Vol. 25 No. 2 (2024): Journal of Accounting, Ethics & Public Policy, JAEPP
e-ISSN 2956-8390; ISSN1089652X

Empowering Internal Control: A Case Study in Leveraging Data and Technologies

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Doi:10.60154/jaepp.2024.v25n2p26

Submitted: 20 March 2024
Accepted: 07 June 2024
Published: 08 June 2024

Cite As:
Zhou J.(2024). *Empowering Internal Control: A Case Study in Leveraging Data and Technologies.* Journal of Accounting, Ethics & Public Policy, JAEPP, 25 (2), 26. https://doi.org/10.60154/jaepp.2024.v25n2p26

Abstract

This essay responds to the PCAOB's call for insights into data analytics and emerging technologies in auditing by developing a Social Construction of Technology (SCOT) framework to embed data analytics and technologies to improve internal control performance. SCOT outlines four phases of institutionalization: problem definition, interpretative flexibility management, stabilization, and social construction. This paradigm is validated through a documented procedure of institutionalizing a data-driven analytic project optimizing the purchase-to-payment process at a state university. The study used a value-focused thinking approach to observe and identify the values at stake in the decisions about how communication among IT, auditors, and management impacts the adoption of technologies. The collected evidence highlights the importance of identifying suitable algorithms and qualified data as the starting point for technology's institutionalization. Additionally, the case study demonstrates mechanisms for preparing an integrated and transparent data platform, emphasizing the role of integrating relevant social groups and technology in circulating emerging technology. This study offers a practical roadmap about how to fit AI and technologies into an institutional social management ecosystem. It contributes to the literature by addressing the emerging technology usage trap and improving analytics performance, offering practical value through a social construct roadmap for institutionalizing emerging technologies.

Keywords: Social Construction of Technology, Technologies Institutionalization, Data Analytics and Technologies, Internal Control Automation

1. Introduction

This essay explores how to fit emerging data and technologies[1] with auditing tasks to improve internal control effectiveness and efficiency. Specifically, this study aims to examine how communication between IT, auditors, and management impacts technology adoption. With digitalization, robotics and artificial intelligence (AI) are gaining daily momentum in organizations. These emerging technologies provide organizations with opportunities and challenges to develop effective and efficient internal controls. Leveraging analytics and robotics are front-burner priorities for internal controls and related business intelligence. Auditors are increasingly aware that businesses are becoming more data-driven. The prevalent emerging data and technologies enhance the quality of internal control systems by embedding controls in automated systems. However, several surveys about the importance of technology show that most organizations do not accept emerging data and technologies (AuditNet, 2012; EY, 2014; KPMG, 2015). Emerging technologies and automatic monitoring still have many hindrances and, therefore, stay at the starting stage. Hence, we need to investigate closely how to harness the power of emerging technologies.

A simple answer to data analytics sparse application is that emerging data and technology are far from being simple tools. To find out where organizations might take advantage of technological innovation, the World Economic Forum and Deloitte carried out a study involving more than two hundred industry experts and senior executives. They found that the most significant disruption mainly came from a combination of AI plus at least one other emerging technology. Deloitte called this phenomenon the "multiplier effect" (Contri, R., 2020, p. 4). A prerequisite of the multiplier effect is that the technology must have functionality coherence with other resources, including employees, culture, and infrastructure. Emerging data and technologies can negatively impact organizational hierarchy if institutions cannot harness the power. Organizations tend to display institutional inertia toward introducing emerging technologies if they perceive that the emerging functionality is hard to manage. Thus, organizations need theoretical guidance to integrate technologies into internal controls safely. "[T]he key challenge that organizations must overcome arises not from the emerging technology, but [from] its adoption." (PwC, 2019, p. 3)

[1] Emerging data and technologies encompass innovative methodologies and tools that are reshaping the field of data management and analytics. This category often includes cutting-edge technologies such as artificial intelligence, machine learning, blockchain, and advanced analytics algorithms. Emerging means that these technologies are in a constant state of evolution and hold the potential to revolutionize how organizations collect, manage, and derive insights from data, thereby driving decision-making and fostering innovation across diverse industries and domains.

Thus, emerging data and technologies have fundamentally changed how humans and technologies work together, creating new benefits and conflicts. It also can lead to new risks that may not be adequately addressed by the current internal controls. Based on this background, the PCAOB (2019) calls for studies on observing the utilization of AI and emerging technologies in auditing. Managers need to adopt a mentality toward accessing and analyzing "data in the business." Many managers currently do not understand what to do with data analytics, especially regarding a long-term strategy to transform internal controls using a data-driven function. One of the biggest challenges for organizations that do not use analytics is understanding where to begin.

Academics developed viewpoints to harness the power of emerging data and technologies in the accounting area. However, prior literature has paid enough attention to the impact of emerging technologies on organizations. However, the literature pays little attention to observing how the interaction of IT and other institutional stakeholders can impact internal control performance. The study needs to consider practices that correspond to "the way we do things around here" or "shared routines or behaviors including traditions, norms, and procedures for thinking, acting, enduring things" (Whittington, 2006, p. 1905).

Social Construction of Technology (SCOT) is one influential work of technology adoption (Pinch & Bijker, 1984). The emergence of this approach in the 1980s, alongside a contextualist history of technology, has significantly challenged the deterministic view of technology's development. Scholars have conducted numerous case studies illustrating that technological design is not solely driven by internal technical logic but rather emerges from negotiations among various social groups, emphasizing the role of social negotiations among inventors, engineers, managers, salespersons, and users in shaping technological outcomes. Pinch (2008) prompted constructivists to delve deeper into the social aspect of technological determinism, utilizing interdisciplinary approaches drawing from sociology, history, and critical theory to illuminate the multifaceted nature of technology-society interactions and offer valuable insights into the complexities of technological innovation and adoption in diverse contexts.

