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BLOCKCHAIN COMO HERRAMIENTA PARA LA FINANCIACIÓN Y TRAZABILIDAD DE EMPRESAS

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Resumen

La tecnología blockchain se ha popularizado en los últimos años de una manera exponencial. Primero en el ámbito financiero, y luego en el sector industrial. Enmarcada en un contexto de transformación digital, esta nueva tecnología que permite registrar, validad y compartir información de manera descentralizada entre múltiples agentes ha cobrado especial relevancia en la financiación emprendedora. Sus características de trazabilidad y calidad en la cadena de valor y la toma de decisiones como un elemento capaz de construir confianza en el inversor o usuario, aumentar la competitividad de un proyecto o mejorar la coordinación interorganizacional son factores impulsores de su adaptación.

Esta tesis pretende demostrar su valor potencial, no solo como una mera herramienta tecnológica, si no de su capacidad de diseño y gestión informacional, verificabilidad y comunicación. En esta investigación estudiamos su aplicación a la financiación emprendedora mediante Initial Coin Offerings (ICOs) y así como su adopción en la industria agroalimentaria para mejorar la calidad, trazabilidad, seguridad y sostenibilidad.

El objetivo principal de este estudio es analizar cómo la información generada por aplicaciones blockchan crea valor en el contexto empresarial, desde la financiación de un proyecto, hasta su ejecución operativa y percepción en el mercado. Para ello se han llevado a cabo tres trabajos publicados como artículos científicos. En el estudio configuracional con fsQCA (muestra de 75 ICOs), los resultados muestran que no existe ninguna condición necesaria, y que el éxito de captación se alcanza por múltiples configuraciones. Por ejemplo mediante una alta valoración del equipo, alto rating, buena interacción con usuarios y plazo corto, mientras que otras configuraciones de éxito combinan comunidad grande, equipo verificado, interacción alta y plazo corto. En contraste, los bajos niveles de captación se asocian a plazos largos y a la coexistencia de comunidad/interacción con baja verificación y bajas valoraciones del equipo.

En el estudio cualitativo de casos en agroalimentario, los hallazgos confirman la relevancia de blockchain para la trazabilidad y la calidad de proceso, y muestran además que, en pymes, las motivaciones incluyen con fuerza elementos sociales y

de sostenibilidad (reducción del desperdicio alimentario, economía circular), observándose diferencias respecto a grandes corporaciones más enfocadas en eficiencia. Asimismo, aparece como reto crítico la capacidad de comunicar el valor de la tecnología a stakeholders y la necesidad de formación y educación para favorecer la adopción.

Resum

La tecnologia *blockchain* s'ha popularitzat en els últims anys d'una manera exponencial, primer en l'àmbit financer i, posteriorment, en el sector industrial. Emmarcada en un context de transformació digital, aquesta nova tecnologia, que permet registrar, validar i compartir informació de manera descentralitzada entre múltiples agents, ha cobrat una rellevància especial en el finançament emprenedor. Les seues característiques de traçabilitat i qualitat en la cadena de valor, així com el seu paper en la presa de decisions com a element capaç de construir confiança en l'inversor o l'usuari, augmentar la competitivitat d'un projecte o millorar la coordinació interorganitzacional, són factors impulsors de la seua adopció.

Aquesta tesi pretén demostrar el seu valor potencial, no sols com una mera eina tecnològica, sinó també per la seua capacitat de disseny i gestió informacional, verificabilitat i comunicació. En aquesta investigació estudiem la seua aplicació al finançament emprenedor mitjançant les *Initial Coin Offerings* (ICOs), així com la seua adopció en la indústria agroalimentària per a millorar la qualitat, la traçabilitat, la seguretat i la sostenibilitat.

L'objectiu principal d'aquest estudi és analitzar com la informació generada per aplicacions *blockchain* crea valor en el context empresarial, des del finançament d'un projecte fins a la seua execució operativa i la seua percepció en el mercat. Per a això, s'han dut a terme tres treballs publicats com a articles científics. En l'estudi configuracional amb fsQCA (mostra de 75 ICOs), els resultats mostren que no existeix cap condició necessària i que l'èxit de captació s'assoleix a través de múltiples configuracions. Per exemple, mitjançant una alta valoració de l'equip, una alta qualificació (*rating*), una bona interacció amb els usuaris i un termini curt, mentre que altres configuracions d'èxit combinen una comunitat gran, un equip verificat, una interacció alta i un termini curt. En contrast, els baixos nivells de captació s'associen a terminis llargs i a la coexistència de comunitat/interacció amb baixa verificació i baixes valoracions de l'equip.

En l'estudi qualitatiu de casos en el sector agroalimentari, les troballes confirmen la rellevància de *blockchain* per a la traçabilitat i la qualitat del procés, i mostren, a

més, que en pimes les motivacions inclouen amb força elements socials i de sostenibilitat (reducció del malbaratament alimentari, economia circular), observant-se diferències respecte de les grans corporacions, més enfocades en l'eficiència. Així mateix, apareix com a repte crític la capacitat de comunicar el valor de la tecnologia als *stakeholders* i la necessitat de formació i educació per a afavorir-ne l'adopció.

Abstract

Blockchain technology has become exponentially popular in recent years, first in the financial domain and later in the industrial sector. Framed within the context of digital transformation, this new technology, which enables the recording, validation, and sharing of information in a decentralized manner among multiple agents, has gained particular relevance in entrepreneurial finance. Its traceability and value-chain quality features, along with its role in decision-making as a mechanism capable of building trust among investors or users, increasing a project's competitiveness, and improving interorganizational coordination, are key drivers of its adoption.

This thesis aims to demonstrate its potential value not only as a technological tool, but also through its capabilities for information design and management, verifiability, and communication. In this research, we examine its application to entrepreneurial finance through Initial Coin Offerings (ICOs), as well as its adoption in the agri-food industry to improve quality, traceability, safety, and sustainability.

The main objective of this study is to analyze how the information generated by blockchain applications creates value in a business context—from financing a project to its operational execution and market perception. To this end, three studies have been conducted and published as scientific articles. In the configurational study using fsQCA (sample of 75 ICOs), the results show that there is no necessary condition and that fundraising success can be achieved through multiple configurations. For instance, success may arise from a high team valuation, high rating, strong user interaction, and a short timeframe, while other successful configurations combine a large community, a verified team, high interaction, and a short timeframe. In contrast, low fundraising levels are associated with long timeframes and the coexistence of community/interaction with low verification and low team valuations.

In the qualitative case study within the agri-food sector, the findings confirm blockchain's relevance for traceability and process quality, and further show that, in SMEs, motivations strongly include social and sustainability elements (food waste reduction, circular economy), revealing differences compared to large

corporations, which are more efficiency-oriented. Additionally, a critical challenge emerges in the ability to communicate the technology's value to stakeholders, as well as the need for training and education to facilitate adoption.

Índice

Agradecimientos 1

Resumen 2

Resum 4

Abstract 6

Índice 8

Capítulo I. Introducción 9

Capítulo II. Cryptoactivos basados en tecnología blockchain: nuevas visiones de la evolución del emprendimiento digital 22

Capítulo III. Blockchain como herramienta para mejorar la calidad, trazabilidad y seguridad en la industria alimentaria: casos de estudio exitosos 28

Capítulo IV. Initial Coin Offerings como alternativa de financiación contemporánea: Caminos para el éxito en la captación de fondos 35

Capítulo V. Conclusiones, limitaciones y futuras líneas de investigación 40

Trabajos publicados 48

Anexos 123

Capítulo I

Introducción

1.1 Introducción

El proceso de transformación digital ha marcado la evolución de los mercados financieros en las últimas décadas. La digitalización de la banca tradicional, el nacimiento de nuevas plataformas digitales globales y el desarrollo de nuevos productos financieros han incrementado las cuotas de democratización financiera y el empoderamiento del usuario particular. Esto les ha permitido acceder a instrumentos antes reservados de manera prácticamente exclusiva a actores institucionales. Paralelamente, las cadenas de suministro también han experimentado múltiples variaciones en los últimos años, entre ellas, la demanda creciente de transparencia y calidad entre los agentes del mercado y los reguladores.

Asimismo, en este marco de desarrollo tecnológico y democratización financiera, también se ha hecho patente una paulatina desintermediación financiera. Este proceso intensifica el efecto democratizador de la tecnología en la industria financiera, y que emerge impulsada por diferentes modelos de negocio y tecnologías contemporáneas basadas en la tecnología.

En 2008 se publica el artículo “Bitcoin: A Peer-toPeer Electronic Cash System” (Nakamoto, S., 2008) y comienza la popularización de la tecnología blockchain. Definimos blockchain como una tecnología tecnología de registro distribuido (*distributed ledger technology, DLT*) que permite el almacenaje de transacciones o eventos de manera descentralizada y compartida, secuencialmente y resistente a modificaciones no autorizadas, mediante mecanismos de consenso y validación de la información a través de los diferentes nodos de una red (Catalini & Gans, 2016; Kshetri, 2018).

La aplicación de esta tecnología ha devenido evolutiva. Mientras que inicialmente se circunscribía al sector financiero, sus características de registro, verificación y coordinación han dado lugar a una infraestructura transversal, aplicable a múltiples ámbitos. Por ejemplo en la financiación emprendedora, la gobernanza de datos y la trazabilidad en cadenas de suministro (Catalini & Gans, 2016; Kshetri, 2018; Saberi et al., 2019).

En este sentido, la literatura académica ha evolucionado de una manera fragmentada. Por una parte, se reconoce una línea de investigación consolidada de trabajos en materia de financiación digital, mayoritariamente a través del estudio de las Initial Coin Offerings (ICOs). Se define ICO como una herramienta de financiación digital, a través de la emisión de tokens, acompañada habitualmente de un *whitepaper* o contrato a modo de compromiso en el que se presentan las características técnicas del proyecto, su propuesta de valor y el destino estimado de los fondos. Estos estudios están centrados en la señalización, la confianza del inversor y el diseño de campañas de captación de fondos. Por otra parte, se ha desarrollado crecientemente una literatura sobre trazabilidad, *Smart contracts,* y mejora de procesos en la cadena de valor. Ambas líneas de investigación presentan una problemática común, fundamentalmente en lo que asimetrías de información, verificabilidad y coordinación entre actores se refiere, si bien la interacción entre ambas no se presenta habitualmente de manera explícita.

Esta ausencia de interacción entre ambas aplicaciones de la tecnología blockchain es el factor motivante del desarrollo de esta tesis, ya que pone de manifiesto la dificultad para desarrollar una explicación integral de la manera en la que la información verificable puede generar valor en diferentes momentos del ciclo empresarial.

El presente trabajo se estructura como una tesis por compendio de artículos, compuesta por tres estudios publicados en revistas académicas bajo la lógica de un mismo programa de investigación. Esta tesis trata de establecer las bases del valor de la tecnología blockchain fundamentado en su valor económico y estratégico, más allá de la naturaleza de esta tecnología, capaz de construir una arquitectura coherente de información verificable. Concretamente, este estudio analiza cómo la señalización (factor que reduce la incertidumbre ex ante), los datos (la información generada, registrada y validada durante la operación) y el relato (la traducción de esta evidencia basada en datos se traslada a diferentes actores para aumentar la confianza y facilitar la toma de decisiones). En este sentido, la tesis propone el marco de Señales – Datos – Relato, que constituye la mayor aportación vertebradora del trabajo.

Esta investigación ha trabajado con diferentes teorías empresariales; la teoría de la señalización, las asimetrías informacionales, la gobernanza de datos, la gestión de operaciones y la creación de valor en entornos digitales. En el ámbito de la financiación emprendedora basada en blockchain, los actores económicos que invierten en los proyectos toman las decisiones bajo un entorno de alta incertidumbre y con información parcialmente incompleta. La teoría de señales ofrece un marco especialmente útil para explicar cómo los promotores intentan comunicar calidad, credibilidad y viabilidad mediante señales observables, costosas o difíciles de imitar (Spence, 1973; Connelly et al., 2011). La literatura reciente sobre ICOs refuerza esta lectura al mostrar que la transparencia del proyecto, la calidad de la información y la estructura de señales influyen en el éxito de captación (de Jong et al., 2020).

Por otra parte, la tecnología blockchain aplicada a la industria agroalimentaria se ha estudiado como mecanismo de trazabilidad, transparencia y de coordinación (Kshetri, 2018; Zhao et al., 2019; Demestichas et al., 2020). De acuerdo con los estudios más recientes en la materia, la aportación real de su aplicación no depende únicamente de la inmutabilidad técnica del registro de datos. Más bien, depende de su integración en estándares, la gobernanza de estos y su usabilidad y valor percibido para el stakeholder final (Cole et al., 2019; Vu et al., 2023; Wang & Scrimgeour, 2023). Esta tesis se alinea con esa visión y la extiende al conectar explícitamente la fase de financiación (señalización) con la fase de operación (producción de evidencia) y con la fase de comunicación al mercado (traducción narrativa).

La tesis defiende que estas dos dimensiones, financiación y operativa, no deben entenderse como compartimentos estancos. Al contrario, forman parte de una misma arquitectura informacional. Un proyecto que se presenta al mercado con determinadas promesas (trazabilidad *end-to-end*, auditorías periódicas o transparencia verificable) necesita posteriormente un sistema de gobernanza de datos y una infraestructura operativa capaces de convertir esas promesas en evidencia observable. Cuando esa continuidad no existe, se produce una disonancia entre la narrativa inicial y la ejecución real, lo que erosiona la confianza

de inversores, clientes y socios. Esta idea se formaliza en la tesis mediante el principio de continuidad, entendido como criterio de diseño según el cual toda promesa estratégica relevante debe corresponderse con datos operativos registrables y validables y evidencias comunicables y comprensibles para los stakeholders relevantes.

1.2 Objetivos

El objetivo de esta tesis puede enunciarse bajo un objetivo general que engloba a los tres estudios que la componen y tres estudios específicos asociados a cada uno de los artículos. En este sentido, el objetivo general es la explicación de cómo la información verificable, basada en tecnología blockchain, contribuye a la creación de valor a lo largo del ciclo empresarial, desde la fase de captación de fondos hasta la fase operativa y de comunicación al mercado, integrando las dimensiones de financiación emprendedora y la de la cadena de suministro agroalimentaria.

Asimismo, este estudio desarrolla tres objetivos específicos, que ayudan a alcanzar el objetivo general de la tesis:

Objetivo Específico 1: Identificación y estructuración del campo de investigación relativo a blockchain, financiación digital, ICOs, smart contracts y aplicaciones agroalimentarias, localizando los principales clústeres temáticos, autores, revistas, líneas de evolución y research gaps.

Objetivo Específico 2: Evaluación de cómo las empresas agroalimentarias traducen promesas de valor en arquitecturas de datos y evidencias verificables, identificando mecanismos de gobernanza, diseño de procesos, interfaces de comunicación y efectos sobre la confianza, la coordinación y la propuesta de valor.

Objetivo Específico 3: Análisis de las combinaciones de condiciones o variables (señales, diseño de campaña y elementos de credibilidad) asociadas al éxito de captación de fondos en entornos de financiación digital basada en blockchain.

1.3 Preguntas de investigación

De acuerdo con lo anteriormente enunciado, la tesis presenta una pregunta dde investigación general y tres preguntas de investigación específicas.

Pregunta de Investigación General: ¿Cómo genera valor la información verificable generada por la tecnología blockchain a lo largo del ciclo de vida de los proyectos emprendedores, desde la fase de financiación, a través de ICOs, hasta la trazabilidad en las operaciones y la comunicación en organizaciones, concretamente en la industria agroalimentaria?

Pregunta de Investigación Específica 1 (Estudio 1: Análisis bibliométrico): ¿Cómo se ha desarrollado la investigación académica y científica sobre la tecnología blockchain aplicada a la empresa y los proyectos emprendedores entre 2016 y 2022, qué clústeres temáticos estructuran este campo y qué research gaps justifican el marco integrado basado en señales – datos – comunicación?

Pregunta de Investigación Específica 2 (Estudio 2 – Estudio multicaso del sector agroalimentario): ¿Cómo adoptan y tangibilizan en sus operaciones las empresas del sector agroalimentario las soluciones basadas en blockchain, ¿cómo se traduce la trazabilidad verificable en eficiencia organizativa, calidad y reputación y cómo se convierten estos datos en un relato comprensible para el cliente y los distribuidores para construir confianza y acelerar su adopción?

Pregunta de Investigación Específica 3 (Estudio 3 – Análisis cualitativo comparativo en ICOs): ¿Qué combinaciones de condiciones financieras (objetivo de financiación y duración de campaña) y de capital social digital (comunidad, comunicación y verificación del equipo fundador y directivo) explican el éxito en la captación de recursos en las ICOs y cómo estas contribuyen a la reducción de asimetrías de la información y a la construcción de la confianza de la comunidad inversora?

1.4 Metodología

La tesis adopta una estrategia multimétodo, adecuada a la complejidad del fenómeno estudiado. No se parte de un único método, sino de una combinación de enfoques que permiten captar distintas dimensiones del problema de investigación, un enfoque bibliométrico y de revisión estructurada para delimitar el campo y fundamentar el marco conceptual, un enfoque configuracional (fsQCA) para analizar causalidad compleja, equifinalidad y asimetría en la financiación

digital basada en blockchain; y un enfoque cualitativo de casos para identificar mecanismos organizativos, prácticas de gobernanza e interfaces de valor en cadenas agroalimentarias (Greckhamer et al., 2018; Pappas & Woodside, 2021).

La combinación de estos enfoques responde a una lógica de triangulación secuencial. El primer estudio aporta amplitud y delimitación conceptual; el segundo, explicación configuracional de patrones causales; y el tercero, profundidad mecanicista y comprensión organizativa del fenómeno. Esta secuencia refuerza la validez global de la tesis al combinar mapeo, explicación y mecanismo.

Tabla 1 Aportaciones teóricas y metodológicas de la tesis

Ámbito teórico	**Qué explica la literatura previa**	**Límite identificado**	**Aportación de esta tesis**
Teoría de la señalización	Las señales reducen asimetrías de información en mercados inciertos (reputación, disclosure, calidad percibida) (Spence, 1973; Connelly et al. 2011).	Frecuente análisis de señales aisladas; menor atención a combinaciones causales y continuidad temporal.	Lectura configuracional de la señalización (arquitecturas de señales) y señalización continua desde captación hasta evidencia operativa.
Blockchain en financiación (ICOs)	Se estudian factores de éxito como whitepaper, equipo, comunidad, actividad en redes y ratings (Howell et al., 2020; Fisch, 2019).	Predominio de enfoques lineales; escasa integración con la fase operativa posterior.	Muestra configuraciones equifinales de señales y diseño, e integra la lógica de financiación con la ejecución empresarial.
Blockchain en supply chain	Se destacan trazabilidad, transparencia, eficiencia y smart contracts (Saberi et al., 2019; Kshetri, 2018).	Tendencia a enfoques tecnocéntricos; limitada atención a gobernanza de datos e interfaces de valor.	Reinterpreta blockchain como capacidad de gobernanza de datos e incorpora la traducción narrativa como mecanismo de valor.
Sistemas de información y marketing	Los datos y la información influyen en confianza, experiencia y decisiones de usuarios (DeLone & McLean, 2003; Venkatesh, 2003).	Menor conexión con evidencia verificable on-chain/off-chain y diseño de trazabilidad empresarial.	Introduce la traducción de evidencia (datos a relatos) como mediador entre arquitectura técnica y valor percibido.
Metodología (QCA/casos/bibliometría)	Existen enfoques robustos para mapear campos, modelar configuraciones y analizar mecanismos (Greckhamer et al., 2018; Donthu et al., 2021).	Rara vez se integran secuencialmente en una tesis aplicada a blockchain y empresa.	Articula una triangulación secuencial (bibliometría - fsQCA - casos) coherente con el fenómeno estudiado.

Fuente: Elaboración propia

1.5 Estructura

Los tres estudios que componen esta tesis muestran fases complementarias de una misma investigación, orientada a explicar cómo la información verificable crea valor empresarial en contextos basados en blockchain.

El Capítulo II cumple una función analítica, de delimitación y estructuración del campo. Mediante un análisis bibliométrico y una revisión estructurada, identifica los principales clústeres temáticos de la literatura y, especialmente, los conceptos puente que permiten conectar financiación digital, gobernanza de datos, trazabilidad y confianza. Este tipo de aproximación resulta especialmente útil en campos emergentes y fragmentados, donde el volumen de publicaciones crece rápidamente y la acumulación teórica es desigual (Donthu et al., 2021). El capítulo aporta, así, el mapa intelectual que fundamenta el posicionamiento teórico de la tesis y justifica la pertinencia de una aproximación integradora.

El Capítulo III traslada el análisis al plano organizativo y operativo, examinando cómo las promesas iniciales de valor (trazabilidad, transparencia, seguridad) se convierten en evidencias verificables dentro de cadenas agroalimentarias. El estudio evidencia que el valor no surge de la adopción tecnológica por sí sola, sino de una arquitectura de gobernanza de datos (roles, estándares, validación, interoperabilidad) y de su traducción en interfaces comprensibles para distintos stakeholders, en línea con trabajos recientes sobre blockchain y gestión de la trazabilidad alimentaria (Zhao et al., 2019; Vu et al., 2023; Wang & Scrimgeour, 2023).

El Capítulo IV profundiza en la fase de financiación, analizando la lógica de creación de credibilidad en entornos de alta incertidumbre (ICOs). A través de un enfoque configuracional (fsQCA), el capítulo muestra que el éxito de captación no depende de variables aisladas, sino de combinaciones causales de señales, diseño de campaña y mecanismos de verificación. La elección de una lógica configuracional se apoya en la literatura metodológica que destaca la utilidad de fsQCA para estudiar fenómenos empresariales con equifinalidad, causalidad conjuntural y asimetría causal (Greckhamer et al., 2018; Pappas & Woodside, 2021).

