lender at the buyer's expense.³²

Assuming all contingencies are removed and financing is in place, the transaction will close, with escrow allocating expenses between the parties, distributing proceeds to the seller, and delivering a seller-executed grant deed to the buyer.³³ At that point, legal title is transferred from the seller to the buyer and recording is *not* required to validate the transfer.³⁴ The norm, however, is that either the escrow or title company arranges to record the grant deed, and the lender records its mortgage or deed of trust.³⁵ Recording puts the world on notice of a property interest and prioritizes such interests against subsequent claims, but is not required to effectuate a valid transfer.³⁶ Thus, recording operates to protect a property interest but is not required to create a property interest.

Many documents are produced over the course of a standard real estate transaction, which are stored in multiple locations with no single

26. *See id.* at 279.

27. *See* ORANGE COAST, *supra* note 20, at 16–17.

28. *See id.* at 5.

29. *See id.* at 3, 5.

30. *See* CAL. DEP'T OF REAL EST., *supra* note 19, at 123, 278–79.

31. ORANGE COAST, *supra* note 20, at 3; *see* CAL. DEP'T OF REAL EST., *supra* note 19, at 123.

32. *Information for Homebuyers*, CAL. DEP'T OF REAL EST., <https://www.dre.ca.gov/consumers/informationforhomebuyers.html> [<https://perma.cc/9HRK-VRPR>]; *see* CAL. DEP'T OF REAL EST., *supra* note 19, at 279.

33. *See* CAL. DEP'T OF REAL EST., *supra* note 19, at 120, 124.

34. *See id.* at 111, 114.

35. *See id.* at 116, 124.

36. *See id.* at 114; *see also* John Mirkovic, Cook Cnty. Recorder of Deeds, Blockchain Pilot Program Final Rep. 12 (2017). Note, however, that conveyance and recording could be unified. *See infra* text accompanying note 89.

index.³⁷ This inefficient process, where each party maintains the files it generates, including documents impacting title which should be recorded (not because recording validates a given interest, but to put the world on notice of such interest and establish priority),³⁸ has been in place for a long time.³⁹ Recording systems are important in property law, but they are fraught with problems which could be avoided or reduced with modernization. Imagine if we used available technology to index or file all documents generated in connection with a property transfer, which documents could be logically sorted and easily accessed by reference to the property address. The next Section provides some background on blockchain, which is important for the reader to be familiar with in order to better understand how easily the problems already raised and later detailed in this article could be avoided.

II. A PRIMER ON BLOCKCHAIN AND DISTRIBUTED LEDGER TECHNOLOGY

This article does not delve into mechanics of blockchain and distributed ledger technology (“DLT”) in-depth,⁴⁰ nor assume the reader has a background in such technology. However, it must provide enough background to understand this technology in relation to title registry and property transfers generally:

A blockchain is a digital ledger of transactions maintained by a network of computers in a way that makes it difficult to hack or alter. The technology offers a secure way for individuals to deal directly with each other, without an intermediary like a government, bank or other third party. . . . The growing list of records, called blocks, is linked together using cryptography. Each transaction is independently verified by peer-to-peer computer networks, time-stamped and added to a growing chain of data. Once recorded, the data cannot be altered.⁴¹

37. See Compton & Schottenstein, *supra* note 17, at 6; see, e.g., Mirkovic, *supra* note 36, at 13–14 (describing the indexing process in Cook County).

38. See CAL. DEP’T OF REAL EST., *supra* note 19, at 111–12, 114.

39. See Compton & Schottenstein, *supra* note 17, at 5 (“Real estate transactions are steeped in traditions that have hardly changed over hundreds of years.”).

40. There are countless sources which describe blockchain in more detail, including the seminal source, SATOSHI NAKAMOTO, BITCOIN: A PEER-TO-PEER ELECTRONIC CASH SYSTEM, <https://bitcoin.org/bitcoin.pdf> [<https://perma.cc/FJ9G-HHY9>].

41. Kevin Voigt & Andy Rosen, *What is Blockchain? Blockchain Technology, Explained*, NERDWALLET (Jun. 29, 2022), <https://www.nerdwallet.com/article/investing/blockchain> [<https://perma.cc/6BVP-5E8B>]; see also Compton & Schottenstein, *supra* note 17, at 5.

Not all blockchain is created equal, and there is more nuance than this article can address, but some distinctions are worth noting:

[T]he term “blockchain” can refer to a well-known, specific blockchain . . . , a custom-built private or public blockchain, or the general idea of creating an immutable, chronological ledger of transactions protected against revision by encryption and consensus algorithms. Another common industry term is “DLT,” or “distributed ledger technology,” meant to differentiate databases built upon proprietary or custom ledgers, or those built without a “Proof of Work” algorithm or an associated cryptocurrency.⁴²

Proof of work and proof of stake are validating methodologies. The former confirms “transactions through a consensus algorithm that requires miners to solve a cryptographic equation by trial and error. This requires expensive computers and uses up a significant amount of energy.”⁴³ Proof of work is not feasible for title registry because of the amount of energy required to validate transactions, given the high volume of recorded real estate documents. However, DLT with proof of stake validation can be designed to be workable:

Proof of stake is a consensus algorithm that requires miners to stake all or a portion of their coins to validate transactions. Miners are chosen to verify a block randomly but those who have a larger stake or have been staking longer have an advantage. The miners chosen must all agree to verify transactions. After they have verified a block, it is added to the chain . . . If they don’t verify it properly, their own stake will be affected and they will lose some or all of their coins. This provides more security to the process since there is no incentive to cheat or steal coins.⁴⁴

Proof of stake requires fewer miners than proof of work and uses less energy.⁴⁵ But both systems compensate miners for their efforts.⁴⁶ With title indexing, who will mine or validate files, and how will they be compensated,

42. Mirkovic, *supra* note 36, at 5.

43. Amanda Reaume, *Proof of Work vs. Proof of Stake: Explained*, SEEKING ALPHA (Jun. 16, 2022), <https://seekingalpha.com/article/4468656-proof-of-work-vs-proof-of-stake> [<https://perma.cc/JTJ5-U98M>]. Note that miners are compensated for their labor through coins. *Id.*

44. *Id.*

45. *Id.* (“While proof of work is the most well-known blockchain consensus model, alternative consensus models like proof of stake might be more efficient since they can increase security, reduce energy use, and allow networks to more effectively scale.”).

