Arthur D Little

Digital Transaction

Blockchain Market Opportunity

Final Report

February 2020

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2 ParallelChain™: Architecture and features

3 Business use cases: In-depth assessment of selected market opportunities

4 Implications for Digital Transaction Limited

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Digital Transaction

Distributed ledger technologies are key to creating efficiency, security and transparency in the digital and connected economy

Evolution to a smart economy

- **Internet of Things:** >25 bn connected devices in 2025
- **Digital representation** (and management) of all assets
- Autonomous systems and processes **increase inter-dependencies**
- Smart **business networks with temporary, focused partnering:** loosely coupled, highly specialized
- Agility and **speed** in execution
- Increasing **regulatory requirements** for data protection and sustainable data management

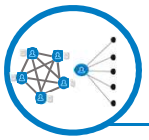
Characteristics of the smart economy

- **Digitally stored value**
- **Rapid pick, plug and play** (for partners)
- **Transaction orientation**
- **Autonomous**
- **Open and modular**
- **Augmented**

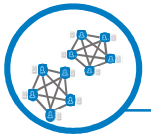
ParallelChain™

Source: Arthur D. Little

Blockchain and distributed ledger technology are used interchangeably but refer to two distinct technologies…



Distributed Ledger Technology



Blockchain

	Distributed Ledger Technology	Blockchain
Definition	**A database held and updated independently** by each node in a network.	**Advanced DLT** defined by its data structure storing & transmitting data in a "**block**" connected in a continuous digital "**chain**"
How data is stored and managed?	**Decentralised data** Records independently constructed & held at each node. Data is shared & synchronised between nodes. When consensus is reached, each node maintains an identical copy of the 'true' ledger	**Decentralised data** Common with DLT, there is no central database as records are held independently by network nodes
Governance	**No central authority** To communicate to each node, store data or determine the 'truth', requiring consensus	**No central authority** Organisation, structure & technology is decentralised, consensus reached by 51% rule (proof of stake) or proof of work

Differentiator

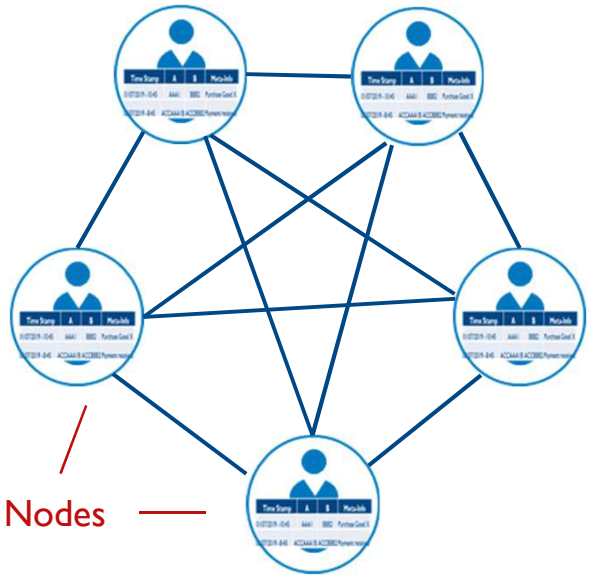
Blockchain uses algorithmic methods to record and synchronize data, establishes rules for reaching consensus, and stores records in an immutable chain

▶ Note: Hybrids of DLT and Blockchain are emerging which diverge from the pure forms described above

Source: Arthur D Little

Distributed ledgers reach consensus by synchronisation of records between independent network nodes to agree a source of truth

Distributed Ledger Technology: Overview



1 Physical actions are broken down into a number data points

Time Stamp	A	B	Meta-Info
01/07/2019 - 10:45	AAA1	BBB2	Purchase Good X

2 Each node independently creates and stores a record (ledger) of the data points

3 Nodes share data in the ledger to confirm its validity

4 When consensus is reached, each node synchronises its ledger to the correct record.

Benefits and drawbacks of a distributed ledger:

- Rapid transaction speed due to **decentralised database** architecture, with low latency of transaction confirmation
- Decentralised control - no single authority can impair or determine the truth
- Past records are not immutable and records are not secure (can be read by other parties)

Source: Arthur D Little

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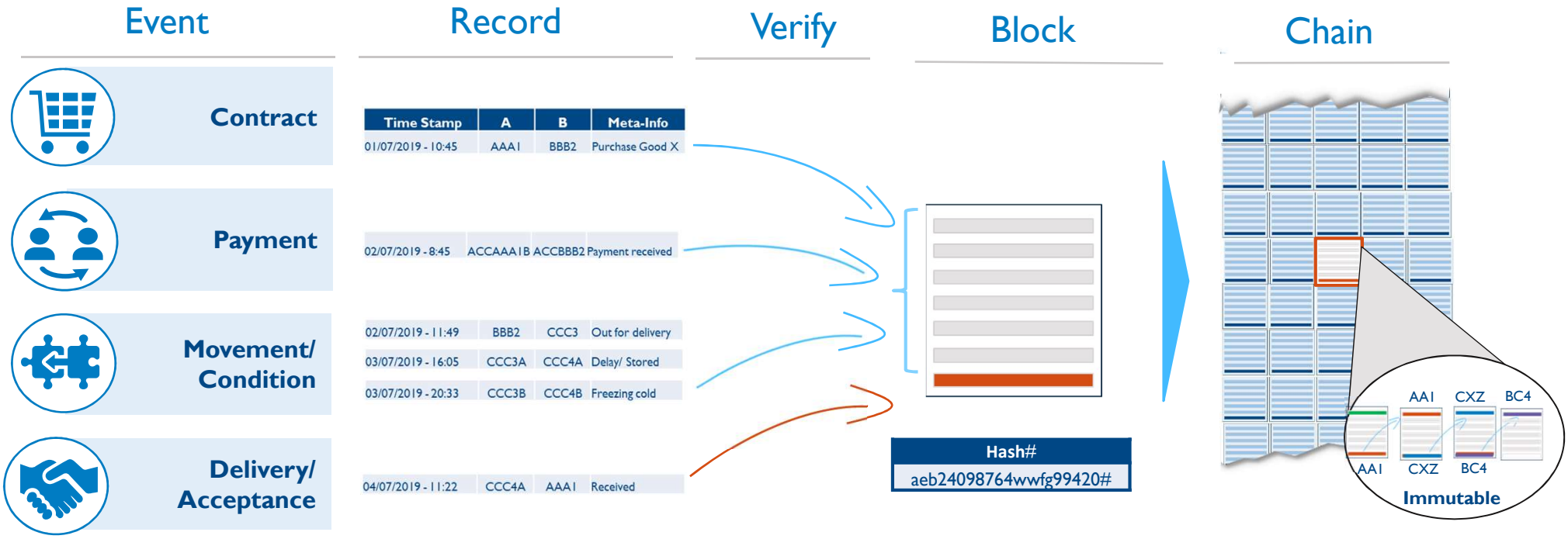
Blockchain creates a 'block' of stored data (transactions, ledger records) in a digital 'chain', with the differentiating property of immutability

Blockchain: Overview



1. Physical actions are broken down into a number data points
2. Each event is recorded in a ledger database – **sequential by design**
3. New entries must be **verified** before being added to block (i.e. consensus required)
4. Unique **Hash#** value created for each block, to identify group of records
5. Chain created in **chronological order and linking hash values**, thus it has immutable characteristic

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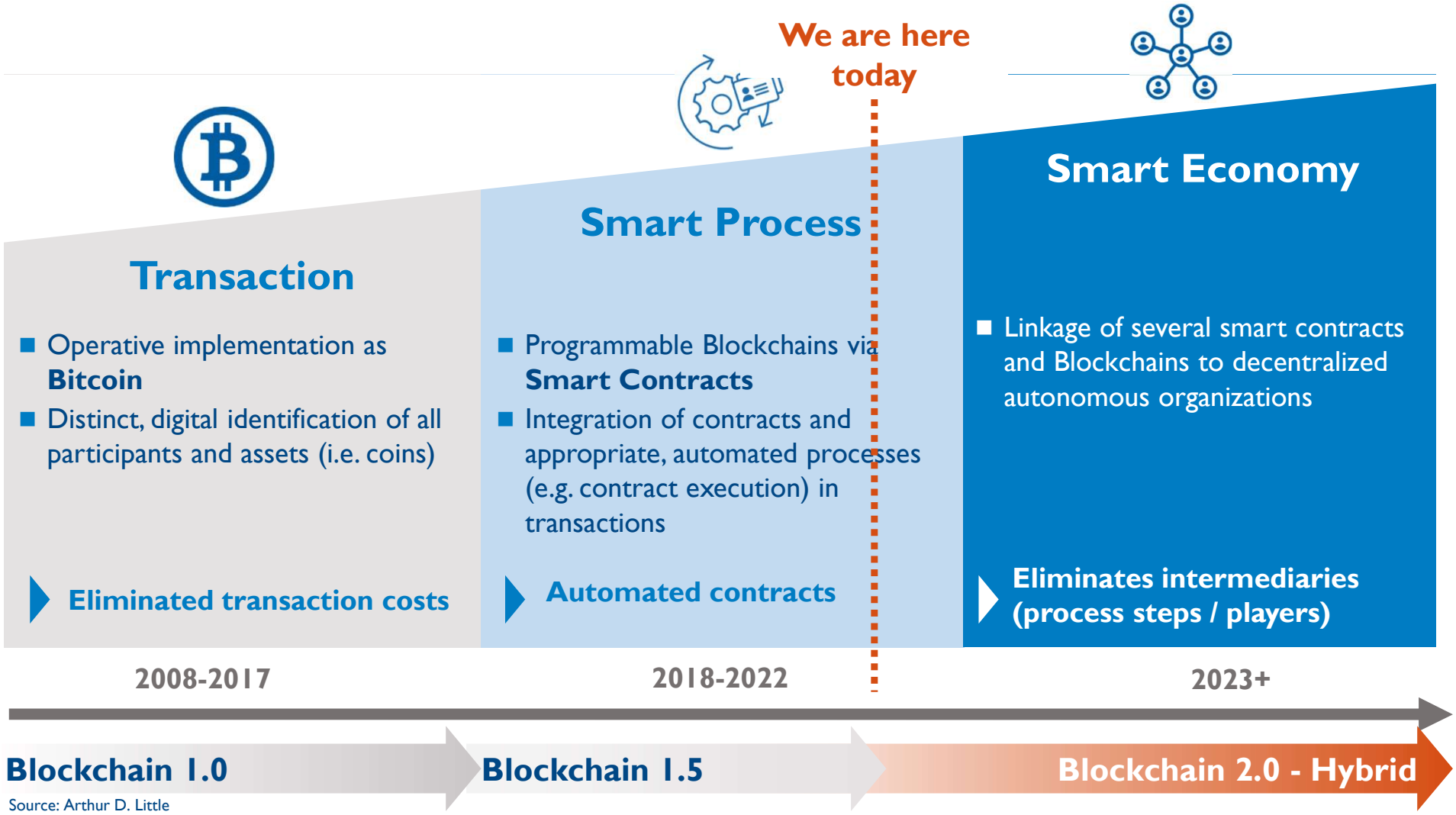
Distributed ledger technology has evolved from cryptocurrency to supporting process improvement and will enable the smart economy



Source: Arthur D. Little

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Characteristics of blockchain support business process optimisation by addressing current challenges & creating new market opportunities

Blockchain Characteristics

1. Immutable	2. Decentral	3. Transparent	4. Control	5. Automated	6. Transactional
Secure single source of truth which cannot be altered	No central authority controls or stores data	Data auditable by third parties and traceable	Records validated by consensus and/or individual	Digitally held, records can create smart contracts	Developed from distributed ledger technology

1 Addresses existing business problems

- Increases availability of data
- Secures data
- Increases compliance
- Reduces transaction costs
- Increases trust and legal certainty

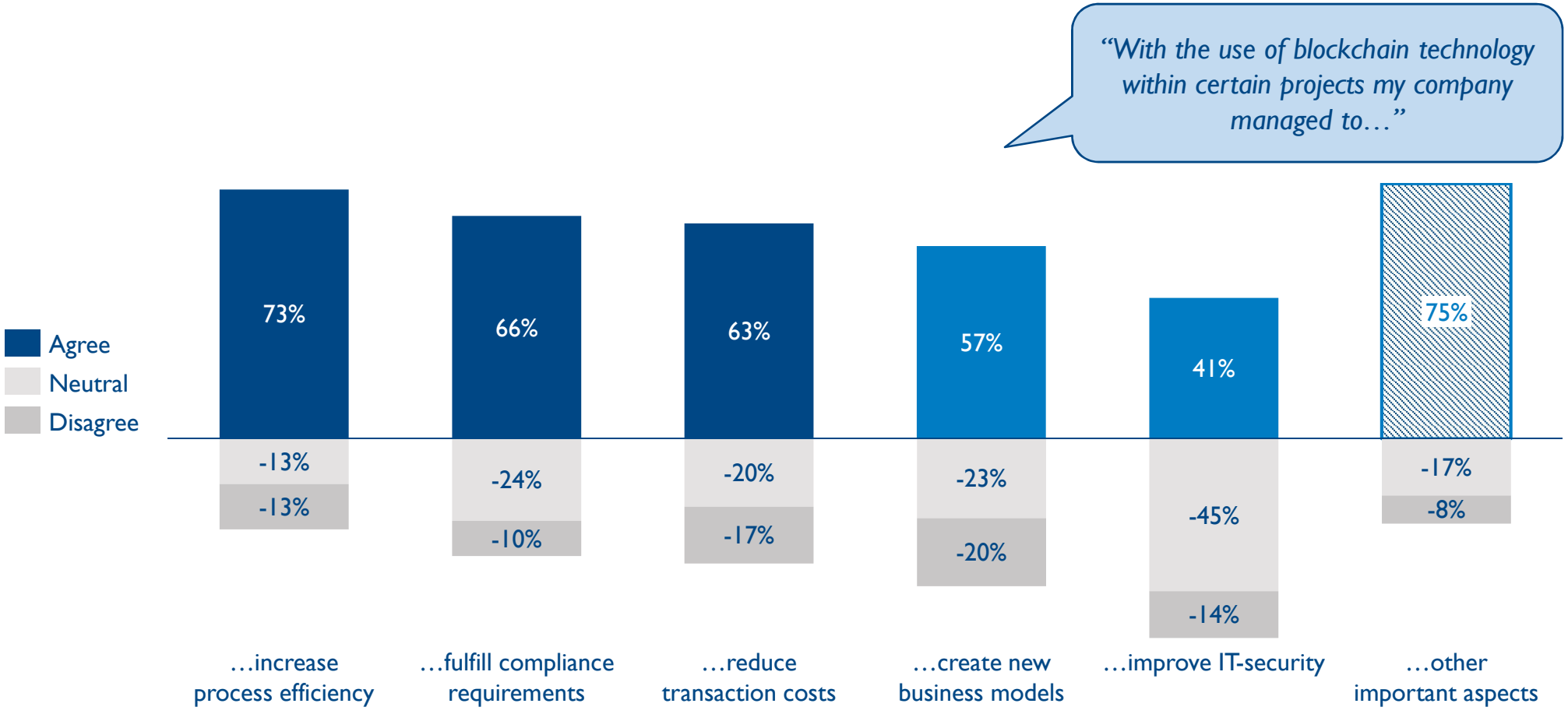
2 Enabler of the Smart Economy

Autonomous systems

Rapid pick, plug & play

Digitally stored value

Process efficiency, compliance, and transaction cost savings are the benefits of blockchain experienced by early adopters



