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THE GHOST IN THE CLEAN MACHINE: A PHENOMENOLOGICAL EXPLORATION OF SMALLHOLDERS' RESISTANCE AND ACCEPTANCE OF BLOCKCHAIN-BASED HALAL TRACEABILITY

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ABSTRACT

Objective: This study examines the socio-technical tensions experienced by smallholder farmers and traditional slaughterers in the upstream halal supply chain following the implementation of a blockchain-based traceability system. The study focuses on how digital traceability reshapes relational trust, professional identity, and everyday work practices.

Research Design & Methods: This study employs a qualitative approach using Interpretive Phenomenological Analysis (IPA). Data were collected through semi-structured interviews, participatory observation, and reflective field notes involving smallholder farmers and traditional slaughterers participating in a pilot of the blockchain-based traceability system. The data were analyzed to identify recurring patterns and interpret the participants' lived experiences.

Findings: This analysis revealed three main themes: the erosion of relational truth, bodies constrained by algorithms, and a crisis of professional identity. These themes illustrate the tension between interpersonal and system-based trust, digital reporting requirements and established work rhythms, as well as traditional job skills and emerging digital competencies. Participants' reluctance toward digital procedures cannot be understood solely as a matter of technological incompetence; it also reflects concerns about professional dignity, autonomy, and recognition of local knowledge.

Implications & Recommendations: These findings highlight the importance of participatory and context-sensitive approaches in blockchain implementation. Digital traceability initiatives must involve upstream stakeholders, provide appropriate training, and accommodate the practical realities of traditional work environments.

Contribution & Value Added: This study expands the scope of halal supply chain research beyond mere technology adoption by examining the human, relational, and professional consequences of digital traceability. It emphasizes that the effectiveness of blockchain-based systems depends not only on technological capabilities but also on their ability to accommodate human roles, relational trust, and local knowledge.

Keywords: Blockchain Traceability, Halal Supply Chain, Socio-Technical Paradox, Digital Panopticon.

JEL codes: O33, Z12, L23
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INTRODUCTION

The global halal industry has transformed from a niche religious market into a trillion-dollar global economic sector that encompasses food processing, pharmaceuticals, cosmetics, and various other economic sectors (Azam & Abdullah, 2020). At the heart of this transformation is halal assurance, which ensures that products comply with Sharia law from their source all the way to the end consumer (Calder, 2020; Tieman, 2020). Historically, halal integrity has relied heavily on certification, documentation, and oversight mechanisms involving various actors in the supply chain (Che Hassan & Osman, 2024). In the modern global economy, supply chains have become increasingly complex and involve various stages and actors, thereby increasing the challenges of maintaining halal integrity, including the risks of contamination and product information discrepancies (Anggraini et al., 2024; Dashti et al., 2024). In response to these challenges, digital technologies are increasingly being developed and discussed as tools to strengthen transparency and the management of the halal supply chain. Blockchain technology, with its characteristics of decentralization, immutability of recorded data, and transparency, is viewed as having the potential to improve halal traceability systems (Sunmola et al., 2025). By recording information at various stages of the supply chain in a distributed digital ledger, blockchain offers the opportunity to strengthen product traceability and build trust through verifiable information (Alamsyah et al., 2022; Sunmola et al., 2025).

A sharp structural mismatch emerges at the most basic level of this digital ecosystem namely, among upstream actors such as small-scale livestock farmers and traditional butchers at slaughterhouses (RPH) (Nisa, 2026). While the macro-policy narrative focuses on increasing transparency and information integration within the supply chain, the micro-reality in the upstream sector remains shaped by manual labor practices, resource constraints, and deeply entrenched social relationships (Nisa, 2026; Vanany et al., 2024). For small-scale farmers and traditional business operators, the implementation of blockchain technology is not merely an improvement to routine operations but also requires readiness in infrastructure, financial resources, and managerial support (Susanty & Vitasari, 2022; Vanany et al., 2024). The implementation of digital traceability systems may also require traditional actors to adjust their work routines and the record keeping mechanisms they have traditionally used (Harsanto et al., 2024; Nisa, 2026). As a result, the implementation of technology in the field does not always proceed smoothly but may face various obstacles, including limitations in technological capacity, cost constraints, and the process of adapting to new formal procedures (Nisa, 2026; Susanty & Vitasari, 2022).