46. *See id.*

if at all? Government agencies responsible for property records would not likely offer miners tokens or compensation in exchange for mining labor, so it is unclear who will bother to validate.⁴⁷ State agencies responsible for land records conceivably could act as nodes for each other, validating each transfer,⁴⁸ and automatically backing up each other's records.

“(DLT) is a digital system for recording the transaction of assets in which the transactions and their details are recorded in multiple places at the same time.”⁴⁹ DLTs utilizing proof of stake can streamline title indexing, reducing friction and lowering transaction costs.⁵⁰ Theoretically, county recorder offices could convert existing obsolete indexes to DLTs, which would efficiently index records and create built-in back-up systems to preserve files.⁵¹ There are, however, drawbacks, which will be discussed in Sections III and V.

Blockchain proponents praise its security, an essential component of any land records system.⁵² “In theory, blockchain is tamper-proof because it is decentralized and not controlled by one party. All the nodes maintaining the same database will be involved in verifying the transaction which is a check on the veracity of the system.”⁵³ While blockchain cannot stop all

47. See VT. STATE ARCHIVES AND RECS. ADMIN., VT. SEC’Y OF STATE, BLOCKCHAINS FOR PUBLIC RECORDKEEPING AND FOR RECORDING LAND RECORDS 24, 36–37 (2019) [hereinafter Vermont 2019 Report] (“Since blockchains are generally comprised of voluntary actors, at any point those actors might decide to stop contributing.”).

48. *Id.* at 38 (“Blockchains could be leveraged as part of a suite of technologies to better manage land transactions; for example, each town in the State of Vermont could participate as a node in a blockchain and verify transactions submitted by private parties transacting land.”).

49. See Sue Troy & Mary K. Pratt, *Distributed Ledger Technology (DLT)*, TECH TARGET (Jun. 2021), <https://www.techtarget.com/searchcio/definition/distributed-ledger> [<https://perma.cc/XA4U-2W8Y>].

50. See Mirkovic, *supra* note 36, at 33; see also Troy & Pratt, *supra* note 49. (“Unlike traditional databases, distributed ledgers have no central data store or administration functionality. In a distributed ledger, each node processes and verifies every item, thereby generating a record of each item and creating a consensus on its veracity. A distributed ledger can be used to record static data, such as a registry, and dynamic data, such as financial transactions.”).

51. See Mirkovic, *supra* note 36, at 26. Blockchain utilizes time stamps like traditional date and timestamps on recorded documents, with built in back-up features. See *id.* Its “timestamp ledger . . . can certify the existence of a specific computer file at a point in time. . . . [which] would be useful if a Recorder of Deeds did lose their entire land records image database. If a customer had the digital file they originally submitted and also submitted it to the blockchain, they could prove that it matches this blockchain record, in essence using another public database to certify records.” *Id.* Cook County noted such a service already exists which can be woven into existing software without fully adopting a blockchain-based system, but it is prohibitively expensive. *Id.*

52. See *id.* at 20; see Compton & Schottenstein, *supra* note 17, at 6–7.

53. See Compton & Schottenstein, *supra* note 17, at 6 (“The system is analogous to creating a unique digital fingerprint (or ‘hash’) for each transaction that is stored in the database by each member of the blockchain. The hash is validated by algorithms and only can be changed if the utilized consensus mechanism verifies that the transaction is legitimate. This assures secure and authenticated transactions.”).

fraudulent conduct, it prevents tampering with hashed files.⁵⁴ Blocks must be verified by multiple miners before being added to a chain and, once added, given validation processes, one cannot unilaterally alter them, forge changes, or add a fraudulent block to a chain.⁵⁵ While blockchain enhances security by preventing records from being altered once filed, it cannot prevent one from filing forged or fraudulently obtained documents.⁵⁶

Inefficiencies and costly mistakes are inevitable in today's outdated recording systems and indexes, but could largely be avoided through updated processes.

The current paper-dependent mode of executing and recording transactions requires . . . that a human employee manually inspect a scanned image of an instrument and retype the data points that are necessary for the property index to be searchable. This manual process is always at risk of error. These typing errors, combined with errors made by private parties in the preparation of the documents, . . . actually perpetuates the complex and costly infrastructure needed to search and "clear" titles. . . . blockchains can unify the conveyance with the public record, meaning that the public record would be an exact and perfect replica of what actually happened.⁵⁷

Blockchain mechanics could prevent common recording errors from arising in the first place. Even if a mistake is not discovered until after a block is created, an updated block could fix the error. A blockchain validation process coupled with a simultaneous conveyance and recording would both minimize mistakes and reduce friction. To better understand common title problems and how blockchain could solve them, the next Section details recording procedures and predictable issues.

III. TITLE SYSTEM MECHANICS AND COMMON PROBLEMS

Any documents that reflect ownership or real property interests, like grant deeds, easements, mortgages, or judgments, should be recorded to put

54. *Id.*

55. *Id.* at 5–6. "Because blockchain relies on encryption to validate transactions by verifying the identities and obtaining the consent of all parties involved, 'false' transactions cannot be added to the blockchain. Accordingly, proponents argue that blockchain could resolve many of the fraud issues arising from identity-theft and fraudulent-payment schemes." *Id.* at 7.

56. *Id.*

57. *See* Mirkovic, *supra* note 36, at 19–20.

the world on notice of such interests.⁵⁸ Real estate transactions rely heavily on precedent,⁵⁹ and traditionally conclude by recording paper documents.⁶⁰ Technology has simplified the process, resulting in less paper and easier access to digitized files.