SCOT has introduced four mechanisms to understand the social foundations of innovative technology design and development. This paradigm explains how emerging technology operates in a complex system. It also helps to observe how the interaction of technologies and humans impacts the institutionalization process. In other words, the SCOT offers a framework for observing how institutions manage their perceptions of technical functionality. It also helps to explain how stakeholders articulate their interest in the changes in technical functionality. Thus, SCOT guides the adoption of new technologies more coherently by finding the fitness of the technologies within the institution.

In the case of IT-supported internal controls, the SCOT helps articulate the relationship between agents (including auditors, vendors, and managers) and technologies. This paper uses the four mechanisms to examine practical activities (including institutionalized analytics schema) and their interpretations (including how to define exceptions and institutional rules). In the prior literature, adopting emerging technologies was often considered separately rather than jointly. Research has mostly focused on technology adoption and the implementation of its mechanical functions. However, less empirical work has attempted to study the integrative processes. There is a need for a better conceptual understanding of the connections among technology, humans, and the social workforce in the evolution of emerging technology adoption.

Based on the motivations described above, we initiated a pilot project to design a rule-based continuous monitoring system (Allies et al., 2006) for a state university's purchase-to-payment (P2P) process. This pilot study's team has four groups: the procurement department, the internal audit department, the human resource department, and the data analysts. As the principal designer in this pilot study, the author observes the entire procedure from project initiation through project adoption. The study uses value-focused thinking approach to observe how different stakeholders claim their interests by articulating the technical requirement in the algorithm selection, data preparation, and analytical results deployment. The data was collected from four sources: institutional documents, transactional data, the memoranda of weekly design WebEx meetings, and daily conversations with relevant stakeholders. We collected data from a simultaneous process of taking actions to complete a specific task and doing research. These two things are linked together by critical reflection. Thus, the evidence has its strength in the field studies because it can avoid response biases from self-reported interviews (Keeney, 1984, 1996 & Keeney et al., 2010).

This essay develops as follows: The second section reviews emerging technologies' applications in internal control development and introduces the SCOT theoretical perspectives. We develop five assumptions based on the literature. Next, we introduce the case study with derived institutional values. The fourth section develops the five propositions of the SCOT framework. We conclude the essay by confirming the rationale behind this study's method.

2. Literature Review: Implementing Technology in Internal Control and the Social Construction of Technology

Technologies can significantly enhance the development of internal control (IC hereafter) and transform organizational design (Kinney, 2000).

According to Auditing Standard No. 2201, IC over financial reporting involves maintaining accurate records and ensuring proper transaction recording. Information technology (IT) automates IC processes and measurements, changing organizational structures through alliances, process redesigns, and information sharing. Over the past three decades, continuous auditing (CA), which applies IT to provide real-time assurance by monitoring transactional data, has evolved, though its adoption has been gradual (Vasarhelyi & Halper, 1991). CA improves IC effectiveness with innovative analytics, such as detecting exceptions and prioritizing high-risk anomalies. Despite challenges like alarm overloading, CA integrates emerging technologies and AI to enhance IC performance (Vasarhelyi et al., 2012; Contri, R., 2020). However, implementing these technologies requires careful exploration and collaboration with stakeholders. The literature calls for more research on how IT, auditors, and management interactions impact ICs, suggesting that a new scope, such as the Social Construction of Technology (SCOT), could be useful for understanding these dynamics.

Resource dependence is the theoretical background in the adoption of emerging technologies. Organizations are open systems; they must actively engage in interdependent relationships with their environment to acquire the necessary resources for survival (Aldrich & Pfeffer, 1976). Organizations face uncertainties and ambiguity and make technological development efforts to respond to environmental pressure. With more available data, organizations can improve their decision-making and risk management with emerging technologies.

SCOT pioneers the design and development of emerging technologies (Pinch & Bijker, 1984). After Pinch and Bijker's seminal work, they integrated some subsequent works (Bijker, 1992, 1995a; Pinch, 1996; Pinch & Trocco, 2002; Pinch, 2008) to introduce four mechanisms to understand the social foundations of technology: (1) define existing problems and the relevant social groups, (2) manage interpretative flexibility, (3) closure and stabilization, and (4) social construction. These mechanisms are matched with the four technology adoption stages: initiation and background analysis, introduction, implementation, and institutionalization.

IC is a process (COSO, 2013). This “process” lens offers fitted perspectives from the SCOT to observe and study emerging data and technologies in ICs: (1) its ongoing character, (2) its interaction, (3) its embedment in social-political contexts, (4) its relation to the capabilities of artifacts, (5) its dependence on shared practical understandings, (6) its refinement capacity to emergent risks, and (7) its enactment of social structures (e.g., their generation, reinforcement, renewal, and transformation) through everyday action (Leonardi et al., 2010). With this clue, the following review is arranged with these mechanisms.

Mechanism 1: Define the existing problem and its related stakeholders.

The resource dependence theory argues that the impetus to search and apply emerging technologies is to extend the limited "resource" to handle the environment (Pfeffer & Salancik, 1978, p.3). The starting point is the problem development. Thus, at this stage, the "relevant social groups" (Pinch & Bijker, 1984, p. 402) play a vital role in new technology applications. The relevant social groups share a particular meaning of the functionality of the new technology. This meaning can then be used to define how technology develops along specific paths and may crucially impact the final social-constructed object (Berg, 1998).