These frictions underscore a critical tension between the technical demands of state-led halal governance and the sociocultural realities of the traditional workforce (Nisa, 2026). Although quantitative approaches in technology adoption research can explain the factors influencing the acceptance of digital systems, such approaches may not necessarily capture in depth the subjective experiences and social meanings workers ascribe to technological change (Vanany et al., 2024). For traditional butchers and small-scale livestock farmers, halal certification is not merely an abstract data point verified mathematically within a digital network. Rather, halal is also a relational and embodied practice rooted in interpersonal responsibility, the precision of ritual slaughter, and local beliefs and traditions (Nisa, 2026). When validation mechanisms which have traditionally been based on experience, religious practices, and local beliefs are integrated into standardized digital procedures, this has the potential to create tension in how stakeholders understand and carry out halal practices (Nisa, 2026). In this context, blockchain has the potential to be perceived not only as a facilitator of transparency and product purity, but also as a form of digital oversight that could impact the professional autonomy of traditional stakeholders. This perception needs to be further explored through the direct experiences of stakeholders at the upstream level.

Although upstream stakeholders play a crucial role in maintaining the continuity of the halal supply chain, academic studies on blockchain in the halal supply chain still largely focus on technological aspects, transparency, traceability, and implementation mechanisms (Alamsyah et al., 2022; Harsanto et al., 2024). A number of studies on blockchain technology adoption use quantitative approaches and technology acceptance frameworks to explain the factors influencing user readiness and acceptance (Vanany et al., 2024). These approaches generally emphasize aspects such as perceived usefulness, ease of use, organizational readiness, and conditions that support technology adoption. Although they help explain the factors influencing adoption, these approaches do not fully account for how actors at the grassroots level experience, interpret, and respond to technological changes in their daily work lives. On the other hand, qualitative research on the halal supply chain has begun to address the experiences and perspectives of stakeholders, but studies that specifically explore the subjective experiences of small-scale livestock farmers and slaughterhouse workers in dealing with a blockchain-based halal traceability system still need to be developed (Alamsyah et al., 2022; Vanany et al., 2024).

This study aims to bridge this gap through the Interpretative Phenomenological Analysis (IPA) approach, by shifting the analytical focus from macro-level infrastructure to the subjective lived experiences of upstream workers (Smith & Fieldsend, 2021). Rooted in the traditions of phenomenology and hermeneutics influenced by the thought of Husserl and Heidegger this approach explores how these actors interpret their professional identities amid the tension between traditional religious obligations and digital surveillance (Smith & Fieldsend, 2021). Therefore, the uniqueness of this research lies in its effort to understand the social and phenomenological experiences underlying the technology adoption paradigm, which is centered on technical aspects. This study explores the socio-technical and existential barriers described as "ghosts" within the blockchain by contextualizing farmers' resistance not merely as a technical failure, but also as a potential effort to preserve cultural identity, the local moral economy, and the autonomy of traditional halal practices amid increasing digital surveillance (Thompson, 1971).

LITERATURE REVIEW

The Socio-Technical Paradox in Blockchain Traceability

Contemporary supply chain epistemology aggressively positions blockchain technology as a manifestation of "algorithmic truth," designed to negate subjectivity, bias, and the potential for human fraud within the product assurance ecosystem (Harsanto et al., 2024; Yavaprabhas et al., 2023). Through the pillars of decentralization, cryptographic encryption, and distributed consensus, this architecture facilitates a radical shift from trust based on institutions or individuals toward a trust structure fully mediated by digital code (code-mediated trust) (Toufaily & Zalan, 2024). In industries with a high level of regulatory sensitivity, such as the halal food sector, blockchain-based traceability is positioned as the gold standard capable of providing absolute and objective proof of Sharia compliance from upstream to downstream. This system operates on the assumption that every operational data

point can be precisely, in real time, and linearly encoded into an immutable cryptographic block (Powell et al., 2022).

