Workshop: Amenability of US Healthcare to Blockchain-Enabled Self-Sovereign Identity (SSI)

Workshop slide deck

Thursday, August 10, 2023

Preliminary agenda and housekeeping

When	What	
10:00 am - 10:15 am EDT 04:00 pm - 04:15 pm CET	Welcome message Introduction to the research study	
10:15 am - 10:40 am EDT 04:15 pm - 04:40 pm CET	Topic: Blockchain-enabled SSI properties Activity: Word jam	Priming
10:40 am - 10:55 am EDT 04:40 pm - 04:55 pm CET	Topic: Pre-workshop expert interviews and survey results Activity: Open discussion	
10:55 am - 11:00 am EDT 04:55 pm - 05:00 pm CET	Break (5 min)	
11:00 am - 12:00 pm EDT 05:00 pm - 06:00 pm CET	Topic: Exploring assessment framework components Activity: Card sorting	Designing I
12:00 pm - 12:05 pm EDT 06:00 pm - 06:05 pm CET	Break (5 min)	
12:05 pm - 12:45 pm EDT 06:05 pm - 06:45 pm CET	Topic: Converging on assessment framework components Activity: Dot voting	Designing II
12:45 pm - 01:00 pm EDT 06:45 pm - 07:00 pm CET	Reflection & closing	Debriefing

Housekeeping

- The session will be recorded
- I have to keep track of time and might have to move us forward – thus, I do not do this because I am rude but because I have to in the interest of time

About thing.online

- On the left side, if you pull out the sidebar, you can see the agenda items (thing.online calls them *flows*)
- If you move your avatar close to another avatar until a circle appears, you are having a private conversation with that person, meaning the rest cannot hear it. If you want to leave the private conversation, just move your avatars away from each other until the circle disappears
- If you run into an issue, just text me on WhatsApp (+ 49 15162809750) or send me a LinkedIn message, I am more likely to see that pop up on my phone than an email
- It only works with Google Chrome and on a desktop (no mobile unfortunately)

Introduction to research study

Methodology

Participatory action research study

Objective: Develop a framework for assessing the amenability (= suitability) of US healthcare system use cases to SSI
Unit of analyses: Use case, system

	Goals	Research Steps
Diagnosing	(i) Identification and (ii) definition of primary **problems** to **successful deployment,** meaning value-adding adoption and use, of administrative, technological innovations in the US healthcare system that share one or more characteristics with SSI to substantiate the need for an SSI amenability **use-case assessment**. (ii) Development of a theoretical problem statement based on theoretical foundations	(i) Semi-structured expert interview study and coding (Gläser and Laudel, 2009) with representatives of core HC stakeholders: Providers, payers, payviders, federal agencies, health IT vendors, clinical data exchanges, academia, manufacturers, emerging technology companies, and cross-stakeholders (ii) Qualitative patient survey
Action Planning	(i) Development of amenability assessment model dimensions (i.e., a **method**) based on theoretical foundations (ii) Operationalization of the model and making it qualitatively testable (iii) Identification of implications for SSI endeavors in US healthcare (iv) Initial evaluation of the assessment model	(i) Workshop with (HC) self-sovereign identity experts with a focus on SSI through verifiable credentials
Action Taking	Application of the amenability assessment model w/ HC stakeholders, evaluation of the main proposition(s), and recommendations for action	(i) Semi-structured interviews with HC stakeholders from diagnosing stage: Providers, payers, payviders, federal agencies, health IT vendors, clinical data exchanges, academia, manufacturers, emerging technology companies, and cross-stakeholders (Part 1)
Evaluation	Evaluation of outcomes of the action research interventions: (i) Check interview data for completeness and accuracy (ii) Clarification of whether the assessment model provides a solid basis to prepare the decision-making process as to whether and how to deploy HC SSI (iii) Final evaluation of whether HC SSI use cases can be implemented	(i) Semi-structured review interviews with HC stakeholders from diagnosing stage: Providers, payers, payviders, federal agencies, health IT vendors, clinical data exchanges, academia, manufacturers, emerging technology companies, and cross-stakeholders (Part 2)
Specifying Learnings	Knowledge documentation and communication to stakeholders from (i) research and (ii) practice (i.e., core HC stakeholders and SSI community)	(i) This thesis (ii) Action research documentation (iii) Final assessment model presentation

We are here now

Sources: Baskerville, R. (1999); Baskerville, R. & Wood-Harper, T. (1996); Stairway to heaven or highway to hell: A model for assessing CA use cases

Establishing a common ground amidst interpretational variance

Definitions overview

Amenability
The likelihood of the **successful deployment** of blockchain-enabled SSI in the US healthcare system

Successful deployment
Value-adding adoption and use

- **Value adding:** Realization of the true potential of the technology (i.e., using the technology to its full intended potential; this includes the notion of scalability)
- **Adoption:** All the information gathering, conceptualization, and planning for the adoption of an innovation leading up to the decision to adopt
- **Use:** All the events, actions, and decisions involved in putting the innovation into use

Unsuccessful deployment
Any deviation from a set **goal** with a set **timeline**, and a set **scope**

Unit of analyses

1. System analysis
2. Use case

My thesis operates on two levels of unit of analysis, i.e., (1) looking at the **entire healthcare system** and not just individual actors in a vacuum, and (2) setting the scope purposefully at the **use-case level**

1 System analysis

- The research is purposefully set at a system level, looking at the entire healthcare system as a whole
- Rational:
  - "To understand an organized whole, we must know both the parts and the relations between them"[1].
  - One of blockchain-enabled SSI's properties is strong, positive network effects

2 Use case

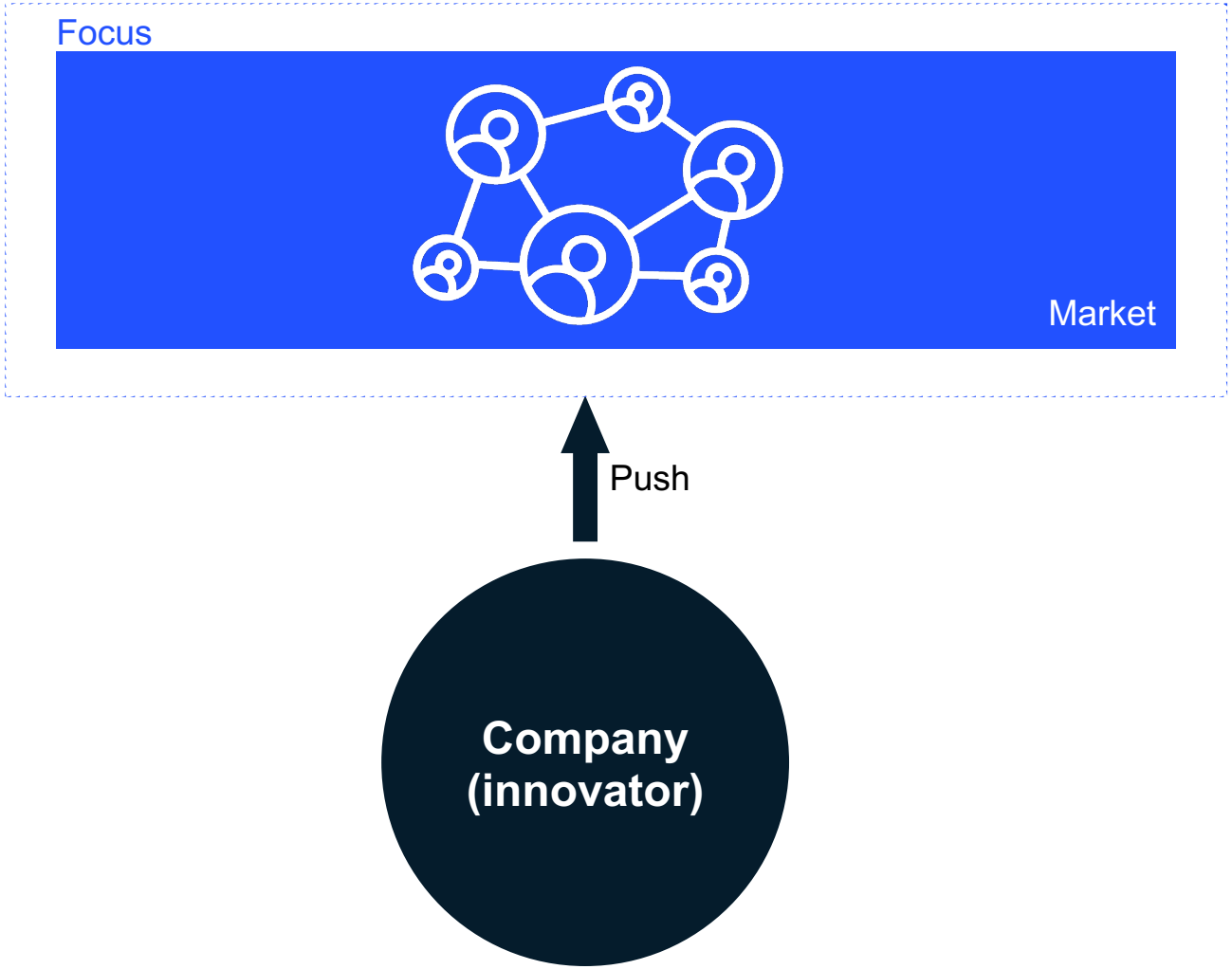
- Use cases can be broken down into a sequence of processes that again comprise several tasks and conditions that determine the task sequence[2, 3].

