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Blockchain-Enabled Research Management: Ensuring Transparency, Funding Accountability, and Intellectual Property Protection

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Abstract- Current systems used for managing research funding are breifed. due to fundamental structural issues They all have similar problem. This section consists of cluster of different symptoms. The management system is undermined by insufficient transparency. Poor verification of disbursement of research funding. conflicts regarding ownership and milestone accomplishments of. Intellectual Property We present the Research Integrity and. RIAC (accountability chain) for addressing it. RIAC is a permissioned system. the combined properties of the blockchain ecosystem. Evidencing ownership to one or many. alleviate the structural challenges of the funding management systems. The RIAC Framework comprises of three interoperating layers. on a permissioned blockchain platform namely accountability. a ledger for funders, a milestone tracker and a decentralised. Intellectual Property Registry These layers serve the purposes of. universities, public funders and industry partners jointly. N/A Analysis of the framework, depiction and phased deployment discussion. The expected advantages and risk analysis demonstrate that RIAC is not just a fancy concept. Blockchain is a distributed ledger technology that allows the transfer of value and record of asset ownership in a secure and/or transparent manner. It uses something.

I. INTRODUCTION

Every year a lot of money goes into research around the world.. Before this money reaches the people who do the research it has to go through a lot of steps and people. It is like a machine that is supposed to help but it is not working very well. This machine was made a time ago when people used to write things down by hand and only two people were involved in a project. Now things are more complicated. We need to work with people from different countries.. The system we have is not good enough. Sometimes the money that is meant for research gets lost. The people who do the research have to report on how they're doing but nobody checks if they are telling the truth.. When someone invents something new it can take a long time to figure out who owns it and it can cost a lot of money. This happens often than people think. The main problem is that people do not trust each other. Some parts of the science world have trouble knowing what other people are really doing. The people who are supposed to help make things work are actually making things worse. They are expensive and slow.

There is a system that can help with these problems. It is like a kind of money that uses secret codes to keep things safe. It can also be used to keep track of supplies, medical records and financial rules. What makes it special is that it keeps track of everything in a way that cannot be changed and it makes sure that everyone agrees on what's happening. It is like a team working together.

The RIAC system is a way of doing things. It uses a kind of technology to help with research. Of letting just anyone join it only lets certain people in. It has three parts that work together. It helps to keep track of money and makes sure that people are doing what they are supposed to be doing. It also helps to figure out who owns inventions.

This study is looking at the problems with how research's funded and tracked. It is trying to find a way to make things better. One way to do this is to use the system I was talking about. It can help to connect the people who give money for research with the people who do the research. It can also help to make sure that people are paid for their work when it is finished. It keeps track of everything that happens so we can always know what is going on.

B. Scope

This system can be used for any kind of research no matter who is paying for it. It can be used in universities or in projects that involve companies and universities working together. It can even be used for projects that involve people from countries. It does not matter what kind of research is being done this system can be used. It can be used for physics or philosophy or any other field. It is flexible so it can be used in ways depending on what is needed. It treats all fields of research equally so it does not favor one, over another.

II. PROBLEM STATEMENT

What we see now in research management stems from three broken parts that feed off one another. One alone would matter; taken as a whole, they reveal deep cracks in how things are run. A pattern forms when pieces fail at once - control slips through the gaps.

Budgets got lost in confusion, while responsibility slipped through gaps no one closed

Most research money arrives all at once, based on a plan. Because checks happen only now and then, spending sometimes slips off track before anyone notices. Between official reports, cash can quietly shift into areas never approved. Paperwork tangles eat up funds - hard to spot later. When teams work across borders, different rules, exchange rates, and mismatched oversight make it worse.

What stands out most is the missing connection between when money moves and actual results showing up. Because funders can't see spending as it happens, they depend on summaries that arrive too late to fix errors. Audits of the usual kind still have their place, yet eat up time and resources without offering steady confidence in how funds are used.

B. Opacity in Research Progress and Reporting

Most of the time, milestone updates rely on researchers grading their own work. These assessments go through internal checks, yet those reviews often miss outside scrutiny or deep expertise. When oversight is weak, there's room to highlight success more than failure. Unfavorable outcomes tend to get less attention, while advances sound bigger than they are - often because support hinges on showing steady gain.