Most states adopted the Uniform Real Property Electronic Recording Act, which authorizes local recorder's offices to record documents in electronic form, including deeds, mortgages, and other instruments. Today over half of these offices accept electronic documents, at least to some extent. In recent decades, some recorder's offices have created computerized indexes for new recordings. By entering the name of a grantor or grantee, the searcher can locate recordings relating to that person, regardless of their chronological sequence. In certain offices, it is also possible to search by property description, usually by street address or lot number. But few offices have developed such indexes for past recordings, because the cost is prohibitive.⁶¹

Although recorded documents are now commonly electronic, the expense inherent in digitizing all files in a property's chain of title would be exorbitant, and e-recording is not yet universally accepted.⁶² To improve efficiency, e-recording should be the norm.⁶³

Rather than mailing paper documents or physically delivering them to the county recorder's office, everyone should be able to submit original documents electronically, regardless of the county. This saves submitters time, stamps, gas, and the stress of traffic and finding parking. Plus, once e-recorded, anyone can quickly conduct a computer search for any interests recorded against a tract of land. Indexes should contain hyperlinks to the underlying files themselves, vastly simplifying the process compared to going to the county recorder's office, locating indexes, pulling the files themselves, then paying to copy the files, page by page. Documents not yet digitized remain problematic because they are still in paper form or microfiche, so computer searches would not locate them, increasing

58. See SPANKLING & COLETTA, *supra* note 14, at 561–562. The article does not have space to detail how to resolve disputes among competing claimants, but in a nutshell, a later bona fide purchaser or lien holder without notice of prior claims has priority. *Id.* at 569.

59. See, e.g., Compton & Schottenstein, *supra* note 17, at 5.

60. See SPANKLING & COLETTA, *supra* note 14, at 533.

61. See *id.* at 568.

62. *Id.*

63. See *The Basics of E-recording*, AM. LAND TITLE ASS'N: ALTA BLOG (Jun. 25, 2019, 1:11 PM), <https://blog.alta.org/2019/06/the-basics-of-e-recording.html> [<https://perma.cc/455G-7PJ9>] (“[O]ver 85 percent of the U.S. population resides in jurisdictions that e-record.”).

transaction costs.⁶⁴ Moreover, they may have deteriorated and are certainly harder to read.⁶⁵

Most states catalog recorded documents through both grantor and grantee indexes.⁶⁶

In the grantee index, each entry is organized alphabetically by the grantee's last name; the grantor index is organized by the grantor's last name. . . . [A]n index entry will [also] contain the type of instrument, the time of recordation, the location of the recorded document (for example, a volume and page number), and a brief description of the property involved.⁶⁷

If not digitized, searches are limited, and the process is fraught with error. If digitized, searches can be expanded to other fields like the property address or instrument type, but problems still remain. While grantor-grantee indexes were effective for centuries, they are subject to errors and inefficiencies, which are mostly avoidable under alternative systems. Some states use tract indexes where the search process is much simpler, as “[e]ach parcel of land is assigned a unique identifier, sometimes called a parcel identification number [‘PIN’]. Every document affecting that parcel is typically filed in a folder under its unique number. A title searcher can simply examine the documents in the folder to assess the state of title.”⁶⁸ Thus, with a tract index, any recorded property interest that affects title can easily be located by reference to the PIN.⁶⁹

Although much harder to use than tract indexes, grantor-grantee indexes are the norm.⁷⁰ They are inherently more error prone.⁷¹ For example, sometimes people forget to record or record out of order.⁷² If there is a mistake on the recorded instrument,⁷³ a property interest can be compromised

64. Dean Arthur R. Gaudio, *Electronic Real Estate Records: A Model for Action*, 24 W. NEW ENG. L. REV. 271, 277 (2002).

65. Toxey H. Sewell, *The Tennessee Recording System*, 50 TENN. L. REV. 1, 16 (1982).

66. See SPANKLING & COLETTA, *supra* note 14, at 560; see also *Grantor-Grantee Index*, CORNELL LAW SCH.: LEGAL INFO. INST.: WEX, https://www.law.cornell.edu/wex/grantor-grantee_index [<https://perma.cc/VBC7-CWDR>] (last updated Jan. 2022) (“[T]he grantor-grantee index is the official documentation of land transfers, and courts look to these indexes to see who owns property.”).

67. SPANKLING & COLETTA, *supra* note 14, at 560.

68. *Id.* at 561.

69. *Id.*

70. *Id.* at 560–561.

71. John R. Lee, *A Primer on Conducting Oil and Gas Operations in the Northern Rocky Mountain States: A Strange New World*, 38 ALTA. L. REV. 74, 94 (2000).

72. See SPANKLING AND COLETTA, *supra* note 14, at 579–80.

73. Sewell, *supra* note 65, at 20. For example, recorded documents with errors are entered into the grantor-grantee indexes with those errors, and may be doomed to eternal obscurity. I recently found a recorded grant deed in my filing pile with an incorrect mailing

or lost.⁷⁴ If there are mistakes inputting data in grantor-grantee indexes, documents become nearly impossible to locate.⁷⁵ In many jurisdictions, an improperly indexed document does not provide notice of claims represented by that document.⁷⁶ Hence, a claimant's interest could be lost even if the claimant was first to record.⁷⁷ Tract indexes and blockchain eliminate or minimize most of the grantor-grantee index problems as described below.

Common grantor-grantee index problems occur when parties with a property interest neglect to record or record too late or too early.⁷⁸ The first instance can produce a wild deed and arises when someone ("X") acquires an interest but does not record.⁷⁹ If X later transfers X's interest to Y and Y records the X-Y deed (the wild deed), there is no link back to the grantor-X transfer.⁸⁰ Wild deeds are recorded, but when predecessors like X fail to record their interest, the wild deed is not attached to prior interests in the chain and thus is not linked in the grantor-grantee index.⁸¹ Wild deeds do not provide constructive notice as they are virtually impossible to locate.⁸² Thus, even if Y paid X valuable consideration and promptly recorded the X-Y deed, Y's rights are inferior to subsequent purchasers for value because the wild deed is outside the chain of title.⁸³ Wild deed problems are nonexistent with tract indexes as the X-Y deed can be located using the PIN. A blockchain-based system could prevent a wild deed from being recorded because a link in the chain is missing, alerting Y to nudge X to record X's deed. Mechanically, when Y attempts to record the "wild" X-Y deed, blockchain

address which means I would not have received property tax bills but for my belated attention to detail!

74. *Id.*

75. For example, if recorded documents are incorrectly indexed, standard title searches would not locate them. *Id.* at 45-46.