- Rational to drill down to a use case unit of analysis:
  - Provides boundaries and scope to make an intangible, potentially paradigm-shifting technology like SSI feel more structured
  - Federal agencies operate at the use case level for policies and mandates, and these are often key drivers for the successful deployment of technologies with characteristics similar to SSI (see pre-workshop research results below, slide 43)
  - Aids in identifying the chess pieces that play a role and play out the relative responsibilities of each

Sources: [1]Bertalanffy (1972, p. 411), [2]Van Der Aalst et al. (2004), [3]Goodhue and Thompson (1995)

The study focuses on the market circumstances of adoption and implementation, not the capabilities of the innovator

Study focus lens



It is certainly relevant that the company entering the market with a technology that it wants to see adopted and used has sufficient resources, skills, and resilience, but these aspects are beyond the scope of this study. Rather than that, this study **focuses** on the **market circumstances** that the technology is anticipated to encounter upon its introduction.

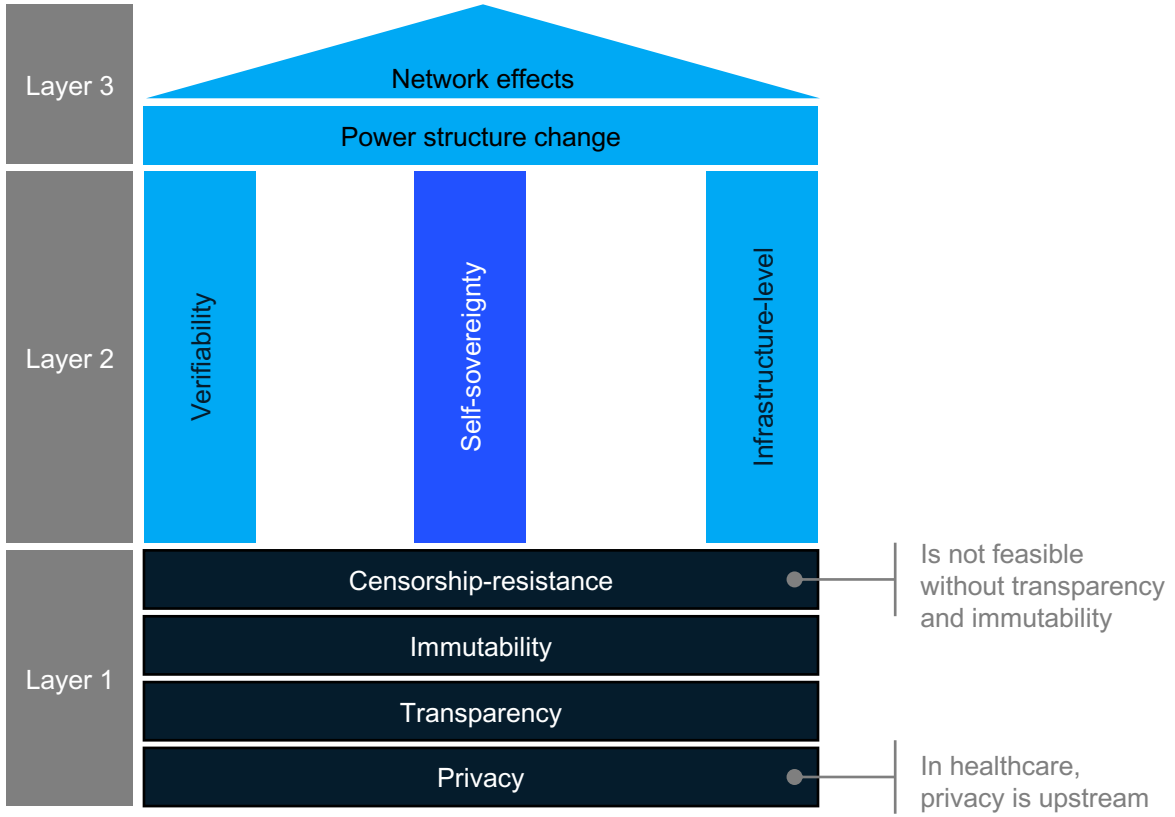
Characteristics of a blockchain-enabled identity metasystem

Defining blockchain-enabled SSI in the healthcare context

Blockchain principles | SSI characteristics

Limitations of current definitions

- Focused on architectural components and principles
- Not MECE



Second-decree

- **Network effects characteristic:** SSI is only useful in conglomerate. It calls for quasi bipolar network effects.
- **Power structure change:** The locus of control shifts from the big players at the center of the network to the periphery

First-degree

- **Self-sovereignty characteristic**
  - All parties to a relationship are considered peers, which means they have equal power and rights. This notion bestows them autonomy about what they request, share, and consent to
  - Sovereignty is non-transferable
- **Verifiability characteristic:** Identity credentials are digitally verifiable instantaneously
- **Infrastructure-level characteristic:**
  - Serves as an identity metasystem with an encapsulating protocol that enables the creation of myriad identity system on top of it
  - Ensures interoperability indexed by scalability across various contexts and interchangeability of different identity technologies operated by multiple providers

Enabling technology

The following first principles of blockchain serve as enabler of self-sovereign identity

- **Censorship-resistance:** Access is public and validation is permissionless; thus, no one can deny access to anyone else
- **Immutability:** All transaction data (not health data) on the blockchain is tamper-proof
- **Transparency:** All protocol rules and transaction data is available for inspection
- **Privacy:** Cryptographic means allow for user data privacy

Sources: Windley (2023), Allen (2016), Ferdous (2019), Cameron (2005), Preukschat & Reed (2021), Malekan (2023), Sovrin Foundation, etc.

Pre-workshop research results

Why is the successful deployment of administrative technology so important?

Implications of unsuccessful deployment

First-order implications

No advancement in better care for people

Degradation of patient care

Second-order implications

Contraction in competent physician care as the physician's energy is being taken towards often uncompensated administrative tasks

Lack of **employee satisfaction**, **burnout**

Lack of **customer satisfaction**

Mistrust and **uncertainty** towards the deployment of any future technology and other stakeholder groups

Loss in momentum and the **window of opportunity** in the space

Financial impact with wasted money, lost profit, delayed billing, and lack of additional financial commitment to drive the deployment process

Escalation of unsuccessful deployment to the C-Suite

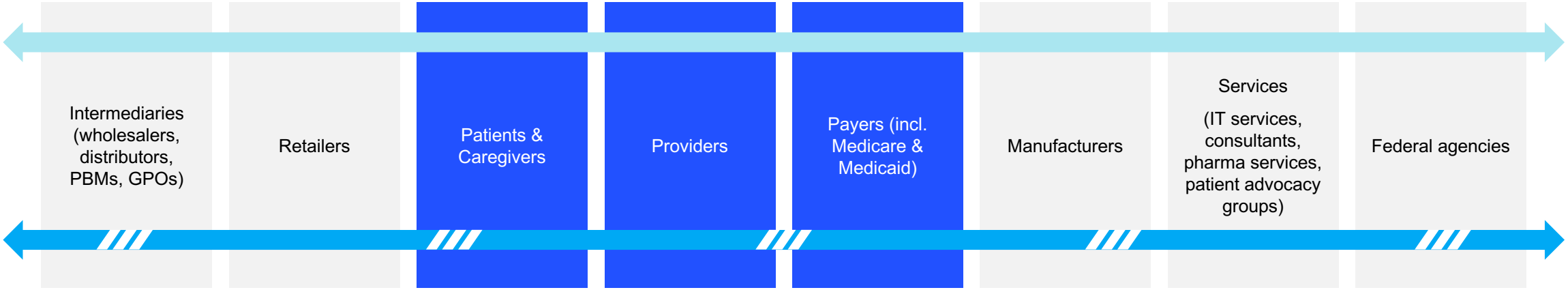
The **vacuum is filled with something** that could be a **worse** outcome

