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The Adoption of Blockchain Technology in Agri-food Traceability: A Comparative Analysis of Benefits and Barriers in Italian and Portuguese SMEs and Consumer Perceptions

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Master in Management of Services and Technology

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BUSINESS
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Department of Marketing, Operations and General Management

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I wish to express my heartfelt gratitude to my Mother, my alpha and my omega, whose unwavering love and support have been the cornerstone of my journey.

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Ad Astra.

Resumo

Esta dissertação tem origem num double degree e desenvolve-se em duas fases de investigação complementares. A primeira, em Itália, analisou benefícios e obstáculos à adoção da blockchain através do projeto nacional TrackIT Blockchain, na plataforma Itachain. O estudo examinou 10 PME agroalimentares apoiadas por instituições públicas, que usaram rastreabilidade em blockchain para proteger produtos Made in Italy contra a contrafação. Embora tenha fornecido informação útil num contexto subsidiado, não abordou outros enquadramentos institucionais nem a perspetiva dos consumidores.

A segunda fase, em Portugal, amplia a análise. Apesar da agenda Blockchain.PT, organizada como consórcio fechado, não existe subsídio aberto comparável ao TrackIT, e as PME e consumidores estudados situam-se fora dessa iniciativa. Foram recolhidas evidências junto de 10 PME agroalimentares portuguesas e 72 consumidores, permitindo comparação entre países e atores.

Os resultados mostram que as PME italianas ligaram a blockchain sobretudo a ganhos reputacionais e credibilidade internacional, mas a adoção enfraqueceu após o fim dos subsídios. As PME portuguesas permanecem em pré-adoção, vendo a tecnologia como dispendiosa e complexa, com benefícios limitados e sem retornos económicos. Os consumidores, em contraste, revelaram confiança, perceção de utilidade e disposição para pagar prémio por produtos certificados, sugerindo procura mais forte do que o assumido pelas PME.

O estudo fornece evidência comparativa sobre a adoção da blockchain na rastreabilidade agroalimentar e conclui que a tecnologia só gera valor quando benefícios reputacionais se convertem em resultados tangíveis através da coordenação institucional, do envolvimento dos consumidores e de normas comuns.

Palavras-chave: Blockchain; rastreabilidade; PME agroalimentares; perceção dos consumidores; barreiras à adoção; estudo comparativo

Classificação JEL: O33, Q13

Abstract

This dissertation originates from a double degree and develops in two complementary phases of research. The first, in Italy, analysed the benefits and obstacles to blockchain adoption through the national TrackIT Blockchain project on the Itachain platform. The study examined 10 agri-food SMEs supported by public institutions, which used blockchain traceability to protect Made in Italy products against counterfeiting. Although it provided useful insights in a subsidised context, it did not address other institutional settings or the consumer perspective.

The second phase, in Portugal, broadens the analysis. Despite the Blockchain.PT agenda, organised as a closed consortium, no open access subsidy scheme comparable to TrackIT exists, and the SMEs and consumers studied lie outside that initiative. Evidence was gathered from 10 Portuguese agri-food SMEs and 72 consumers, enabling comparison between countries and actors.

The results show that Italian SMEs linked blockchain mainly to reputational gains and international credibility, but adoption weakened after subsidies ended. Portuguese SMEs remain in a pre-adoption stage, viewing the technology as costly and complex, with benefits limited and without measurable returns. Consumers, in contrast, demonstrated trust, perceived usefulness, and willingness to pay a premium for certified products, suggesting stronger demand than SMEs assume.

The study provides comparative evidence on blockchain adoption in agri-food traceability and concludes that the technology generates value only when reputational benefits become tangible outcomes through institutional coordination, consumer engagement, and common standards.

Keywords: Blockchain; traceability; agri-food SMEs; consumer perception; adoption barriers; comparative study

JEL Codes: O33, Q13

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Glossary of acronyms

AI – Artificial Intelligence
API – Application Programming Interface
Blockchain.PT – National mobilisation agenda on blockchain (Agenda Mobilizadora, PRR, Portugal)
DCE – Discrete Choice Experiment
EDI – Electronic Data Interchange
ERP – Enterprise Resource Planning
EVOO – Extra Virgin Olive Oil
IBS – Iscte Business School
ICE – Italian Trade Agency (Agenzia ICE)
IoT – Internet of Things
Iscte – University Institute of Lisbon
Itachain – Blockchain traceability platform within TrackIT (Italy)
JEL – Journal of Economic Literature classification codes
k – Number of items in the scale
M – Mean (arithmetic average)
N – Sample size
OECD – Organisation for Economic Co-operation and Development
PDO – Protected Designation of Origin
PEOU – Perceived Ease of Use (TAM construct)
PGI – Protected Geographical Indication
PRR – Recovery and Resilience Plan (Plano de Recuperação e Resiliência, Portugal)
PU – Perceived Usefulness (TAM construct)
QR – Quick Response (code)
r – Pearson's correlation coefficient (2-item scale reliability)
R&D – Research and Development
ROI – Return on Investment
SD – Standard Deviation
SME / SMEs – Small and Medium-sized Enterprise(s)
TAM – Technology Acceptance Model
TrackIT – TrackIT Blockchain Programme (ICE, Italy)
WTP – Willingness to Pay
α – Cronbach's alpha
ω – McDonald's omega

1. Introduction

In recent years, the agri-food sector has been confronted with growing challenges related to authenticity, transparency, and consumer trust. The proliferation of counterfeit products and the increasing complexity of global supply chains have exposed the vulnerabilities of traditional traceability systems, which are often fragmented, lack standardisation, and remain susceptible to manipulation. These weaknesses not only threaten public health but also erode brand reputation and undermine the competitiveness of quality producers in international markets, making the search for secure and transparent traceability solutions a strategic priority.

Blockchain technology has emerged as a promising response to these issues. Its decentralised architecture, immutable record keeping, and capacity to provide a single transparent version of the truth across all stakeholders can, in principle, address many of the shortcomings of conventional traceability mechanisms. By ensuring the integrity of supply chain data and enabling real time information sharing, blockchain can enhance operational efficiency, strengthen trust, and safeguard product authenticity. Nevertheless, while its technical potential is well documented, real-world adoption among small and medium-sized enterprises (SMEs) remains uneven, shaped by sectoral structures, cultural attitudes, and regulatory environments.

This dissertation originates from a unique academic pathway undertaken within the framework of a double degree programme between the University of Palermo in Italy and ISCTE (University Institute of Lisbon) in Portugal. The first stage of this research journey was conducted in Italy, where the analysis focused on agri-food SMEs participating in the government project TrackIT Blockchain, promoted by the Italian Trade Agency (ICE) and using the Itachain platform. The TrackIT initiative aims to protect and promote Made in Italy products through blockchain technology in international markets, particularly in the four main sectors most affected by counterfeiting: agri-food, textiles, cosmetics, and design. Among the nine official technological providers selected for the initiative, Itachain had, at the time of the Italian study, the largest number of adopters, with 76 SMEs actively using its services. The platform was developed by a temporary consortium composed of Blockchain Italia, HSPI and Innova.

The decision to focus on this project was directly influenced by my professional experience, as I completed my internship at Blockchain Italia, the lead company responsible

for developing Itachain. This role provided first hand exposure to the technical, organisational, and operational dynamics of blockchain implementation in real business contexts. It also allowed me to closely observe the adoption process, the challenges faced by SMEs, and the strategic implications of such technology in practice.

Within this framework, the Italian study sought to identify the benefits and barriers associated with blockchain adoption, guided by the research question:

What benefits and obstacles influence the adoption and stable integration of blockchain technology in traceability processes within Italian agri-food SMEs?

The results showed that while Italian agri-food SMEs recognised certain advantages, such as improved credibility in foreign markets, the most widely acknowledged benefits were intangible, notably improvements in brand reputation and perceived transparency. At the same time, several significant barriers emerged, including high implementation and integration costs, limited internal technical expertise, and a lack of critical mass among supply chain partners, which in turn reduced the potential network effects of the technology.

In the Italian case, while blockchain was generally associated with reputational gains and a signal of innovation in foreign markets, SMEs reported minimal measurable economic returns, limited operational integration, and the absence of a fully engaged supply chain ecosystem, while high implementation and integration costs, insufficient technical automation, and cultural misalignment with artisanal business models emerged as structural barriers to long-term adoption. Overall, blockchain adoption depends not only on the intrinsic qualities of the technology but also on the balance between perceived benefits and obstacles, strongly shaped by institutional contexts and conditions of economic sustainability.

Building on this premise, the second stage of the research was designed in Portugal, as a direct continuation of the Italian study but with an expanded scope.

The rationale was clear. If perceptions of blockchain's benefits and drawbacks are influenced by structural, cultural, and regulatory factors, and if the Portuguese agri-food sector, particularly in export oriented segments such as fisheries and wine, differs from the Italian sector in both market structure and consumer expectations and purchasing behaviour, then it becomes essential to examine whether the patterns observed in Italy are also present in Portugal. Furthermore, in order to achieve a more comprehensive understanding, the

Portuguese study integrates the perspective of consumers, assessing their willingness to embrace blockchain-enabled traceability in food products alongside the viewpoint of SMEs. This allows assessing whether, alongside firms' perceptions, consumers also show interest and willingness to pay for blockchain-based traceability systems, thereby addressing a dimension absent from the Italian analysis.

This broader scope contributes to a literature where comparative studies between Italy and Portugal on blockchain adoption in agri-food traceability are virtually absent, and integrated analyses that consider both producers and consumers are rare. Previous works have tended to focus either on technological feasibility or on adoption factors within a single stakeholder group and national context. Few have adopted a comparative approach capable of revealing how differences in national contexts and market cultures shape adoption trajectories.

Against this background, the research question guiding this dissertation is:

How do the benefits and obstacles influencing the adoption and stable integration of blockchain technology in traceability processes differ between Italian and Portuguese agri-food SMEs, and how are these factors perceived by consumers in the Portuguese context?

This research question frames an exploratory and comparative study from multiple perspectives, aimed at mapping the operational and strategic dimensions of blockchain adoption together with its reception in the marketplace. The objectives are to compare adoption patterns of blockchain-enabled traceability systems in Italian and Portuguese SMEs, assess Portuguese consumers' attitudes towards blockchain traceability, identify and analyse the benefits and barriers perceived in both countries, and highlight similarities and differences that can inform both theoretical development and practical strategies for fostering blockchain adoption in agri-food supply chains.

The dissertation is structured to reflect the logical progression of the research. Chapter 2 reviews the literature on blockchain technology, with a particular focus on its applications in agri-food supply chains, and contextualises the Italian and Portuguese sectors. Chapter 3 outlines the methodology, describing the research design, data collection instruments, sampling strategies, and analytical techniques. Chapter 4 presents the empirical results obtained in Portugal, covering both SMEs and consumers. Chapter 5 compares these findings with those previously collected in Italy. Chapter 6 concludes the work, synthesising the main

findings, presenting targeted recommendations for policymakers, SMEs, and consumers, acknowledging limitations, and suggesting avenues for future research. Through this dual country and cross-stakeholder approach, the study explores the barriers and enablers of blockchain adoption in agri-food traceability and compares the evidence from Italy and Portugal, offering both academic insights and practical guidance for fostering adoption across different contexts.

2. Literature Review and Research Question

This chapter reviews the literature on blockchain for agri-food traceability, with attention to architectures, sectoral applications, and ecosystem governance. It then examines drivers and barriers for SMEs, followed by consumer attitudes and willingness to pay. On this basis, it states four premises that frame the comparative analysis, and concludes with the research question that guides the study.

2.1 State of the Art on Blockchain in agri-food Traceability

Research on blockchain in agri-food supply chains has evolved from proofs of concept to domain specific pilots and, more recently, to adoption and governance challenges. This trajectory is commonly analysed through a technology, organisation, and environment lens (referred to as the TOE framework), across initiation, decision, and implementation stages.

Foundations and architectures

Blockchain was initially conceptualised as a distributed ledger ensuring immutability and transparency through hashing and consensus (Nakamoto, 2008). In agri-food contexts, implementations often explore public blockchains like Ethereum, yet reviews emphasise a growing reliance on permissioned models to balance auditability with confidentiality. Smart contracts are described as tools to automate process rules and compliance checks (Demestichas et al., 2020). Systematic reviews emphasise that blockchain has the potential to underpin end-to-end traceability, yet its realised effectiveness depends less on cryptography than on standards, governance, and collective partner mobilisation (Yogarajan et al., 2023). In other words, the decisive factor is less the cryptographic design itself than the organisational scaffolding that surrounds it.

On-chain and off-chain integration

Evidence across pilots shows that blockchain traceability is never purely on-chain. Fernandes et al. (2023) in olive oil, Cruz and Rosado da Cruz (2020) in fisheries, and Morais et al. (2023) in hybrid platforms converge on a common point: workable solutions notarise critical events on-chain while storing richer product data and sensor streams off-chain. This hybrid pattern lowers costs and latency but introduces new dependencies on APIs and legacy systems. Case studies highlight different trade-offs: Fernandes et al. (2023) demonstrate how asynchronous updates can make systems usable for SMEs, while Cruz and Rosado da Cruz

(2020) expose scalability and cost constraints that confine pilots to experimental scope. Together, these observations show that feasibility for SMEs rests less on ledger immutability than on pragmatic architectures balancing usability, cost, and confidentiality.

Sectoral applications

Applications in wine, hams, olive oil, and fisheries reinforce this picture. Arvana et al. (2023) operationalised blockchain across six companies in the Portuguese ham sector, while Tokkozhina et al. (2022) developed a permissioned blockchain prototype for wine traceability, showing potential to reduce counterfeiting and strengthen consumer trust. Alongside the olive oil and fisheries pilots, these initiatives demonstrate that blockchain can deliver visible transparency and faster traceback. Yet they also reveal recurring bottlenecks: uneven data quality, fragmented participation, and strong reliance on focal actors. These cases suggest that blockchain traceability succeeds when partners align around shared identifiers and consumer-facing interfaces, and stalls when adoption remains isolated or provider-dependent.

Cross-country evidence

Comparative reviews across OECD member countries confirm that blockchain adoption concentrates in high value categories such as meat, dairy, and seafood, where authenticity and origin are commercially critical (Charlebois et al., 2024). Despite differences in national contexts, the same structural barriers recur: lack of shared standards, high implementation costs, weak digital skills, poor rural connectivity, and fragmented adoption dependent on coordinating roles. The evidence reinforces what sectoral pilots already indicate: blockchain is technically viable, but its realised value emerges only when collective governance and institutional support align multiple actors.

The literature portrays a clear progression: from feasibility demonstrations, to pilots, and now to ecosystem level questions. Across studies, a consistent message emerges: blockchain has established credibility as a traceability infrastructure, but adoption remains dominated by small scale experiments. Few cases demonstrate sustained integration or stable use across entire supply chains. For SMEs, this gap is decisive. Adoption outcomes hinge less on cryptographic features than on reliable data capture, shared governance, financing instruments, and the ability to orchestrate fragmented partners. This explains why many initiatives stop at pilots and why coordinated national or industry led programmes are critical in moving beyond proof of concept. These insights motivate the focus on SME level drivers and barriers in Section 2.2, and on consumer attitudes in Section 2.3.

2.2 Drivers and Barriers to Blockchain Adoption in agri-food SMEs

Building on the ecosystem level insights from Section 2.1, this section turns specifically to how such conditions shape drivers and barriers for SMEs.

Research on blockchain adoption in agri-food SMEs consistently shows that while benefits are recognised, their realisation depends on structural and institutional conditions that vary across contexts. Evidence consistently points to two main sets of drivers, reputational value and operational efficiency, and two broad categories of barriers, economic and organisational constraints, and ecosystem challenges.

Reputational and informational value

Across studies, the strongest driver lies in blockchain's ability to reinforce reputation and consumer trust. Evidence from wine, cured meats, and pasta shows that verifiability of origin and quality supports brand credibility, especially in categories vulnerable to imitation (Fani et al., 2025; Cricelli et al., 2024; Compagnucci et al., 2022). Firm level models confirm that transparency and security act as the most powerful antecedents of adoption intention (Bernardino et al., 2025), while behavioural evidence highlights the role of attitude, perceived control, and ease of use, especially for SMEs whose competitive position depends on authenticity (Prisco, 2022). The evidence is clear: blockchain generates informational value when it is consumer-facing and easy to interpret, and when SMEs receive external support to structure their traceability systems.

Operational efficiency and enabling conditions

Beyond reputation, blockchain can also streamline internal processes. Studies highlight gains in audit speed, reduced manual reconciliation, and a shift from personal trust to data based rules (Silvestri et al., 2024). Yet these effects emerge only under specific enabling conditions: shared standards, confidentiality controls, and governance neutrality (Behnke & Janssen, 2020), and more broadly on managerial support, usability, trust, and regulatory frameworks that shape adoption across contexts (Marengo & Pagano, 2023). Efficiency is therefore not intrinsic to blockchain, but contingent on broader institutional frameworks and support instruments.

Economic and organisational constraints

Barriers are equally well documented. Costs of implementation and integration are the most persistent obstacle, cited across the majority of studies (Mbadlisa & Jokonya, 2024). These

weigh more heavily on SMEs, which also face weak digital skills, uncertain returns, and limited automation at data capture points (Cricelli et al., 2024; Fani et al., 2025). Behavioural evidence reinforces this pattern: adoption advances only when SMEs perceive sufficient facilitating conditions, and concerns about blockchain's energy use can further dampen intention if not addressed (Prisco, 2022; Bernardino et al., 2025). Collectively, these results indicate that high costs interact with organisational readiness, creating structural resistance even when reputational benefits are evident.

Ecosystem and governance challenges

The second category of barriers concerns the wider ecosystem. Studies emphasise that interoperability, input quality, and scalability are interdependent challenges, particularly in fragmented supply chains (Vu et al., 2021). Transparency adds value only when a critical mass of partners participates; otherwise, firms fear revealing strategic information and adoption stalls (Osei et al., 2021). Evidence from olive oil, pasta, and fresh produce confirms that orchestrating roles, whether universities, providers, or government programmes are indispensable to coordinate actors and sustain adoption (Silvestri et al., 2024; Compagnucci et al., 2022). Without orchestration, projects remain isolated, provider-dependent, and rarely progress beyond pilots. A Portuguese design driven case study, drawing on 15 interviews with small farmers and two customers, found that a facilitation structure similar to a Food Hub is needed to coordinate producers, customer interfaces, and exchange rules. Where such coordination is absent, pilots remain isolated and provider-dependent, and crypto only payment options are perceived as an extra barrier to real use (Scuri et al., 2023).

The literature positions blockchain adoption in agri-food SMEs as a trade-off between reputational and operational gains on the one hand, and financial and ecosystem constraints on the other. Adoption outcomes appear to be shaped less by blockchain's technical features than by the institutional and organisational context surrounding it, including access to finance, levels of digital readiness, governance structures, and the coordination of fragmented actors. This helps explain why Italian SMEs engaged in the TrackIT project reported reputational advantages without corresponding economic returns, and why Portuguese SMEs, operating with weaker institutional support, may face even greater challenges. These dynamics frame the central comparative question of this dissertation, namely how benefits and obstacles interact in influencing blockchain adoption across Italian and Portuguese agri-food SMEs.

2.3 Consumer Attitudes Towards blockchain-enabled Traceability

Research on consumer attitudes shows a consistent tension: while transparency and authenticity are valued, actual uptake of blockchain-enabled traceability depends on literacy, usability, and the ability to align with category specific expectations. Evidence from Italy, Portugal, and international contexts highlights four themes: awareness and trust, attitude and segmentation, value and willingness to pay, and authenticity and reputation.

Awareness and trust

In Italy, only about 31% of 392 respondents reported familiarity with blockchain in food contexts (Martinelli & De Canio, 2024). In Portugal, direct evidence remains limited, but a frozen fish supply chain pilot surveyed 112 retail consumers and found that the availability of traceable information increased willingness to purchase, regardless of age, gender, or education (Tokkozhina et al., 2023). These insights suggest that while literacy about blockchain itself remains low, consumers consistently respond positively when credible and accessible traceability cues are provided. International evidence confirms that trust is the decisive mediator: system quality, information quality, and service quality all reinforce trust, which in turn drives intention (Lin et al., 2021). These findings indicate that consumers respond positively not to blockchain as a term, but to visible and credible assurance cues. In the Italian wine context, novelty seeking consumers showed greater trust and adoption when information was delivered through simple QR code interfaces (Adamashvili et al., 2024).

Attitudes, technology readiness, and segmentation

In Italy, ease of use and usefulness shape attitudes and intentions, with no significant demographic effects (Martinelli & De Canio, 2024). In China, ease of use weighs more than usefulness, and positive technology readiness traits strengthen adoption (Li et al., 2025). In New Zealand, two segments emerge: Pioneers, younger and more educated urban males, and Conservatives, older and less educated females in smaller towns. Here, incentives and food traceability expertise drive uptake, while complexity hinders it (Wang & Scrimgeour, 2023). Adoption is not uniform, requiring tailored communication for innovators and mainstream consumers.

Value, price sensitivity, and willingness to pay

Evidence points to a nuanced picture. A simulation model suggests that, despite some interest in traceability, the actual adoption of blockchain-based food traceability would remain very low, mainly due to high price sensitivity: when a price premium is required, more than 1/3 of consumers drop out, and advertising effectiveness is minimal (Füzesi et al., 2020). By contrast, a discrete choice experiment with 245 young Italian consumers for extra virgin olive oil finds a positive willingness to pay, but only when blockchain reinforces the "Italian origin" attribute. In that case, the average accepted premium is about €4 to 5 per liter above the highest market price, while blockchain alone shows much more limited effects (Staffolani et al., 2025). Taken together, blockchain rarely justifies a price premium on its own, but it can unlock willingness to pay when it certifies attributes already central to consumer choice, particularly authenticity and provenance.

Authenticity and reputational effects

In Portugal, a survey of 417 fish consumers revealed moderate interest in traceability (mean 4.96/7) and a positive impact on purchase intention (5.12/7). Respondents expressed greater trust when origin and processing details were available, especially regarding correctness and authenticity (Tokkozhina, Martins & Ferreira, 2024). Since blockchain was deliberately omitted from the questionnaire, the survey demonstrates that consumers value reliable information rather than the technology itself. This suggests that blockchain should be framed not as a novelty but as an enabler that reinforces authenticity signals. Supporting this, Ma (2025) shows that blockchain linked to authenticity cues reduces perceived quality delays, increases goodwill, and enhances brand trust, highlighting its role as a credible amplifier of transparency and reputation.