Esta tesis desarrolla una lógica integradora de los estudios, basada en el marco Señales – Datos – Relatos, que conecta tres niveles del fenómeno empresarial, la fase *ex ante* de captación y reducción de incertidumbre, la fase operativa de producción y validación de datos, y la fase relacional de comunicación de evidencia y generación de confianza.

Tabla 2 Contribuciones a los objetivos específicos (OEs) y preguntas de investigación (PI) de cada estudio

Capítulo	**Qué se hace**	**Objetivo específico**	**Pregunta específica**	**Método**	**Output**	**Contribución a la pregunta general**
Capítulo 2 / Estudio 1 (Análisis bibliométrico, 2016–2022)	Se estructura el campo académico sobre blockchain aplicada a empresa y proyectos emprendedores e identifica clústeres, evolución y brechas (gaps).	Objetivo específico 1 (OE1): Identificación y estructuración del campo de investigación (clústeres, autores, revistas, evolución y research gaps).	PIE1 (Estudio 1): ¿Cómo se ha desarrollado la investigación académica y científica sobre blockchain aplicada a la empresa y los proyectos emprendedores entre 2016 y 2022, qué clústeres temáticos estructuran este campo y qué research gaps justifican el marco integrado basado en señales–datos–comunicación?	Bibliometría + revisión estructurada (WoS/Scopus; co-ocurrencia, co-citación y coautoría).	Clústeres temáticos, líneas de evolución, autores y journals clave y gaps; justificación del marco integrado señales–datos–comunicación.	Define el marco conceptual y el gap; delimita y justifica el puente financiación–operaciones–comunicación y orienta variables del resto de estudios.
Capítulo 3 / Estudio 2 (Estudio multicaso del sector agroalimentario)	Evalúa cómo las empresas agroalimentarias traducen promesas de valor en arquitecturas de datos y evidencias verificables, y cómo convierten los datos en un relato comprensible para cliente y distribuidores.	Objetivo específico 2 (OE2): Evaluación de cómo las empresas agroalimentarias traducen promesas de valor en arquitecturas de datos y evidencias verificables (gobernanza, procesos, interfaces y efectos).	PIE2 (Estudio 2): ¿Cómo adoptan y tangibilizan en sus operaciones las empresas del sector agroalimentario las soluciones basadas en blockchain, cómo se traduce la trazabilidad verificable en eficiencia organizativa, calidad y reputación y cómo se convierten estos datos en un relato	Estudio multicaso cualitativo (entrevistas, documentación, procesos/operaciones y canales de comunicación).	Mecanismos de gobernanza y diseño de procesos, interfaces de comunicación y efectos sobre confianza, coordinación y propuesta de valor; barreras y facilitadores de adopción.	Responde a la fase operativa y de mercado: cómo la información verificable se materializa en valor (eficiencia/calidad/reputación) y se convierte en comunicación útil.

Capítulo	Qué se hace	Objetivo específico	Pregunta específica	Método	Output	Contribución a la pregunta general
			comprensible para el cliente y los distribuidores para construir confianza y acelerar su adopción?			
Capítulo 4 / Estudio 3 (Análisis cualitativo comparativo en ICOs – fsQCA)	Analiza combinaciones de condiciones financieras y de capital social digital (señales) asociadas al éxito de captación de fondos en ICOs y su vínculo con la reducción de asimetrías y construcción de confianza.	Objetivo específico 3 (OE3): Análisis de combinaciones de condiciones (señales, diseño de campaña y credibilidad) asociadas al éxito de captación de fondos en financiación digital basada en blockchain.	PIE3 (Estudio 3): ¿Qué combinaciones de condiciones financieras (objetivo de financiación y duración de campaña) y de capital social digital (comunidad, comunicación y verificación del equipo fundador y directivo) explican el éxito en la captación de recursos en las ICOs y cómo contribuyen a la reducción de asimetrías de la información y a la construcción de la confianza de la comunidad inversora?	fsQCA (muestra de ICOs): calibración de condiciones y análisis de configuraciones (equifinalidad/asimetría causal).	Configuraciones de éxito y de no-éxito; condiciones núcleo/periféricas e interpretación sobre reducción de asimetrías y confianza.	Responde a la fase de financiación: cómo la información/señales (credibilidad, comunidad, comunicación, verificación y diseño de campaña) se combinan para generar valor vía captación.
Integración de la tesis (síntesis transversal)	Integra los tres estudios para explicar el ciclo completo: financiación (ICOs/señales) → operación (trazabilidad/datos) → comunicación (relato al mercado).	OE1–OE3 (conjuntamente).	Pregunta de investigación general (integración de PIE1–PIE3).	Síntesis teórica y discusión cruzada de hallazgos de los tres artículos.	Marco integrado y respuesta unificada a la pregunta general; contribuciones teóricas/metodológicas e implicaciones prácticas.	Cierra el ciclo: muestra cómo la información verificable crea valor desde la captación hasta la operación y la comunicación al mercado.

Fuente: Elaboración propia

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Capítulo II

Blockchain technology-based crypto assets: new insights into the evolution of the understanding of digital entrepreneurship

Cryptoactivos basados en tecnología blockchain: nuevas visiones de la evolución del emprendimiento digital

Blockchain technology-based crypto assets: new insights into the evolution of the understanding of digital entrepreneurship

Klaus Ulrich, José Manuel Guaita Martínez, Patricia Carracedo & Domingo Ribeiro Soriano

Management Decision

Q1

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Subject: Management

Impact factor 2024: 1.13

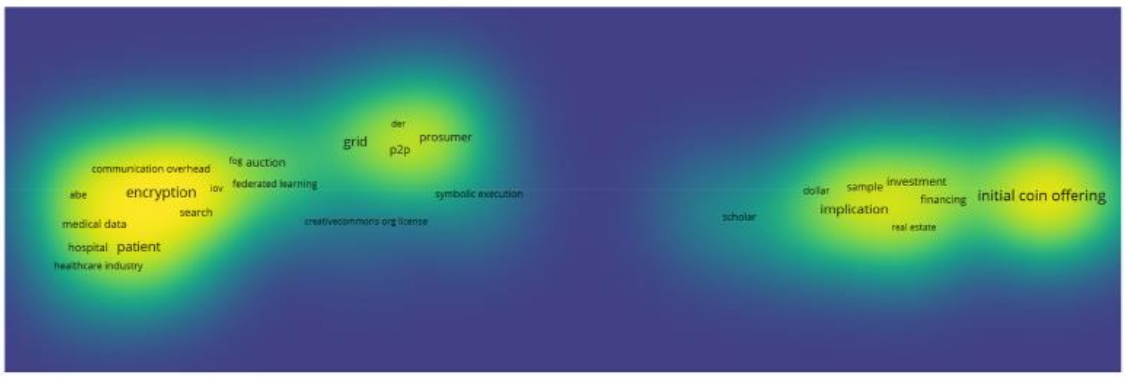
Este estudio tiene como propósito analizar cómo la evolución de la investigación académica de los criptoactivos y de la tecnología blockchain en el contexto del emprendimiento digital. Blockchain ha dejado de ser una mera curiosidad financiera para convertirse en una infraestructura capaz de redefinir la forma de registrar, validar y comunicar información de una manera empresarial. En este contexto, el verdadero valor de blockchain no radica sólo en la tecnología. La principal aportación de valor a la empresa reside en su capacidad para diseñar y gestionar la construcción de información que sea verificable, auditable y que sea compartida entre múltiples agentes. Esto tiene implicaciones directas sobre la confianza, la coordinación interorganizacional y la competitividad de los proyectos.

Para dar sentido a este debate, esta aportación organiza la revisión de literatura mediante una aproximación bibliométrica apoyada en técnicas de minería de texto. Se elaboran mapas de co-ocurrencia, usando como principales fuentes Web of Science y Scopus y como herramienta de visualización VOSviewer. La búsqueda se construye en torno a términos, que según el propio planteamiento del artículo, resultan ser las aplicaciones en el entorno empresarial y emprendedor de blockchain más relevantes, sobre todo Initial Coin Offerings (ICOs), smart contracts, industrial/corporate blockchain y Security Token Offerings (STOs), considerando publicaciones en inglés y tomando como punto de partida el año 2016, cuando la producción científica sobre estos tópicos comienza a intensificarse.

Los resultados describen un crecimiento sostenido del interés académico a lo largo del periodo analizado y muestran una configuración claramente multidisciplinar, aunque con un peso muy significativo de las áreas técnicas (Computer Science e Ingeniería), y una presencia relevante, aunque comparativamente menor, de disciplinas de management, economía y empresa. A partir de los mapas generados, el artículo identifica núcleos temáticos que articulan la conversación científica. Por un lado, aparece un clúster central asociado a ICOs, que concentra buena parte del debate sobre financiación emprendedora, señalización y asimetrías de información, y que funciona como eje desde el cual se conectan otras líneas de investigación.

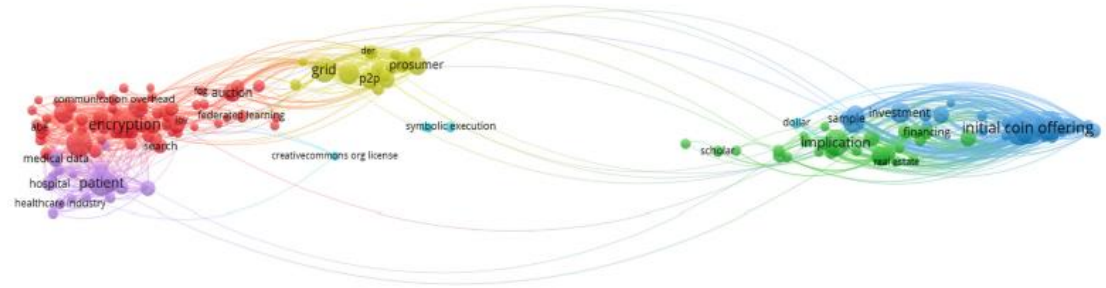
Por otro lado, emergen focos aplicados especialmente visibles en ámbitos como salud (gestión y compartición segura de datos), IoT y control de acceso/intercambio de información, y también energía, donde blockchain se vincula a esquemas de intercambio descentralizado, prosumers y nuevas configuraciones de mercado. En paralelo, se mantiene un bloque más infraestructural centrado en criptografía y mecanismos de seguridad, que actúa como soporte de los anteriores.

Ilustración 1 Mapa de densidad - Scopus



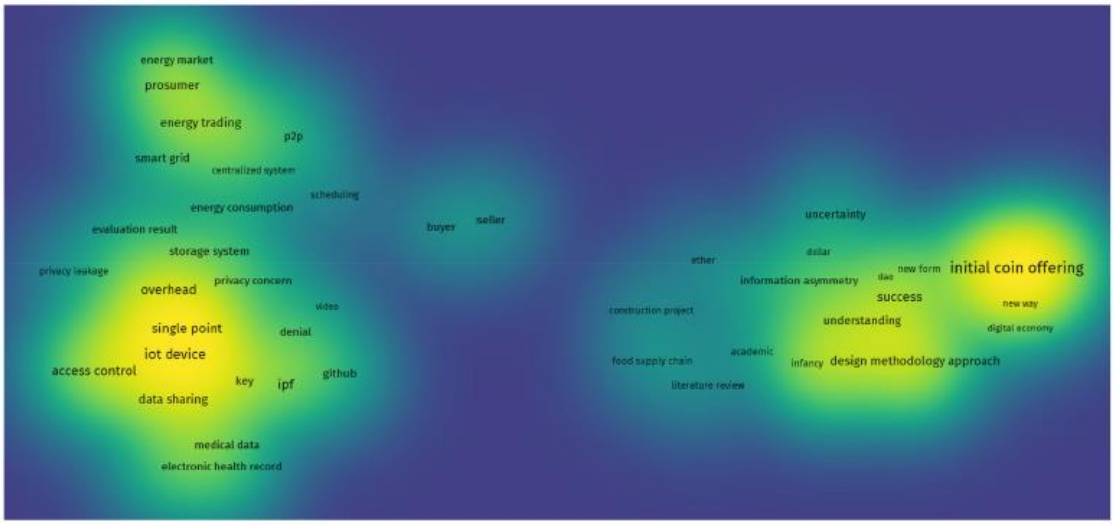
Fuente: Elaboración propia

Ilustración 2 Mapa de red - Scopus



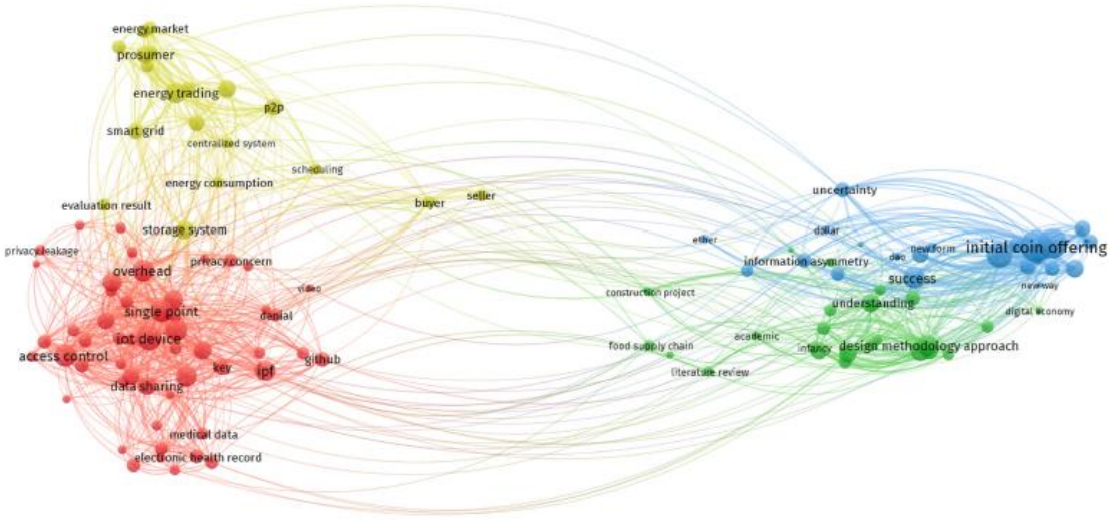
Fuente: Elaboración propia

Ilustración 3 Mapa de densidad - Web of Science



Fuente: Elaboración propia

Ilustración 4 Mapa de red - Web of Science



Fuente: Elaboración propia

A partir de esta evidencia, el artículo concluye que la investigación sobre blockchain y criptoactivos en emprendimiento digital se ha estructurado históricamente alrededor de la financiación —con las ICOs como fenómeno tractor—, pero que la agenda se ha expandido hacia aplicaciones industriales y sectoriales donde la propuesta de valor se concentra en la trazabilidad, la coordinación, la integridad del dato y la automatización contractual. Desde una óptica más crítica, también se reconoce que la evolución tecnológica (por ejemplo, los mecanismos de consenso y su relación con el consumo energético) y, sobre todo, la dimensión regulatoria, condicionan la consolidación de estas soluciones y abren la puerta a enfoques más "institucionalizados" como las STOs. En consecuencia, el trabajo propone como implicación general que el estudio de blockchain en empresa debe avanzar integrando simultáneamente el componente tecnológico (seguridad, escalabilidad, eficiencia), el organizativo (gobernanza de datos, coordinación entre actores) y el de mercado/regulación (confianza, cumplimiento, legitimidad), y sugiere profundizar en los dominios de mayor tracción identificados por la propia evidencia bibliométrica, particularmente finanzas emprendedoras, IoT y aplicaciones sanitarias.

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Capítulo III

Blockchain as a tool to improve quality, traceability and safety in the food industry: successful case studies

Blockchain como herramienta para mejorar la calidad, trazabilidad y seguridad en la industria alimentaria: casos de estudio exitosos

Blockchain as a tool to improve quality, traceability and safety in the

food industry: successful case studies

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British Food Journal

Q1

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Impact Factor 2024: 1.14

Este estudio analiza la tecnología blockchain como una herramienta capaz de mejorar los estándares de calidad, trazabilidad y seguridad en la industria agroalimentaria. La literatura previa se ha centrado en un análisis primordialmente técnico. En este sentido, blockchain se ha consolidado como una tecnología de registro descentralizado e inalterable, capaz de aumentar la transparencia y disminuir el fraude, los errores o la falta de control entre los agentes de la cadena de valor. Su implementación dentro del sector va más allá del aumento de la eficiencia. Se hace necesaria por tanto la investigación de los factores motivantes estratégicos que impulsan a las pymes a implementarla, especialmente, los motivantes sociales y de sostenibilidad que pueden influir en su adopción, aprendiendo de los errores observados entre las empresas de mayor tamaño

Para ello, este análisis pretende determinar los factores motivantes de la adopción de dos empresas del sector agroalimentario. Estableciendo para ello una comparativa de dos realidades diferentes, dado que ocupan posiciones distintas en la cadena de valor, dentro del sector. El artículo construye un marco teórico que deriva en dos hipótesis principales. En primer lugar, la gestión social del desperdicio alimentario y los excedentes son un factor motivante y determinante para el éxito de una implementación exitosa. En segundo lugar, la combinación de motivación innovadora, búsqueda de mayor calidad y concienciación social de la empresa pueden dar lugar a nuevos modelos de negocio basados en blockchain.

Estos modelos de negocio facilitan la generalización de la tecnología en el sector agroalimentario.

El artículo se desarrolla en base a un enfoque cualitativo. Concretamente a través del estudio de dos casos españoles: por una parte, Gourmet Catering and Events, una empresa con larga trayectoria en hostelería y catering que aplica blockchain de manera integral desde el procesado de materias primas hasta la entrega final y, en su caso, la donación de excedentes. Y por otra, Naria Digital, una empresa tecnológica orientada a la transformación digital de entidades sociales y especializada en la digitalización y trazabilidad de la gestión de excedentes y ayuda alimentaria, donde blockchain constituye el núcleo de su propuesta de valor. La evidencia empírica se construye a partir de entrevistas en profundidad. Las entrevistas están realizadas a directivos, grabadas, transcritas y codificadas con apoyo del software de transcripción y análisis cualitativo Atlas.ti. El guion se centra en comprender el origen de la adopción, el alcance de aplicación, el valor añadido percibido, los problemas encontrados y las líneas futuras de desarrollo.

Los resultados muestran que, en ambos casos, la adopción de blockchain se vincula a beneficios clásicos ampliamente discutidos en la literatura. Estos beneficios son la trazabilidad, la transparencia, la seguridad del registro y la capacidad de auditoría. El hallazgo principal es que, en estas empresas, dichos beneficios se articulan y se justifican de forma consistente mediante un marco ético y sostenible. En el caso de Gourmet, blockchain no solo permite controlar procesos y garantizar seguridad sanitaria, sino que se convierte en una herramienta para gestionar excedentes y garantizar que la donación cumpla condiciones verificables. Esto refuerza una lógica de circularidad y reducción del desperdicio alimentario. En el caso de Naria, blockchain se presenta como habilitador de un ecosistema digital orientado a conectar necesidades sociales con excedentes de empresas. La empresa desarrolla soluciones que incrementan la transparencia y la eficiencia del proceso. Asimismo, tratan de posicionar la tecnología como base de un modelo de negocio con vocación social. A partir de esta comparación, se desprende que, frente a grandes multinacionales que tienden a priorizar la eficiencia operativa y la transparencia en cadenas globales, las organizaciones

pequeñas y medianas pueden estar más impulsadas por el componente social y sostenible y por la creación de valor percibido por el consumidor y otros stakeholders.

Un resultado relevante es que las barreras de adopción no se limitan a restricciones técnicas o financieras. Incluyen un desafío estratégico de primer orden, la dificultad de comunicar de forma comprensible el valor de blockchain a clientes, empleados, proveedores y agentes del entorno, lo que introduce la comunicación y la alfabetización tecnológica como condición práctica para la adopción efectiva. En ese sentido, las contribuciones gerenciales enfatizan la necesidad de educación y formación, y abren implicaciones para reguladores, sugiriendo que marcos flexibles e incentivos podrían acelerar la adopción en un sector sensible donde calidad y seguridad son críticas.

Tabla 3 Resultados de las entrevistas a Gourmet Catering & Events y Naria Digital

	Gourmet catering and events	Naria digital
Description	- Since 1957 - Catering activity for social and corporate events, with its own production - 4.7 million turnover	- Since 2019 - Food aid collection digitization activity for transparency and traceability of donation or/and business activity - 77K turnover
Application of blockchain technology in the enterprise	- Integral application from the raw material processing process to its arrival to the final customer or, if applicable, to the donation of food. The technology is applied throughout the value chain, recording food production in the blockchain, as well as the processes, times, dates and production units involved in its preparation. After that, distribution at catering events or the donation of surplus food to various social organizations is tracked. Each and every product can be monitored at any stage of the process. This comprehensive application serves as a guarantee for the social organizations that receive the food, to certify that it has not been offered to the public beforehand, and that it therefore complies with current food regulations in order to be donated - In this sense, the benefits presented to the company not only translate into technical and quality aspects, but also have a clear contribution to the company's sustainability, reducing food waste and contributing to circular economy business models	- Application of blockchain technology as their business model and value proposition. They are providers of this technology for companies in the food sector. The company is in charge of developing the blockchain for the company requesting its services, as well as studying the best possible application for each business reality, also carrying out consultancy work in this regard. It is therefore a direct application in the product they offer - Naria Digital considers as a benefit in the application of blockchain around which its business model revolves, the leverage of recent technological development in the industry, which can be used to provide services to companies without sufficient technological capacity to carry out these developments, as well as to provide the environment with tools that improve traceability and efficiency in food consumption
Origin of the idea of applying blockchain to the enterprise	- The company has been committed to reducing food waste since its inception. Sanitary requirements, increased quality and the need to guarantee and dignify the quality of the food that is donated prompted the implementation of blockchain technology in the company - They start using blockchain following a proposal from a technology provider	- The origin of the idea of implementing blockchain technology is parallel to the origin of the start of the company, which was born from a Final Degree Project, when detecting the disconnection of the social sector with the food needs
Development of the blockchain technology used in the company	- The company's blockchain technology was developed by a third party	- The development of the technology is their own; they are suppliers of this technology
Value added to the company by blockchain technology	- Innovation and digitization of processes - Efficiency - Surplus management - Donations management	- Business model based on the development of blockchain technology for clients in the food sector and social organizations
Problems and challenges	- Ability to convey the value of technology to customers, employees and suppliers - Control of the different actors involved in the value chain	- Low digitization in general of traditional companies in the agri-food sector - Difficulty in explaining the advantages and uses of blockchain in the food sector to customers
Future lines of application and future projects	- Consumer education - Certification of blockchain use as a seal of approval	- Innovation within innovation - Physical asset tracking - Smart contracts - Drug traceability - Multichain

Fuente: Elaboración propia

Teóricamente, el artículo aporta al integrar blockchain con la lógica de sostenibilidad y economía circular, defendiendo que la generación de valor percibido y, por ende, la ventaja competitiva sostenible, depende de cómo la tecnología se articula con objetivos sociales y ambientales, no solo con argumentos de eficiencia. Finalmente, reconoce las limitaciones inherentes a estudios cualitativos de casos de éxito (tamaño muestral y representatividad) y propone como futuras líneas extender el análisis a otros contextos geográficos, realizar estudios cuantitativos sobre percepción del consumidor e impacto en decisiones de compra, y explorar en clave longitudinal cómo la adopción de blockchain afecta a la competitividad económica y al cumplimiento de objetivos sociales y de sostenibilidad en el largo plazo.