When facing uncertainties from the environment, the relevant social groups (the technology stakeholders) seek to manage the problem with potential technologies. This process requires them to define the technologies' functionality to solve the issues raised. Both humans and technologies remain active according to the logic of their realm: technology performs mechanical functions, and humans interpret and articulate the variants that continually spring up (Berg, 1998).

IC design and management are highly regulated. It has peculiar social groups for the adoption of emerging technologies. The relevant groups include government agencies (i.e., SEC, PCAOB), professional associations (i.e., AICPA, COSO), auditors, managers at all levels, and staff in almost every business process. Thus, an IT-supported IC system needs a "co-construction" (Fujimura, 1996). As Bijker (1995) claims, the SCOT must "figure out a way to take the common evolution of technology and society as our unit of analysis (P. 10)."

Based on the discussions above, we developed Assumption 1 as follows.

> *Assumption 1: Accountability is the logical starting point of emerging data and technologies' application. It requires necessary and sufficient data accessibility and identifiable data flowing within the analytics.*

The first strategic action is to arouse the collective consciousness of the existing problem. In a semi-structured interview with key AI leaders and informants in six North American companies, Vial et al. (2020) found that data accessibility is a big challenge for businesses when it comes to taking advantage of emerging technologies. AI efforts can fail if organizations do not carefully manage data access throughout the development and production life cycle. It is necessary to enhance data accessibility to improve technologies' accountability, boosting emerging technologies' applications.

Multiple stakeholders shape technology accountability in IC systems. The first focuses on economic resources, emphasizing the need for a cost-benefit balance, termed affordability (Leonardi, 2003), highlighting the importance of cost-effective IC solutions. The second involves stakeholders from regulatory resources, encompassing government regulations and industry standards, such as those in the Sarbanes-Oxley Act, imposing stringent IC assessment requirements. Additionally, COSO provides a comprehensive IC framework for legal compliance guidance. The third group consists of stakeholders from technological resources, prioritizing suitable and efficient technologies to deliver solutions, emphasizing technological utility.

Data accessibility and fitted technologies are the preconditions for all stakeholders when they are searching for effective solutions. The prevalent digital transformation has made data ubiquitously available. According to Vial et al. (2020, p. 256), "Data accessibility is not about the properties of data itself; it is about having the required elements in place for machines to get the data." The study shows that data accessibility is often mistakenly treated exclusively as an IT problem, not a management problem. The divergent interests produce some data issues in data accessibility and the whole data value chain. Relevant stakeholders need to adjust their perceptions about the emerging functionality in internal controls.

In intergroup negotiation, regulators and top management have more influence on introducing emerging technologies to ICs. Institutions need to comply with SOX and its requirements for IC development. Under this regulation, the profession emphasizes the necessity of the COSO's IC framework. Accountable and reliable results are the fundamental requirement of the regulations. Also, other stakeholders have the same technical demand for their task goals. Thus, accountability can be a logical starting point to harmonize all stakeholders' interest claims. This requirement emphasizes data accessibility and a traceable data flow within the analytics.

Mechanism 2: Manage the diverse functionalities of the new artifact among stakeholders.

Different stakeholders of newly constructed technologies have different interpretations of the functionality of these new artifacts. This "interpretation flexibility" is important in understanding how technology is socially constructed. "One of the key components of interpretative flexibility is that the artifact's actual functionality is not determined by its technological properties, but rather by the meanings attributed to it by relevant social groups" (Leonardi, 2013, p. 72). Thus, in the process where a designer develops and applies an artifact to solve the problem, the object "works" only if it can be understood to "solve" the problem (MacKenzie, 1996, p. 35). Relational ontology is the premise to understand how technologies become socially constructed and evolved. The foundation of "things" is first and always a nexus of relations (Slife, 2005, p. 262). Qualities, properties, and identities do not exist independently or inherently "inside" a substance; instead, these characteristics depend on how, when, and where they are related to each other (Emirbayer, 1997, p. 186).

A different interpretation of new artifacts emphasizes the interaction between stakeholders and emerging technologies. Technologies are highly consequential through human action, and human action gives technology meaning. Berg (1998) claimed the criteria for the successful application of computer-supported cooperative work. The cooperation emphasizes the emergence of new technological capabilities and users' ability to recognize their usefulness. It also underscores the importance of technology applications adhering to an equality criterion and employing cultural and formal languages for effective communication with stakeholders.

A different interpretation of new artifacts can cause essential institutional inertia to hinder the application of technologies at this stage. Generally, intricacy and opacity are two interrelated processes that can lead to inaction. Intricacy refers to the number of steps in organizational changes and the complexity of the change (Carroll & Hannan, 2000). The more complicated things that need to be changed, the more difficult reform will be. Opacity means a "black box" that cannot be explainable. Suppose stakeholders cannot fully understand the selected functions and what will change with emerging technologies. In that case, they are mostly unable to support the change. Thus, the adoption team must try to gain a consentaneous understanding of the selected technology. This goal requires emerging data and technologies to be accountable and interpretable. Furthermore, the adoption requires technologies to work without mainly changing their current operating mechanism.

Based on the discussions above, we developed Assumptions 2 and 3 as follows.

Assumption 2: Co-construction can improve technologies' adaptability.
Assumption 3: Data infrastructure capability is the foundation of the institutionalization of emerging data and technologies.

