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Emerging Technology IS Course Design: Blockchain for Business Example

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Abstract:

IS curricula require constant updating to accommodate the emergence of new technologies. Designing and delivering effective emerging technology courses within the constraints of existing programs remains an important challenge faculty face. This paper presents a template for approaching these courses from a learning theory perspective. Results of tests of this template, developed for teaching blockchain, indicate that it successfully strikes the balance needed in an IS program while simplifying the work of designing the structure of an emerging technology course. Additionally, this design was able to deliver this success in an online format, which can be a more challenging format for observing application of knowledge. Blockchain is a disruptive emerging technology opportunity for businesses to unlock value through trusted and "smart" peer-to-peer transactions, wherein smart means businesspeople can custom design processes for verification and transfer of assets. The blockchain example provided here includes a flexible 7-scenario design targeted to enable a constructive, project-based learning approach focused on authentic learning experiences. The template as applied to blockchain may be used directly or adapted for easier development of other emerging technology courses.

Keywords: Emerging Technology, Pedagogy, Blockchain, LinuxOne, Hyperledger, Teaching Blockchain, Scenario-Based Teaching, Transaction Processing System.

[Department statements, if appropriate, will be added by the editors. Teaching cases and panel reports will have a statement, which is also added by the editors.]

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1 Introduction

Delivering emerging technology courses presents a uniquely difficult challenge that must be addressed for a complete information systems (IS) program (Leidig & Salmela, 2021). Emerging technology represents the unknown businesses are trying to understand as they seek competitive advantage (Fenn & Raskino, 2008). They hire students wanting them to bring knowledge of emerging technologies to assist in developing new products and services. Delivering the emerging technology knowledge and skills to students is uniquely difficult as compared to more typical courses because the content is unstable. Access to the tools may be very limited. Faculty probably will not already have the exact technical skills and will need new training. Further, there may not be extra pay or incentives for faculty to pursue the training and develop the courses. This paper presents a template we developed and tested for designing and delivering an effective emerging technology IS course that addresses these challenges. The test centers on delivering blockchain for business knowledge and skills in an emerging technology elective course in an IS program to IS majors as well as non-IS majors. To begin, we situate this example by mapping the course at a conceptual level to prior content within IS so that the emerging aspect can be connected into the existing corpus of IS knowledge for easier uptake and integration. That mapping begins with the next paragraph here in the introduction.

Since the earliest efforts at conducting business digitally in the 1960s and 1970s, effectively representing, conducting, and managing transactions has been the dominant concern. Systems like American Airlines' SABRE for distributed airline ticketing started in 1970 became early successes because they could reliably deliver the correct ticketing and assure payment. These early systems became trust brokers in part because they were backed by large industry brands. Today the opportunities are changing due to blockchain.

Blockchain technology enables peer-to-peer (disintermediated) transactions to be verified with an algorithmic hash on a shared ledger rather than a central trust broker. It also allows customization of processes and data storage in relation to the transaction objects by individual blockchain designers. Finally, it can be an open technology with a set of tools that has become usable for technically-minded business people. It was emerging when we began this project in 2018 and remains within the hype cycle, a sign of being emerging, even as of writing of this paper ("Gartner Hype Cycle for Blockchain and Web3, 2022," 2022). Thus, businesspeople and academics need to understand this new opportunity and figure out how to incorporate it.

Academic courses on transaction processing systems (TPS) started to show up in the late 70s, mostly in business schools. These gradually faded out and became a single chapter in intro to Management Information Systems courses. Today, not a single U.S. IS program out of 509 AACSB-accredited ones surveyed in 2017 reports having such a course (Clark et al., 2017). We can assume from this observation that TPS has changed little in recent times and requires little special focus. Unfortunately, the same analysis indicates almost no curricular presence of emerging technology courses either. It seems more likely that even though technology has changed (ie. blockchain is revolutionizing TPS opportunities right now) and there may be important new related topics, the difficulty of finding and incorporating them into teaching impeded innovation. We need examples and models to enable emerging technology teaching in IS. Courses should now be designed to teach blockchain for business, but to make that happen we need justification, templates, examples, and methods to make that easier. This paper addresses this need.

In the following sections we will present a scenario-based template for delivering both theoretical and technical (hands-on) emerging technology knowledge to a mix of students, many of whom have little or no technical background in computing. This course in which we tested the template relies on seven industry-situated scenarios to contextualize the new opportunities afforded by blockchain and initially partnered with a leading blockchain deployment technology vendor to deliver the technical experiences.

2 Course Design and Theoretical Approach

Emerging technology in relation to the information systems (IS) field is information technology undergoing considerable development and experimentation and which exists in markets characterized by early stages of a hype cycle when finalized architecture has not stabilized and the industry is still not consolidated (Fenn & Raskino, 2008; Milovich et al., 2020). Emerging technology courses are not only requisite to information systems curricula (Leidig & Salmela, 2021), they present specific challenges regarding core theoretical approaches to teaching and learning (Anderson, 2016). The chief dilemma is that objectivist learning theory suggests the professor needs to be the source of knowledge. Meanwhile, the emerging technology is still emerging, and there are many unknowns making it very difficult for anyone to already know enough to simply encapsulate and convey adequate knowledge. Because social contexts of use for emerging technologies are still developing, knowledge of the technologies will need be acquired and fit into the existing frameworks people have, and we cannot fully know in advance where the best fits will be. These latter aspects imply a need to add constructionist and constructivist approaches. Briefly, a constructionist approach in our IS context means experiencing the tool itself in order to understand what are potential affordances within designs and how one may create them (Resnick, Mitchel & Kafai, 1996). An affordance is a socially situated understanding of how to use a technology communicated by its designs. They are a way to convey effective usage to users through design decisions. These affordances are critical to IS success as they can explain how users will get real value out of specific deployments of technologies such as social media (Leidner et al., 2018) or big data analytics (Lehrer et al., 2018). Constructivist means enabling students to develop meaning through interactive and iterative experiences with the subject matter in ways that enable them to integrate their emergent understandings with their prior knowledge thereby enabling deeper understanding and longer term retention and re-applicability of knowledge (Ackermann, 2001).

This mix of three theoretical approaches needed for optimizing delivery of emerging technology courses leads to a need for project- and problem-based learning via cases and hands on experiences (i.e., constructionism) (Hung et al., 2006; Nilsen & Purao, 2005). This tension exposes the problem that the IS faculty member will not likely be able to serve as the sole expert in an emerging technology course (i.e., objectivism), rather they will need to cultivate “techno-savviness” by tapping into student capabilities and shared contexts (i.e., constructivism) (Li et al., 2021). It also underscores the pedagogical difficulty, as a given faculty member must be flexible and able to handle multiple approaches comingled.

We need not discuss how to deliver objectivist understandings here as developing and delivering lectures is very common and not the central challenge for teaching emerging technologies. There is a literature on developing more effective lectures, but we will leave that to the reader to pursue if needed. Instead, we focus on incorporating the second two approaches. One method for creating the needed context for constructivism is to develop an applied case assignment requiring students to imagine the technology in a specific setting and elaborate on its deployment through scenarios, as in using blockchain technology to solve a lettuce supply chain issue (Milovich et al., 2020). The limitation of such an approach is that students may not get hands on experience with the technology (i.e., constructionism) if the scenario simply requires theoretical extrapolation. In such a case, students would not get as much tangible value from the project- or problem-based curricula because their capacity to imagine and fully understand the capabilities and limitations of the emerging technology would likely miss actual constraints in the deployed real environment (Brigid J. S. Barron et al., 1998). Further, developing an understanding of the technology would also be enhanced by exposure to a range of scenarios across industries in which it may cause digital disruption (i.e., the iterative aspect of constructivism) (Case et al., 2019). Having a range will increase the likelihood of students acquiring cognitive flexibility and adaptability skills (Spiro et al., 1994). To better extend the learning to achieve a balance of technical and managerial skills, such scenarios should be enhanced with hands-on technology experience of some sort, which can be achieved through active learning using platforms provided in cooperation with industry partners (Gricar et al., 2005).

Another design consideration for our teaching approaches is reflection. Contructionism requires opportunities for reflection. Because the context will need to be elaborated and is unlikely to already be fully known by any participant in the class, reflection becomes more important as a means for learning about the usefulness and usability of the technology (Schön, 1987). This reflection need equally applies to faculty as well, as they will need to be integrating new knowledge, particularly in a first teaching of such a course but also as new iterations of the technology emerge and need to be integrated into the course. Such reflection will be aided by deploying a four-phase process of co-presence with the technology, initial descriptions, analysis and then experimentation (Rodgers, 2002). We can deliver this with hands-on scenarios in an emerging technology course using a design encompassing these four phases.