There are two primary data flows, administrative data flow and clinical data flow, in the US healthcare system

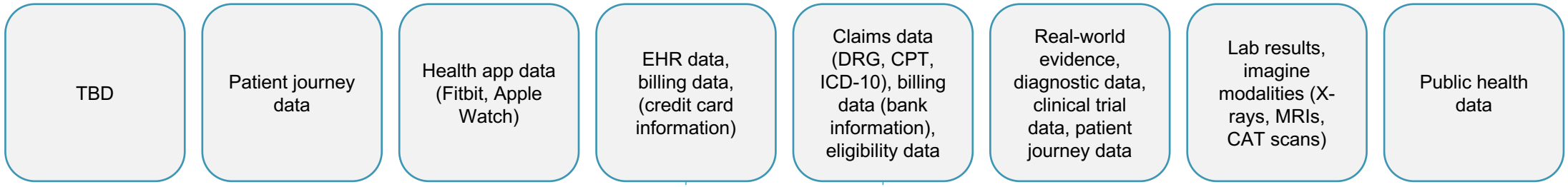
Data flows in US healthcare

Administrative data flow (= data flows to pay for healthcare)
Clinical data flow (= data flows to treat healthcare)
Impaired flow

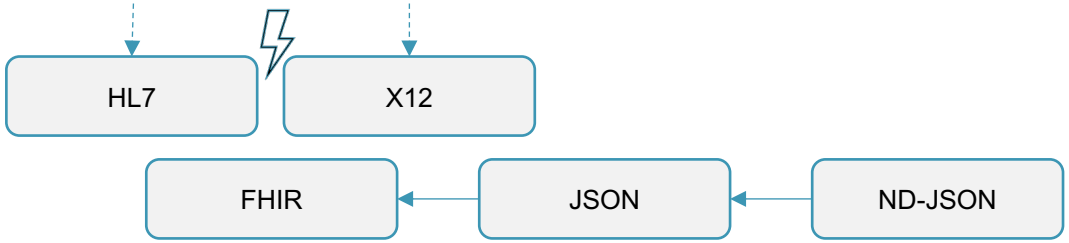
Data sources / holders



Exemplary data sets



Data formats



The following technologies were discussed during the interviews and patient survey

Electronic health records (EHRs)

Standardized data formats (FHIR, X12, etc.)

Blockchain (in general, and in the context of digital identity)

Artificial intelligence (AI)

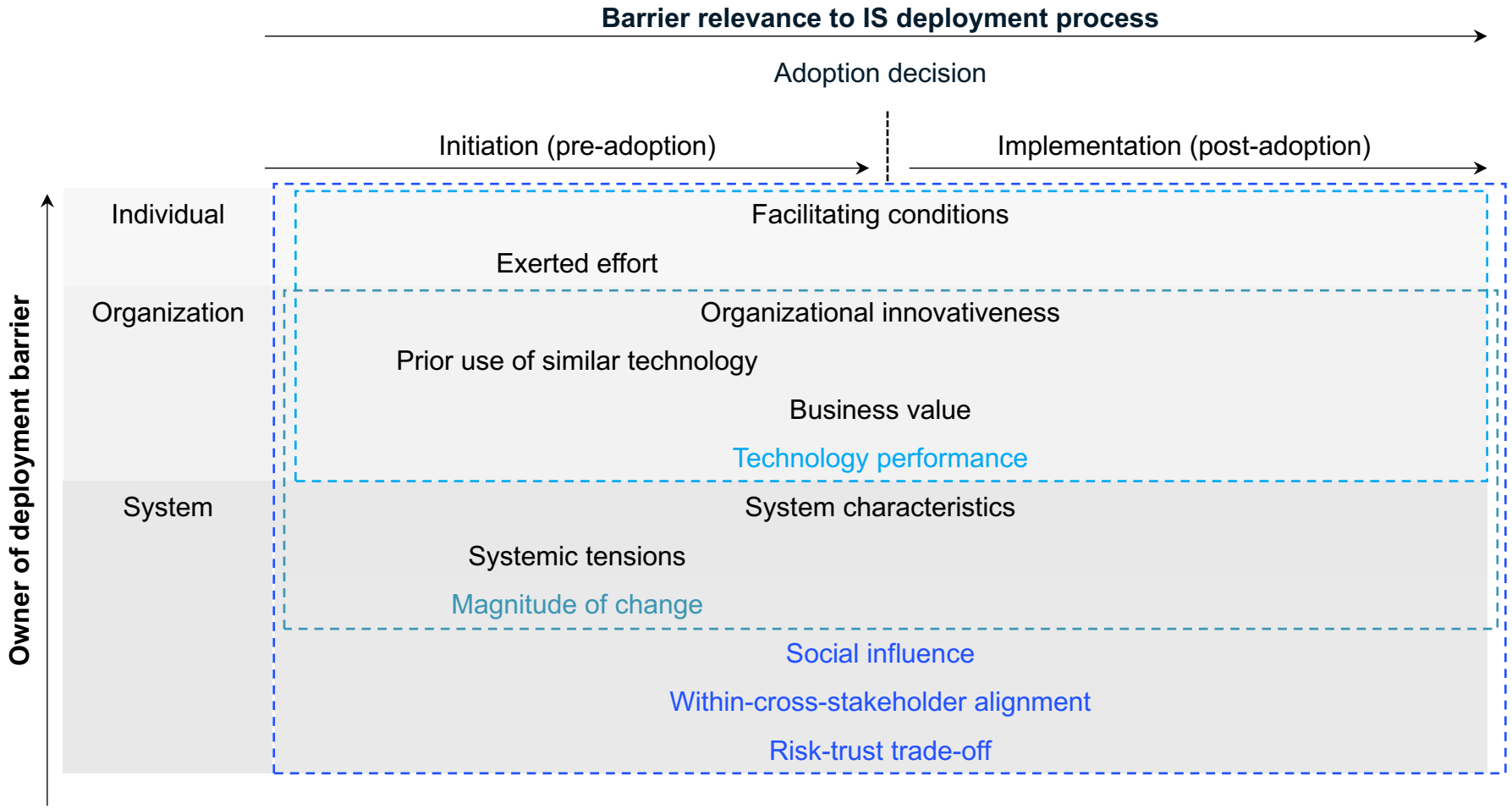
Electronic patient support programs

Technology discussion frequency

Because these technologies were discussed in an administrative context, as opposed to a medical context, they will be referred to as **administrative technologies** from this point forward, although this term might not do justice to all of the technologies involved.

Theoretical foundations for interviews

Variables



Dependent variable: Barriers to successful deployment of multiple stakeholder involving and power structure changing technologies

- **Successful deployment:** (1) system-wide (= critical mass) adoption, (2) system-wide (= critical mass) use, (3) value-adding (= materialization of the true potential of the technology)
- **Initiation:** "All of the information gathering, conceptualization, and planning for the adoption of the innovation, leading up to the decision to adopt" (Rogers, 2005, pp. 420-21).
- **Implementation:** "All the events, actions, and decisions involved in putting the innovation to use" (Rogers, 2005, p. 421).

Sources: Own image but technology innovation deployment process is adapted by Rogers (2005)

Barriers to successful deployment of technologies that share +1 characteristics with blockchain-enabled SSI (1/15)

Owner of deployment barriers: Individual

Theoretical foundation

Barrier relevance to technology innovation deployment process

Adoption decision

Initiation (pre-adoption) → | Implementation (post-adoption) →

Path dependence[1, 2]

Negative past experience with prior technologies
Explanation: Previously, physicians were enthusiastic about new technology-facilitated processes; however, they were frequently disillusioned when it came time to implement them.
Implication: These physicians tend to be more skeptical until a solution has been proven, often assuming that innovation will require additional work.

Excessive technology portfolio
Explanation: Physicians already have too many technologies and applications to handle.
Implication: New technologies need to integrate with existing ones, such as EHRs, to ensure seamless functioning. This may be achieved through strategic partnerships with health IT vendors.