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Capítulo IV

Initial Coin Offerings as a Contemporary Financing Alternative: Successful Ways to Raise Funds

Initial Coin Offerings como alternativa de financiación contemporánea: Caminos para el éxito en la captación de fondos

Initial Coin Offerings as a Contemporary Financing Alternative: Successful Ways to Raise Funds

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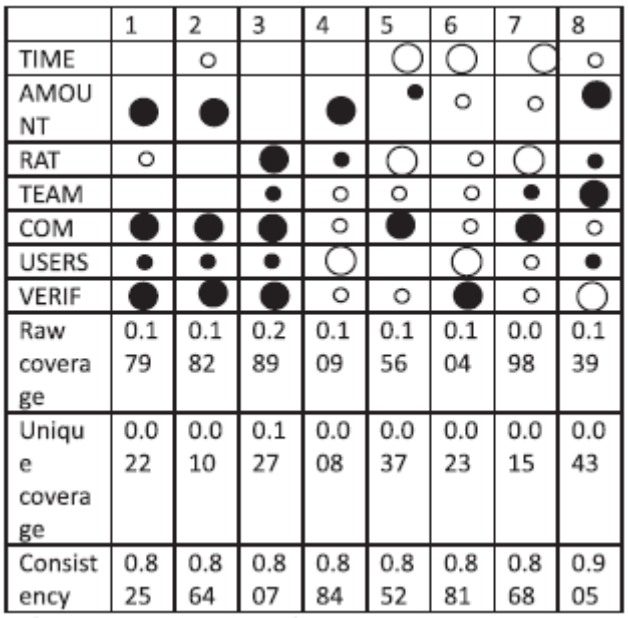
El artículo aborda las Initial Coin Offerings (ICOs) como una alternativa contemporánea de financiación emprendedora basada en blockchain. En un contexto de transformación del sector financiero, esta herramienta de financiación viene impulsada por la digitalización y el auge de las soluciones fintech. Parte de la premisa de que las propiedades de blockchain, privacidad, seguridad e inmutabilida, hacen especialmente atractivos estos mecanismos para conectar emprendedores e inversores globales. No obstante, su expansión ha venido acompañada de riesgos relevantes (fraude, incertidumbre regulatoria y volatilidad). Desde ahí, el trabajo se plantea cubrir un vacío específico de investigación. Aunque la literatura sobre ICOs ha crecido desde 2017–2018, todavía es limitada, no ha profundizado lo suficiente en determinantes financieros del éxito, ni en variables que condicionan riesgo y rendimiento, a pesar de ser centrales en la decisión de inversión. Con ese objetivo, el estudio propone analizar de forma comparativa cuáles son las vías (configuraciones) que conducen al éxito o al fracaso en la captación de fondos, entendiendo el "éxito" como el porcentaje de objetivo de financiación alcanzado respecto a lo inicialmente solicitado.

Para articular la explicación, el artículo desarrolla un marco teórico que culmina en siete proposiciones agrupadas en tres bloques: variables financieras del proyecto (tiempo de captación de fondos, importe solicitado y rating/riesgo), variables de capital humano (calidad/valoración del equipo) y variables de comunidad–comunicación–confianza (tamaño de la comunidad en redes, interacción con

usuarios, y verificación del equipo/promotores). La lógica subyacente es clara, en mercados con asimetría de información y alta incertidumbre como el cripto, la capacidad de levantar fondos no depende de un único factor aislado, sino de combinaciones entre "señales" financieras, reputacionales y comunicativas. Empíricamente, se construye el análisis a partir de datos de ICOholder, un agregador presentado como la mayor base global de ICOs, con una base inicial de 245 proyectos que, tras depuración por datos incompletos, queda en 75 casos, tamaño considerado adecuado para fsQCA. Se emplea fsQCA por su capacidad para capturar equifinalidad y causalidad compleja; se calibra con percentiles (90/50/10) y se reporta que no hay condiciones necesarias (consistencia > 0,9) para el logro del objetivo. En la suficiencia, se identifican varias rutas hacia el éxito: una ruta con alta consistencia describe ICOs que solicitan grandes importes y combinan solvencia del equipo, rating alto e interacción positiva con usuarios, típicamente con plazos cortos; otra ruta relevante combina importe alto, gran comunidad en X/Twitter, elevada verificación del equipo y buena interacción, también con plazos cortos; y una tercera ruta (la que cubre más casos de éxito) enfatiza especialmente rating alto, comunidad grande, equipo verificado y buena valoración del equipo. En contraste, los patrones de bajo logro tienden a asociarse con plazos largos y, aunque sorprendentemente en algunos casos coexisten comunidades grandes e interacción, el núcleo del fracaso aparece cuando se combina eso con baja verificación, peor valoración del equipo y/o rating reducido, además de importes solicitados pequeños en una de las configuraciones.

Ilustración 5 Condiciones suficientes para el éxito de las ICOs



	1	2	3	4	5	6	7	8
TIME		○			◯	◯	◯	○
AMOUNT	●	●		●	•	○	○	●
RAT	○		●	•	◯	○	◯	•
TEAM			•	○	○	○	•	●
COM	●	●	●	○	●	○	●	○
USERS	•	•	•	◯		◯	○	•
VERIF	●	●	●	○	○	●	○	◯
Raw coverage	0.179	0.182	0.289	0.109	0.156	0.104	0.098	0.139
Unique coverage	0.022	0.010	0.127	0.008	0.037	0.023	0.015	0.043
Consistency	0.825	0.864	0.807	0.884	0.852	0.881	0.868	0.905

Fuente: Elaboración propia

En la discusión, el artículo interpreta el plazo corto como señal de demanda (se completa rápido el objetivo), subraya el papel instrumental de comunidad e interacción como palancas de visibilidad y tráfico, y matiza que, en un mercado con inversores proclives al riesgo, pueden coexistir configuraciones exitosas incluso con ratings bajos, coherente con el trade-off riesgo–retorno. En cuanto a las implicaciones prácticas, se destaca cómo planificar ICOs para maximizar la captación, destacando comunidad, comunicación, verificación y diseño del periodo de fundraising, aportaciones teóricas por introducir variables poco exploradas y por aplicar fsQCA al fenómeno, y limitaciones vinculadas a la reducción de casos por datos faltantes, a la cobertura incompleta del agregador y a la heterogeneidad internacional de los proyectos; como futuras líneas, sugiere ampliar variables (regulatorias/ambientales) y datasets.

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Capítulo V

Conclusiones, limitaciones y futuras líneas de investigación

La tesis, estructurada como compendio de artículos, se ha desarrollado con una lógica secuencial, mapeo del campo y sus puentes conceptuales, explicación configuracional de la credibilidad y el éxito en captación, e identificación de mecanismos organizativos que convierten promesas de transparencia en evidencia útil para la decisión en cadenas agroalimentarias. Esta lógica se sintetiza en el marco Señales - Datos - Relatos y se operacionaliza mediante el principio de continuidad (promesa - dato operativo - evidencia comunicada). La investigación ha tenido como propósito analizar, cómo la información verificable basada en blockchain, contribuye a la creación de valor en dos áreas analizadas hasta el momento por separado. Por un lado, la financiación emprendedora digital y por otro, la gestión de la cadena agroalimentaria. A partir de tres artículos científicos publicados, el trabajo ha desarrollado una propuesta integradora que conecta la fase de captación de recursos, la fase de ejecución operativa y la fase de comunicación de evidencias al mercado.

El primer objetivo consistió en identificar y estructurar el campo de investigación relativo a blockchain en financiación y en *supply chain*, localizando corrientes, clústeres y puentes conceptuales. Los resultados del estudio bibliométrico permiten concluir que la literatura se organiza en subcampos con desarrollos propios (financiación digital/ICOs, *smart contracts* y adopción en cadenas de suministro), pero conectados por un núcleo común: la confianza como problema organizativo y la verificabilidad como recurso para reducir asimetrías de información y fricciones de coordinación (Donthu et al., 2021; Saberi et al., 2019; Zhao et al., 2019).

De forma relevante, el mapeo bibliométrico no solo justifica el posicionamiento de la tesis, sino que refuerza su hipótesis integradora: la continuidad entre promesas y evidencias aparece como una intersección todavía insuficientemente tratada de forma unitaria en la literatura, especialmente cuando se conectan resultados financieros (captación) con resultados operativos (toma de decisiones y coordinación) (Vu et al., 2023).

El segundo objetivo consistió en examinar cómo las empresas agroalimentarias convierten promesas de transparencia y trazabilidad en arquitecturas de datos y

evidencias verificables, y cómo esa evidencia se traduce en valor para múltiples stakeholders. La tesis concluye que el valor no emerge automáticamente de la adopción de blockchain, sino de una combinación de gobernanza de datos (roles, permisos, reglas), estandarización e interoperabilidad, validación (incluyendo la fiabilidad de oráculos), y traducción narrativa en interfaces adecuadas para consumidor, B2B y regulador (Cole et al., 2019; Queiroz & Wamba, 2019; Wang & Scrimgeour, 2023; Zhao et al., 2019).

Este resultado confirma que blockchain debe interpretarse como capacidad organizativa: reduce costes de verificación y coordinación cuando se inserta en procesos y reglas de decisión; de lo contrario, el riesgo es construir trazabilidad técnica con bajo uso real y bajo impacto organizativo (Catalini & Gans, 2016; Vu et al., 2023).

El tercer objetivo fue identificar qué combinaciones de condiciones (señales y decisiones de diseño) se asocian al éxito de captación en ICOs. El enfoque configuracional resulta pertinente porque los mercados de financiación digital presentan causalidad compleja: distintas combinaciones pueden llevar a un mismo resultado (equifinalidad) y las causas del éxito no necesariamente son el reflejo inverso de las causas del fracaso (asimetría causal) (Greckhamer et al., 2018; Pappas & Woodside, 2021).

En términos sustantivos, la tesis concluye que la credibilidad en ICOs se entiende mejor como arquitectura de señalización que como suma de variables aisladas. Este hallazgo se alinea con la teoría de la señalización, donde el valor de una señal depende de su coste, dificultad de imitación y relevancia para el receptor, pero la extiende al mostrar que las señales operan en configuraciones y bajo condiciones de contorno del diseño (Spence, 1973; Connelly et al., 2011; de Jong et al., 2020). Así, la contribución no es solo identificar factores, sino describir combinaciones de variables de credibilidad y éxito adaptadas al contexto.

Tabla 4 Síntesis integradora de los capítulos de la tesis

Capítulo	Pregunta principal	Método	Hallazgo principal	Contribución teórica	Implicación empresarial
Cap. II (Artículo 1)	¿Cómo se estructura la literatura sobre blockchain en financiación y supply chain, y cuáles son sus puentes conceptuales?	Bibliometría + revisión estructurada	El campo presenta clústeres parcialmente desconectados, conectados por conceptos puente (confianza, trazabilidad, transparencia, gobernanza).	Fundamenta una lectura integradora del campo desde la lógica de información verificable.	Ayuda a posicionar proyectos y decisiones de innovación en marcos conceptuales sólidos.
Cap. III (Artículo 2)	¿Qué combinaciones de señales y diseño explican el éxito de captación en ICOs?	fsQCA	El éxito responde a configuraciones causales (equifinalidad), no a efectos netos aislados; existe asimetría causal.	Amplía la teoría de señalización con una lectura configuracional en financiación digital.	Permite diseñar campañas como arquitecturas de señales adaptadas al contexto.
Cap. IV (Artículo 3)	¿Cómo se traduce una promesa de trazabilidad/transparencia en valor verificable en empresas agroalimentarias?	Estudio de casos / análisis cualitativo	El valor depende de la gobernanza de datos y de la traducción de evidencia a interfaces y relatos útiles.	Reinterpreta blockchain como capacidad organizativa de gobernanza de datos.	Ofrece criterios de diseño para trazabilidad útil, compliance y diferenciación comercial.
Integración doctoral	¿Cómo se conecta la promesa ex ante con la evidencia ex post?	Integración conceptual y comparativa	La creación de valor depende de la continuidad entre promesas, datos operativos y evidencias comunicadas.	Formula el marco Señales - Datos - Relatos y el principio de continuidad.	Guía para alinear financiación, operación y comunicación en proyectos basados en blockchain.

Fuente: Elaboración propia

5.1 Implicaciones teóricas

En primer lugar, la presente investigación contribuye demostrando que la señalización opera en arquitecturas de condiciones (equifinalidad y asimetría), lo que amplía la aplicación contemporánea de la teoría de señales en contextos de alta incertidumbre (Spence, 1973; Connelly et al., 2011; Greckhamer et al., 2018).

Asimismo, otra implicación teórica derivada de esta tesis es la necesidad de entender blockchain, no solo como una tecnología, si no como una infraestructura que reduce costes de verificación y coordinación si se integra con gobernanza y procesos (Catalini & Gans, 2016; Cole et al., 2019).

Por último, con este trabajo se formaliza la traducción de evidencia técnica en relatos e interfaces como mediador entre arquitectura de datos y valor percibido/decisional (Wang & Scrimgeour, 2023; Vu et al., 2023).

5.2 Implicaciones gerenciales y regulatorias

En financiación tokenizada, los proyectos emprendedores deben comprender que los inversores no evalúan señales en vacío, sino una coherencia de señales bajo restricciones de diseño. La conclusión de este trabajo es la necesidad de diseñar un sistema de señalización (verificación, comunicación, estructura de campaña) con consistencia narrativa y evidencias verificables (Connelly et al., 2011; de Jong et al., 2020).

En el sector agroalimentario, la trazabilidad eficaz exige gobernanza y estándares. Seleccionar eventos críticos, asegurar la validación fiable, y habilitar la interoperabilidad con sistemas existentes. Sin esa disciplina, la adopción tecnológica tiende a producir registros de bajo valor decisional (Cole et al., 2019; Queiroz & Wamba, 2019; Zhao et al., 2019).

Por otro lado, para que la evidencia se convierta en valor, debe ser comunicada con un diseño informacional orientado al usuario, segmentación por stakeholder (B2C/B2B/regulador), reducción de carga cognitiva y métricas de uso real. La adopción por parte del consumidor depende de la experiencia y comprensión del

beneficio, no solo de la existencia de trazabilidad técnica (Wang & Scrimgeour, 2023; Vu et al., 2023).

En cuanto a las implicaciones regulatorias, de este estudio se deriva la idoneidad de establecer unos estándares mínimos de divulgación y verificabilidad en financiación tokenizada, y marcos de interoperabilidad en cadenas de suministro (Saberi et al., 2019; Zhao et al., 2019) con el fin de reducir asimetrías de información, aumentar las garantías de cara al inversor, y por ende, potenciar la adopción de la tecnología.

5.3 Limitaciones y futuras líneas de investigación.

Este estudio contribuye de manera analítica a través del estudio configuracional desarrollado y el estudio de casos. Cabe mencionar, que los datos analizados en el Estudio II (fsQCA) pueden ser limitados, dada la fragmentación, heterogeneidad y baja disponibilidad de datos a través de plataformas agregadoras de este mercado. Si bien la muestra es suficiente para un estudio cualitativo-comparativo, para estudios puramente cuantitativos puede resultar escasa, por lo que, para realizar a futuro este tipo de análisis será necesario ampliar el tamaño muestral (Greckhamer et al., 2018; Pappas & Woodside, 2021). Asimismo, en el Estudio III (Casos), la transferencia está condicionada por el contexto sectorial, la ubicación geográfica, la complejidad de la cadena de valor y la madurez digital.

En cuanto a las futuras líneas de investigación, se abren diferentes alternativas para profundizar en los resultados obtenidos en esta tesis. En primer lugar, la realización de un estudio longitudinal con el objetivo de validar el principio de continuidad propuesto. En segundo lugar, estudios experimentales sobre interfaces de producto/ servicio que permitan evaluar los formatos que maximizan la confianza y facilitan la toma de decisión del inversor. Asimismo, esta tesis puede derivar en estudios cuantitativos que permitan validar los resultados de este trabajo, así como ampliar el estudio a otros sectores intensivos en regulación y con altas necesidades de trazabilidad, como el sector farmacéutico, la cadena de frío logística, o el sector salud (Saberi et al., 2019; Vu et al., 2023; Wang & Scrimgeour, 2023).

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Trabajos publicados

TP1. Management Decision. Blockchain technology-based crypto assets: new insights into the evolution of the understanding of digital entrepreneurship

TP2. British Food Journal. Blockchain as a tool to improve quality, traceability and safety in the food industry: successful case studies

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Blockchain technology-based crypto assets: new insights into the evolution of the understanding of digital entrepreneurship

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Abstract

Purpose - The study aims to shed light on the concepts most addressed in scientific research, which blockchain topics are of most interest, how relevant are these tools for academia, and how relevant are they?

The authors have developed a bibliometric study of scientific Design/methodology/approach - publications on blockchain made since 2016. For the analysis, the VOSviewer software version 1.6.19 has been used, which allows a statistical analysis of scientific publications on the subject. Findings - The study manifest the relevance of Initial Coin Offering, growth of research interest in this field and the relevance of blockchain technology in the development of entrepreneurial projects. Originality/value - This study provides a complete and updated picture of the scientific research on blockchain for the subsequent transfer of knowledge to the business world. Keywords Bibliometric analysis, Blockchain technology, Crypto assets entrepreneurship, Digital evolution, Entrepreneurial finance, Startup financing Paper type Literature review

1. Introduction

Blockchain is a technology that has introduced technological disruption on a global level. Blockchain is not only disruption at the financial level; it is a technology that is changing processes in multiple fields of action and industries (Cai, 2018). The very nature of the blockchain has implications that transcend the merely technological. According to Nakamoto (2008), we can define blockchain as a distributed ledger technology that enables the storage and transmission of information in a secure, transparent and decentralized manner. It consists of a

chain of interconnected blocks containing data verified and validated through cryptography and network consensus.

The decentralization, transparency and anonymity of blockchain systems (Huang et al., 2022; Zheng et al., 2017) give it characteristics of efficiency, expansion of the space of civil Vol. 62 No. 9, 2024 pp. 2836-2854

liberties, and reduction of dependence on imperfect and sometimes biased regulatory systems, which encourage innovation and technological development. Likewise, blockchain

technology, either through crypto assets or through the implementation of the technology in applications and processes (Chen, 2018).

technology Thanks to the application of blockchain in the financial sector, a large number of entrepreneurs have been able to finance their projects through Initial Coin Offers (ICOs). The boost to project finance is not limited to specific sectors, such as finance/FinTech but has an impact on a wide range of sectors with a high impact on the economic reality of many countries, such as tourism, industry or publishing, among many others (Prados-Castillo et al., 2023; Tappuni, 2020).

This innovative method of raising funds to finance business projects through the issuance of tokens has also been beneficial for the competitiveness of the financial sector in general (Larios-Hernández, 2017). The more sources of financing there are in the market, the greater the competition in the market, and therefore the more efficient it will be, which will make it easier for entrepreneurs to finance new projects (Sgroi, 2022). In this sense, according to previous studies by Augusto et al. (2019), we see how blockchain networks enable collaborative business, build partnerships, align incentives and build synergies that enhance their companies. The generation of these blockchain-based environments drives innovation and digital entrepreneurship, as well as socially responsible business models (Al-Omoush et al., 2023). One of the keys for the blockchain to establish the ideal collaboration framework for the generation of collaborative professional environments is the high degree of trust and security provided by the technology. In this sense, through smart contracts, a multitude of contracts can be developed agilely, monitor or establish the traceability of operations and processes, among other advantages. This contractual framework enables and encourages the development of corporate partnerships and makes them more agile and efficient by reducing the bureaucratic burden and automating processes (Di Ciccio et al., 2018).

In this regard, it is estimated that two billion people have no or very limited access to financial resources. In this sense, blockchain technology, fully decentralized and accessible to everyone with Internet access, is boosting the financing of new projects (Larios-Hernández, 2017). This decentralization essentially seeks to dispense with financial intermediaries (Kaskaloglu, 2014). It also enables access to financing for financially underdeveloped regions, for economic, social, political or regulatory reasons, including market power in the case of highly banked financial markets that operate under a monopoly, quasi-monopoly or excessive concentration regime.