These studies show that consumers value blockchain mainly when it reinforces authenticity signals and makes them more credible and accessible. Transparency drives behavioural intention only when information is accessible, credible, and aligned with category specific expectations. Adoption tends to stall when literacy is low, price sensitivity is high, and user experience does not reflect the needs of different consumer segments. For SMEs, this implies that the consumer side is an active condition of adoption: blockchain-based traceability creates value only if end users perceive, trust, and act on the information.

Table 2.1 summarises the consumer side evidence by theme for Italy and Portugal and distils the practical implications:

*Table 2.1. Consumer evidence on blockchain-enabled traceability, comparison Italy and Portugal***.**

Theme	Italy (evidence)	Portugal (evidence)	Implication
Awareness and trust	Familiarity is low (31 percent, N = 392, survey), yet trust emerges as a key mediator of intention; simple QR code supports uptake in wine. (Martinelli & De Canio 2024; Adamashvili 2024)	Traceable information raises purchase intention (N = 112, survey); trust is higher with origin and processing details (N = 417, survey). (Tokkozhina 2023; Tokkozhina, Martins & Ferreira 2024)	Make origin and processing data prominent; keep the interface simple and consumer-facing.
Attitude and usability	Ease of use and usefulness predict intention; no strong demographic effects reported (survey). (Martinelli & De Canio 2024)	Evidence points to trust in correctness and authenticity; segmentation to be assessed.	Prioritise usability and clarity over technical labels;pre-test segments before scaling.
Price sensitivity and willingness to pay	Willingness to pay is positive only when Italian origin is reinforced in EVOO (young consumers, N = 245, DCE), €4 to 5 per litre; simulation indicates high price sensitivity. (Staffolani 2025; Füzesi 2020)	Preference strengthens with credible authenticity and origin cues (survey evidence).	Tie any premium to core authenticity attributes rather than the technology itself.
Framing of technology	Novelty seeking consumers respond more to simple QR delivered information than to the term blockchain. (Adamashvili 2024)	Higher trust and intention when information is clear and verifiable. (Tokkozhina 2023; 2024)	Present blockchain as enabling infrastructure; foreground product authenticity.

2.4 Research Premises

Based on the analysis of the literature and bibliographic evidence, four fundamental premises are articulated.

Premise 1. Context specificity and institutional setting in Italy and Portugal

The forces that drive or impede blockchain adoption in agri-food supply chains are context specific. Industry structure, cultural attitudes toward technology, and the presence of government support shape how SMEs evaluate the cost benefit balance of adoption.

In Italy, strong institutional backing, for example the TrackIT Blockchain programme promoted by the Italian Trade Agency (ICE, 2022), has effectively removed entry barriers. TrackIT was launched in 2022 with a budget of approximately €2.6 million and it fully covered the cost of blockchain traceability services for SMEs for about eighteen months. During this period firms incurred no adoption costs because ICE paid for the technology provider, the system integration, the QR code generation, and the inclusion of products in a shared digital showcase for international buyers. The programme was open access for exporting SMEs in the four main sectors of Made in Italy: agrifood, fashion, cosmetics, and design. Selected firms were matched with one of nine certified technology providers. By mid 2025 more than 330 companies had joined and nearly 2,300 products were registered on the TrackIT platform. This makes it a concrete example of how direct subsidies can accelerate adoption and coordinate many firms on a common service.

In Portugal, by contrast, there is no open-access subsidy scheme equivalent to TrackIT. The national reference initiative is Blockchain.PT (2023), an Agenda Mobilizadora funded by the PRR (Plano de Recuperação e Resiliência) with a total investment of about €58.85 million for the period 2023 to 2025. The agenda is implemented by a fixed consortium of 56 organisations, including technology firms such as VOID Software, Anchorage Digital, and SenseFinity, major corporates such as Sonae MC, universities and research institutes such as ISCTE and several Politécnicos, and public entities such as OesteCIM and the Government of the Azores. It includes a farm-to-fork work package in agri-food, but funding is reserved for the participating partners. For SMEs outside the consortium, benefits are therefore indirect: they may eventually adopt solutions developed within the project, recruit from the pool of 1,000 professionals trained, or align with emerging standards and interoperable platforms, but they do not receive immediate financial support for adoption.

This institutional asymmetry motivates the comparison developed in this study. Italy illustrates a short term adoption programme with direct subsidies for SMEs, while Portugal pursues a long-term innovation agenda that strengthens the ecosystem through R&D but leaves most firms reliant on private providers or smaller pilots for actual adoption.

Premise 2. Comparative and cross-stakeholder evidence gap

There is a gap in comparative and cross-stakeholder analyses that limits generalization across countries and actors. Most existing studies focus on a single country or examine only the firm side, which obscures important interaction effects. By contrasting Italy and Portugal, two Southern European economies with strong food traditions but different exposure to blockchain and different market structures, the study adopts a comparative lens. National context can shift the perceived balance of benefits and obstacles. Italian SMEs are more likely to highlight the protection of premium brand image in international markets, while Portuguese SMEs tend to underline transparency and compliance with external requirements, reflecting different strategic orientations. Network barriers can also manifest in diverse ways, with Italy showing more coordinated forms of onboarding facilitated by national initiatives, whereas in Portugal adoption remains more fragmented and often dependent on project based or provider led efforts. The comparison is exploratory and aims to generate insights and patterns that are transferable across actors and contexts.

Premise 3. Consumer demand as a condition for sustained integration

Sustained integration depends on both firm side capabilities and consumer side demand. Blockchain-enabled traceability creates market value only if consumers recognize, trust, and use the information. Trust, perceived usefulness, ease of use, and willingness to pay are therefore central. The literature on consumer attitudes remains limited compared to firm focused studies, which is a risk because indifference or skepticism in actual purchasing contexts can undermine adoption even when pilots succeed. Measuring Portuguese consumers' perceptions allows the study to test whether demand side factors can reinforce adoption in a context without direct subsidies for SMEs. It also makes it possible to assess heterogeneity across consumer segments and to identify where price sensitivity and user experience improvements are most critical to translate transparency into purchasing behaviour.

Premise 4. Post-trial in Italy and early-stage adoption context in Portugal

The decisive test of value occurs after pilots and incentives, in a steady state integration phase. In Italy, the availability of a time limited public subsidy created the conditions to observe a true post-trial setting, where firms face continuation decisions, deepen or scale back process integration, onboard partners beyond early pilots, and reassess commercial and operational returns as public support tapers off. In Portugal, most SMEs operate under early-stage conditions without direct adoption subsidies, so adoption choices are more sensitive to baseline digital readiness, integration costs, and the availability of partners willing to participate along the chain. Accordingly, the analysis concentrates on comparable indicators across contexts. It examines digital readiness, data governance, the share of events recorded on-chain versus off-chain, cost thresholds for breakeven adoption by firm size and product type, trajectories of partner onboarding, and the role of consumer demand in sustaining scale up among early and potential adopters. Comparing a post-trial environment with an early-stage environment isolates the role of public subsidy and coordinated onboarding versus firm and provider led adoption and helps identify the factors associated with stable integration versus discontinuance.

These premises set the stage for an exploratory and comparative, multi perspective investigation. They indicate that the balance of benefits and obstacles varies by country, Italy and Portugal, and by stakeholder viewpoint, producers and consumers. They also inform the measurement of digital readiness, integration costs, data governance, partner adoption, and, on the consumer side, trust, perceived usefulness, ease of use and willingness to pay.

2.5 Research Question

Building on these premises, the research question that guides this dissertation is exploratory and comparative in nature:

How do the benefits and obstacles influencing the adoption and stable integration of blockchain technology in traceability processes differ between Italian and Portuguese agri-food SMEs, and how are these factors perceived by consumers in the Portuguese context?

This research question directs attention to both cross-national comparison, Italy and Portugal, and cross-stakeholder comparison, producers and consumers. It encapsulates the core aim, to determine whether the drivers and barriers observed in Italy's relatively favorable

setting hold true in Portugal's more nascent landscape, and to assess Portuguese consumer sentiment regarding blockchain-enabled traceability. Answering this will contribute original comparative evidence and practical guidance on fostering blockchain adoption in agri-food supply chains across different contexts. This dual perspective fills a gap in the literature, which has so far considered either firm adoption or consumer perception in isolation.

3. Methodology

3.1 Research Design

The study adopts a cross-sectional mixed methods design. Primary data were collected in Portugal from two groups, agri-food SMEs and consumers, through structured questionnaires using Google Forms. In the SME survey open-ended prompts were also included to capture practical details in respondents' own words. Findings are later benchmarked against the Italian phase to derive cross-country insights in Chapter 5.

The purpose is to map in a clear and comparable way the perceived benefits, barriers, and conditions for stable blockchain traceability adoption among SMEs, and, among consumers, perceived usefulness, ease, security and trust, social influence, intention to use, and attitudes toward origin, authenticity, transparency, sustainability, and willingness to pay.

3.2 Data Collection and Procedure

The questionnaires were administered in Portuguese. SME respondents were owners, managers, or staff with responsibility for traceability, digitalisation, or strategic decisions, while consumer respondents were residents in Portugal aged 18 or above. Reproductions of the instruments are provided in Annex A for SMEs and Annex B for consumers.

Sampling combined purposive outreach and snowballing through sector associations, LinkedIn, direct email, community contacts, and university networks. The survey was conducted between August and September 2025, yielding 10 SMEs and 72 consumers. These data are later compared with the Italian phase, which included 10 SMEs, in order to develop the cross-country analysis presented in Chapter 5.

The inclusion criteria required SMEs to be agri-food firms operating in Portugal with a knowledgeable or decision making respondent, while consumers had to be residents in

Portugal aged 18 or above, purchasing food at least monthly. All respondents received an information note and provided consent online. Responses were anonymous.

3.3 Instruments and Comparability

The Portuguese instruments were adapted from the Italian phase to ensure comparability while removing references specific to TrackIT and ICE. The translation was revised by two native speakers and pre-tested with a small group of respondents.

For SMEs, company profile included main activity, turnover band, respondent role, export share, and adoption level. The survey then addressed perceived benefits and obstacles, perceived complexity, and digitalisation level. Conditions for stable adoption were measured on five-point scales, covering partner adoption, consumer recognition, clearer standards and norms, and external market requirements. Respondents were asked about future intentions over the next three years and gave open-ended answers on the main obstacle, factors that could help continuation or expansion, and modes of partner collaboration. The sustainable monthly budget for a blockchain-based traceability service was expressed in categorical bands, and the importance of standards and interoperability was measured on a five-point scale.

For consumers, sociodemographic profile covered age, gender, education, household income, frequency of buying organic products, and familiarity with blockchain. QR ease of use was measured on seven-point items assessing general ease, learning process, ability to retrieve information, and perceived complexity. Core TAM constructs, namely Perceived Usefulness, Perceived Ease of Use, Perceived Security and Trust, Social Influence, and Intention to Use, were measured on seven-point scales. Single items captured perceptions of origin, authenticity, transparency, and sustainability. Willingness to pay was expressed in categorical premium bands. Two single items assessed the applicability of blockchain in agri-food distribution and its expected medium to long-term effects, both on seven-point scales. Respondents also indicated their information priorities when purchasing food from a predefined list, with the possibility of specifying other preferences.

For SMEs, constructs and answer options mirror those used in the Italian phase, including benefits, barriers, adoption status, and conditions. Items specific to TrackIT and ICE, such as satisfaction with providers, are considered qualitatively as contextual differences rather than

matched one to one. Budget and standards were retained from the Italian phase to interpret differences in cost sensitivity and interoperability expectations.

For consumers, the use of seven-point TAM constructs, the inclusion of Social Influence, the QR ease of use block, the single items for origin, authenticity, transparency, and sustainability, the categorical willingness to pay, and the information priority question align the instrument with the organic distribution literature and allow side by side comparison with recent Portuguese studies on traceability and trust.

3.4 Analysis Plan and Ethical Considerations

The analysis is descriptive and designed for direct comparison with the Italian phase and with international studies. Frequencies, percentages, means, and standard deviations are reported for all items and constructs.

For SMEs, given the very small sample size of 10, results are reported consistently with both counts and percentages (e.g., “four firms (40%)”). Open-ended responses are analysed thematically through inductive coding, with synthesis of key themes and representative statements.

For consumers, composite scores were computed for Perceived Ease of Use (PEOU), Perceived Usefulness (PU), and Intention to Use by averaging their respective items. The “complexity” item in PEOU was reverse-coded so that higher values consistently indicate greater ease. Internal consistency was assessed using Cronbach’s α for all scales; given the breadth of PEOU, we also report McDonald’s ω (one-factor, PCA estimate). For two-item scales (PU, Intention), α is equivalent to the Spearman–Brown reliability; we additionally report the inter-item correlation r. No CFA/SEM was run due to the small N ($N = 72$).

Exploratory cross tabulations are shown where informative, such as willingness to pay by blockchain familiarity for consumers or adoption status by export share for SMEs. Only the most relevant graphs are presented in the main text, while the complete set of outputs is provided in Annex C for SMEs and Annex D for consumers.

Ethical principles guided the study throughout. Participation was voluntary, informed consent was obtained online, and no unnecessary personal data were collected.

3.5 Data Limitations

The samples are non-probabilistic and results cannot be generalised to the whole population. The SME sample is very small and skewed toward management roles, which may emphasise strategic perspectives more than operational ones. The consumer sample is predominantly young, highly educated, and relatively affluent, which may increase stated willingness to pay and technology readiness compared to the general population. The analysis aims at comparability across contexts rather than inference.

4. Empirical Results in Portugal

Note on Data Presentation: To ensure readability, only the most relevant graphs and histograms from the SME and Consumer surveys are included in the main text of this chapter. The complete set of visual outputs, including all questions not directly discussed here, is provided in Annex C: Complete Results of the SME Survey and Annex D: Complete Results of the Consumer Survey.

4.1 Results: SMEs Survey

The survey of Portuguese agri-food SMEs produced 10 valid responses. Although the sample size is limited, the diversity of the companies allows for an exploratory view of perceptions, expectations and barriers regarding blockchain adoption in the sector.

Company profile

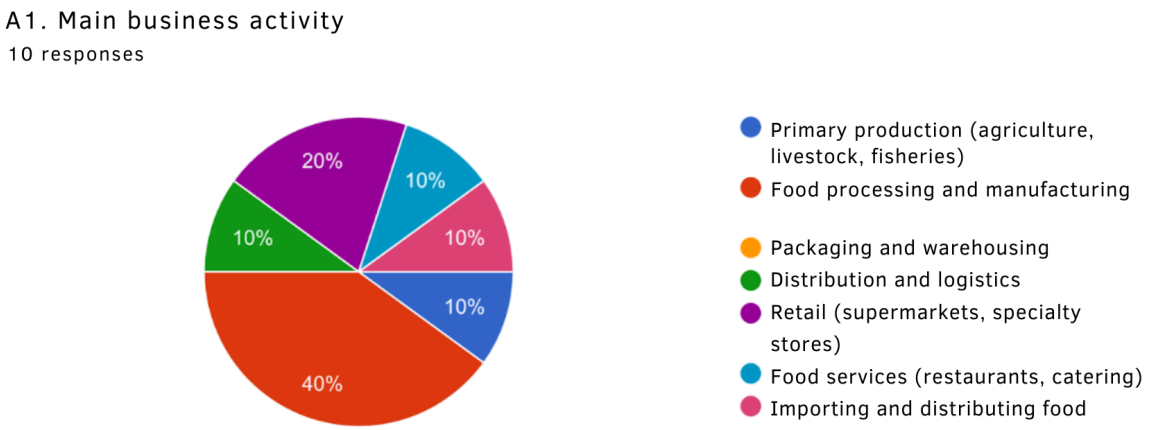

Figure 4.1. Main business activities of the Portuguese agri-food SMEs surveyed (N = 10)

The respondents represent a wide variety of activities within the agri-food chain. Most companies (40%) operate in food transformation and processing, while others are active in retail (20%), logistics (10%), food services (10%), import and distribution (10%), and primary production (10%). This diversity shows that blockchain is considered potentially relevant across multiple stages of the chain, not only in production or retail.

With respect to annual turnover, the sample is weighted towards larger SMEs. Four firms (40%) report revenues between €5 and 10 million, and two (20%) above €10 million, while

the remaining four firms (40%) fall between €300,000 and €3 million, confirming that the respondents are not microenterprises but established firms with structured operations.

In terms of the respondents' positions, four respondents (40%) were in management, three (30%) in supply chain and logistics, one (10%) in operations and production, one (10%) in sales and business development, and one (10%) in quality. No respondents were from IT or technological innovation. This means the results reflect both strategic and operational responsibilities rather than purely technical viewpoints.

International orientation is limited. Six firms, 60%, export less than 25% of their sales, two, 20%, export more than 50%, and two do not export. This indicates a predominantly domestic market focus, reducing exposure to international certification requirements where blockchain traceability could be more strongly demanded.

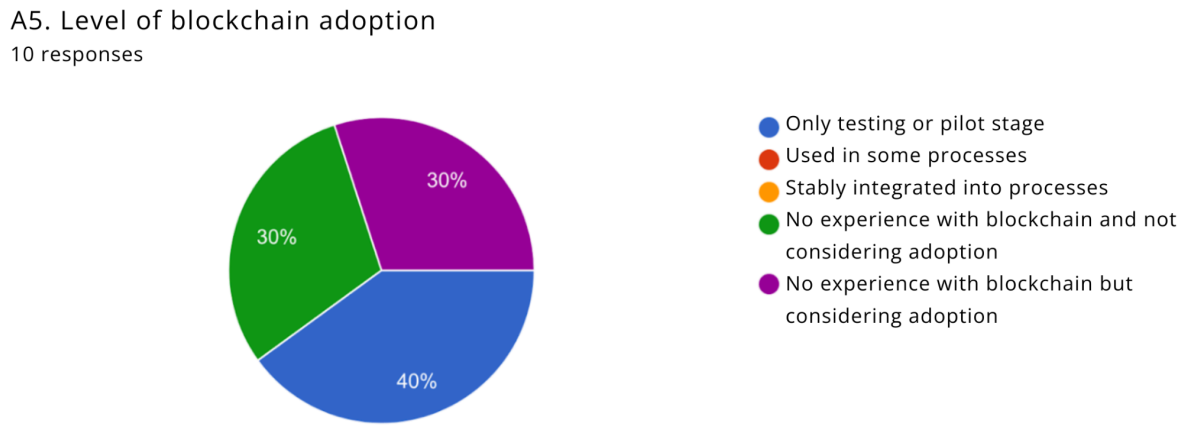

Figure 4.2. Level of blockchain adoption among Portuguese agri-food SMEs

Blockchain adoption remains at an early-stage. Four firms (40%) reported having conducted pilot tests, while three (30%) declared no experience and no intention of adopting. Another three (30%) also had no experience but were considering adoption. None reported use in selected processes or stable integration into business operations. These results confirm that blockchain is still almost entirely absent from actual practice among Portuguese SMEs.

Expected benefits

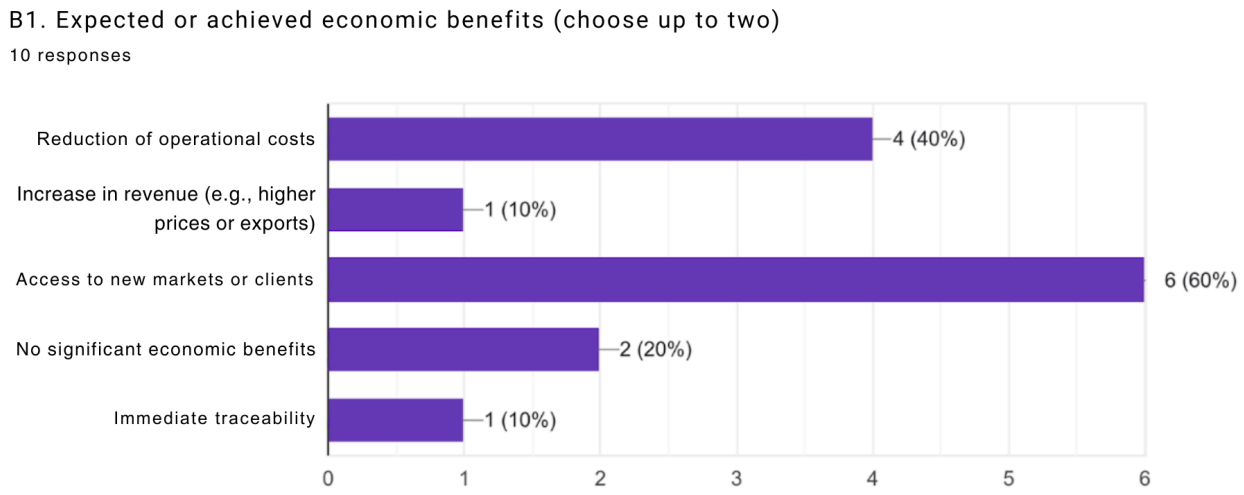

Figure 4.3. Economic benefits of blockchain adoption in Portuguese agri-food SMEs

When asked about economic benefits, six companies (60%) pointed to access to new markets or clients. Four (40%) highlighted operational cost reduction as a potential gain, while only one (10%) mentioned increased revenues through higher prices or exports. At the same time, two companies (20%) explicitly declared that they did not expect any significant economic benefits. Positive economic options were selected far more often than "no significant benefits", suggesting that blockchain is perceived less as a direct source of revenue growth and more as a tool for market positioning and operational efficiency.

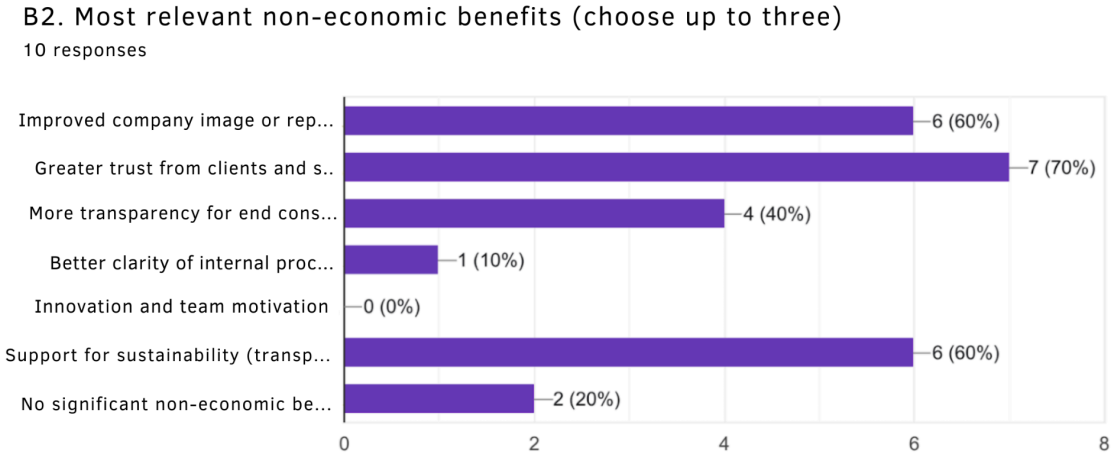

Figure 4.4. Non-economic benefits of blockchain adoption in Portuguese agri-food SMEs

Non-economic benefits were more strongly recognised than economic ones. Seven companies (70%) highlighted greater trust among clients and suppliers, six (60%) pointed to

improved corporate reputation, another six (60%) mentioned support for sustainability through transparent supply chains, and four (40%) valued greater transparency for final consumers. Only one firm (10%) referred to better clarity of internal processes, and none indicated innovation or employee motivation. Two respondents (20%) stated that they saw no relevant non-economic benefits. Non-economic benefits were selected much more frequently than "no non-economic benefits", confirming that blockchain is associated above all with reputational and relational value, rather than measurable financial gains.