New technology perceived as complementary
Explanation: The new technology is not perceived by users as a replacement for the old one.
Implication: Users either use the two technologies in parallel or revert to the old workflow.

Exerted effort[3-6]

New technology perceived as a burden
Explanation: Physicians are hesitant to adopt and use any solution that takes longer than their current practices. They are driven by metrics, such as the number of clicks required to complete a task.
Implication: If the technology requires more clicks than before, physicians often find unintended workarounds.

Burned out physicians
Explanation: There is a shortage of physicians and healthcare personnel, and they are overworked.
Implication: Physicians often lack the time to familiarize themselves with new technologies. Newly introduced technologies may not be top of mind for them; hence, they do not immediately think of incorporating them into their work. Physicians tend to focus on activities they perceive as valuable, such as their immediate business or family commitments, in order to manage their time efficiently.

Interoperability efforts perceived as uncompensated additional work
Explanation: Physicians do not receive compensation for the improving flow of clinical information within and across organizations.
Implication: They do not voluntarily engage in any activity for which they are not financially compensated.

Complexity of new technologies
Explanation: Frequently, technologies are not designed by clinicians, leading to their complexity, excessive clicking, and diverting physicians from providing patient care.
Implication: Physicians often experience disappointment and frustration with new technologies.

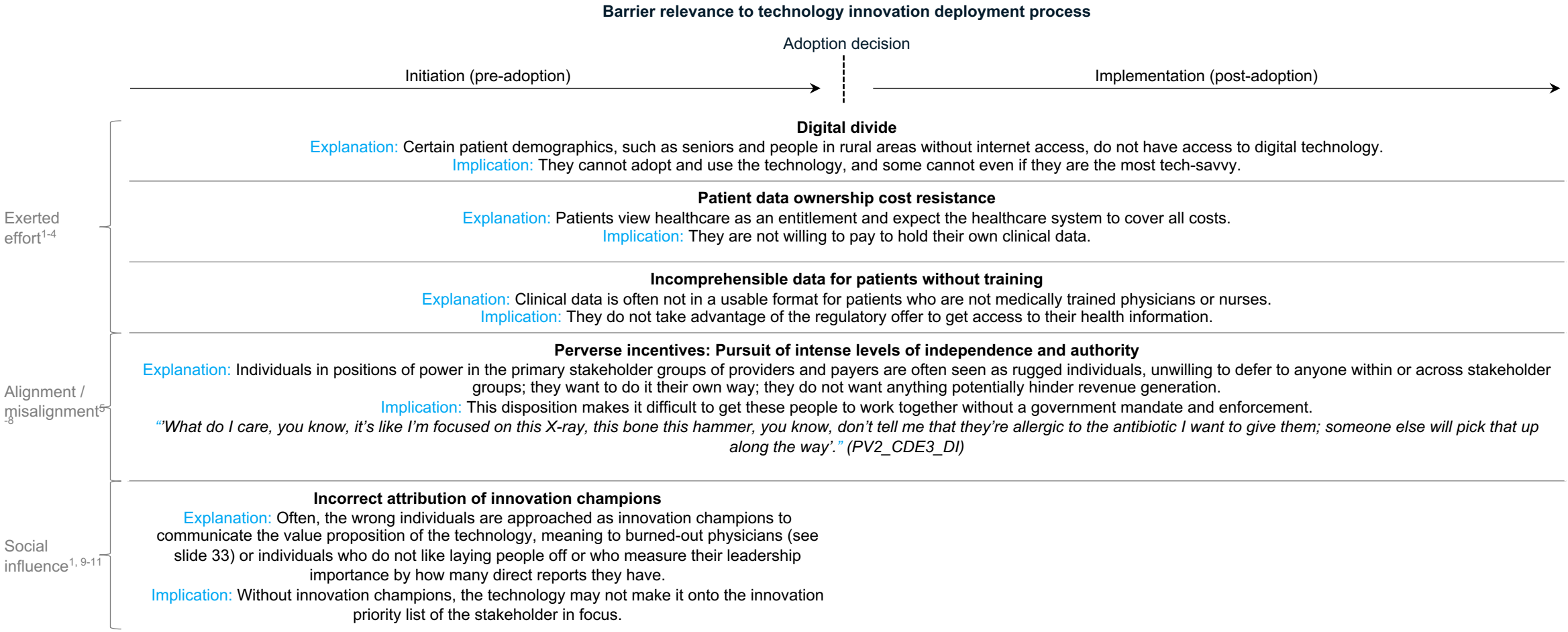
Lack of pain
Explanation: The technology solution does not solve a problem sufficiently painful to be a driver of change for all involved stakeholders.
Implication: It is necessary to understand each stakeholder's pain lens.
"Pain drives change." (M1_DI)

Sources: [1]DiMaggio (1988), [2]Cohen and Levinthal (1990), [3]Venkatesh et al., (2003), [4]Thompson and Graetz (2019), [5]Kruse et al. (2016a), [6]Kruse et al. (2016b)

Barriers to successful deployment of technologies that share +1 characteristics with blockchain-enabled SSI (2/15)

Owner of deployment barriers: Individual

Theoretical foundation



Sources: [1]Venkatesh et al., (2003), [2]Thompson and Graetz (2019), [3]Kruse et al. (2016a), [4]Kruse et al. (2016b), [5]Holmgren & Adler-Milstein (2016), [6]Corsaro and Snehota (2011), [7]Kahn (1969), [8]Hansen and Baroody (2020), [9]Rogers (2005), [10]Kraut et al. (1998), [11]Hao et al. (2018)

Barriers to successful deployment of technologies that share +1 characteristics with blockchain-enabled SSI (3/15)

Owner of deployment barriers: Individual

Theoretical foundation

Barrier relevance to technology innovation deployment process

Adoption decision

Initiation (pre-adoption) → | Implementation (post-adoption) →

Organizational innovativness[1]

Risk-averse leadership attitude

Explanation: Many healthcare executives are risk-averse due to the compensation structure that ties their pay to the organization's performance, and they do not want to bear the consequences if the innovation does not pan out. In addition, because executives in low-margin organizations are focused on keeping the lights on, innovations must fight for executive mindshare.

Implication: These decision makers tend to stick to the status quo and are averse to innovation, so radical innovation tends to lose out in the prioritization process.

Facilitating conditions[2-5]

Workflow incompatibility

Explanation: Many companies have built great software solutions, but they end up forcing physicians to change the way they are used to working. Changing workflows is not a zero-sum game, but someone wins, and someone loses.

Implication: Changing workflows can cause individuals to feel a loss of control or quality of work.

"One of the first things I look at now that I'm an investor, and I'm looking at companies that have cool technology solutions to enable data transfer is, you know, 'How easily does it integrate into the workflow of the doctor or the nurse?', and … there's so many companies I've met that have these really cool, … software solutions they built to do all kinds of analytics and dashboards and, … beautiful ways of representing data, but it ends up forcing the clinician to completely change the way they're used to working to support whatever needs to be done with this platform." (CS2_A2_DI)

Limited process redesign

Explanation: The introduction of a new technology does not always entail process redesign. For example, when transitioning from paper to electronic health records, they still had to document the information. However, the former process involved using pen and paper, whereas the new process uses digital means.

Implication: Some individuals feel disaffected by the new technology.

Generational divide

Explanation: The digitization of healthcare makes older generations of physicians feel like everything has changed since they were in residency.

Implication: They resist with hair and bones against any profound changes.

Competence discomfort

Explanation: Often, healthcare professionals feel incompetent to use software such as EHRs because they are afraid of human error when entering information or clicking the wrong place.

Implication: They prefer to not use them, delegate or go back to the tried and proven.

Sources: [1]Rogers (2005), [2]Venkatesh et al., (2003), [3]Teckert (2020), [4]Dauwed (2019), [5]Kruse et al. (2016a)

Barriers to successful deployment of technologies that share +1 characteristics with blockchain-enabled SSI (4/15)

Owner of deployment barriers: Individual

Theoretical foundation

Barrier relevance to technology innovation deployment process

Initiation (pre-adoption) → Adoption decision → Implementation (post-adoption)

Risk-Trust trade-off[1, 2]

Patient privacy and security concerns

Explanation: For many patients' data movement and ubiquity is not perceived as a desirable state. Many patients do not want their health data to be recorded in the EHR and to be shared with other healthcare stakeholders because they are afraid to be denied future care if the system has all her health information and the data analytics show that she should not be granted access to or reimbursed for a certain treatment. Further they are afraid of general data leaks.