In this sense, through blockchain technology it is possible to raise funds globally by issuing tokens. As we will develop in greater depth later, the issuance of tokens consists of issuing representations of virtual property rights hosted on a decentralized blockchain around the world. Until now, entrepreneurs have traditionally relied on the banking sector, venture capital entities, investment funds and other traditional financial instruments to finance their businesses. In this sense, people based in financially underdeveloped environments did not have access to these opportunities. These barriers are beginning to dissipate with this technology, generating a very

positive impact on economic growth and the development of the entrepreneurial ecosystem (Saura et al., 2022; Rawhouser et al., 2023). As a result of the development of the entrepreneurial ecosystem, digital sustainable business models are generated that contribute to generate more resilient businesses, boosting the digital transformation, productive labor and the economy of a region or country (Cheng et al., 2023; Isensee et al., 2023; Li et al., 2023a, b).

It is also worth highlighting the potential of the application of this technology to corporate fundraising and the generation of communities (Wilson et al., 2022). In a way, those participating in the project generate a sense of community associated with the project, also boosting loyalty and brand value. It also drives and incentivizes early adopters and developers to develop complementary products (Parker et al., 2016). The FinTech environment of innovation and financial digitalization generates an ideal atmosphere for

the implementation of blockchain technology in the financial area of the company. This introduction of blockchain technology in finance is relatively recent, and it is essential to study and diagnose its implementation.

Likewise, according to studies by Bakcerzak et al. (2022), the transparency of technology and its decentralization facilitate the work of good corporate governance of the company, interconnecting decision-making processes, building cognitive computational systems, optimizing the time and security of transactions or offering decentralized payment systems. In short, the entrepreneurial ecosystem is significantly boosted at a global level. Previous works by Bedin et al. (2021) have concluded that the application of blockchain helps to generate collaborative economy ecosystems. These ecosystems are characterized by more efficient and cost-effective customer experience processes. Furthermore, blockchain technology finds valuable applications in transactions within smart cities, enabling the monitoring of processes and events in near real-time. In other aspects related to social life and how with this technology application channeled through the business world, philanthropic initiatives are also emerging, trying for example to maximize social welfare through an app based on Ethereum, in a clear demonstration of the Corporate Social Responsibility (CSR) potential of this technology.

Therefore, it is clear that technology has an intrinsic value capable of generating major disruptions in the business world; however, it is essential to comment that it will be the implementation and generalization among the set of companies that will determine the success of this transition (Morkunas et al., 2019).

1.1 Study contribution and objectives

The approach of this article is to provide the scientific and business community with an updated and real picture on the scientific research carried out so far on blockchain technology in its application in business and entrepreneurship. During the last few years, blockchain technology and its application in the financial field through crypto assets have attracted the attention of the academic and business world; however, a lack of information about the global state of research in this area has been detected.

That is why, we propose this study with the objective of presenting an updated report on blockchain research applied to the business world. The analysis has been developed using bibliometric techniques accepted and endorsed by the scientific community, so the results presented are of maximum reliability. Another objective of this study is to investigate in depth which areas, techniques or modalities of business and industrial blockchain have been studied so far, so that we can provide this information to the scientific and business community, to

enhance research in those areas where sufficient research is being done, and also to boost research in those areas where there may be a lack of knowledge. Ultimately, the aim of this article is to promote global and transversal research on blockchain applied to business and industry, and to encourage the transfer of knowledge between the academia and business.

In this research, we will first address a literature review in Section 2, "Theoretical Background," in which we will establish the bases established so far in academia about blockchain technology, and the main tools of the technology applied to the corporate and industrial world. Subsequently, in Section 3 "Methodology," we will develop the methodology used in the analysis, as well as the software used, and the parameters introduced for the analysis. In Section 4, "Results," we will analyze the results obtained from the bibliometric study, as well as make the relevant interpretations of them. Finally, in Section 5, "Conclusions," we will draw the main conclusions of the analysis and comment on the main limitations and possible lines of future research.

2. Theoretical background

The first blockchain network was launched by Satoshi Nakamoto (pseudonym of a person or technology group of people unidentified at the time of writing this article). This groundbreaking network laid the foundations for the creation of the bitcoin cryptocurrency, which was destined to change the paradigm of the contemporary monetary system. Additionally, this technology gave rise to a new class of financial products known as crypto assets (Alzhrani et al., 2022). We can define it as a decentralized and distributed accounting system, specifically a general ledger, in which all transactions are recorded in blocks of information, which are part of the chain. In this way, a blockchain of information is configured, public and accessible to all (Nakamoto, 2008).

However, it is worth mentioning one of the main disadvantages of the technology: the high level of resources consumed at the computational level by the "Proof-of-Work (PoW)" algorithms, which in turn is accompanied by high energy consumption and the need for specific equipment to perform these functions (Wolfskehl, 2018). PoW is a consensus protocol used in blockchain to validate transactions and add new blocks to the chain. In PoW, network participants must solve a difficult cryptographic puzzle, known as a "PoW," to demonstrate that they have devoted a certain number of computational resources to validating the transaction. The first participant to solve the puzzle and validate the transaction receives a reward in the form of cryptocurrency (Nakamoto, 2008; Pass et al., 2017). Despite this, it is worth noting that the amount of energy consumed by a blockchain network varies depending on the nature of the network. First, if it is a blockchain with PoW or not, or if it is an enterprise blockchain, in which case it consumes less than the previous two. As has been established in previous studies on the subject, it is the PoW that is the differentiating element in terms of energy consumption of the blockchain (Sedlmeir et al., 2020). At the same time, it is worth mentioning that a different mechanism is being developed to guarantee the immutability and security of the systems, the Proof-of-Stake (PoS), which has been shown to significantly reduce energy consumption in the verification processes of transactions and operations, although lower levels of reliability and fairness are still observed than with the PoW mechanism (Zhang and Kin, 2020). PoS is a consensus protocol used in blockchain to validate transactions and add new blocks to the chain. Unlike PoW, in which participants must solve difficult cryptographic problems to prove that they have dedicated computational resources to validate transactions, in PoS, participants prove that they have a certain number of cryptocurrencies, which are blocked as collateral, to be

eligible to add blocks to the chain. This improves the efficiency and energy sustainability of cryptocurrency mining, as it does not require the use of large amounts of computational resources like PoW (Buterin, 2014; Ge et al., 2022). The blockchain technology is in continuous development, trying to optimize its operation in every way, in order to increase the pace of its mass adoption.

2.1 Role of blockchain in entrepreneurship

Blockchain technology is democratizing the entrepreneurial environment globally (Rawhouser et al., 2022). As we outlined earlier in the introductory section of this paper, blockchain and digital finance open the doors for entrepreneurs based in geographic locations where the financial sector is underdeveloped or uncompetitive to access funds from investors around the world to develop their projects (Cowen, 2020; Li et al., 2023a, b). Likewise, the blockchain applied to finance, especially to fundraising through instruments such as ICOs or security token offerings (STOs) is an element of financial inclusion. The decentralized and accessible nature of the technology enables access to capital and credit for entrepreneurs residing in regions with underdeveloped financial systems (Larios-Hernández, 2017). Likewise, these instruments enable the support of a community of investors to an entrepreneurial project in a sustained manner over time, and promote innovation,

encouraging early adopters to participate in open-source-based communities and open projects (Chen, 2018).

This technology is also enabling the development of projects in sectors or activities prohibited by the different governments of the world. This factor can have a double impact. On the one hand, it can be positive as it breaks the entrepreneurial barriers of dictatorial countries or countries with autocratic governments, but on the other hand it can also make possible the financing of illegitimate or illegal activities in practically all countries, such as drug trafficking, prostitution or arms trafficking (Sanders et al., 2018; Bogus et al., 2020).

Likewise, the blockchain enables a boost in regulatory update and optimization. The speed and transparency of data exchange, coupled with the low transaction barriers of this technology, also enable competition between different regulators (Novak, 2019). The creation of more favorable conditions for doing business, the relaxation of bureaucratic requirements and even the integration of different blockchains from different agencies make it possible to boost economic activity and accelerate the development of an advanced legal framework appropriate to market circumstances (Markey-Towler, 2018).

2.2 Initial Coin Offerings and startup financing

This philosophy of continuous improvement and process optimization, coupled with the immutability, transparency and security features of blockchain, makes it a perfect technology to be combined with the business world. It has the potential to drive value generation and foster the development of new and innovative business models. The first concept we are going to analyze in this study is the ICOs. A term that was born closely related to the monetary and financial nature of the first blockchain, and that has managed to revolutionize the raising of funds for the development and creation of companies today.

Currently, it is worth highlighting the importance of blockchain technology in industry and in venture financing. As the previous studies by Frizzo-Barker et al. (2020) show, the implementation of this technology in the area of financing entrepreneurial projects has grown significantly in recent years. This generalization of the technology also has implications at the

economic level on the importance of institutional and financial decentralization, competitiveness within the industry and the importance of a regulatory framework that provides security and innovation capacity to companies (Kher et al., 2021). Some authors have highlighted the similarities of ICOs with another relatively innovative financial fundraising instrument, which has already been on the market for a significant number of years: crowdfunding. In this sense, both models seek to raise funds to develop a project (or continue it) through a community of investors and require a minimum level of funding to achieve a successful campaign (Sanchez, 2017). This tool allows entrepreneurs to raise funds through the sale of a cryptocurrency/crypto asset to the investment community (Hsieh and Oppermann, 2021). In an ICO, a company or project issues a cryptocurrency or token and sells it to investors in exchange for another cryptocurrency, such as Bitcoin or Ethereum, or fiat money, such as dollars or euros. In exchange for their investment, investors receive a certain amount of tokens that can be used on the project's platform or exchanged on the cryptocurrency market (Zhang et al., 2022). It is an interesting tool, which has become increasingly popular in recent years, because thanks to the decentralization that characterizes it, it allows the generation of communities of stakeholders (investors, founders, developers, employees etc.) with direct contact and the ability to interact through digital media that allow a communicative fluency ideal for these agents (Brochado and Troilo, 2021). Some of the main advantages of ICOs are the ability to trade the tokens acquired in the issue in secondary markets, with the consequent liquidity characteristic that this implies, and that, on the contrary, instruments such as crowdfunding do not count. Likewise, it is a tool that allows quick and unbureaucratic funding acquisition, as opposed to

traditional project financing models, associated with traditional banking or the capital market (Debler, 2018; Rohr and Wright, 2019). Given that ICOs have experienced several

technology fraud events (Sharma, 2021). It is especially necessary to explore the potential factors that could explain the success of ICO campaigns in the present and in the future. Studies on the subject by Belirski and Boreiko (2021) show the importance of a functional regulation of crypto assets, the need to publish whitepapers of the projects, as well as their codes, and the need to receive back up from investors during the pre-sale.

Given the importance of ICOs in the landscape of the application of blockchain technology to the entrepreneurial world, we consider it relevant to take stock of the situation in terms of academic publications related to token issuances.

2.3 Smart contracts

Smart contracts have gained significant importance in the blockchain and cryptocurrency landscape since their huge development in recent years. We can define smart contracts as executable codes that are developed on a blockchain and that allow the establishment that enables a contractual framework between different parties, without the need for the intervention of a public fiduciary figure, such as a notary (Khan et al., 2021). Smart contracts are contracts between parties that will be executed automatically when certain circumstances set forth in the contract occur. For example, let's assume that a smart contract has been signed in which it is established that when a certain price level is reached, the order to sell a specific asset will be executed. This sale order will be executed automatically when that price level is reached, all the conditions initially signed being incorruptible, unalterable and transparent, so that the transactional security conferred by this type of contracts to the operations that frame them is very high. The contractual information is stored in the blockchain, which keeps the immutability

and irrevocability characteristics of the technology. Smart contracts can be developed on various blockchains, such as Ethereum or Cardano. Each of the different platforms on the market to develop smart contracts has different characteristics in terms of programming, security levels, execution speed etc. (Osterland and Rose, 2020).

Although these smart contracts currently have a regulation in the legal systems of the different countries that cannot be considered as developed and adequate to the speed at which technology advances, it has been established in previous works by Gilcrest and Carvalho (2018), the potential transformations and legal benefits that could lead to the massive adoption of smart contracts in our daily operations. In this sense, it opens the door to the tokenization of assets through smart contracts to establish the property rights on that underlying, in all Business2Business, Business2Consumer or Consumer2Consumer transactions to try to ensure the good end of the same, monitoring the progress in the execution of signed projects . . ..

Therefore, we can establish smart contracts as a fundamental mechanism in the application of blockchain technology to the entrepreneurial and business landscape, especially in terms of the legal and security framework for agreements and transactions between parties. In this sense, in the following section, we will study the current state of scientific publications on the subject, in order to make a research diagnosis on this important topic of the entrepreneurial and industrial blockchain.

2.4 Industrial blockchain

In the previous sections, we have seen how the nature of blockchain technology gives it a special attraction in the field of entrepreneurship, fundraising and the legal framework for conducting business operations and formalizing agreements between parties. However, blockchain is also finding application and development in the industrial sector (Al-Jaroodi

and Mohamed, 2019). First of all, it is worth commenting on the application of blockchains to the supply chain. In this sense, the traceability allowed by the blockchain in which it is possible to observe during the whole process the transactions, operations and actions that take place allows to increase the transparency of the processes (Ivanov et al., 2019). Also, previous studies by Cole et al. (2019) have theorized and demonstrated the added value of using blockchain in industry, especially in terms of improving product safety.

Also, the technology allows for greater efficiency, in that the need for intermediaries (and thus transaction costs) is reduced. Moreover, the application of this technology implies the improvement of product quality management, as well as the optimization of and reduction of errors in inventory management (Li et al., 2021). Previous studies by Tanwar et al. (2022) have theorized about the potential of the blockchain on security and reliability issues in the deployment and generalization of 5G and future 6G technology with reduced upfront capital input and reduced operational costs. Likewise, the Industrial Internet of Things (IIoT) is digitally transforming the manufacturing industry. The need to manage the set of data generated and collected through the IIoT with security conditions and guarantees that meet the regulatory and elementary standards of privacy and data management of third parties position the immutable and secure blockchain technology as a key lever for the promotion and generalization of the IIoT (Zhang et al., 2020).

In this sense, the industrial applications of blockchain are proving to be (and will become even more) key to the development of a digitized, intelligent and sustainable industry. We consider it

essential to study the scientific publications to date on this subject, because of its important role in entrepreneurship and the business world.

2.5 Security token offering

STOs have been gaining significant importance in the entrepreneurial landscape, especially after the cryptocurrency boom, and the ICOs mentioned in the first section of this literature review. STOs have some similarities with ICOs, in the sense that both represent investment in a project/asset registered through a blockchain (Blandin et al., 2019). The main difference between STOs and ICOs is that STOs are subject to regulation, and under the jurisdiction of the laws of the country where they operate (Lambert et al., 2022). In other words, tokens issued in an STO are considered regulated securities, in the same way as other types of regulated financial instruments, such as shares or bonds listed on stock exchanges. In this sense, STOs are a fundraising tool with greater security for investors than ICOs, and also with greater legal coverage as they are covered by the financial laws established by each regulator.

Another factor to take into consideration in the business area when raising funds through an STO is what the white paper should include. The white paper is the document that includes the main characteristics of the project, its objectives, values, mission, description of the company, information on partners, financial, legal, organizational or technological aspects, among others. In this sense, according to analyses by Bongini et al. (2022), it seems to indicate that technological projects applied to health sciences seem to be performing well. There are also fundamental variables common to all sectors that can determine the success of an STO, such as the correct communication, the concreteness and brevity of the white papers or the environmental impact of the project.

Next, we will perform a bibliometric analysis of the number of publications on the subject of this concept, as well as the three previous ones, with the aim of quantifying the studies carried out and exploring those fields that need further scientific development.

3. Methodology

This section describes all the phases used to obtain the scientific publications made since 2016 and using a bibliometric method accepted by the scientific academy. Currently, bibliometric analysis tells us where the spearhead of research is and where science is moving, facilitating a scientific mapping along with co-authorship networks, the basis of this research is in text mining. It should be noted that this is a bibliometric study based on the impact of publications as measured by the citations obtained, as opposed to a bibliographic study based primarily on the studies of internationally influential authors (Anwar et al., 2023). Bibliometric analyses have become popular as rigorous methodologies for the treatment of large volumes of scientific data. The advantage it brings lies in showing the evolution of the different scientific fields according to the analysis of what the scientific community is researching, focusing on the most emerging fields.

Bibliometric studies of scientific literature are usually focused on the use of this database (Web of Science, WoS), using different text mining software, which have been analyzed by different authors (Donthu et al., 2021; Moral-Muñoz et al., 2020), the most relevant being Bibexcel, Biblioshiny, BiblioMaps, Citespace, CitNetExplorer, SciMAT, Sci2 Tool and VOSviewer, the latter developed by Leiden University in 2019.

In our work, we have chosen the two main scientific databases, WoS and Scopus, for the reliability of the scientific information deposited in them and for being the main providers of publication metadata and bibliometric indicators (Pranckut_e, 2021) and in both cases, we have used the open-source software VOSviewer, which provides us with a visual analysis showing the terms grouped and forming different clusters taking as reference the selected documents according to the selected criteria.

First, the analysis of publications on blockchain in the WoS database is shown, which currently belongs to Clarivate Analytics and for two fundamental factors: (a) the large volume and variety of journals and therefore of articles that are deposited in it, certified in its more than 21. The database contains more than 21,000 journals published since 1990, and (b) the excellent quality of the content of the articles published in this database, the vast majority of which are in English, backed by the high impact factor of the journals, as demonstrated by the high level of citations referenced in them.

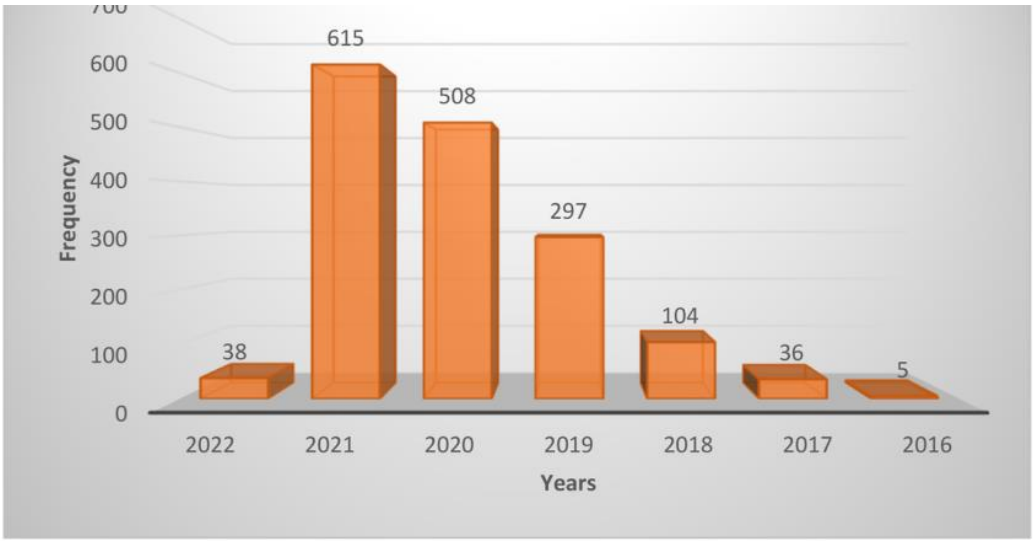
Second, the Scopus database, created by Elsevier in 2004, has been analyzed, where not only the enriched metadata of the scientific articles have been recorded, but Scopus also offers complete profiles of authors and institutions. Its reliability makes it a source for bibliometric data analysis, as is our case. Enabling large-scale analysis in research evaluations, research landscape studies, science policy evaluations and university rankings (Baas et al., 2020).

The robustness of VOSviewer is demonstrated by the relevance of the papers published in recent years and the number of different scientific fields analyzed: supply chain management (Katoch, 2021), urban sustainability (Sharifi, 2021), engineering (McAllister et al., 2021), blockchain and coronavirus disease 2019 (Covid-19) (Guaita Martínez et al., 2022), Covid-19 and business (Carracedo et al., 2021) or crowdlending (Ribeiro-Navarrete et al., 2021), among others.

In the WoS analysis, the search criteria were selected as follows: TOPIC-TITLE-ABS ("initial coin offering" OR "smart contracts" OR "industrial blockchain" OR "corporate blockchain" OR "security token offering") AND (LIMIT-TO (DOCTYPE, "ar")) AND (LIMIT-TO (LANGUAGE, "English")),

which resulted in 1,606 initial references, and which is represented in Figure 1, 1,603 between 2016 and 2022, since 3 remain between 2000 and 2015, not offering this information in the figure due to its low relevance over the total.

Figure 1. Time Horizon WoS, 2016-2022.

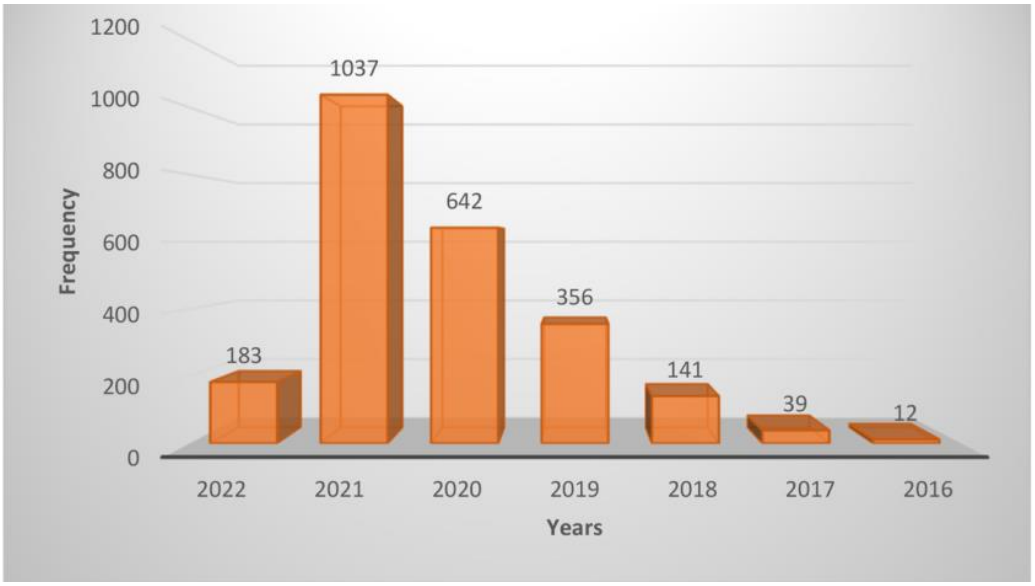


Source: Figure by authors.