Source: ADL's survey of the transport and logistics industry

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While most current use cases optimise existing business processes, we anticipate other sources of greater value to emerge overtime

Blockchain supports "digital business" / the smart economy

	Business **Process Optimization**	Business **Operation Re-design**	Business **Model Innovation**
	Digitizing (manual and labour intensive) business processes	**Re-organization of organizational structure, processes and systems**	**New logic for business models with novel services, players and ecosystems**
Why Block-chain?	■ Traceability and transparency is key ■ Multiple heterog. roles / units involved ■ „Single-truth" of data is needed	■ Connected, distributed information ■ Real-time traceability ■ Intermediaries create in-efficiencies	■ New, decentral inform. is aggregated ■ Value-creation is distr. in network ■ Data is monetized
Examples	✓ **Inter-company invoices** ✓ **Managing access rights**	✓ **Tracing cargo end-to-end** ✓ **Assets booking service autonomously**	✓ **360° customer data** ✓ **Monetizing customer data**

Enabling digital business with more efficient and effective architecture and processes

Potential for disruption new ways of generating revenue

Source: Arthur D. Little

Benefits from operational redesign are now starting to emerge - some examples…

Blockchain is being used with other technologies (incl. AI, IoT) to create **seamless processes for Dubai city stakeholders** by redesigning processes to provide excellence in customer experience and international leadership in the field.

Walmart and nine other food companies have partnered with IBM in food logistics. The aim is to improve the **diagnosis of issues involved with food recalls**, such as tracing outbreaks more quickly to limit customer risk. Walmart joined the initiative after the outbreak of salmonella in its supply chain.

Blockchain is currently being used to **track high-value cargo**, with plans to extend to all shipments. Blockchain based **industry standards** for supply chain logistics are being developed and new operational designs explored.

Source: Arthur D Little, Graphic source: IBM, Fedex and Smart Dubai

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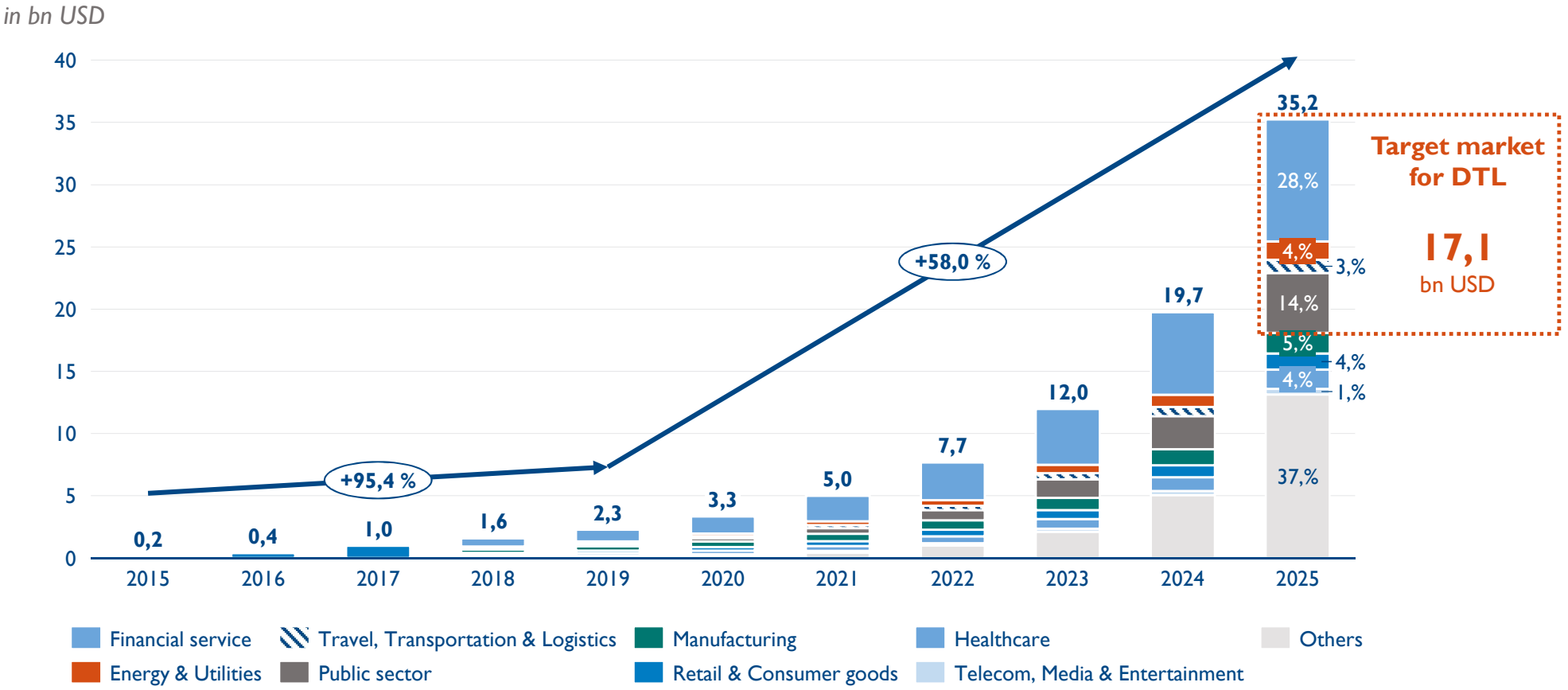
Market for distributed ledger solutions is growing rapidly: forecast CAGR of 58% from 2019 to 2025 - total market to reach US$35.2bn by 2025

Evolution of global market for distributed ledger solutions



Source: Statista, Arthur D Little analysis

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Industry adoption by Blockchain is driven by maturity and performance of systems – ParallelChain™ is ready for the current wave in ENUT & T&T

Timing, drivers and catalysts of change: „one size does not fit all“

Evolution by industry…

	2008-2017	2018-2022	2023+
Drivers	**Cost reduction**, **security**, operational optimisation (already highly digitalised / sequential processes)	**Decentralised energy, dynamic pricing, revenue sharing**, , **traceability**, interoperability	**Cost reduction (automation), service improvement**, data security, customisation, industry convergence
Catalyst	**Risk management - Decentralisation of IT systems**	**Change in business needs - Clean energy/ CO2 reduction, traceability of products**	**Change in business model - automation, homecare, eGov services**

▶ Opportunities are cross-cutting - i.e. data security is relevant to financial services, healthcare & other sectors)

Source: Arthur D. Little

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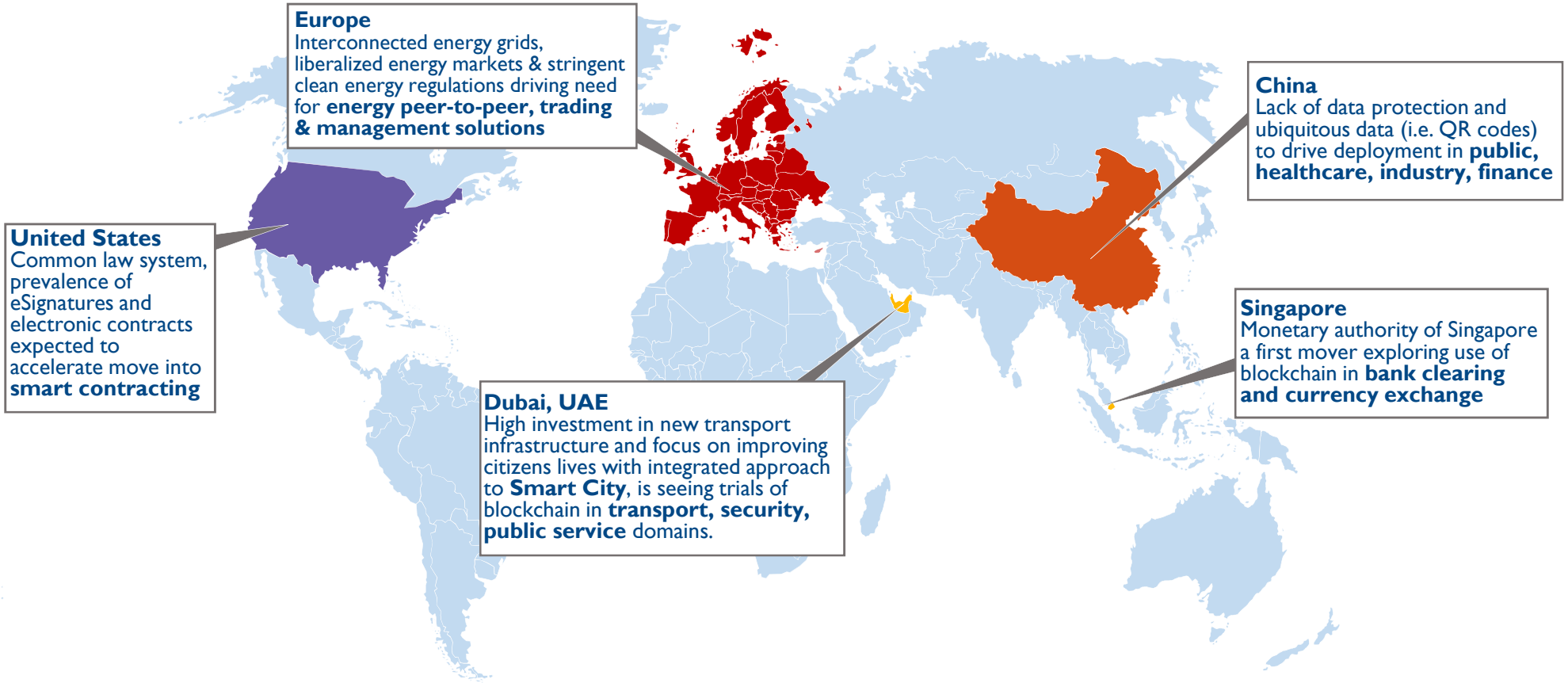
Geographically we expected the uptake of blockchain to differ widely by industry due to cultural and regulatory factors

SELECTIVE – Not Exhaustive

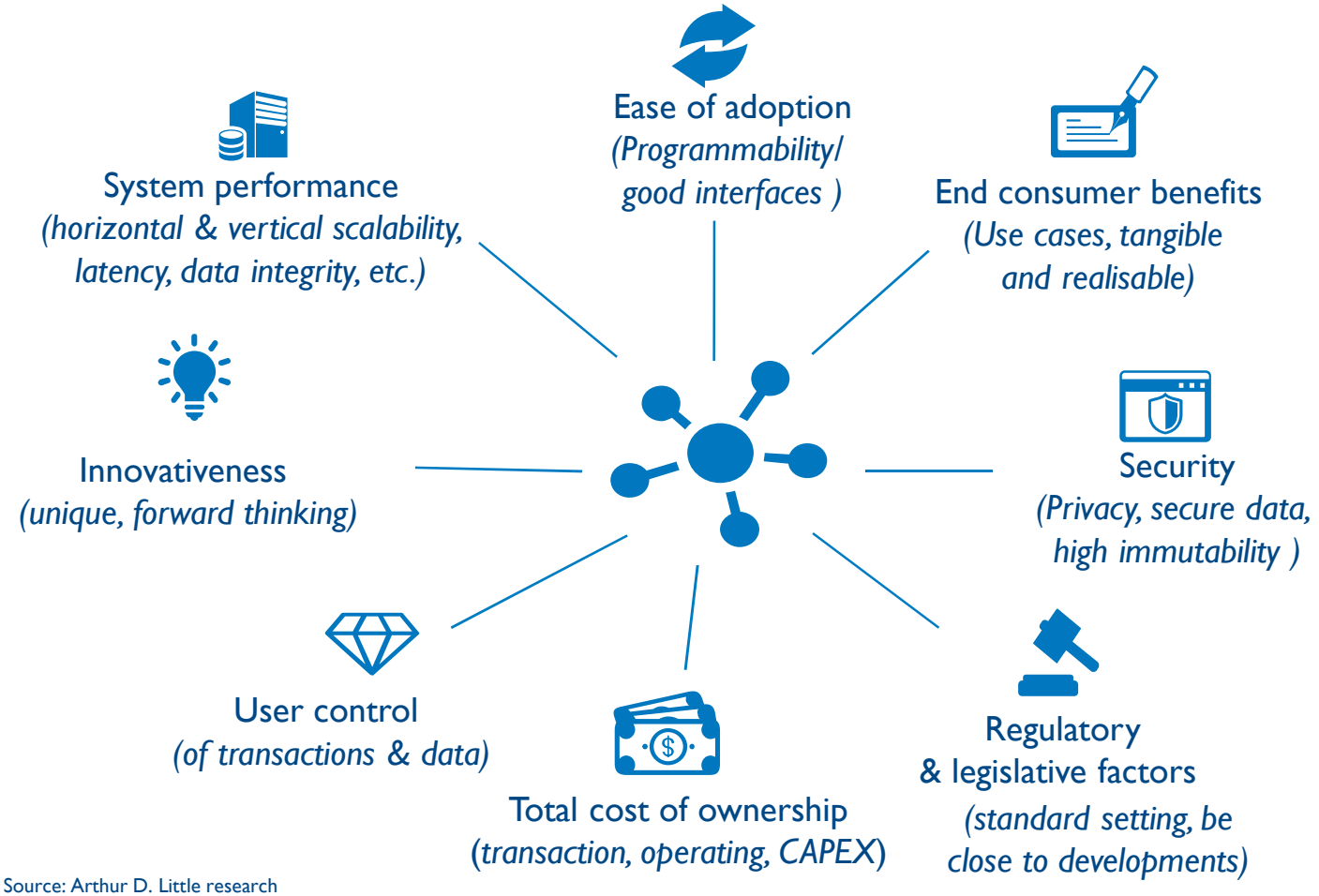
Blockchain: Anticipated first movers by geography



Source: Arthur D. Little research

Solution competitiveness is major factor in industry blockchain adoption, varying by business use case

Solution competitiveness: industry drivers



Key Takeaway

- Uptake of blockchain is dependent upon more than technology
- We will assess the competitiveness of other solutions on the market to identity the 'niche' opportunities most attractive for ParallelChain™.
- Political, regulatory, legal, technological & cultural conditions differ by country/region.