Implication: Digital trust of patients starts to be compromised, leading to lower willingness to share personal health information via the digital medium, turning to making phone calls to schedule appointments. To not have highly sensitive health information recorded in the EHR, patients tend to lie about their (chronic) conditions to their physicians.

Contextual factors of privacy and security concerns

Explanation: The patient's willingness to share data is influenced by contextual factors such as the stakeholder requesting personal health information (PHI), the purpose for which the information is requested, and the type of information requested. This is consistent with the existing literature, although it has been quantitively demonstrated that the type of information requested does not have a significant effect on the willingness to provide access to PHI as all PHI is considered sensitive[1]. Primary care providers are the most trusted by patients as they appear to be genuinely concerned about their health. Compared to primary care providers, hospitals and pharmacies are less trusted. Payers, health app providers, manufacturers, and government agencies are the least trusted. This is due to their perceived self-interest in collecting data and generating profit or their lack of established relationships with patients. In general, organizations with a negative or controversial public image or little perceived authority are less trusted. A relationship with an organization increases its trustworthiness. Furthermore, the quantitative study revealed a relationship that was not identified in the present study, indicating that individuals with negative emotions concerning their current health status are more willing to disclose PHI.

Implication: The context of sharing PHI appears to significantly influence a patient's willingness to share data electronically.

Perception of security determined by system assurance, not inherent technology features

Explanation: Perceptions of a technology's security often rely on circumstantial information. This information may include whether friends and family have used or trust the technology, if the patient had a good experience with the technology before, whether the terms and conditions are reasonable, whether the company providing the technology has had negative press, whether the user can decline to have their data sold to third parties, or whether security measures like complex passwords or two-factor authentication are required. These references are based on the assurances provided with the system rather than the inherent security features and actual capabilities of the technology. This finding is consistent with previous research on this topic[1].

Implication: Patients are likely to place less importance on the specific technical details of the underlying technology than on the safeguards surrounding it.

Technology performance[3-12]

Limited task-technology fit

Explanation: Information technologies are designed to streamline physicians' tasks and improve patient care, but their user-unfriendliness can impede physicians from accomplishing their tasks. Further, health IT systems are often optimized for the billing of healthcare, instead of for patient care.

Implication: Physicians encounter difficulties in reconciling patient care, which is their primary responsibility, and managing various duties like data management, alerts, documentation, and billing that assist or complement their work. This struggle frequently results in a shortage of time for patient care. In addition, optimizing for billing comes at the expense of effective patient care.

Sources: [1]Anderson and Agarwal (2011), [2]Mauwed et al. (2019),), [3]Zhu et al. (2006), [4]Thompson and Graetz (2019), [5]Rathert et al. (2017), [6]Adler-Milstein et al. (2015), [7]Scarbrough and Kyratsis (2022), [8]Martínez et al. (2023), [9]Sahi et al. (2018), [10]Teckert (2020), [11]Kruse et al. (2016a), [12]Kruse et al. (2016b)

Barriers to successful deployment of technologies that share +1 characteristics with blockchain-enabled SSI (5/15)

Owner of deployment barriers: Organization

Theoretical foundation

Barrier relevance to technology innovation deployment process

Adoption decision

Initiation (pre-adoption) → | Implementation (post-adoption) →

Exerted effort[1-4]

High switching costs

Explanation: All existing information needs to be transferred; new and old technology are expected to run in parallel for a while as patient care must continue

Implication: The two IT systems need to be paid in parallel; while the obsolete technology is expected to fade out, it often continues to stick around

"I think that fax machines sitting out there is the big testament to, you know, even though things should go away, they stick around sometimes." (PY2_DI)

Complexity of decentralized technologies

Explanation: While decentralized technologies such as blockchain work well for a zero-trust architecture, in practice, requiring all network validators to maintain their nodes is challenging and requires a certain level of expertise; blockchain-based solutions are perceived as too much of a hassle.

Implication: Stakeholders easily revert to old-school relational database structures.

Magnitude of change[3, 4]

Deep organizational change

Explanation: The more deeply a technology, such as EHRs, is embedded in an organization, and the more individuals touch the technology, the more problems with adoption and use arise down the road.

Implication: Individuals, especially physicians, are apprehensive about software or human error, either on their end because they do not feel knowledgeable enough to use the technology correctly, or because someone else upstream or downstream in the organization has made a mistake.

Alignment / misalignment[5-8]

Perverse incentives: Compensation structure

Explanation: The salaries of employees within the health system are tied to the organization's performance.

Implication: Reducing waste generation, for example, by improving clinical data sharing to avoid redundant treatments and tests, can have negative effects on payroll across the organization.

Perverse incentive: Being number one

Explanation: Organizations strive to be the market leader in their field. For instance, health IT vendors aim to provide more functionality in their systems than their competitors and get everyone to use their platform by making it closed.

Implication: The pursuit of being the best and creating lock-in may harm interoperability and therefore hinder the improvement of patient care.

Sources: [1]Venkatesh et al., (2003), [2]Thompson and Graetz (2019), [3]Kruse et al. (2016a), [4]Kruse et al. (2016b), [5]Holmgren & Adler-Milstein (2016), [6]Corsaro and Snehota (2011), [7]Kahn (1969), [8]Hansen and Baroody (2020)

Barriers to successful deployment of technologies that share +1 characteristics with blockchain-enabled SSI (6/15)

Owner of deployment barriers: Organization

Theoretical foundation

Barrier relevance to technology innovation deployment process

Adoption decision

Initiation (pre-adoption) → | Implementation (post-adoption) →

Business value[1-4]

Absence of a superior business case

Explanation: To be adopted, an innovation's business case must surpass that of others to secure a higher rank in the prioritization list; otherwise, it must be mandated for adoption. The system's narrow operating margins make ROI requirements exceptionally high. Thus, an innovation must demonstrate its profitability and meaningful value from the outset, regardless of its underlying technology. Individuals often prioritize costs over value propositions, given the industry's continuous cost focus and the difficulty of quantifying the latter in many innovations. In addition, the difficulty of quantifying benefits also leads to ROI uncertainty[4].

Implication: The expectation of profit drives innovation in healthcare, and the fiduciary duty to shareholders does not always align with decentralized technology use cases.

"… it's not that … a hospital's looking and saying, 'Well, we could do this interoperability thing, but you know, we think it'd be better not to.' That's not it at all; they're choosing which of their children to feed and which ones they gonna let starve to death." (CS1_DI)

High direct and indirect adoption and implementation costs

Explanation: High implementation costs, maintenance costs, switching costs, opportunity costs, potentially lost business intelligence if the innovation requires data sharing, lost revenue if the innovation reduces waste, such as duplicative testing, legal risks, reduced productivity due to using old and new system in parallel and loss in medical examinations[3], political costs[2].

Implication: Smaller providers and self-insured employers cannot afford such investments. In addition, any major innovation will put the organization on hold for several years, closing it off from other innovations in order to focus on implementation.

"You're doing a brain transplant. … when we're talking about the payer side, the core claim systems when you change those out, it's like doing a simultaneous heart, brain, and lung transplant. But let's say it's just one; you're just doing a brain transplant. In the middle of the brain transplant, would it be a good idea to do another surgery that, say, implement some kind of robotics device that required the brain to do a bunch of things? None of that. You're going to hold the brain function as still as possible." (CS1_DI)

Sources: [1]Zhu et al. (2006), [2]Flessa and Huebner (2021), [3]Teckert (2020), [4]Kruse et al. (2016a)

Barriers to successful deployment of technologies that share +1 characteristics with blockchain-enabled SSI (7/15)

Owner of deployment barriers: Organization

Theoretical foundation

Barrier relevance to technology innovation deployment process

Adoption decision

Initiation (pre-adoption) → | Implementation (post-adoption) →

Organizational innovativness[1,2]

The inherent low-margin core of healthcare

Explanation: Providers, particularly small hospitals, operate on very thin margins of 1%-2%.
Implication: The IT budgets of these organizations are constantly under pressure. Historically, hospitals have spent 2%-3% of their total revenue on IT, while the average American industry spent about 7%-8%. Thus, the IT staff is typically underfunded and must often deal with well-intentioned yet costly government-mandated upgrades and programs, leaving them with a limited budget for additional IT innovations.