76. *See, e.g., Baccari v. De Santi*, 70 A.D.2d 198, 202-3 (N.Y. App. Div. 1979) ("[T]he recording was done improperly . . . [I]t is our opinion that since the index has . . . been made part of the record . . . an erroneous indexing by the clerk fails to give constructive notice of the existence and contents of the instrument."). *But see Luthi v. Evans*, 576 P.2d 1064, 1070 (Kan. 1978) ("We also wish to make it clear that in situations where an instrument of conveyance containing a sufficient description of the property conveyed is duly recorded but not properly indexed, the fact that it was not properly indexed by the register of deeds will not prevent constructive notice.").

77. *See, e.g., In re McCormick*, 417 B.R. 362, 367 (Bankr. M.D.N.C. 2009) (Under North Carolina law, instruments must be properly indexed to be considered properly registered and will not be deemed registered until indexed in a way to put a "careful and prudent title examiner" on notice). *But see MidCountry Bank v. Krueger*, 762 N.W.2d 278, 286 (Minn. Ct. App. 2009) (holding a properly recorded mortgage, improperly indexed by the county recorder, provided constructive notice).

78. *See SPRANKLING AND COLETTA, supra* note 14, at 579-80.

79. *Id.* at 579.

80. *Id.*

81. *See, e.g., Wild Deed*, USLEGAL.COM, <https://definitions.uslegal.com/w/wild-deed/> [<https://perma.cc/A323-EHNS>] (last visited Sept. 20, 2022).

82. *See, e.g., SPRANKLING & COLETTA, supra* note 14, at 579.

83. *Id.*

would reject it and could notify Y its interest is untethered, preventing the wild deed from being recorded until X's prior deed is recorded and hashed.

When someone ("P") acquires a property interest but delays recording it,⁸⁴ a "deed recorded too late" problem may arise. If P1 later acquires an interest in the same property and records before P, P1's rights are better than P's rights in most jurisdictions.⁸⁵ Deeds recorded too late do not provide constructive record notice in a majority of jurisdictions, for efficiency reasons.⁸⁶ Title searchers will not find deeds recorded too late in typical grantor-grantee index searches.⁸⁷ Plus, P is the best cost-avoider. If P simply recorded as soon as P acquired an interest, there is no problem. A tract index cannot resolve this problem because when P neglects to record, there is no grant deed to locate. However, it is still possible to link prior deeds to later deeds with a tract index, which is nearly impossible with grantor-grantee indexes. Blockchain likewise would not resolve problems with deeds recorded too late because it cannot force someone like P to record promptly. However, if counties updated their systems "to combine the act of conveyance and the act of providing notice (recordation) of the conveyance into one event,"⁸⁸ recording is out of P's hands, which would also simplify the closing process.⁸⁹ If conveyances and recording were part of a single transaction, then that transaction could be hashed and added to a chain, leaving no problematic gaps. Blockchain could thus expedite property transfers by automatically uploading and recording a conveyance at closing.

A different problem arises if someone records a property interest before acquiring it – a "deed recorded too early." For example, buyer ("B") is in escrow to buy Blackacre from seller ("S") and the closing is delayed. B plans to flip Blackacre and already entered into a contract with B1 to sell Blackacre to B1. The B-B1 sale closes and B1 records the B-B1 deed, which was technically recorded too early as B did not then own Blackacre. Meanwhile, before the S-B sale closes, S decides to sell Blackacre to Z, who promptly records the S-Z deed. In most jurisdictions, a deed recorded too early does not provide constructive record notice,⁹⁰ so Z's rights to Blackacre are better than B1's, even though B1 acquired an interest first. A blockchain-based system would reject the B-B1 deed recorded too early because B did not then own Blackacre, alerting B1 not to proceed with the transaction until

84. See SPRANKLING & COLETTA, *supra* note 14, at 580. Although this rarely happens when escrow and title companies manage transactions, it still occurs. It is more likely when parties bypass escrow as in all cash deals, and parties place deeds in filing piles.

85. *Id.*

86. *Id.* (Forty-eight states have notice or race-notice acts, where later purchasers without notice of prior interests have priority).

87. *Id.*

88. See Mirkovic, *supra* note 36, at 34.

89. *Id.* ("[B]y unifying the conveyance and the creation of the record, risk of pending claims that aren't indexed prior to a transaction (but are still valid claims nonetheless) is mitigated, as the record populates much faster, closer to 'real time.'").

90. See SPRANKLING & COLETTA, *supra* note 14, at 580–81.

B has title. In other words, blockchain could prevent the deed recorded too early problem at the point when B1 tries to record by alerting B1 there is no hash proving that B owns the property. B1's deed could not be recorded until B owns Blackacre *and* records the S-B1 deed. While a tract index would not prevent the problem, if B1 performed a title search before closing on the B-B1 deal, B1 would *not* see B as grantee in the chain of title, alerting B1 not to proceed until B owns Blackacre.

Even without human error at the root of the title issues described above, life changes can inadvertently create problems. For example, grantors or grantees may change their names following original index entries,⁹¹ but may not think about changing recorded instruments. It is hard enough to update driver's licenses, social security numbers, passports, and credit cards, without adding to the list documents recorded prior to one's name change. However, if a property owner neglects to update recorded instruments and appropriate grantor-grantee indexes to reflect changed names, no one can link original recorded documents with later files in the chain. Blockchain or tract indexes avoid this problem because new files are linked by a hash or added by tract number, regardless of name changes.

A different set of title registry issues relates to security. There are many cracks in the current system, making it easier for swindlers to engage in deceptive behavior.⁹² Recorded documents procured by fraud or forgery directly harm those scammed and can create title headaches.⁹³ “[A] parcel of real property can be fraudulently conveyed to another by simply forging and recording a new deed, something that can be done anonymously through the mail.”⁹⁴ Unscrupulous people can also procure title fraudulently,⁹⁵ or sell property they do not own.⁹⁶ For example, they can pressure a vulnerable

91. This happens daily with marriages or divorces, or when people just decide they prefer names other than their birth names. *See, e.g.*, Tanya Marsh, *Foreclosures and the Failure of the American Land Title Recording System*, 111 COLUM. L. REV. SIDEBAR 19, 21–22 (2011), <https://columbialawreview.org/wp-content/uploads/2016/05/Marsh.pdf> [<https://perma.cc/NHL3-K83W>].

92. *See* Compton & Schottenstein, *supra* note 17, at 7.