A final concern for developing an IS emerging technology course is the overall progression of experiences across the course from beginning to end. One well-known model for knowledge scaffolding in course design is Bloom’s taxonomy (Bloom et al., 1984). It presents a cognitive processes hierarchy we apply to the blockchain emerging technology learning as follows:

- identify and define the technology (B1 - remember)

- do B1 within varying applied contexts (B2 - understand),
- setup the technology and run it (B3 - apply),
- analyze a technical deployment to understand how it works (B4 - analyze),
- evaluate usage value in terms of business process and management needs (B5 - evaluate)
- develop and implement improvements to smart contracts and retest B5 (B6 - create)

As Bloom's taxonomy provides a 'best practice' approach to teaching complex thinking and concepts, this design offers a reusable template for designing other IS emerging technology courses as well (Figure 1). The overall approach begins with developing and delivering a short overview of the technology using articles, guest speakers, personal knowledge, and other sources gathered by the professor and assembled into one or more objectivist presentations. The next step focuses on students learning the affordances of the technology and how to express them through technical designs using at least two hands-on scenarios. At this point they should get a strong sense of how the technology can be deployed and what real design options exist within a given version or platform selected by the professor and possibly developed with a vendor. This tangible learning prepares them to analyze and evaluate the technology for opportunity and value within business processes. The next step presents them with a decision model of some sort, perhaps expressed in a decision tree or set of criteria, for understanding when and why to select the technology versus existing alternatives (again objectivist). Ideally, this step will be grounded with one or more articles from reputable (non-vendor) sources suggesting guidance. Once they have this decision framework, the next step is to apply it in 2+ managerially focused scenarios in contexts different from the technical ones earlier. Finally, students complete one or more scenarios in which they manipulate the technical implementation, assess business value, and then manipulate it again to evaluate the improvement as a mastery activity putting together all dynamics learned in the course. In the following sections, we will walk through our process of applying the template.

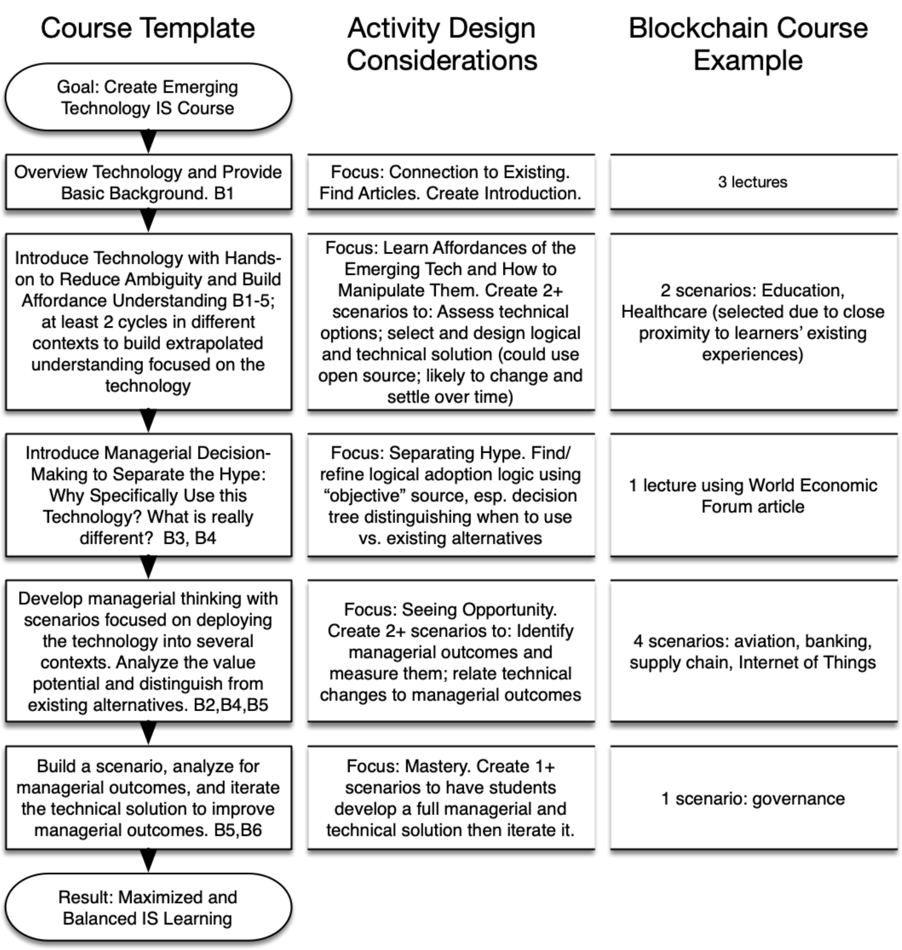

Figure 1 Course Design Template for Emerging Technology IS Course

2.1 Context Selection and Template Application

Within theory of knowledge and learning, there is a notion that context adjacency enables easier creation and integration of new concepts by enabling the relation via schemata (Wadsworth, 1989). The implication for an emerging technology course is that the designer must consider the larger domain and its history and select existing concepts that best fit together with the known aspects of the emerging technology to be taught. Another way to think of this aspect is to consider that in design science research we identify a kernel theory concerning the distinguishing technology capabilities in a potential context (Walls et al., 1992). We are identifying here the extended kernel properties to explicitly include in the learning.

To illustrate, take the target technology to be blockchain and the domain to be information systems (IS). Within IS, blockchain fits into the topic of transaction processing systems (TPS), adding aspects like assurance and verification. Traditionally, the underlying context and learning goals for TPS course would focus on a list such as the following which we developed when brainstorming and initially designing the course (note that we probably should have added in verification and failure handling as they were important in TPS too):

1. Batch versus immediate processing
2. Data capture and transmission methods
3. Contexts (examples) for TPS
4. Queues and conflict resolution

Blockchain technology innately handles items 1,2 and 4. Transactions are cleared as they are entered (1). Protocols are IP-based, typically over port 80, and each transaction is immediately sequenced and confirmed (2,4). Contexts of use are still needed (3,5). What blockchain technology adds to the TPS space is the concept of ownership and digital access (6), intentional design of smart contracts and rules governing transaction behaviors between peers (7), and interface designs and other methods for conveying assurance to build trust (8) These latter four contexts can then become a focus for the emerging technology learning in each scenario:

5. Contexts (examples) for Blockchain
6. Ownership (private versus public)
7. Design of P2P (Peer-to-Peer) transactions (rules)
8. Methods embedding in processes to build trust

In the next sub-sections, we present seven industry scenarios. At this point in applying the template, the faculty would brainstorm potential scenario contexts for the emerging technology and then analyze them to identify the best opportunities for hands-on demos based on their knowledge of the technology, any offerings from vendors, practitioner guidance, and online available tutorial content. Then, they can develop them. We developed these seven as we applied the template: education, healthcare, aviation, FinTech, supply chain, Internet of Things (IOT), and governance. As presented in column 3 of Figure 1 of the template, the scenarios are designed to enable exposure to technical, managerial, and mastery tasks. From a theoretical standpoint, there is no specific reason for seven scenarios. The number of scenarios should be at least two for technical and two for managerial depth of thinking and learning to enable a dialectic of reflection across examples. We designed, wanting to cover the major industries where practitioner literature indicated major opportunity for disruption. To this end, these seven seemed to be the necessary and sufficient set at the time to represent the majority of such potential as reported in news stories and articles. They were also achievable within a 16-week semester.

A scenario is neither a case nor a use-case. A case is a more extended and contextualized learning module that provides richer, multi-actor ambiguity and detail. A use-case provides much more specific and limited detail with fewer users and less detail. We define a scenario as a context in which an emerging technology may be used to accomplish an activity that may include multiple use-cases decoupled between multiple different users. Our hypothesis was that this level of detail would satisfy the necessary and sufficient for delivering both the managerial and technical experiences students need. They would be detailed enough for the managerial as well as short enough to do multiple examples for building technical skill and extrapolating abstract understandings.

To prepare the technical and mastery scenarios, we developed server images complete with basic blockchain infrastructure already setup including at least one web interface for at least two different stakeholder types involved in the scenario and access to the smart contract editor and transaction ledger.

Students would receive login credentials. They could then not only edit the contracts, but they could also test the processes in part or whole to see what the results would be. Then, they could reflect and tweak the processes to improve them and implement new features and fixes. During the overall process of the course, all students would also engage in troubleshooting and question and answer sessions as they work through the scenarios. All of this was designed for online delivery, though it could also be used face-to-face.

At level 1 of the template (B1-Rembering): blockchain is introduced to students in three lectures along with discussion and Q&A sessions. The lectures connect blockchain through articles and discussions helping student remember the emerging technology. At the end of the lectures students took and had to pass the introduction to blockchain certificate exam by IBM. This first level provided an overview and background of the emerging technology including distributed ledger technology (DLT), peer-to-peer decentralization, consensus, and incentive mechanisms.