The strategic action at this stage is to manage the most vulnerable stage and promote relevant stakeholders' consensus on technology application. In discussing the adoption of emerging technologies in ICs, SCOT emphasizes what technologies do and what they express, translate, and output (Robichand et al., 2013). This consideration means that the technologies are not only actors but also interpreters. Emerging technologies do not pre-exist as entities but are instead created and continually reconfigured through relations. The assumption is that ties are primary and objects secondary (Gergen, 2010). Everything that exists is thus always becoming a formation of relational effects. This ontology offers a matched angle to observe the relations among the stakeholders, the analytics artifact, and how they interact with each other. We should not follow the internal mechanisms separately. Understanding the broader scope of technology institutionalization involves examining the interaction between institutional pressures and traditional technologies, as well as the relationship between technological mechanisms and the relevant social elements. For example, it is necessary to articulate the analytics' specific technical requirements for regulators, management, and auditors in data selection procedures, algorithm choice, and the interpretation of the results.

Managing the diverse functionalities of the new artifact becomes easy if stakeholders can find an agreeable solution to harmonize different interest claims. Emergent technologies' accountability requires robust data infrastructure capability (Vial et al., 2020). A study from the World Economic Forum and Deloitte about technological innovation found that a general data control layer acts as a significant function for the "multiplier effect" (Contri, R., 2020, p.3). A commonality of some powerful AI applications in finance services is that these applications have a well-developed central data control layer, a task-oriented database, or a flexible data platform (Contri, R. 2020). The data platform needs traceable data sources and transparent data flow and needs to meet three requirements. First, it can cover the completeness of the control rules for the entire IC system. Second, it can be shareable for all analytics tools embedded in each process to enhance its analytical capability. Third, it has a transparent data flow for data preparation.

Under these two assumptions above, the regulators (e.g., SEC and PCAOB) expect to promote emerging technologies to decrease SOX 404 compliance costs. Management can have more confidence in having a useful management tool and simultaneously keep the existing decision-making routines and business hierarchy. Auditors expect to improve their working efficiency but avoid learning complicated IT techniques. End-users can relieve their worries by avoiding power abuse via complicated analytical algorithms and achieving a fair institutional environment.

Mechanism 3: Technologies' stabilization and final institutionalization management.

The third mechanism is related to the second: all newly created technologies should reach a stabilization and closure state before becoming social-constructed technologies. Pinch et al. (1984: pp. 426) demonstrated that "closure in technology involves stabilizing an artifact and the 'disappearance' of problems." Stabilization means that technology is accepted in the organization. After the iterative intergroup negotiation, the artifact stabilizes the meaning from the interpretative flexibility. This consensus signifies that artifacts reach a state of finalization. They demonstrated two avenues of stabilization. The first is rhetorical finalization, whereby the dominant group defines and emphasizes its finality. The second is finalized by redefining the problem, an ongoing procedure (Covaleshi et al., 1988).

Barad has an excellent argument about the notion of "stabilization" and "becoming": "Agencies are not attributes (of either humans or technologies) but ongoing reconfigurations of the world" (Barad, 2003, p.822). For example, the tree rings demonstrate "the sediment materiality of an ongoing process of becoming" (Barad, 2007, p.135). Another example is the result of a Google search. The information obtained with a Google search done today will shape research practices differently from what the Google search had done last month or will do next week. Furthermore, in certain circumstances, such differences may be quite consequential. Mazmanian et al. (2014) studied how arrangements that produce active forms of agency emerge in ongoing work by observing the process of reconfiguration of how the cosmic craft is understood and represented to those charged with its care and maintenance.

Thus, human action shapes technology by defining its function and explaining its output (Leonardi, 2013). Adopting technology requires understanding how it is embedded in its social context. Barad (2007) stated that discourse must be related to specific forms and at particular times and places. It is not a separate or static entity but dynamically produced in practice. Therefore, the closure of emerging technology is often periodic and needs ongoing refinement.

For example, Orlikowski and Scott (2012) observed TripAdvisor, an online hotel evaluation system. They found that shifts in how guest feedback, over time, is accepted in practice, from comment cards to online reviews, produce different guests, hoteliers, and hotels. Moreover, the performance changes, in turn, are serving to reconfigure the hospitality industry. Thus, the stabilization mechanism requires that the emerging data and technologies have a self-adjustment mechanism to adapt themselves to emerging risks and uncertainties.

Based on the discussions above, we developed Assumptions 4 as follows.

Assumption 4: The refinement of analytics is an ongoing process with relevant stakeholders.

The stakeholders have managed conflicts over the selected emerging data and technologies at this stage. The consensus makes the adoption action shift into how to refine the mechanical capability of the selected technologies. The criterion for closure and stabilization of IT-supported ICs is developing and deploying control rules. The project can be stabilized after the relevant stakeholders use the analytical results in their decision-making. The rise of algorithmic practices in auditing and accounting raises critical questions about intervention, surveillance, accountability, and ethics (Scott & Orlikowski, 2012). From the perspective of discursive practices, the following questions are valuable to consider in tuning emerging technologies in ICs: (1) What algorithms are being manifested, and how in particular times and places; (2) What situated outcomes are being produced as a result of their performance; (3) What realities and their functional performance are being enacted in practice over time; and (4) How the different entailments of algorithmic phenomena play out and under what conditions do essential empirical and ethical questions have significant salience for our understanding of management.

The answers to these questions need ongoing refinement. In other words, a data-driven analytics project can only have periodic closure. The expected scenario is to achieve the “multiplier effect” (Contri, 2020, p.3); it needs to have an ongoing process to adapt to an unfamiliar environment and derive new analytics features. Besides, the digital transformation of the business process provides opportunities to run experiments to optimize business processes, so the ongoing refinement gives technical support to analytics artifacts (Thomke, 2020).