93. *See id.* (“An all-too-familiar example: fraudster knows that a home is owned by an absent or elderly individual; fraudster files a forged deed based on documents openly available on the county website and then sells the property, pocketing the purchase price, and leaving behind a tale of woe.”).

94. *See* Mirkovic, *supra* note 36, at 10.

95. *See, e.g.*, *Raub v. Gen. Income Sponsors of Iowa, Inc.*, 176 N.W.2d 216 (Iowa 1970) (warranty deed was fraudulently obtained from plaintiff).

96. *See* Mirkovic, *supra* note 36, at 36. Cook County “has encountered victims of a fraudster who sells properties he does not even own (sometimes outright, sometimes as ‘contract for deed’), many of which are barred from reconveyance by a judge due to their very dangerous condition. Additionally, many of these homes have delinquent utilities and water bills which must be paid before a deed can be recorded. In some cases, the amount of past due utilities and taxes equals or exceeds the value of the property, and these victims do not have the resources to come up with another \$20,000. In some extreme circumstances, victims pay the fraudster \$15,000-20,000 in cash, spend thousands of dollars of their own

person to sign a deed or a piece of paper that is purportedly something else, but is actually a grant deed.⁹⁷ Though not foolproof, depending on the nature of the scam, verification processes embedded in blockchain could prevent some problems.⁹⁸ Converting conveyance and recording to a single step process where transfers are not finalized until a document is accepted for recording would eliminate other problems.⁹⁹ Even with these improvements, blockchain does not ensure authenticity of documents presented for recording.¹⁰⁰

Title registry systems have a myriad of problems, but many solutions exist, none of which are perfect, and some of which can be stacked. Tract indexes avoid most grantor-grantee index problems, including those involving wild deeds and deeds recorded too early, and spelling errors or typos (unless, of course, one uses the wrong PIN or property description). Technology also exists to simplify how we gather, access, and record information pertaining to real estate transactions. Blockchain could simplify current processes, reduce errors, offer greater security, and minimize friction. In fact, various agencies have either considered adopting blockchain for title registry, already adopted blockchain through pilot programs, or permanently implemented blockchain-based title registry, which will be described in the next Section.¹⁰¹

IV. BLOCKCHAIN, PROPERTY TRANSFERS, AND LAND RECORDS IN PRACTICE

Modern technology offers many options to update the cumbersome way real estate transfers are managed, documented, and recorded with greater security, built-in back-up, and lower transaction costs.¹⁰² Accordingly, agencies throughout the world have begun to use blockchain in connection with real estate transactions.¹⁰³ The Republic of Georgia chose blockchain to

money on renovations, only to find that they cannot record the deed and assume ownership.”
Id.

97. *Link v. Page*, 10 S.W. 699, 700 (Tex. 1889).

98. For example, blockchain could prevent alterations to existing documents. A “record is hashed and the hash stored in the blockchain. That hash is protected, but if the record is altered it will no longer validate.” Vermont 2019 Report, *supra* note 47, at 26.

99. See Mirkovic, *supra* note 36, at 19–20.

100. See VT. STATE ARCHIVES AND RECS. ADMIN., VT. SEC’Y OF STATE, BLOCKCHAIN TECHNOLOGY: OPPORTUNITIES AND RISKS, 19–20 (Jan. 15, 2016) [hereinafter Vermont 2016 Report] (“[B]lockchain technology does not verify or address the reliability or the accuracy of the contents.”).

101. *Id.*; see generally Mirkovic, *supra* note 36.

102. See Compton & Schottenstein, *supra* note 17, at 6.

103. See Shefali Annand, *A Pioneer in Real Estate Blockchain Emerges in Europe*, WALL ST. J. (Mar. 6, 2018), <https://www.wsj.com/articles/a-pioneer-in-real-estate-blockchain-emerges-in-europe-1520337601?mod=searchresults&page=1&pos=3> (“In India, the Andhra Pradesh state has tied up with ChromaWay to build a blockchain-based solution to record property deals In the Republic of Georgia, the National Agency of Public

document property deals for several compelling reasons,¹⁰⁴ noting that “the blockchain based land titling system allows the public to easily verify the ownership of a property deed without fear of manipulation or theft from government administrators.”¹⁰⁵ The system is instantly accessible, transparent, and allows property owners to more readily use their real property as collateral.¹⁰⁶

The Republic of Georgia wanted to reduce transaction costs through an immutable system that also minimized ongoing corruption,¹⁰⁷ thus it entered a one-year pilot program using blockchain for title registry.¹⁰⁸ The results aligned with the country’s goals as it “protected the data from internal manipulation and external cyberattacks and instilled trust in the integrity of the national digital land registry system.”¹⁰⁹ Thus, the Republic of Georgia continues to use blockchain for land registry matters.¹¹⁰ A summary of the program noted that it can be expanded for greater impact by utilizing existing blockchain data to verify property ownership in connection with other “government programs related to benefit programs, disaster relief, and financial aid.”¹¹¹ Importantly, the blockchain component did not fully replace the existing title registry system; rather, it was a back-end addition to the existing front-end program.¹¹² It in effect created an index with hashing to identify where to find documents within the land registry database.¹¹³ Consequently, at the front end, full text documents, which would be too

Registry has been storing real estate titles, triggered by a new sale or purchase or a mortgage registration, on a blockchain structure for the past year. So far 1 million land titles have been saved, each with a unique hash code, according to the agency’s chairman.”).

104. See, e.g., Jyostna Grandhi, et al., *Reforming Title Deeds via Blockchain and Challenges—Indian Perspective*, 401 LECTURE NOTES IN NETWORKS AND SYSTEMS 147, (2023) https://doi.org/10.1007/978-981-19-0098-3_16 [<https://perma.cc/3QBX-M8B7>].

105. *Restoring Trust in Public Land Registries Project Capsule: Republic of Georgia Land Titling System*, NEW AM. (Dec. 15, 2020), <https://www.newamerica.org/digital-impact-governance-initiative/digital-impact-and-governance-initiative/digi-blogs/project-capsule-georgia-land-titling-system/> [<https://perma.cc/JR7A-ES7N>] [hereinafter *Georgia Land Titling System*].

106. *Id.*

107. See *id.* (“Despite reforms to increase transparency in the Republic of Georgia’s land registry system, officials could still arbitrarily alter land titles and left the public skeptical of the database’s integrity.”).