In the second level, they completed technical scenarios requiring operating the different stakeholder workflows to experience smart contract operations and then edit and re-experience the change. The diploma presentation to a hiring manager process in first scenario reduces students' initial ambiguity and builds their affordance understanding. Students' familiarity with the education context makes this a good first scenario choice. It helps them remember (B1) and understand (B2) blockchain, they apply (B3) blockchain ID# to the diploma and analyze (B4) how a hiring-manager can authenticate the certificate. Students evaluate (B5) and create (B6) the education diploma process. This scenario allow student to build extrapolated understanding of the emerging technology – a blockchain disintermediation attribute in action. The healthcare scenario reinforces and avoids ambiguity of the emerging technology context also in a familiar process. Students learn how the data owner, the patient in this healthcare scenario, grants and denies access to the network participants; students are also introduced to the concept of immutability where the different participants can append but not delete. Personal data control by attributing an access decision to the data owner builds affordance understanding.

In the third level, between the technical and managerial scenarios, students had to prepare to analyze managerial outcomes, particularly undergraduates without background in technology investment decision-making. This part of the template is necessary because any emerging technology may be difficult to assess due to 'hype' concerning its actual value and capabilities (Fenn & Raskino, 2008). To address this need, an ET courses needs to take a moment to focus on what hype is and how to decide whether the emerging technology makes sense or not (a decision tree). One or more practice papers from reputable sources can fit this need. We found a perfect paper on this topic (Mulligan et al., 2018) and embedded it into an activity and lecture prior to the managerial scenarios. You can see that step in the template.

Level 4 in the template (B2-Understand, B4-Analyze, B5-Evaluate): students assume a manager's role to solve "real world" problems extending their newly acquired blockchain knowledge, analyze the value of blockchain distinguished from existing alternatives, and solidifying their emerging technology knowledge and hands-on experience in a different context.

- The aviation scenario introduces blockchain's identity and authentication attribute (KYC – know your customer) challenging students to think about a new business application for the emerging technology and innovate new possibilities.
- The FinTech scenario introduces distributed ledger technology (DLT), a complex technical term, challenging students to deploy and apply this blockchain attribute; students are expected to apply ledgers for solving managerial issues.
- The supply chain scenario students develop managerial thinking by applying smart contracts for a semi-autonomous decision process.
- The IoT technology itself was emerging when students were learning the emerging blockchain technology. This IoT scenario gives confirmation to Level 4 in the template by developing managerial thinking that increases understanding (B2), analyzing (B4), and evaluating (B5) a familiar home appliance chore as a context.

Here students applied (B3) the decision tree to the six scenarios to analyze (B4) a practical fit for each scenario. Through this process students learned what is different with the emerging technology and discussed how it can create value for different stakeholders.

Level 5 in the template (B5-Evaluate, B6-Create): scenario 6 engages students in building a blockchain solution – voting distributed app (dApp). Students acclimated about the emerging technology are now required to create a dApp using Hyperledger Fabric blockchain platform. Here, students are expected to analyze the managerial outcomes, iterate through the dApp code and optimize the solution. The create (B6) stage enables student to master the emerging technology completing the Blooms taxonomy levels.

The fifth and final synthesis level of the template had students work on a scenario with both technical and managerial tasks. They had to develop it, analyze it, and then re-develop it based on the analysis to meet multiple different managerial needs. Each student had to submit working code with a managerial write-up as the final project of the class. Students also had to pass the advanced blockchain certificate exam by IBM to conclude the course.

Descriptions of the individual scenarios follow and illustrate how much detail is needed.

2.2 Education – Technical Hands-on Scenario

Diplomas are assets verifying successful completion of courses of study. They are used to certify knowledge in hiring as well as academic program applications. Unfortunately, fake diplomas are widespread and easy to access (Lancaster, n.d.). In 2015, more than 40 fraudulent websites in the UK were shutdown selling fake degrees (*Fake University Degree Websites Closed*, 2017). Blockchain offers a mechanism to verify authenticated diplomas with increased operational efficiency. The scenario is depicted in Figure 2.

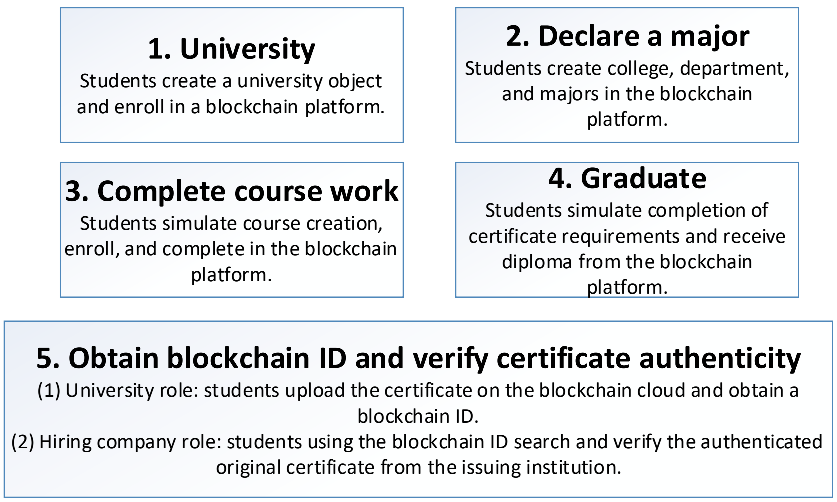

Figure 2. Blockchain-based Diploma Tracking Solution

Students, acting in the role of the issuing institution, experiment issuing a diploma with blockchain verification. This solution enables employers or other institutions to verify the authenticity of a diploma directly from the source increasing the operational efficiency instead of going through an intermediary. In the diploma stage, students get a hands-on experience role playing multiple stakeholders including enrolling at a university, select a college, select courses, graduate with a certificate, and send employers your verified blockchain ID#.

2.3 Healthcare Scenario – Technical Hands-on Scenario

Patient's medical records are traditionally kept in healthcare provider's files or computers often spread across several silos of databases (Wicklund, 2014). A global view of the patient's medical history is hampered by the proprietary nature of disparate healthcare providers' databases not to mention the privacy and security challenges.

Blockchain-based solutions place the patient back at the center of the health record processes and give control to the patient. The patient may grant or revoke a health provider's access to her/his medical record. The patient and healthcare providers are able to view the overall healthcare of the patient avoiding the fragmented silos of medical information. Such blockchain-based solutions grant control of data privacy back to the patient. Figure 3 depicts the Blockchain-based solution.

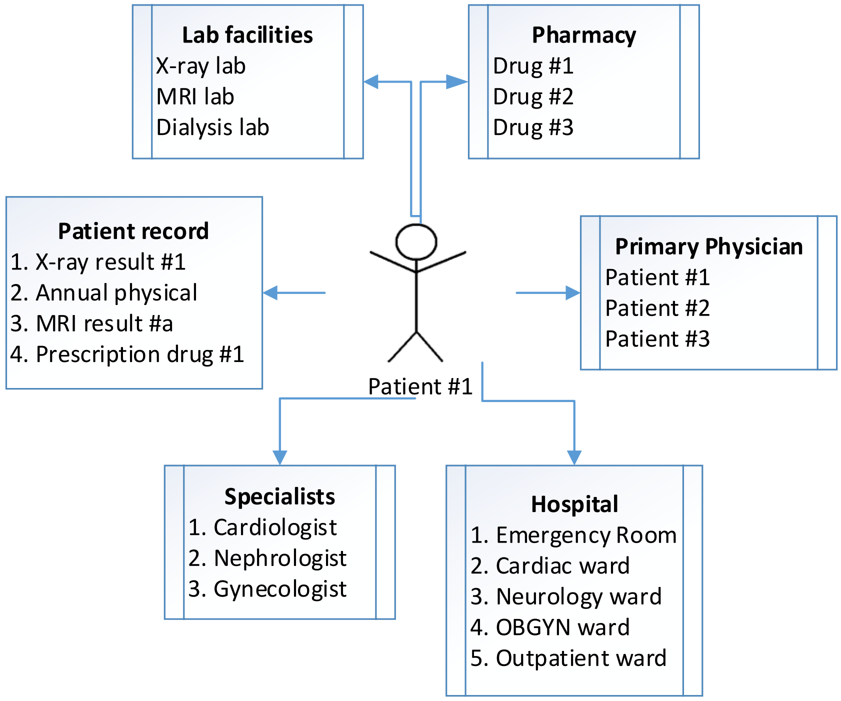

Figure 3. Blockchain-based Personal Healthcare Data Management Solution

In the healthcare scenario, students hands-on experience roleplaying multiple stakeholder roles including (a) patient's primary care physician visit; (b), patient's role to grant blockchain protected data-store access to primary physician to upload the results and receive orders for X-ray, MRI, and medication; and (c) Patient's role to grant 3rd party complementary service providers like labs, pharmacy, and specialist facilities to upload lab results, prescription order, and specialist report (Cardiology specialist and cardiac ward at the hospital for second opinion). Simulating multiple stakeholders' roles, students get hands-on experience including each facility getting access only to the data shared and accessing in a secured format despite easy information sharing. Students learn about cryptographic signatures, a difficult technical concept, to secure access only to intended target audience.