The determinism of this technology gives rise to a massive socio-technical paradox when confronted with empirical realities at the upstream level of the supply chain (Vanany et al., 2024). Top-down digital governance policies often overlook the fact that the effectiveness of blockchain software depends heavily on the quality of human interaction as the primary source of data input (the oracle problem) (Powell et al., 2022). This is where structural distortions occur: blockchain architecture inherently assumes a highly standardized, rigidly procedural, and formally mechanized work environment (Nisa, 2026; Vanany et al., 2024). In contrast, the upstream ecosystem dominated by small-scale farmers and traditional slaughterhouses relies entirely on operational flexibility, tacit manual expertise, and informal communication patterns (Nisa, 2026). This fundamental misalignment triggers a clash with the logic of rigid systems.

When digital order which demands precise data input is forced into a dynamic and largely manual upstream environment, blockchain technology no longer functions as an enabler of efficiency but acts as a disruption that creates latent administrative burdens (Nisa, 2026; Powell et al., 2022). Recent studies indicate that the behavioral resistance emerging among small-scale actors is not merely a reflection of low digital literacy or financial constraints (Vanany et al., 2024). This phenomenon is a manifestation of resistance to the imposition of mechanical standardization that reduces their flexibility at work (Nisa, 2026). The failure of blockchain integration in upstream communities confirms that mathematically sophisticated digital technologies will remain functionally paralyzed if they fail to align with social structures, local customs, and organic, relationship-based work systems that have sustained these communities across generations (Vanany et al., 2024).

The Digital Panopticon and the Threat to Actors' Agency (A Foucauldian Perspective)

In the realm of industrial sociology and institutional control, the transition toward a blockchain-based digital traceability system can be critically analyzed using Michel Foucault's theory of spatial sovereignty and the Panopticon surveillance apparatus (Foucault, 2008). The essence of panopticism in the contemporary era has undergone a radical metamorphosis; it no longer manifests as a physical watchtower at the center of an institutional complex but has transformed into a network of permanent data visibility that compels subjects to discipline themselves autonomously and constantly (Foucault, 2008). Blockchain-based supply chain traceability systems redefine the boundaries of the upstream workspace which was originally private and personal into a digital public space that is fully transparent, exposed, and inspectable by external actors or regulatory authorities at any time, without geographical limitations (Aloisi & De Stefano, 2022). This asymmetric oversight works by capturing every micro-operational activity in detail, transforming it into cold efficiency metrics, and storing it in permanent encryption.

Like local butchers and independent livestock farmers, this automated digital surveillance is perceived as a direct threat to their agency, the privacy of their operational tactics, and the sovereignty of their tacit knowledge which has been socially recognized and respected within their communities (Nisa, 2026). When sacred manual expertise is commodified and subjected to algorithmic standardization, workers experience an acute professional identity crisis. These digital tracking policies strip them of their autonomy in setting the rhythm of their independent work and reduce them to mere mechanical components of a technology governance architecture that is centrally controlled from a distance (Aloisi & De Stefano, 2022; Chai et al., 2024). The phenomenon of behavioral resistance that has emerged on a massive scale in the field whether manifesting as passive noncompliance, delays in data entry, or even the deliberate manipulation of system errors is not a reflection of technical incompetence or a reluctance to move forward (Nisa, 2026). Rather, these actions must be understood as a fundamental form of existential resistance against the alienation of labor and the dehumanizing effects of technology. This is an active defensive strategy by traditional actors to reject their positioning as pathological subjects who are fully disciplined and controlled by the panopticon of digital surveillance algorithms (Foucault, 2008; Nisa, 2026).