Source: Arthur D. Little research

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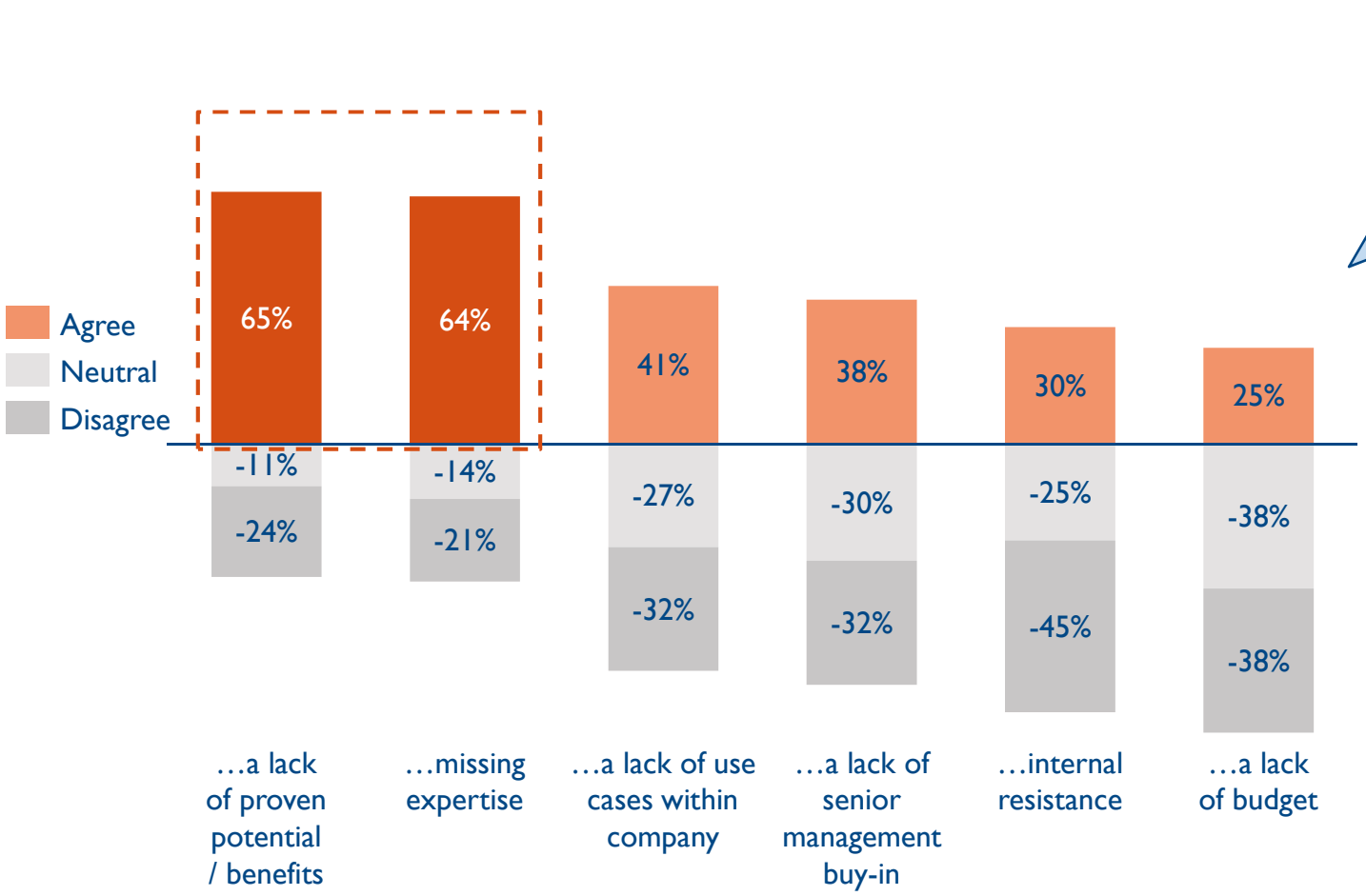
Solution competitiveness - Lack of expertise and proven value are impeding blockchain's breakthrough in the transport and logistics industry



"Implementation of blockchain projects in my company was impeded by…"

Other reasons

- Missing ROI positive business case in short term
- Customer disinterest
- Lack of proven solutions
- People don't know it
- Lack of a consortium
- Resource (time/ money) restraint

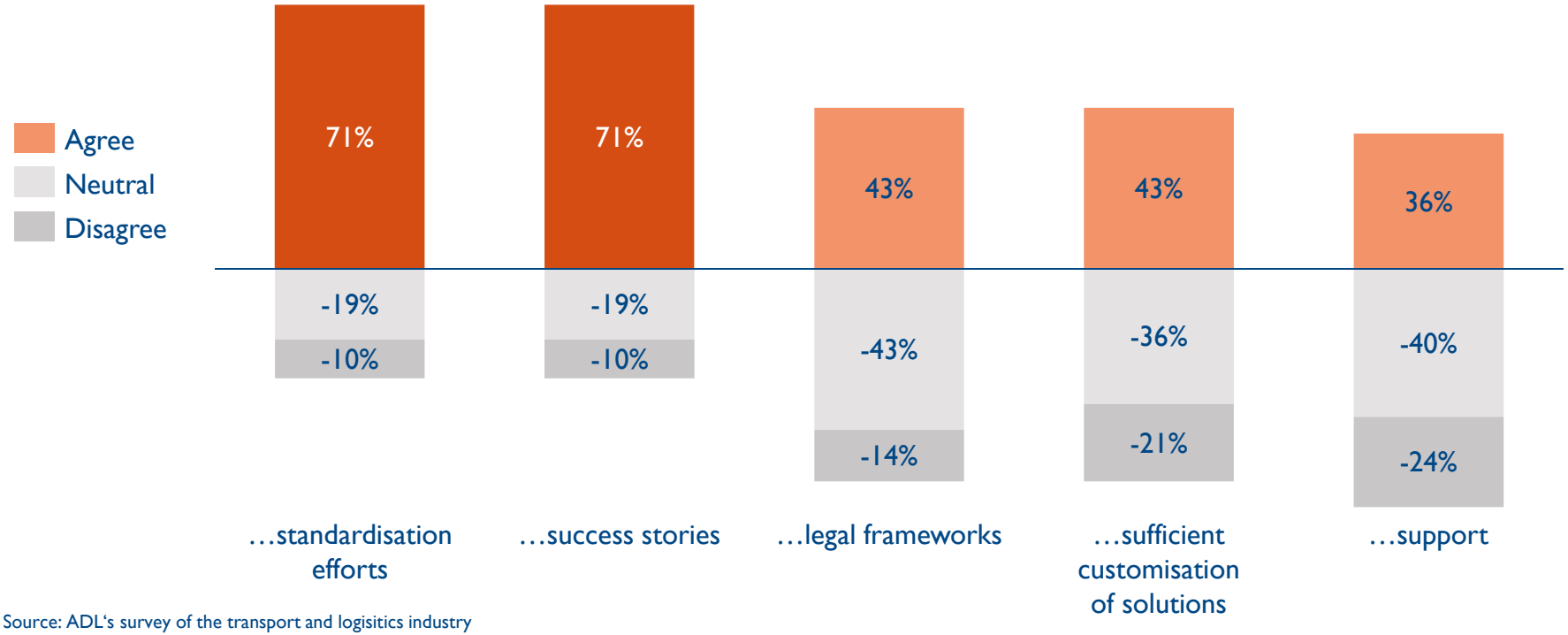
Source: ADL's survey of the transport and logistics industry

Standardisation & more success stories would be beneficial in accelerating adoption in transport and logistics industries

"So far, we **do not see business applications of blockchain that cannot be solved without** blockchain. We pilot and learn, but we do not depend on blockchain solutions in our business yet."

- *Survey participant*

"A breakthrough of blockchain technology within my company's industry is impeded by a lack of…"



Source: ADL's survey of the transport and logisitics industry

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Digital Transaction Limited (DTL) is a emerging provider of high performance distributed ledger technology, based in Hong Kong

Start-up established in 2018 by experienced veterans in computer networking, database, cybersecurity, and computer design disciplines from MIT, Carnegie Mellon, Harvard, Hong Kong University of Science & Technology, among others.

DTL's vision is:

- Industry specific solutions based on ParallelChain™
- Development of partner network for solution implementation (i.e. Customization, app development, integration)
- Successful Asia-based solution provider

ParallelChain™ is a second generation permissioned blockchain system designed to address the limitations of current blockchains on the market and increase performance

Killer Applications provide real world business solutions – e.g. **ChattelChain™**, **ConstructionChain™, PreventiveChain™, ApprovalChain™**.

Source: Arthur D Little interviews and DTL company documentation

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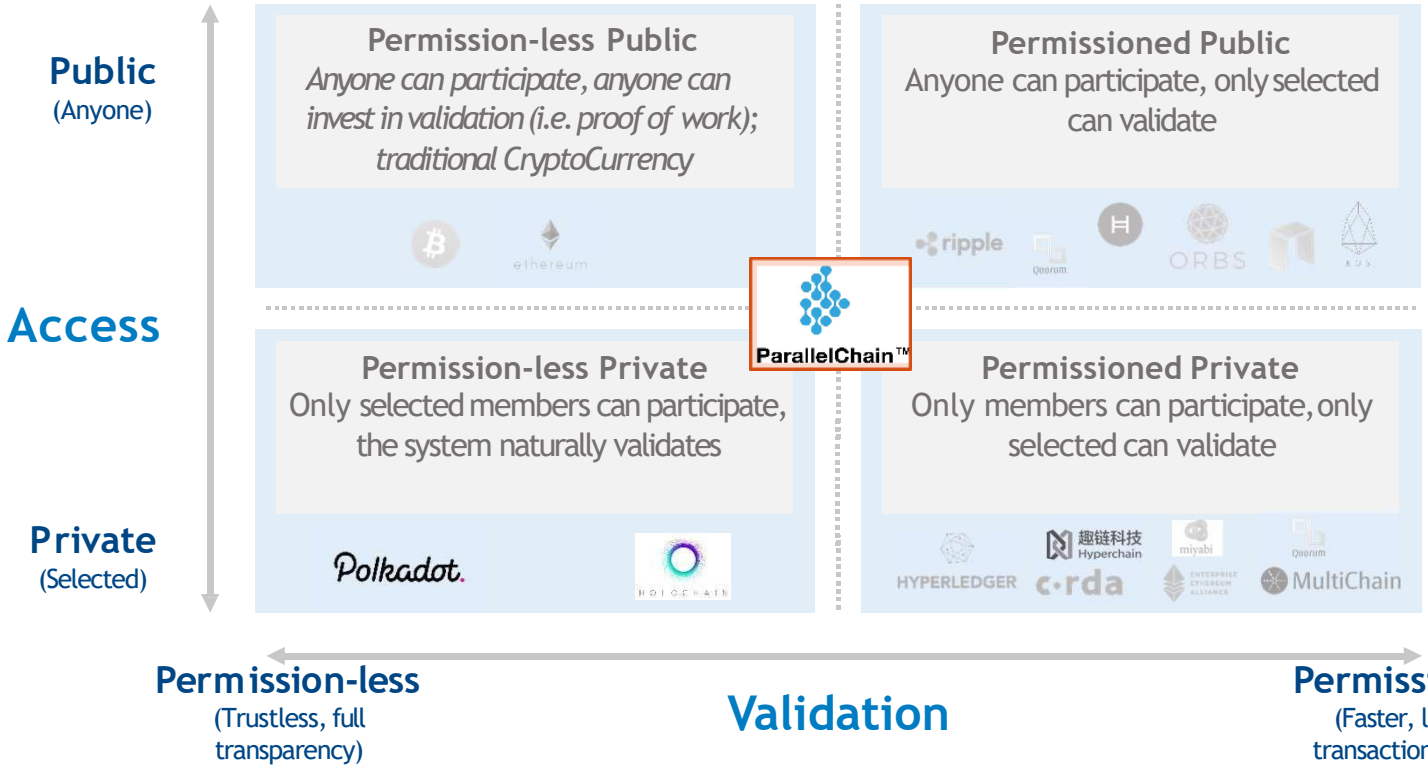
Distributed ledger technologies are technically categorised by their access model & data validation – ParallelChain™ is private with both validation features