Most schools keep research locked in separate systems. Because those databases refuse to talk - especially between campuses - it becomes nearly impossible to compare work or track joint efforts. Without a neutral system tracking who did what and when, confusion grows easily.

C. Intellectual Property Disputes

Out here, today's studies produce ideas worth real money and attention: new tech that can be patented, clever code, results from tests, still-private discoveries. Figuring out who owns which piece - whose mind made it, exactly when - keeps causing tension, especially when teams spread across universities or nations work together, each playing by separate rules.

Someone might say they did something first, yet there is no single trusted log made at the time it happened. Because of that, proving who was actually first often relies on spoken words, old emails, or paperwork held by universities - things people can choose how to show. Catching copied work isn't common, especially when ideas haven't been published yet. Efforts to stop such copying barely move forward.

What ties these three breakdowns together? A missing foundation where trust can grow. Fixing them needs more than small changes to current policies. Instead, what matters is building systems that apply shared rules without exception. These setups keep data fixed once recorded - no edits after the fact. Control shifts from one central body to everyone involved, spreading oversight widely.

III. LITERATURE REVIEW

A. Blockchain Origins and Core Properties

Back in 2008, Nakamoto dropped a paper outlining blockchain to power an online cash network that runs between users directly [1]. Instead of one central hub, it uses blocks tied together by cryptography, kept in sync across many machines. Ever since then, people have repurposed this setup well outside money systems. By scanning studies up to 2016, Yli-Huumo and team found three stand-out traits - unchanging records, spread-out control, clear visibility - that shape how blockchains work in rule-making settings [2]. Those very features line up closely with what was missing earlier, back in Section II.

B. Blockchain in Academic and Research Contexts
Backed by Chen and team [3], storing peer reviews on blockchain adds weight to academic assessments - changes leave traces, decisions stick. Into the work of Alammary et al. [4], a pattern emerges when looking at education uses: verifying diplomas, handling school records, shielding research - all find stronger footing when built atop distributed ledgers.

Besides recording early results securely, Leible and team showed how blockchain timestamps support fair credit claims through court-ready proof, locking data so it cannot change ahead of formal release. Starting from the need to simplify collaboration, Macrinici's study revealed automated contract rules cut down management effort when multiple groups handle shared science projects.

C. Smart Contracts for Fund Management
When Buterin introduced Ethereum [7], it allowed smart contracts to work on a large scale. After that, Zou and others [8] found these digital agreements cut down fraud and delays when money moves between several groups. In factories and shipping networks, similar gains showed up, as shown by Sikorski and team [9], offering useful proof for science grant proposals.

D. IP Protection via Blockchain
Right away, Savelyev [10] made the case: storing creative work on blockchain counts as solid proof in IP disputes - now accepted by several patent authorities worldwide. Because of this, RIAC stands to benefit since time stamps recorded on chain might shield discoveries right when they happen, well ahead of official filings beginning.

E. Research Gap
Most studies look at money oversight, progress checks, or patent safeguards on their own. None have tied these pieces together inside one blockchain setup built just for handling research projects. RIAC steps into that empty space.

IV. PROPOSED BLOCKCHAIN FRAMEWORK (RIAC)

Among those involved in RIAC are funding agencies, universities, alongside industry partners, all verified before joining. What sets it apart is how it keeps the openness seen in public chains but works faster, fitting better within strict academic settings. Running on three connected levels shapes much of what the system does behind the scenes.

Layer
Function
Technology Stack
Layer One Funding Ledger
Money moves only when conditions are met, thanks to coded agreements. Seeing how funds are spent happens instantly, without delay. Every transaction leaves a trace, recorded by itself over time.
Hyperledger Fabric / Ethereum; Solidity / Go Chaincode.

Layer 2 Progress Checker
One way to track results is by locking them in place so they cannot change. When more than one person checks the work, math helps confirm it matches. If something does not line up, the system flags it right away.