The Tension Between the Moral Economy and the Market Economy in Halal Certification

The sociocultural and psychological dimensions of resistance to blockchain adoption in the upstream sector are deeply rooted in a profound conflict of values between the Moral Economy and the Market Economy (Thompson, 1971). theory of the Moral Economy asserts that within the ecosystem of traditional societies or local communities, economic transactions and the validation of legitimacy are not driven by profit maximization or formal metrics, but are strictly bound by the ethical norms of reciprocity, social reputation, and transcendental spiritual commitments (Thompson, 1971). In the context of religion-based product certification particularly for meat products halal status has traditionally been treated as a deeply sacred moral and spiritual domain. The validity of a product's purity is validated through the personal piety of the slaughterer, religious oaths, and a network of trust among neighbors that has organically developed based on interpersonal relationships (Nisa, 2026).

The penetration of blockchain technology imposes the logic of the market economy into this sacred space, delegating the essence of trust which was originally interpersonal in nature to rigid, calculative, and impersonal technocratic instruments (Toufaily & Zalan, 2024). Blockchain demands proof of compliance that must be

mathematically and constantly verified, which indirectly reduces the integrity of human faith to nothing more than a string of digital code (Powell et al., 2022). When this spiritually grounded reliability rich in local values is forcibly replaced by standardized encryption codes, upstream actors experience severe value dissonance and cultural alienation. They feel that their religious integrity, moral honor, and spiritual commitment are being called into question by a cold, soulless technological system (Nisa, 2026). It is this philosophical dissonance that has crystallized into a solid wave of cultural resistance at the grassroots level. Small-scale farmers and traditional workers reject the implementation of blockchain technology not because they are anti-modernity, but because they realize that excessive digitization does not enhance the substantive sanctity of halal products. On the contrary, such digital commodification actually erodes the essence of ritual sincerity and spiritual nobility, which are the most fundamental pillars of the concept of halalan tayyiban in their religious traditions (Nisa, 2026; Powell et al., 2022).

METHODS

This qualitative study employs the Interpretative Phenomenological Analysis (IPA) approach to deeply explore how small-scale livestock farmers and traditional butchers interpret their work identities and spiritual autonomy, which have been disrupted by the blockchain-based halal traceability system. The primary focus of this study is to capture the humanistic and psychological aspects of resistance among upstream actors, rather than merely mapping technical obstacles.

Table 1 Prosedur Operasional Riset

Stages	Field Implementation	Academic Rationale
Participants & Sampling	Purposive homogeneous sampling of 6–10 informants (small-scale slaughterhouse butchers and independent farmers) who are required to use blockchain and exhibit signs of inner conflict or resistance.	Ensuring a homogeneous sample so that lived experiences can be explored intimately and in depth, in accordance with the traditions of the social sciences.
Data Collection	A combination of in-depth conversations (semi-structured interviews), direct observation at the slaughterhouse starting at dawn (go-along interviews), and the researcher's journal (reflective journaling).	Capturing data beyond verbal transcripts, such as body language, expressions of confusion during data entry, and emotional tension in the field.
Data Analysis (Manual)	Analysis was conducted manually (without computer software) following a protocol: rereading transcripts, adding marginal notes, and summarizing them into broad psychological themes.	Maintaining the researcher's empathy as the primary instrument. Human pain and anxiety were analyzed through the researcher's keen intuition, not algorithms.

Ensuring Data Validity (Trustworthiness)

To maintain the objectivity and rigor of the research without the aid of technology, the researcher applied three pillars of validation:

1. Bracketing (Epoche): The researcher first identified and "bracketed" all academic egos, modernization biases, and theoretical knowledge about blockchain prior to the interviews. This is done so that the researcher's mind is fully open to accepting reality from the informants' perspective.
2. Member Checking: The researcher revisits the informants in person to discuss the initial interpretation. This step ensures that their heartfelt expressions and narratives are not misinterpreted by the researcher.
3. Human Audit Trail: The entire process of coding, manual note-taking, and the transformation of raw data into final themes is meticulously documented in a dedicated notebook as a transparent and accountable research audit trail for reviewers.