Distributed ledger technologies

SELECTION



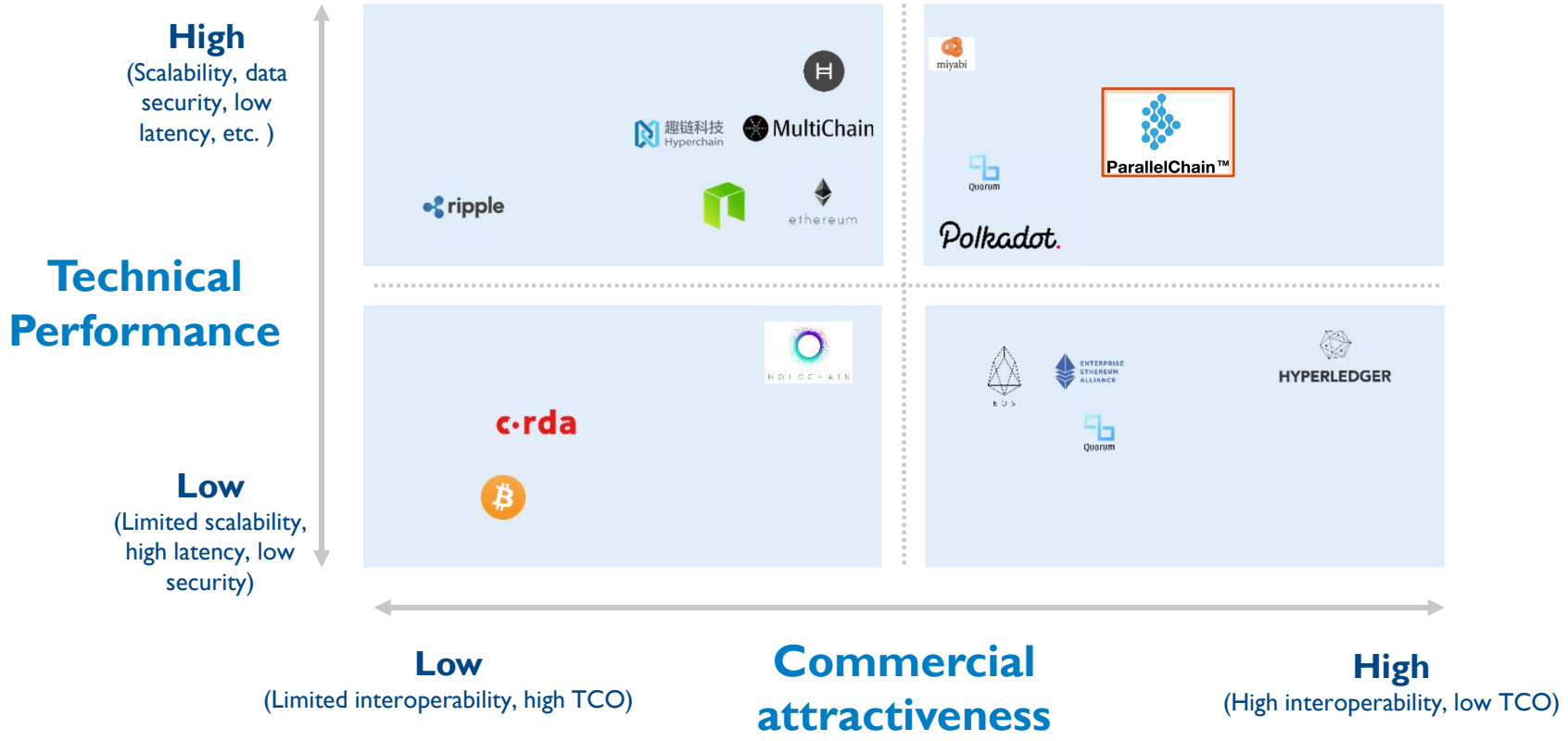
ParallelChain™ is a hybrid private blockchain solution with both permissioned and permission-less functionality, addressing the limitations of early blockchain solutions (Hyperledger, Ethereum, Bitcoin, etc.)

Source: Arthur D. Littleanalysis

In terms of commercial attractiveness and technical performance, we consider ParallelChain™ to be a second generation technology

Distributed ledger technologies

SELECTION



Source: Arthur D. Little Analysis

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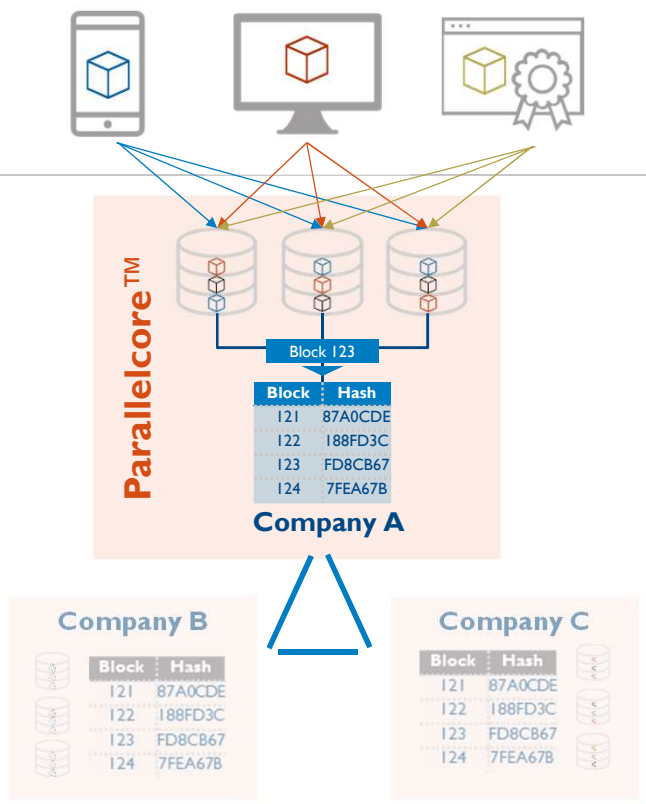
ParallelCore™ is the central component for executing smart contracts, storing data and creating hash values for the decentral Physical Chain

Logical structure for ParallelChain™ based system

Applications

Platform
ParallelChain™



KillerApplications

Execution of business process/ logic using common application backend engine

- Business process integration / data management

ParallelCore™

Multiple, parallel chains acting as distributed database system; creating individual transaction hash value combined into new participant specific block

- High performance: latency, transaction speed, scalability
- Ease of integration: common data structure, interfaces
- Ability to forget
- Execution environment for smart contracts

ParallelHash™

Hashed values of participant (e.g. Company A) specific transactions, stored in participant's ParallelCore

- Tamper resistance and immutability
- Cross-organization transactions

Source: DTL Whitepaper, Arthur D. Little

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ParallelChain™ features and differentiation potential

	Requirements / purchase criteria	Relevant ParallelChain™ features	Differentiation: Selling point	Differentiation: Premium	Differentiation: Unique selling point	Strengths/ Weaknesses
Performance	Elasticity & horizontal scalability	Elasticity: up-to 100,000 TPS[1] from single node	●	●	●	★
		Horizontal scalability: up to 10,000 participants	○	○	○	
	Latency	Real time update	●	○	○	
		Proof for transaction	●	●	●	★
	Data integrity	True immutability	●	●	●	★
		Ability to be forgotten	●	●	●	★
	Privacy and security	Public key infrastructure	○	○	○	
		Pre-emptive access control mechanism	●	○	○	
		Protection of enterprise: No sharing of private company data	●	●	○	
	Consensus	No consensus required	●	○	○	👎
Enabling	Programmability	Full smart contract support (Go, Solidity)	●	●	○	★
		Open ParallelChain™ API, open ParallelChain™ SDK	○	○	○	
	Interfaces	Etherium and Hyperledger connector	●	○	○	
		Execution of Hyperledger Smart Contracts	●	○	○	★
	Geographic interoperability	Supports applications in China and rest of the world	●	○	○	
Operations	Transaction costs	None	●	●	○	
	Operating costs	Total cost of ownership comparable to similar solutions	●	○	○	

Source: Arthur D. Little

1) TPS = Transactions per second, performance proportionally increases with number of nodes

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Consensus in ParallelChain™ offers performance enhancing features in some applications

Public Blockchain 1.0

Node makes a transaction and awaits confirmation

Each node is **unknown to each other**, so 51% rule used to determine truth and consensus

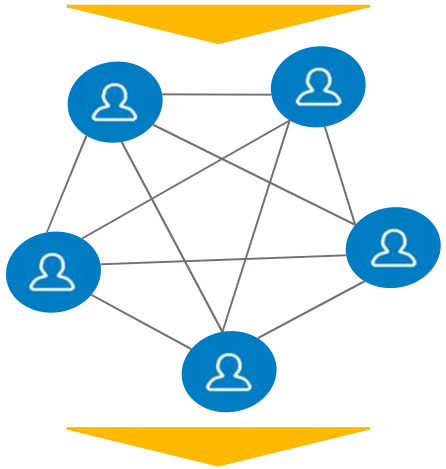
- Democratic process determines the truth (51% or more users must confirm the transaction)
- Optimal when users do not know each other (i.e. public market place) to establish trust
- A synchronised process, it takes time for each node to confirm the transaction (high latency), thus is slower at confirming transactions compared to a hybrid blockchain

Hybrid Blockchain 2.0

Node makes a transaction and awaits confirmation

Each node is **know to each other** (i.e. Within the same company) or pre-vetted (i.e. verified users)

ParallelChain™



- Known to each other, trust is pre-established such that a consensus mechanism is not required
- An authority can determine the truth (i.e. makes a ruling on whether the transaction is valid) if a dispute occurs
- In a consortium the authority can be the administrator, CEO or leading participant
- Validation of the transaction in this way makes confirmation a much faster process (low latency)

Source: Arthur D Little analysis

There are situations where no consensus in ParallelChain™ is advantageous to users and brings performance advantages

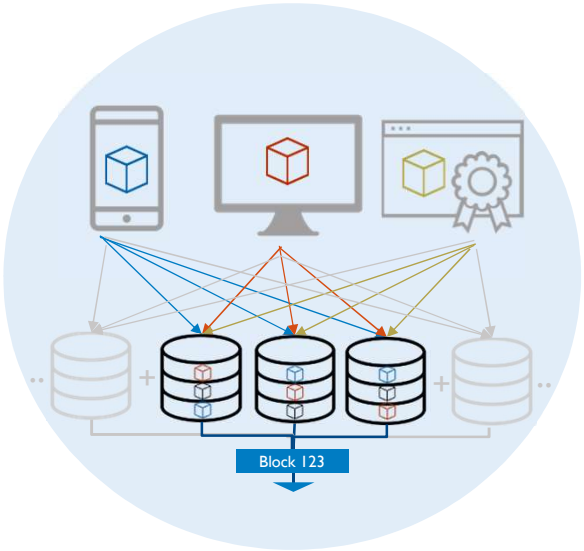
No consensus in ParallelChain™

Use Case	
Consortium	In a consortium between known participants, a lead authority can be established. Examples of where a single authority can be defined include: ■ Consortium of suppliers and contractors to a single customer (i.e. OEM) ■ Logistics provider responsible for end-to-end order fulfilment (i.e. DHL) ■ Owner of a loyalty programme which others are participants (i.e. airline alliances)
Registered Users	Registration of users allows vetting of those in the network to establish trust and prevent disputes arising (i.e. as identity, financial funds and ownership can be pre-determined and validated. Examples include: ■ Online trading platforms (i.e. for tokenised assets) ■ Consortiums of companies (i.e. bank clearing systems)
Internal ledger	Within companies a single source of truth exists for internal systems, that of the CEO, CFO or system administrator. Consensus in such cases is not required

Source: Arthur D Little research and analysis

Core performance parameters: ParallelChain™ (1/2)

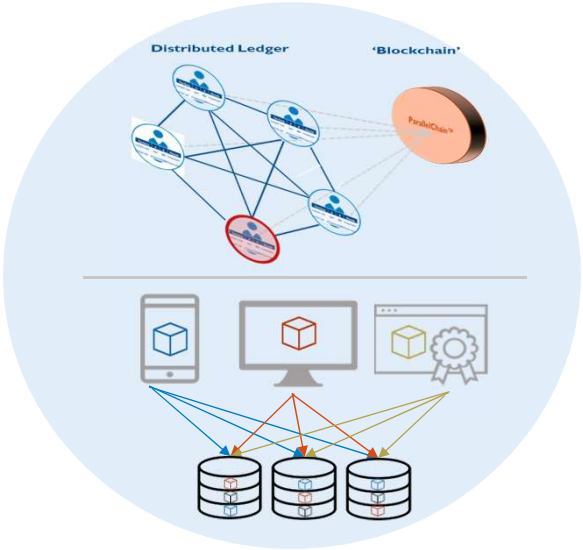
Elasticity



Transactions processed in parallel across multiple nodes. Hash value ensures sequential processing and traceability.

Additional nodes add to processing capability & capacity continuously

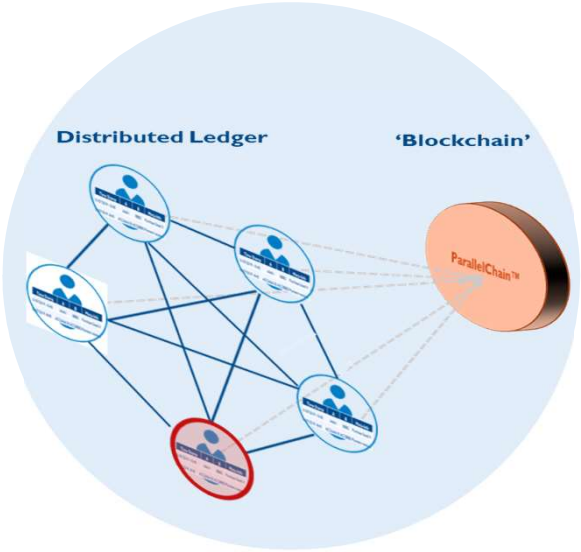
Latency



Confirmation of transactions occur in the 'distributed ledger' layer of ParallelChain™.

Consensus is assumed with private network, so very low latency. Forking is not possible as although asynchronistic truth is always apparent in time to verify transaction

Immutability

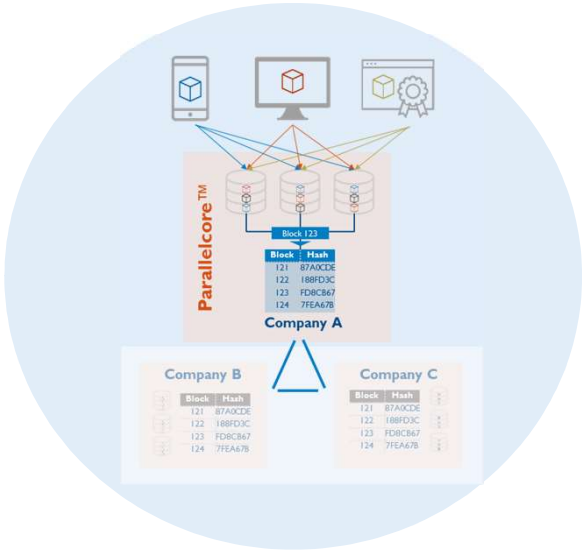


Blockchain sits at the back of of the distributed ledger recording the hash corresponding to the actual record held in the relevant network node. Stored in the chain, records are fully immutable.