2.4 Aviation Scenario – Technical Hands-on Scenario

Airline tickets have achieved increased efficiency through online processing and issuance. However, tracking baggage and trading airline tickets remains a problem (*Why Can't You Sell an Airline Ticket to Someone Else? - Quora*, n.d.; Yogerst, 2013). A blockchain-based solution supports smart luggage tracking where the luggage is aware of its route and sends alerts. In cases of loss or misplaced luggage, the airline agent and passenger are alerted by the smart luggage. Figure 4 depicts an airline ticket scenario with smart luggage.

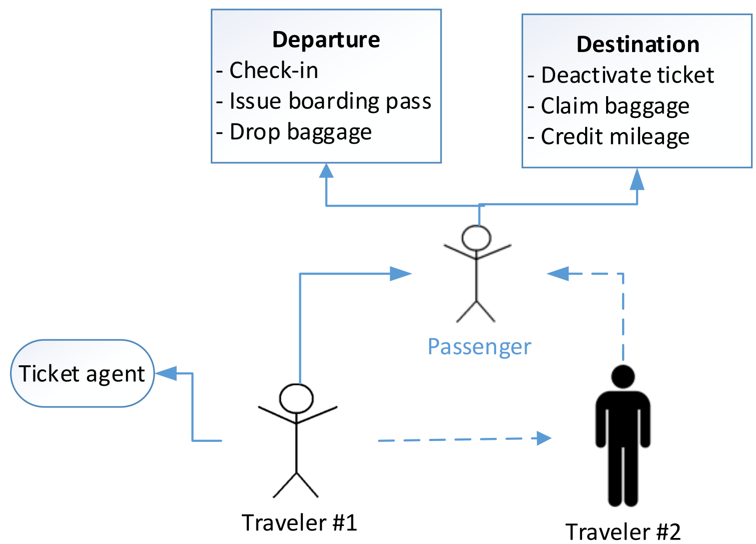

Figure 4. Blockchain-based Airline Ticket Tracking and Trading Solution

In the aviation scenario, students get a hands-on experience applying the emerging technology to develop solutions not yet existing. User story 1: Traveler #1 purchases a ticket (from an agent or online) with secured blockchain ID associating traveler and luggage. At the destination, students are expected to solve a lost or left-behind luggage problem by innovatively applying blockchain to avoid a traveler walking away without claiming baggage. User story 2: Traveler #2 buys the ticket from Traveler #1; the smart blockchain ID disassociates the ticket from the seller and creates a new secured association with the buyer. Students are expected to apply blockchain innovatively to authenticate Traveler #2 and deactivate Traveler #1. This creates a new business opportunity for travelers to buy and sell airline tickets, just like any sporting events or entertainment tickets, with all the challenges of identity verification and authentication facilitated by blockchain technology. Students deploy the emerging technology analyzing its value to solve problems like airline security and TSA requirements to automatically authenticate when tickets are sold or traded among individuals.

2.5 FinTech Scenario – Managerial Analysis Scenario

Funds settlement brings significant operational efficiency. Funds settlement that used to take days can be settled in minutes using blockchain-based solutions, releasing a much-needed capital to the economy.

Figure 5 depicts funds settlement between fund sender and fund receiver. Customers 1, 2, and 3 make purchases using payment methods backed by different banks.

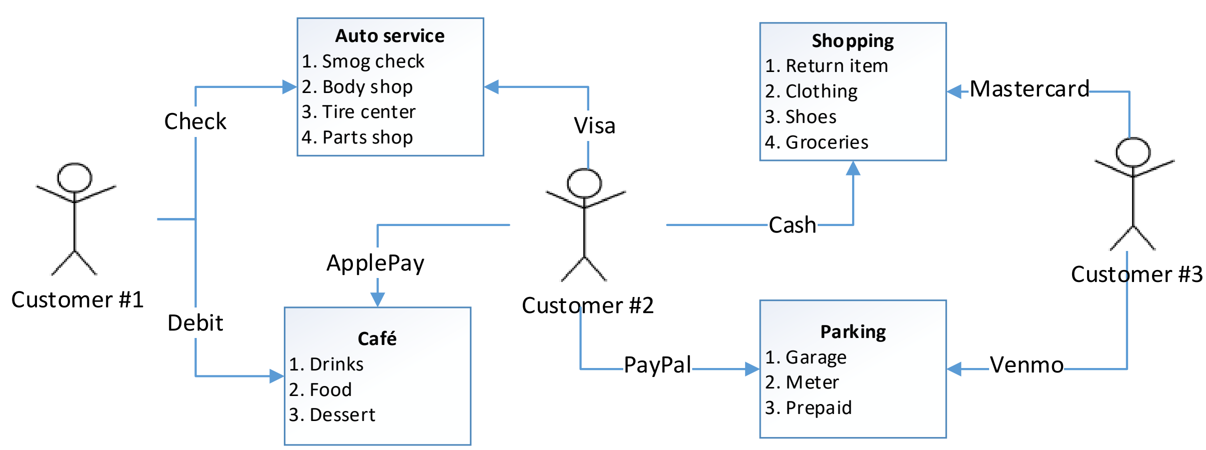

Figure 5 Blockchain-based Funds Settlement Solution

Event #1. Customer #1 made four transactions: paid for tires using his/her check backed by Bank #1; goes to a food court and pays for food using his/her debit card backed by Bank #2; goes to a vending machine and buys a drink using his/her debit card backed by Bank #2; and takes his/her car for a smog check and pays with check backed by Bank #1.

Event #2. Customer #2 made four transactions today: bought parts for her/his car using a visa card backed by Bank #1; prepaid for her/his monthly parking pass using a PayPal online account backed by Bank #3; paid for dessert using her/his ApplePay mobile account backed by Bank #1; and purchased groceries using cash.

Event #3. Customer #3 made four transactions: pays to park her/his car at a garage using Venmo online payment platform backed by Bank #2; returns an item purchased from a store and gets a refund on her/his Mastercard backed by Bank #3; goes to the mall and buys a running shoes using Mastercard backed by Bank #3; and relaxes at the park after paying at a parking meter using her/his Venmo online payment platform backed by Bank #2.

Table 1. Individual Ledgers for FinTech Transactions

Ledger: Customer #1			**Ledger: Customer #2**			**Ledger: Customer #3**		
Description	Method	Amount	Description	Method	Amount	Description	Method	Amount
1. Tires	Check	$350.75	1. Parts	Visa	$45.60	1. Returns	Mastercard	($76.20)
2. Food	Debit	$11.65	2. Prepaid	PayPal	$32.25	2. Shoes	Mastercard	$32.20
3. Drinks	Debit	$3.50	3. Dessert	ApplePay	$2.40	3. Garage	Venmo	$10.00
4. Smog	Check	$16.00	4. Groceries	Cash	$62.30	4. Meter	Venmo	$2.10

Customer transactions are maintained in individual ledgers. Blockchain Know Your Customer (KYC) attribute uniquely identifies each customer's identity, method of payment, payment amount, and transaction details. Funds settlement is executed expediently sorting the transactions, calculating balance earned or due, and transfers to the appropriate bank.

Table 2. Bank Ledgers for FinTech Transactions

Ledger: Bank #1			**Ledger: Bank #2**			**Ledger: Bank #3**		
Method	Amount	Balance	Method	Amount	Balance	Method	Amount	Balance
1. Check	$350.75	$350.75	1. Debit	$11.65	$11.65	1. Mastercard	($76.20)	($76.20)
2. Visa	$45.60	$396.35	2. Debit	$3.50	$15.15	2. Mastercard	$32.20	($44.00)
3. Check	$16.00	$412.35	3. Venmo	$10.00	$25.15	3. PayPal	$32.25	($11.75)
4. ApplePay	$2.40	$414.75	4. Venmo	$2.10	$27.25			

2.6 Supply Chain Scenario – Managerial Analysis Scenario

A B2B transaction with routine items like office supplies can achieve higher operational efficiency with fewer errors normally introduced due to manual execution. Blockchain-based Smart Contracts can semi-autonomously execute decisions using pre-defined rules. See example in Figure 6.