Phased approaches to technology adoption

Explanation: Organizations often want to take a phased approach to technology implementation rather than bringing traditional processes to a screeching halt all at once.
Implication: They are slow to adopt new technologies and reluctant to communicate clearly about the process change, resulting in less exposure to social influence as manifested by social contagion and imitation and delaying the onset of network effects.

System closure

Explanation: Some organizations, such as health IT vendors, try to keep their systems as closed as possible, fearing that opening them up to others will lead to data breaches and security problems (see "Organization's privacy and security concerns", slide 41).
Implication: While this benefits these organizations by creating lock-in and serves patients on a cursory level by keeping their data secure, it may be detrimental to the larger patient population as the true intent of these systems, which is to have a complete picture of a patient's health, aggregating all of their health information data points, cannot materialize.

Location

Explanation: While existing literature shows that rural practices report lower rates of innovation adoption due to high-cost in relation to low IT budgets, bandwidth, and patient acceptance barriers[2], the interviews revealed that innovation is most likely to occur in more peripheral settings that are not as strictly regulated by HIPAA, which typically leads to innovation paralysis due to fear of legal risk.
Implication: Location is a strategic consideration in innovation adoption efforts.

Sources: [1]Rogers (2005), [2]Kruse et al. (2016a, 2016b)

Barriers to successful deployment of technologies that share +1 characteristics with blockchain-enabled SSI (8/15)

Owner of deployment barriers: Organization

Theoretical foundation

Barrier relevance to technology innovation deployment process

Adoption decision

Initiation (pre-adoption) → | Implementation (post-adoption) →

Facilitating conditions[1-4]

Absence of objective facilitating factors

Explanation: A shortage of healthcare personnel makes it challenging to provide adequate training that covers all necessary technology capabilities. Training someone also means distracting them from their primary responsibilities, and if the technology is complex or new, it is difficult to find a sufficient labor pool with specialized expertise.

Implication: Without adequate training, individuals may perform tasks in a less efficient and cumbersome manner, if they can perform them at all. Moreover, certain decentralized technologies face challenges in finding enough proficient experts with the necessary knowledge to engage with the technology.

Technology performance[5-14]

Insufficiency of a Pareto superior solution

Explanation: The fact that an idea is Pareto superior, such as in terms of efficiency gains or patient outcomes, is not sufficient for adoption.

Implication: Certain forces exist that cannot be contained by simple Pareto-superior solutions.

"Like when we look around … healthcare system, it's not uncommon to see a fax machine being heavily used … by organization and that's not because there's not better technologies, it's just because like the incentives really aren't there to motivate people to embrace some of those changes." (PY2_DI)

Functional performance setbacks

Explanation: Certain technologies encounter complications during adoption, as is the case with blockchain technology where recurring issues with unsynchronized nodes have been reported.

Implication: Organizations often encounter obstacles when attempting to resolve technology issues. This is especially true for blockchain technology since its nodes have a black-box character and consensus must be reached with other nodes, which requires coordination among involved parties.

Integration hurdles

Explanation: Common challenges include data onboarding of current patients and *conversion*, meaning the uploading of any legacy data the organization may want to keep for recordkeeping purposes into the new format of the new system.

Implication: If the integration results in errors at the next patient visit, data will not flow seamlessly.

Sources: [1]Venkatesh et al., (2003), [2]Teckert (2020), [3]Dauwed (2019), [4]Kruse et al. (2016a), [5]Zhu et al. (2006), [6]Thompson and Graetz (2019), [7]Rathert et al. (2017), [8]Adler-Milstein et al. (2015), [9]Scarbrough and Kyratsis (2022), [10]Martínez et al. (2023), [11]Sahi et al. (2018), [12]Teckert (2020), [13]Kruse et al. (2016a), [14]Kruse et al. (2016b)

Barriers to successful deployment of technologies that share +1 characteristics with blockchain-enabled SSI (9/15)

Owner of deployment barriers: Organization

Theoretical foundation

Barrier relevance to technology innovation deployment process

Adoption decision

Initiation (pre-adoption) → Implementation (post-adoption)

Technology performance[1–10]

Lack of data veracity, authenticity, and timeliness

Explanation: Data is inaccurate due to over- and under-coding, the practice of reporting a different diagnosis than the patient actually had, resulting in a higher DRG (diagnostic-related group) payment from the payer; incomplete; not timely; not secure; and not actionable.

Implications: Delays in patient treatments, significant waste generation, and frequent data breaches are common consequences.

Risk-Trust trade-off[11, 12]

Organization's privacy and security concerns

Explanation: Some healthcare providers are reluctant to accept clinical data via email due to concerns related to privacy and security. Instead, they prefer to receive data via fax. The motivation to adhere to HIPAA regulations and avoid legal ramifications for mishandling clinical data appears to be a primary concern, rather than genuine worries about patient privacy and security. Many organizations view the potential liability under HIPAA as a common concern when it comes to transferring clinical data. In addition, organizations express concern over potential loss of business intelligence that could negatively impact their competitive advantage.

Implication: Organizations share data only to the extent needed to comply with regulatory requirements. Further, organizations' choices on how to implement systems seem influenced by their biases, which may be based on inaccurate or accurate perception of legal requirements and liability. Such biases may hinder systems from functioning optimally. For example, the industry has embraced under-matching of identity data instead of over-matching as a few fear HIPAA penalties. Under-matching refers to a situation where records of the same person are not linked together. While under-matching may lead to duplication and wastage, over-matching, which refers to linking multiple records incorrectly, may result in more severe outcomes, such as diagnostic errors or unintentional disclosure of a patient's health information, leading to financial and criminal liability under HIPAA.

"And so, my analogy of the game of bowling is there's a penalty for the ball going in the gutter on the right there is no penalty for the ball going in the gutter on the left. So, everybody just constantly throws the ball to the left gutter to make sure that they avoid the penalty. Until there's a mandate to say avoid both gutters equally, get the ball down the middle. We can't expect people to try to get the ball down in the middle." (CS1_DI)

Sources: [1]Zhu et al. (2006), [2]Thompson and Graetz (2019), [3]Rathert et al. (2017), [4]Adler-Milstein et al. (2015), [5]Scarbrough and Kyratsis (2022), [6]Martínez et al. (2023), [7]Sahi et al. (2018), [8]Teckert (2020), [9]Kruse et al. (2016a), [10]Kruse et al. (2016b), [11]Anderson and Agarwal (2011), [12]Mauwed et al. (2019)

Barriers to successful deployment of technologies that share +1 characteristics with blockchain-enabled SSI (10/15)

Owner of deployment barriers: System

Theoretical foundation

Barrier relevance to technology innovation deployment process

Adoption decision

Initiation (pre-adoption) → | Implementation (post-adoption) →

Path dependence[1, 2]

Technology repurposing

Explanation: Rather than embracing the new technology, using it, and making it work, proven technology has been relegated and repurposed to fit the need. For example, while claims data flows seamlessly within and across institutions, clinical data does not (see "Architectural design failures", slide 47 for more details); thus, frequently claims data is used for clinical purposes.

Implication: Enormous generation of waste through unnecessary treatments and patients.

Magnitude of change[3, 4]

Shift in power structures

Explanation: Technologies that are decentralized and democratic, that only make sense in a conglomerate and that remove certain intermediaries, are doomed to fail without some overarching force that compels them to behave and work together because of individual power dynamics and competitiveness, i.e., there is a lot of existential fear that the rug could be pulled out from under any of them at any time and a monopoly established.

Implication: Getting such a technology adopted requires different proportions of scalability, bringing together multiple stakeholders, and applying democratic mechanisms to product management.

Alignment / misalignment[5-8]

Perverse incentives: Superior position in business negotiations

Explanation: Stakeholders want to keep any proprietary information on their business management to themselves.

Implication: Stakeholders are apprehensive about sharing data that can be used to conduct correlation analysis and gain insights into their business model and profitability at the level of business components, exemplified by the building of fire walls.

Perverse incentives: Ambition for in-house data retention

Explanation: The stakeholders aim to maintain control of clinical data in-house.

Implication: Organizations prefer to develop their own technologies, including software applications, rather than outsourcing data management.