Source: Arthur D Little analysis

Core performance parameters: ParallelChain™ (2/2)

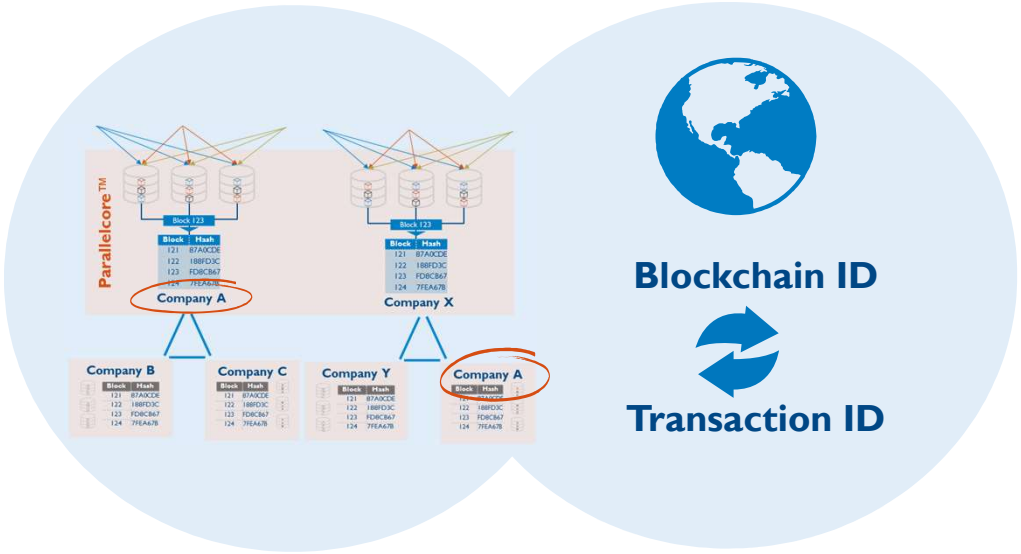
Ability to be forgotten



Blockchain only stores hash values corresponding to the records held on the owners IT system/ network node.

Deletion of actual data is possible, leaving only the hash value as proof that a transaction between A and B took place

Dispute resolution



If company A is active in more than one ParallelCore™, atomicity protocol like two phase commitment can be implemented to verify transaction.

Limitation is that more than one transaction is required to establish truth

Globally unique blockchain & transaction IDs can be compared to verify transaction was executed and the result. Disputes resolution systems (Kleros) already exist

Source: Arthur D Little analysis

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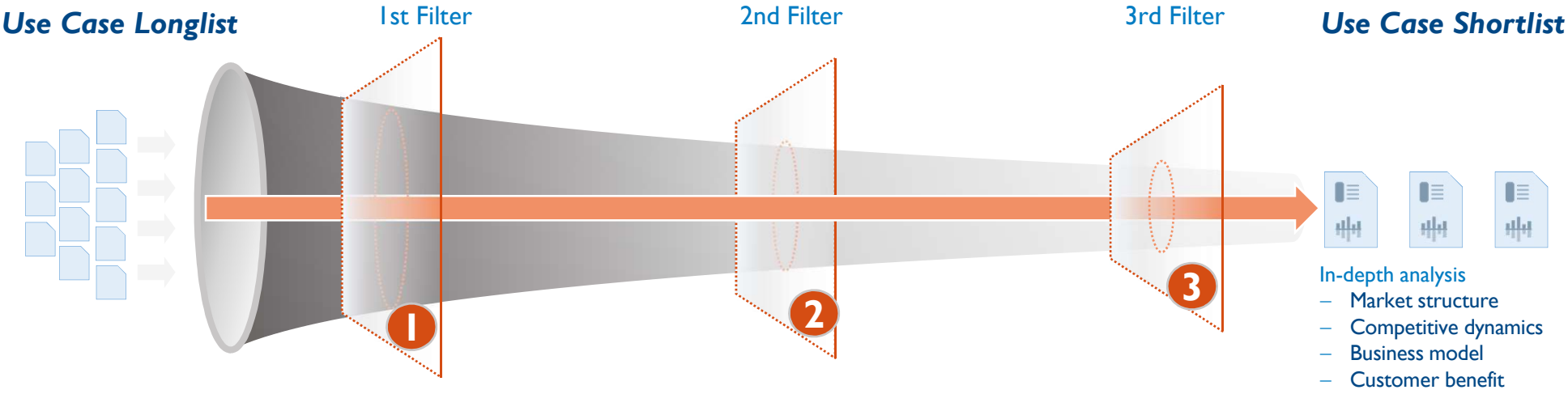
We applied three strategic filters to identify a shortlist of use cases for in-depth analysis and comparative assessment with ParallelChain™



1st Filter: Blockchain fit

- Filter to **disqualify use cases not suitable for Blockchain** (e.g. mature market for traditional IT solutions, single party involved, static data, etc.)
- Evaluate **required system characteristics**: Access: public vs. private; Validation: permissioned vs. permission-less

2nd Filter: ParallelChain™ fit to use case

- Evaluate **fit of ParallelChain™ characteristics** (e.g. transaction speed, costs, interfaces required, etc.) to the requirements of the use cases

3rd Filter: Attractiveness for DTL growth plan

- Evaluate **strategic fit** with DTL growth/ evolution plans
- **Fit with DTL capabilities** (i.e. go-to-market, operational support)
- High level assessment of market feasibility

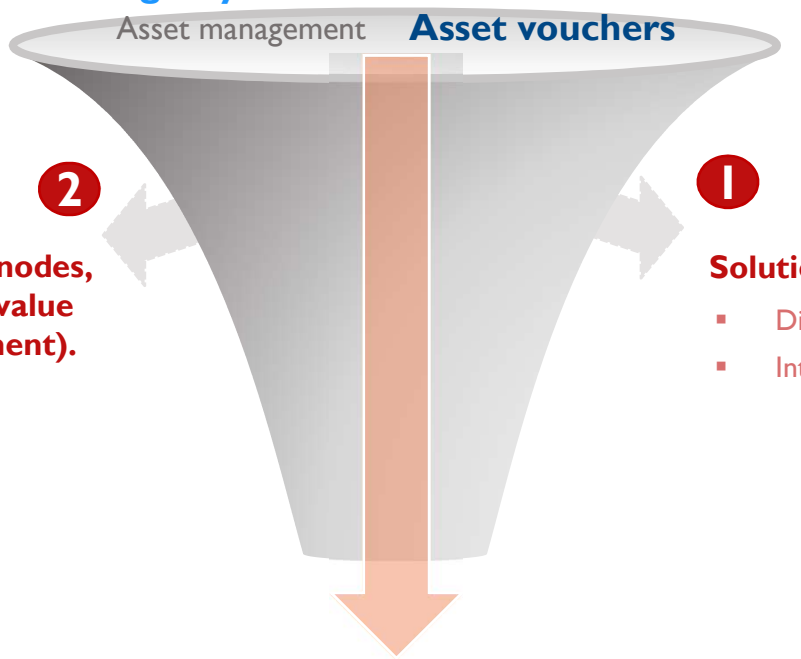
>100 use cases → **~40 use cases** → **~14 use cases**

Source: Arthur D. Little

From a long list of >100 use cases, we identified a short list of 39 where blockchain has advantages over existing solutions & there is goodness of fit

LONG LIST

Internal accounting **Contract management** Digital identity
Cross-border transactions Ticket revenue sharing
Land registry **Loyalty programmes** Rail signalling
Asset management **Asset vouchers**



2

Poor fit to blockchain (few active nodes, low user/transaction volume, low value in trust, public authority requirement).

- Internal contracting
- Internal accounting
- Land registry

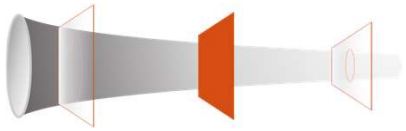
1

Solutions exist superior to blockchain

- Digital signature DocuSign Adobe Sign
- International roaming WORLDSIM

RELEVANT USE CASES

Source: Arthur D Little analysis

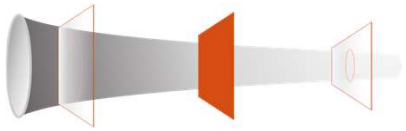


We evaluated the use case fit for ParallelChain™ based on performance requirements, business structure & solution scope

Assessment criteria for Use Case fit with ParallelChain™

(Technical) performance requirements	High parallel processing demand: Scalability >4,000 TPS[1]
	Near-real time update: Latency <2s
	Regulatory obligation for data management : Ability to be forgotten
Business and operation requirements	Regulatory obligation for full traceability and transparency: Immutability
	Near zero costs for transaction
	Known and established participants
	Full decentralization: No proof of stake / superior participants
	Focus on transaction
Solution requirements	Active data operations: Analytics, modification
	Managing rich data: storage and retrieval
	Workflow / process focused
	Asynchronized operation

Source: Arthur D. Little
1) TPS = Transactions per second

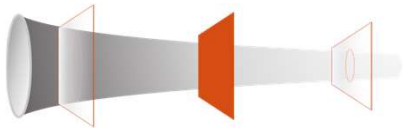


Mapping market attractiveness against the use case fit of ParallelChain™ we identified a shortlisted of fourteen (14) blockchain use cases

Shortlisted business use cases (1/2)

High attractiveness use cases		Description
Financing services & Banking	Asset tokenisation	Tokenisation allows assets, once valued, to be subdivided and traded. Blockchain provides immutable record of ownership and the quantum traded, thus establishing a platform from which shares in assets are traded or used as collateral on loans.
	Cross border payments	Distributed ledgers reduce operational costs and bring people closer to real-time transactions. Specifically, the distributed ledger technology allows transactions to be settled directly, and keep track of transactions better than existing protocols, like SWIFT for central and commercial banks.
	Clearing and settlement	Clearing and settlement of loans and securities between financial institutions is currently a slow and burdensome. Blockchain can automate to reconciliation of the ledger, improving operational efficiency.
Construction	Subcontractor management	The construction project usually involves sub-contractors from different parties, the blockchain solution enables the transparency of sub-contractor management and identify reliable subcontractors for a project through subcontractors' deliverables tracking
Transportation & Logistics	Railway management – Rail signaling	The adoption of blockchain technology can improve the railway operation efficiency and safety as part of new digital rail infrastructure
Telecommunications	Digital Identity	The blockchain solution gives individuals total privacy and control of their personal information, while making data shareable on a trusted network, enabling digital identities to be created and loyalty schemes developed
Energy & Utilities	Peer-to-peer energy grid	A peer-to-peer energy market is a shared network of individuals who trade and buy excess energy from other participants without the central authorities, such as wholesale entities
	CO2 certificate trading	Large ledger required to reconcile CO2 permits and emissions of industrial players, also with the functionality to trade permits. Blockchain can automate and ensure the security of these processes

Source: Arthur D Little research

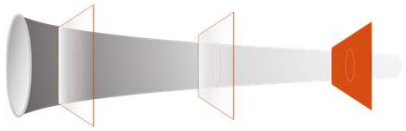


Mapping market attractiveness against the use case fit of ParallelChain™ we identified a shortlisted of fourteen (14) blockchain use cases

Shortlisted business use cases (2/2)

High attractiveness use cases		Description
Business sector	Contract management	Existing paper contracts can be placed on a shared blockchain database that every designated party can use to securely view contracts, revise and accept changes, all captured on the blockchain ledger
	Know Your Customer	Business needs to efficiently verify the identity of individuals to conduct transactions (i.e. payments), often multiple times (flight check/ boarding/ border control) Blockchain can support the creation of local identities which bring efficiency, security and convenience to users
	Access control	Blockchain can be used to maintain a secure ledger of users accessing a system recording login, usage, screenshots, etc. Combined with data on behaviour can provide enhanced security and a deterrent to would be data leakage
Healthcare	Medical billing & claim	The back-end of healthcare is slow, complex, and expensive. Blockchain, aligned with data standards, has the potential to speed up some of these processes and reduce costs
Insurance	Fraud detection and risk prevention	By facilitating better data sharing, Blockchain's shared ledger technology can save insurers the expense of paying for public and subscription data to prevent fraud
	Property and Casualty insurance	Blockchain technology enables automated real-time data collection and analysis, potentially making some types of P&C claims process up to 3x faster and 5x cheaper than at present

Source: Arthur D. Little analysis



Digital Transaction

We have selected five (5) business use case for in-depth assessment

Selected business use cases

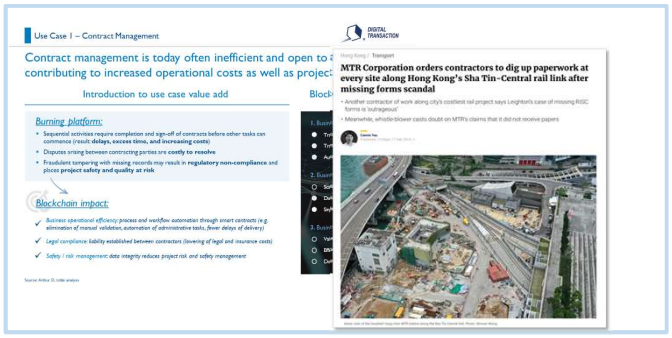
		Rationale for selection
Construction	Contract management	▪ Large market potential as construction sector representative of broader contract management opportunities in other industries ▪ Strong local demand for solution, with trial of application ongoing ▪ DTL has strong industry intelligence and experience
Financing services & Banking	Asset tokenisation	▪ Large market potential from new business model applicable to many different assets ▪ Strong fit to ParallelChain™ – high performance, private platform, ability to be forgotten, interoperability with other blockchain (smart contracting) ▪ DTL already partnered with legal and property partners to realise opportunity
Energy & Utilities	Peer-to-peer energy grid	▪ Strong fit with ParallelChain™ - high performance, usability/integration with multiple systems required by use case ▪ Tailoring of solution likely for enterprise and consumer energy users, creating 'niche' market opportunities
Business sector	Know Your Customer	▪ Large market potential with many leading potential customers in the Asia region (i.e. world leading airports, transport operators). ▪ Strong fit with ParallelChain™ – ability to be forgotten, security, no data conversion
Business sector	Preventative Security	▪ Large cross-cutting industry potential, PreventiveChain™ app developed ▪ Strong fit with ParallelChain™ – real time update, security and interoperability

Source: Arthur D Little

For each business use case we have adopted the following approach

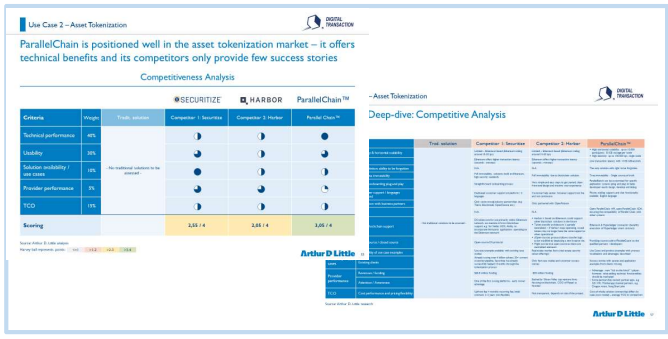
Business Use Case: Structure of analysis