Mechanism 4: Social-constructed artifacts

Socially constructed technologies include social structure and technological structure. Bijker (1995, pp.123) agrees that technological frames are not characteristics of systems or institutions but exist between actors. The framework elements can impact the interactions of the relevant social groups and lead to the attribution of meanings to the constructed artifacts. Different stakeholders have specific technical requirements in each implementation procedure of emerging data and technologies. For example, auditors and regulators emphasize the algorithm’s interpretative ability, and management may require accuracy. Thus, a technological frame constitutes the shared structure of interpretation of an artifact among members of a relevant social group (Klein & Kleiman, 2002).

Stinchcombe (1965) argued that in attempting to overcome their “liability of newness,” organizations built up a stock of resources and processes that locked them into specific structures and rules. The defined routines and technologies are the infrastructure of the interaction of human and nonhuman agencies. Nonhuman entities achieve this closure through their mechanic function (Barad, 2003; Pickering, 1995).

Based on the discussions above, we developed Assumption 6 as follows.

Assumption 5. Ethics issues can cause institutional inertia in adopting emerging technology. Managing moral problems at the beginning of the design process is necessary.

SCOT encompasses multiple potential underpinnings, and the foundation is a relational ontology (Latour, 2005; Pickering, 1995). The center is that relations are more important than entities (Leonardi, 2013). This notion of SCOT emphasizes technologies in practice. It is integral, inherent, and constitutive, shaping the contours and possibilities of everyday organizing. Thus, the IT application can be more effective if the technology can fit its culture and hierarchy. Even though the technologies have robust mathematic logic, some users may potentially twist and alter what the technology "carries." Data analytics cannot assess moral or ethical concerns (AICPA, 2020). Ethical issues can hinder the adoption of these emerging technologies and need to be managed well.

3. Application of the SCOT to a Purchase-to-Payment Audit Data Analytics Project

This essay's research question is about how communication among IT, auditors, and management impacts the development of emerging data and analytics projects and how to institutionalize suitable technologies to improve ICs. This question is a strategic matter and is related to multiple stakeholders. We initiated a pilot purchase-to-payment (P2P hereafter) audit data analytics project to develop a rule-based continuous monitoring system for a P2P process at a state university to obtain insights into this question. The one-and-a-half-year participatory case study allowed us to observe the entire procedure from the project initiation to its adoption. The team closed this project successfully when the rule-based continuous monitoring system was officially institutionalized in January 2019.

The study uses the Value-Focused Thing approach (Keeney, 1992, 1994) to collect evidence from the simultaneous process of taking actions to accomplish specific tasks and doing research. The integration of practical and academic perspectives can enhance understanding of how professionals approach and execute problem-solving in practice. Keeney and Winterfeldt (2010) successfully used a similar method to extract the terrorists' values by examining their writings and verbal statements. Instead of interviewing decision-makers and stakeholders, we extracted what the project stakeholders claimed and did by capturing the stakeholders' behaviors in the weekly WebEx meeting, the organization's documents, and the project team's emails. Kunz et al. (2016) used the same approach to develop a strategy map of the Balanced Scorecard of a newspaper company. The coding approach maintains consistency with the method: "Integrating the grounded theory method and case study research methodology within Information System research" (Halaweh et al., 2008, p.11).

3.1. An Introduction to the P2P Audit Data Analytics Project and the Data Coding Protocol

The institution in this pilot study is a state university in the northeastern US with multiple campuses and over 60,000 students from all US states and more than 125 countries. The university's large-scale purchasing process, known as P2P, offers significant theoretical value due to its frequency, amount, and variety. The author, a principal project designer, collaborated with a cross-departmental team, including internal audit, procurement, human resources, information systems, data analysts, and consultants, to develop a rule-based continuous monitoring system, officially institutionalized in January 2019. The project's timeline included data access identification, metric definition, benchmark development, exception analysis, automation, and ongoing model refinement.

3.2. Data Collection and Value Inference-Technological Part

Data collection focused on the technical aspects of the project, utilizing university policy files, project initiation documents, weekly meeting memos, stakeholder communications, and responses from policy violators. The value-focused thinking approach derived and categorized objectives from the collected data. The study identified 55 objectives related to improving the effectiveness and efficiency of the P2P monitoring system, organized into fundamental and means objectives, as shown in Tables 1 and 2.

Table 1: Fundamental Objectives Related to IT-supported Internal Controls

Overall Objective:
***Develop effective and efficient P2P monitoring system using emerging technologies**
Sub-objectives:
Relieve Institutional Pressures
-Improve P2P efficiency
-Improve the decision-making adaptability across many departments
-Improve inter-institutional compatibility
-Alleviate misaligned interest contradiction
Improve the Accountability and Reliability of the Technologies
-Develop traceable algorithms
-Improve the interpretability of the algorithms
-Handle ethical issues
-Assemble a cross-sectional expert team
Protect the Security of Assets
-Fraud detection
-Segregation of duties
Improve Data Infrastructure Capability
-Data relevancy
-Data completeness
-Data reliability

Business Policy Compliance
-Select Necessary and suitable attributes
-Signify the operational weaknesses
Due Diligence
-Gain support from the top management
-Improve the cross-departmental communications
-Seek to adopt emerging technology
-Respond to algorithm-driven decision making
-Elevate the collective consciousness of the operational weaknesses
Improve IT capability of ICs
-Develop a suitable architecture to accumulate business intelligence
-Develop a data platform to standardize the necessary data
-Improve the adoption of emerging technology
-Confirm the analytical results by a cross-sectional project team
-Explore suitable technology to signify the efficiency contradictions, the non-adaptability contradictions, the inter-institutional incompatibility, and the misaligned interest contradictions.