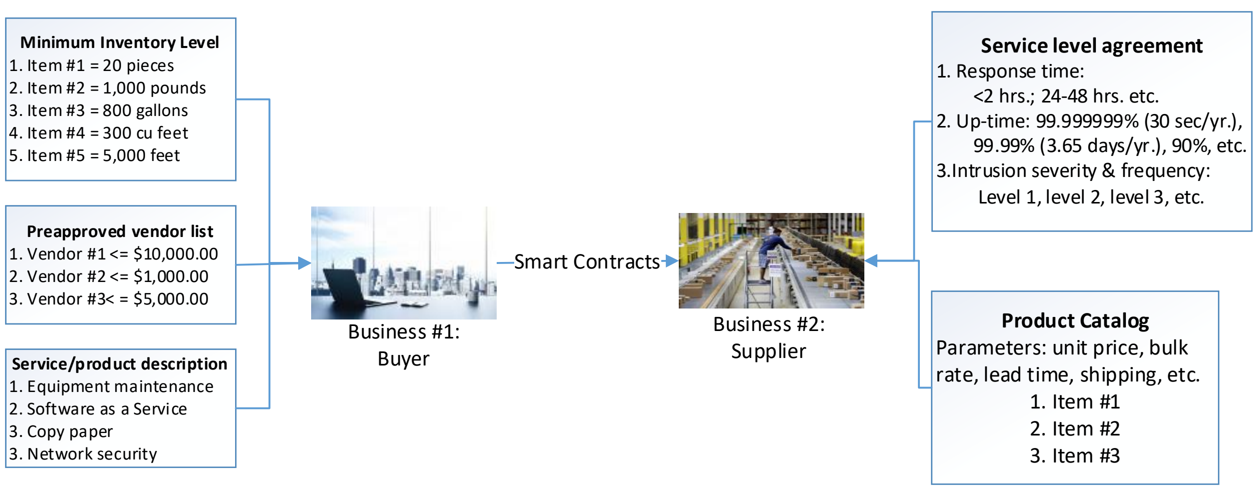

Figure 6. Blockchain-based Supply Chain Solution

Supply chain scenario: two business partners, a buyer (business #1) and a supplier (business #2) engage in a blockchain-based smart contract with semi-autonomous decisions. The buyer sets the minimum level of inventory to trigger automatic reorder, identifies preferred list of vendors, and provides the product description and item attributes. The seller agrees to a service level agreement and avails its inventory list for selection. Smart contracts execute these rule-based actions on behalf of buyer and supplier. The app automates the manual execution, reduces errors, and increases operational efficiency without locking either one into the others' supply chain software while maintaining process transparency to both.

2.7 Internet of Things (IoT) Scenario – Managerial Analysis Scenario

Internet of Things (IoT) incorporates smart contracts and autonomous decision making. D2D (Device-to-Device) transactions are contractual agreements facilitated by smart contract and autonomous decision making. We use a home appliance scenario where a dishwashing machine keeps track of available detergent by employing IoT technologies. The IoT device supported by a smart contract prompts vendors to bid, orders detergent, and maintains minimum inventory levels.

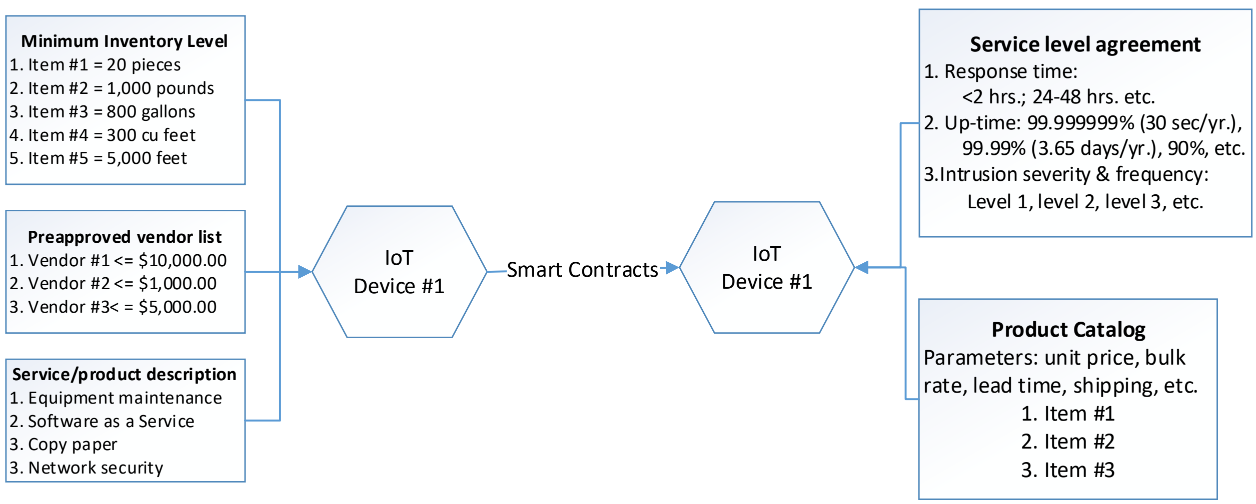

Figure 7. Blockchain-based Internet of Things Solution

IoT scenario (Figure 7): a home appliance like a dishwashing machine equipped with an IoT device can directly interact with a warehouse that sells detergent. Homeowner-buyer (IoT Device #1) and supplier (IoT Device #2) may each conduct business transactions through their IOT devices. Homeowner-buyer sets the minimum level of detergent inventory needed, e.g. reorder when detergent level drops below half gallon, the same is programmed on the supplier side (IoT Device #2). Household-buyer and supplier agree in advance on payment, reorder quantity, and means of delivery. Such agreement is executed efficiently through a smart contract using semi-autonomous blockchain-based solution.

2.8 Governance Scenario – Combination Synthesis Scenario

Governance scenario (Figure 8): Board of directors voting among multiple strategic options.

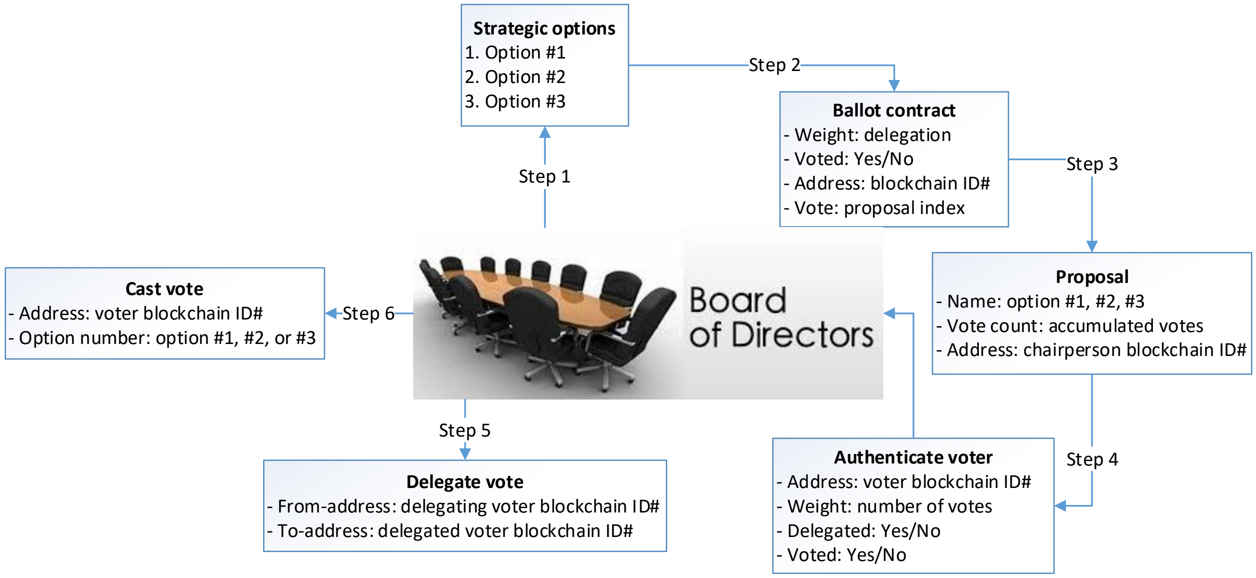

Figure 8. Blockchain-based Governance Solution

Step 1: Board of Directors discuss and identify a small number of strategic options for vote.

Step 2: A Smart Contract is created with parameters including weight, voted status, address, and vote count. Weight is the number of votes an authenticated director is authorized to cast. The default weight is one vote. Directors can delegate their vote to another director.

Step 3: A proposal for each strategic option is created with a unique name for each option. Vote count accumulates the number of votes a proposal has received; total vote count with the option name is reported at the end. Cryptographically secured and immutable blockchain ID# (address) is assigned to each proposal.

Step 4: Board of Directors eligible to vote in the current proposals are authenticated. A unique and immutable blockchain ID# (address) is assigned to each eligible voter. The default one vote is assigned to each eligible voter. Whether or not a voter delegated her/his vote is tracked; if a voter delegate her/his vote, then her/his vote weight is set to zero, i.e. no longer able to cast a vote. When the voter cast his/her ballot, a flag indicating already "voted" is set for that director.