1 Why blockchain? What problem is it addressing?



2 What traditional and blockchain solutions exist on the market?

3 Competitiveness assessment of solutions



4 Implications for Digital Transaction Limited

Recommendations

Source: Arthur D. Little

Assessing the competitiveness of solutions, we adopt the DTL client perspective of the Chief Technology Officer & Chief Business Development

Current focus

SELECTED

	Chief Technology Officer & Chief Business Development	Chief Financial Officer	Chief Executive Officer & Chief Commercial Officer
POSITION			
OBJECTIVE	Creation of new business opportunities	Cost optimisation	Ensuring innovation: operations and business model
ASSESSMENT CRITERIA	Technical Performance ✓ Usability ☐ Solution Availability/ Use cases ✓ Provider Performance ✓ Total Cost of Ownership ✓	Technical Performance ☐ Usability ☐ Solution Availability/ Use cases ✓ Provider Performance ✓ Total cost of Ownership ✓	Technical Performance ☐ Usability ✓ Solution Availability/ Use cases ✓ Provider Performance ✓ Total cost of Ownership ✓
WEIGHTING	■ High weighting given to: ○ Technical performance (Scalability, future proofing, ○ Usability (i.e. interoperability with existing systems) ○ Solution availability (use cases)	■ High weighting given to: ○ Total Cost of Ownership ○ Solution availability / use cases	■ High weighting given to: ○ Innovative capabilities ○ Enabling of business processes and opportunities ○ Usability

Source: Arthur D. Little

Use Case 1

Contract Management

Arthur D Little

Digital Transaction

Contract management is today often inefficient and open to abuse, contributing to increased operational costs as well as project risks

Introduction to use case value add

Burning platform:

- Sequential activities require completion and sign-off of contracts before other tasks can commence (result: **delays, excess time, and increasing costs**)
- Disputes arising between contracting parties are **costly to resolve**
- Fraudulent tampering with missing records may result in **regulatory non-compliance** and places **project safety and quality at risk**

Blockchain impact:

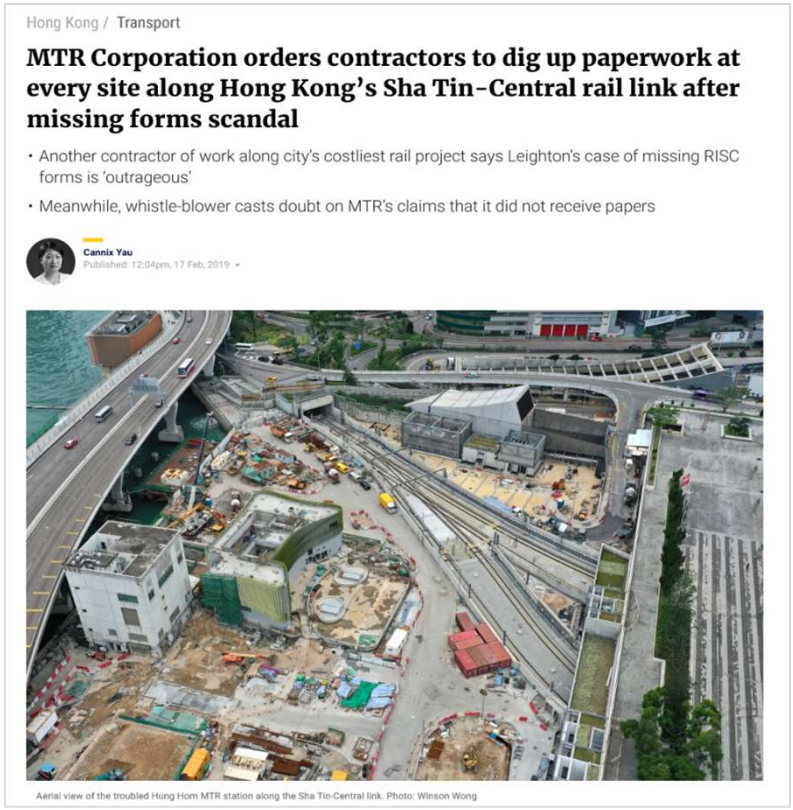
- ✓ *Business operational efficiency: process and workflow automation through smart contracts (e.g. elimination of manual validation, automation of administrative tasks, fewer delays of delivery)*
- ✓ *Legal compliance: liability established between contractors (lowering of legal and insurance costs)*
- ✓ *Safety / risk management: data integrity reduces project risk and safety management*

Blockchain features

Source: Arthur D. Little analysis

Recent construction project incidents in Hong Kong illustrate the need for new solutions to address contracting management issues

Contracting problem - example



Hong Kong / Transport

MTR Corporation orders contractors to dig up paperwork at every site along Hong Kong's Sha Tin–Central rail link after missing forms scandal

- Another contractor of work along city's costliest rail project says Leighton's case of missing RISC forms is 'outrageous'
- Meanwhile, whistle-blower casts doubt on MTR's claims that it did not receive papers

Cannix Yau
Published: 12:04pm, 17 Feb, 2019

Aerial view of the troubled Hung Hom MTR station along the Sha Tin-Central link. Photo: Winson Wong

Solution requirements

- **Digital based forms/ platform** to ensure ease of RISCs completion, compliance and reduce time taken
- **Real-time updates** to ensure effective project and risk management by monitoring activity
- **Seamless integration of data sources** to ensure full plug and play compatibility with existing software solutions/ business systems
- **Encryption** to ensure records are securely held and contract details are not shared unintentionally
- **True immutability** ensures only a single source of truth is created, which is tamperproof
- **Transparency** as records must be verifiable a third party (i.e. regulator)
- **Traceability:** previous records must be retrievable to provide audit trail

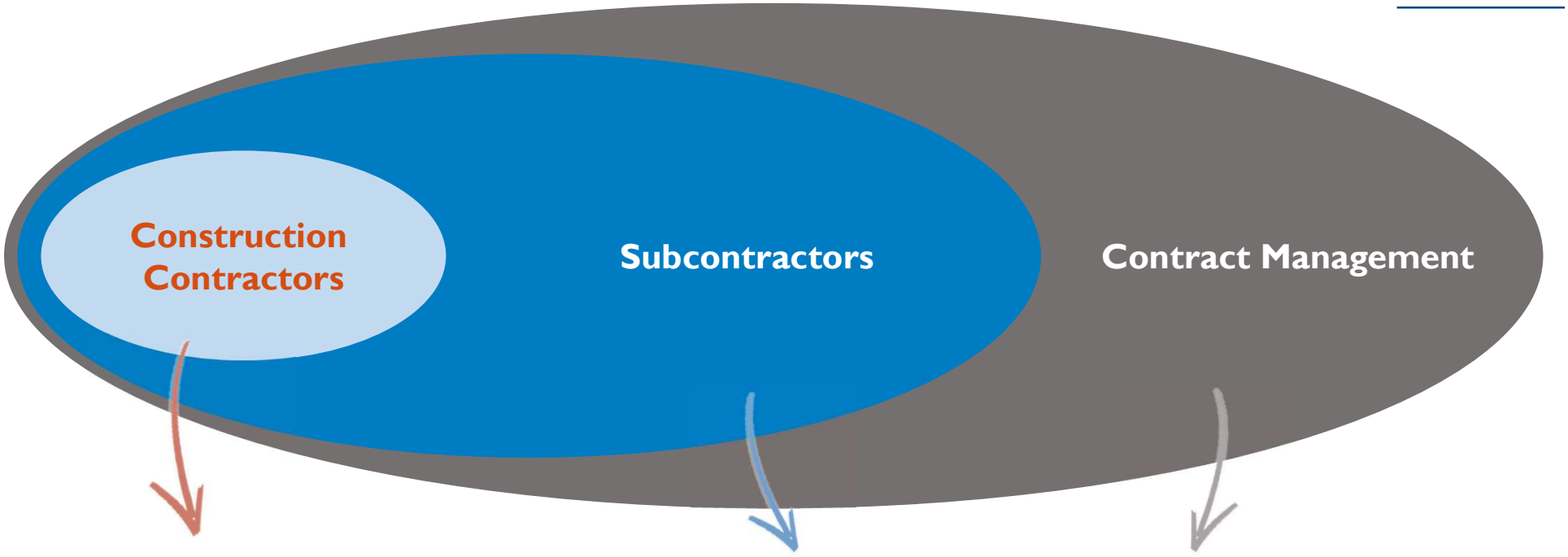
Source: South China Morning Post; Arthur D. Little

Digital Transaction

The construction industry is representative of the use case opportunities in the broader market for contract management solutions

Construction contract management

ILLUSTRATIVE



Source: Arthur D. Little

ParallelChain™'s competitors: Blockchain based contract management solutions aim to reform the rigid contract lifecycle management approach

Traditional solutions

SELECTION

Blockchain solutions (Backend & Frontend)

APTTUS	▪ Dedicated to drive contract compliance at scale while reducing cycle times, avoiding bottlenecks, improving negotiating outcomes, and eliminating errors.
SAP Ariba	▪ SAP Ariba Contracts platform addresses "contract management" and "commitment management" in a hosted environment with high data security standards.
Gatekeeper	▪ Cloud-based vendor and contact management solution with automated alerts, customization and collaboration tools and integrations with other software.
avidxchange	▪ Cloud-based solution allowing businesses to complete audit trails of payment and its associated documents while recording user history.
coupa	▪ Enterprise wide contract lifecycle management tool that accelerate contract creation speed, robust work flows and permissions.

ORACLE	▪ Blockchain-based contract management provider enabling smart contract creation, event notification and automated contract execution.
corda	▪ Distributed ledger software provider that processes and records data to promote a decentralized network environment (mainly towards the financial sector).
icertis	▪ Contract management platform enabling firms to transform contracts into assets and giving them new capabilities to increase revenue / control costs, risks.
Konfidio Contract Solutions	▪ A blockchain contract management platform improving each stage of the contract lifecycle management by its differential accelerator program.
MONAX	▪ Open-source contract lifecycle management platform that uses blockchain, smart contracts and other business processes for contract management.

Recommendation: We consider **SAP Ariba, Icertis, and Corda as closest competitors** to ParallelChain™ to be assessed in depth.

Source: Arthur D. Little research

Deep-dive assessment

Overview of blockchain solutions in the field of contract lifecycle management

Deep-dive blockchain solutions

Competitors of ParallelChain™: current status

	ORACLE	corda	icertis	Konfidio Contract Solutions	MONAX
Founding year	1977	2014	2009	2016	2014
Headquarters	Redwood City, California (U.S.)	New York (U.S.)	Bellevue, Washington (U.S.)	Berlin, Germany	New York City, New York (U.S.)
Employees	136.000 (total in 2019)	~355 (in 2019)	>900	>35	~26
Revenue	~$40 billion revenue (2019)	N.A.	~$122 million revenue (2019)	N.A.	~$3.5 million revenue (2019)
Funding	N.A.	$112 million funding (2018)	N.A.	N.A.	N.A.
Operating status	Contract-management cloud solution fully integrated	Contract-management software fully integrated	Leading contract-management platform fully integrated	Blockchain-based contract management system developed and tested for a Fortune 500 company	Active platform
Platform (Frontend / Backend)	Frontend solution – Backend Hyperledger	Frontend and backend blockchain provider	Frontend solution – Backend MS Azure blockchain	Frontend solution – Backend Ethereum	Frontend solution – Backend Ethereum

Source: Arthur D. Little research

Digital Transaction

ParallelChain™ offers superior technical performance and high usability to realize market opportunities

Competitiveness Analysis

Criteria	Weight	Tradit. solution: SAP Ariba	Competitor 1: Icertis	Competitor 2: R3 Corda	Parallel Chain™
Technical performance	40%	◑	◑	◕	●
Usability	30%	◑	◕	◕	◕
Solution availability / use cases	10%	◕	●	◕	◑
Provider performance	5%	◕	●	◑	◔
TCO	15%	◑	◕	◑	◑
Scoring		**2,15 / 4**	**3,05 / 4**	**2,80 / 4**	**3,05 / 4**

Source: Arthur D. Little analysis

Harvey ball represents points: <=1 | >1-2 | >2-3 | >3-4

The inevitable inadequacies of traditional contract management tools influence the contract lifecycle management efficiency seriously

Limitations: Traditional contract management tool

Traceability – Traditional contract management software has limited capability to reflect real-time modification and inability to trace previous transaction, especially for antiquate cases

"It is difficult or sometime even impossible for us to trace the transaction which implemented few years ago"

Vice President & Chief Procurement Officer of Hologic, 2019

Compliance requirement – The compliance inspection in traditional contract management tool is still relying on manual check which is very time/cost-consuming

"The contract drafted in different regions should meet the related standards, yet the traditional tool cannot provide any support on it"

Vice President & Chief Procurement Officer of Hologic, 2019

Standardization – Contract standards are varying across different regions, standardization is a very time-consuming process in traditional management approaches

"The contract standard is quite different between India and Japan. We always need to spend much time on contract standardization agreement when signed a contract with Japanese supplier"

Vice President & Chief Procurement Officer of Hologic, 2019

Source: Expert interview, Arthur D Little analysis

Blockchain is still a technology with much hype, the further improvement is necessary to reflect its differentiated value

Inadequacies: Blockchain contract management tool

Cost – The cost of blockchain contract management software is higher than traditional contract management tools, and the cost is predicted to further growth as time goes by

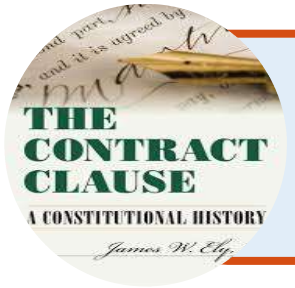
"The cost of contract management has direct relationship to the economic of scale, specifically, the expenditure on contract management is rising with an increasing volume of contract"

Vice President & Chief Procurement Officer of Hologic, 2019

Database management – New policies, regulations and data are continually flow in while blockchain contract management software doesn't have data deletion ability, which will influence the compatibility in the long term

"we have a lot of new policies, new requirement and new data storage coming in, yet we cannot delete the antiquate useless data"

Vice President & Chief Procurement Officer of Hologic, 2019



Contract modification – It is very difficult and costly to revise the existing clauses on smart contract. smart contracts are read sequentially and if a critical piece is revised, the contract won't run

"The smart contract is current inability to account for implied expectations or deal with unforeseen circumstances. It is very difficult if not impossible to change the contract clause, the tiniest mistake can be so costly"

Vice President & Chief Procurement Officer of Hologic, 2019

Source: Expert interview, Arthur D Little analysis

The blockchain contract management tool brings dramatical improvement to the overall contract lifecycle management