Key objectives included enhancing data infrastructure capability, accountability for data-driven analytics, and IT capability. These required a shareable data platform, interpretable algorithms, and improved visualization for communication efficiency. The study emphasized the importance of traceability and interpretability of algorithms and a standardized data platform, both of which were central to achieving the project's goals.

Table 2: Means Objectives Related to IT-supported Internal Controls

Algorithm Traceability and Interpretability
-Develop 'if-then' rule-based algorithms
-Utilize visualization technology
-Promote communication among relevant stakeholders
Ethical Issues
-Explore techniques to handle ethical issues based on training data, source data, algorithms, and outcome interpretations.
Fraud Detection
-Detect stakeholders that have conflicts of interest
-Utilize three-way comparison
-Detect transactional Anomalies
Segregation of Duties
-Approvers should be different from applicants
-Vendors *cannot* be businesses belonging to the faculty or staff
Standardized Data Platform to Achieve Data Quality Requirement
-A semantic conceptual data model
-Meta-data driven data architecture for data combination
-Accumulation of expertise to prepare useful, relevant data attribution
Improve IT Capability of ICs

-Explore solutions hidden in the data pattern
-Use the synthetic team to improve the diffusion of analytical expertise
-Seek potential reinforcement learning
Improve Adoption of Emerging Technology
-Top management support
Goal-congruence Process of Control Rules
-Multi-group decision-making process
-Fine-tuning of analytical algorithms periodically

Figure 1 below illustrates the relationships between the objectives and the means to achieve them. The fundamental objective was to develop effective control rules supported by routine meetings and periodic tuning. Algorithm traceability and interpretability and a standardized data platform were identified as crucial for ensuring accountability, reliability, and overall system effectiveness. These elements play a significant role in IT-supported internal controls, as discussed in detail in Section 5.

3.3. Mechanisms of Institutionalizing Emerging Technologies - Social Part

The university successfully institutionalized emerging technologies in its P2P process by addressing these mechanisms, enhancing control effectiveness and stakeholder collaboration.

Mechanism 1: Defining Problems and Social Groups.

The university's CFO initiated the P2P analytics project due to external regulatory pressures and internal control issues. Under Sarbanes-Oxley, nonprofit CFOs must sign forms 990 or 990-PF, necessitating effective ICs. The university's 2016-2017 financial report had a qualified opinion from KPMG, prompting the organization of chancellor unit meetings to enhance P2P controls. Additionally, the CFO aimed to establish a data-driven monitoring system to boost the university's reputation. Lacking technical expertise, the university sought help from the author's team and hired a project coordinator with data analytics experience. All stakeholders, including internal audit, management, and HR, supported the project to ensure accountability and reliability.

Mechanism 2: Manage the diverse functionalities of the new artifact among stakeholders.

Stakeholders initially had low expectations and concerns about the new technology's impact on their interests. The initial stages were challenging, particularly integrating data from different systems like Oracle Data Warehouse, SciQuest, and People HR system. The internal auditing department had to request data from the SciQuest vendor, complicating the process. Over six months, the team worked on data issues, gaining a breakthrough when analytics detected 961 rule-violating transactions. This result captured leadership's attention, forming a co-construction team and a robust data platform ensuring accountability.