Obstacles and barriers

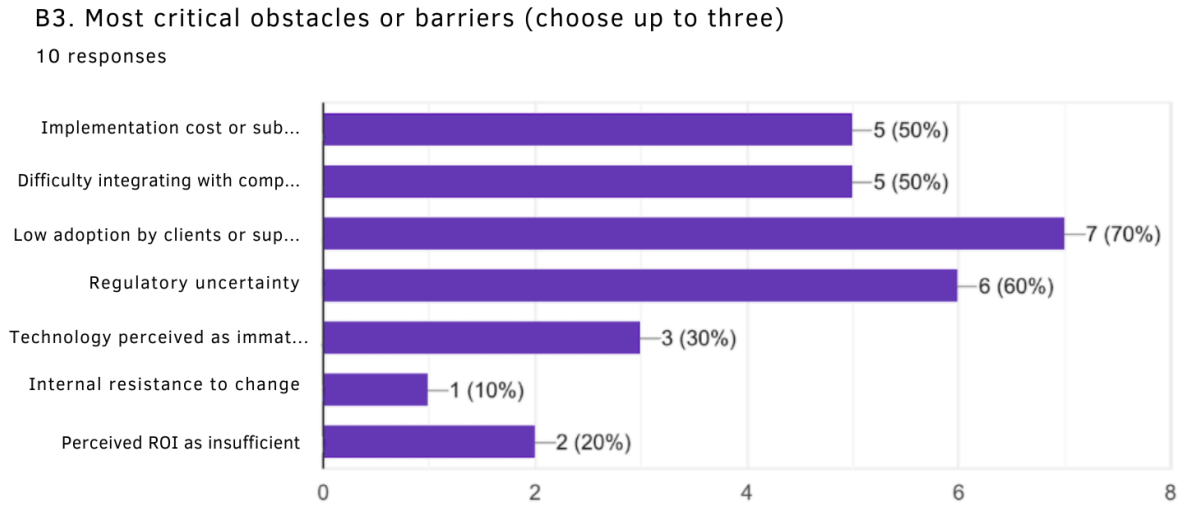

Figure 4.5. Main obstacles and barriers to blockchain adoption in Portuguese agri-food SMEs

The survey revealed several critical barriers to adoption. The most frequently cited was the low adoption by clients and suppliers, mentioned by seven companies (70%). Regulatory uncertainty was reported by six firms (60%). Five companies (50%) highlighted difficulty of integration with existing systems, and another five (50%) cited implementation or subscription costs. In addition, three respondents (30%) considered blockchain a still immature technology, two (20%) pointed to an insufficient perceived return on investment, and one (10%) referred to internal resistance to change. Overall, the most pressing obstacles concern ecosystem adoption and systemic integration, while purely financial concerns, though relevant, appear secondary.

Perceptions of complexity and digitalisation

Blockchain is widely perceived as complex. Five companies (50%) rated its use as "4" on a five-point scale, while three (30%) rated it as "5", indicating very high complexity. Two firms

(20%) gave lower scores of "2" and "3" (one each), and none (0%) considered blockchain simple. This shows that Portuguese SMEs expect blockchain to be technologically and organisationally demanding.

In terms of digitalisation, seven firms (70%) rely on ERP or internal management systems, two (20%) use only basic tools such as spreadsheets and email, and one (10%) reported some integration with partners via EDI, IoT, or cloud. None (0%) mentioned advanced technologies such as artificial intelligence or big data. The surveyed SMEs can therefore be described as moderately digitalised: they have internal systems in place but show limited external connectivity and no advanced integration.

Conditions for stable adoption

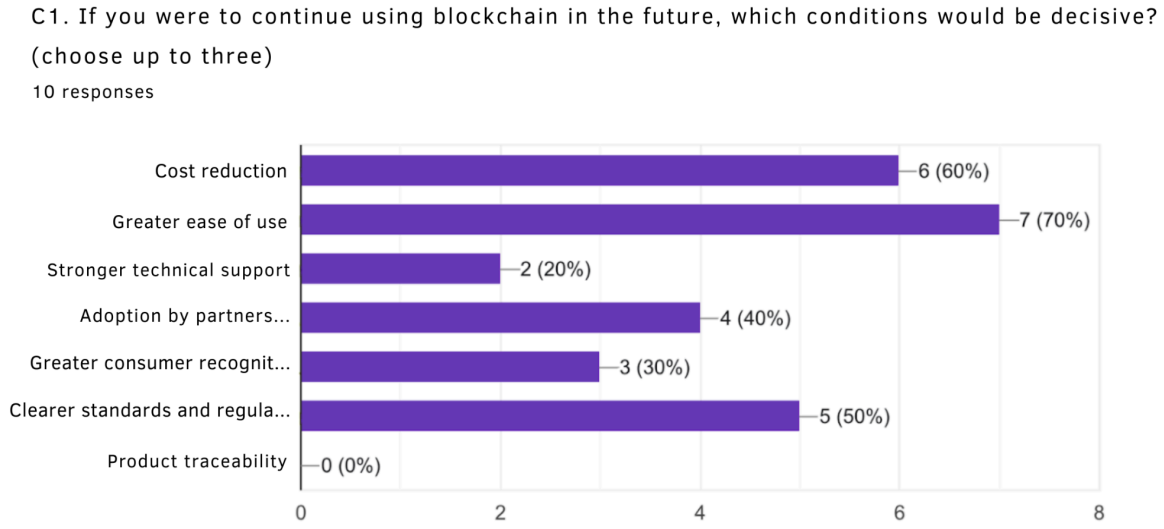

Figure 4.6. Conditions considered decisive for stable blockchain adoption

The conditions most often cited as decisive for stable adoption were greater ease of use, mentioned by seven companies (70%), and cost reduction, mentioned by six (60%). Clearer standards were highlighted by five firms (50%), while adoption by value chain partners was considered decisive by four (40%). Consumer recognition was cited by three companies (30%), and solid technical support by two (20%). Product traceability was not mentioned by any respondent (0%). This suggests that traceability is taken for granted as an inherent feature of blockchain, and therefore not perceived as a separate condition for stable adoption.

When asked about the importance of partner adoption directly, seven companies (70%) rated it as highly important, with three firms (30%) assigning a score of “4” and four (40%) assigning the maximum score of “5”. Two companies (20%) gave a score of “3” and one

(10%) a score of “2”, while no firm rated it as “1”. Similarly, external market requirements were considered influential: six firms (60%) rated their importance as “4” and one company (10%) as “5”, leading to a total of 70% assigning high importance (scores 4 or 5). Two firms (20%) gave a score of “3” and one (10%) a score of “2”, while none rated it as “1”. Standards and interoperability were also perceived as crucial: four companies (40%) gave the highest score “5”, three firms (30%) rated “4”, two (20%) rated “3”, and one (10%) assigned “2”. No company rated this condition as “1”.

These results confirm that, while SMEs prioritise internal enablers such as usability and cost reduction, they also recognise that network effects, standards, and external pressures are crucial for long-term and stable adoption.

Future intentions

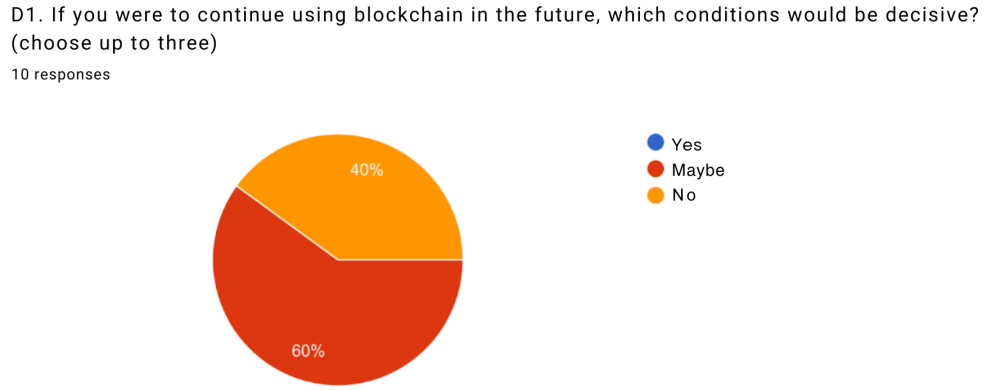

Figure 4.7. Future intentions regarding blockchain adoption

The outlook remains characterised by scepticism. None of the companies (0%) expects blockchain to become a stable part of their processes in the next three years. Six companies (60%) answered “maybe”, while four (40%) explicitly answered “no”.

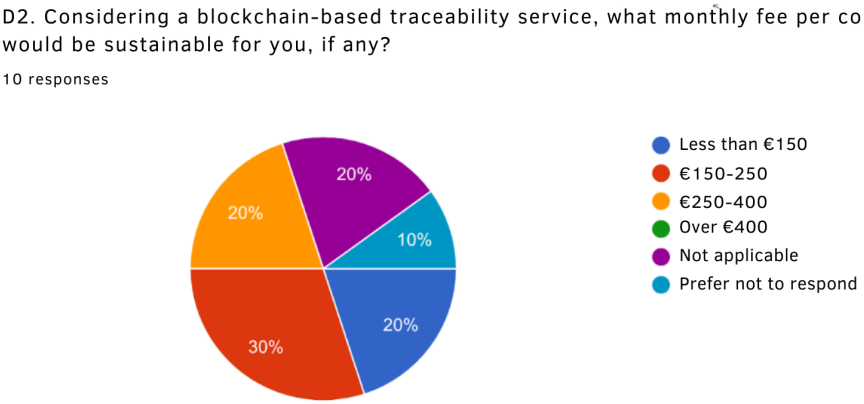

Figure 4.8. Preferred monthly fee for a blockchain-based traceability service for SMEs

When asked about the sustainability of monthly fees for a blockchain-based traceability service, answers were dispersed. Two companies (20%) indicated a preference for a monthly fee below €150, three (30%) between €150-250, and two (20%) between €250-400. Two companies (20%) answered “not applicable”, and one (10%) preferred not to respond. These results confirm a low willingness to pay, with no company (0%) willing to spend more than €400 per month.

Open-ended responses

The qualitative comments reinforced the quantitative findings. The main obstacles mentioned were lack of knowledge of the technology, lack of quantifiable advantages, insufficient infrastructure to support blockchain, the complexity of integration with client systems, and high initial costs combined with regulatory uncertainty. Several respondents explicitly stated that no significant benefits were expected at this stage.

When asked what would convince them to maintain or expand blockchain in the long-term, most pointed to external factors. These included requirements from business partners, adoption across the logistics chain, requests from consumers for more precise traceability and quality control, and clearer evidence of economic and operational benefits. Some also mentioned the need for greater regulatory clarity.

Finally, regarding collaboration between clients and suppliers, respondents highlighted the importance of investment, modernisation, training, and user friendliness. One company suggested that suppliers should help customers adopt blockchain in their daily shopping activities. Others pointed to joint platforms, standardised protocols, and data alignment as essential to make blockchain truly useful across the value chain.

The survey reveals a very early-stage of blockchain adoption among Portuguese agri-food SMEs. Four firms (40%) have only run pilot tests, while the others have no direct experience, with three (30%) not considering adoption and another three (30%) only considering it hypothetically. The technology is perceived as highly complex, with most respondents rating it "4" or "5" on a five-point scale.

Benefits are mainly associated with reputation and trust, with 70% citing greater confidence among clients and suppliers, 60% corporate reputation, and 60% sustainability.

Economic benefits remain secondary and uncertain, with 40% mentioning cost reduction and 60% access to new markets.

The most critical barriers are systemic rather than individual: low adoption by clients and suppliers (70%), regulatory uncertainty (60%), integration with existing systems (50%), and technology immaturity (30%). Costs and ROI are also mentioned but less frequently.

The majority of firms (60%) do not expect blockchain to become part of their processes in the near future, and willingness to pay is low, with no company willing to spend more than €400 per month. Conditions considered necessary are primarily cost reduction (60%) and ease of use (70%), alongside clearer standards (50%), consumer recognition, and partner adoption.

The results point to a scenario where blockchain adoption in Portuguese SMEs depends less on internal motivation and more on external drivers such as market requirements, consumer demand, and ecosystem-wide coordination.

Consistency with the Literature Review

The findings from the Portuguese SME survey align closely with the patterns identified in the literature reviewed in Chapter 2. Studies emphasise that blockchain in agri-food supply chains is perceived less as a source of direct economic gain and more as a tool to reinforce reputation, trust, and transparency. This was confirmed in the survey: 70% of firms associated blockchain with greater trust among clients and suppliers, 60% with reputation and sustainability, while only 40% mentioned cost reduction and 60% access to new markets. As described in prior research (Fani et al., 2025; Compagnucci et al., 2022), reputational value appears stronger than measurable financial returns.

The barriers reported also converge with the literature. Weak network effects were mentioned by 70% of firms, regulatory uncertainty by 60%, integration difficulties by 50%, and technological immaturity by 30%. Costs and insufficient ROI were cited but less frequently. The high perceived complexity (average rating 4.0/5) and the limited digital maturity beyond ERP systems (70% use ERP, 10% report some integration with partners via EDI, IoT, or cloud, while none employ AI or big data) confirm structural readiness gaps, echoing previous studies on SMEs' technological integration challenges (Silvestri et al., 2024; Marengo & Pagano, 2023).

Long-term adoption, as the literature suggests, requires systemic enablers such as shared standards, interoperability, and coordinated onboarding (Behnke & Janssen, 2020). The Portuguese SMEs expressed awareness of these needs, rating interoperability and partner adoption as important. Yet the conditions most frequently cited as decisive were cost reduction (60%) and usability (70%), showing that at an early-stage firms prioritise internal efficiency over broader governance. This pattern reflects the tendency described by Vu et al. (2021), where ecosystem factors become decisive only once adoption scales.

Finally, scepticism about future adoption is consistent with theoretical expectations. None of the firms expects blockchain to become part of their processes within three years, 60% answered 'maybe' and 40% 'no', and willingness to pay is low, with no firm sustaining costs above €400 per month. As highlighted in the literature, without national incentives or coordinated governance, most pilots fail to stabilise into long-term integration. The Portuguese case confirms this fragility and underscores the need to compare with Italy, where TrackIT Blockchain showed how institutional support can mitigate some of these barriers.

4.2 Results: Consumer Survey

Sample Profile

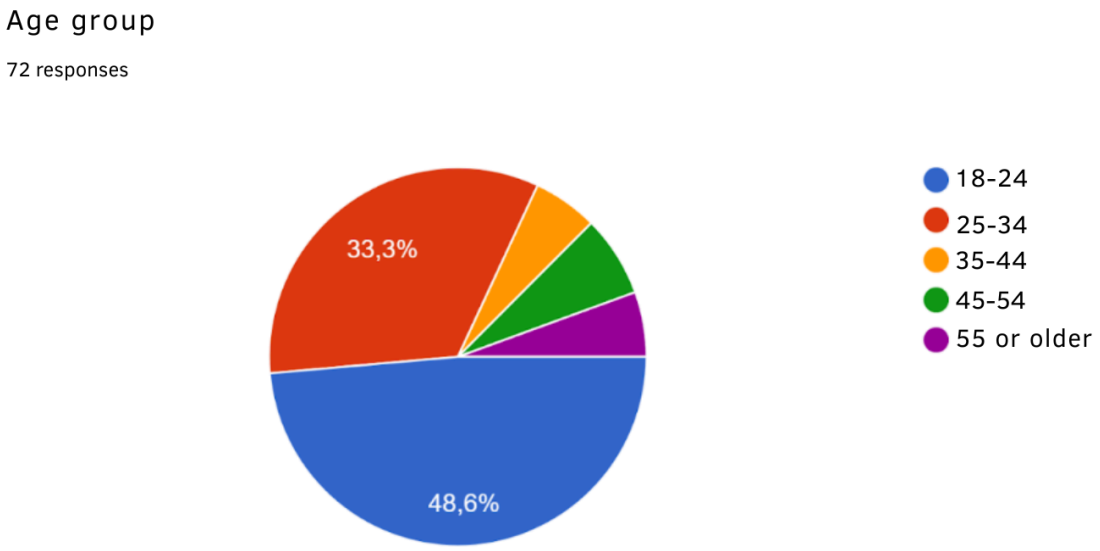

Figure 4.9. Age distribution of consumer respondents (N = 72)

The consumer survey collected N = 72 valid responses. The age distribution shows a clear prevalence of younger adults: 35 respondents (48.6%) were between 18-24 years old, followed by 24 (33.3%) in the 25-34 group. The middle categories were much less

represented, with 4 participants (5.6%) in the 35-44 group, 5 (6.9%) aged 45-54, and 4 (5.6%) aged 55 or more. This confirms that the sample mainly reflects younger cohorts, though with some coverage of older groups, ensuring at least partial heterogeneity.

Gender distribution was 44 respondents (61.1%) male and 28 (38.9%) female. Educational attainment was remarkably high: 31 respondents (43.1%) had a bachelor's degree, 35 (48.6%) a master's, and 2 (2.8%) a doctorate. Only 4 (5.6%) reported secondary education as their highest completed level.

Household income was concentrated in the higher brackets of the scale used. 25 respondents (34.7%) reported household earnings above €3,500 per month, 21 (29.2%) between €2,500-3,499, 16 (22.2%) between €1,500-2,499, and 4 (5.6%) between €750-1,499. None declared less than €750, while 6 participants (8.3%) preferred not to answer. Together, the profile corresponds to young, highly educated, and relatively affluent consumers.

Purchasing Habits

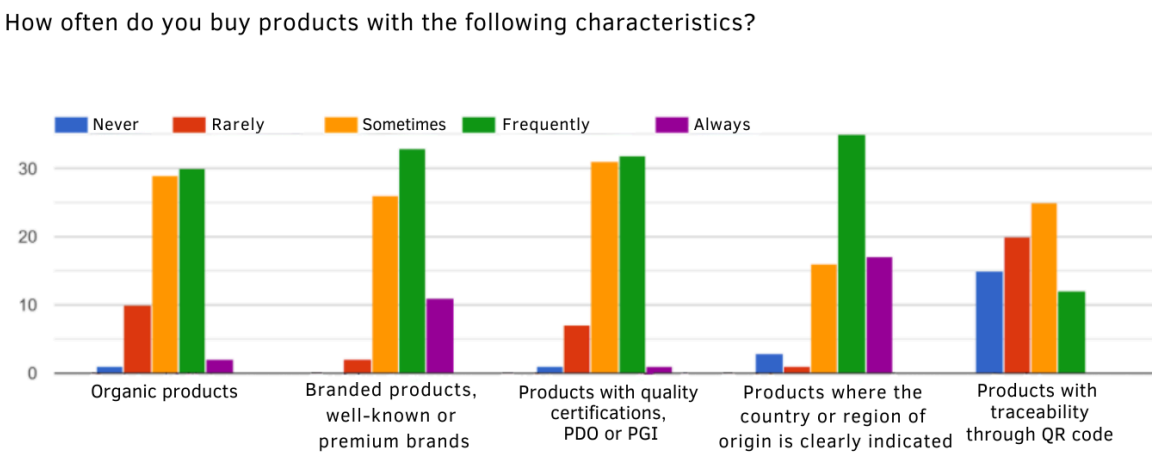

Figure 4.10. Purchasing habits of food products among consumers

Patterns of purchasing confirmed a strong orientation toward quality, provenance, and authenticity. Organic products were purchased frequently or always by 32 respondents (44.4%), with another 29 (40.3%) buying them sometimes, for a total of 61 respondents (84.7%) reporting regular organic purchases. Branded or premium products were purchased frequently or always by 44 respondents (61.1%), and sometimes by 26 (36.1%). Certified products (PDO/PGI) reached similar levels, with 64 respondents (88.9%) reporting at least occasional purchases. Products with explicitly stated country or region of origin were highly

valued. 68 respondents (94.4%) bought them at least sometimes, and 52 (72.2%) frequently or always.

QR-based traceability remained less common. 35 respondents (48.6%) rarely or never bought them, while 37 (51.4%) reported occasional or frequent purchases. This imbalance highlights that direct blockchain-enabled experiences in food shopping are still limited, despite consumers' existing preference for indicators of quality and provenance.

Familiarity with blockchain

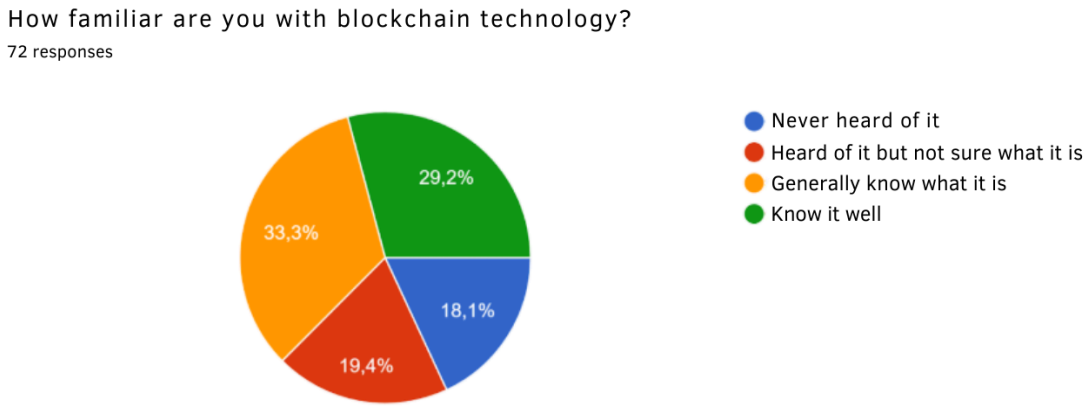

Figure 4.11. Consumers' familiarity with blockchain technology

Knowledge of blockchain was mixed but relatively high in this sample. 13 respondents (18.1%) had never heard of it, 14 (19.4%) had only heard of it without knowing details, 24 (33.3%) knew it in general terms, and 21 (29.2%) declared they knew it well. In total, 45 respondents (62.5%) showed at least general or strong familiarity, confirming that among educated and affluent consumers, blockchain literacy is spreading.