"One of the other big pharma companies' chief data officers said, 'data is more valuable than oil. And we just don't know what yet, and we don't know how to value it.'" (M1_DI)

Perverse incentives: Diverging sets of incentives

Explanation: Although the US government, being the largest payer in the healthcare system, plays a significant role, the system is operated by for-profit companies that are driven by diverse sets of incentives that revolve around financial gain and status in one fashion or another.

Implication: Organizations are not motivated by the greater good of the system, e.g., reducing waste generation through efforts to minimize duplicate testing; cooperation is hampered, making it difficult to align stakeholders on a collective path, exemplified by decentralized technologies that have governance decisions at their core struggling to take hold; organizations need to understand where value comes from and the underlying incentives.

Sources: [1]DiMaggio (1988), [2]Cohen and Levinthal (1990), [3]Kruse et al. (2016a), [4]Kruse et al. (2016b), [5]Holmgren & Adler-Milstein (2016), [6]Corsaro and Snehota (2011), [7]Kahn (1969), [8]Hansen and Baroody (2020)

Barriers to successful deployment of technologies that share +1 characteristics with blockchain-enabled SSI (11/15)

Owner of deployment barriers: System

Theoretical foundation

Barrier relevance to technology innovation deployment process

Adoption decision

Initiation (pre-adoption) → | Implementation (post-adoption) →

Alignment / misalignment[1] -4

Misalignment of business practices

Explanation: Often interacting stakeholders do not follow the same practices, e.g., describing diagnosis and procedures in different ways

Implication: Hampers progress towards interoperability (see "Technical interoperability deficiency", slide 47 for more details).

Cognitive misalignment: Semantic interoperability

Explanation: It is common for two physicians to interpret the same information differently.

Implication: To achieve semantic interoperability, a significant amount of upfront work is required to establish a common understanding of terminology, ontology, and definitions.

Absence of altruistic inclination

Explanation: Stakeholders aim to have technologies tested for their implementation in the industry, but there is no willingness to bear individual costs; achieving equitable collaborations for all stakeholders involved is complex.

Implication: Piloting for the for the benefit of the community to improve the technology and eventually scale is difficult; altruistic solutions do not work on the long term

Regulatory leeway

Explanation: There is a lack of mandates, manifested by "may" instead of "shall" statements, and enforcement to combat perverse incentives and drive stakeholders to adopt ubiquitous formats and standards; even if there is enforcement, the cost of compliance can often be higher than that of non-compliance.

Implication: The industry tends to change and shuffle around the priority list only when mandated and enforced, and even then, stakeholders weigh up the cost of compliance versus non-compliance; thus, it takes a significant combination of circumstances for the industry to affect major change without government mandates and enforcement.

"The government put out a rule about [hospitals having to publish their price of procedures], and the industry sued. … The court said, 'Congress has this authority because the President has his authority, dear hospitals, you have to publish it.' So, about half the hospitals looked at what the fine was and said, 'I'd rather pay the fine than publish the data.' And you might think … , 'Well, they didn't want to do all the hard work of gathering the data and normalizing and publishing.' It wasn't that at all. … It was that inside that data, where business secrets … of what doctors refer to me, what doctors do I refer to, and how much did I negotiate prices with the different payers. Those business secrets the hospitals believed were so important they'd rather be non-compliant, look bad in the newspaper, and get fined by the government than to comply with the rule." (CS1_DI)

Policy dilemma

Explanation: Federal agencies are faced with the dilemma of directly regulating certain issues, requiring relevant actors to meet respective milestones, and engaging with industry early in the regulatory process to entice them to move them down a particular path even without a mandate in place

Implications: Federal agencies have to navigate between laggards, those who need a stick, and stakeholders who are willing to innovate early.

Sources: [1]Holmgren & Adler-Milstein (2016), [2]Corsaro and Snehota (2011), [3]Kahn (1969), [4]Hansen and Baroody (2020)

Barriers to successful deployment of technologies that share +1 characteristics with blockchain-enabled SSI (12/15)

Owner of deployment barriers: System

Theoretical foundation

Barrier relevance to technology innovation deployment process

Adoption decision

Initiation (pre-adoption) → | Implementation (post-adoption) →

Alignment / misalignment[1-4]

Regulatory ineffectiveness

Explanation: Final regulations tend to be repeatedly postponed; when they are enacted, they often (a) are not comprehensive enough, leaving loopholes for targeted stakeholders, (b) lenient (see "regulatory leeway" above), demonstrating a desire to be evolutionary rather than revolutionary, while some provisions are so tightly regulated down to the protocol that they stifle innovation, (c) shift too much of the burden of achieving specific policy goals onto one stakeholder group (e.g., the primary beneficiaries of the data are not those involved in the up-front data collection, or one-sided investment is required), (d) fail to address perverse incentives by not compensating for the imbalance created by changing the system, and (e) come as an afterthought while the industry has already moved forward.

Implication: A situation is created in which not all stakeholders are enthusiastic about moving the case forward but feel disenfranchised about doing work for which they see no value or are not adequately compensated; federal agencies have a highly complex task of aligning business interests with policy interests and accommodating all stakeholder needs on the table and predicting the share of free market capitalism.

Social influence[5-8]

Cold-start problem

Explanation: No stakeholder wants to be the first to adopt a technology.

Implication: To overcome the cold-start problem in healthcare, it is necessary to build on the existing legacy processes rather than initiating something new and revamping everything.

Lack of same-side and cross-externalities

Explanation: The level of adoption has not yet reached the point where positive network effects set in, and the technology reaches escape velocity.

Implication: The technology is not unlocking the value it was intended to.

System characteristics

Size of the US healthcare system

Explanation: The healthcare system in the United States accounts for around 20% of the Gross Domestic Product (GDP). With expenses amounting to approximately $4.3 trillion, it is comparable in size to a small country.

Implication: Approximately 30% of the system's processes result in waste due to fraud, abuse, mistakes, duplications, and unnecessary procedures. Consequently, there is a general effort to reduce costs without considering the negative impact on downstream factors, such as patient care. In theory, policies could eliminate the significant waste that is so intractably built into the system. However, the waste is so substantial that it would result in the eradication of numerous livelihoods in absolute terms. Effecting real change within this vast system is enormously challenging.

"If you were to take all of the healthcare in the United States, all the spending, … and you were to make it a country, a sovereign nation-state, it would be the fourth largest country in the world; it would be larger than Germany. … When you have a system that large - I forget, I think the last statistic I saw said one in nine Americans works in the US healthcare system - when you have a system that large, a good idea doesn't change it. A Pareto superior solution does not change it. A PowerPoint does not change it. A single law, even as big as something like the ACA [Affordable Care Act], doesn't change it." (CS1_DI)

Sources: [1]Holmgren & Adler-Milstein (2016), [2]Corsaro and Snehota (2011), [3]Kahn (1969), [4]Hansen and Baroody (2020), [5]Venkatesh et al., (2003), [6]Rogers (2005), [7]Kraut et al. (1998), [8]Hao et al. (2018)

Barriers to successful deployment of technologies that share +1 characteristics with blockchain-enabled SSI (13/15)

Owner of deployment barriers: System

Theoretical foundation

Barrier relevance to technology innovation deployment process

Adoption decision

Initiation (pre-adoption) → | Implementation (post-adoption) →

System characteristics

Medicare as a driver of change in the system

Explanation: The majority of patient flow and reimbursement comes from Medicare, a government-sponsored and -run health insurance program (between 58% and 64% of every healthcare dollar is spent by the government).

Implication: With providers heavily dependent on Medicare patients and cash flow, Medicare, as a slow-to-change, inefficient, and poorly run government agency, acts as an oversized influencer and director of change in healthcare.

Healthcare being a business

Explanation: The US healthcare system is not state-run but by for-profit companies, despite the government having some control, and those for-profit companies have a fiduciary duty to their shareholders.

Implication: Despite healthcare's noble purpose to improve the health of the population, healthcare is not a charitable sector; it is a business. Ultimately, the patient is the product, meaning there is an opportunity to make money at every step of the patient journey.

Subsector oligopolies

Explanation: Often, a few large companies dominate a particular space, such as Epic and Cerner in health IT.

Implication: Many stakeholders are beholden to these companies. For example, in health IT, the large health IT vendors, due to their oligopoly, try to find the lowest common denominator, making it difficult for users of these services and products to influence the technology roadmap.

Healthcare's hallmarks of inter-connectedness and obligation to never stop

Explanation: Healthcare is inherently tied to the ongoing health and well-being of individuals and populations; it can never stop. It is very fraught with humanity due to its emotional, personal, and private nature. In addition, everything in healthcare is interconnected, meaning that a failure in one part of the healthcare system will affect downstream processes.