Value generated: Blockchain contract management tool

Speed up contract cycles – The blockchain solution streamlines contract processes by eliminating intermediaries and digitalizing information

"By digitalizing and simplifying their supply chain and procurement processes, our contract management process speed up by 50%"

Lion Corporation, 2019

Negotiation efficiency/Traceability improvement – The blockchain solution enables the better track and reporting of changes in contract value as renegotiations took place

"SAP Ariba brings me the template to create the contract with the conditions that would populate the correct choice of alternative clauses"

A large health care provider, 2019

Transaction cost reduction – The automatically contract execution driven by smart contract drives down the contract transaction cost dramatically

"The SAP Ariba's cloud solution makes our procurement process easy and cost effectiveness. Our administrative and legal cost reduced by up to 30%"

A German transportation player, 2019

Source: Expert interview, Arthur D Little analysis

Digital Transaction

Interview with HK construction company provides insight on competitive landscape and market acceptance of blockchain solutions

Hybrid Blockchain 2.0: Ahead of the market

Criteria	Technical Performance	Usability	Availability	Provider performance	TCO	Overall	Comment
ConstructionChain™ *(powered by ParallelChain™)*							■ Blockchain 2.0 – high performance, ahead of the market ■ Consortium model difficult to align with stakeholders may slow adoption in this context
Inspecto™ *(powered by Ethereum)*							■ Required quick and simple initially ■ No need for consortium – admits this is the future ■ More functionality planned (smart contract)

Required proven reliability, simple set-up and low costs (i.e. off-the-shelf), with relevant support available

Required basic system at first to generate stakeholder buy-in. familiarity with tech and build internal capabilities. High performance not required

Needed to manage costs for essentially quick and basic operation (pay per use model)

Source: Interview with Gammon

We recommend DTL to market its outstanding technical performance to meet future needs, but start small to build market acceptance

Key recommendations according to our analysis

- **Start small addressing current market needs for simple solutions** that prove the technology, build client understanding and establishes a trusting relationships with DTL.
- **Run pilot projects by partnering up** with key players to build portfolio of use cases and trust as a reliable provider, also demonstrating the benefits of the technology to a wider audience
- **Raise awareness** by educating your customers on the performance advantages of Hybrid Blockchain 2.0 and the potential business opportunities which can be realised by considering and planning now.
- **Target suitable markets** (e.g. Europe with liberalized energy markets) and focus on niche market segments with limited existing competition and which need tailored solutions
- **Influence** the market by being involved in the development of standards relevant to blockchain (i.e. smart contracts, BIM in construction, privacy rules) and driving demand for solutions (i.e. in tendering technical requirements)

Source: Arthur D. Little analysis

Use Case 2

Asset Tokenization

Arthur D Little

Digital Transaction

Asset shares can today only be transacted in complex organisational structures, involving costly legal & administrative procedures

Introduction to use case value add

Burning platform:

- Legal **entity must be established** before asset shares can be transacted, e.g. investment in 1) a share of the entity owning a property, or 2) a share of the property itself
- Involved intermediaries (i.e. legal professionals, banks) cause **high transaction costs**
- **Illiquidity of the asset** can diminish its value and attractiveness to investors (i.e. investors may value assets higher if a part of the asset can be owned)

Blockchain impact:

- ✓ *Value optimization of existing assets, e.g. through: realization of full stored value by trading shares of assets increases its total value*
- ✓ *Realization of value in previously non-traded assets*
- ✓ *Improvement of transaction efficiency (trading becomes less costly)*

Blockchain features

Source: Arthur D. Little analysis

Recent blockchain-based investment in Switzerland displays how digital tokens may increase efficiency and reliability in the real-estate industry

Asset tokenization – example

Source: The Coin Republic 2020

Key facts

Latest news: blockchain technology-based investment for building in a famous street in Zürich, Switzerland

- Switzerland-based investment firm BrickMark, from RFR Holdings purchased the building for $134 million
- BrickMark issued digital tokens that are reinforced by a bond, which investors can buy and trade a section of the buildings rental income / growth in sale value
- Purchase is one of the first trials to give value to real-estate by usage of blockchain-based digital tokens
- BrickMark's digital token is based on Ethereum blockchain (ERC-20 protocol) and uses smart-contracts to validate token holder's rights as well as to pay dividends / fees
- Tokens will be traded on the blockchain which leads to an increase in efficiency and reliability (comparing to paper-based currency forms)
- Other real estate tokenization example: WeCan (Geneva, Switzerland) bought two properties in Portugal with digital tokens (worth $11 million)

ParallelChain™'s competitors: Our analysis focused on rival blockchain solutions as tokenised assets did not exist in traditional solutions

Traditional solutions

« no traditional solutions in the scope of the analysis »

SELECTION

Blockchain solutions

SECURITIZE

- End-to-end issuance platform that have managed to establish themselves as the industry leader with regards to digital securities.

HARBOR

- Issuance platform specialized on real-estate security token offerings (ERC-20 token standard ensuring compliance in secondary security trade).

POLYMATH

- Security tokenization platform that provides the infrastructure to unlock security token creation, issuance, and management directly on the blockchain.

AlphaPoint

- White label platform that enables customers to launch new services by providing solutions to digitize assets, launch markets, and reduce operational costs.

TrustToken

- Platform to create asset-backed tokens by enabling tokenization that is legally enforced, audited, and collateralized.

Recommendation: We consider **Securitize and Harbor as closest competitors** to ParallelChain™ to be assessed in depth.

Source: Arthur D. Little research

Deep-dive assessment

Overview of blockchain solutions in the field of asset tokenization

Deep-dive blockchain solutions

Competitors of ParallelChain™: current status

	SECURITIZE	HARBOR	POLYMATH	AlphaPoint	TrustToken
Founding year	2018	2017	2017	2013	2017
Headquarters	San Francisco (U.S.)	San Francisco (U.S.)	Toronto, Canada	Greater New York Area (U.S.)	San Francisco Bay Area (U.S.)
Employees	47	16	46	69	43
Revenue	$6.9 million revenue (2019)	N.A.	$9.1 million revenue	N.A.	N.A.
Funding	$26.8 million funding	$38 million funding	N.A.	$17.6 million funding	$21.7 million funding
Operating status	Active – already helped 10 outfits through tokenization process	Active asset tokenization platform	Active – successfully helped various companies complete security token offerings	Active with >100 global customers	Active
Platform (Frontend / Backend)	Frontend solution – Backend Ethereum	Frontend solution – Backend Ethereum	Frontend solution – Backend Ethereum	Frontend solution – Backend R3 Corda, DAH, Hyperledger, Ethereum	Frontend solution – Backend Ethereum

Source: Arthur D. Little research

ParallelChain™ is positioned well in the asset tokenization market – it offers technical benefits and its competitors only provide few success stories

Competitiveness Analysis

Criteria	Weight	Tradit. solution	Competitor 1: Securitize	Competitor 2: Harbor	Parallel Chain™
Technical performance	40%	- No traditional solutions to be assessed -	◑	◑	●
Usability	30%		◕	◑	◕
Solution availability / use cases	10%		●	◑	◑
Provider performance	5%		◕	◕	◔
TCO	15%		◑	◑	◑
Scoring			**2,55 / 4**	**2,05 / 4**	**3,05 / 4**

Source: Arthur D. Little analysis

Harvey ball represents points: <=1 | >1-2 | >2-3 | >3-4

An overview of the most popular asset tokenization platforms and their differentiators…(1/3)

Blockchain solutions comparison: Asset tokenization

Manufacturer	Description	Key Differentiation
Tezos	■ Tezos is an open-source platform for assets and applications backed by a global community of validators, researchers, and builder that addresses key barriers facing blockchain adoption to date, include smart contract safety, long-term upgradability, and open participation	■ Smart Contract Security ➢ The domain-specific language for writing smart contracts on Tezos, Michelson, is designed to facilitate formal verification to support the creation of more secure smart contracts ➢ Michelson is designed to improve smart contract security, which will help instill confidence in users and foster real adoption by various parties ■ Democratic platform upgrade ➢ Tezos offers a potential solution to fork-based governance[1] via a mechanism that lowers the coordination and execution costs of conducting upgrades so as to strongly disincentivize stakeholder fragmentation ➢ Once social consensus is reached via the Tezos governance process, the software running on nodes is automatically updated to the newly approved protocol, thereby upgrading the network and avoiding a fork that may have occurred due to an inability to manually intervene
HARBOR	■ Harbor's digital platform improves the entire lifecycle of alternative investments – from streamlining investor onboarding, verification and subscription processing, to simplifying ongoing investor relations, and unlocking enhanced liquidity options with blockchain technology that give investors greater access and flexibility	■ Granting fully control on Cap table ➢ Harbor platform is designed to give the security token issuer control over their cap table, including the ability to unlock liquidity to select groups of investors ■ Ability to unlock liquidity to select groups of investors ➢ Harbor continuously track the real-world identity of buyers and sellers and enables the company to get ability to restrict liquidity among trusted parties ■ Locking up capital without locking in investors ➢ Once investors exit, it provides others with greater access to existing funds that may have been previously closed as investors exit

Note: 1) Fork exist when there is conflict on whether or not to upgrade the exist platform. Cryptocurrencies largely derive value from network effects while network effect will be changed under the platform upgradation. As such, mechanisms that disincentivize forks to better retain network effects are essential to secure stakeholders' financial best interest when conducting a platform upgrade

Sources: Press release, Arthur D Little research

An overview of the most popular asset tokenization platforms and their differentiators…(2/3)

Blockchain solutions comparison: Asset tokenization

Manufacturer	Description	Key Differentiation
POLYMATH	■ A leading security tokenization platform that dedicated to offering a reliable and frictionless tokenization platform ■ Providing the foundational infrastructure unlocking security token creation, issuance, and management directly on the blockchain	■ Security trading - Trader identity approval ➢ For investor: An investor on the Polymath platform will first need to be validated by a KYC/AML[1] accreditation provider that includes providing proof of wealth and background, much like how a regular investor would acquire accreditation. The investor will then be defined which specific permissions are given to participate in ST20 token trading. ➢ For issuer: The issuer would link up with a 3rd party legal delegate to confirm details of the token offering such as jurisdictions, types of offering, and hold times. Once the compliance process completed, a smart contract will be established that allows trading of the token in accordance with the rules established during the approval process ➢ All qualification approvals are conducted by 3rd party
AlphaPoint	■ A Hong Kong-based fintech company founded in 2016 that connects asset owners and investors to boost access to investment opportunities and enables company to transforming traditionally alternative, illiquid assets into Digital Asset-Backed Securities	■ Smart contract security – Hardware enforced privacy ➢ AlphaPoint TrustedVM™, a trusted virtual machine enabled by Intel SGE technology enables any set or subset of blockchain data, including smart contracts to remain fully confidential from intermediaries and network participants, significantly enhancing the privacy and security of the AlphaPoint Distributed Ledger Platform (*Smart contracts execute inside TrustedVM™, ensuring data is never visible to unpermissioned parties*) ■ Simplified development ➢ Smart contracts and blockchain applications may be written in TypeScript and JavaScript, instead of highly specialized languages

Note: 1) KYC/AML = Know you clients/Anti-Money laundering
Sources: Press release, Arthur D Little research

An overview of the most popular asset tokenization platforms and their differentiators…(3/3)

Blockchain solutions comparison: Asset tokenization

Manufacturer	Description	Key Differentiation
SECURITIZE	■ Securitize is an issuance platform that was founded in 2017. Operating in the United States, they have managed to establish themselves as, arguably, the industry leader with regards to digital securities. While most issuance platforms are still working to get off the ground, Securitize has already successfully helped 10 outfits through the tokenization process	■ Pre-Trade Verification ➢ Due to the complex nature of digital securities, it is not as simple as sending tokens from one person to another. A series of checks must first be made to ensure that both wallets are compatible from both a functionality, and regulatory, standpoint ➢ Simply by entering the wallet addresses, people can verify if a transaction will be authorized according to the restrictions and regulations specific to the chosen token. By using the Pre-Trade Verification Tool, people can avoid spending any gas[1] for a trade that's not going to go through, and in many cases the tool will even provide a reason as to why a trade is not possible

Note: 1) Gas refers to what is essentially the 'fuel' needed to complete a transaction. With the network still utilizing a proof-of-work protocol, successful transactions are contingent on a group of miners lending their computational power to the process. Miners are not in the business of processing transactions for free, however. Gas is, simply put, the amount of compensation that required by miners in order to complete a transaction on the network
Sources: Press release, Arthur D Little research

We recommend that tokenisation should be a core market for DTL, but that challenges exist to achieve success

Key recommendations according to our analysis

Be active in the broad ecosystem and partner up with important players in the value chain, e.g. fintech start-ups, banks, regulators, lawyers, and financial institutions investing/owning property and similar assets.

Leverage DTLs technical performance by targeting platforms with high technical performance requirements (e.g. real-time transactions, data deletion, 24/7 operation).

Raise awareness by educating your customers on the fit of ParalleChain™ to their needs. A market with many new start-ups, substantial marketing effort is needed for DTL to standout from the pack

Target suitable markets by identifying those markets most accessible to and provide least competition for DTL, giving due consideration to regulations (e.g. London for gold, New York/ Hong Kong for property).

Source: Arthur D. Little analysis

Use Case 3

Clean Energy

Arthur D Little

Digital Transaction

Trading in clean energy from decentralised sources requires transparency, real-time immutability & low transaction costs

Introduction to use case value add

Burning platform:

- **Limited traceability of the CO2 certificate** (validation that the energy used by organizations is created by a green source)
- **Supply of energy** from decentralized sources to the grid **lacks transparency**
- Intermediaries involved in the transaction cause **high transaction costs**, a disincentive for investors

Blockchain impact:

- ✓ *Single point of truth and traceability enable certification for implementation of renewable source of energy (benefit: companies are able to meet environmental objectives)*
- ✓ *Reduction of transaction costs through Peer-to-Peer trading (e.g. automated billing)*
- ✓ *Reduction of investment costs for purchase of renewable energy supply (e.g. for solar panels) through trading of energy surplus*

Blockchain features

Source: Arthur D. Little analysis

Blockchain energy tracking solution in Spain illustrates how organizations can certify reduction of CO2 and meet their environmental objectives

Clean energy – example

Key facts

Latest news: department store chain El Corte Inglés uses blockchain solution to track renewable energy consumption

- El Corte Inglés works with utility company EDP group for blockchain application
- The traceability solution will be used concerning validation of the origin of electricity from EDP's wind farms in Spain which power El Corte Inglés stores in in Malaga, Seville, and Madrid
- The project will use a "Blockchain Energy Tracking" system for real-time transparency of the origin of consumed energy
- Blockchain solution helps the department to certify a reduction in its CO2 emission
- Blockchain benefit: companies are able to meet their environmental objectives
- EDP's blockchain solution certifies the renewable source of each megawatt-hour consumed by El Corte Inglés

Source: Ledger Insights, Coinnewsspan 2020

Parallel Chain's competitors: Blockchain based solution providers may transform energy trading – regulatory hurdles have to be overcome

Traditional solutions

SELECTION

Blockchain solutions

- **enmacc**: With its independent OTC platform, Enmacc providers prosumers with easy and cost-efficient access to professional energy trading.
- **sonnen**: German company providing infrastructure and IT platform for supplying and trading power from renewable energies.
- **ICE**: ICE OTC Energy provides physically settled bilateral contracts for global crude and North American natural gas and power.
- **next**: Next Kraftwerke provides market access and trading platforms for customers and sellers of power from renewable energies.
- **TRAYPORT** A TMX COMPANY: Trayport's platform solution enables users to access the physical and financial European wholesale electricity market.