RESULT AND DISCUSSION

Based on an in-depth phenomenological analysis of the lived experiences of small-scale livestock farmers and traditional butchers at the Slaughterhouse (RPH), the introduction of blockchain technology is not viewed merely as an administrative tool. Rather, this forced adoption triggers complex inner struggles that threaten self-esteem, diminish spiritual values, and create anxiety stemming from latent surveillance. The thematic structure identified in this study is summarized in Table 2.

Table 2 Superordinate Themes, Emergent Themes, and Theoretical Conceptualizations of Participants' Lived Experiences

Superordinate Theme	Emergent Theme	Theoretical Conceptualization
Death of Relational Truth	Shift from interpersonal trust to system-based trust; reduction in recognition of moral legitimacy	Moral Economy and Trust in Blockchain
Algorithmically Enclosed Bodies	Perceptions of digital surveillance; tension between work rhythms and the demands of digital record-keeping	Panopticism and Digital Surveillance
Professional Identity Crisis	Devaluation of traditional expertise; shifts in recognition and competency hierarchies	De-skilling dan Professional Identity

Source: Authors' analysis of interview data (2026).

Algorithmically Enclosed Bodies and the Digital Panopticon in the Slaughterhouse

The implementation of digital traceability systems has also transformed workers' experiences in carrying out their activities at the slaughterhouse (RPH). Work that previously depended on the physical condition of the livestock, manual skills, and coordination among workers must now be aligned with the demands of digital record-keeping. This shift can create tension when the need to enter data in a timely manner clashes with work situations that are not always predictable. A senior slaughterhouse worker described his experience: "Now, working here feels like being locked up in an invisible prison. We used to work calmly, just flowing with the rhythm of the animals' breaths as they were about to be slaughtered. Now, everything is dictated by digital deadlines. If data entry is even ten minutes late because a cow goes berserk, the central system immediately flashes a red warning. I feel like there's a giant eye on the ceiling constantly watching my every hand movement. "We were forced to rush, gripped by anxiety all night long." This experience demonstrates that digital systems not only function as recording devices but can also shape workers' perceptions of surveillance and control over their activities. From Foucault, (2008), perspective, panoptic mechanisms operate through the possibility of constant surveillance, thereby prompting individuals to regulate their own behavior. In the context of digital work, technology-based surveillance can also influence workers' autonomy and experiences (Aloisi & De Stefano, 2022; Chai et al., 2024).

This study interprets this experience as a "digital panopticon in the abattoir," that is, a situation in which workers feel that their activities are increasingly bound by standards, indicators, and digital monitoring mechanisms. However, the experience of being monitored does not necessarily prove that the entire blockchain system is designed to control workers or that all their activities are directly monitored. This interpretation refers to the informants' perceptions of the consequences of using the system in their work environment. Tension arises because slaughtering activities involve dynamic material conditions, whereas digital recording systems tend to demand consistency and accuracy in data entry. A study on the implementation of halal technology in Indonesia also indicates that the adoption of blockchain faces organizational and operational challenges that must be addressed during the adoption process (Vanany et al., 2024). Thus, the primary issue lies not in the digital technology itself, but in the alignment between system design, working conditions, and worker capacity. These findings underscore the need for a traceability design that accounts for the operational rhythm of slaughterhouses, including flexibility in record-keeping when unpredictable on-site conditions arise.