Scale reliability and descriptives (N = 72).

Internal consistency was high for the short two-item scales (PU α = .925, r = .86; Intention α = .879, r = .78). For PEOU, Cronbach's α was modest (α = .605), while McDonald's ω indicated acceptable reliability for a broader construct (ω = .762). Given the very high means and low dispersion for the QR-related items, the PEOU composite was retained and interpreted with ω as the primary index. All subsequent analyses use these composites (means reported in the table).

Table 4.1. Reliability and descriptives for consumer scales (N = 72)

Scale	k	α	ω	r (2-item)	M	SD
PEOU	4	.605	.762	-	5.57	0.94
PU	2	.925	-	.86	5.52	1.32
Intention	2	.879	-	.78	5.35	1.28

Ease of use of QR codes

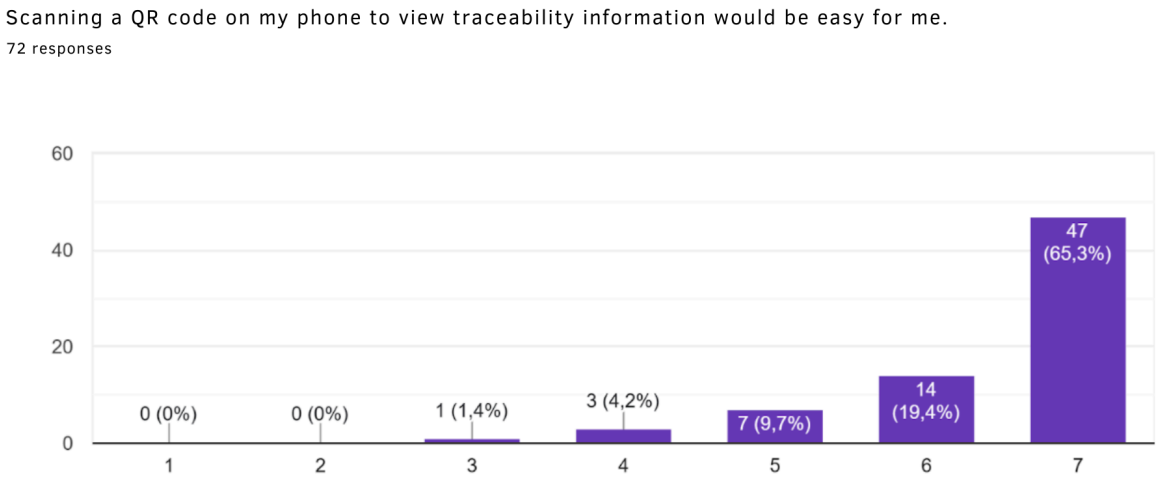

Figure 4.12. Ease of use of QR codes for consumers

Perceived ease of use was extremely high. On a scale from 1 to 7, the mean score for the statement "Reading a QR code on my phone to access traceability information would be easy for me" was 6.43 (SD = 0.93). 47 respondents (65.3%) selected the maximum value (7/7), and only 1 respondent (1.4%) gave a low score of 3 or below.

Learning to use a blockchain-enabled traceability service was also considered straightforward, with a mean of 5.40 (SD = 1.57). Retrieving exactly the desired information scored similarly high at 5.72 (SD = 1.15). Complexity was perceived as low: the item "This

service might be complicated to use" had a mean of 3.24 (SD = 1.77), with 30 respondents (41.7%) assigning scores of 1-2. These results confirm that technological barriers are minimal.

Perceived usefulness

The service was considered useful by the majority. The item "This service would be useful for me as a consumer" reached a mean of 5.57 (SD = 1.38), with 59 respondents (81.9%) assigning values between 5-7. Agreement with the statement "It would help me make better purchasing decisions" was similarly positive, with a mean of 5.44 (SD = 1.35). 40 respondents (55.6%) placed themselves at the higher end of the scale (scores 6-7), confirming that usefulness is strongly recognised.

Security and trust

Perceived security was one of the strongest dimensions. The statement "Overall, I consider this service secure" received a mean score of 5.86 (SD = 1.08), 49 respondents (68.1%) selecting values of 6 or 7. Even without deep technical understanding, consumers clearly associated blockchain with safety, transparency, and reliability, confirming prior studies that underline trust as a key driver of adoption.

Social influence

The construct of social influence produced more moderate results. The mean score was 5.19 (SD = 1.10), with 31 respondents (43.1%) selecting the central score of 5, while only 7 respondents (9.7%) gave the maximum 7. This indicates that peer effects are not decisive for blockchain adoption in food traceability, at least in this demographic.

Intention to use

Intentions were positive but less decisive than perceived usefulness. The item "If available, I would intend to use this service" reached a mean of 5.47 (SD = 1.32). In total, 57 respondents (79.2%) indicated values between 5 and 7. Expected frequency of use scored a mean of 5.21 (SD = 1.40), with 54 respondents (75.0%) selecting values between 5 and 7. Compared to attributes such as authenticity or transparency, the distribution was less extreme, suggesting that although consumers recognise the value, they are not yet fully ready to integrate blockchain traceability into everyday shopping.

Origin, authenticity, and transparency

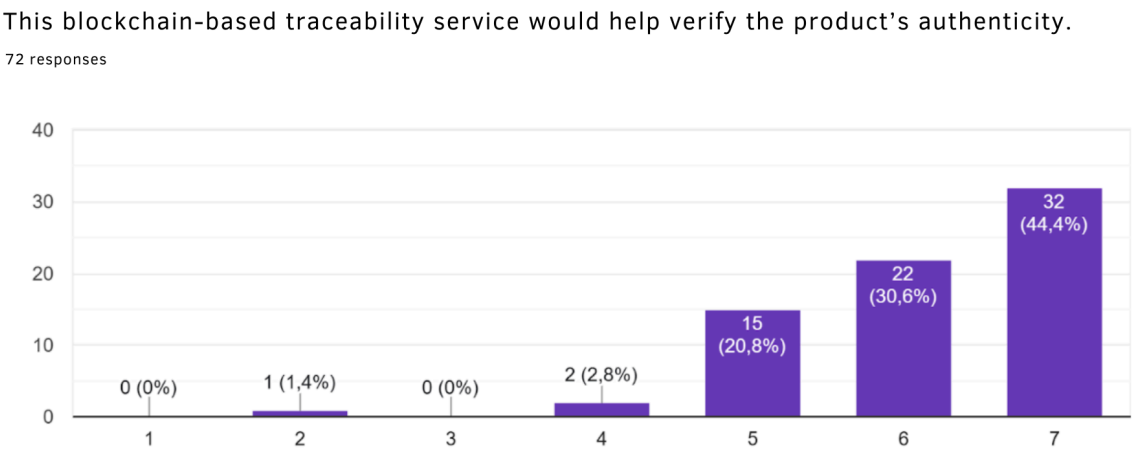

Figure 4.13. Consumer perception of authenticity in blockchain-enabled traceability. Origin and transparency show similar patterns, full charts in Annex D.

These aspects received the strongest and most consistent evaluations. Confidence in product origin scored a mean of 6.07 (SD = 1.04), authenticity verification 6.13 (SD = 0.99), and transparency of the supply chain 6.07 (SD = 1.04). In all three cases, around three-quarters of respondents (75-76%) selected values between 6 and 7. These results confirm that credibility of origin, authenticity verification, and supply chain transparency are the highest-rated value dimensions of blockchain-enabled food traceability.

Agri-food applications

Regarding applicability in the distribution and commercialisation of agri-food products, 47 respondents (65.3%) believed blockchain could be applied to a large extent, 23 (31.9%) were neutral, and 2 (2.8%) indicated a small extent. Considering usefulness specifically for distribution and commercialisation, 46 respondents (63.9%) selected a large extent, 19 (26.4%) were neutral, and 7 (9.7%) indicated a small extent.

On medium and long-term effects, 54 respondents (75.0%) agreed these would be positive, 13 (18.1%) were neutral, and 5 (6.9%) expected only small effects. These values confirm a generally optimistic outlook, tempered by a degree of caution, regarding the systemic integration of blockchain in agri-food chains.

Willingness to pay

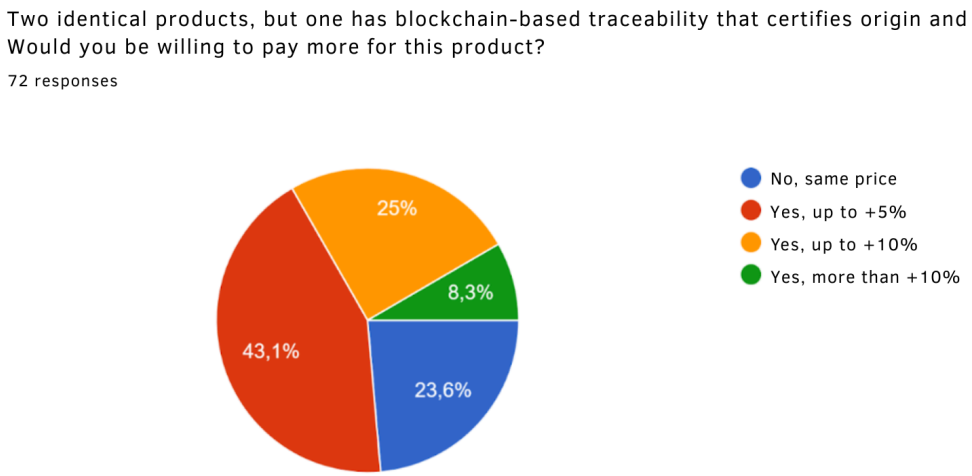

Figure 4.14. Consumer willingness to pay for blockchain-certified food products

Consumers showed a marked willingness to pay more for blockchain-certified products. 31 respondents (43.1%) were willing to pay up to +5%, 18 (25.0%) up to +10%, and 6 (8.3%) more than +10%. Only 17 respondents (23.6%) were unwilling to pay any premium. In total, 55 consumers (76.4%) expressed readiness to pay more, confirming that a substantial majority perceives blockchain certification as a value worth a price premium, particularly in relation to authenticity and traceability.

Blockchain and sustainability

The association between blockchain and sustainability was strong. The item "Blockchain traceability can contribute to a more sustainable food chain" scored a mean of 5.68 (SD = 1.23). 47 respondents (65.3%) selected values of 6 or 7, while only 3 respondents (4.2%) gave low scores (≤3). Blockchain is increasingly perceived not only as a technological innovation, but also as a tool for environmental responsibility and systemic improvement.

Information priorities

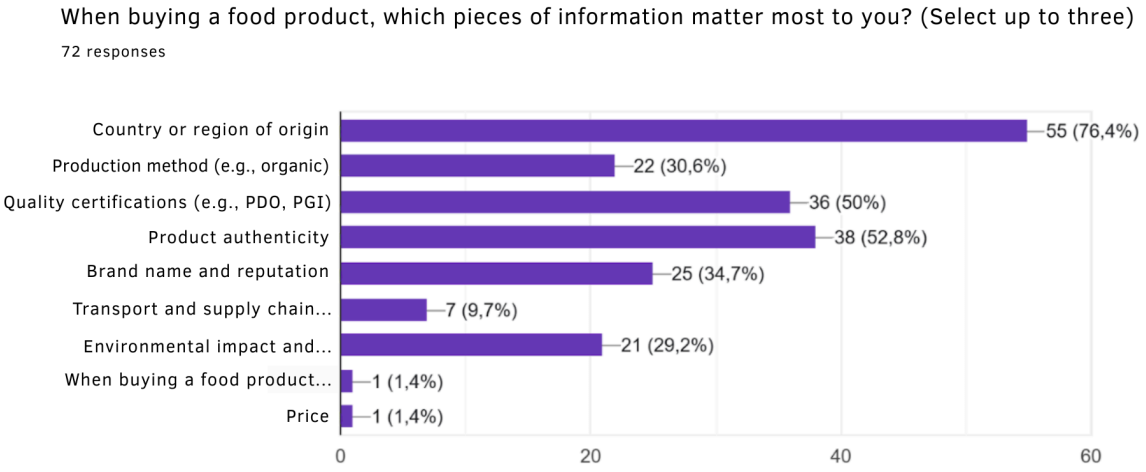

Figure 4.15. Information priorities for consumers when purchasing food products.

When asked which information mattered most when buying food, consumers showed a strong focus on provenance. 55 respondents (76.4%) selected country or region of origin, 38 (52.8%) authenticity, and 36 (50.0%) quality certifications. Lower priorities included production method (22 respondents, 30.6%), brand reputation (25, 34.7%), and environmental impact (21, 29.2%). Transport conditions were chosen by only 7 respondents (9.7%), and price by just 1 (1.4%). This confirms that, within this sample, price sensitivity is minimal, while provenance and authenticity dominate decision-making.

The survey provides a detailed and coherent picture of Portuguese consumers' attitudes toward blockchain-enabled traceability. The sample, predominantly young, educated, and affluent, perceives the technology as easy to use, secure, and particularly valuable for guaranteeing origin, authenticity, and transparency. Willingness to pay is high, and sustainability is strongly linked to blockchain, confirming its role as more than a technical novelty. At the same time, intention to use remains weaker than perceived benefits, highlighting a gap between conceptual appreciation and everyday adoption. These results are now examined in light of the Literature Review.

Consistency with the Literature Review

The Portuguese consumer evidence is consistent with the Literature Review in 2.3 that presents blockchain as an enabling infrastructure for authenticity, transparency, and trust rather than a feature to be valued on its own. Usability emerges as the primary driver of

acceptance. Respondents report that scanning QR codes is very easy, which confirms that simple, consumer-facing interfaces reduce barriers more effectively than the technology label itself (Martinelli & De Canio, 2024; Wang & Scrimgeour, 2023; Adamashvili et al., 2024). In line with this view, participants react to visible and verifiable traceability cues delivered through QR, rather than to references to blockchain as a technical term (Tokkozhina et al., 2023).

Trust operates as the key mediator between information quality and intention to use. Perceived security is high, and the highest ratings concern authenticity, transparency, and origin, which mirrors the core value dimensions identified by prior studies in food categories that depend on credible provenance. This pattern supports the interpretation of blockchain as an amplifier of authenticity signals rather than a stand-alone novelty (Lin et al., 2021; Tokkozhina, Martins & Ferreira, 2024).

Willingness to pay also follows the conditional pattern documented in the literature. A clear majority accepts a moderate premium when the service certifies attributes that already matter at the point of choice, most notably provenance and official certifications. This is consistent with evidence that premiums are weak when "blockchain" is presented in isolation, but become acceptable when it verifies salient quality cues such as PDO or PGI status or national origin (Füzesi et al., 2020; Staffolani et al., 2025).

Finally, the data reproduce the well-known gap between attitudes and routine behaviour. Perceived usefulness is solid, yet intention and expected frequency of use remain more cautious, which aligns with studies showing that trust and ease of use are necessary but not sufficient. Routine uptake requires clear category framing, at-shelf visibility of the claims, and a frictionless user journey from QR scan to decision (Martinelli & De Canio, 2024; Wang & Scrimgeour, 2023). Overall, the results confirm the central message of the Literature Review: blockchain delivers consumer value when it makes authenticity, origin, and transparency visible and credible through simple interfaces, and when any price premium is anchored to those same attributes rather than to the technology label.

Comparative Discussion

The consumer survey conducted for this dissertation can be better understood when compared to other recent empirical studies investigating consumer perceptions of blockchain in food and beverage contexts. Two complementary Portuguese studies and one international benchmark

provide valuable reference points: the Master's thesis by Matilde Freitas Ribeiro de Lima (2024) on blockchain-enabled loyalty programs (Portugal), the Master's dissertation by Marina Gherboveţchi (2024) on the coffee supply chain (Portugal), and the large scale study by Georgescu, Onete, Pleșea, Chița, and Sava (2022) on organic foods under the European Green Deal (Romania). Together, these works situate the present findings both within the Portuguese academic context and in relation to broader European evidence.

Comparison with Ribeiro de Lima (2024)

Ribeiro de Lima's dissertation, *"How Blockchain Technology Impacts Loyalty Programs and the Willingness of Consumers to Adopt Them"*, offers insights into consumer adoption outside the agri-food chain but with strong relevance for trust, perceived value, and intention to use. Her findings confirm that perceived usefulness and ease of use are decisive factors, while perceived security strongly reinforces trust. These results mirror the Portuguese agri-food survey, where consumers reported very high ease in scanning QR codes and a solid perception of security. Importantly, both studies highlight a gap between perceived benefits and actual intention to use: in Ribeiro de Lima's work, adoption intention was moderated by habit and social influence, while in the present survey general intention scored positively but less decisively. This convergence suggests that across different consumer domains, blockchain is appreciated conceptually but not yet fully integrated into daily decision-making.

Comparison with Georgescu et al. (2022)

The Romanian study by Georgescu and colleagues provides one of the most detailed quantitative analyses of consumer attitudes towards blockchain for organic foods. Their survey revealed that consumers considered blockchain feasible, useful, and expected positive long-term effects, with product safety, origin verification, and blockchain familiarity as the strongest predictors of positive attitudes. These findings align with the Portuguese results, where authenticity, transparency, and origin emerged as the highest-rated attributes. Both studies therefore highlight blockchain as an authenticity amplifier, reinforcing safety and credibility rather than introducing novelty for its own sake. The Portuguese survey, however, revealed a greater willingness to pay, with most respondents ready to accept a price premium, while in the Romanian context consumers showed higher price sensitivity. This divergence reflects socio-economic and cultural differences in how authenticity and premium quality are valued.

Comparison with Gherboveţchi (2024)

The dissertation by Gherboveţchi, *"Sustainability from Farm to Cup: Consumer Perspectives on the Adoption of Blockchain Technology in the Coffee Supply Chain"*, introduces a commodity-specific perspective. Her survey revealed relatively low awareness of blockchain but very high willingness to use it and strong confidence that it could enhance trust in the coffee industry. This parallels the Portuguese agri-food survey, where consumers associated blockchain with security and trust-enhancing attributes. Differences, however, emerge in consumer concerns: in the coffee study, attitudes toward sustainability, traceability, and transparency were more neutral, while authenticity and quality were the main concerns. In the present survey, by contrast, authenticity, origin, and transparency all received very high evaluations, reflecting the symbolic weight of provenance in categories such as wine, olive oil, and PDO/PGI products. Willingness to pay also diverged: in Gherboveţchi's study, fewer consumers were ready to pay a premium for blockchain-traced coffee, while in the present survey about three out of four respondents accepted at least a moderate premium (76.4%). This suggests that willingness to pay is category-dependent, stronger when blockchain reinforces heritage-linked authenticity attributes than in global commodities like coffee.

These comparisons highlight three consistent messages. First, across contexts, ease of use and trust are confirmed as necessary preconditions: consumers accept blockchain when presented through simple QR codes and when it guarantees credibility in origin and safety. Second, authenticity and provenance consistently emerge as the strongest value drivers. Whether in loyalty programs (Ribeiro de Lima), organic foods (Georgescu et al.), or coffee (Gherboveţchi), consumers reward blockchain mainly when it strengthens confidence in authenticity rather than as a technological novelty. Third, willingness to pay is context-sensitive. In organic food and coffee studies, premiums are moderate and shaped by income constraints or commodity perceptions, whereas in Portugal willingness to pay is stronger, reflecting the socio-economic profile of respondents and the cultural salience of authenticity in national products. Ultimately, combining Portuguese evidence with one international benchmark confirms the Literature Review premise: blockchain-enabled traceability gains consumer legitimacy only when framed as a transparent and trustworthy assurance mechanism. Its role is that of an enabler of authenticity and sustainability, with outcomes depending on context, product category, and expectations.

Table 4.2. summarises the comparison with the reference studies:

Table 4.2. Comparative summary of consumer evidence on blockchain-enabled traceability (Portugal survey vs. reference studies)

Dimension	**Portugal, Giuseppe Zuccaro (agri-food, N = 72)**	**Ribeiro de Lima (2024, Loyalty Programs)**	**Georgescu et al. (2022, Organic Food, N = 273, Romania)**	**Gherboveţchi (2024, Coffee Supply Chain, N = 72)**
Blockchain familiarity	18.1% never, 19.4% heard, 33.3% general, 29.2% well; 62.5% at least general	Consumers already familiar with QR codes; trust reinforced by security	Familiarity significant predictor, stronger than demographics	Low: 34.7% aware, 65.3% not aware
Ease of use (QR scanning / learning)	QR M = 6.43 (SD = 0.93); learning M = 5.40 (SD = 1.57)	Ease > usefulness in adoption; QR familiarity strong	"Familiarization with QR types" significant predictor	Not measured as mean; 75.0% adoption willingness despite low awareness
Perceived usefulness	Useful M = 5.57 (SD = 1.38); helps decision M = 5.44 (SD = 1.35)	M≈5.0 (SD = 1.4), usefulness shaped by social influence and habit	47.6% considered blockchain useful in organic food	High perceived benefits: transparency 68.1%, authenticity 58.3%, traceability 54.2%
Perceived complexity	Low: M = 3.24 (SD = 1.77)	Not a barrier due to QR familiarity	Not directly measured	Neutral attitudes toward traceability and transparency (median≈3.0)
Security / Trust	High: M = 5.86 (SD = 1.08)	Security predicted trust → adoption	Safety & origin verification strongest predictors	84.7% said blockchain would enhance trust in coffee

Origin / Authenticity / Transparency	Authenticity M = 6.13 (SD = 0.99); Transparency M = 6.07 (SD = 1.04); Origin M = 6.07 (SD = 1.04)	Trust and security mediated adoption	Origin verification highly significant	Authenticity and quality concern higher (M≈3.9); transparency/traceability more neutral
Social influence	Moderate: M = 5.19 (SD = 1.10)	Increased perceived usefulness but not ease	Not a central predictor	Not directly highlighted
Intention to use	Intention M = 5.47 (SD = 1.32); frequency M = 5.21 (SD = 1.40)	Intention moderated by trust & ease, less by usefulness	40.3% feasible, 69.2% expect positive medium-long term	75.0% willing to use blockchain
Willingness to pay (WTP)	43.1% up to +5%, 25.0% up to +10%, 8.3% > +10%, 23.6% none	Focus on loyalty and economic incentives	Not central, but income/familiarity mattered	38.9% yes, 37.5% depends, 23.6% no
Sustainability perception	High: M = 5.68 (SD = 1.23); 65.3% scored 6-7	Not central	Framed within EU Green Deal; 69.2% expected positive long-term effects	81.9% believed blockchain improves fair trade & sustainability

5. Comparative Analysis of Results between Portugal and Italy

Comparability note: In Portugal, because Blockchain.PT is a closed consortium largely involving larger firms and research institutions, the SME survey targeted agri-food companies outside the consortium to capture a broader sector view. This choice ensures comparability with the Italian phase (TrackIT focused on SMEs) and avoids bias from a narrow group of beneficiaries. Details on programmes and sampling are provided in Sections 2.4 and 3.