In the Scopus analysis, the search criteria were selected as follows:

TOPIC-TITLE-KEY ("initial coin offering" OR "smart contracts" OR "industrial blockchain" OR "corporate blockchain" OR "security token offering") AND (LIMIT-TO (DOCTYPE, "ar")) AND (LIMIT-TO (LANGUAGE, "English")), which resulted in 2,413 initial references, and which is represented in Figure 2, 2,410 between 2016 and 2022, since 3 remain between 1997 and 2015, not offering this information in the figure due to its low relevance over the total.

Figure 2. Time Horizon Scopus, 2016-2022.

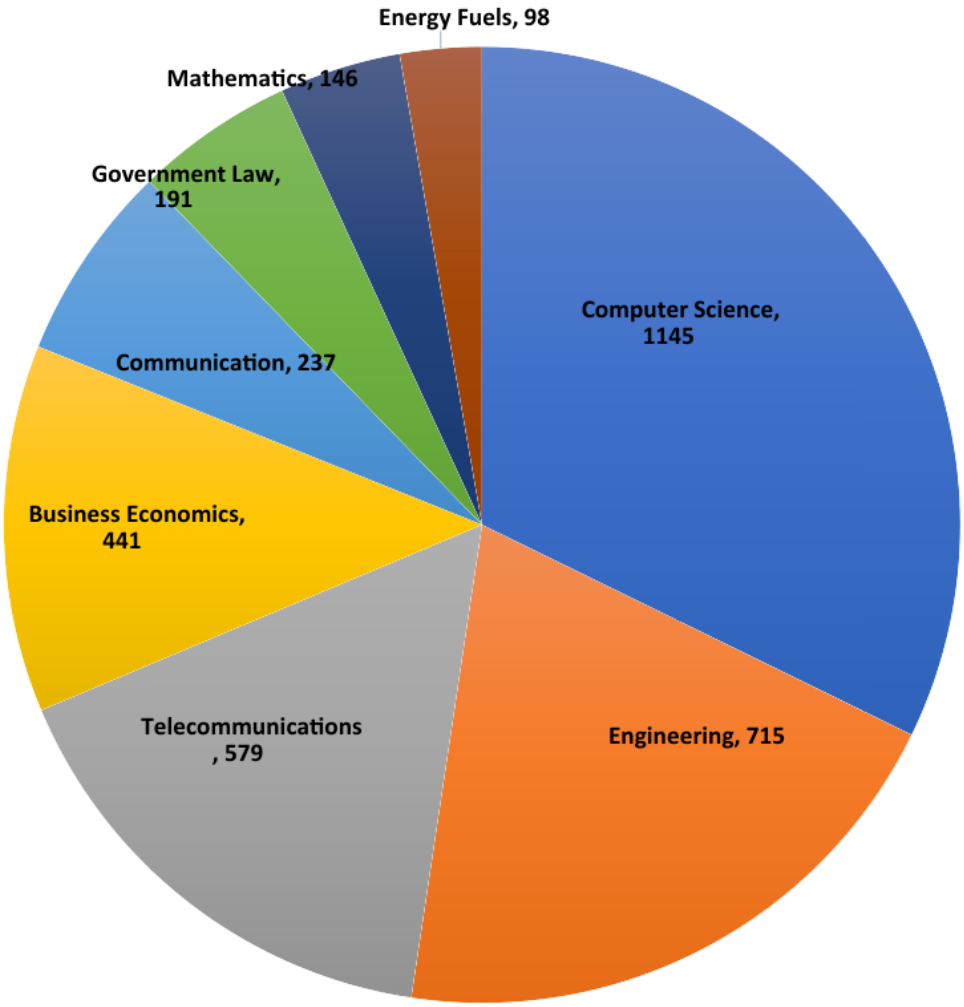


Source: Figure by authors.

In the case of both databases, there is an increase in the number of articles researched on our analyzed topic, taking into account two items, one the databases are not the same (Scopus Time Horizon WoS 2016-2022 vs WoS) and the search criteria even using the same words, WoS allows searching by topic, title and Abstract while Scopus offers the possibility of choosing the criteria of topic, title and technology keywords, this criterion being different with WoS.

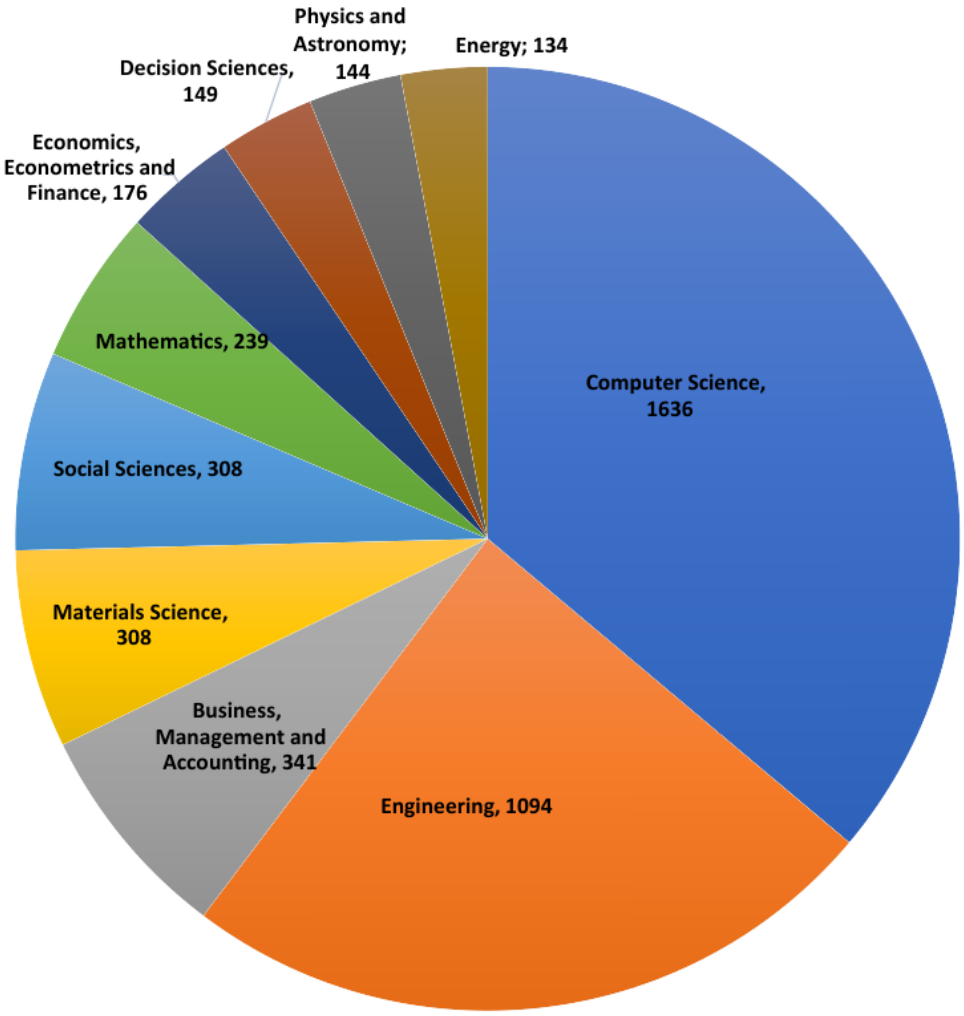
Next, based on the databases analyzed, the different research areas in which the different studies on the topics investigated have been developed are detected, with Figures 3 and 4 showing the separate analysis in WoS and Scopus, respectively. We have taken into account all those research areas that have had a frequency ≥2% of the total, being 4,734 in WoS and 5,015 in Scopus, noting that an article can share several thematic lines.

Figure 3. Thematic areas WoS.



Source: Figure by authors.

Figure 4. Thematic areas Scopus



Source: Figure by authors.

In both WoS and Scopus, Computer Science and Engineering are the research areas with the highest number of published articles. The third position shows the first major difference, since in Scopus, Business, Management and Accounting is shown with 341 articles, while in WoS, Telecommunication occupies this position with 579 articles, and the fourth most researched subject area is Business Economics with 441 in WoS. The last major thematic area is energy, in both cases with 98 in WoS and 134 in Scopus.

In order to do the bibliometric analysis and network visualization, the VOSviewer software, version 1.6.19 was released on 23 January 2023, was used. This tool constructs and displays these networks taking into account co-citation and co-authorship relationships and adding the co-occurrence criterion (Van Eck and Waltman, 2010). As Moral-Muñoz et al. (2020) explain in their review of bibliometric analysis software tools, VOSviewer builds its

maps based on a co-occurrence matrix: similarity matrix, mapping technique and optimization problem correction, highlighting its great visualization and its ability to load and import data from many sources.

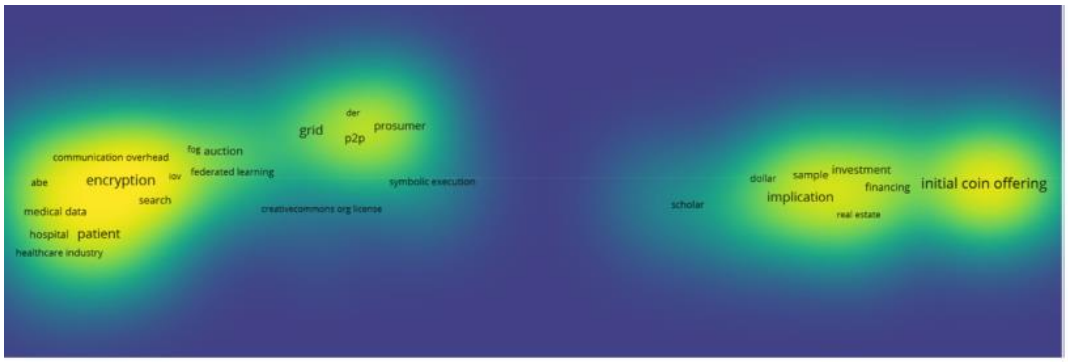
The term relevance in VOSviewer acquires prominence in the analysis since in the maps created with the article text data those general terms are excluded through a relevance scoring for each term (Van Eck and Waltman, 2011). The mapping of terms in VOSviewer allows the visualization of the relationship between the terms that appear most frequently in each of the

articles, taking into account the criteria marked in the search engines of each database, in our case, WoS and Scopus. As a result, it shows a map of terms in two- dimensional form, linked to each other and where the distance between terms shows the relationship between them. Their relationship is marked by the co-occurrences in the analyzed articles. The letter size of each term, the number of interconnection lines with other terms and the thickness of these facilitate the relevance of each term. In this way, highly relevant networks of co-occurrences are grouped into clusters, and here the importance of this tool is established: each group or cluster can be considered as a relevant research topic (Van Eck and Waltman, 2014).

4. Results

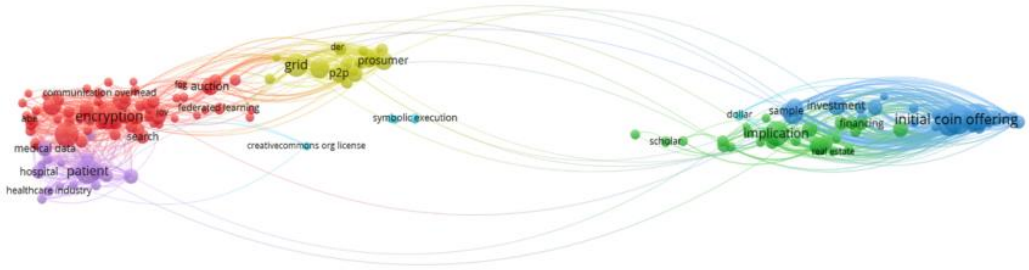
The results of the bibliometric analysis applied with the VOSviewer software to the two databases treated, Scopus and WoS, are shown below. Figures 5 and 6 visualize the most relevant terms according to the visualization capabilities of VOSviewer: Map by density and network map, in the Scopus database. The map density is particularly useful to get an overview, for each cluster separately, of the important areas of a map. Specifically, the color of a point in a map is close to the color of a certain cluster if there are a large number of items belonging to that cluster in the neighborhood of the point (Van Eck and Waltman, 2010). The network map is identical to the network visualization except that items are colored differently. The size of label and a circle is determined by the weight of the item so that the higher the weight of an item, the larger the label and the circle of the item. The color of a term is determined by the cluster to which the item belongs. At the end, lines between items represent links between them. The distance between terms in the visualization approximately indicates the relatedness of the items in terms of co-citation links (Van Eck and Waltman, 2011). In conclusion, the use of these maps is important as they provide a graphical representation of the relationships between the most relevant terms in our analysis.

Figure 5. Map by density Scopus.



Source: Figure by authors.

Figure 6. Map by network Scopus.

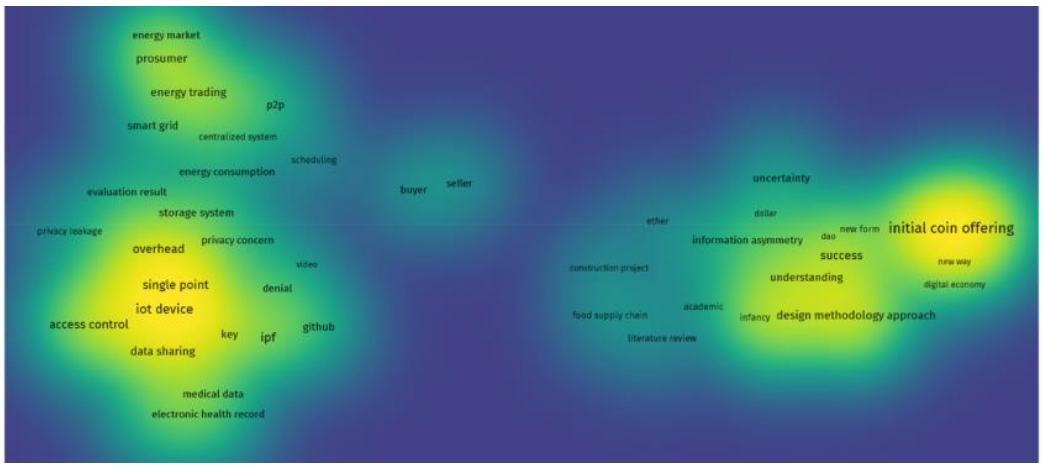


Source: Figure by authors.

In Scopus, five clusters are highlighted, which in turn form two large subgroups. The figure on the right shows the blue cluster, which includes the most relevant term: ICO, together with financing, investment, sample and dollar (Rajasekaran et al., 2022). In the green color, the most relevant term is implication, together with real estate and solar. On the left side, there are three very close clusters, the yellow cluster is composed by the terms grid, p2p and prosumer (Samuel et al., 2022), the red cluster by encryption, search, communication, overhead, learning (Xiang and Zhao, 2022) and finally, the purple cluster is supported by the terms patient, healthcare industry, medical data and hospital (Mamun, 2022).

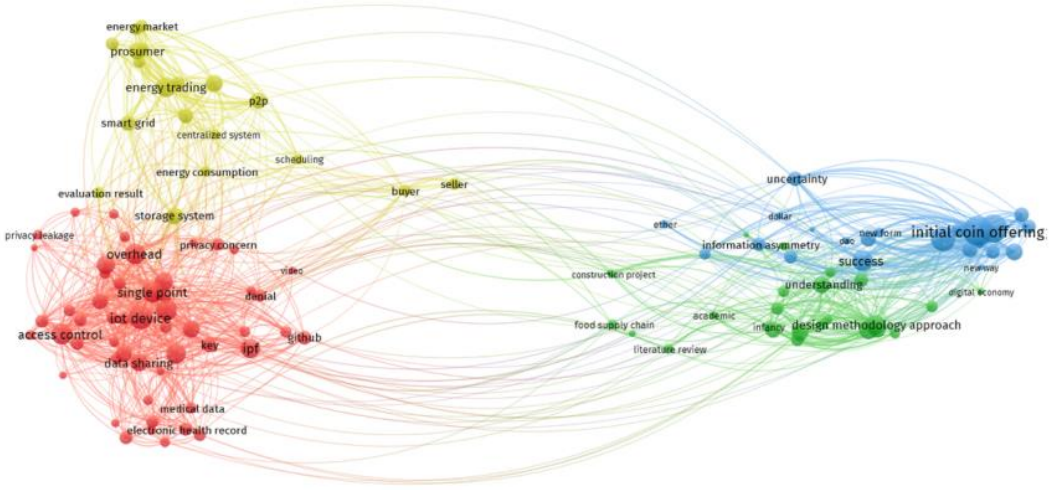
Figures 7 and 8 visualize the most relevant terms according to the visualization capabilities of VOSviewer: Map by density and network map, in the WoS database.

Figure 7. Map by density WoS.



Source: Figure by authors.

Figure 8. Map by network WoS.



Source: Figure by authors.

In WoS, four clusters are highlighted, which, as in Scopus, form two large subgroups. In ICO, together with success, uncertainty, information, asymmetry and dollar (De Andrés et al., 2022). In the green color, the most relevant term is methodology, approach, design, academic, literature review and understanding (Kumutha and Jayalakshmi, 2022). On the left side, there are two distinct clusters, the yellow cluster is composed of the terms energy trading, energy consumption, prosumer, energy market, storage system, as the most prominent terms (Valdivia and Balcell, 2022) and finally, the red cluster is composed of IoT device, single point, data sharing, access control, and to a lesser extent medical data and health (Anitha and Haritha, 2022).

5. Conclusions

A bibliometric analysis has been applied through the VOSviewer software with the aim of technology studying the evolution of scientific research in relation to the topic of blockchain technology applied to the new business landscape. The study has provided not only the research landscape at the scientific level but also manifests what should be the public and private policies to support scientific research to optimize the resources of educational and university institutions.

One of the contributions of this study has been to perform a bibliometric analysis comparing the two most powerful databases of scientific dissemination: WoS and Scopus, showing the main research on blockchain technology and its application in different thematic areas as well as the transcendent linkage between the published research topics.

The results of the study manifest the relevance of ICO, and both databases visualize a cluster that suggests a growing evolution of blockchain technology in the financial sector. During the last 5 years, the emergence of ICOs as sources of financing for entrepreneurial projects has revolutionized the financial system, the ability to capture funding from the market, without the need to resort to intermediaries, traditionally banking, has enabled the creation of many innovative and disruptive projects.

As a point of coincidence in WoS and Scopus, there is a high level of study focused on the research lines themselves, the search for the state of academic research with new methodologies, projects, review of scientific literature, involvement of the scientific community, etc. A greater variety of scientific studies around blockchain technology is noted, not only by the number of articles since 2016 but also by their diversity and scientific depth.

Another relevant conclusion of the study lies in the application of blockchain technology itself. In Scopus, a powerful cluster is formed related to the healthcare sector, medical data, hospital and the healthcare industry. In this field, blockchain technology is developing multiple and innovative technological applications, driven by the growth of investments in this sector. In WoS, a relevant interest is detected in the Internet of Things (IoT), another field where blockchain technology is more developed, the implementation of blockchain technology in the industrial field, specifically through Smart contracts, is a very powerful tool to make business processes more efficient, and therefore, increase productivity. Its derivation to the consumer is related to another cluster where the term prosumer appears in both databases, although in WoS it is related to the thematic area of energy, where blockchain technology is representing a technological revolution closely related to climate change. In Scopus, prosumer appears strongly linked to p2p networks.

Finally, in Scopus, a last cluster appears linked to the encryption technology itself developed by the blockchain, a natural link as it is part of the blockchain industry.

As mentioned above, the results are very interesting at the academic level but also at the managerial implications level. As we can see, along with the market trend, blockchain technology as a lever for financing companies is becoming increasingly relevant in the financial sector. Also, according to the results obtained, we can see how the rise of this technology also brings with it concerns about the regulatory framework, the success factors of ICO campaigns and their environmental impact and energy consumption.

These aspects are relevant, since they are challenges to be addressed in the generalization of ICOs, STOs or other fundraising mechanisms based on blockchain, building sustainable and ethical business models that have a positive impact on all stakeholders.

Future research suggests an analysis of the optimization of the application of blockchain technology in all the most disruptive thematic areas: finance, IoT and medicine. Undoubtedly, three fundamental sectors in the economy of the 21st century. From here, an impact analysis should be produced to suggest innovation and entrepreneurship policies, generating employment by public and private institutions. The changes in the

financial sector, the industrial sector and medicine generate a new disruptive technological-entrepreneurial framework, which suggests immediate action with a view to the medium and long term. In this sense, it will be very interesting to advance in future research toward the analysis of the design of both public and private policies to encourage the generation of a financial innovation ecosystem that promotes credit for entrepreneurial projects. In this sense, it will be very positive to see how a public-private collaboration can be articulated to provide the sector with an adequate regulatory framework to give it legal certainty, and that the private sector can continue to develop efficient and agile blockchain-based financing solutions.

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Further reading

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Blockchain as a tool to improve quality, traceability and safety in the food industry. Successful case studies.

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Blockchain as a tool to improve quality, traceability and safety in the food industry. Successful case studies.