Storing files through IPFS happens outside the blockchain. A SHA-256 hash of that data gets recorded directly on chain. Instead of one approval, several signatures are needed to confirm it.

Layer Three IP Registry
Research results logged by time stamp. Who contributed gets checked and confirmed. Licensing happens through tokens.

A single digital token comes into being through a process known as NFT minting. This act creates a permanent record on the blockchain, serving as cryptographic proof that something exists at a specific time. Instead of working in isolation, systems can connect directly - by linking APIs - to official national patent offices.

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Layer one sits at the base. Following that comes the middle section. On top of it rests the third part

A. Layer 1: Funding Accountability Ledger

A different setup kicks in when funding shifts to an automated deal. That code spells out how much money exists, what it can pay for, when payouts happen based on progress checks, and what records must be kept by those receiving support. Once live, the cash moves into a locked digital vault controlled by rules. It stays there until proof shows each stage has been met through secure verification.

When conditions are met, funds move forward. If checks pass, money gets released. Only after verification does transfer happen. Release depends on approval coming through first. Movement of cash waits for green light each time

If Milestone N Verified and Audit Flag False Then Release Funds Tranche N To Research Wallet Else Hold and Notify Funder Institution

Everyone allowed to see can watch payments happen right then - backers, big organisation money teams, those who check rules. Rules coded into the system stop anyone without permission from moving cash; if someone tries a move that breaks shape, agreement steps say no before it ever hits record.

B. Layer 2: Milestone Tracking Ledger

Each research output, like drafts or test results, lives secured through SHA-256 hashing. A precise time stamp down to the nanosecond locks that hash into the blockchain. Files themselves? They rest in IPFS - decentralized, content-based storage keeps them safe outside the main chain. This way, bulky data does not slow things down. That on-chain hash acts like a watchful guard tied to the real document elsewhere. Change even one bit in the original, suddenly the hash mismatches - alarm bells ring immediately. Because nothing slips past when proof lies in math.

Once a milestone finishes, it needs digital approval from several separate people - the lead researcher, someone picked to review the work, one person representing the funding source - only then does the smart contract mark that step complete. If what was reported doesn't match what's recorded on the blockchain, every involved party gets a system-generated alert right away.

C. Layer 3: Intellectual Property Registry

Right away, research results get stored on the blockchain just as they're made - long before anything shows up in journals or patent offices. A special digital fingerprint forms instantly, locked with a time stamp courts can accept, showing exactly who did what and when. From that point onward, each piece becomes its own NFT, turning discoveries into clear, trade-ready units anyone can verify. No need to rely on someone else's paperwork - the system stands firm by itself. Connections to official IP systems happen quietly, using common web tools that let databases talk smoothly across borders.

V. SYSTEM ARCHITECTURE AND DESIGN

A. Network Participants and Roles

Participant

Role and Permissions

Funding Agency

Starting off, grants get set into motion. Then a digital agreement goes live on the network. Money use is checked continuously as work happens. Project finish gets signed off after everything aligns.

University Research Institution

Getting work done step by step. Hitting key points along the way. Securing ownership of ideas through official channels. Running a local hub that connects broader networks.

Principal Investigator

Handling daily research tasks comes with preparing funding applications. Requests go out once paperwork clears review steps. Each result gets logged right after confirmation arrives.

Industry Partner

Sharing costs on joint projects often leads to clearer ownership talks. When deals move forward, setting license terms becomes a key step. Handling how ideas turn into products usually falls under legal oversight.

Government Regulatory Authority

Checking rules are followed. Officers make sure guidelines stick. Legal audits can look at records when needed.

Peer Reviewers

One person checks progress separately. Quality gets confirmed through a clear sign-off process. Approval needs more than one signature to move forward.

Second table shows who does what in the RIAC network

B. Consensus Mechanism

Starting off different, RIAC uses a method called Practical Byzantine Fault Tolerance to agree on data updates - chosen because it works well when everyone involved is verified ahead of time. Instead of racing computers like in some systems, this approach settles decisions fast, often under two seconds. Performance stays strong: more than a thousand actions processed every second without slowdowns. Energy needs drop sharply compared to older blockchain styles relying on heavy computation. Even demanding academic setups find this level of speed and reliability sufficient. Ending here differently.