Implication: Technology they rely on is not allow to fail them ever, or it would come not only at the detriment of the bottom line but patient safety.

Normalization of IT failures

Explanation: Failed IT implementations, failure defined by going back to what there was before, are common in the industry; thus, IT failures are normalized.

Implication: While they might shine a bad light onto the leader, they tend not to be career-ending neither for the individual employed by the company that made the decision and oversaw the failed effort nor for the vendor who failed to bring the implementation to bear as in other industries might be the case.

Federative nature of the US

Explanation: State and federal efforts and laws often work in opposition to one another.

Implication: The healthcare stakeholders are confused, uncertain, and hesitant to act due to fear of non-compliance with regulations, which hinders the pace of change.

Barriers to successful deployment of technologies that share +1 characteristics with blockchain-enabled SSI (14/15)

Owner of deployment barriers: System

Theoretical foundation

Sources: [1]Talcott Parsons (1951), [2]Functionalism and social change – Parsons, [3]Anderson and Agarwal (2011), [4]Mauwed et al. (2019)

Barriers to successful deployment of technologies that share +1 characteristics with blockchain-enabled SSI (15/15)

Owner of deployment barriers: System

Theoretical foundation

Barrier relevance to technology innovation deployment process

Adoption decision

Initiation (pre-adoption) → | Implementation (post-adoption) →

Technology performance[1-10]

Architectural design failures

Explanation: The healthcare system has two distinct types of data flows: the flow of data for healthcare payments (known as claims data) and the flow of data for treating patients (known as clinical data). The healthcare system is mainly designed to handle the flow of data for healthcare payments rather than the flow of clinical data. This can be explained by several reasons: (a) HIPAA (The Health Insurance Portability and Accountability Act) created a safe harbor for the movement of healthcare data for payment purposes, which made people more willing to use it, (b) standardized and ubiquitous formats were established, (c) standard code sets were developed, (d) the systems were capable of working with the new data standards, and (e) payment tends to be the top priority for stakeholders.

Implication: Clinical data does not flow, is not easily accessible, and its user-unfriendly organization impeding physicians from effectively carrying out their primary responsibility of patient care.

Scalability constraints

Explanation: The lack of standardization and ubiquity can constrain scalability. For example, electronic medical records have encountered scalability problems while attempting to resolve the challenge of developing technology that is versatile enough to be implemented and utilized in various settings, while still accommodating the tailored needs of their clients.

Implication: The market's demand for high levels of customization often impedes scalability and, thus, ubiquity.

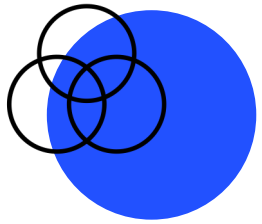
Technical interoperability deficiency

Explanation: Technical interoperability requires (a) standardized, ubiquitous formats (which can be more easily thought as envelops), (b) standard code sets (which can be more easily thought as the common understanding of the alphabet used to write the letter that goes in the envelope) to describe diagnoses and procedures in a unified way, and (c) systems that are capable of working with these standards. However, past efforts in the US healthcare system failed to meet one or all of these three requirements. Often, different code sets are being used even within health systems to address the varying needs of different departments.

Implication: Achieving technical interoperability requires the presence of all three elements. The use of different code sets even within health systems explains why departments in the same organization my be unable to communicate with each other.

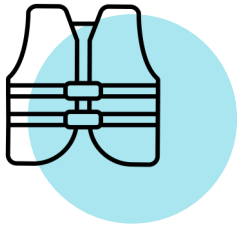
Sources: [1]Zhu et al. (2006), [2]Thompson and Graetz (2019), [3]Rathert et al. (2017), [4]Adler-Milstein et al. (2015), [5]Scarbrough and Kyratsis (2022), [6]Martínez et al. (2023), [7]Sahi et al. (2018), [8]Teckert (2020), [9]Kruse et al. (2016a), [10]Kruse et al. (2016b)

Key takeaways



Depending on the administrative technology in focus they **share** different **characteristics** with blockchain-enabled self-sovereign identity:

- Power structure change
- Network effects
- Immutability
- Transparency
- Privacy



The implications of **unsuccessful technology deployment** are **detrimental** in healthcare, given that it is in the game of life.

There is a **need for an assessment framework** to determine the U.S. healthcare system's amenability to blockchain-enabled self-sovereign identity.

Development of the assessment model

Let's imagine the CEO of Trinity Health shows interest in SSI …

Assessment framework setting

Dr. Richard J. Gilfillan, is the CEO of Trinity Health, the 5th largest health system by net patient revenue ($20 bn)

Richard went to a healthcare conference and heard his colleagues discuss about SSI and got curious

However, Richard is not an SSI expert and, thus, would like to assess whether it could be put to use in Trinity Health

While IT failures are normalized in the industry, he is highly driven by status and identifies himself through his successes

Richard needs an **assessment framework** to **help him make the decision** of whether certain use cases at Trinity Health are suitable for SSI

Theoretical foundations of the assessment framework

Structural and conceptual guidance:

1. Leverage **the explanatory structure** of process virtualization theory by Overby and Konsynski (2010)
2. Leverage the **innovation adoption process** by Rogers (2005)
3. Lean on the amenability assessment framework approach taken by Christoph Engel et al. (2023)

Theoretical guidance:

1. Theories of innovation adoption / diffusion research
2. Expert interviews

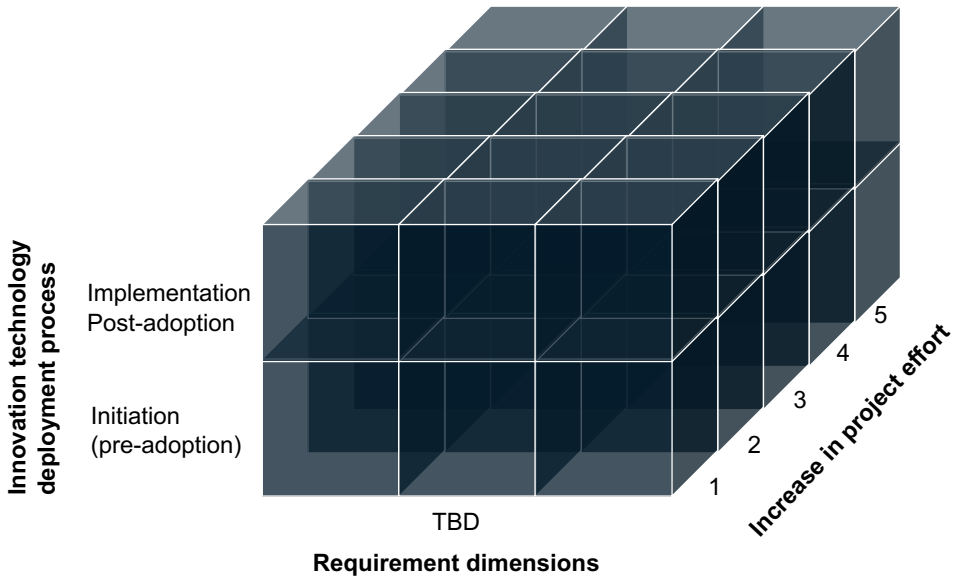
The **concept** behind the framework i.e., the foundations and walls of a house

A first set of dimensions for a blockchain-enabled SSI use case in terms of the requirements of its characteristics i.e., the interior including furniture of a house

The assessment framework we build will act as a decision-support tool to determine the degree of a use case's suitability to SSI

Workshop objective

Concept behind the assessment framework



Main proposition

The higher (lower) the level of a certain requirement dimension, the lower (higher) the amenability of a use case for blockchain-enabled SSI

1 = disagree 5 = agree

	Increases project efforts					
	1	**2**	**3**	**4**	**5**	
Assessment constructs	Requirement dimension A					Pivotal comments
A						
B						
C						
…						

Next steps

1. **Transcription:** Transcribe and review the workshop

2. **Analysis:** Analyze the identified requirement dimensions

3. **Operationalization:**
   - Identify further constructs from the existing literature
   - Develop a set of closed questions for each construct

4. **First evaluation:** Conduct a first assessment of the retrieved model dimensions by a healthcare SSI expert who did not attend the workshop

I’d love to get your feedback on the workshop!

Please take out your phone to scan the QR code

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