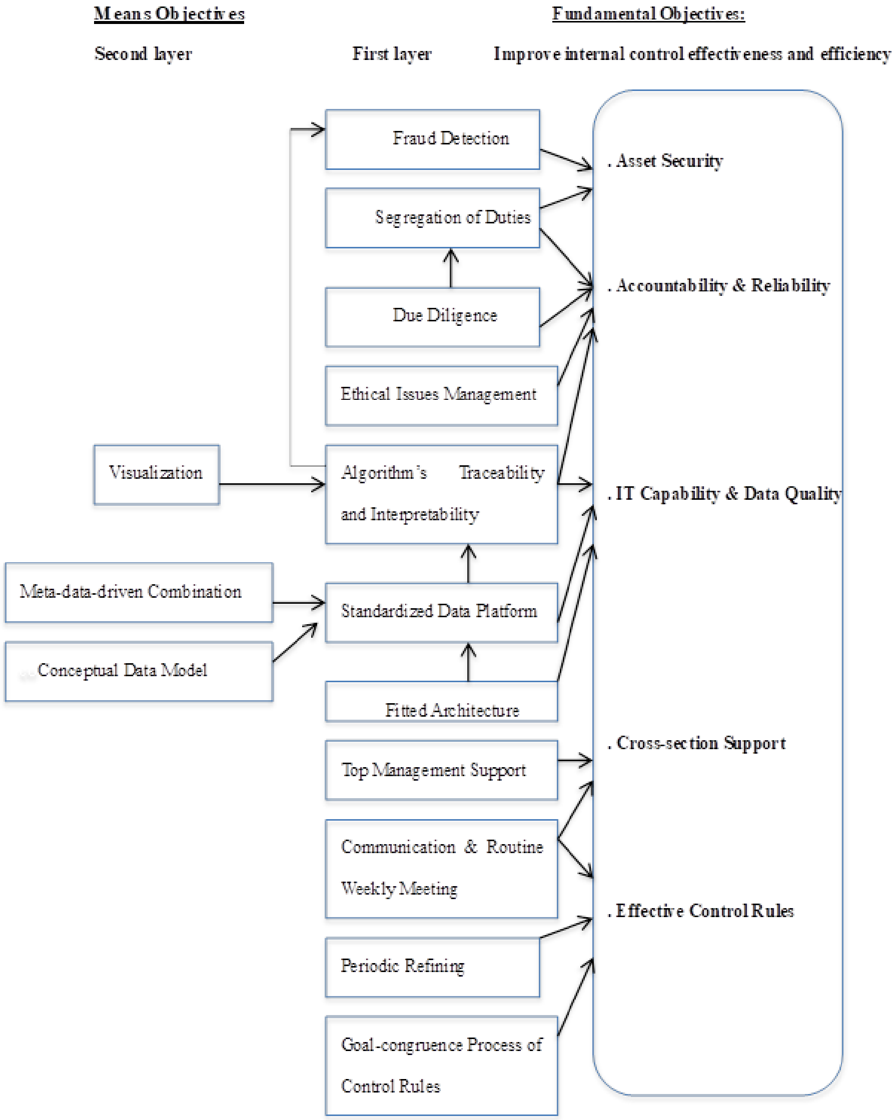

Figure 1: A Means-ends Objectives Network for IT-supported Internal Controls

Mechanism 3: Stabilization and Official Institutionalization

Stakeholders reached a consensus on the technology's functionality, realizing its benefits for decision-making and transparency. Enthusiasm grew, and departments like HR and procurement became more responsive. The team, including internal audit, procurement, HR, and data analysts, developed 14 control rules for the P2P process. Continuous communication with end-users refined the system, improving its intelligence and efficiency. Tableau dashboards prioritized risks, engaging end-users. Text mining and IF-THEN rules analytics enhanced specific audit tasks. Successful collaboration led to stakeholder acceptance and even career advancement for some team members.

Mechanism 4: Social Construction of IT-Supported Internal Control Systems

Technologies have technical and social structures, with social aspects influencing technical implementation. The design team addressed ethical issues from the project's inception, embedding considerations into the system through parameters and arrangements. The project managed ethical concerns related to data sources, training data, algorithm selection, and output interpretation.

4. A Framework to Guide Emerging Technologies' Institutionalization

The case study provides a thorough insight into the initiation and development of emerging data and technologies in the IC system. In this section, we extended the evidence coding from the case into a general institutional scope and used the value propositions of the P2P analytics project as a theoretical framework. These derived values have a general meaning as a framework to guide the adoption of emerging data and technologies in other contexts.

As Figure 2 below shows, the impetus to adopt emerging technologies is operational contradictions from inside and outside. The pressures push top managers to put a "coercive isomorphism" (DiMaggio & Powell,1991, p. 4) action to propel a better solution. This institutional evolution routine remains consistent with the current literature and extends the SCOT scope.

Specifically, the forces come from resource dependence, reflected as four contradictions: efficiency, non-adaptability, misaligned interest contradictions, and inter-institutional incompatibility (Seo et al., 2003). Simultaneously, some successful cases from peer organizations accelerate the pressure on management (Wagner, 2010). At this stage, mathematical logic and computation ability make algorithms achieve more effective decision-making than humans. Algorithmic objectivity can signify the organizations' contradictions and elevate the consciousness. of contradictions to push mimic isomorphism (DiMaggio & Powell,1991; Mittelstadt et al., 2016), which can accelerate institutionalization. A suitable strategy to harness emerging technology's potential is to take the "co-construction" procedures. Following the assumptions, we develop five propositions to guide emerging technologies' application in internal controls with the SCOT framework.

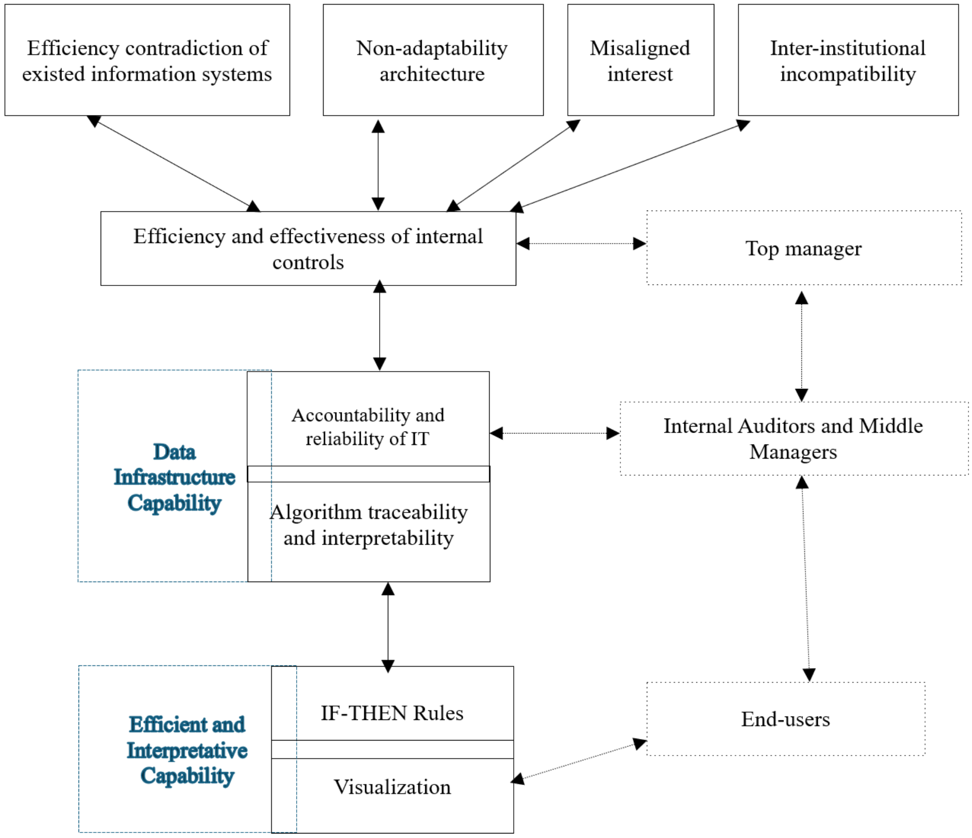

Figure 2: A strategic roadmap for emerging technology institutionalization

Proposition 1: Accountability and Reliability as the Foundation for Adopting Emerging Technologies