The comparative analysis between Italy and Portugal highlights how institutional settings, perceived benefits, systemic barriers, and consumer attitudes interact in shaping the adoption and sustainable integration of blockchain-enabled traceability in agri-food SMEs. By considering Italian SMEs involved in the TrackIT Blockchain initiative, Portuguese SMEs at an early-stage of exploration, and Portuguese consumers, it is possible to observe both convergences and divergences that inform the understanding of blockchain's role in food supply chains and to place the two national experiences in direct dialogue. All Italian SME evidence cited in this chapter derives from the prior Itachain/TrackIT study (Zuccaro, 2025). Unless otherwise indicated, references to Italian SMEs refer to that study.

5.1 Adoption Stage and Institutional Context

The Italian case represents a **post-trial environment**. Through the TrackIT Blockchain programme, the Italian Trade Agency (ICE, 2022) provided SMEs with free access to blockchain traceability services for eighteen months, covering provider costs, integration, and the creation of QR codes linked to a shared digital showcase. This programme successfully mobilised over 330 firms and more than 2,300 products. Italian SMEs therefore had the opportunity to test blockchain in practice, gaining visibility on international platforms and experimenting without financial risk. However, once the subsidy expired, most firms became reluctant to continue. The data collected show that the majority declared no willingness to pay the proposed subscription fee, with only a small minority indicating that they might continue at a very low price. The Italian trajectory thus demonstrates that while subsidies can accelerate adoption, they do not guarantee long-term sustainability unless tangible benefits are perceived. This finding was central to the Italian thesis, which concluded that reputational value alone is insufficient to sustain adoption in the absence of measurable returns.

The Portuguese case, by contrast, reflects an **early-stage adoption environment**. Unlike Italy, where SMEs could access TrackIT without barriers, in Portugal there is no equivalent

subsidy scheme. Blockchain.PT, the national agenda funded by the Recovery and Resilience Plan, operates through a fixed consortium of partners, leaving most SMEs outside its direct benefits. In Portugal, adoption among the surveyed SMEs remains at an embryonic stage: four out of ten companies had conducted pilot tests, but none reported integration in business processes. The remaining six had no direct experience, with three explicitly stating they had no intention to adopt. Blockchain is still perceived as complex, difficult to integrate, and economically uncertain.

This contrast illustrates the role of **institutional context**: Italy shows what happens after a subsidy-driven trial, while Portugal shows the difficulties of starting without incentives. Both settings, however, point to the same structural challenge: blockchain adoption is not self-sustaining in SMEs without enabling frameworks that reduce costs, simplify integration, and foster market demand. The double degree perspective makes it possible to read these two stages together: the Italian case captures the post-trial fragility of adoption, while the Portuguese case illustrates the pre-adoption inertia.

5.2 Perceived Benefits

Across both Italian and Portuguese SMEs, the benefits of blockchain are associated more with reputational and relational gains than with financial performance.

In Italy, 7 firms (70%) valued the improvement of brand reputation and market positioning, while 4 firms (40%) mentioned greater transparency for clients and consumers. However, 9 firms (90%) reported no significant economic change, either in terms of cost reduction or revenue growth. These results indicate that blockchain was mainly perceived as useful for marketing visibility, especially abroad, but not as a driver of measurable financial returns.

In Portugal, 7 firms (70%) associated blockchain with stronger trust among clients and suppliers, 6 (60%) with improved reputation, and 6 (60%) with sustainability. By contrast, only 4 firms (40%) expected cost reductions, 6 (60%) market access, and just 1 (10%) revenue growth. This confirms the Italian findings, showing that intangible benefits dominate while financial returns remain uncertain and secondary.

From the demand side (see Section 4.2), about three quarters of respondents gave high ratings (6–7) to origin, authenticity, and transparency, and 76.4% expressed willingness to pay

a price premium for blockchain-certified products. This challenges the **Italian conclusion** that demand was absent: Italian SMEs reported no consumer awareness, but the Portuguese evidence demonstrates that demand exists, especially among younger, educated, and affluent groups. The problem lies not in the absence of demand, but in the failure to connect it to supply.

5.3 Obstacles and Barriers

The barriers encountered by SMEs in both countries show strong convergence, though they manifest at different stages.

Italian SMEs, after experimenting with Itachain, reported that the main obstacles were a lack of measurable return on investment, low awareness among domestic consumers, and weak network effects along the supply chain. Several firms underlined that most clients did not even know what blockchain was, and that the added work of uploading data was not justified by tangible outcomes. Complexity of the dashboard and rigidity of the interface were also cited as reasons for discontinuation. These findings informed the Italian thesis recommendations for automation, ERP integration, and simplified dashboards.

Portuguese SMEs, positioned earlier in the adoption curve, stressed similar but slightly different issues. Seven firms (70%) pointed to the absence of adoption by clients and suppliers, which limited the network effect. Six firms (60%) highlighted regulatory uncertainty, while five firms (50%) reported integration difficulties with their ERP systems and another five (50%) cited costs of implementation. Three firms (30%) perceived blockchain as technologically immature, while only two (20%) mentioned insufficient ROI and one (10%) internal resistance. Complexity was consistently rated very high, with eight firms (80%) scoring 4 or 5 on a 5-point scale. The Portuguese case thus confirms that when SMEs have not yet adopted, the barriers appear even stronger and more deterrent, stopping adoption before firms can even raise specific technical requests as in Italy.

Consumers, in contrast, did not perceive such barriers. From the consumer side (see Section 4.2), QR scanning is perceived as very easy and the service as secure and useful. However, intention to use remains more cautious than perceived usefulness. This confirms the classic attitude–behaviour gap and explains why, despite potential demand, everyday adoption is not yet consolidated.

5.4 Willingness to Pay and Economic Sustainability

Economic sustainability emerges as the most fragile dimension in both Italy and Portugal.

In Italy, once the free trial ended, most SMEs declared they would not continue with Itachain at the proposed fees. Out of ten respondents, one firm (10%) stated it would surely continue, one (10%) was willing to pay but only under €150 per month, three (30%) answered "maybe" conditional on discounts or new functionalities, and five (50%) openly rejected continuation, citing high costs and lack of benefits. Among those indicating a lower acceptable price, both firms (100%) selected the category below €150 per month. These results confirmed that €150 represented a psychological threshold, beyond which firms would not continue, and supported the recommendation for flexible, consumption-based pricing models.

In Portugal, the pattern was similar. Out of ten surveyed SMEs, two firms (20%) indicated a sustainable fee below €150, three (30%) between €150-250, and two (20%) between €250-400. None (0%) declared willingness to sustain more than €400. Another two firms (20%) considered the service not applicable, and one (10%) preferred not to respond. These results confirm that willingness to pay is concentrated below €250 and that, without subsidies or clear economic returns, blockchain is not seen as a viable expense for SMEs.

In sharp contrast, the consumer survey in Portugal revealed that 55 respondents (76.4%) were willing to pay more for blockchain-certified products, most of them accepting a premium of 5-10%. This **challenges and refines the Italian SMEs' perception** that consumer demand was missing. It shows instead that willingness to pay exists but has not been activated, because blockchain is not yet visible in retail channels or linked to consumer choice at the point of sale.

5.5 Future Outlook

The future perspectives diverge significantly.

In Italy, the termination of ICE's subsidy led many SMEs to discontinue or express scepticism about continuing blockchain use. The prevailing perception is that unless the costs decrease or consumer demand increases, blockchain will not become a stable part of their

processes. This confirmed the Italian thesis conclusion that without a supportive ecosystem, adoption risks remaining a pilot episode.

In Portugal, scepticism also prevails but with a more nuanced distribution. None of the surveyed SMEs expressed certainty that blockchain would become part of their operations in the next three years, four firms (40%) explicitly rejected the possibility, while six (60%) responded “maybe”, signalling indecision rather than outright refusal. Complexity, lack of partner adoption, and low willingness to pay keep the outlook fragile and pessimistic.

Consumers, however, offer a more optimistic vision. 54 respondents (75.0%) believed that blockchain will have positive medium- and long-term effects on agri-food chains, especially in relation to sustainability and consumer trust. This demonstrates that the consumer side recognises long-term value, even if SMEs remain sceptical.

5.6 Cross-country and cross-stakeholder connections

The three perspectives reveal a coherent but incomplete picture.

Italian SMEs demonstrate that adoption is possible when institutional incentives remove entry barriers, but they also show that such adoption is fragile if it does not translate into economic returns. Portuguese SMEs, without comparable incentives, remain hesitant, perceiving blockchain as costly, complex, and disconnected from their priorities. Most did not reject it outright but expressed uncertainty about its future adoption. Portuguese consumers, on the other hand, express strong trust, ease of use, and willingness to pay, suggesting that demand-side potential exists but is not being met by supply-side readiness.

The connection between the two studies is clear. The Italian thesis showed that adoption is not sustainable without economic returns, even when subsidies remove entry barriers. The Portuguese dissertation confirms this fragility, but also adds a crucial element: consumer demand exists and is stronger than Italian SMEs assumed. This directly challenges the Italian conclusion that the absence of demand was the decisive barrier. Instead, the Portuguese results demonstrate that the missing link is the capacity of SMEs and institutions to connect latent consumer willingness to pay with concrete supply-side offers.

The comparative evidence therefore strengthens, extends, and in part revises the findings of the Italian study. It strengthens the claim that reputational benefits dominate and that

barriers are systemic. It extends the analysis by showing how adoption struggles even to begin in the absence of incentives. And it revises the Italian findings by revealing that consumer demand is not absent, as firms assumed, but remains largely untapped. The approach highlights that blockchain adoption in agri-food SMEs is fragile and discontinuous, shaped more by governance, standards, and demand activation than by technical capacity alone.

With respect to the RQ (Section 2.5), the results indicate differences driven mainly by institutional context and stage of adoption; the formal answer is presented in Chapter 6.

Table 5.1. Comparative summary of blockchain adoption in Italy and Portugal (SMEs and consumers).

Dimension	**Italy SMEs**	**Portugal SMEs**	**Portugal Consumers**
Adoption stage	Post-trial (after 18-month subsidy)	Pre-adoption/pilot stage	N/A (attitudes and intentions only)
Institutional setting	Open, subsidised national programme (ICE, TrackIT)	No open subsidy; benefits restricted to closed consortium partners	Market perspective only
Sample (N)	10 SMEs	10 SMEs	72 consumers
Main benefits	Reputation abroad, visibility in export markets, limited measurable returns	Trust and reputation, sustainability, limited economic benefits	Strongest ratings for authenticity, origin, transparency
Key barriers	Lack of ROI, low domestic awareness, weak network effects, rigid user interface	Low partner adoption, regulatory uncertainty, ERP integration costs, high complexity, immaturity	Technology seen as easy and secure; attitude–behaviour gap
Willingness to Pay	Continuation only at very low fees (≤ €150/month)	Concentrated below €250/month, none above €400	76.4% willing to pay a premium (+5–10%)
Future outlook	Sceptical post-subsidy; most discontinued	Sceptical or “maybe”; no firm expects stable adoption	75% expect positive medium- to long-term effects
Core implication	Subsidies enable trials but do not guarantee sustainability	Barriers prevent adoption from starting without incentives	Consumer demand exists but is not connected to supply

6. Conclusions and Practical Recommendations

6.1 Conclusions

The analysis shows that blockchain adoption in agri-food SMEs depends less on technical feasibility than on institutional context, economic sustainability, and ecosystem coordination. Both studies confirm that reputational and relational benefits dominate over measurable financial returns.

The double degree design allows these dynamics to be seen as two stages of the same trajectory. The Italian case illustrates a post-trial dynamic: adoption rose with subsidies but collapsed once they ended. The Portuguese case, in contrast, illustrates a pre-adoption scenario: without incentives or institutional onboarding, most firms did not even start. Together, they represent two points of the same path, one where adoption retreats after incentives, the other where it struggles to begin without them.

The consumer perspective in Portugal, absent in the Italian study, introduces a decisive correction. Italian SMEs largely assumed that consumer demand was missing. The Portuguese survey, however, shows the opposite: most consumers value authenticity and transparency and declare willingness to pay a premium for blockchain-certified products. This challenges the Italian conclusion and reframes the central obstacle: not the absence of demand, but the inability of SMEs and institutions to connect existing consumer willingness with credible, visible supply side offers.

The findings demonstrate that the benefits and obstacles shaping the adoption and stable integration of blockchain in agri-food traceability differ primarily by institutional setting and adoption stage. In Italy, public incentives enabled widespread trials but did not translate into post-subsidy sustainability: benefits remained reputational, with no measurable economic gains, making economic sustainability the decisive obstacle. In Portugal, in the absence of subsidies and with a closed consortium, SMEs face ecosystem barriers (partner adoption, standards, ERP integration) and remain at a pre-adoption/pilot stage. On the demand side, Portuguese consumers attribute high value to origin, authenticity, and transparency and show a significant willingness to pay, which indicates that demand exists. The true bottleneck is therefore the weak connection between this latent demand and concrete supply-side offers. Blockchain adoption in agri-food SMEs is thus driven less by internal technical capacity and

more by governance, interoperable standards, and demand activation (e.g. retailer engagement, at-shelf claims, QR-to-decision pathways). Pricing and integration mechanisms (ERP connectors, simplified interfaces, flexible pricing) emerge as critical levers to stabilise adoption beyond the pilot stage.

6.2 Managerial Contributions

The findings of this research translate into contributions at three complementary levels.

At the institutional level, Italy showed that subsidies are powerful but insufficient if temporary. They create momentum but risk collapse once removed, while Portugal illustrates the opposite risk, with adoption barely starting in the absence of incentives. Hybrid schemes are therefore recommended, combining financial aid with long-term measures such as interoperable standards, training, and consumer education.

At the technical level, SMEs in both countries indicated concrete needs: usability, ERP integration, automated data uploads, and pricing aligned with thresholds below €250 per month. Even reduced fees in Italy remained above what SMEs considered feasible, and Portuguese firms expressed similar concerns despite limited trial experience. Providers should anticipate these barriers by investing in usability, automation, and flexible pricing that make blockchain an invisible layer rather than an additional burden.

At the market level, the Portuguese consumer survey demonstrates that willingness to pay exists. The challenge is to make blockchain visible at the point of purchase and to link QR codes with narratives of authenticity, provenance, and sustainability. SMEs should not present blockchain as a technical novelty but as a storytelling device that reinforces trust, supported by packaging cues and promotion campaigns.

Italy shows what happens when supply is activated without sustained demand, Portugal when demand exists but supply is absent. Coordinated action across institutions, providers, and SMEs is needed to connect the two sides.

6.3 Limitations

This research, while offering original comparative insights, is subject to several limitations that must be acknowledged. The most immediate limitation is the small sample size: 10 Italian SMEs, 10 Portuguese SMEs, and 72 Portuguese consumers. This necessarily restricts

the generalisability of the findings and positions the study within an exploratory rather than confirmatory tradition. The value of the analysis lies in the patterns and contrasts that emerge across contexts, but these cannot be interpreted as statistically representative of the wider population of agri-food firms or consumers.

A second limitation concerns the asymmetry of data collection. On the firm side, the Italian evidence reflects SMEs that had direct experience with the Itachain platform under the TrackIT Blockchain programme, while the Portuguese evidence derives from a broader group of agri-food SMEs outside the Blockchain.PT consortium. On the consumer side, only Portuguese respondents were surveyed. This asymmetry enriches the analysis by broadening the scope beyond firms, but it also limits the possibility of a fully balanced cross-country and cross-stakeholder comparison.

Third, the results capture a specific institutional moment rather than a stable equilibrium. Italy was analysed in a post-subsidy phase, when TrackIT had ended and SMEs faced the decision of whether to continue at their own expense. Portugal, by contrast, was analysed in a pre-adoption environment, where no comparable incentive scheme had been introduced. As institutional frameworks evolve, consumer awareness increases, and provider offerings mature, the perceptions of benefits and barriers observed here may shift in different directions. The findings should therefore be interpreted as a snapshot of two trajectories rather than as definitive outcomes.

Although internal consistency was estimated (α for all scales; ω for PEOU), the consumer scales were intentionally short (two items for PU and Intention; four for PEOU). This constrains reliability and precludes factor modeling with N = 72. In particular, α can be downward biased for heterogeneous constructs, hence we report ω for PEOU. Results should therefore be read as indicative and exploratory.

Finally, the Portuguese SME survey did not generate direct evidence on the role of technology providers, a factor widely emphasised in the literature. Italian respondents formulated highly concrete requests for greater usability, ERP integration, and pricing below the €150 monthly threshold, but Portuguese SMEs, having little or no practical experience, did not express similar operational demands. This absence is itself informative: it suggests that in Portugal the ecosystem is still weakly structured, and blockchain is perceived more as a distant and immature innovation than as a service embedded in daily operations.

Despite these limitations, the comparative design remains a distinctive contribution. By capturing Italy in a post-trial phase and Portugal in a pre-adoption phase, and by integrating the consumer dimension in the Portuguese case, the study offers a nuanced view of how blockchain adoption in agri-food SMEs is shaped by institutional context, ecosystem readiness, and market demand.

6.4 Future Research Directions

Future research should strengthen external validity through larger and more balanced samples of SMEs and consumers in both countries. Matching firms by size, sector, and export intensity would improve comparability, while longitudinal designs could capture adoption, continuation, and discontinuation over time. Platform usage logs and basic commercial indicators would help connect perceived benefits with observable outcomes.

On the supply side, future studies should include technology providers, public agencies, and certification bodies to examine how usability, interoperability, and ERP integration influence adoption and retention. Field evaluations can test onboarding bundles with different levels of automation, training, and support. Rigorous designs such as phased rollouts or matched comparisons would help estimate the marginal effect of each component.

On the demand side, consumer analysis should be extended to Italy for a symmetric cross-country view. Experimental work can test how point-of-purchase visibility, QR code design, and narrative framing affect trust, usefulness, and willingness to pay. Choice experiments and in-store trials can assess whether reputational value converts into actual purchases and price premia, and under what conditions these effects persist beyond novelty.

Ecosystem heterogeneity deserves systematic analysis. Comparative studies across additional countries and product categories can reveal whether the Italian and Portuguese cases are unique or part of broader patterns. Multilevel models can separate firm, sector, and country effects, while common indicators for economic sustainability, such as integration effort, data maintenance costs, acceptable price thresholds, and conversion rates from consumer interest to sales, would allow findings to accumulate across contexts.

Only under coordinated institutions, shared standards, and consumer engagement will blockchain move beyond pilots and deliver lasting value.

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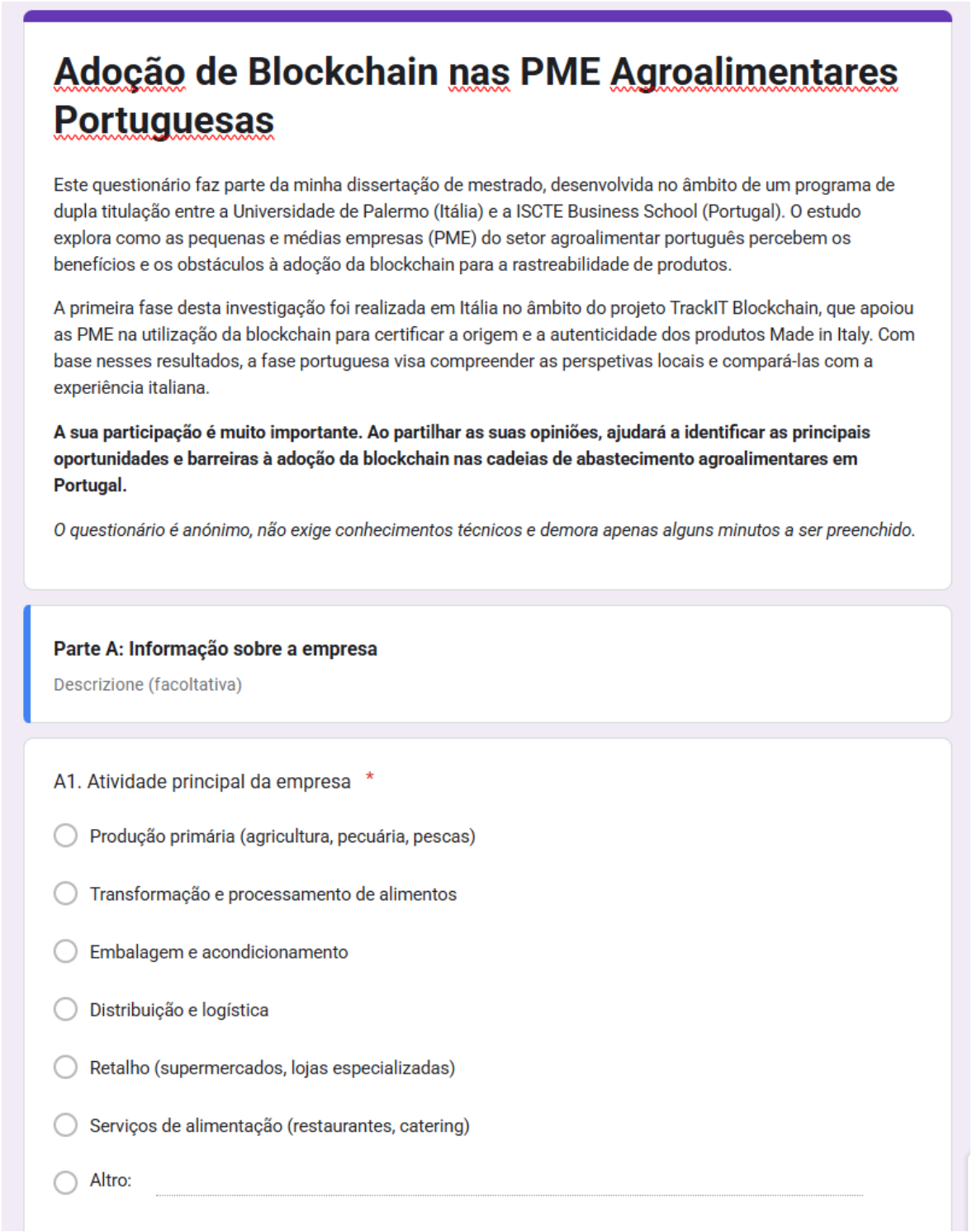
Annexes

Annex A: Questionnaire for SMEs (Portugal)

Full SME questionnaire (Portuguese). Sections: Company profile; Adoption status; Perceived economic/non-economic benefits; Obstacles and barriers; Perceived complexity & digitalisation; Conditions for stable adoption; Future intentions; Budget; Standards & interoperability; Open-ended items (main obstacle; enablers; collaboration with partners).