Step 5: Board of Directors may delegate their vote (default weight = 1) to another eligible and authenticated voter. The delegating Director's blockchain ID# ("from" address) is shown as initiating the delegation process by clicking/tapping the delegated Director's ("to" address). The vote weight for the "from" address is reduced to zero and the vote weight of the "to" address is incremented by one.

Step 6: Board of Directors cast their vote.

Students are provided with a sample voting demo app and required to create and execute code that implements the voting process. Each student is expected to submit working code and managerial write-up as the final project of the class.

3 Methods and Administrative Design

Deploying this type of course required serendipity, logistics, and preparation. The serendipity came from one faculty member having already taken a blockchain training at an IS conference and having become certified on their technology a year prior to this project. That training also brought the vendor connection that helped launch the first iteration of the course. This type of training is often available at IS conferences and offers every IS faculty member the opportunity to access the resources needed to develop courses like these. The course preparation began with a strategic meeting including the faculty authors here with various university system and industry leaders. They identified a gap related to financial technology ("fintech") knowledge, skills, and abilities and provided some seed grants to develop courses. This meeting happened early in Fall semester 2018. By October, the first version of the draft syllabus allowed application for a special topics course for Spring 2019, and the small seed grant funding allowed hiring a graduate research assistant with technical skills to assist in the technical development of the course content. It would have been possible to develop the content without this grant, but having it expanded the scope of the course to include the web interfaces.

The technical infrastructure design and implementation required analysis of the all the available, approved options within local policy. For example, we wanted students to run blockchain solutions with web hosted interfaces. Local university policies did not allow for this type of hosting for students. We had to get an exception. Further, many available software solutions in industry for deploying blockchains were very difficult to use. Most depended on fairly heavy use of command line shell scripts. We wanted this course to welcome even the newest of students with no technical background. We also wanted the course to balance managerial with technical because IS mixes both and our industry partners indicated an interest in both. This meant command line solutions would not work. Within the marketplace a few vendors had semi-graphical interface solutions for accessing and customizing the technology. IBM was willing and eager to collaborate and had their Hyperledger software that met these needs. So, we worked with them. Other possibilities later emerged and were used in successive runs of the course including Ethereum, but we began with LinuxOne in cooperation with IBM.

Though the Hyperledger-Fabric would enable hosting and deployment of a blockchain, the interfaces for the system needed further web server hosting. The LinuxOne cloud service provided student accounts for every student and could image those accounts for each scenario ensuring each started with the same standard scenario base. Creating those base images took months and the funding of a technical GRA position for assistance. Later, these solutions even required modifications and fixes as the first section of the course ran, meaning that the GRA position actively worked for a full year tweaking and improving and fixing. Ultimately, we were able to fully deploy the first three (technical) scenarios in time for the first run of the course.

Because of the multiple competing constraints, developing these technical scenario experiences will probably be the most difficult aspect of designing and delivering an emerging technology course using this template for most faculty. The sample of students who had taken this course at the time of writing includes a total of 105 in four different semesters with 60 males and 45 females. The data included here were drawn from the first semester's group of 32 students who completed the optional end of semester feedback survey. Twenty-seven of those 32 completed the survey, and their results are reported below.

4 Assessment and Analysis of Results

While reflection was built into the scenarios with discussions each time, overall reflection on the course completes the cycle from a constructivist perspective. To achieve this reflection required meeting a variety of constraints, and we present the tool and analysis here as part of our course template and a reflection on the template's efficacy. We designed and deployed a retrospective survey and discussion at the end of the semester as part of the course – survey questionnaire is provided in Exhibit A. We designed this survey to tap into the elements of our course design, especially to capture the difference between technical and managerial knowledge acquired and identify levels of progression along Bloom's taxonomy. We kept it brief to increase completion rates by reducing the burden on students during the busy end of the semester. The survey was distributed online through the Learning Management system. Twenty-seven students completed the survey. Students also provided comments in an open-ended comment section asking, "What would you like more of in this course?". Student feedback is listed in Exhibit B. Results were shared with the students and discussed in one wrap-up session.

The course was listed as an upper division elective for undergraduate business college students. There was no prerequisite to this course, so any sophomore, junior, and senior students could register. An abbreviated syllabus with course description and learning objectives is provided in Appendix C. Prior to this course 41% of students said they knew "none at all" about blockchain, 44% reported little knowledge, 11% reported moderate knowledge of some definitions and examples, and one said they knew a great deal including definitions, examples, technical knowledge and experience.

After completing this course 30% said they knew a great deal including definitions, examples, technical knowledge and experience, 48% said they feel they know a lot about blockchain, and 22% said they gained moderate knowledge with definitions and examples. At least in terms of self-perception, the course design delivered successfully on this measure.

Table 3. Student Self-Reported Skill Before and After

	Before		After	
A great deal - definition, examples, technical knowledge and experiences	1	4%	8	30%
A lot	0	0%	13	48%
A moderate amount - definition and examples	3	11%	6	22%
A little	12	44%	0	0%
None at all	11	41%	0	0%
	27	100%	27	100%

Students were asked about their satisfaction about the business and technical knowledge about blockchain 70% and 59%, respectively, said they were very satisfied, and 26% and 33%, respectively, said they were somewhat satisfied. An additional one said they were very unsatisfied about the business context; on the technical context somewhat unsatisfied and very unsatisfied were 4% (one person) each.

Table 4. Student Satisfaction with Business and Technical Content

	Business Context		Technical Context	
Very satisfied	19	70%	16	59%
Somewhat satisfied	7	26%	9	33%
Neither satisfied nor unsatisfied	0	0%	0	0%
Somewhat unsatisfied	0	0%	1	4%
Very unsatisfied	1	4%	1	4%
	27	100%	27	100%

Students were asked their competency in the following three contexts:

- If someone in business asked you to give them an example of how blockchain can really make a difference versus existing solutions, how well could you answer them at this point?

Table 5. Student Self-Reported Actionable Basic Knowledge

Extremely well	7	26%
Very well	12	44%
Moderately well	7	26%
Slightly well	1	4%
Not well at all	0	0%
	27	100%

- Suppose you are hired, and your new company is using Hyperledger to deploy blockchain. How competent would you be in reading a smart contract and analyzing its flaws compared to a statement explaining what it should be doing?

Table 6. Student Self-Reported Actionable Technical Skill

Extremely competent	2	7%
Somewhat competent	17	63%
Neither competent nor incompetent	6	22%
Somewhat incompetent	2	7%
Extremely incompetent	27	100%

- Suppose someone at a dinner party approaches you talking about bitcoin and blockchain. They do not seem to know the difference. How well could you explain the difference to them at this point?

Table 7. Student Self-Reported Actionable Integration Knowledge

Extremely well	11	41%
Very well	7	26%
Moderately well	7	26%
Slightly well	2	7%
Not well at all	0	0%
	27	100%

When asked about recommending the class to their friends or colleagues in a scale of 0-10 where 0 is not at all likely and 10 is extremely likely, 56% rated 10, 7% rated 9, 22% rated 8, 11% rated 7, and 4% rated 2. This question yields a net promoter score of 59.

5 Discussion and Recommendations

IS faculty face a constant need of creating and delivering content on emerging technologies. Very few programs build this content into dedicated courses, and perhaps none add those courses as requisites within their programs (Clark et al., 2017). Why? Universities require all manner of administrative work in addition to the work of creating content and logistics for new courses. Perhaps most faculty receive no compensation for that extra work, and they turn to adding elements of emerging technology to existing courses or special topics electives as a result. No matter the reason, having a tested template to follow as a guide may be helpful. We offer this template for that purpose.

Overall, students have been very satisfied with this course design, more so than some prior Special Topics emerging technology courses run in the program. By way of summary, we can review the evaluation survey results according to Bloom's cognitive processes as targeted in the design. To do so, we designed our evaluation to tap into these different levels with just a few questions as well as we could imagine. You can see the mappings and result analysis below (Table 8).