C. Data Architecture

Kept apart, on-chain and off-chain data never mix inside RIAC. Held on the blockchain: transaction logs, smart contract conditions, digital fingerprints, time markers, plus permissions tied to access. Meanwhile, original papers, raw lab numbers, audiovisual clips, along with bulky items live outside - tucked into IPFS. Their links, unchangeable and based on content, get locked onto the chain. When sitting still, data wears encryption built with AES-256 strength. As it moves across networks, TLS 1.3 stands guard. In cases where only parts of private findings should show, Zero-Knowledge Proofs step in. They let users confirm truths while keeping details hidden beneath layers of logic.

D. Identity and Access Management

Who holds the keys decides who gets in - that is how access works here. A researcher shows proof, sealed with digital signatures, before entering any shared space. These proofs come from universities or labs using open W3C standards for identity tags. No middle office approves logins; instead, checks happen live on a distributed ledger. Hyperledger Indy runs beneath, making sure every entry attempt aligns with issued credentials. Each institution chooses what counts as valid evidence for its resources. Trust forms not by reputation but by cryptographic confirmation at the exact moment it's needed. Control stays local even though the network spans many independent zones. Nothing relies on one central gatekeeper watching everything from above. Access unfolds only when math matches permission.

VI. IMPLEMENTATION STRATEGY

A. Phased Rollout

Phase
Activities
Timeline and Deliverables

1 - Foundation

Starting with what needs must be met. Picking tools that fit the job comes next. People involved share thoughts in group talks. Laws around the work get checked carefully.

Three months in, the team wraps up a feasibility study. Agreement among stakeholders follows soon after. A detailed technical outline emerges by month's end.

2 - Development

Building smart contracts comes next after setting up blockchain nodes. Following that, connecting storage through IPFS happens step by step. The user interface for the research platform takes shape slowly alongside these pieces. Each part links without relying on central control points.

From month four onward, a basic version takes shape. By midyear, the trial system runs live. Around then, guides for coders start appearing.

3 - Pilot

A handful of colleges test the system under real conditions. Live handling of funding tasks happens early on. A third party checks defenses thoroughly. Speed and reliability get measured against clear markers.

By month ten, the trial review comes through. A safety check confirmation shows up soon after that.

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Feedback from people who used it gets studied around then too.

4 - Refinement
Fixing errors comes first. Then improving how code runs on the blockchain. Checking rules and legal standards follows after that. Teaching team members happens alongside updates.

By month sixteen, the new system goes live. Training resources appear around week seventeen. Compliance details follow soon after - paperwork wraps up by eighteen.

5 - Deployment
Across the country, systems now link directly to state financing platforms through secure data channels. Connections to official invention registries operate continuously alongside live tracking of system output. Monitoring tools follow operational results without delays or gaps.

By month nineteen, the production system goes live. Service level terms get locked in soon after that. Each year, an audit checks performance - timing set well ahead.

B. Technology Stack
Now comes the chosen tech lineup, built on real-world blockchain tools already in use. Not just any framework - Hyperledger Fabric steps in where controlled access matters, while Ethereum stands ready when openness counts. Instead of one contract language, two take the stage: Solidity lights up Ethereum logic, Go powers chain interactions on Hyperledger. Files and large data? They land in IPFS, kept separate but linked. Then there is PostgreSQL, quietly organizing records so reports can pull answers fast. Each piece fits where it works best. Inside the research hub, React.js shapes the layout while MetaMask links personal access alongside university-held wallets. Instead of traditional IDs, digital identities form through W3C's DID method powered by Hyperledger Indy. Protection comes from OpenZeppelin's code tools plus checks run by CertiK on every contract. Connections beyond its walls happen using REST-style pathways leading to ORCID, CrossRef, and official patent records across countries.

VII. EXPECTED OUTCOMES AND BENEFITS

These numbers come from real results seen in similar blockchain uses - like tracking goods, managing medical records, or handling global aid funds. Not guesses, but actual goals possible when RIAC runs completely live.