Adoção de Blockchain nas PME Agroalimentares Portuguesas

Este questionário faz parte da minha dissertação de mestrado, desenvolvida no âmbito de um programa de dupla titulação entre a Universidade de Palermo (Itália) e a ISCTE Business School (Portugal). O estudo explora como as pequenas e médias empresas (PME) do setor agroalimentar português percebem os benefícios e os obstáculos à adoção da blockchain para a rastreabilidade de produtos.

A primeira fase desta investigação foi realizada em Itália no âmbito do projeto TrackIT Blockchain, que apoiou as PME na utilização da blockchain para certificar a origem e a autenticidade dos produtos Made in Italy. Com base nesses resultados, a fase portuguesa visa compreender as perspetivas locais e compará-las com a experiência italiana.

A sua participação é muito importante. Ao partilhar as suas opiniões, ajudará a identificar as principais oportunidades e barreiras à adoção da blockchain nas cadeias de abastecimento agroalimentares em Portugal.

O questionário é anónimo, não exige conhecimentos técnicos e demora apenas alguns minutos a ser preenchido.

Parte A: Informação sobre a empresa

Descrizione (facoltativa)

A1. Atividade principal da empresa *

- Produção primária (agricultura, pecuária, pescas)
- Transformação e processamento de alimentos
- Embalagem e acondicionamento
- Distribuição e logística
- Retalho (supermercados, lojas especializadas)
- Serviços de alimentação (restaurantes, catering)
- Altro: .....

A2. Intervalo de volume de negócios anual *

- ○ Inferior a €300k
- ○ €300k-€1m
- ○ €1-3m
- ○ €3-5m
- ○ €5-10m
- ○ Superior a €10m

A3. Função do respondente *

- ○ Direção
- ○ TI ou Inovação Tecnológica
- ○ Operações ou Produção
- ○ Cadeia de Abastecimento ou Logística
- ○ Vendas ou Desenvolvimento de Negócio
- ○ Altro: .....

A4. Quota de exportação no total das vendas *

- ○ Nenhuma
- ○ Inferior a 25%
- ○ 25-50%
- ○ Superior a 50%

A5. Nível de adoção de blockchain *

- ○ Apenas testes ou piloto
- ○ Utilizada em alguns processos
- ○ Estavelmente integrada nos processos
- ○ Nenhuma experiência com blockchain e não considera a adoção
- ○ Nenhuma experiência com blockchain mas está a considerar a adoção
- ○ Altro: .....

Parte B: Benefícios, obstáculos e condições

Descrizione (facoltativa)

B1. Benefícios económicos esperados ou obtidos (escolha até dois) *

- ☐ Redução de custos operacionais
- ☐ Aumento de receitas (por exemplo, preços superiores ou exportação)
- ☐ Acesso a novos mercados ou clientes
- ☐ Sem benefícios económicos significativos
- ☐ Altro: .....

B2. Benefícios não económicos considerados mais relevantes (escolha até três) *

- [ ] Melhoria da imagem ou reputação da empresa
- [ ] Maior confiança de clientes e fornecedores
- [ ] Mais transparência para os consumidores finais
- [ ] Melhor clareza dos processos internos
- [ ] Inovação e motivação da equipa,
- [ ] Apoio à sustentabilidade (cadeia transparente)
- [ ] Sem benefícios não económicos significativos
- [ ] Altro: .....

B3. Obstáculos ou barreiras mais críticos (escolha até três) *

- [ ] Custos de implementação ou subscrição
- [ ] Dificuldade de integração com os sistemas da empresa
- [ ] Baixa adoção por clientes ou fornecedores (efeito de rede fraco)
- [ ] Incerteza regulamentar
- [ ] Tecnologia percebida como imatura
- [ ] Resistência interna à mudança
- [ ] ROI percebido como insuficiente
- [ ] Altro: .....

B4. Quão complexa seria para a sua empresa a utilização de uma plataforma de blockchain? *
(Se a sua empresa nunca utilizou, responda em termos da sua perceção.)
Escala 1-5, onde 1 = Nada complexa e 5 = Muito complexa

1	2	3	4	5
○	○	○	○	○

B5. Nível de digitalização da empresa *

- ○ Sem sistemas digitais relevantes
- ○ Ferramentas básicas (folhas de cálculo, email)
- ○ ERP ou sistemas internos de gestão
- ○ Integração com parceiros (EDI, IoT, cloud)
- ○ Avançado (IA, big data, sistemas integrados multiator)
- ○ Não sabe / Não aplicável

B6. Na sua opinião, se fosse implementada, os consumidores finais confiariam nas informações fornecidas através da blockchain? Escala 1-5, onde 1 = Nada e 5 = Totalmente *

1	2	3	4	5
○	○	○	○	○

Parte C: Condições para adoção estável

(Se a sua empresa ainda não utiliza blockchain, responda em termos das condições que poderiam levá-la a adotar.)

C1. Se fosse continuar a utilizar a blockchain no futuro, que condições seriam decisivas? (escolha até três) *

- ☐ Redução de custos
- ☐ Maior facilidade de utilização
- ☐ Apoio técnico mais sólido
- ☐ Adoção pelos parceiros da cadeia de valor
- ☐ Maior reconhecimento por parte dos consumidores
- ☐ Normas e padrões mais claros
- ☐ Rastreabilidade do produto
- ☐ Altro: .....

C2. Quão importante é que os parceiros da cadeia (fornecedores, clientes, distribuidores) adotem a mesma tecnologia para que ela seja útil para si? Escala 1-5, onde 1 = Nada importante e 5 = Muito importante *

1 2 3 4 5

C3. Em que medida os requisitos externos de mercado (clientes, distribuidores) influenciam a sua decisão de adotar a blockchain? *
Escala 1-5, onde 1 = Nada e 5 = Em muito grande medida

1 2 3 4 5

C4. Quão importantes são os padrões partilhados e a interoperabilidade (por exemplo, formatos de dados comuns, APIs, protocolos) para trocar informações entre sistemas e tornar a blockchain realmente útil para si? Escala 1-5, onde 1 = Nada importante e 5 = Extremamente importante. *

1 2 3 4 5

Parte D: Intenções futuras

Descrizione (facoltativa)

D1. Nos próximos três anos, espera que a blockchain se torne uma parte estável dos processos da sua empresa? *

- Sim
- Talvez
- Não

D2. Pensando num serviço de rastreabilidade baseado em blockchain, que mensalidade por empresa seria sustentável para si, se alguma? *

- ○ Inferior a €150
- ○ €150-250
- ○ €250-400
- ○ Superior a €400
- ○ Não aplicável
- ○ Prefiro não responder

Parte E: Perguntas abertas

Descrizione (facoltativa)

E1. Qual é o principal obstáculo que limita ou poderia limitar o uso de blockchain na sua empresa? *

Testo risposta lunga

E2. O que seria necessário para o convencer a manter ou a expandir o uso da blockchain a longo prazo? *

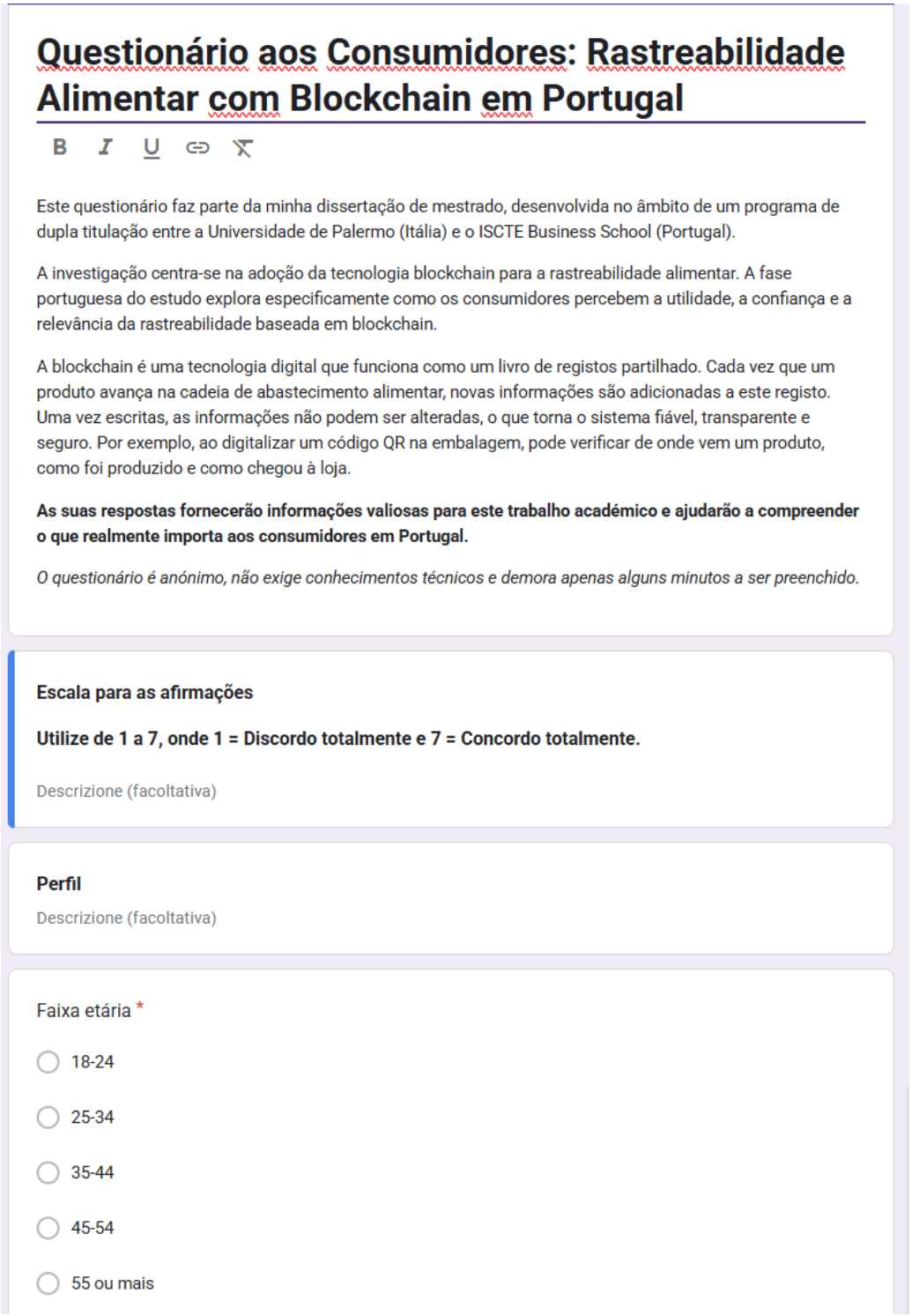
Testo risposta lunga

E3. Como devem colaborar clientes e fornecedores para tornar a blockchain realmente útil para a sua cadeia de valor? *

Testo risposta lunga

Annex B: Questionnaire for Consumers (Portugal)

Full consumer questionnaire (Portuguese). Blocks: Demographics; Purchasing habits; Blockchain familiarity; QR ease-of-use (4 items, one reverse-coded complexity); Perceived Usefulness (2 items); Perceived Security/Trust; Social Influence; Intention to Use (2 items); Single items on Origin/Authenticity/Transparency/Sustainability; Willingness to Pay (premium bands); Applicability and medium-/long-term effects; Information priorities.



Questionário aos Consumidores: Rastreabilidade Alimentar com Blockchain em Portugal

Este questionário faz parte da minha dissertação de mestrado, desenvolvida no âmbito de um programa de dupla titulação entre a Universidade de Palermo (Itália) e o ISCTE Business School (Portugal).

A investigação centra-se na adoção da tecnologia blockchain para a rastreabilidade alimentar. A fase portuguesa do estudo explora especificamente como os consumidores percebem a utilidade, a confiança e a relevância da rastreabilidade baseada em blockchain.

A blockchain é uma tecnologia digital que funciona como um livro de registos partilhado. Cada vez que um produto avança na cadeia de abastecimento alimentar, novas informações são adicionadas a este registo. Uma vez escritas, as informações não podem ser alteradas, o que torna o sistema fiável, transparente e seguro. Por exemplo, ao digitalizar um código QR na embalagem, pode verificar de onde vem um produto, como foi produzido e como chegou à loja.

As suas respostas fornecerão informações valiosas para este trabalho académico e ajudarão a compreender o que realmente importa aos consumidores em Portugal.

O questionário é anónimo, não exige conhecimentos técnicos e demora apenas alguns minutos a ser preenchido.

Escala para as afirmações

Utilize de 1 a 7, onde 1 = Discordo totalmente e 7 = Concordo totalmente.

Descrizione (facoltativa)

Perfil

Descrizione (facoltativa)

Faixa etária *

- 18-24
- 25-34
- 35-44
- 45-54
- 55 ou mais

Género *

- ◯ Feminino
- ◯ Masculino
- ◯ Outro
- ◯ Prefiro não responder

Nível de escolaridade concluído *

- ◯ Ensino secundário
- ◯ Licenciatura
- ◯ Mestrado
- ◯ Doutoramento

Rendimento mensal do agregado familiar *

- ◯ Inferior a 750 €
- ◯ 750 € – 1.499 €
- ◯ 1.500 € – 2.499 €
- ◯ 2.500 € – 3.499 €
- ◯ 3.500 € ou mais
- ◯ Prefiro não responder

Com que frequência compra produtos com as seguintes características? *

	Nunca	Raramente	Às vezes	Frequentemente	Sempre
Produtos bioló...	○	○	○	○	○
Produtos de m...	○	○	○	○	○
Produtos com ...	○	○	○	○	○
Produtos em q...	○	○	○	○	○
Produtos com r...	○	○	○	○	○

Quão familiarizado(a) está com a tecnologia blockchain? *

- ○ Nunca ouvi falar
- ○ Já ouvi falar mas não sei bem o que é
- ○ Sei, de forma geral, o que é
- ○ Conheço bem

Facilidade de utilização de códigos QR

Descrizione (facoltativa)

Ler um código QR no meu telemóvel para visualizar informações de rastreabilidade seria fácil para mim. *

1	2	3	4	5	6	7
○	○	○	○	○	○	○

Utilidade da rastreabilidade com blockchain

Descrizione (facoltativa)

Utilidade da rastreabilidade com blockchain

Descrizione (facoltativa)

Este serviço de rastreabilidade baseado em blockchain seria útil para mim como consumidor. *

1	2	3	4	5	6	7
○	○	○	○	○	○	○

Ajudar-me-ia a tomar melhores decisões de compra. *

1	2	3	4	5	6	7
○	○	○	○	○	○	○

Facilidade de utilização

Descrizione (facoltativa)

Aprender a utilizar este serviço de rastreabilidade baseado em blockchain seria fácil para mim. *

1	2	3	4	5	6	7
○	○	○	○	○	○	○

Este serviço de rastreabilidade baseado em blockchain tornaria fácil obter exatamente a informação que quero. *

1	2	3	4	5	6	7
○	○	○	○	○	○	○

Complexidade percebida

Descrizione (facoltativa)

Este serviço de rastreabilidade baseado em blockchain pode ser complicado de utilizar. *

1	2	3	4	5	6	7
○	○	○	○	○	○	○

Segurança e confiança

Descrizione (facoltativa)

No geral, considero este serviço de rastreabilidade baseado em blockchain seguro. *

1	2	3	4	5	6	7
○	○	○	○	○	○	○

Influência social

Descrizione (facoltativa)

Saber que pessoas em quem confio utilizam este serviço influenciaria a minha decisão de o usar. *

1	2	3	4	5	6	7
○	○	○	○	○	○	○

Intenção de utilização

Descrizione (facoltativa)

Se estivesse disponível, eu tencionaria utilizar este serviço de rastreabilidade baseado em blockchain nas minhas compras. *

1	2	3	4	5	6	7
○	○	○	○	○	○	○

Espero vir a utilizar este serviço de rastreabilidade baseado em blockchain frequentemente. *

1	2	3	4	5	6	7
○	○	○	○	○	○	○

Origem, autenticidade e transparência

Descrizione (facoltativa)

Este serviço de rastreabilidade baseado em blockchain aumentaria a minha confiança na origem do produto. *

1	2	3	4	5	6	7
○	○	○	○	○	○	○

Este serviço de rastreabilidade baseado em blockchain ajudaria a verificar a autenticidade do produto. *

1	2	3	4	5	6	7
○	○	○	○	○	○	○

Este serviço de rastreabilidade baseado em blockchain melhoraria a transparência da cadeia de abastecimento. *

1	2	3	4	5	6	7
○	○	○	○	○	○	○

A blockchain pode ser utilizada na distribuição de produtos agroalimentares (incluindo biológicos). *

- ○ Em pequena medida
- ○ Nem concordo nem discordo
- ○ Em grande medida

Utilizar blockchain é útil na distribuição e comercialização de produtos agroalimentares (incluindo biológicos). *

- ○ Em pequena medida
- ○ Nem concordo nem discordo
- ○ Em grande medida

Os efeitos a médio e longo prazo seriam positivos para a cadeia de distribuição agroalimentar. *

- ○ Em pequena medida
- ○ Nem concordo nem discordo
- ○ Em grande medida

Disposição para pagar e sustentabilidade

Descrizione (facoltativa)

Dois produtos idênticos, mas um tem rastreabilidade com blockchain que certifica a origem e autenticidade. Estaria disposto(a) a pagar mais por este produto? *

- ○ Não, o mesmo preço
- ○ Sim, até +5%
- ○ Sim, até +10%
- ○ Sim, mais de +10%

A utilização de blockchain na rastreabilidade pode contribuir para uma cadeia alimentar mais sustentável. *

1	2	3	4	5	6	7
○	○	○	○	○	○	○

Prioridades de informação

Descrizione (facoltativa)

Ao comprar um produto alimentar, quais são as informações que mais lhe importam? (Selecione até três) *

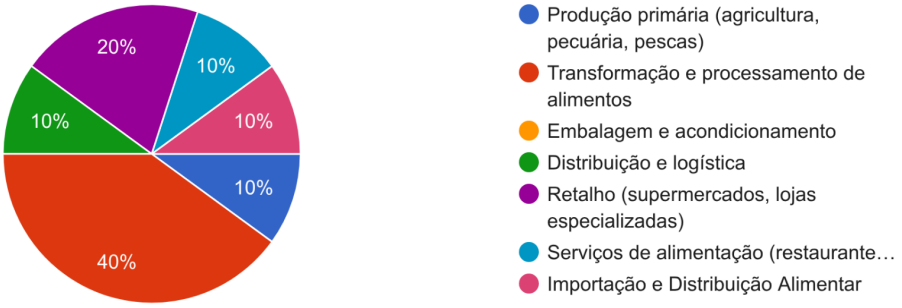
- ☐ País ou região de origem
- ☐ Método de produção (ex. biológico ou pesca sustentável)
- ☐ Certificações de qualidade (ex. DOP, IGP, ou biológico)
- ☐ Autenticidade do produto
- ☐ Nome e reputação da marca
- ☐ Condições de transporte e cadeia de frio
- ☐ Impacto ambiental e sustentabilidade
- ☐ Altro: .....

Annex C: Complete Results of the SME Survey (Portugal)

Complete SME survey outputs: full frequency tables by item, cross-tabulations (e.g., adoption × export share), and all figures not shown in Chapter 4 (labelled C1–C…).

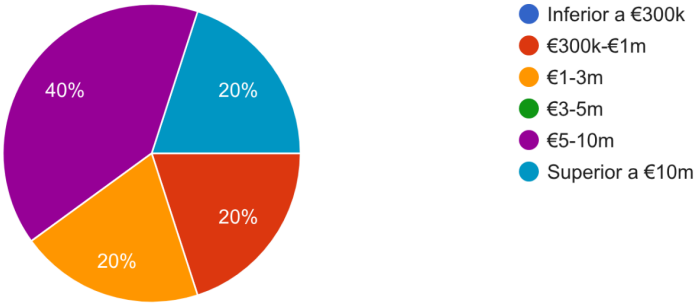
A1. Atividade principal da empresa

10 risposte



A2. Intervalo de volume de negócios anual

10 risposte

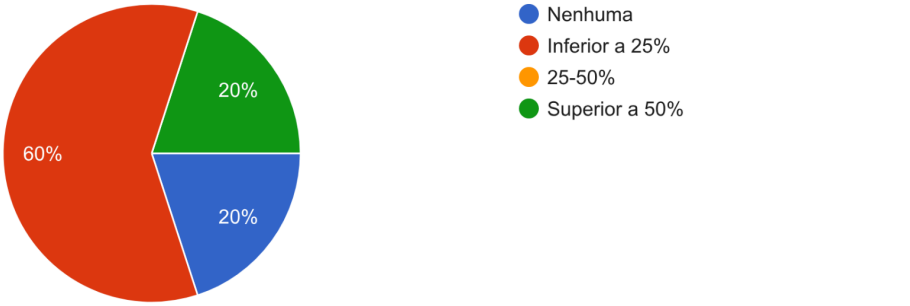


A3. Função do respondente

10 risposte

A4. Quota de exportação no total das vendas

10 risposte

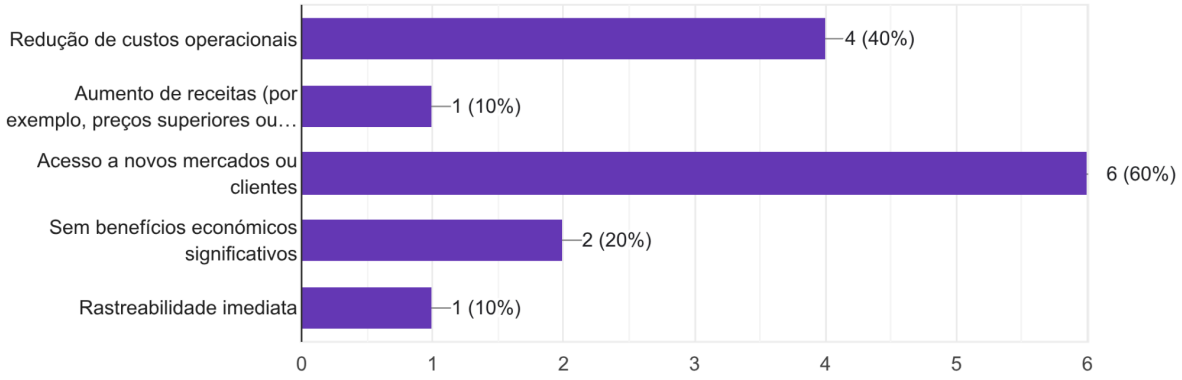


A5. Nível de adoção de blockchain

10 risposte

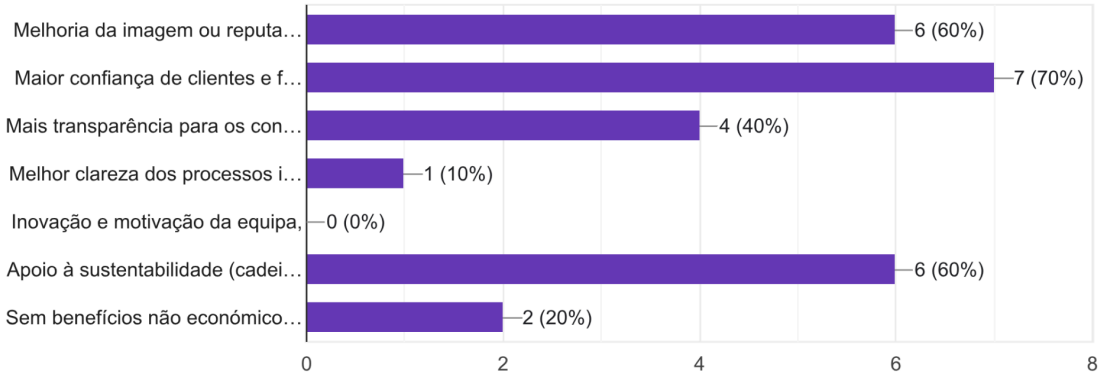
B1. Benefícios económicos esperados ou obtidos (escolha até dois)