Table 8. Summary of Survey Responses by Bloom Cognitive Process Levels

Bloom Cognitive Process Level	Evaluation Question(s)	Result Analysis
1 Remember	1,2	No students report knowing little or nothing after the course. 100% report knowing definitions and examples.
2 Understand	7	68% report they could differentiate blockchain and bitcoin very well or better at a dinner party.
3 Apply	1,2	78% report gaining significant technical application knowledge.
4 Analyze	5	68% report they could make the case very well or better for blockchain versus other technologies for a business setting
5 Evaluate	6	70% report becoming capable of evaluating a smart contract for improvement
6 Create	6	70% report becoming capable of evaluating a smart contract for improvement

At the lowest level, the course design was completely successful. At the higher levels, we can see that more than two-thirds of the students gained advanced learning. Because some reported advanced proficiency on some questions and not on others, this led to almost all students gaining some advanced learning and capabilities. Our satisfaction questions underscore this analysis as 96% were somewhat or very satisfied with the business-related context learned and 92% reported the same for technical knowledge. We think this is an important balance to strike for an IS emerging technology course between user/use context and technology application learning. IS is the strategic computing degree in which students prepare to make business decisions about technology. If this course were taught in computer science or an IT program, the content emphasis would reasonably be less managerial. Of the students not satisfied with the technical knowledge, a closer look at the results showed they were ones who came into the course with advanced technical skill and who wanted to learn bitcoin mining. These were not the stated objectives of the course. So, we believe the overall design achieved its learning goals.

A second contribution from this template for teaching IS emerging technologies is appropriate flexibility. Because emerging technologies are emerging, we have to expect that course content will need to demonstrate multiple different technical and business aspects initially and that these will change over time. In our case, we have been able to transition the course to different faculty with them successfully delivering the content nuanced to their specific interests and backgrounds. And, in testing and running four different sections of this course in different semesters with this design, we recognized emerging needs. Ethereum and Hedera became important options for blockchain deployment. Meanwhile, IBM stopped supporting the exact original implementation we were using. We were able to swap in scenarios using those technologies into latter runs of the course successfully. We believe this scenario design, positioned between simple use-cases or more complex full teaching cases, enables that more flexible approach and is particularly appropriate for emerging technology courses. It can also expand or contract to fill longer or shorter teaching spaces. With a full semester, 3-credit course, we used 7 scenarios. In a shorter space, one could reasonably reduce the number so long as they keep the managerial and technical, ideally with some repetition at least in one master scenario.

Finally, the open source blockchain playground setup as designed allowed instructors to view student work directly within the student server instances. Students could share their instances with instructors and tutors for remote feedback. Student progress was monitored directly on their personalized virtual machine. Support and assistance to hand-hold students was done through a student-to-student peer learning process where student tutors helped students in need, and the class was successfully delivered in an online format. What happens if faculty do not have connections to industry or experience with the technology? The original technical connection for this work came from an AIS conference at which one of the faculty authors took an optional workshop provided by IBM on blockchain development a year prior to the course development. These types of experiences are critical for developing initial skills, confidence, and connections. Otherwise, there may be targeted trainings available in online platforms within faculty resources at their universities or through local technology associations that may help. IS department administrators should realize that if they want these types of emerging technology courses, they will need to invest in faculty development of this sort, sometimes proactively and in advance of tangible plans.

Future iterations of this course could design a blockchain deployment for the course itself, which would have students complete their assignments using blockchain technology.

6 Conclusion

This paper presents an emerging technology IS course template faculty can adjust and reuse to deliver courses efficiently and effectively. IS faces many emerging technology challenges at any given time. The tools constantly change as they emerge. Being able to quickly and effectively deliver courses to convey technical and managerial knowledge and skills in these topics is a strategic advantage of IS programs. To that end, we need solutions to help faculty who often have very limited time and other resources to create these learning experiences. We hope this template and example will assist many.

Acknowledgements

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References

Ackermann, E. (2001). Piaget's constructivism, Papert's constructionism: What's the difference. *Future of Learning Group Publication*, *5*(3), 438.

Anderson, T. (2016). Theories for Learning with Emerging Technologies. In G. Veletsianos (Ed.), *Emergence and Innovation in Digital Learning: Foundations and Applications* (pp. 35–50). Athabasca University Press. https://doi.org/10.15215/aupress/9781771991490.01

Bloom, B. S., Krathwohl, D., & Masia, B. (1984). *Taxonomy of Educational Objectives* (Second). Longman.

Brigid J. S. Barron, Schwartz, D. L., Vye, N. J., Moore, A., Petrosino, A., Zech, L., Bransford, J. D., & The Cognition and Technology Group at Vanderbilt. (1998). Doing with Understanding: Lessons from Research on Problem- and Project-Based Learning. *The Journal of the Learning Sciences*, *7*(3/4), 271–311. JSTOR.

Case, T., Dick, G., Granger, M., & Akbulut, A. (2019). Invited Paper: Teaching Information Systems in the Age of Digital Disruption. *Journal of Information Systems Education*, *30*(4), 287–297.

Clark, J., Clark, C., Gambill, S., & Brooks, S. (2017). IS Curriculum Models, Course Offerings, and Other Academic Myths/Hopes. *Journal of Higher Education Theory & Practice*, *17*(9), 61–68.

Fake university degree websites closed. (2017, January 3). https://www.bbc.com/news/uk-england-38494664

Fenn, J., & Raskino, M. (2008). *Mastering the Hype Cycle: How to Choose the Right Innovation at the Right Time*. Harvard Business Press.

Gartner Hype Cycle for Blockchain and Web3, 2022. (2022, July 22). *Avivah Litan*. https://blogs.gartner.com/avivah-litan/2022/07/22/gartner-hype-cycle-for-blockchain-and-web3-2022/

Gricar, J., Pucihar, A., & Lenart, G. (2005). Active Learning Model for Teaching B2B e-Marketplaces. *Journal of Information Systems Education*, *16*(1), 103–108.

Hung, D., Tan, S. C., & Koh, T. S. (2006). Engaged Learning: Making Learning an Authentic Experience. In D. Hung & M. S. Khine (Eds.), *Engaged Learning with Emerging Technologies* (pp. 29–48). Springer-Verlag. https://doi.org/10.1007/1-4020-3669-8

Lancaster, T. (n.d.). Everything you need to know about fake degrees and the "universities" awarding them. *The Conversation*. Retrieved March 4, 2019, from http://theconversation.com/everything-you-need-to-know-about-fake-degrees-and-the-universities-awarding-them-71132

Lehrer, C., Wieneke, A., vom Brocke, J., Jung, R., & Seidel, S. (2018). How Big Data Analytics Enables Service Innovation: Materiality, Affordance, and the Individualization of Service. *Journal of Management Information Systems*, *35*(2), 424–460.

Leidig, P., & Salmela, H. (2021). *IS2020 A Competency Model for Undergraduate Programs in Information Systems* (p. 186). The Joint ACM/AIS IS2020 Task Force. https://is2020.hosting2.acm.org/wp-content/uploads/2021/06/is2020.pdf

Leidner, D. E., Gonzalez, E., & Koch, H. (2018). An affordance perspective of enterprise social media and organizational socialization. *The Journal of Strategic Information Systems*, *27*(2), 117–138. https://doi.org/10.1016/j.jsis.2018.03.003

Li, Y., Slyke, C. V., Ferratt, T., Gallivan, M., Stafford, T., & Sumner, M. (2021). ACM SIGMIS CPR Panel Report: Should Information Systems Professors be More Techno-savvy than Students? (And What Would that Mean for Teaching in Times of the COVID-19 Crisis?). *Communications of the Association for Information Systems*, *48*(1). https://doi.org/10.17705/1CAIS.04844

Milovich, M., Nicholson, J., & Nicholson, D. (2020). Applied Learning of Emerging Technology: Using Business-Relevant Examples of Blockchain. *Journal of Information Systems Education*, *31*(3), 187–195.

Mulligan, C., Scott, J. Z., Warren, S., & Rangaswami, J. (2018). *Blockchain Beyond the Hype A Practical Framework for Business Leaders* [White Paper]. World Economic Forum. https://www.weforum.org/whitepapers/blockchain-beyond-the-hype/

Nilsen, H., & Purao, S. (2005). Balancing Objectivist and Constructivist Pedagogies for Teaching Emerging Technologies: Evidence from a Scandinavian Case Study. *Journal of Information Systems Education*, *16*(3), 281–292.

Resnick, Mitchel, & Kafai, Y. B. (Eds.). (1996). *Constructionism in Practice: Designing, Thinking, and Learning in a Digital World*. Lawrence Erlbaum Associates.

Rodgers, C. R. (2002). Seeing Student Learning: Teacher Change and the Role of Reflection. *Harvard Educational Review*, *72*(2), 230–253. Arts Premium Collection; ProQuest Central; Social Science Premium Collection.

Schön, D. A. (1987). *Educating the reflective practitioner: Toward a new design for teaching and learning in the professions* (pp. xvii, 355). Jossey-Bass.

Spiro, R. J., Coulson, R. L., Feltovich, P. J., & Anderson, D. K. (1994). *Cognitive flexibility theory: Advanced knowledge acquisition in ill-structured domains* (p. 615). International Reading Association.

Wadsworth, B. J. (1989). *Piaget's theory of cognitive and affective development /*. Longman.