Professional Identity Crisis and the Erosion of Traditional Skills (De-skilling)

The third theme suggests that the adoption of blockchain technology has the potential to influence how senior butchers perceive their professional expertise and honor. In the informants' experience, slaughtering skills are understood not only as technical abilities but also as competencies built through experience, practice, and social recognition. However, as work processes become increasingly reliant on digital applications, some workers feel that the ability to operate devices has become a new measure of professional competence. A senior master butcher remarked: "For decades, I've been respected in this community because my hands are sharp, steady, and know exactly how to honor and calm an animal before slaughter. Now, my entire life's honor has crumbled just because my calloused thumb often presses the wrong button on that smart app. The young people sitting at computers in the office scold me as if I don't know how to properly butcher a cow, just because I stumble when filling out digital forms. "I no longer feel valued as a man or as a butcher." This narrative highlights the tension between skills acquired through hands-on experience and the administrative and digital competencies that are increasingly required in the workplace. In this context, de-skilling can be understood as the experience of traditional skills losing recognition due to changes in competency standards and work evaluations. This finding is also relevant to studies on the materiality of halal and the workforce in Indonesia, which position work practices and workers' competencies as crucial components of halal implementation (Nisa, 2026).

These experiences indicate that digitalization can influence professional identity and intergenerational relationships within slaughterhouse environments (Widari & Jazadi, 2025). When senior workers have difficulty using the app, they may be placed in positions where they are perceived as less competent, despite their extensive experience in slaughtering practices. This situation can shift the basis of professional recognition from mastery of

ritual and manual skills toward the ability to comply with digital procedures. From the perspective of this study, this shift is interpreted as a crisis of professional recognition, which for some informants is also linked to self-esteem and the masculine identity associated with the butcher's trade. However, these findings are not intended to suggest that all male workers are experiencing a crisis of masculinity; rather, they demonstrate how changes in competency standards can be perceived as a threat to the identity they have long built through their work. This tension reveals that the success of technology adoption cannot be measured solely by app usage or data completeness. The system must also recognize the practical knowledge, experience, and skills that workers already possess. Therefore, participatory digital training, intergenerational mentoring, and the involvement of slaughterers in the design of operational procedures are essential to ensure that digital transformation does not result in the marginalization of workers who are integral to the halal certification process.

CONCLUSION

This study reveals that the implementation of a blockchain-based halal traceability system in the upstream halal supply chain creates tension between technological standardization and the moral, social, and practical realities of traditional practitioners. The experiences of smallholder farmers and traditional slaughterers show that halal assurance is not merely a matter of digital verification but is also rooted in spiritual commitment, personal reputation, practical expertise, and relational trust. Therefore, increasing reliance on digital records can be perceived as an erosion of relational truth, especially when technological evidence is deemed more important than the moral integrity and traditional knowledge of workers. These findings further highlight two interrelated consequences of digitization: the perception of constant digital surveillance and the declining recognition of traditional professional expertise. These experiences are reflected in the concepts of the digital panopticon and the crisis of professional identity. Crucially, skepticism and reluctance to engage with digital systems should not be automatically interpreted as technological incompetence but must be understood in relation to workers' efforts to maintain autonomy, professional dignity, and established practices. By highlighting these experiences, this study expands the discussion on the digitization of the halal supply chain beyond the adoption of technology to include its moral, social, and identity-related aspects.

These findings have practical implications for governments, halal certification bodies, slaughterhouse operators, and technology developers. The implementation of blockchain-based halal traceability systems must move beyond the dominant top-down, technology-centric approach toward a participatory socio-technical design that accommodates operational realities and the knowledge of upstream stakeholders. Digital systems must provide sufficient flexibility in data recording, recognize the practical expertise of traditional workers, and avoid treating digital proficiency as the sole indicator of professional competence. Therefore, participatory training, ongoing technical assistance, and the involvement of farmers and slaughterers in system development are crucial for strengthening technology adoption and operational sustainability. Ultimately, the effectiveness of a digital halal traceability system should not be evaluated solely based on data completeness, system compliance, or technological efficiency, but also on its ability to uphold the moral legitimacy, human role, and social trust that form the foundation of halal practices.

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