10 risposte



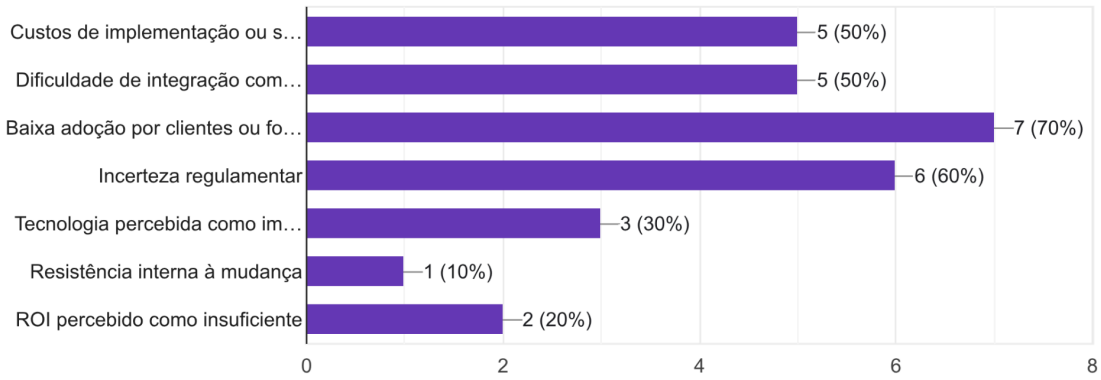
B2. Benefícios não económicos considerados mais relevantes (escolha até três)

10 risposte



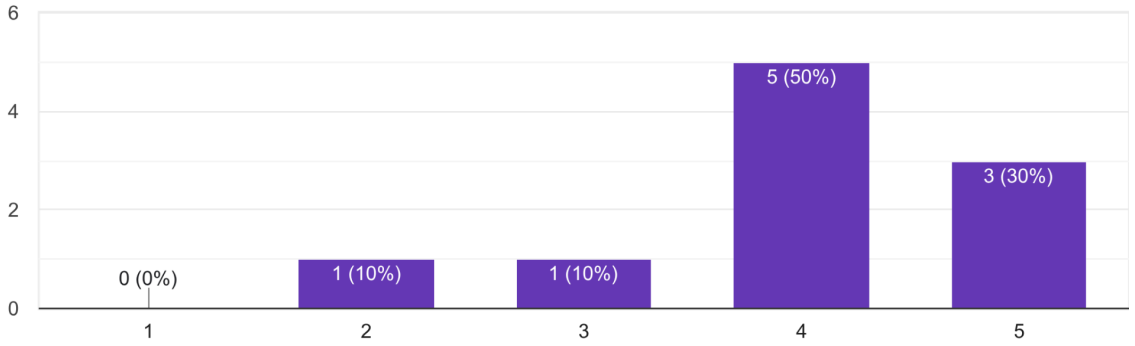
B3. Obstáculos ou barreiras mais críticos (escolha até três)

10 risposte



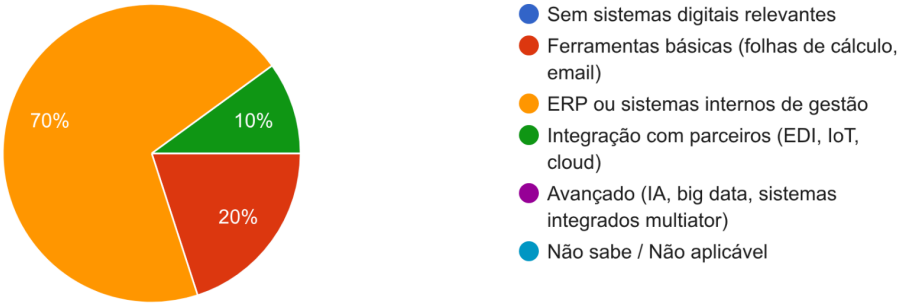
B4. Quão complexa seria para a sua empresa a utilização de uma plataforma de blockchain? (Se a sua empresa nunca utilizou, responda em termos d...-5, onde 1 = Nada complexa e 5 = Muito complexa

10 risposte



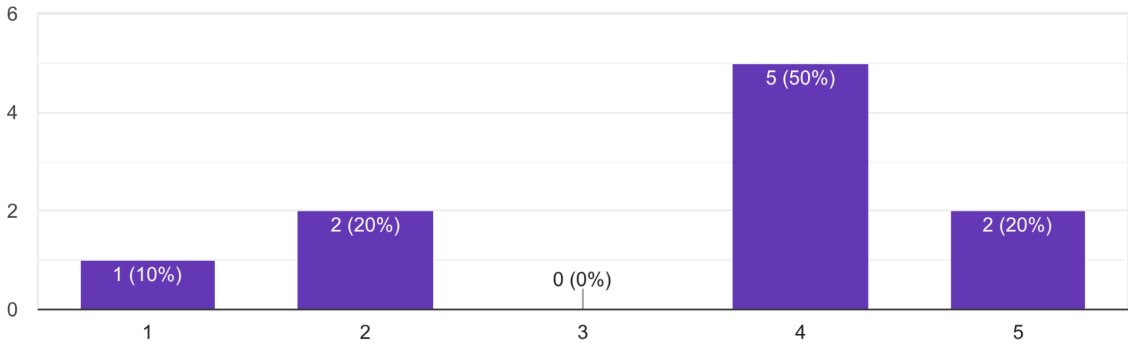
B5. Nível de digitalização da empresa

10 risposte



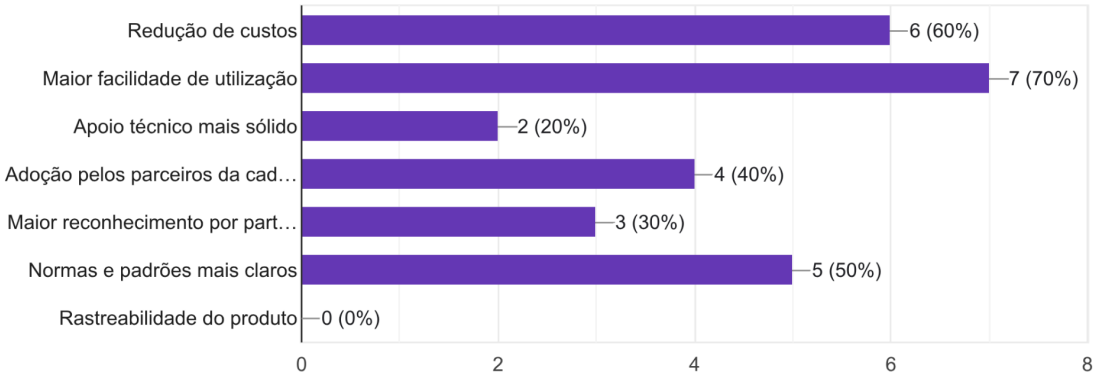
B6. Na sua opinião, se fosse implementada, os consumidores finais confiariam nas informações fornecidas através da blockchain? Escala 1-5, onde 1 = Nada e 5 = Totalmente

10 risposte



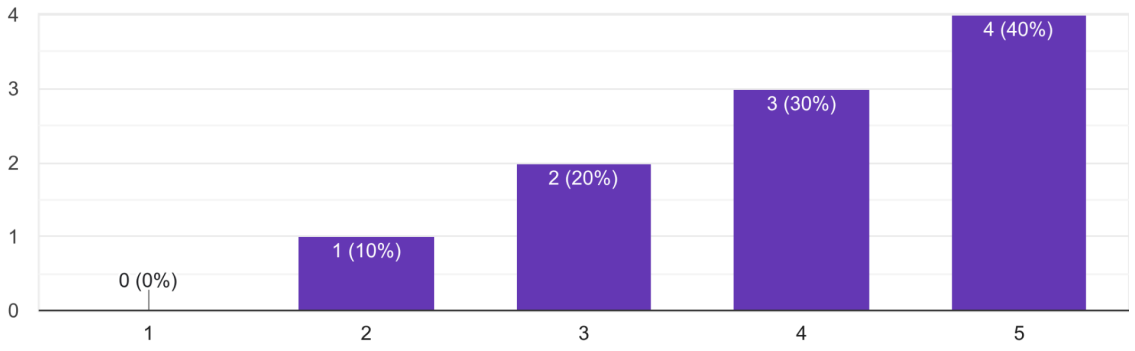
C1. Se fosse continuar a utilizar a blockchain no futuro, que condições seriam decisivas? (escolha até três)

10 risposte



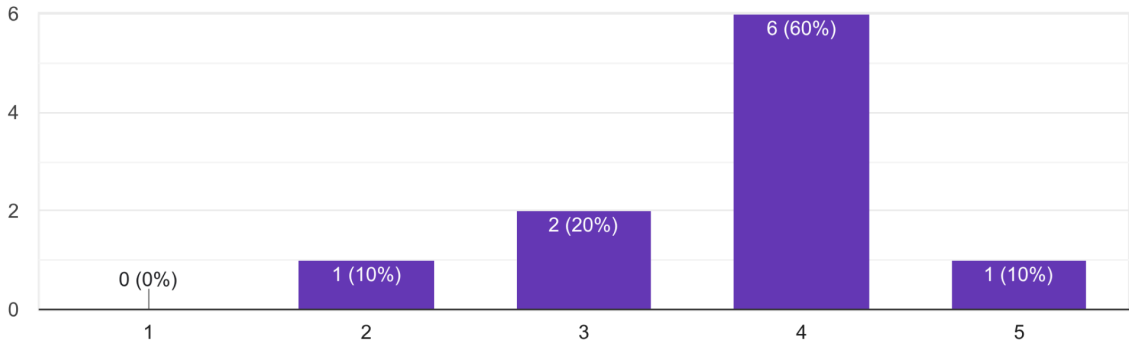
C2. Quão importante é que os parceiros da cadeia (fornecedores, clientes, distribuidores) adotem a mesma tecnologia para que ela seja útil para si? E... onde 1 = Nada importante e 5 = Muito importante

10 risposte



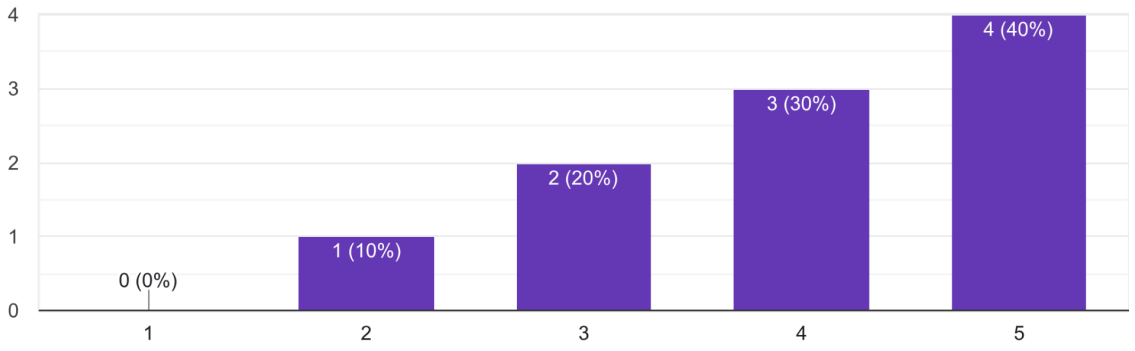
C3. Em que medida os requisitos externos de mercado (clientes, distribuidores) influenciam a sua decisão de adotar a blockchain? Escala 1-5, onde 1 = Nada e 5 = Em muito grande medida

10 risposte



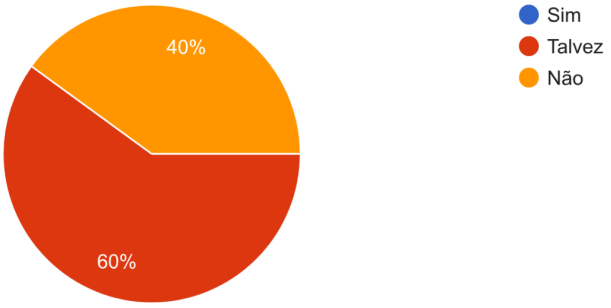
C4. Quão importantes são os padrões partilhados e a interoperabilidade (por exemplo, formatos de dados comuns, APIs, protocolos) para trocar infor... Nada importante e 5 = Extremamente importante.

10 risposte



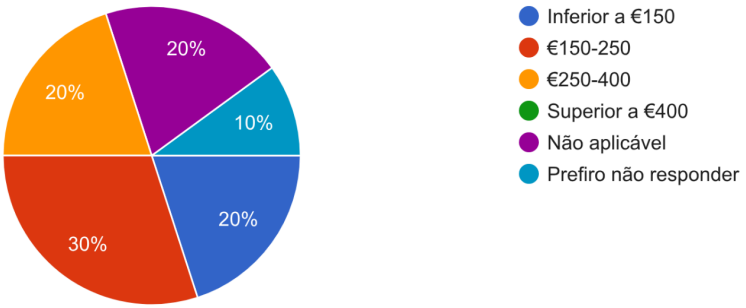
D1. Nos próximos três anos, espera que a blockchain se torne uma parte estável dos processos da sua empresa?

10 risposte



D2. Pensando num serviço de rastreabilidade baseado em blockchain, que mensalidade por empresa seria sustentável para si, se alguma?

10 risposte



Parte E: Perguntas abertas

E1. Qual é o principal obstáculo que limita ou poderia limitar o uso de blockchain na sua empresa?

10 risposte

Os custos iniciais e a incerteza sobre o enquadramento legal

NA

Sem benefícios significativos

O desconhecimento da tecnologia e das potencialidade; Não ver vantagem quantificável na sua utilização; Infraestrutura de suporte à tecnologia; Adaptação organizacional e de processos

Lack of knowledge

A integração com diferentes sistemas de clientes é um desafio significativo.

infrastructure

A integração com os sistemas atuais é complexa

Os custos são demasiado elevados e não vemos retorno

infrastructure

A integração com os sistemas atuais é complexa

Os custos são demasiado elevados e não vemos retorno

Custo

E2. O que seria necessário para o convencer a manter ou a expandir o uso da blockchain a longo prazo?

10 risposte

- Demonstração prática de benefícios económicos e maior clareza regulatória.
- NA
- Solicitação por parte de parceiros com peso no negócio
- Ser exigido pelo cliente uma maior precisão na rastreabilidade, controlo de qualidade dos produtos e segurança dos dados; Demonstração efetiva dos benefícios económicos e operacionais
- Market adoption
- Adoção generalizada na cadeia logística e exigência internacional
- Consumers request
- Necessitamos que os distribuidores e clientes também utilizem a blockchain
- Só se fosse obrigatório por lei

E3. Como devem colaborar clientes e fornecedores para tornar a blockchain realmente útil para a sua cadeia de valor?

10 risposte

- Alinhamento de dados e uso de plataformas comuns na cadeia de abastecimento
- NA
- Não sabemos responder, pois não temos solicitações de parceiros neste sentido
- Investimento na tecnologia e modernização das empresas; Reestruturação de processos internos
- I think suppliers have to make it user friendly and teach their customers to use the blockchain and adopt it more easily in the daily base customer shopping activities.
- Parcerias baseadas em plataformas comuns, protocolos padronizados e formação conjunta
- good training
- Colaboração através de plataformas comuns, formação e partilha de padrões
- Não aplicável, pois não temos interesse

Necessitamos que os distribuidores e clientes também utilizem a blockchain

Só se fosse obrigatório por lei

Requisitos de cliente

E3. Como devem colaborar clientes e fornecedores para tornar a blockchain realmente útil para a sua cadeia de valor?

10 risposte

NA

Não sabemos responder, pois não temos solicitações de parceiros neste sentido

Investimento na tecnologia e modernização das empresas; Reestruturação de processos internos

I think suppliers have to make it user friendly and teach their customers to use the blockchain and adopt it more easily in the daily base customer shopping activities.

Parcerias baseadas em plataformas comuns, protocolos padronizados e formação conjunta

good training

Colaboração através de plataformas comuns, formação e partilha de padrões

Não aplicável, pois não temos interesse

Ter a informação requisitada alinhada e acessivel

(OPCIONAL) Se estiver interessado em receber informações sobre o estudo, deixe o seu endereço de e-mail aqui.

Entraremos em contacto em breve.

2 risposte

NA

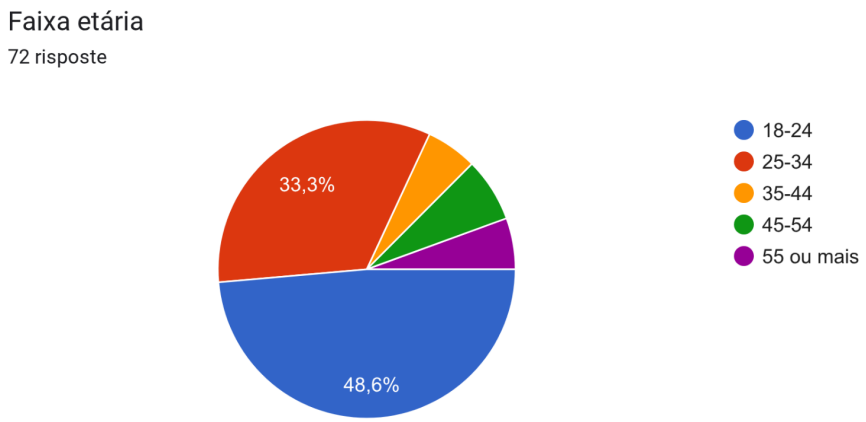
rui.rodrigues@gelpeixe.pt

Annex D: Complete Results of the Consumer Survey (Portugal)

Reliability computation notes (Cronbach's α and McDonald's ω)

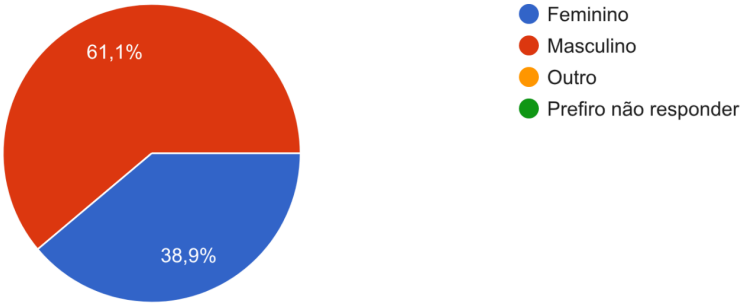
We computed Cronbach's α for all composites. For PEOU (4 items combining ease and a reverse-coded complexity item) we also report McDonald's ω (one-factor, PCA estimate) as a more robust reliability index under heterogeneous content. For two-item scales (PU, Intention) α equals the Spearman–Brown reliability; ω is not informative for k = 2. Composites were used descriptively (no CFA/SEM).

Scale	k	α	ω (one-factor)	M	SD
PEOU (Perceived Ease of Use)	4	0.605	0.762	5.57	0.94
PU (Perceived Usefulness)	2	0.925	-	5.52	1.32
Intention to Use	2	0.879	-	5.35	1.28



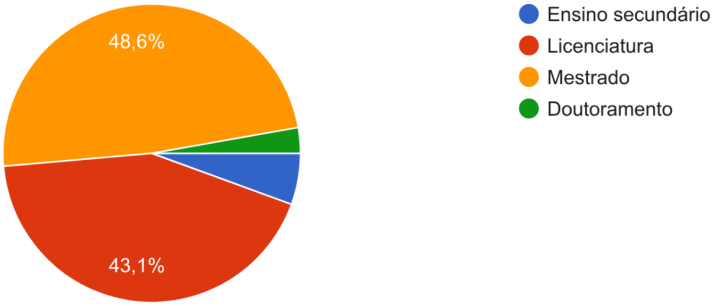
Género

72 risposte



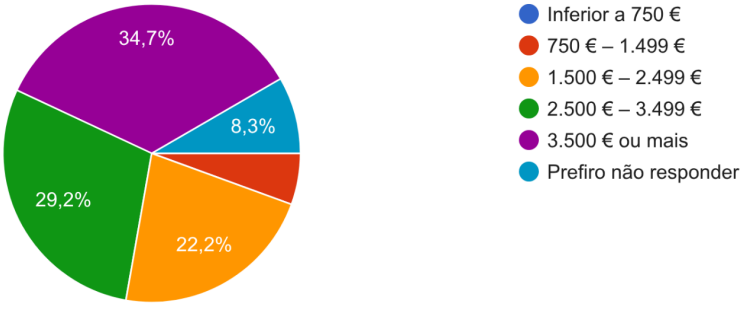
Nível de escolaridade concluído

72 risposte

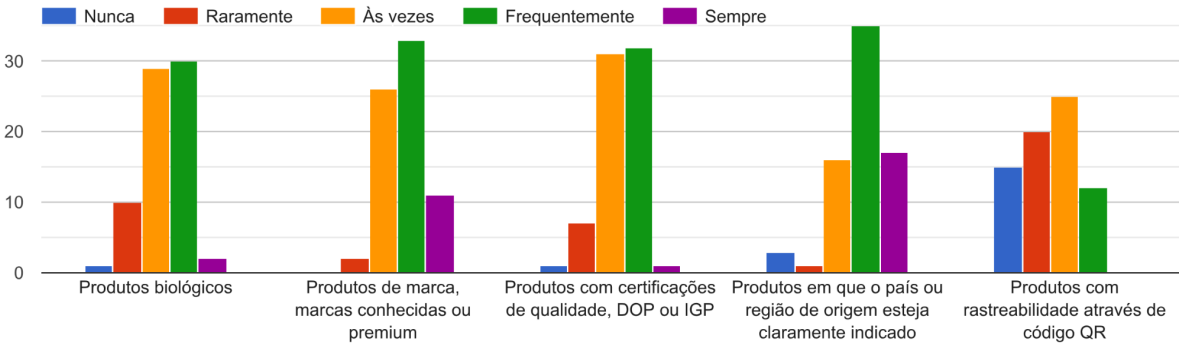


Rendimento mensal do agregado familiar

72 risposte

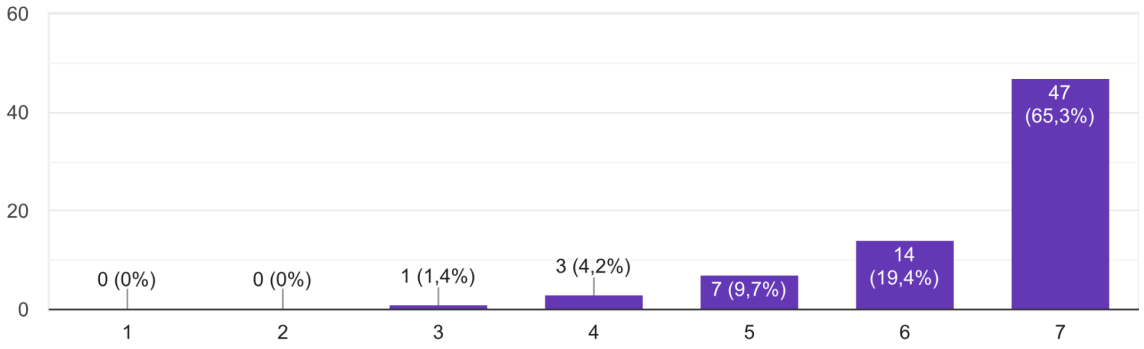


Com que frequência compra produtos com as seguintes características?