108. See Qiuyun Shang and Allison Price, *A Blockchain Based Land Titling Project In The Republic Of Georgia: Rebuilding Public Trust And Lessons For Future Pilot Projects*, 12 INNOVATIONS: TECH., GOVERNANCE, GLOBALIZATION 72, 75 (2018).

109. *Georgia Land Titling System*, *supra* note 105.

110. See *id.*

111. *Id.*

112. See *id.* (“The blockchain-based land title system is a back-end addition to the existing NAPR land registry system which uploads an immutable hash, or digital receipt, of a land transaction to the Bitcoin blockchain. The front-end application was left unchanged to reduce confusion by users.”).

113. See *id.* (“The timestamp appended to each hash proves to the owner that the land record has not been altered since the original transaction was initiated by the user and authorized by the NAPR.”).

voluminous to retain in the chain, remain intact, with indexing at the backend through blockchain.¹¹⁴

Sweden's Lantmateriet ("Land Administration Agency"),¹¹⁵ analyzed whether to switch to a blockchain-based system for land matters,¹¹⁶ and even completed one real estate transfer through blockchain.¹¹⁷ Although it is logistically simpler for a country with a single recording and land transfer system to adopt existing technology and transition to blockchain, Sweden has tabled the project for now.¹¹⁸ While it had merit, ultimately it was hampered by some key hurdles such as more urgent national priorities,¹¹⁹ legal constraints,¹²⁰ and blockchain's reputation.¹²¹

Cook County, Illinois studied whether existing databases were compatible with DLT, and evaluated the security and legal protections offered through digital records and transactions.¹²² While it found blockchain could securely simplify real estate transactions, it still posed practical, legal, and structural challenges.¹²³ Practically, it was not clear the square peg of real estate transaction procedures should be altered to fit the round hole of blockchain.¹²⁴ Legally and structurally, Cook County first had to "consider

114. *See id.* ("Anchoring the digital receipts to the Bitcoin blockchain extends the security and transparency of a public blockchain to the land registry database, where stakeholders can freely access and verify information without the fear of manipulation by hackers or corrupt officials.")

115. *See About Lantmateriet*, LANTMÄTERIET, <https://www.lantmateriet.se/en/about-lantmateriet/> [https://perma.cc/YKS2-QXXA] (last visited Sept. 7, 2022).

116. *See Annand, supra* note 103 ("Sweden's nearly 400-year-old land mapping and registration authority is likely to become one of the first government agencies to test using blockchain technology for conducting property sales.")

117. Telephone Interview with Mats Snäll, formerly Sweden's Chief Digital Officer at Lantmateriet (Sept. 6, 2022). Snäll said they completed one transaction. *See id.* He also said Sweden did groundwork to transition to a blockchain-based system for real estate transactions and title registry but was hampered by legal and practical considerations. *See id.*

118. *See Erik Alander et al., Blockchain 2022 - Sweden*, CHAMBERS AND PARTNERS, <https://practiceguides.chambers.com/practice-guides/blockchain-2022/sweden/trends-and-developments> [https://perma.cc/BYF7-Q8S4] ("The project was initiated in 2015 and finalised in 2019.")

119. Telephone Interview with Mats Snäll, *supra* note 117. Snäll indicated that national security, health, and climate issues were more pressing at this time. *See id.*

120. *Id.* (Sweden still requires paper, not digital records, for real estate transfers. Thus, it would have to change its laws to accept digital records before proceeding with a blockchain-based registry.)

121. *Id.* Snäll suggested there was lingering concern about blockchain's use for illegal activity. *See id.*; *see, e.g., David Black, Cryptocurrency Fuels Growth of Crime*, FORBES (Mar. 11, 2022), <https://www.forbes.com/sites/davidblack/2022/03/11/cryptocurrency-fuels-explosive-growth-of-crime/?sh==5c0ffb0c618a> [https://perma.cc/G8AW-GDUM].

122. *See Mirkovic, supra* note 36, at 7. Findings from Cook County's study are woven throughout this article.

123. *See id.* at 43.

124. *See id.* ("It is perhaps more innovative to see how we can use technology to change legal processes rather than to first change legal processes so that they can fit a specific technology. For example, the impacts of making real estate instruments into bearer-assets (tokens) need further study and input from legal experts.")

requiring all legal claims to a property to be placed in the public record . . . [and whether to] . . . continue to spread vital property information across more than five government offices [and] . . . continue to maintain a property records system that is different in each county, or make an effort to standardize the data or format?”¹²⁵ Although Cook County’s study found blockchain offered many upsides, it concluded that the County was not ready to completely overhaul its existing system and would continue working with others to develop a better process to resolve outstanding issues.¹²⁶

South Burlington, Vermont, adopted a pilot program using blockchain to record land records.¹²⁷ Although programmers determined blockchain “can reduce or eliminate some drawbacks and pitfalls of traditional transactional models, such as processing time, cost, and data integrity,”¹²⁸ for a variety of reasons, it did not adopt blockchain when the pilot concluded.¹²⁹ I met with Donna Kinville, South Burlington’s City Clerk, who indicated that when the pilot ended, several shortcomings persisted, including the time and expense of running dual systems and problems effectively linking documents once recorded.¹³⁰ Ultimately, they needed more time for further study and to consider how to best update longstanding procedures.¹³¹ For example, “Vermont’s land records are largely stored in paper or other analog formats such as microfilm, and many municipalities, as the primary custodians, have little in the way of digital infrastructure to support electronic recording or preservation of records, even if they were able to accept them.”¹³² In addition, “[f]or blockchain to be a candidate for Vermont’s land recordings, some major overhauls would need to be made to State law and standard operating procedures. Inserting blockchain technology into existing processes would add additional overhead with little additional value gained.”¹³³ In sum, although blockchain offered many advantages that could eliminate common title problems, reduce transaction expenses, and enhance security, those benefits were outweighed by the costs. Thus, for now, blockchain is not the best solution to Vermont’s title registry inefficiencies.

125. *Id.* at 43–44.

126. *See id.* at 46–48.

127. *See generally* Vermont 2019 Report, *supra* note 47.

128. *Id.* at 5.

129. *See id.* (“For blockchains to be a candidate for Vermont’s land recordings, some major overhauls would need to be made to State law and standard operating procedures. Inserting blockchain technology into existing processes would add additional complexity with little additional value gained.”).