Abstract

Purpose

The purpose of the study is to determine the motivations of two companies in the food sector to successfully implement blockchain technology in their value chain, or as the core of their business model. The study, focused on relatively small companies, analyses technical motivations such as traceability, transparency and security, as well as sustainable and social variables. The aim is to analyse specifically the role of the latter in the decision-making process regarding blockchain technology by small and medium-sized companies.

Design/methodology/approach

A qualitative study of two successful cases of blockchain technology application in the food sector has been carried out. To this end, in-depth interviews were conducted with senior executives from both companies, who occupy different positions in the sector's value chain. The interviews were recorded and processed with specific software, transcribed and coded.

Findings

The findings of the study highlight the relevance of blockchain technology for ensuring traceability and process quality in the food industry, as well as the social and sustainable motivation of companies when making decisions regarding blockchain technology adoption. These results suggest that there are differences in motivations between small and large companies, as well as an increase in perceived value on the consumer side.

Originality / value

The study addresses a research gap in the investigation of the application of blockchain technology in the food industry, exploring the determining variables for the adoption of the technology in agri-food SMEs. The research brings a global and multidimensional view to the research question, focusing on its ability to drive innovation, sustainability and generate new business models.

British Food Journal

1. Introduction

Blockchain is a disruptive and transformative technology that is revolutionizing multiple aspects of all types of industries, including the food industry, where it is playing a key role in terms of traceability and product quality control. Blockchain technology is characterized by endowing the environments in which it is applied with transparency, traceability and security. The blockchain is ultimately a ledger in which all transactions and movements made and collected in the blockchain are recorded. It is a public chain, which any user can consult, in order to ensure the transparency of the process, and avoid possible fraud or security pain points. These characteristics allow the different stakeholders involved in a food industry process to trace everything that has happened to the food, from the first moment the raw material is processed.

Although the blockchain concept is traditionally associated with the cryptocurrency sector, due to the significant starting point established by Bitcoin, its application transcends this financial sphere. The decentralized and immutable nature allows for great advantages in its industrial application. Thus, there are numerous examples of applications in the supply chain management sector. The ability of all stakeholders to track in real time the goods and raw materials with which the company operates provides a high degree of transparency to the processes, being able to detect points of friction and improvement, as well as to determine responsibilities in cases of negligence or human error (Guaita-Martinez et al., 2022).

Even if it is a relatively modern and novel technology, its application has begun to spread to a multitude of sectors, positioning it as one of the working points par excellence of the scientific and industrial community (Al-Jaroodi & Mohamed, 2019). According to previous works by Marchesi et al. (2022), safety and efficiency position it as a technology capable of solving multiple quality problems currently existing, although there are still points of improvement that need to be polished, in order to ensure the total safety and reliability of the system.

In this sense, blockchain technology is positioned as an important edge within the Industry 4.0 system, adopting an important role due to its characteristics, specifically in the food industry (Saha et al., 2024). In this sense, some research has been conducted on the implementation of this technology in the food industry, however, we have found a gap in the research through case studies between companies that use the blockchain for

British Food Journal

their productive and industrial processes and those that act as suppliers of the former. The purpose of using blockchain technology can be a significant driver for its general implementation in the corporate world. It is not the same to have the goal of seeking financing through ICOs, ensuring the traceability of an industrial process, or controlling the quality of a specific product. Previous work by Al-Jaroodi & Mohamed (2019) demonstrates that in industrial processes, blockchain introduces digital identities, establishes distributed security systems in the ledger, or enables micro-measurements and controls of industrial processes. These factors may motivate the use of blockchain at the industrial level by this type of company. On the other hand, authors like Lu et al. (2019) have extensively explored the field of blockchain applications in service sector companies. While it is true that the broad applicability of the technology potentially generates significant interest among these types of companies, its widespread adoption (beyond the financial sector) still has a long way to go. In this context, the need for companies whose business model is the development of blockchain for other companies becomes evident, converting blockchain into a service and a business model that can increase productivity, transparency, and security in companies (Blanco-Gonzalez-Tejero et al., 2024). However, beyond the economic and technical variables, there are social realities that technological innovations like blockchain can help to solve, such as the problem of food waste (Kör et al., 2022). This study aims to address on one hand the research problem of identifying the motivating factors for two leading companies in their sectors to implement blockchain technology in their industrial and service processes. On the other hand, it tries to explore with these success stories the importance of blockchain for sustainable business models or those that consider sustainability and social issues as differential value elements that their business tries to address, as social enterprises or enterprises with a clear social component guiding their activity and/or objectives (Lödar-Miculeac, 2024; Suárez-Giri & Sánchez-Chaparro, 2023). The analysis seeks to determine the different challenges faced by industrial and service companies in their adoption of the technology, what determines the success of its application depending on the nature of their activity, and what challenges they have had to overcome, and must continue to overcome in the future, to integrate blockchain into their value proposition. The study intends to address the identified research gap regarding the lack of studies exploring the drivers and barriers to blockchain use in agri-food companies, as well as the importance of blockchain technology in the development of actions and business models based on sustainability (González-Mendes et al., 2024). In this sense, the

British Food Journal

implementation of blockchain technology in the agri-food industry has been partially studied so far. Two studies have analyzed the benefits and characteristics of the development of this technology in the industrial sector, also within the food, agricultural and agri-food industry. In this sense, the previous studies have had an eminently technical perspective, with no special emphasis on the strategic decision-making phase, nor on the drivers that have pushed companies to make the decision to invest in this technology in their production processes and value chain. On the other hand, and as we have introduced previously, we also found an important research gap in the existing literature regarding the business perspective and business models that can be generated around the application of this technology in the food sector and complementary or adjacent sectors. Therefore, the paper aims to delve qualitatively into the key factors for the successful implementation of blockchain technology in food sector companies, and also to study relevant aspects of two successful cases of companies that have managed, on the one hand, to increase the added value of their products and services, and on the other hand, to develop a business project that enables the implementation of blockchain technology in the food industry. Both case studies also allow us to address a key dimension in contemporary business: sustainability. The application of technology in these case studies allows not only to increase the quality and safety of the value chain, but also to alleviate the problem of reducing food waste in the hotel and catering sector.

The paper is structured after this introductory part with a Literature Review section in which there will be an exhaustive review of previous works on the technology and its application to the agri-food sector, a methodological section explaining the methodology applied in this study, the presentation of the results obtained and a subsequent section of conclusions and academic and professional implications of the study.

2. Literature Review

2.1 Blockchain technology, definition and features

Blockchain technology was developed and introduced by Nakamoto (2008), in the Bitcoin whitepaper. From the beginning, it is established in this disruption as a revolutionary platform capable of securing and guaranteeing the reliability of processes in transactions (Xu et al., 2019). The blockchain is a decentralized network of nodes. We define the node as a network participant that maintains a copy with all the information of the blockchain, positioning itself as a network of different control points that hold the

British Food Journal

information of the globality of the network, increasing security and reducing dependence on third party intermediaries, whose purpose is to attest to the veracity or not of an operation or transaction within the network (Morkunas et al., 2019). Transactions on the blockchain are secured with cryptographic mechanisms; that is, once a transaction occurs within the network, it cannot be altered or deleted, securing the history of transactions and movements made, being tamper-proof and increasing levels of security and quality (Dong et al., 2023). In this sense, these features allow for the possibility of constantly auditing transactions, increasing the levels of trust and transparency, validating the integrity of the ledger (Thakur, 2023). On the other hand, the cryptography on which the blockchain is based allows a certain degree of anonymity, by using cryptographic addresses instead of personal information to participate in the network (Dong & Pan, 2023).

2.2 Industrial application of the blockchain

The pursuit of efficiency is an intrinsic and constant dynamic in the industry. Similarly, consumer and regulatory demands require an increase in standards and quality systems to ensure regulatory and consumer-demanded standards (Panghal et al., 2023). In this sense, the practical implementation of blockchain to streamline processes, increase reliability in different industrial ecosystems, and enhance the security framework is essential (Peng et al., 2023). Thus, blockchain relies on a distributed ledger among the various nodes of the system, providing data integrity and authenticity, mitigating operational, fraud, and counterparty risks (Hao et al., 2024). Therefore, the ability to facilitate project traceability and record all variables that participate integrally in the manufacturing and commercial process enhances transparency to different stakeholders, conveying greater value in the product sale, thus capable of raising margins and profitability.

In this regard, traditional industries, such as finance, are transforming due to the theoretical implications of research, academic impact, and regulatory standards. One of the industries that is implementing blockchain more rapidly in its value chain and is also taking greater advantage to control and increase product quality is the food industry (Longo et al., 2020). In this sense, the integration of this decentralized and immutable technology capable of recording all actions occurring in the sector's value chain provides viable solutions to improve food safety and prevent fraud (Kumari et al., 2023). Through

British Food Journal

the use of cryptographic techniques and consensus mechanisms, blockchain provides tamper-proof records of food-related transactions, from food production to distribution through retailers (Vu et al., 2023). In fact, many consumers are already demanding the adoption of blockchain to track food traceability, especially in the so-called early adopter consumer segment, who value variables such as innovation and the incentives and complexity of the system (Wang & Scrimgeour, 2023). Furthermore, this technology is proving to be a great enhancer and driver of the value provided by companies in the growing food delivery sector, studies by Shukla et al. (2024) indicate that users of such platforms have a greater perception of performance, effort and social influence in the case of the companies that apply it, resulting in determining variables for their food consumption decision making through these platforms. In fact, this study indicates that factors such as digital culture are not determinant variables in the association between Unified Theory of Acceptance and Use of Technology antecedents and the intention to use Open Network for Digital Commerce platforms, suggesting the potential universality of the results, transcending cultural barriers and determinants. On the other hand, the numerous food safety issues in past decades have led to increased regulation, health and quality requirements in the sector (Martinez et al., 2007), with consumers positively valuing trust in the product information, especially regarding sustainable issues, provided by the food manufacturer, and the different suppliers and producers in the value chain, even for products involved in slave labour and other health and legal scandals such as coffee (Hansen, 2016; Dionysis et al., 2022; Trochez et al., 2023).

The food industry faces a major challenge: one third of the food produced globally is wasted, which poses a major challenge for all actors in the sector. Previous work by Al-Obadi et al. (2022) highlights the importance of reducing food waste through the adoption of innovative techniques that enable a sustainable transition in the value chain, in this sense we want to explore how blockchain as an innovative technology is helping to execute this change within companies in the sector, as well as enabling the creation of entrepreneurial projects that help in this process of change.

Furthermore, the application of blockchain in this industry has the potential to promote sustainability and foster ethical practices by enabling transparent and unalterable documentation of environmental and social practices, providing consumers with higher quality information (Roy et al., 2022). In this sense, sustainability has proven to be a very relevant factor in the food sector, specifically also in the organization and management

British Food Journal

of food events, according to studies by Ramos & Salgado (2023). Furthermore, according to previous studies by Friedman and Ormiston (2022), the blockchain has been shown to act as an important tool to improve the sustainability of the food value chain, as well as to address potential challenges in the field of food sustainability. Communication about the value provided by blockchain technology, or by social or sustainable aspects is key to the degree of acceptance of this communication through traditional or new advertising tools such as social networks or influencers, and the food industry can make use of them to convey these messages to consumers and stakeholders (Ata et al., 2022). On the other hand, previous studies by Bonetti et al. (2024) have also highlighted the importance of this technology in the marketing dimension of the adopting company, improving brand positioning, or strengthening customer relationships. Considering all the aspects discussed previously in this section, the benefits of blockchain technology in industrial and logistic processes within the food industry are clear, however the business sector can also benefit from its application in its value proposition to improve the communication of its sustainability actions (Cao et al., 2023; Garcia-Sánchez et al., 2024), acting as a driver for eco-innovation (Chin et al., 2022) and being an innovative and valuable element in the marketing activities of the food industry (Bonetti et al., 2024). Moreover, it is worth noting the potential of smart contracts to automate agreements among value chain participants, reducing time, costs, and striving for fair compensation for farmers and producers (Dehghani et al., 2022).

According to the previously established theoretical framework, and considering the objectives of this study stated in the introduction, as well as the existing research gap at the date of writing this article that we intend to cover, we state the following hypotheses that we will try to demonstrate in our qualitative study.

Hypothesis 1: For the successful implementation of blockchain in the food industry, both in industrial and service companies, a social approach to food waste management, the value chain and the treatment of surpluses is essential.

Hypothesis 2: The innovative vocation of the company, together with the search for higher quality and a social conscience with the reduction of food waste can generate new business models based on blockchain that serve as support for the generalization of the technology in companies in the sector.

British Food Journal

3. Method

3.1 Research design

Since this is an emerging topic, we have decided to conduct a study with a qualitative approach, contrasting two case studies that allow us to satisfactorily address the research questions of this paper. In this sense, we have made a comparison of two case studies of two different companies, Naria Digital and Gourmet Catering and Events, which integrate blockchain technology in different ways in their value proposition. In this way, we have focused first on a company that develops blockchain solutions to offer them to companies in the food industry, while we have studied another company belonging to the food sector that implements this technology in an integral way throughout its value chain. In this sense, we intend to analyze the innovative, disruptive effect and the shared and unique positive effects of both case studies, contextualized in different realities within the application of technology in the same sector.

3.2 Case selection

After defining the different points of analysis, we proceeded to carry out a screening of the different casuistry and scenarios that allowed us to approach an analysis of the impact of blockchain technology at different points in the value chain of the food industry, thus proceeding to select, on the one hand the supplier of this technology, and on the other hand a company that integrates the entire value chain of the sector, from the acquisition of raw materials from local suppliers, until it reaches the end customer, passing through the entire industrial manufacturing process. This selection of cases is motivated by the research objective of this paper, which is to determine the drivers of blockchain technology adoption in companies linked to the food sector, not only in companies with industrial or manufacturing processes, but also in companies that provide services. In this sense, we seek to elucidate whether there are other factors apart from those currently explored for the adoption of the technology, such as efficiency and traceability, and whether there are motivators from a more social and sustainability perspective that can drive blockchain in food companies, or/and linked to the sector. That is why we have selected a company that has processes that integrate almost the entire value chain, such as Gourmet Catering & Events, a Spanish company dedicated to the production of food that will subsequently be offered in caterings for different events and companies, and on

British Food Journal

the other hand a technology company whose activity is the development of specific software based on blockchain for companies in the food sector, such as Naria Digital.

3.3 Data collection and analysis

For the development of this study, two in-depth interviews were conducted with key informants, using physical tools, specialized online meeting and recording software, and transcription. In this sense, we have used the Zoom tool for online connections and to record the face-to-face interviews. We have also used the specific software TurboScribe, which uses Artificial Intelligence tools as a technological engine, which has allowed the recording and further processing of the interview through the Atlas.ti software, which has allowed us to encode the content.

The interview followed a semi-structured format focusing on seven main questions that allow the contextualization of the scope of application, the business reality and the value provided by blockchain technology. Namely: the company's background, the current application of blockchain technology in its activity, the origin of the idea of its application, authorship of the blockchain development (own or through third parties), value added to the company, problems and challenges of its application and future projects and lines of industrial application.

4. Results and discussion

4.1 Case descriptions

In this section of the paper we will present the two case studies, both based in Spain and with a national scope of action. Although the activity of both is located in Spain, the nature of their activity and their scope differ, being located in different parts of the value chain.

4.1.1. Gourmet Catering & Events

Gourmet Catering & Events is a company based in Valencia (Spain), which was founded in 1957 in the hospitality sector, with the aim of creating events in emblematic and historic buildings in the city of Valencia, to later expand throughout the region of Valencia (Gourmet Catering & Events, 2024). The company has entered a process of national growth, expanding to other Spanish regions. The company serves more than 360,000 users annually, and organizes more than 2,000 events, placing all its activity

British Food Journal

under the umbrella of sustainability and talent. The company has a strong commitment to environmental respect, fair payment to local suppliers, innovation and development (Gourmet, 2024).

4.1.2 Naria Digital

Naria Digital is a company dedicated to accompanying social entities in their digital transformation processes, also specializing in the management of surplus food companies (Naria, 2024). The company aims to digitize and connect the social sphere of business entities, contributing to the circular economy and increasing food safety. The company is one of the leading providers of blockchain technology to the food industry, with a wealth of experience, and is guided by inclusiveness and sustainability (Naria, 2024). According to the company's mission, they seek to empower young people, so that they can enjoy a dignified life and equal opportunities, transforming society and eradicating social exclusion (Naria, 2024).

4.2 Results

Table 1 shows the results obtained in the interviews with the companies participating in the study. As we can see, these are two very different companies, not only in terms of size and experience in the market, but also in terms of their activity. Although we can say that both companies have their scope of action in the food sector, on the one hand as a catering company that offers its services for social and business events, and on the other hand a technology company that develops blockchain technology for the food sector.

Table 1 Differences between the companies in the study

	Gourmet Catering & Events	**Naria Digital**
Description	- Since 1957 - Catering activity for social and corporate events, with its own production. - 4.7 million turnover	- Since 2019 - Food aid collection digitization activity for transparency and traceability of donation or/and business activity. - 77K turnover

British Food Journal

Application of blockchain technology in the enterprise	- Integral application from the raw material processing process to its arrival to the final customer or, if applicable, to the donation of food. The technology is applied throughout the value chain, recording food production in the blockchain, as well as the processes, times, dates and production units involved in its preparation. After that, distribution at catering events or the donation of surplus food to various social organizations is tracked. Each and every product can be monitored at any stage of the process. This comprehensive application serves	- Application of blockchain technology as their business model and value proposition. They are providers of this technology for companies in the food sector. The company is in charge of developing the blockchain for the company requesting its services, as well as studying the best possible application for each business reality, also carrying out consultancy work in this regard. It is therefore a direct application in the product they offer. - Naria Digital considers as a benefit in the application of blockchain around which its business

British Food Journal

	as a guarantee for the social organizations that receive the food, to certify that it has not been offered to the public beforehand, and that it therefore complies with current food regulations in order to be donated. - In this sense, the benefits presented to the company not only translate into technical and quality aspects, but also have a clear contribution to the company's sustainability, reducing food waste and contributing to circular economy business models.	model revolves, the leverage of recent technological development in the industry, which can be used to provide services to companies without sufficient technological capacity to carry out these developments, as well as to provide the environment with tools that improve traceability and efficiency in food consumption.
Origin of the idea of applying blockchain to the enterprise	- The company has been committed to reducing food waste since its inception. Sanitary requirements,	- The origin of the idea of implementing blockchain technology is parallel to the origin

British Food Journal

	increased quality and the need to guarantee and dignify the quality of the food that is donated prompted the implementation of blockchain technology in the company. - They start using blockchain following a proposal from a technology provider.	of the start of the company, which was born from a Final Degree Project, when detecting the disconnection of the social sector with the food needs.
Development of the blockchain technology used in the company.	- The company's blockchain technology was developed by a third party.	- The development of the technology is their own; they are suppliers of this technology.
Value added to the company by blockchain technology	- Innovation and digitization of processes - Efficiency - Surplus management - Donations management	- Business model based on the development of blockchain technology for clients in the food sector and social organizations.
Problems and challenges	- Ability to convey the value of technology to customers,	- Low digitization in general of traditional

British Food Journal

	employees and suppliers. - Control of the different actors involved in the value chain.	companies in the agri-food sector. - Difficulty in explaining the advantages and uses of blockchain in the food sector to customers.
Future lines of application and future projects	- Consumer education - Certification of blockchain use as a seal of approval	- Innovation within innovation - Physical asset tracking - Smart contracts - Drug traceability - Multichain

Source 1 Own elaboration

4.3 Discussion

Having shown the results obtained in the qualitative study developed, we can establish that these results endorse and expand the existing evidence on the application of blockchain in the food industry. Firstly, we see how the motivation of the use of this technology by Gourmet Catering & Events to improve transparency and traceability in the whole supply chain is fundamental to achieve this objective, according to what was also previously studied by Duan et al. (2020). These attributes improve the safety and authenticity of raw materials in manufacturing processes, ensuring full traceability in the case of Gourmet, a fundamental and vital aspect in the management of surplus food for subsequent donation in conditions that safeguard quality, thus aligning with the goal of reducing food poverty, in line with previous findings in the work of Yu et al. (2024).

Moreover, the results suggest that the motivations of smaller companies may differ from those of large corporations such as Walmart or Nestlé, which are early adopters of technology in this industry (Armonk, 2017). While large, multinational companies focus primarily on operational efficiency and ensuring transparency in global supply chains, the companies analysed in this study appear to focus on the sustainable factors and societal

British Food Journal

benefits of applying blockchain to the food industry. This is for example the case of Gourmet, very focused on the guarantee of sanitary requirements for the management of food surpluses, which makes us identify ethics and sustainability as motivating factors for the application of technology, as we have previously established in the theoretical framework with the studies of Roy et al. (2022).

On the other hand, the study shows that beyond the barriers derived from the technical and/or financial limitations of a company (Panghal et al., 2023; Al-Jaroodi & Mohamed, 2019), in the case of the companies analysed in this study there are additional problems, no less crucial than those traditionally established in previous literature on the subject, such as the complexity of communicating the value of technology to the company's stakeholders. This finding of the study is very much in line with Hypothesis 1 established in the literature review: it is not enough to communicate the technical benefits of efficiency and transparency to the market, but it is also necessary to be able to communicate that there is a complementary ethical and social vocation for the successful implementation of this technology also in smaller companies.

It is worth highlighting the importance of the blockchain as a driver of innovation, which in turn can be an element of competitive advantage in the market for sustainability-oriented companies. These findings complement and complete the lines of previous studies analysed in the literature review in works such as those of Cao et al. (2023), and the application of blockchain could be a driving force for business models based on this technology, and/or transparency and sustainability, as for example in the case of Naria, which was born directly with this vocation, or in the case of Gourmet, which is evolving qualitatively in this sense with the implementation of the technology in its value chain.