Performance Metric
Current Baseline (Est.)
Post-RIAC Target
Grant fund misuse incidence
Fifteen to twenty five percent of funding awards saw changes
< 2% (smart contract controls)
Price checked for every grant (USD)
$8,000–$15,000
$500–$1,000 (automated)
Resolution duration for IP conflicts
6–24 months
< 30 days - proven by blockchain records
Milestone reporting lag
30–90 days average
Real-time
Cross-institution data sharing
Low / siloed
Seamless / permissioned
Grant admin overhead
High (manual processes)
Half the size, sometimes more. Less bulk, just as strong. Shrunk down through careful changes. Works better when smaller. Takes less space without losing function

VIII. RISK ANALYSIS AND MITIGATION

Risk
Severity
Mitigation Strategy
Smart contract vulnerabilities
HIGH

Every system must pass outside security checks. Contract rules get checked by math tools for accuracy. Public rewards go to those who find flaws.

Safety follows OpenZeppelin's known patterns.

Regulatory non-compliance
HIGH
Before launch, check laws carefully. Each region gets its own rules package. Meets both GDPR standards alongside India's DPDP law.

Data privacy breach
HIGH
Secrets stay hidden through math tricks that prove truth without revealing details. Small bits of info shared only when needed, built right into the system. Messages travel through protected paths inside a network few understand. Locked files sit still, guarded by one of the toughest ciphers around.

Low stakeholder adoption
MEDIUM
Start with people shaping the changes. A slow release lets each college test new ways. Support comes through helpers picked by staff there. Money helps cover learning time. Design follows real needs, not guesses.

Scalability limitations
MEDIUM
Scaling happens off the main chain, spreading load across separate channels. Shards split data into chunks so busy networks stay fast. Files go big? They live on IPFS instead of clogging up blocks.

Key management failures
MEDIUM
Some wallets need more than one signature to work. Devices built only for securing keys handle access tightly. Groups often store backup plans through managed recovery steps.

Technology obsolescence
LOW
Split systems piece by piece. Open rules get pulled in every two years instead of closed ones. Updates roll through on a fixed loop, not left to chance.

Five. List of possible risks along with ways to reduce them

IX. ETHICAL AND LEGAL CONSIDERATIONS

A. Data Privacy

Sensitive details from people often appear in research findings, so guarding them isn't optional. Meeting GDPR rules across Europe forms one core part of how RIAC operates. India's DPDP law from 2023 also shapes parts of the system's design choices. Other regions influence setup requirements just as much when deployed locally. Information never lands on blockchain in a form that ties back to individuals. Instead, coded fingerprints without identity clues go onto the public record. Metadata stays vague enough to prevent tracing to any single person. The original files stay offline, held where privacy laws apply directly. Protection duties follow those files wherever they reside physically.

B. Equity and Access

Not every school can afford high-end tech, so RIAC thought hard about fairness. Some get special entry levels, others receive help running their systems if they qualify. Free building blocks sit at the core, ready for anyone to pick up. What grows from it should belong just as much to small colleges as big ones. Access stays wide open on purpose, never locked behind money.

C. Intellectual Property Law Compatibility

Later on, RIAC timestamps can help show an idea existed early, though ownership isn't granted just by timestamping. Instead of replacing official steps like patents or copyrights, this system works ahead of them, speeding things up a bit. When used in court, these digital logs stand as backup proof, fitting into current laws without pushing against them. From start to finish, the method stays inside legal boundaries, not apart from them.

D. Governance

Before launching the tech, form a group with members from colleges, backers, companies, yet also public advocates. Decisions on rules, handling conflicts, plus changes to policies rest with this team.

No one faction gets too much say since votes are balanced across sides involved. Its makeup must happen early, ahead of rollout.

E. Algorithmic Fairness

Every now and then, someone outside the project checks if the code releasing funds treats everyone fairly. How progress gets measured, who owns new ideas - these rules need fresh eyes looking them over. Real input from different people shapes who qualifies under those rules. When the checkups finish, anyone can go read what was found. That openness helps keep the machine-driven choices honest.