Accountability and reliability are crucial for adopting the latest information system technologies, as they ensure a transparent and traceable data flow within analytics. At the initial stage, defining the problem and engaging stakeholders to build collective awareness is essential. The aim is to bridge stakeholder interests with the functionality of emerging technologies. These technologies can meet stakeholder requirements and manage complexity by ensuring accountability and reliability. Objective algorithms, such as Boolean-based IF-THEN rules, help address existing contradictions and pressures, providing clear and unbiased solutions. This makes the technology more effective in executing tasks without human biases.

Proposition 2: Building a Strong Data Infrastructure

A robust data infrastructure is essential for institutionalizing emerging technologies. It's important to manage the flexibility of new technology interpretations to gain stakeholder consensus. The foundation of technological capability lies in having qualified data and ensuring data accessibility. Data-driven solutions often require data from multiple systems and formats. A standardized, task-oriented data platform can integrate data from diverse sources without disrupting existing systems, thus easing institutional resistance and enhancing internal control processes. This platform allows for experimentation and efficiency improvements by effectively structuring and leveraging big data.

Proposition 3: Enhancing Adaptability Through Co-Construction

The success of data-driven solutions depends on the cooperation of all stakeholders. Lax behavior can compromise control functions, highlighting the need for a co-construction team in developing IT-supported internal control systems. The P2P data project exemplifies the benefits of collaborative efforts. The project team developed analytics rules, detected transactions, and circulated a report for management verification. This structured approach, involving stakeholder feedback and qualitative data collection, boosts participation and drives project progress.

Proposition 4: Continuous Refinement of Emerging Technologies

Refining the mechanical functionality of technologies is an ongoing process involving stakeholders. Performance may vary across contexts, requiring adjustments for optimal utility. The relationship between humans and technologies is dynamic, with the interaction between exceptions and benchmarks refining automatic controls (Orlikowski et al., 2008). Periodic reassessment of algorithms, outcomes, contexts, and combinations is crucial for optimizing decision-making routines. Organizational routines are seen as social and technical assemblages shaped by technological capacities and embedded in institutional life, contributing to the reconstitution of organizational reality (Latham & Sassen, 2005; Feldman & Pentland, 2003).

Proposition 5: Integrating Ethical Considerations

Ethical considerations must be integrated into the design and implementation of emerging technologies. Data-driven solutions raise moral issues, and the results of analytics often inform decision-making, potentially impacting the institution's political hierarchy (Weiner, 1954). Addressing ethical concerns proactively is essential to prevent institutional inertia and facilitate the adoption of emerging technologies. Ethical issues should be managed from the outset, incorporating considerations related to data sources, training data, algorithm selection, and output interpretation. This approach ensures the responsible and effective use of emerging technologies.

Conclusion

Following the value-focused thinking approach, this study formulated a theoretical framework integrated with five propositions to harness the power of emerging data and technologies to enhance internal control performance. By documenting the system's implementation process, we observe how SCOT mechanisms can mitigate institutional inertia and effectively leverage technologies. The evidence highlights technology's role in signifying external and internal pressures, motivating internal audit departments to apply AI and technologies to alleviate their burdens. Despite facing challenges from technical and social forces, the design and development of the continuous IC monitoring system are guided by these propositions, offering insights into how to harness the power of data-driven technologies.

The application of emerging data and technologies in ICs is a collaborative process requiring engagement with relevant social groups to institutionalize data-driven systems and optimize organizational decision-making routines. The fundamental requirement is the availability of suitable algorithms and qualified data, enabling accountable and reliable analytics results to address institutional pressures effectively. Integrating relevant social groups and technology aids in circulating emerging technology while overcoming data issues, which remains a significant challenge, addressed through techniques and mechanisms demonstrated in the case study.

This study offers a practical roadmap for fitting AI and technologies into an institutional social management ecosystem. It presents a theoretical adoption strategy for promoting emerging data and technologies in ICs, contributing to the literature by addressing the emerging technology usage trap and enhancing analytics performance. Responding to the PCAOB's call for research on emerging technologies in auditing, the study offers practical value through SCOT mechanisms for institutionalizing emerging technologies. Additionally, the six propositions provide technical guidance for developing a more flexible data-driven analytical schema.

Limitations and Future Research

One limitation of this study is that the subject university is a non-profit organization. Consequently, inferences drawn from this case may differ from those applicable to profit-making institutions, which could provide more quantifiable evidence for the research question. The operational dynamics and financial priorities of non-profit organizations often vary significantly from those of profit-driven enterprises, potentially affecting the generalizability of the findings. Another limitation is that this study's observation of emerging technologies is confined to the initial stages of design and implementation. This early focus limits the understanding of these technologies' long-term impact and efficacy. A more extended study period would yield deeper insights into the technologies' integration, adaptation, and sustained benefits within the organizational framework.

Additionally, future research should aim to incorporate more quantifiable cost-benefit analyses of technology adoption. This would provide a clearer understanding of the financial implications and operational efficiencies gained from implementing new technologies. By addressing these limitations, subsequent studies can enhance the robustness and applicability of their findings across various organizational contexts.

Conflict of Interest: The author of the paper did not report any conflict of interest.

Funding Statement: The author did not obtain funding for this study.

Data Statement: All data are available in the content of the manuscript.

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