4.3.1 Practical and managerial contributions

The results obtained in the study verify the strategic importance of the implementation of blockchain technology in companies in the food sector, its supply and value chain, and in companies derived from or related to the industry.. Likewise, this work explores the bases established in works such as that of Sengupta & Kim (2021), which explore the impact of transparency on customer satisfaction, making it clear in our study that it is indeed an important driver, which improves customer satisfaction insofar as the customer perceives it as an additional element of value to the product or service.

British Food Journal

According to the results obtained in Naria's qualitative study, the implementation of blockchain technology as the core of the business model can establish a basis for the generation of innovative digital business ecosystems that help to solve social problems such as food poverty, which demonstrates Hypothesis 2 from which we started the study. In this sense, blockchain applied in the food sector contributes to the generation of social value and the development of the circular economy, as outlined in previous work by Kör et al. (2022). Furthermore, the study highlights the urgent need to promote education and training on the functioning and value of blockchain technology among all stakeholders, as indicated in previous studies by Gallego-Losada et al. (2022), on the need and importance of consumer technology literacy, not only in the financial sphere, but also in food businesses. While there are numerous previous studies highlighting the benefits of the technology in industry in general, and the food sector in particular, adoption remains modest, and understanding the value of the technology is an important issue, according to the results. On the other hand, the results obtained may have regulatory implications for policy makers, and it may be interesting to establish a regulatory framework that favours and encourages the adoption of technological solutions such as those offered by blockchain technology in order to guarantee high quality standards in goods as sensitive as those produced in the food industry. La regulación a desarrollar puede ser variada, como hemos analizado en el presente artículo la adopción de la tecnología todavía es limitada y se encuentra en fase de desarrollo en muchos aspectos. No obstante, se puede recomendar la creación de una regulación flexible y beneficios fiscales que fomenten e incentiven la innovación basada en la tecnología blockchain, así como recompensar a los agentes económicos que la empleen en el desarrollo de soluciones que mejoren la calidad y eficiencia industrial y empresarial.

4.3.2 Theoretical contributions

The work has focused on expanding previous knowledge on the importance of blockchain technology in the food industry, and specifically the value of social, sustainable, ethical and innovative aspects in terms of its ability to drive mass adoption. In this sense, the analysis of these two case studies shows the catalytic capacity of new business models based on technology, together with social and environmental responsibility. The paper aims to provide a multidimensional and holistic view of the implementation of technology in companies in the food sector, or related to it, as well as its importance at different points in the value chain.

British Food Journal

The generation of added value perceived by consumers can constitute a source of sustainable competitive advantage over time, together with the strategic implementation in the organisation and the monitoring of the company's sustainability objectives. In this sense, the work contributes to an aspect that has been little explored so far in this area, the integration of blockchain with the principles of the circular economy. The case of Naria as a technology developer, and Gourmet as an implementer of the technology in its business model, demonstrates the driving capacity of quality in food waste management, efficiency and technological innovation applied to the reduction of food poverty.

5. Conclusions

Aaccording to the results obtained in this study, we can affirm that the perception in relation to the value provided by technology, although there are some differences given the nature of the service provided by both companies, they mention aspects widely endorsed in previous literature. On the one hand, the ability to boost innovation and digitization of the company, through this tool that technologically allows the control and traceability of the process (Ellahi et al., 2023). On the other hand, it also increases quality and therefore the perceived value of the customer, as well as improving consumer satisfaction (Queiroz et al., 2019; Sengupta, 2021).

The results obtained demonstrate that two companies of different sizes, one medium-sized and one micro-enterprise, operating in the food sector, or providing services to it, are able to successfully apply blockchain technology. In the case of Naria, this constitutes the core of its business model, and for Gourmet it provides greater traceability, efficiency and security to its value chain. However, it should be noted that while these findings are of interest, they are confirming previous research that has already been carried out. Beyond endorsing previous studies, this work has shown that the social and sustainable approach is a key variable for the successful implementation of blockchain in the food sector, insofar as the social and sustainable motivation for the implementation and adoption of the technology is a key variable for both companies. In the specific case of Naria, the results derived from the qualitative study suggest that blockchain-based digitisation can be a differentiating element in the food industry, and a driving force for the generation of new business models based on blockchain technology and sustainability, thus demonstrating the second starting hypothesis of this paper, which was stated based on some ideas previously elucidated in works such as Roy et al. (2022).

British Food Journal

5.1 Limitations and future research lines

The implementation of blockchain technology is already a reality in the food sector, not only by large multinational companies, but also by medium and small companies that are committed to this technology to increase transparency, product traceability, quality, but also because these features can generate a positive impact on a social and sustainability level, for example with the management of food waste to promote the circular economy or/and reduce food poverty. In this sense, these findings have been obtained through the study of two successful case studies of companies closely linked to the food sector, which are located in different positions in the value chain, and are based in Spain. The limitations of a study of success stories such as the one developed are common to the limitations found in studies that follow a similar methodology, or qualitative methodologies in general, related to sample size and representativeness. In this sense, we have tried to alleviate this handicap by working on a solid theoretical basis already established in previous scientific studies, trying to give depth to previously established findings, and exploring new hypotheses derived from these studies. From these limitations, as well as from the results obtained in the study, we can open the door to different lines of future research. In this sense, we propose the possibility of developing quantitative studies among companies in the food sector on customer perception of the value provided by the technology in question, and its impact on purchasing decisions, following our results and previous work by Wang & Scrimgeour (2023). On the other hand, as future lines of research, this study can be carried out with a broader geographical scope, allowing us to capture the reality in other geographical regions as well. It also opens the way for longitudinal studies on the impact of blockchain technology on the long-term competitiveness of food companies, both in economic-financial terms and in terms of social and sustainability objectives. Finally, it will be interesting to continue a line of research previously opened by Tagscherer & Carbon (2023), on the leadership role of the people responsible in the food business for innovation and the current or potential implementation of blockchain technology, as well as its effect on the business and social ecosystem at the level of adoption of the technology.

British Food Journal

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British Food Journal

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Initial Coin Offerings as a contemporary financing alternative: Successful ways to raise funds

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Abstract

Initial Coin Offerings (ICOs) have emerged as a modern alternative financing instrument capable of connecting economic agents, entrepreneurs and investors from all over the world. The benefits of blockchain technology in terms of privacy, security and immutability make these financing tools particularly attractive. In this study we analyze ICOs through the world's largest global database of ICOs. The analysis has been carried out through fsQCA methodology to a sample of 75 projects funded through this funding tool and aims to answer what are the possible ways to achieve success in fundraising in an ICO. The results shed light on the importance of financial factors such as the risk of the operation, but also related to communication and user communities for the success or failure of these campaigns. The aim of this study is to provide entrepreneurs with a tool to help them plan their ICOs, develop them in a suitable way to attract the largest amount of funds and mobilize investors' resources, achieving a synergy between the entrepreneur and the investor, with impactful, innovative and profitable projects. It is also intended to

contribute to the academic development of the subject with comparative qualitative studies.

1. Introduction

In recent years, the financial sector has undergone a significant transformation, driven by technological progress and digitalization. In this context, the Fintech industry has begun to develop, which refers to business models based on financial solutions combined with digital technology (Werth et al., 2023). The applications generated in this segment are diverse and extensive, ranging from payment solutions and neobanks to investment platforms in equity and debt for individuals and companies that traditionally did not have access to such financial instruments. Fintech companies have contributed to financial inclusion, the democratization of the sector, and greater efficiency and competitiveness in the financial industry (Choudhary & Thenmozhi, 2024).

In this regard, technologies and innovations such as artificial intelligence, big data, and blockchain have served as driving forces for new financial solutions based on software or digital solutions (Blanco-González-Tejero et al., 2024). These innovations have enabled the creation of new products and services and access to capital and credit under different economic, financial, and temporal conditions compared to those existing in the traditional financial sector. Consequently, the reduction of dependence on intermediaries such as banks, notaries, or other highly bureaucratic institutions has energized the startup sector, providing them with new tools to access financing. In this context, Initial Coin Offerings (ICOs) emerge as a new fundraising tool based on blockchain technology.

In the landscape of entrepreneurial finance, Initial Coin Offerings (ICOs) have manifested as a compelling departure from traditional channels, such as venture capital and crowdfunding. This distinctive fundraising paradigm involves the issuance of digital tokens or coins, in return for cryptocurrencies like Bitcoin or Ethereum, an innovation that bears noteworthy implications for the economic ecosystem. The tokens, traded on cryptocurrency exchanges, derive their valuation from the intricate interplay of market forces, an aspect underscored in the work of Campino et al. (2022).

The ascendancy of ICOs in underwriting nascent entrepreneurial initiatives has experienced a meteoric rise over recent years. The quantum leap in funds, surpassing $13.7 billion in 2018, marks a paradigm shift, effectively doubling the figures of 2017, as chronicled by Campino et al. (2021). According to the most recent industry information

available, in 2020, 2329 projects were financed through these financial instruments, especially with regard to financing platform projects, business services and cryptocurrencies (Statista Research Department, 2023). The trajectory of the sector has been characterized by nuanced dynamics post-2020. Following a period of gradual decline, ICOs experienced a renaissance in subsequent years. Despite a measured deceleration in fundraising levels during 2022 and 2023, ICOs continue to exert an irresistible allure as a financial instrument for entrepreneurs and startups alike. This trajectory is anticipated to endure, propelled by an expanding recognition among entrepreneurs and investors of the resounding potential of ICOs as a potent fundraising mechanism. Notably, the evolutionary arc of ICOs has witnessed a discernible pivot towards projects centered on utility tokens, designed to access specific services or products within a given platform. This transformation has catalyzed the emergence of novel business models grounded in blockchain technology and cryptocurrencies (Guaita-Martinez et al., 2022), a theme expounded by Ackermann et al. (2019). ICOs, as elucidated by the European Parliamentary Research Service (2021), empower entrepreneurs to mobilize capital for avant-garde projects by issuing digital tokens in exchange for cryptocurrencies or fiat currencies. Beyond their immediate financial impact, ICOs harbor the transformative potential to democratize global financial investments, affording universal access to capital for groundbreaking ideas. ICOs, as a component agent of the Fintech landscape, are fundamental to financial development (Gallego-Losada et al., 2021). Moreover, their transitory yet substantial value to investors positions ICOs as a pivotal funding source for sustainable initiatives, particularly in regions where conventional banking infrastructure remains underdeveloped. As posited by Bitetto and Cerchiello (2023), ICOs bear the potential to contribute significantly to the economic development of such regions by facilitating access to capital for pioneering projects (García-Monleón et al., 2023).

Nevertheless, the seemingly boundless allure of ICOs is tempered by inherent risks. The unbridled nature of the industry, bereft of regulatory moorings, has precipitated a proliferation of fraudulent or deceptive ICOs, prompting a discerning scrutiny from regulatory bodies and governments worldwide. Against this backdrop, wherein Initial Coin Offerings emerge as an alternative financial conduit for entrepreneurial ventures, the current inquiry capitalizes on the evolving nature of this nascent subject. In this regard, the literature on the subject is not very numerous due to the novelty of the

technology. The few scientific studies that have explored project variables so far have not focused excessively on financial variables, or those directly related to the financial determinants of the success of this type of operation. In this sense, the aim of this paper is to fill this gap detected in the literature review, performing an exhaustive analysis in the largest public database of ICOs on the financial variables that can determine the success or failure of an operation. In the study we have included the variable of fundraising time, the volume requested, the credit rating, the professional assessment of the management team, the community around the project, the degree of user interaction, as well as the degree of verification of the management team by the verification platform. The aim herein is to conduct a nuanced comparative qualitative study leveraging fsQCA, with a core mission to unravel the multifaceted factors that underpin the success or failure of an ICO. Likewise, the ultimate goal of this article is to find out the keys to the success of entrepreneurial projects that have resorted to this innovative way of financing their business, based on the empirical and theoretical studies developed in other alternative financing channels, such as crowdfunding or crowdlending. In this sense, the new ways of financing companies through digital channels share the importance of the community of users, so starting from this basis, we have selected the study of variables related to this characteristic such as the size of the community of investors in a project, its interactive capacity through different channels, platforms and social networks, or the project management team, key to the generation of trust in the community.

The article is structured in such a way that we will elaborate on the section 2 Theoretical framework of the study, building the propositions that we will try to demonstrate with the subsequent study. Subsequently, we will present Section 3 that describes the data and the comparative qualitative methodology with which we have worked, as well as the software used for it. After that, we will show in Section 4 and 5 the results obtained in the study and discuss them by establishing relationships between them and the previous bibliography on this subject. Finally, we will establish in Section 6 the conclusions of the research project, suggesting future lines of research and the limitations that we have encountered in this project.

2. Theoretical Background

Initial Coin Offerings (ICOs) constitute an innovative fundraising mechanism, affording entrepreneurs the means to secure capital for their projects through the issuance of digital tokens, which are exchanged for either cryptocurrencies or conventional fiat currencies.

The foundation of ICOs rests upon blockchain technology, a decentralized and distributed ledger system designed to meticulously record transactions in a secure and transparent manner (Wang et al., 2023). This revolutionary innovation engenders a tamper-proof and immutable transaction record, obviating the necessity for intermediaries, such as banks and financial institutions (Javadpour et al., 2023). ICOs constitute together with crowdfunding, cryptocurrencies and blockchain technologies a vibrant framework for financial and entrepreneurial interaction and development (Bogusz et al., 2020). The incorporation of blockchain technology in ICOs yields several merits, encompassing reduced transaction costs, expedited processing times, and an augmentation of transparency and security. Academic research about ICOs starts in 2017 and 2018 with the some first works such as those of Górka & Pietruk (2018), Gutfleisch (2018) or Kampakis (2018) in which they investigate the benefits of that incipient way of financing, the potential it had to go around and the legal framework in which this financial instrument could be developed in the European Union. Research on ICOs has advanced and grown significantly in recent years, showing an upward trend in terms of publication of scientific articles on the subject, with four of them registering more than 200 citations each, among which are the works of Fisch (2019), Adhami et al. (2018), Chen (2018) and Xu (2019).

ICOs conventionally transpire in two discernible phases: the pre-sale and the public sale. In the pre-sale stage, the project team extends token offerings to a select cohort of investors at a discounted valuation. This phase is typically earmarked for high net worth individuals and institutional investors. Subsequently, the public sale stage unfolds, opening to the general public and facilitating the sale of tokens at a predetermined fixed price.

The popularity of ICOs as a fundraising mechanism for startups is underscored by their efficacy in swiftly accumulating substantial capital. However, it is imperative to acknowledge the attendant risks associated with this mode of fundraising, including fraud, regulatory uncertainties, and market volatility. Prudent investors are strongly urged to undertake exhaustive due diligence before embarking on ICO investments, thereby navigating the multifaceted landscape of this innovative financial paradigm with circumspection and informed decision-making. With the aim of supporting the decision-making process of entrepreneurs, people involved in ICO operations and investors, we are going to develop a theoretical framework that will serve as a basis for establishing the

seven propositions that form the backbone of this study. These seven propositions have been proposed based on the gap detected in previous research on financial variables (or variables that significantly condition key financial variables such as profitability and risk of a project), and which of course condition the success or failure of a campaign, understood as the amount of funds raised in relation to the amount initially requested. In this sense, we begin by constructing the theoretical framework that has served for the enunciation of the propositions that we will try to analyze in the following study.

2.1 Financial variables of the project

ICOs have multiple characteristics to analyze at the time of their launch. Undoubtedly, variables that directly impact the financial aspect of the investment are very important to analyze, as they are crucial variables in the investor's decision-making process (Karem et al., 2023). When launching a project to the market to raise funds, it is essential to determine the fundraising period. This period may vary depending on the nature of the issuance, potential demand, and the financial instrument being used. Previous studies conducted on IPOs, ICOs, crowdfunding projects… with other methodologies and in other markets suggest that shorter fundraising periods are usually related to a higher amount of money raised (Aslan et al., 2023; Mendes da Silva et al., 2016). The fundraising period is a vital period in which the project is presented to the market, with all its components that characterize it, mission, vision, values, objectives, management team… Therefore, it is necessary to prepare the project's market presentation, especially from the moments before the ICO when communicating, and during the fundraising period (Pierrakis & Bhimireddy, 2023). Similarly, other previous studies indicate the importance of the amount of money demanded in other fundraisings. In this sense, it is important to adjust the amount demanded to the real needs of the project. However, in this study, we want to verify which type of projects attract investment from ICO investors, those that request large amounts of money or those that request smaller amounts. In this line, it is interesting to analyze another key variable in debt or equity issuances of all types of financial instruments; the credit rating (Kim et al., 2023). Previous studies by de Choi (2022) suggest that determining an initial value of the token, as well as an amount requested that is not too small (but not too high), is relevant for fundraising. The rating indicates the risk that the investor assumes when investing in a particular project or company. The risk determines another key variable for the investor, which is the expected return on investment. Until now, this factor has not been analyzed in ICOs, so there is a

gap in the literature on the subject that we want to complete with this research that we will develop in the following sections.

Based on the above premises, we establish the following propositions:

Proposition 1: The fundraising period is a relevant condition for the achievement of the financing objectives of a project that carries out an ICO to raise funds.

Proposition 2: The amount of money requested is relevant to obtain the fundraising goal established in the ICO.

Proposition 3: The risk rating of the issue is an important variable to obtain the funds required for the development of the project.

2.2 Human resources as key variables for the success of the project

Human resources are a key factor in the business management of any organization. According to the Human Capital Theory, economic resources dedicated to employee training are seen as an investment, since they ultimately benefit the company, and therefore also social benefit and the development of a country (Nemeth, 2017; Sweetland, 1996). Improving employees' knowledge and soft skills has a positive impact on their productivity and the company's innovation capacity, which generates a positive impact in the long term on business results. In this sense, it is important to have a team with the necessary technical knowledge to be able to develop their work satisfactorily (Lakshmi & Hymavathi, 2022; Jafar et al., 2021; Samreen et al., 2024)). Likewise, for the project to be sustainable in the long term, a multidisciplinary and complementary team must be available (Loving, 2021). The variety of profiles gives the company the ability to solve problems from different points of view (Marquez, 2014; Tagscherer & Carbon, 2023). Recent studies on the subject point out the importance of having a multigenerational team, in which senior profiles with experience and commitment coexist with junior profiles with highly developed digital skills and a novel and unbiased vision of company management and/or the job position (Erasmus et al., 2017). On the other hand, it is also worth noting the benefits of having a multicultural team, which, given its idiosyncrasy and different approach to problems, allows the human team to complement each other (Lu et al., 2022; Szymanski & Kalra, 2021). Other studies on the subject have investigated the importance of these factors in the ability to raise funds in debt and capital issues, either through traditional means or through alternative financing methods such as crowdfunding and crowdlending. In this sense, the human factor is key, both for the success of the

project and for the ability to raise funds (Chenmanur et al., 2022: Huynh, 2016). Currently, there are few research studies on the role of the human team in the success of ICOs, although Campino et al. (2021) pointed out its importance in their previous research. These studies serve as a starting point for us to try to contribute to the literature and previous research.

In this sense, we have also considered it of paramount importance to study the role of verifying the existence of the human team in projects to drive fundraising in ICOs. Confidence in the project's success and the capabilities of its founders and managers is of vital importance in any investment process (Huang et al., 2022; Zafar et al., 2023). In this regard, it is worth noting the context of high uncertainty that characterizes the cryptocurrency issuance sector. The youth of this instrument, the boom it experienced from 2018 onwards, and the absence of specific regulation have made it possible for fraudulent projects to occur, whose fundraising campaign only aimed to raise funds without subsequently developing a real project (Hornuf et al., 2022; Grobys et al., 2022). Therefore, it seems logical that the verification of the existence, experience, and capabilities of the project management team can be considered as one of the key variables for fundraising in ICOs. It is also worth noting that previous studies by Wymer & Cacija (2022) and Kim et al. (2017) have demonstrated the importance of being able to build a brand image and reputation that can give investors' confidence in the project fundraising team, as well as improve the donation experience, which is a clear variable for potentially increasing fundraising. It should be noted that these previous studies focus mainly on fundraising campaigns through alternative financing platforms that are primarily donation-based projects. In this sense, we have detected a gap in the study area regarding fundraising operations with ICOs for business projects. Based on the beforementioned we propose the following two propositions of the study:

Proposition 4: The human team that makes up the project is a relevant variable to raise money from investors in the ICO.

Proposition 7: The verification of the existence of the project promoters is an important condition to reach the ICO funding goal.

2.3 Community and communication as key variables to successfully ICOs

Every company needs customers to make sales and ensure its continuity over time. Nowadays, companies have great tools to connect with their customers in a direct, simple,

and relatively inexpensive way through instruments such as social media. This is especially important for companies based on digital business models (Abdolvand et al., 2016; Alarcón et al., 2015; Ata et al., 2022; Laudien & Guaita-Fernandez, 2023). The company's activity on social media can generate engagement with the community, weave a network that feeds the company through constant or recurring feedback, or develop online actions to obtain market data and information that can be used later in the development of products or services that meet the demands of society collected through the market (Hall-Phillips et al., 2016). On the other hand, the company's interaction on social media can also generate synergies with other business projects to develop new products or improve the company's value proposition (Ghanadpour & Shokouhyar, 2021). Being able to have a community on social media can also be interpreted as a signal of market interest in the company and allows the transmission of informative and/or commercial messages in an agile and efficient way, or to build a powerful and consumer-friendly brand image (Sharma et al., 2023, Dülek & Saydan, 2019; Khan & Mujitaba, 2023). Likewise, the correct interaction on social media by the company can serve to improve consumer confidence in the project (Matin et al., 2022), a very relevant aspect, and complementary to proposition 7, which deals with the importance of verifying the team to build investor confidence in a volatile and uncertain sector.