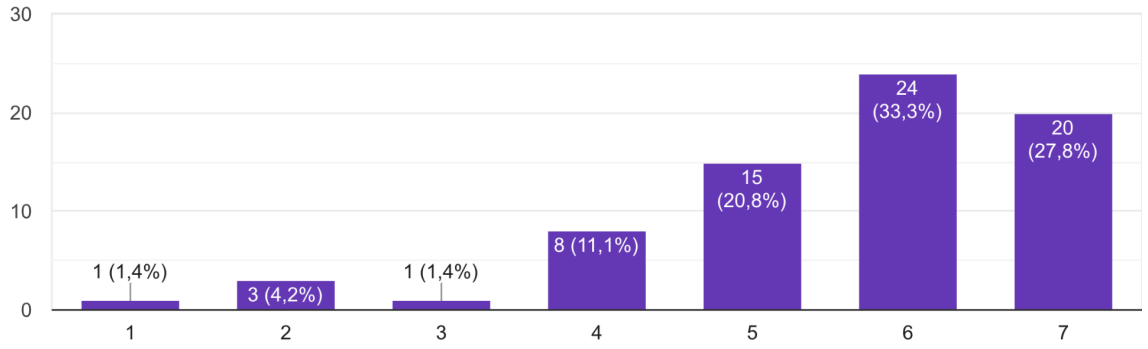


Ler um código QR no meu telemóvel para visualizar informações de rastreabilidade seria fácil para mim.

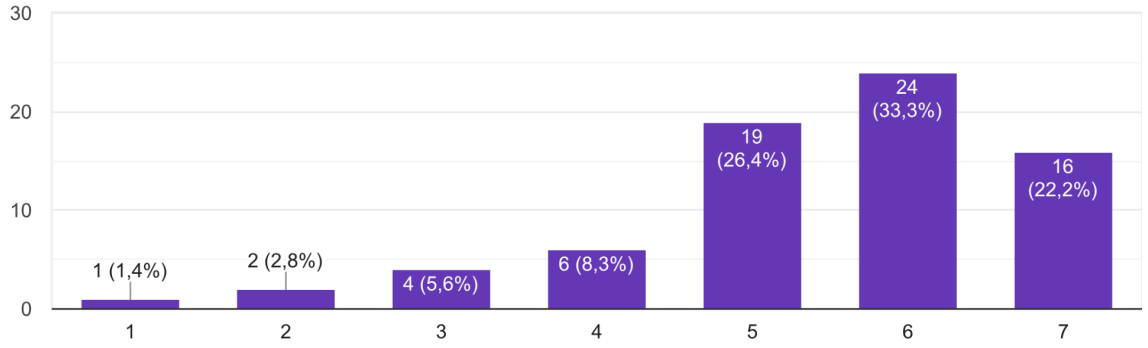
72 risposte



Este serviço de rastreabilidade baseado em blockchain seria útil para mim como consumidor.
72 risposte

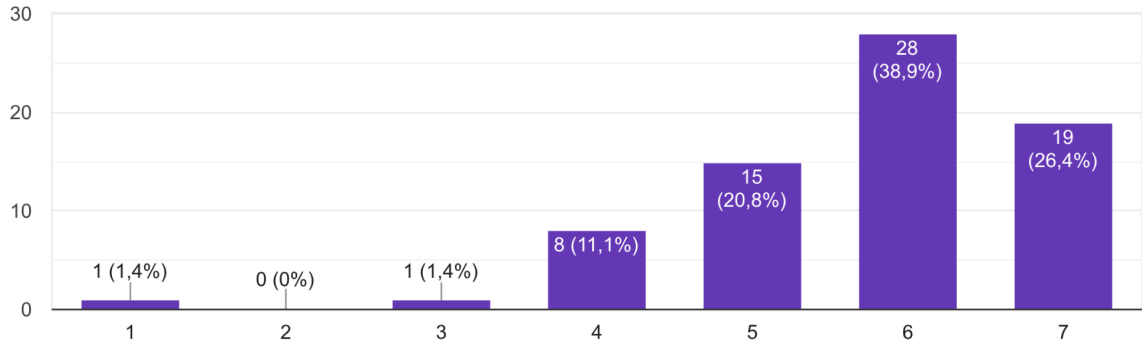


Ajudar-me-ia a tomar melhores decisões de compra.
72 risposte



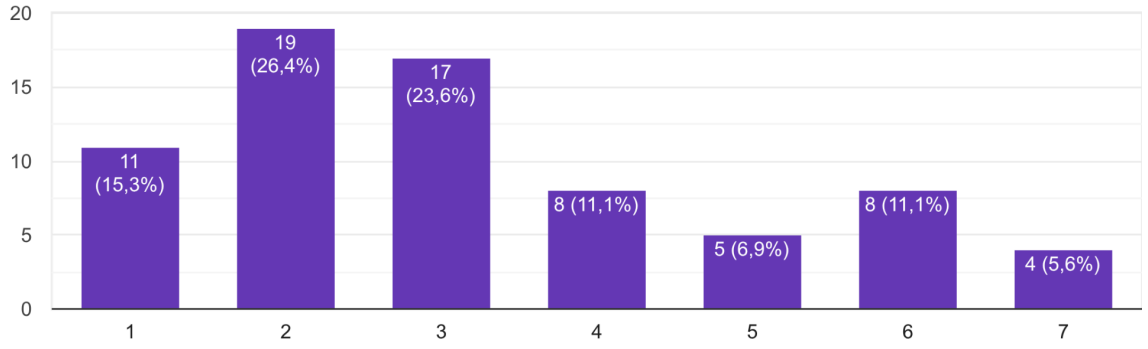
Este serviço de rastreabilidade baseado em blockchain tornaria fácil obter exatamente a informação que quero.

72 risposte



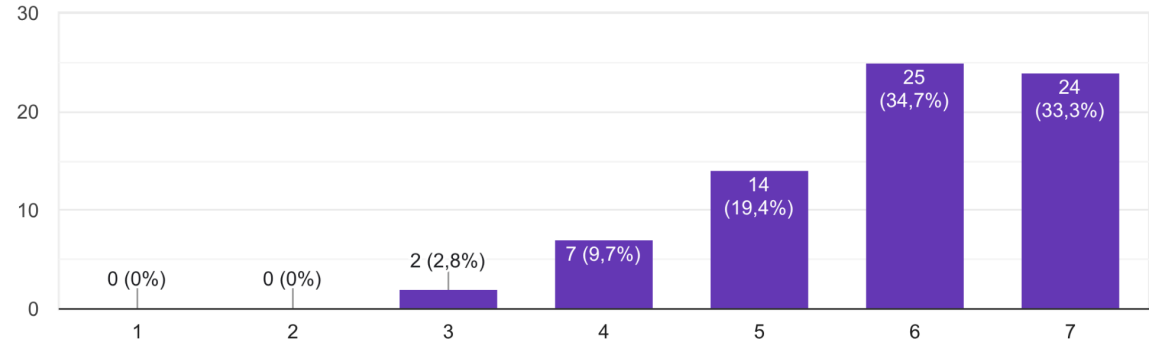
Este serviço de rastreabilidade baseado em blockchain pode ser complicado de utilizar.

72 risposte



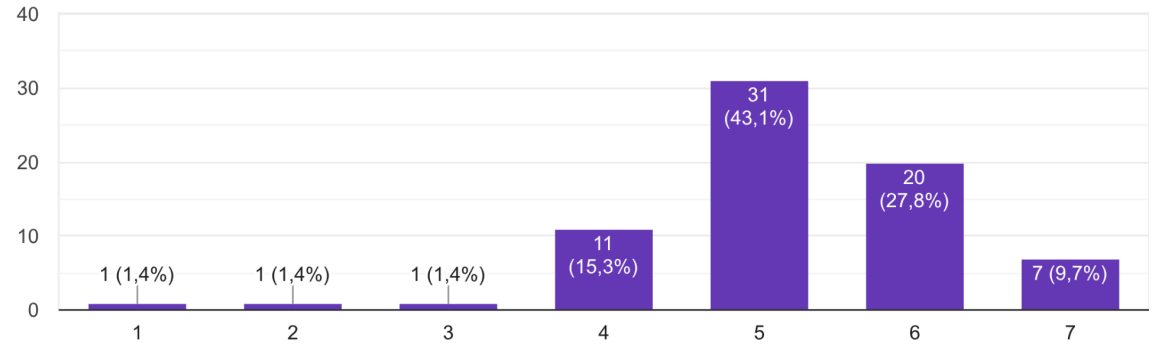
No geral, considero este serviço de rastreabilidade baseado em blockchain seguro.

72 risposte



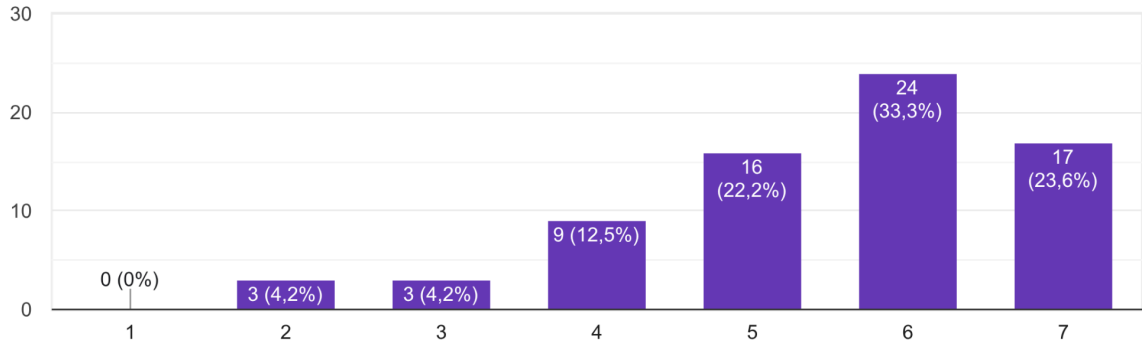
Saber que pessoas em quem confio utilizam este serviço influenciaria a minha decisão de o usar.

72 risposte



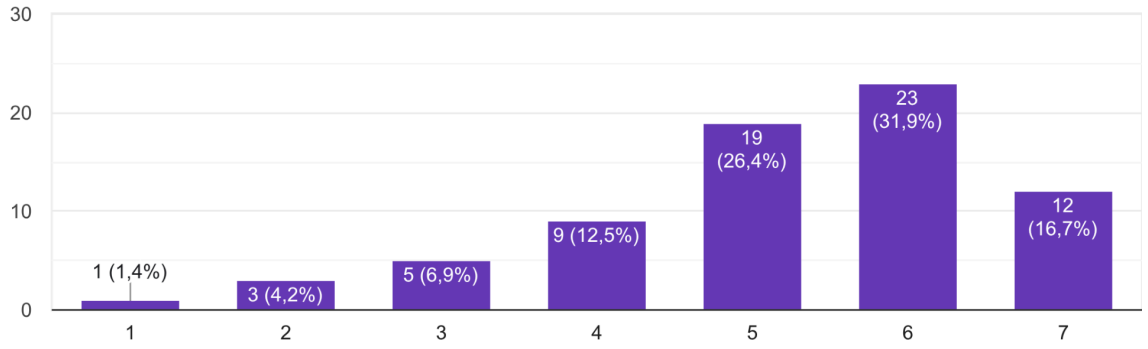
Se estivesse disponível, eu tencionaria utilizar este serviço de rastreabilidade baseado em blockchain nas minhas compras.

72 risposte



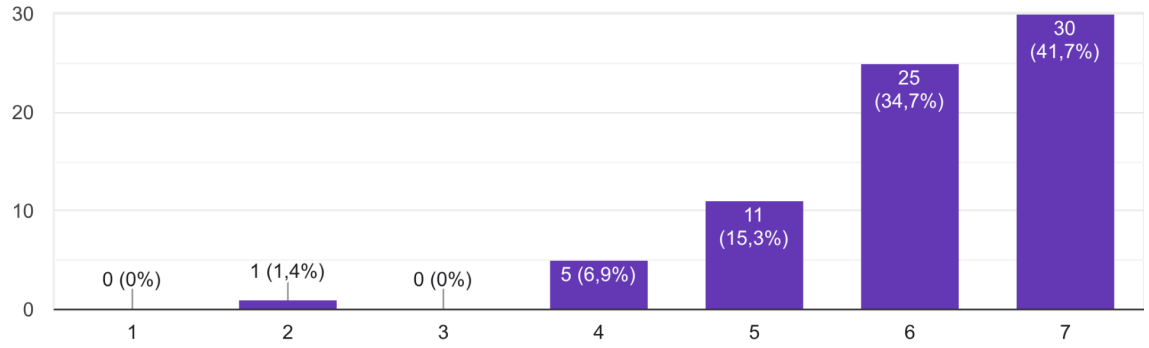
Espero vir a utilizar este serviço de rastreabilidade baseado em blockchain frequentemente.

72 risposte



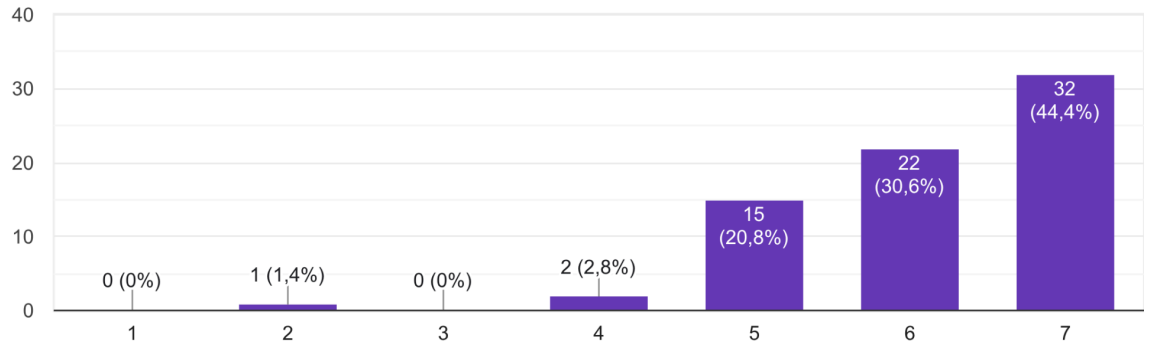
Este serviço de rastreabilidade baseado em blockchain aumentaria a minha confiança na origem do produto.

72 risposte



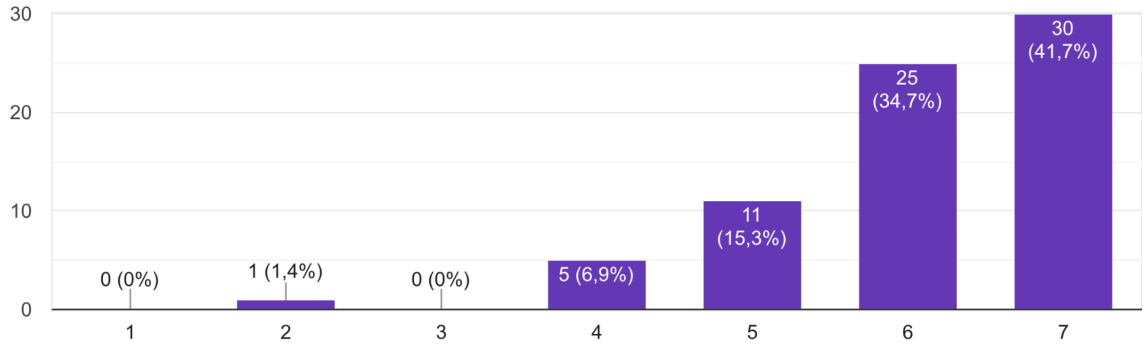
Este serviço de rastreabilidade baseado em blockchain ajudaria a verificar a autenticidade do produto.

72 risposte



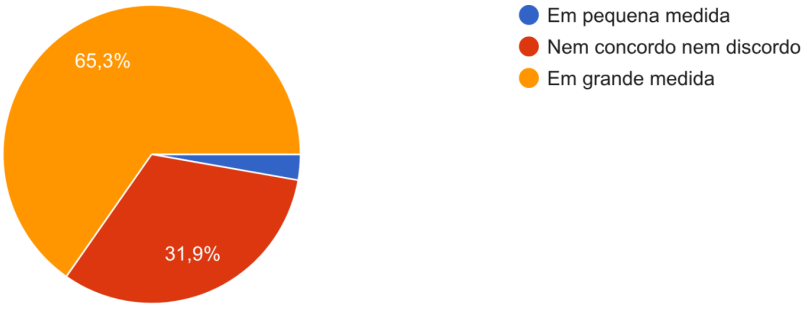
Este serviço de rastreabilidade baseado em blockchain melhoraria a transparência da cadeia de abastecimento.

72 risposte



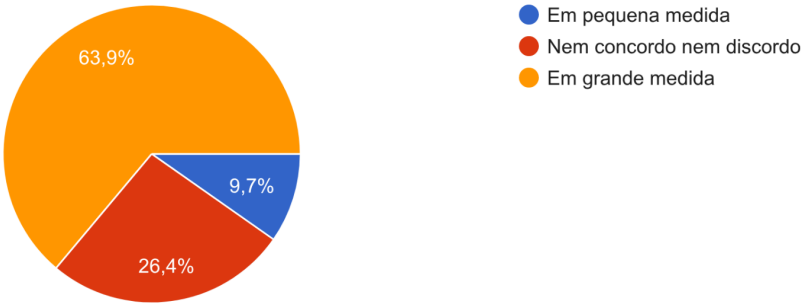
A blockchain pode ser utilizada na distribuição de produtos agroalimentares (incluindo biológicos).

72 risposte

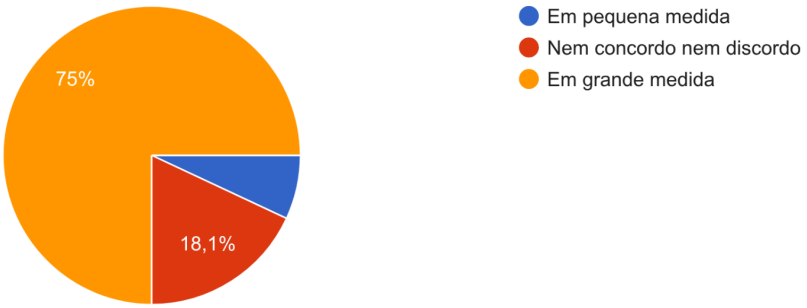


Utilizar blockchain é útil na distribuição e comercialização de produtos agroalimentares (incluindo biológicos).

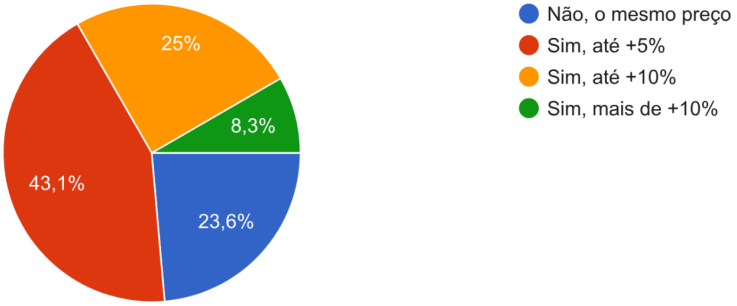
72 risposte



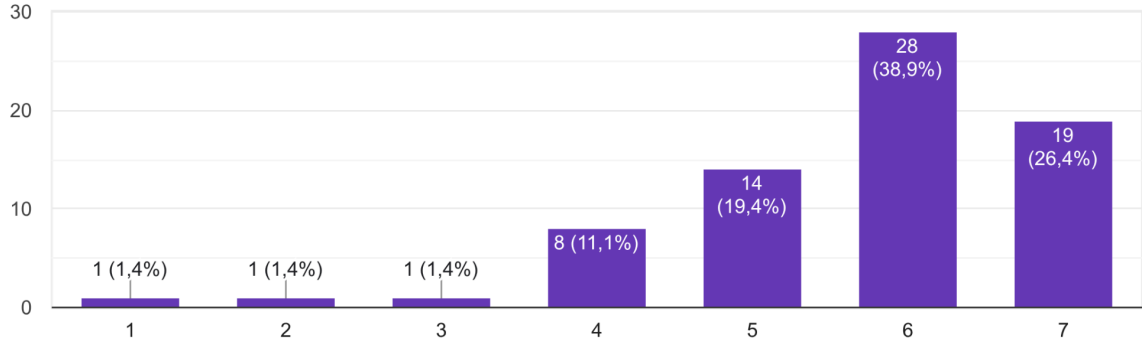
Os efeitos a médio e longo prazo seriam positivos para a cadeia de distribuição agroalimentar.
72 risposte



Dois produtos idênticos, mas um tem rastreabilidade com blockchain que certifica a origem e autenticidade. Estaria disposto(a) a pagar mais por este produto?
72 risposte



A utilização de blockchain na rastreabilidade pode contribuir para uma cadeia alimentar mais sustentável.
72 risposte



Ao comprar um produto alimentar, quais são as informações que mais lhe importam? (Selecione até três)

72 risposte