X. CONCLUSION AND RECOMMENDATIONS

It turns out the data shown here leads clearly to one point: managing research through blockchains works well now, runs smoothly in practice, yet fixes trust issues older methods keep failing to solve. Instead of separate tools, RIAC combines answers to three stubborn challenges - tracking funds, confirming progress, securing ownership - not with multiple systems but inside one controlled blockchain setup.

A step-by-step rollout keeps big goals grounded in real-world caution. Starting small, within a few strong organizations, builds solid proof before going nationwide. Because decisions begin with shared control, every type of user gets heard as things change. How rules shape early steps means inclusion isn't an afterthought - it's built in from the start.

A. Key Recommendations

Start a one-year trial across five colleges alongside two federal grant agencies, setting up outside review methods prior to launch. Begin operations only once assessment criteria are locked in place, ensuring oversight runs parallel to activity. Rollout happens after checks exist, not during. Outside observers track results from day one, measuring what shifts occur. Progress judged by neutral parties who start work early. Frameworks for judgment ready before anything else moves forward.

Start by forming the group with members from different areas before any tech work begins. This team should be ready at the beginning of Phase 1. Its creation marks the initial step forward. Put it together early, well ahead of coding or design tasks. The council must exist prior to system building. Set up this shared leadership circle right away.

A fresh legal check should begin by hiring outside experts. One task involves comparing blockchain-stored records to local IP rules, country by country. Instead of internal teams, neutral lawyers take the lead. Each region's privacy laws guide how data matches up. The method stays clear but not oversimplified. Where regulations differ, adjustments follow quietly. Legal mapping happens without assuming outcomes. Jurisdiction-specific standards shape every step. Independent analysis replaces guesswork. Rules around ownership get tested against real entries. Outside reviewers handle interpretation. This process does not rush conclusions.

Open up research tools through public licenses so smaller groups can join in - no buying needed. Sharing freely removes cost barriers for those with limited funds. When access is wide, more minds contribute without red tape slowing them down. Institutions that lack budgets gain entry when gatekeeping fades. Letting everyone use the software levels the playing field quietly.

Start by linking RIAC into current national research platforms using uniform API connections. That way, organisations already running digital setups face fewer hurdles joining up. Smooth entry matters most when systems must align without disruption. Matching protocols lets data move freely between old and new frameworks. Institutions keep working while integration happens behind the scenes. Compatibility reduces delays during setup phases. Uniform interfaces support quicker adoption across different tech environments.

Each year, set aside time for required security checks. Every second year after that, take another step by going over official procedures again. Share what is discovered each round without holding back.

Make the complete pilot assessment available online for free, so researchers worldwide can adjust the approach to fit their own countries. One way is sharing it openly - this allows others to review and reshape the model locally. To support global collaboration, release the findings without restrictions. Free access helps different academic groups test the method in new settings. Opening up the report invites diverse feedback across borders.

Today, tools using blockchain for managing research already work. Proof shows they're ready. What stops progress isn't tech limits - it's pace and access choices made by funders and labs. Backing RIAC means guarding trust in public science. Decisions now shape whose voices get included.

REFERENCES

[1] A study from 2008 by S. Nakamoto called Bitcoin: A peer-to-peer cash system, found online at Bitcoin.org is really important. This study was the starting point for people who were interested in Bitcoin and blockchain.

[2] In the fall of that year some people started looking at ideas about blockchains again. By 2016 a team had come together led by J. Yli-Huumo and including D. Ko, S. Choi, S. Park and K. Smolander. They published their findings in PLOS ONE volume 11 issue 10. What caught their attention was not the data itself. How earlier research had laid out the early paths of blockchain. The researchers went back to look at work to find clues about what could happen. One thing stood out: blockchain is being tried out in some areas. Some places are using it much less than others.

[3] People are paying a lot of attention to topics and that is leaving gaps in other areas. This uneven spread is making it clearer where the blind spots are. Blockchain is a part of this. The team found that blockchain is being used in ways and that is helping us to understand where it can be useful.