If having a community on social media is important for business success and signaling interest to investors, public communication to that community and to the general public is crucial for success in ICOs (Suh & Hijal-Moghrabi, 2023). Previous studies by Kshetri (2018) have shown that communication is a very important element in successfully executing an ICO. Active communication by project managers should serve as an element to facilitate understanding of its operation, structure, objectives, and goals (Boukis, 2023). Likewise, it is vital to keep the investor informed about the progress on the project roadmap. The need to carry out subsequent ICOs to continue raising funds for the project makes it necessary not only to build a relationship of trust but also to maintain it over time. Good and fluid communication is very important to reduce information asymmetry, be transparent, and as a consequence, send a message of reliability to the market, which can boost current and potential investors of the project.

Based on the above premises, we propose the following propositions::

Proposition 5: Having a large community in social networks is a relevant condition to achieve the funding goal established in the ICO.

Proposition 6: The active communication of the ICO managers is an important variable to raise funds from investors.

3. Data and methodology

This analysis has been conducted based on a database compiled with information provided by ICOholder, an aggregator platform for ICOs and Initial Exchange Offerings. The company is a smart tracker, a global analytics platform with the world's largest crypto database, providing financial and business information and creating ratings for various ICOs worldwide (American Conference Institute, 2024). The database, compiled from information published on the platform, consists of 245 projects, encoding financial, business, community follower-related, and project security variables (verification of the same). After cleaning the database, we conducted the analysis on 75 projects, as the remaining ones did not contain all the information required for this study. According to Schneider & Wageman (2012) studies, a sample size greater than 50 cases is sufficient for fsQCA studies.

In this study, we have employed the fsQCA methodology given the nature of our research question, which basically deals with what characteristics an ICO must have to raise a high proportion of funds relative to the total requested from the market in the issuance. This methodology has been used in this study, considering the nature of the research question, which tries to explore the conditions that lead to successful fundraising in ICOs. In this sense, the ability of fsQCA to show us different paths that can lead to this result makes the methodology the perfect tool to answer the research question. This methodology is relatively young; however, in recent years, it has enjoyed great popularity in subjects related to social sciences, specifically entrepreneurship and management (Kumar et al., 2022). FsQCA is a comparative qualitative methodology that seeks to find combinations of conditions (called variables in quantitative terminology) that lead to a specific outcome (Mendel, 2013). It is a methodology suitable for working with medium-sized samples, and whose variables present complex and nonlinear relationships (Schneider & Wageman, 2012). The method works based on Boolean algebra, as well as fuzzy set theory (Huang et al., 2022). The results show the complex causal relationships between variables, showing us different paths that can lead to the outcome under study (Douglas et al., 2022). These paths are called configurations, and each of them presents a different combination of variables that serves to achieve the analyzed outcome (Romero-Castro et

al., 2022; Fiss, 2011). The results show the necessary and sufficient conditions for the occurrence or non-occurrence of the outcome (Sun et al., 2023).

In the following, we present the conditions and the outcome we have considered for the study:

Table 1. Variables.

CONDITION / OUTCOME	**DEFINITION**
TIME (CONDITION)	Time period that the project has set in the ICO to raise funds.
AMOUNT (CONDITION)	Amount of money (in dollars) that the company has set as a fundraising target in the ICO.
RAT (CONDITION)	Rating assigned by ICOholder to the project carried out by the ICO. The rating has been determined by its team of expert analysts and ranges from 1 to 5, where 1 indicates a low rating and 5 a high rating, i.e. a high quality project.
TEAM (CONDITION)	Score given by ICOHolder to the founding and managing team of the project that is launching the ICO.
COM (CONDITION)	Community of followers in social network X (formerly Twitter) that the project has.
USERS (CONDITION)	Interaction that users have with the company launching the ICO. ICOHolder rates it with a score ranging from Very Low to Very High. We have coded this score on a scale of 1 to 5.
VERIF (CONDITION)	Percentage of the ICO management team whose existence is verified by ICOholder.
GOAL (OUTCOME)	Percentage of the fundraising obtained in the ICO with respect to the set target (may exceed 100%).

3.1 Calibration

Before proceeding to perform the analysis that will allow us to determine the necessary and sufficient conditions to reach the outcome, it is necessary to carry out the calibration process (Yang et al., 2022). In fsQCA, the calibration process tries to convert raw numerical values into numbers that are between 0 and 1 and that indicate the degree of

membership in fuzzy sets (Kraus et al., 2018). Without having all the data calibrated and understood between 0 and 1, the fuzzy analysis cannot be performed to determine the necessary and sufficient conditions. To carry out the calibration, we have followed the instructions established in previous works by Pappas & Woodside (2021). The calibration process has been carried out through fsQCA 4.1 software. To carry out the calibration, we have set the 90th percentile as the full membership point, the 50th percentile as the crossover point, and the 10th percentile as the full non-membership point.

Table 2. Statistics.

	TIME	AMOUNT	RAT	TEAM	COM	USERS	VERIF	GOAL
Full membership (90th percentile)	147.9	11706965	4.32	4.649	15078.9	5	1	1.798
Crossover point (50th percentile)	59	2001039	3.98	4.05	3809	5	0.44	0.68
Full non-membership (10th percentile)	20.3	200000	3.501	3.459	559.6	2	0	0.06
Maximum	609	36000000	4.64	4.8	78010	5	1	10.27
Minimum	5	22900	2.04	1	0	2	0	0.01
Average	81.59459	4174352	3.945811	4.02	8568.149	4.081081	0.487432	1.010541
Median	59	2001039	3.98	4.05	3809	5	0.44	0.68
Standard Deviation	90.33422	6328646	0.393342	0.544776	16192.5	1.202244	0.410246	1.680196

4. Results

In this section we will then develop the results obtained in the necessity and sufficiency analysis of this study. in order to determine the conditions. and their configurations. that make it possible to achieve the outcome studied.

4.1 Necessity analysis

According to the work of Ragin (2006). we can establish a relationship of necessary condition for the occurrence of an outcome when the level of consistency is higher than 0.9. Consistency is a measure that indicates the degree to which a causal condition leads to an outcome. In this case. when it reaches levels above 0.9 we will say that it is a necessary condition. i.e.. that the outcome needs its presence (or absence) for it to occur.

Table 3. Necessity analysis.

	HIGH LEVELS OF GOAL ACHIEVEMENT	LOW LEVELS OF GOAL ACHIEVEMENT

	Consistency	Coverage	Consistency	Coverage
FSTIME	0. 508	0. 579	0. 547	0. 558
~FSTIME	0. 611	0. 601	0. 586	0. 516
FSAMOUNT	0. 562	0. 673	0. 434	0. 465
~FSAMOUNT	0. 553	0. 522	0. 695	0. 587
FSRAT	0. 630	0. 643	0. 520	0. 475
~FSRAT	0. 485	0. 530	0. 609	0. 595
FSTEAM	0. 609	0. 622	0. 553	0. 505
~FSTEAM	0. 516	0. 563	0. 587	0. 573
FSCOM	0. 541	0. 641	0. 471	0. 500
~FSCOM	0. 578	0. 550	0. 662	0. 563
FSUSERS	0. 772	0. 571	0. 756	0. 500
~FSUSERS	0. 325	0. 599	0. 351	0. 580
FSVERIF	0. 590	0. 623	0. 519	0. 490
~FSVERIF	0. 517	0. 546	0. 601	0. 568

According to the results obtained. as we can observe. there is no condition. or lack thereof. that exceeds a consistency level of 0.9. so we cannot say that in this case there is any condition necessary for the occurrence of the outcome.

4.2 Sufficiency analysis

Next. we present the results obtained in the sufficiency analysis. both for high levels of fundraising in the ICO and subsequently for reduced levels. The sufficiency analysis aims to identify the combinations of conditions (variables) that are sufficient for the occurrence of an outcome. In fsQCA. the sufficiency analysis is based on the nonlinear relationships between conditions and the equifinality of the results. This means that we are going to obtain different combinations of variables that lead us to the same outcome (Ragin. 2008). This represents a relevant variation compared to other purely quantitative methodologies that show only one solution. The comparative qualitative technique allows us to capture complex relationships between variables. and this factor is ideal for social science studies like this. since the reality of ICOs and businesses is ultimately conditioned by human interaction and action. which is not linear. predictable. and variables cannot be isolated. The sufficiency analysis is based on Boolean logic and fuzzy set theory. Through reductions of truth tables. we obtain three different solutions in the fsQCA analysis: the

complex solution. the parsimonious solution. and the intermediate solution (Woodside et al.. 2012). It is relevant to note that. according to Ragin (2008). it is necessary to reach a consistency level of at least 0.75 in order to consider the study as academically representative. In this study. we present the results obtained according to Fiss (2011). combining the intermediate and parsimonious solutions. In this sense. black circles indicate that the condition reaches high levels (or presence) for the occurrence of the outcome. while white circles indicate that the variable will register low levels (or absence) for the occurrence of the outcome. Large circles indicate that the condition is present in the intermediate and parsimonious solution. while small circles indicate that it is only present in the intermediate solution. The absence of circles indicates the irrelevance of the condition for the occurrence of the outcome.

4.2.1 High levels of goal achievement

In the following. we will show the results obtained for high levels of fundraising in the ICOs analyzed.

Table 4. Sufficiency analysis: High levels of goal achievement.

	1	2	3	4	5	6	7	8
TIME		○			◯	◯	◯	○
AMOUNT	●	●		●	•	○	○	●
RAT	○		●	•	◯	○	◯	•
TEAM			•	○	○	○	•	●
COM	●	●	●	○	●	○	●	○
USERS	•	•	•	◯		◯	○	•
VERIF	●	●	●	○	○	●	○	◯
Raw coverage	0.179	0.182	0.289	0.109	0.156	0.104	0.098	0.139
Unique coverage	0.022	0.010	0.127	0.008	0.037	0.023	0.015	0.043
Consistency	0.825	0.864	0.807	0.884	0.852	0.881	0.868	0.905

Solution coverage: 0.509. Solution consistency: 0.791

Configuration 8. which registers the highest levels of consistency. 0.905. indicates that those projects that manage to reach a large relative amount of funds in ICOs are characterized by being large projects that request large amounts of money. have solvent teams with a high score in terms of capabilities. have a high rating. i.e. they are relatively safer projects. and users value them adequately. having a good interaction with them. On the other hand. they tend to be projects with short fundraising periods. few followers on Twitter and with a small proportion of verified members. This configuration has a raw coverage of 0.139.

Configuration 2. which reaches a raw coverage level of 0.182. i.e. it represents 18.20% of the cases in which the projects achieve high levels of fundraising. are characterized by being ICOs in which a large amount of money is requested. have a large community of followers on Twitter. a large part of their management and founding team is verified. and present good interaction with users. On the other hand. they are projects whose fundraising period is short. The configuration presents a consistency level of 0.864.

Configuration 3. which represents the highest number of cases. 28.9%. shows us that for the ICO to be successful and achieve its financing objectives. it is necessary for it to have a high rating. a large community of followers on Twitter. its management team and founder to be verified and to achieve a good score in terms of management capabilities. This configuration presents a consistency level of 0.807.

4.2.2 Low levels of goal achievement

Table 5. Sufficiency analysis: High levels of goal achievement.

	1	2	3	4
TIME	●	●	●	●
AMOUNT	○	○		•
RAT	◯	◯	○	
TEAM	○	○	○	○
COM	○		●	●
USERS	◯	◯	•	•
VERIF		•	◯	◯
Raw coverage	0.150	0.133	0.146	0.156
Unique coverage	0.036	0.014	0.015	0.030
Consistency	0.806	0.798	0.884	0.862

Solution coverage: 0.267. Solution consistency: 0.821

Configuration 3 suggests that those ICOs that raise a low amount of funds are characterized as projects with a long fundraising period. a large community of followers on Twitter. and good interaction with users. but that nevertheless have few verified team members. the team has a low valuation and a low rating. This configuration has a consistency level of 0.884 and represents 14.6% of the cases of ICOs that record low fundraising.

Configuration 4 shows us that the ICOs that register low levels of fundraising with respect to those initially required are those projects that have a high fundraising period. a large Twitter follower community. request large amounts of money. and present a good

interaction with their users. On the contrary. their team has a low rating and most of it is unverified. This configuration has a raw coverage level of 0.156 and a consistency level of 0.862.

Configuration 1. which represents 15% of the cases in which ICOs register a low level of fundraising. suggests that these projects are characterized by long fundraising periods. reduced rating. insufficient interaction with users. requesting a small amount of money. their team is not well valued and has a small community of followers on Twitter. This configuration has a consistency level of 0.806.

5. Discussion of results

The results obtained in the study indicate. first of all. the importance of the project's fundraising deadlines. As shown in Table 4. ICOs that raise a large amount of funds are characterized by short fundraising periods. while those that do not reach their funding targets. or even remain at low levels. are characterized as ICOs with long fundraising periods. This can be interpreted as a symptom of high market demand; the project does not require a long time to raise funds. the demand from investors is so high that in a short time they complete their funding goal. a high number of investors want to be part of the project by acquiring their coins. It is also interesting to note that in most cases. the projects that manage to raise the proposed funds are usually projects that request a large amount of capital from the ICO. In contrast. in the study carried out to determine the characteristics of the projects that register a low amount of compliance with the financing goal. they tend to be projects that request little money. These findings are in line with what was previously proposed by Deng et al. (2022) in fundraising campaigns on crowdfunding platforms.

On the other hand. we have also recorded that in most of the configurations that indicate success in fundraising ICOs are characterized by the positive component of their community: it is important to have a large community of X (Twitter) followers and to present a good interaction with users. These results are in line with what was previously studied in analyses by Kaur & Gera (2017); having large follower and user communities improves brand engagement and visibility. is able to redirect more traffic to the website and can positively impact fundraising campaigns. However. it is striking how in half of the projects with poor fundraising results. these two factors are also present. We can infer that this is because other factors come into play in fundraising through ICOs. and in the

case of projects that do not achieve their goals. we identify that these factors coexist with the absence of a well-valued team and low team verification. as well as sometimes reduced ratings.

In this regard. also comment on the importance of equipment verification to achieve the objectives in the ICO campaign. Although in this study there is some ambiguity as to the factor played by the valuation of the team in ICOs. since the results are ambiguous.

On the other hand. it is worth commenting that although it is a characteristic feature of ICOs that fail in their fundraising task that they have a low rating. it is also present in a large part of the configurations that lead to the success of ICOs. This may be due to the risk profile that the investor in the crypto market usually has. This is an investor more prone to risk-taking in investment. and may be looking for extraordinary returns in this market. also coupled with a lower rating. following the classic risk-return trade-off in finance (Gurdiev & O´Loughlin. 2020).

6. Conclusions

The crypto and blockchain sector applied to the financing of entrepreneurial projects has experienced rapid evolution in recent years. It is a young industry. with rapid but irregular evolution. marked by the volatility of this market (Yi et al.. 2018; Sun et al.. 2022). In this context. Initial Coin Offerings. coin issuances based on blockchain technology. have positioned themselves as a driving force for the financing of entrepreneurial and disruptive projects in many sectors. such as the financial sector. the industrial application sector or the fashion industry. among others (Hu et al.. 2023). The ability to be part of these projects and raise funds simply by having an Internet connection. allowing connection with creditors and debtors from around the world. is a lever for financial inclusion that allows the development of areas where there is little developed financial or banking sector. In this context. more and more entrepreneurs and companies are interested in accessing this type of tool.

Practical implications

The study carried out has allowed us to extract a series of conclusions that will guide those projects that plan to raise funds through ICOs. The first conclusion we draw is the importance of the community in the ability to raise funds in an ICO; having a large number of followers on social networks and interacting correctly with users is a key variable to generate engagement. awareness. direct traffic to the campaign and the

platform of the ICO promoter. and mobilize funds. These findings are in line with previous studies by Belleflamme et al. (2014) on other types of participatory and digital finance instruments. like ICOs. Likewise. we can conclude that large-scale projects that establish short fundraising periods are characteristic features of successful ICOs. That is. the relevance of the image that is transmitted to the market is observed: large and ambitious projects that impose reduced fundraising periods because they know their potential and trust that the investor will demand their project. These results are in line with and somewhat complement previous work by Brown et al. (2017). emphasizing the importance of branding in ICOs. similar to what happens in crowdfunding campaigns. Having a good brand image to raise funds. and using fundraising to build brand image. a synergistic relationship that feeds back positively to generate value and trust in the market. The results obtained in the study align with previous studies by Zafar et al. (2023) and Ferrer et al. (2022) regarding the relevance of trust in this market: the need to have a verifiable team with good management capabilities is crucial to the success of the ICO and other participative financing sources. In such a volatile and uncertain market as crypto. where cases of fraud or scams have been recurrently reported. it is very important that the human factor is honest and capable. and that it articulates coherent. informative. and transparent communication to the community.

Theoretical implications

With this study. we also aim to contribute to the previous literature written on ICOs and blockchain applied to business and entrepreneurship. This research aims to shed light on some unexplored areas of study in ICOs so far. such as the importance of the fundraising period. the amount demanded. or the verification of the founding team. Likewise. we have contributed academically to studies on ICOs with the novel fsQCA methodology. So far. very few studies have been developed with this methodology in this subject. and we wanted to shed light on this area of study with the comparative-qualitative methodology. capturing complex relationships and showing different paths to achieve success in ICOs.

Limitations and future research lines

The study is not without limitations. among them the reduction of cases that we have experienced as a consequence of the absence of some of the information in the aggregator platform. Also. this platform. although it provides the largest database of ICOs in the world. does not contain all the ICOs. so other projects may have different characteristics

from the results obtained. It should be noted that the results obtained in the analysis emanate from an international database. with the presence of projects from multiple countries. geographic regions and different societies. While this brings great richness to the study. since the generalizations and extrapolations that can be derived from it have significant potential. it should also be mentioned that there may be regional particularities that may cause some of the results obtained to vary.

In this sense we have also included variables that we have been able to locate thanks to the aggregator platform. including 7 conditions in the fsQCA study. given that this is the maximum accepted by the methodology. by way of future lines of research it would be interesting to include other variables that may impact fundraising. such as regulatory or environmental variables and develop another study with larger datasets and different methodologies.

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Anexos

A1. Glosario de términos técnicos, siglas y anglicismos

A2. Glosario técnico

Glosario de términos técnicos, siglas y anglicismos

Sigla / término	Desarrollo o equivalente	Capítulos
API	Application Programming Interface	III, IV
B2B	Business to Business	IV
B2C	Business to Consumer	IV
Blockchain	Cadena de bloques	II, III, IV
DLT	Distributed Ledger Technology	III, IV
EPCIS	Electronic Product Code Information Services (GS1)	IV
ERP	Enterprise Resource Planning	IV
fsQCA	Fuzzy-set Qualitative Comparative Analysis	III
GS1	Estándares globales de identificación y trazabilidad	IV
ICO	Initial Coin Offering	III
IoT	Internet of Things	IV
IIoT	Industrial Internet of Things	IV
KPI	Key Performance Indicator	III, IV
KYC	Know Your Customer	III
MVP	Minimum Viable Product	III
On-chain	Registro en blockchain	III, IV
Off-chain	Registro fuera de blockchain	III, IV
PoC	Proof of Concept	IV
QR	Quick Response code	IV
SCM	Supply Chain Management	IV
SLA	Service Level Agreement	IV
Smart contract	Contrato inteligente	III, IV
STO	Security Token Offering	III
UI	User Interface	IV
Whitepaper	Documento técnico-estratégico	III, IV
WMS	Warehouse Management System	IV
WoS	Web of Science	II

Glosario técnico

Término	Definición	Capítulos
Arquitectura de señalización	Configuración de señales (verificación, comunidad, comunicación, reputación técnica) utilizada para reducir incertidumbre en la fase de financiación.	III
Arquitectura de datos	Diseño de captura, validación, almacenamiento, acceso e intercambio de datos en una organización o red interorganizativa.	IV
Asimetría causal	Principio del enfoque configuracional según el cual las condiciones que explican la presencia de un resultado no son el simple inverso de las que explican su ausencia.	III
Asimetría de información	Situación en la que una parte dispone de mejor información que otra, afectando confianza y decisiones.	III, IV
Calibración (fsQCA)	Transformación de variables empíricas en puntuaciones de pertenencia a conjuntos difusos (0-1) usando anclas teóricas y empíricas.	III
Cobertura (fsQCA)	Medida de relevancia empírica de una configuración causal; indica qué proporción de casos del resultado explica una solución.	III
Consistencia (fsQCA)	Grado en que una configuración de condiciones se asocia de forma sistemática con un resultado.	III
Dato verificable	Dato cuya procedencia, integridad y validez pueden comprobarse mediante registros y validaciones.	III, IV
Disonancia informacional	Desajuste entre la promesa comunicada y la evidencia operativa realmente disponible.	III, IV
Equifinalidad	Principio según el cual diferentes combinaciones de condiciones pueden producir el mismo resultado.	III
Evidencia auditable	Información susceptible de revisión y validación por terceros de forma objetiva.	III, IV
Gobernanza de datos	Conjunto de roles, políticas y estándares que determinan cómo se registran, validan, acceden y usan los datos.	IV
Lógica configuracional	Enfoque que explica resultados como combinaciones de condiciones, no como efectos netos aislados.	III
Modelo de madurez	Escala de niveles de desarrollo de una capacidad organizativa; en la tesis, continuidad entre promesas, datos y evidencias.	IV

Narrativa de valor	Relato estructurado que explica cómo una propuesta genera beneficios para un público específico.	III, IV
Oráculo (oracle)	Servicio o mecanismo que introduce datos externos en blockchain (temperatura, ubicación, firma, etc.).	IV
Principio de continuidad	Criterio de diseño según el cual cada promesa debe mapearse a un dato operativo y a una evidencia comunicable.	I, III, IV
Trazabilidad	Capacidad de seguir el historial y transformación de un producto a lo largo de la cadena.	IV
Trazabilidad end-to-end	Seguimiento completo desde origen hasta destino final cubriendo múltiples actores.	IV
Triangulación	Uso combinado de varias fuentes, métodos o evidencias para reforzar la validez del análisis.	II, III, IV