130. Meeting with Donna Kinville, South Burlington City Clerk (July 14, 2022).

131. *Id.*

132. Vermont 2019 Report, *supra* note 47, at 5.

133. *Id.*

V. IS BLOCKCHAIN THE ANSWER, AND IF NOT, WHAT'S NEXT?

Counties in the United States typically each have their own title offices with individual idiosyncrasies, but they all share common inefficiencies and security flaws. Blockchain and tract indexes avoid many title issues and offer significant improvements. A summary of the Republic of Georgia's titling system said "[t]he immutable and transparent nature of Blockchain could curb forgery of land titles, create an unmodifiable history of land transactions, and allow real-time verification of land ownership."¹³⁴ One commentator noted another strength is that "[b]y keeping relevant chain-of-title documents on a blockchain, government offices will have an organized, efficient, and unalterable system of accessing and adding property records to a publicly shared database."¹³⁵ Digitization layered on blockchain could also eliminate problems with paper files and the time-consuming paper shuffle involved in a real estate transaction. Blockchain replaces outdated paper deeds with true digital assets and tracks changes on an immutable ledger that acts as a secure shared source for documents between multiple parties and organizations.¹³⁶ With all blockchain's promise to improve title registry, ongoing practical and legal obstacles impede its adoption.

If agencies move to blockchain, one practical hurdle is they would have to run parallel systems during the transition, which is labor and resource intensive.¹³⁷ This hurdle by itself is enough to deter many agencies from proceeding. Additionally, blockchain is only feasible if governing laws allow digital records. Cook County faced this obstacle because its only official records are the Recorder's records, which still must be paper documents or scanned versions of those documents. "This means that a blockchain transfer, to be afforded notice in Cook County, must ultimately produce a paper document that evidences a transaction."¹³⁸ Such a policy negates the efficiency goal of moving to blockchain. This archaic position is typical in many counties, increasing costs and reducing efficacy. While individual counties can and have updated their laws to permit digital records, a piecemeal approach hinders progress. States can more efficiently enact legislation permitting electronic documentation of real estate transactions, which can also be done nationally.¹³⁹

Even where digital records are permitted for present and future files, if registries are populated with older paper records or microfiche, or e-records

134. Shang & Price, *supra* note 108, at 73.

135. Matt Koroncok, *The New "Chain" of Title: How Blockchain Will Affect Land Title Research, Recordation, and Insurance*, 5 TEX. A&M J. PROP. L. 401, 405 (2018).

136. *What are the Benefits of Blockchain in Real Estate?*, CONSENSYS, <https://consensus.net/blockchain-use-cases/real-estate/> [<https://perma.cc/HT5B-6FVU>] (last visited Sept. 20, 2022).

137. *See, e.g.*, Meeting with Donna Kinville, *supra* note 130.

138. Mirkovic, *supra* note 36, at 11.

139. *See* Marsh, *supra* note 91, at 25 (suggesting that once we go digital, neither county nor state boundaries make sense, and we should federalize recording rules).

are incompatible with software, problems persist. Either those records will not be part of the new system (which defeats the point of an integrated digitized system), or agencies will have to devote resources to digitize or convert existing public records.¹⁴⁰ Then they must create blocks for each record. These are herculean, but still attainable, tasks.¹⁴¹

Transitioning to a paperless system without wet signatures requires uniform acceptance of e-notarization.¹⁴² Notaries play an important role, verifying that signatories: (1) are who they say they are, (2) have mental capacity, and (3) are freely signing without duress.¹⁴³ Traditional notary requirements made sense in the context in which they developed, but the context has changed. Modern technology allows e-notaries to instantly transfer digital files to a blockchain or tract index and still perform important notary functions when signatories appear in person before them.¹⁴⁴ In order to streamline recording and title searches, e-notarization should be permitted nationally regardless of whether we adopt blockchain, tract indexes, or an alternate system.

Blockchain and tract indexes do not store actual recorded documents, serving a directory function instead. Complete documents cannot practicably be added to blockchain because they contain too much data.¹⁴⁵ Thus, in places like the Republic of Georgia, compatible systems are required to ensure blockchain serves a backend indexing function, while instruments themselves remain stored in the frontend.¹⁴⁶ Alternatively, stored information could be condensed as Cook County recommended, with public records streamlined “to plain-text data inputs, and perhaps a permanent hash value of

140. See Mirkovic, *supra* note 36, at 27 (Cook County worked with Onyx to convert over 190 million files in three months, mark them for security purposes, and align the data to match its indexing systems.)

141. See *id.*

142. Michael Lewis, *Remote Notarization: What you Need to Know*, THE NAT'L NOTARY BULLETIN (July 15, 2022), <https://www.nationalnotary.org/notary-bulletin/blog/2018/06/remote-notarization-what-you-need-to-know> [<https://perma.cc/EZ33-5QWB>] (With e-notarization, “documents . . . are notarized in electronic form, and the Notary and document signer sign with an electronic signature. But all other elements of a traditional, paper notarization apply to electronic notarization, including the requirement for the signer to physically appear before the Notary.”).

143. See Mirkovic, *supra* note 36, at 12 (“Notarization (the process of having a trusted third party confirm the identity of the person signing a document) is . . . hard to accomplish on anything other than paper.”).

144. See Lewis, *supra* note 142. Remote notaries took off during the Covid-19 pandemic, with over 43 states passing laws allowing remote notaries. See *id.* Unlike e-notaries that still meet with clients in person, “remote notarizations typically involve digital documents that are signed and notarized electronically. However they go a step further in that the transaction is conducted online rather than in person.” *Id.*

145. See, e.g., Vermont 2019 Report, *supra* note 47, at 25 (“What is unique to blockchains is the limited amount of information contained within a single transaction. Limited information is necessary for computational efficiency. Decrypting more data costs more.”).

146. See *Georgia Land Titling System*, *supra* note 105.

the sales contract file. Such an effort would make public records more lightweight, more accurate, and more importantly, they would be standardized and look nearly the same across the entire state.”¹⁴⁷ Recorder’s offices are already accustomed to condensing information in existing indexes, thus they would simply have to thoughtfully design compatible blockchain systems.