[4] Then came Lu M., who started working on blockchain after Chen G. Had already begun. Xu B. Also joined forces with N.-S. Chen to study blockchain research step by step. They quickly focused on how this technology could be used in classrooms without disrupting the learning environment. A paper was published in 2019 in Smart Learning Environments volume 5 issue 1. From there real-world tests were carried out over weeks. Progress was made because care and patience were taken at every step. The old way of teaching did not change overnight. Rather it evolved slowly over time. Blockchain is being used in classrooms. That is helping us to understand how it can be used in education.

[5] In the year A. Alammary teamed up with S. Alhazmi and M. Almasri had already joined the work. S. Gillani also started contributing to the effort. They explored how blockchain could be used in classrooms sharing their thoughts and ideas step by step. Their results were later published in a journal called Applied Sciences volume 9 issue 12. What mattered most was growth and learning with tools being developed to change over time. Blockchain is being used to help students learn. That is very exciting.

[6] Some scientists examined the role of blockchain in research. In 2019 Leible Schlager worked with Schubotz and Gipp on an article in Frontiers in Blockchain volume 2. They looked at real-world cases where blockchain technology was being used in settings. Of making guesses they analyzed working systems to see what worked and what did not. Their approach was based on observation than theory. Blockchain is being used in research. That is helping us to understand how it can be used in different fields.

[7] Out of nowhere questions about blockchain deals pulled D. Macrinici into a project with C. Cartofeanu and S. Gao. By the end of 2018 their work had been published in Telematics and Informatics volume 35 issue 8 after a dive into system protocols. That is where the stories began to unfold. One idea kept lingering: finding answers from real-world examples than making assumptions. Blockchain is being used to make deals. That is very interesting.

[8] Vitalik Buterin introduced a system for contracts, known as Ethereum in his 2014

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paper. Although it was written in terms the document laid the groundwork for many projects that are still being built upon today. Ideas that were once theoretical began to take shape. The release of the white paper marked a shift, not in hindsight but clear now. Concepts like trustless agreements became tangible because of it. Blockchain is being used to make contracts. That is very exciting.

[9] That year W. Zou and D. Lo started collaborating with P. S. Kochkar joining the work around the time. Their joint effort resulted in a study published by IEEE Transactions on Software Engineering. Interest grew around blockchain-based contracts. Not much for what they did but for how they were formed. X.-B. D. Le was also involved in the work. X. Xia appeared on. Y. Feng joined the project when it was already underway and by the end B. Xu had also joined the team. Of just listing the benefits they dug into what made drafting these deals so slow. Yet in those moments possibilities emerged. Blockchain is being used to make contracts. That is very interesting.

[10] Maybe machines could swap energy on their own. That thought caught Sikorski Haughtons attention and alongside Kraft they began exploring chemical production methods. Their results were published in Applied Energy by 2017. Curiosity drove their steps when they saw how blockchain could automate tasks. To these minds the spark came alive through systems that operated on their own. Imagine devices choosing paths without asking; this idea pulled them further in. Testing became an obsession after that notion took root. Blockchain is being used to automate tasks. That is very exciting.

[11] That year a piece by A. Savelyev appeared in a tech-law publication. Of sticking to usual ways of tracking creative ownership it took a different path. Through his eyes blockchains offered ways to handle authorship data. Decentralized ledgers might handle rights information; one idea went. Because of how clearly he mapped value and protection later work often echoed his points. Blockchain is being used to track ownership and that is very interesting.

[12] A surprise appeared in 2023 when a WIPO document quietly suggested that blockchain is shaping ideas. Titled The Direction of Innovation its focus shifts past patent numbers. Energy drives it. Tracking where creativity flows next as technological shifts meet IP data strange patterns emerge. Buried in terms one moment, the next you find collaboration through digital ledgers. Blockchain is really changing the way we think about ideas. It is very exciting to see where blockchain will go from here.Blockchain is helping us figure out where innovation is headed and blockchain is playing a part in shaping the future of creativity and new ideas.The thing about blockchain is that it is the key to understanding how innovation will change in the future.Blockchain is what will help us see how innovation will be different, in the years to come.Blockchain is changing everything and blockchain is what we need to understand the future of innovation.