Walls, J. G., Widmeyer, G. G., & El Sawy, O. A. (1992). Building an Information System Design Theory for Vigilant EIS. *Information Systems Research*, *3*, 36–59.

Why can't you sell an airline ticket to someone else? - Quora. (n.d.). Retrieved March 4, 2019, from https://www.quora.com/Why-cant-you-sell-an-airline-ticket-to-someone-else

Wicklund, E. (2014, April 10). "Silo" one of healthcare's biggest flaws | Healthcare IT News. *Helthcare IT News*. https://www.healthcareitnews.com/news/silo-one-healthcares-biggest-flaws

Yogerst, J. (2013, February 13). Best and Worst Airlines for Lost Luggage. *Travel + Leisure*. https://www.travelandleisure.com/slideshows/best-and-worst-airlines-for-lost-luggage

Appendix A: Retrospective Survey Questions

1. Before you took this course, how much did you know about blockchain?

None at all	A little	A moderate amount – definition and examples	A lot	A great deal – definition, examples, technical knowledge and experiences

2. As you are completing the course now, how much do you feel you know about blockchain?

None at all	A little	A moderate amount – definition and examples	A lot	A great deal – definition, examples, technical knowledge and experiences

3. How satisfied are you with the business related context for blockchain that you received in this course?

Very satisfied	Somewhat satisfied	Neither satisfied nor unsatisfied	Somewhat unsatisfied	Very unsatisfied

4. How satisfied are you with the technical knowledge about blockchain that you received in this course?

Very satisfied	Somewhat satisfied	Neutral	Somewhat unsatisfied	Very unsatisfied

5. If someone in business asked you to give them an example of how blockchain can really make a difference versus existing solutions, how well could you answer them at this point?

Not well at all	Slightly well	Moderately well	Very well	Extremely well

6. Suppose you are hired, and your new company is using Hyperledger to deploy blockchain. How competent would you be in reading a smart contract and analyzing its flaws compared to a statement explaining what it should be doing?

Extremely incompetent	Somewhat incompetent	Neither competent nor incompetent	Somewhat competent	Extremely competent

7. Suppose someone at a dinner party approaches you talking about bitcoin and blockchain. They do not seem to know the difference. How well could you explain the difference to them at this point?

Extremely incompetent	Somewhat incompetent	Neither competent nor incompetent	Somewhat competent	Extremely competent

8. On a scale from 0-10, how likely are you to recommend this course to a friend or colleague? (0 = Not at all likely and 10 = extremely likely)

0	1	2	3	4	5	6	7	8	9	10

Appendix B: Student Written Feedback in the Retrospective Survey

What would you like more of in this course?

More real-world examples of businesses implementing blockchain and how it impacts their business processes.
I thoroughly enjoyed the labs in this course. I really enjoyed getting the hands on/real world experience. I have recommended several of my friends to take this class already.
More hands on blockchain experience if possible
I like the more hands-on aspects of the course; like the interactive labs. More of that kind of thing would be good.
More hands-on application of problem solving. Perhaps could offer made-up business problems and have the student build or come up with a corresponding original blockchain solution.
I would not change anything in this class. The class was great and very informative with a lot of real-life use cases.
Less (or more relevant): business use cases as labs
more use case to understand all concept
I would maybe like more textbook reading and less of the lab work.
This course seemed to only be focused on the blockchain concepts that are generally accepted by IBM and other large business entities and taught nothing about other actual blockchain projects that are revolutionizing the business world. Taught nothing about centralized/decentralized exchanges, margin trading etc. Taught nothing about the uses of blockchain in the real world outside of the most straightforward textbook ones. Would like to see more talk of regulation in blockchain by governments.
Better instructions
It would have been nice to have a couple more hands-on labs and see how blockchain is deployed. But overall, I enjoyed the course.
I honestly don't know. Everything is well balanced, and I feel like the material given is more than sufficient!
N/A
I would like to see more examples of how blockchain is changing multiple industries in the world.
More use case examples
I would like more labs since I found them very interesting
More use cases
Nothing, it was a great course.
I would like to see more business specific examples on how Blockchain can help in the future of business transactions and procedures.
nothing

Would like hands-on coding. Same coding that the Miners do.
I think that your PowerPoint presentations were really great where you narrated over them and gave us a better understanding of the material. I think it would be best if this course was offered in person as it would allow us to see the material in person, as it can be a bit difficult as an online learner. Overall this was a very great class and I think that it covered the use cases in important sectors such as financial, government, and healthcare. I think a cool use case could be in the video game industry regarding account security. Video gaming is becoming a very big part of the younger generation and it could help students relate more to the class. Very great class and thank you for teaching Professor!
Better explanation for Mac user.
I think the writing assignments were very helpful too
More hands-on experience with blockchain platforms, manipulating and organizing data.
I would have liked to learn more about bitcoin along with blockchain. I know that the course wasn't focused on that, but I think a unit on that would have been fun!
I would like more labs using blockchain.
I like the more hands-on aspects of the course; like the interactive labs. More of that kind of thing would be good.
I would like more architecture opportunities. There have been instances over the semester where I ran into a problem that could maybe benefit from a blockchain solution but did not have the architecture aptitude to tinker with the idea. I understand that a CS class would be more appropriate for this but could be a good value-add to an already great class.
This course was great. I don't have any suggestions on how to make it better.
More fintech examples as labs, smart contract examples as labs
More use-cases
I would like to go more in depth with Blockchains.
Acknowledgment of blockchain uses other than ones provided by IBM.
Cool blockchain activities and maybe more time inside the vms [virtual machines] you supplied
It would have been nice to have a couple more hands-on labs and see how blockchain is deployed. But overall, I enjoyed the course.
I honestly don't know. Everything is well balanced, and I feel like the material given is more than sufficient!
N/A
I would like to learn more about how blockchain can enhance the utilization of cryptocurrencies by businesses and governments.
Videos were very helpful.
I think more interactive assignments instead of reading assignments would help students be

engaged and interested to learn
I liked the Blockchain essentials on IBM.
More use cases
Nothing, it was a great course.
I would like to have a few more real-world examples to help better understand the scope of Blockchain potential.
I liked the lab assignment
Would like to learn how to write the code that is written by miners.
I would like more of the hands-on activities rather than writing assignments because for me personally I benefit more from hands-on activities.
I really enjoyed the IBM badges as it not only helped me improve my knowledge on Blockchain; it also allowed me to show others that I have that knowledge as well. If we could incorporate another one of those in the next curriculum that would be great.
the concepts, the competent and how the work really looks like for running a Hyperledger
I would like to have seen a little more explanation of the scripts we were running and what they do. Maybe the beginning of the course could include basic Linux commands and what they mean "chmod, cd ..," etc.

Appendix C: Abbreviated Syllabus

INFORMATION SYSTEMS AND SECURITY DEPARTMENT

IS4490-W01, BLOCKCHAIN FOR BUSINESS (ONLINE)	
Course Description:	In this course, students will experiment decentralized trust, modify an application and create tamper-proof transactions without intermediary, use secured and transparent triple entry accounting, and present a point of view to stakeholders. Students learn the underlying technology for trustless transaction platform – Blockchain. The course engages the learner in applying triple entry accounting with secured and transparent ledger. Students earn IBM certified Blockchain badge as part of this course. Students will also engage in hands-on blockchain use-cases including financial services (FinTech), supply chain, healthcare, education, governance, Internet of Things (IoT), and transportation-airline.
Prerequisites:	None

Course Schedule:

Date	**Topic**	**Assessments Due**
AUG 19 – SEP 01	Module 1: Blockchain Essentials Badge	IBM Badge #1
SEP 02 – 15	Module 2: University use-case	Lab 1
SEP 16 – 29	Module 3: Transport sector use-case	Lab 2
SEP 30 – OCT 13	Module 4: Healthcare use-case	Lab 3
OCT 14 – 27	Module 5: FinTech use-case	Lab 4
OCT 28 – Nov 10	Module 6: Governance vote use-case	Lab 5
NOV 11 – 24	Module 7: Professional engagement	Engagement Report
NOV 25 – Dec 08	Module 8: Blockchain Foundations Badge	IBM Badge #2
Finals Week	Retrospective Survey: Lessons Learned	Retrospective Survey

Class Learning Outcomes (LO)

Because of completing this course, students will be able to achieve the following course learning objectives:

- LO1: Describe blockchain technology components including ledgers and immutability.
- LO2: Explore a business blockchain use-case and differentiate between permissionless (public) and permissioned (private) blockchain.
- LO3: Apply blockchain technology to solve business problems and demonstrate the transfer of assets across a business network.
- LO4: Apply chaincode (Smart Contract) in a business environment. For example, Hyperledger-Fabric (HLF).
- LO5: Model a business network using a web-based interface. For example, HLF.
- LO6: Demonstrate a blockchain application. For example, HLF.

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