Since technology always changes, a move to blockchain will require ongoing time and resources to educate users.¹⁴⁸ However, employees working with new systems do not have to be software experts or coders, they simply require training on how to use new systems.¹⁴⁹ With that said, “[a]ny mandate to digitize or otherwise allow electronic recording of land records would likely need to have some funding attached, as many municipal clerks do not have modern technological infrastructure or training to be able to design, implement, contract, or sustain an initiative on this scale without additional funding.”¹⁵⁰

One major legal hurdle arises from blockchain’s relative youth and complexity, resulting in difficulties with determining how to best regulate it.¹⁵¹ Professor Neitz asked professionals what blockchain regulation should address and found “[e]ach of them clearly and unequivocally stated that uniformity of regulation across the United States would be good for business. It would be much easier for blockchain businesses to plan and expand their operations if states were aligned on regulatory issues.”¹⁵² Without a regulatory framework in place, it is unlikely any agency will sink the costs into, or take the risk of, transitioning to blockchain.

Once blockchain regulations are in place, it is essential to review state and local laws to ensure that a blockchain system would comply with existing laws, and if not, to determine how to expeditiously update laws. For example, some states still require paper documents and blockchain might run afoul of archiving requirements.¹⁵³ Moreover, not all states allow e-signatures and many still do not permit e-notarization.¹⁵⁴ Agencies may not have the resources for a comprehensive review and legislators may not consider this important enough to prioritize it. The simplest solution would involve federal legislation authorizing digital documents and e-recording.

147. Mirkovic, *supra* note 36, at 44.

148. *See* Compton & Schottenstein, *supra* note 17, at 8.

149. *See* Phillip Sander, *How can Your Employees be Educated Efficiently to Really Understand Blockchain Technology? Ethereum as a Christmas present*, MEDIUM (Dec. 11, 2018), <https://philippsandner.medium.com/how-can-your-employees-be-educated-efficiently-to-really-understand-blockchain-technology-b5c7bfa6a714> [<https://perma.cc/U3KK-8SCN>].

150. Vermont 2019 Report, *supra* note 47, at 40.

151. *See* Michele Benedetto Neitz, *How to Regulate Blockchain’s Real-Life Applications: Lessons from the California Blockchain Working Group*, 61 JURIMETRICS J. 185, 201 (2021) (“Federal and state regulators are struggling to keep up with the fast pace of blockchain technology development.”).

152. *Id.* at 200.

153. *See, e.g.*, Vermont 2019 Report, *supra* note 47, at 5.

154. *See, e.g., id.*

That may be easier said than done given that it requires moving from the present, county-by-county recording system to an electronic system without boundaries. “Currently, local governments control land transfers. Political resistance to giving up this control would seem likely, unless, for instance, it were part of a broader program to privatize government functions.”¹⁵⁵ Since federal laws and regulations are layered upon different laws in each of the fifty states and thousands of county-level permutations, inefficiencies stemming from recording nuances abound.¹⁵⁶ Uniform acts on e-signatures and recording would certainly expedite modernization, but it remains a formidable task to convince agencies to cede power to the state or even federal laws to achieve uniformity.

Blockchain has other thorny issues which this article does not have space to explore, but they must be resolved before it is widely adopted for title registries. For example, while more secure than current systems, blockchain is not impenetrable.¹⁵⁷ In addition, finding the appropriate balance between privacy concerns and the need for a public record is complicated. Although blockchain cannot solve all recording problems, it has advantageous features that should be deployed when updating recording systems. The Cook County Report recommended that any customized system should include the following features:¹⁵⁸

Designed to be immutable . . . [which] ensures that existing records cannot be changed. [prevents forgery or fraudulent actions]

Distributed or shared – Full copies of each individual office’s land records are stored by each office in the network, thereby automatically creating backups in multiple locations. [this concept should be utilized by any agency that adopts blockchain as part of its protocol]

Non-repudiation – An established and publicly accepted method of digitally signing transactions is used to self-certify acts, . . . or a means for human notaries to attest electronically. [simplifies process and creates digital files]

Designed to be autonomous . . . when the blockchain is deployed, significant coding effort is done up front to ensure that once it begins operation it cannot fail and thus cannot

155. Compton & Schottenstein, *supra* note 17, at 8.

156. See WORLD POPULATION, *supra* note 16.

157. See Stuart Madnick, *Blockchain Isn’t as Unbreakable as You Think*, MIT SLOAN MGMT REV. (Nov. 13, 2019), <https://sloanreview.mit.edu/article/blockchain-isnt-as-unbreakable-as-you-think/> [<https://perma.cc/K4K7-C3TH>].

158. The author’s comments are in brackets.

require constant or even routine maintenance. It should run automatically after data is fed into it and only in the way it was designed to work.¹⁵⁹ [this feature makes it much more efficient than existing systems, thus reducing transaction costs]

A blockchain-based title registry reduces transaction costs by eliminating middlemen and their fees and streamlining real estate transfers, including how deals are documented all the way through recording. It also minimizes fraud and costs associated with avoiding it, uncovering it, and fixing it. It prevents many of the most common title problems and by its nature, DLT has a built-in back up system for recorded documents. Thus, it avoids loss due to fire, flood, computer crashes, and other calamities. Even with blockchain's tremendous potential, it would take immense will, relentless advocacy, time, and resources to convert to it from systems that have developed over hundreds of years. Moreover, co-existing systems would have to be in place during any transition, and it only makes sense with uniform recording laws throughout the country.

There are many ways to use blockchain to resolve title problems and simplify real estate transactions, and even stack some blockchain attributes with existing systems, but the transition costs are presently too high. It would be simpler to shift from grantor-grantee indexes to tract indexes, which will not solve all problems but will avoid or solve many of them. Tract indexes already exist in many states and organize files in a much more efficient, logical, and user-friendly manner than grantor-grantee indexes. Efficiencies can be further enhanced with universal recognition of e-signatures and e-recording, which would also pave the way for adoption of conveyance and recording in a digital one-step process. At the same time, a tract index system could produce a mini-abstract for each tract, while inexpensively and simply reducing the most common title errors. While blockchain has the promise to revolutionize many aspects of how we do business, it is not viable until we establish a stable regulatory foundation and consistent laws.

159. Mirkovic, *supra* note 36, at 17.