- **we power**: Blockchain-based green energy financing and trading platform helping renewable energy producers to raise capital by issuing their own energy tokens.
- **SettleMint**: PaaS based blockchain solution enabling prosumers to exchange their energy surplus (focus on P2P energy trading and distribution of electricity).
- **enerchain**: Blockchain-based solution that enables energy suppliers to guarantee its customers the origin of the delivered energy in a transparent way (P2P trading).
- **POWER LEDGER**: Blockchain platform providing a market trading and clearing mechanism for businesses to decide whom they sell energy surplus to.
- **ELECTRIFY.ASIA**: Energy technology company connecting owners of distributed energy resources to consumers by building a sustainable energy ecosystem for P2P trading.

Recommendation: We consider **Power Ledger and Electrify Asia as closest competitors** to ParallelChain™ to be assessed in depth.

Source: Arthur D. Little research

Deep-dive assessment

Digital Transaction

Overview of blockchain solutions in the field of clean energy

Deep-dive blockchain solutions

Competitors of ParallelChain™: current status

	we power	SettleMint	enerchain	POWER LEDGER	ELECTRIFY.ASIA
Founding year	2017	2016	2016	2016	2017
Headquarters	Vilnius, Lithuania	Louvain, Belgium	N.A.	Perth, Australia	Singapore
Employees	>20	16	<10	34	>13
Revenue	$70 million funding	N.A.	<$1 million	>$1 million	N.A.
Funding	N.A.	~$3.7 million funding	N.A.	$35 million funding	$30 million funding
Operating status	Active – alpha version of financing & trading platform online since 2018	Active – developing more than 35 fully functioning blockchain applications	Active trading platform Enerchain 1.0	Active – Power Ledger platform is already up and running	Active, but still partly in testing phase (already transacted >60 GWh)
Platform (Frontend / Backend)	Frontend solution – Backend Ethereum	Blockchain agnostic* – working with Ethereum, Bitcoin, Bigchain DB etc.	Frontend solution – Backend Tendermint	Ethereum-based, but blockchain agnostic	Frontend solution – Backend Ethereum

Source: Arthur D. Little research

*) Blockchain agnostic: single platform that allows multiple different chains

Digital Transaction

ParallelChain™ should further promote its energy use case and build business partnerships with organizations from promising markets

Competitiveness Analysis

Criteria	Weight	Tradit. solution	Competitor 1: Power Ledger	Competitor 2: Electrify Asia	Parallel Chain™
Technical performance	40%	- No traditional solutions to be assessed -	◕	◑	●
Usability	30%		◕	◕	◕
Solution availability / use cases	10%		◑	◔	◑
Provider performance	5%		◕	◑	◔
TCO	15%		◑	◑	◑
Scoring			**2,75 / 4**	**2,20 / 4**	**3,05 / 4**

Source: Arthur D. Little analysis

Harvey ball represents points: <=1 | >1-2 | >2-3 | >3-4

A strong business use case for high performance blockchain exists, but more is need to promote the benefits and ParallelChain™ as a solution

Implications for DTL

Europe	Target market should be Europe (and possibly parts of North America later on), driven by liberalised energy markets and highly regulated conditions promoting clean and decentralised energy
Awareness raising	High performance features of ParallelChain™ fit well with the requirements of this use case, but too few players in value chain are aware of blockchain, let alone ParallelChain™. Significant awareness raising is required.
Partnership	Consider partnering with "innovation oriented" leading energy utilities to prototype and demonstrate the technology to a wider audience and build relationship with future potential customers
Broad application base	Launch initiatives in multiple application types to ensure simultaneous testing with various stakeholders (suppliers, grid companies, traders, aggregators) thus enabling the ability to bet on multiple opportunities at the same time

Source: Arthur D. Little analysis

We recommend DTL to carefully prioritize geographies and partners, and position initiatives throughout the different energy ecosystem areas

Key recommendations according to our analysis

- **Be active in the broad ecosystem and partner up** with the energy community at large (e.g. work groups, forums, EU discussion platforms, …)and become known
- **Envision scalability options** which should enable fast growth in this hyper fragmented energy market environment (through partnering, "as a service" offering, etc.)
- **Pick your geographies** as function of the overall market maturity (e.g. degree of unbundling, innovation friendliness, …) and regulatory environment (e.g. stringent requirements imposed)
- **Pick your partners** given the big differences in "progress level" between utilities, perform a careful due diligence on target client, covering the entire value chain (suppliers, grid companies, aggregators, …)

Source: Arthur D. Little analysis

Use Case 4

Know your customer

Competitive assessment and recommendations

Arthur D Little

Digital Transaction

Know Your Customer (KYC) solution: Verifying a customer's identity and enabling smooth transactions in the smart economy

Introduction to use case value add

Burning platform:

- Personal identities are **costly to verify** (multiple proofs: passport, biometrics, PIN, signature required)
- Time taken to verify identity creates **customer inconvenience** and adversely **impacts business operational efficiency** (i.e. staff needed to undertake checks)
- Concerns over **data privacy** represent a major barrier for the digital economy

Blockchain impact:

✓ *Business operational efficiency:* *Automated transition, no multiple verification checks, and process simplification (no checks required at airports, train stations, public venues, malls etc.)*

✓ *Customer experience:* *Inconvenience decreases through simplified processes*

✓ *Security / Risk Management:* *Improved risk management and security through identification and profile assessment*

Blockchain features

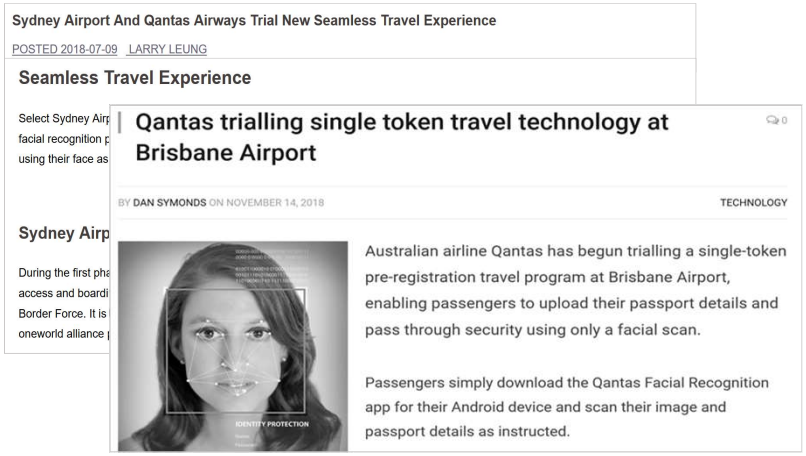
Source: Arthur D. Little analysis

Digital Transaction

Interest is growing in single token technology – data storage and management are still challenges to address in the travel industry

KYC - example

Interest seen from airport operators and airlines indicates that implementation of the technology is still on a trial level …



Sydney Airport And Qantas Airways Trial New Seamless Travel Experience

POSTED 2018-07-09 LARRY LEUNG

Seamless Travel Experience

Select Sydney Airp
facial recognition p
using their face as

Sydney Airp

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Qantas trialling single token travel technology at Brisbane Airport

BY DAN SYMONDS ON NOVEMBER 14, 2018 TECHNOLOGY

Australian airline Qantas has begun trialling a single-token pre-registration travel program at Brisbane Airport, enabling passengers to upload their passport details and pass through security using only a facial scan.

Passengers simply download the Qantas Facial Recognition app for their Android device and scan their image and passport details as instructed.

Today's obstacles

… due to a number of challenges

1. *Accuracy expectations*

"…error standard is still below expectation … expecting ***less than 0.05%*** *error…"*
– Changi

2. *Data protection and security concerns*
(e.g. British airways facing record fine €183 million for data breach)

3. *Customer's right to be forgotten*
(once flight is completed)

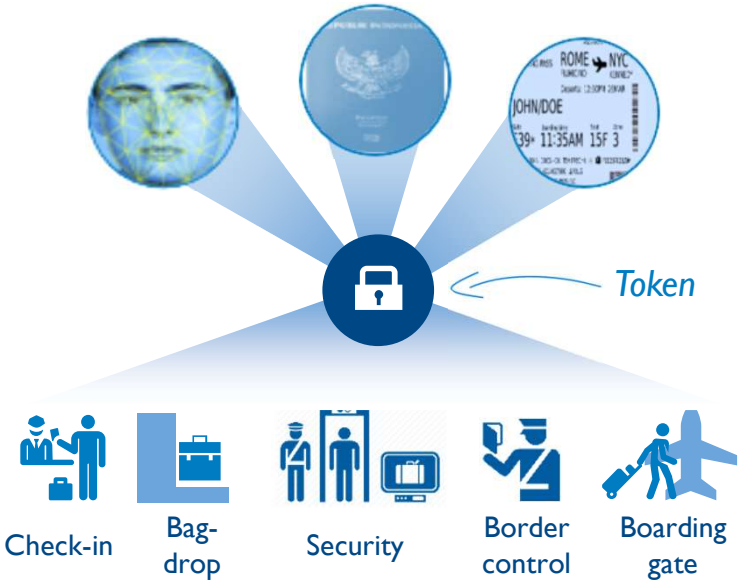
Implementation of **"single token travel" at leading airports is arriving** – ~30% of airports and ~25% or airlines said they are interested in single token travel implementation in 2020.

Source: Arthur D. Little research; interviews, SITA

Digital Transaction

The KYC use case focuses on the single token concept to improve identity management and customer experience in air travel

Single Token Travel



Blockchain enables secure use of data across check points:

- Identity "token" is generated by combining face, ID and boarding pass which requires "pre-registration" (i.e. at check-in or online)
- "Token" is then used across passenger check points to complete KYC processes

Source: IATA, interviews, SITA

How it benefits airports / airlines

Customer Experience

- Once "token" is generated, passengers will only have to their "token" to confirm identity - results in reduced inputs (especially helpful for passengers who are unfamiliar with self-service)

Business process efficiency

- Airports and stakeholders (e.g. airlines) no longer need to allocate staff for processing
- Staff can focus on "experience-driven" tasks, e.g. assisting elderly persons, or those new to the technology
- Automated administrative processes through smart contracts (i.e. loyalty promotions, duty-free pick-up)

Security

- Integrated data points benefit airports and stakeholders in identity management

Privacy

- Use of blockchain enables sharing of data without centralised control and disclosure of personal information. Encrypted hash value is shared.

Digital Transaction

Due to missing KYC applications in the past, our analysis focused on rival blockchain solutions

Traditional solutions

« no traditional solutions in the scope of the analysis »

SELECTION

Blockchain solutions

BLOCKPASS

- Fully integrated platform for digital identity verification with a KYC solution that uses blockchain and smart contracts to solve compliance procedures.

civic

- Civic Reusable KYC is a blockchain-based tool enhancing basic account verification services by enabling users to scan / verify identity documents.

SELFKEY

- SelfKey is a blockchain-based digital identity system that allows individuals and companies to control and manage digital identities.

ShoCard

- Digital identity verification system using blockchain-based data and facial recognition to streamline how airlines verify passenger identities e.g. at the airport..

Zamna

- Validation platform that checks passenger information accuracy / biometric data by attaching an anonymous token (e.g. suited for for airlines / governments).

Recommendation: We consider **Civic and SelfKey as closest competitors** to ParallelChain™ to be assessed in depth.

Source: Arthur D. Little research

Deep-dive assessment

Overview of blockchain solutions concerning know your customer

Deep-dive blockchain solutions

Competitors of ParallelChain™: current status

	BLOCKPASS	civic	SELFKEY	ShoCard	Zamna
Founding year	2017	2015	2017	2015	2016
Headquarters	Hong Kong	San Francisco, California	Mauritius	Cupertino, California	London, UK
Employees	63	>30	30	~20	20
Revenue	N.A.	~$1.4 million revenue	N.A.	~$1.9 million	N.A.
Funding	N.A.	$35.8 million total funding	$21.7 million total funding	$5.5 million total funding (2 rounds)	$5.9 million total funding
Operating status	Active	Active – one of the most prominent KYC providers in the market	Active – successful token sale	Active – technology implemented	Active, but still in test mode – Emirates Airline as one of the major clients
Platform (Frontend / Backend)	Frontend solution, Backend Ethereum (stores most of Blockpass business logic)	Frontend solution – Backend Ethereum	Frontend solution – Backend Ethereum	Frontend solution – blockchain agnostic	Frontend solution – N.A.

Source: Arthur D. Little research

ParallelChain™ should leverage its advantage in technical performance for the KYC use case – use case benefits should be marketed further

Competitiveness Analysis

Criteria	Weight	Tradit. solution	Competitor 1: Civic	Competitor 2: SelfKey	Parallel Chain™
Technical performance	40%	- No traditional solutions to be assessed -	◑	◑	●
Usability	30%		◕	◕	◕
Solution availability / use cases	10%		◕	◑	◑
Provider performance	5%		◕	◑	◔
TCO	15%		◑	◑	◑
Scoring			**2,45 / 4**	**2,30 / 4**	**3,05 / 4**

Source: Arthur D. Little analysis

Harvey ball represents points: <=1 | >1-2 | >2-3 | >3-4

Digital Transaction

Use case requires tailoring solution to industry, creating niche's for high performance solutions which we recommend DTL targets

Key recommendations according to our analysis

Run pilot projects by partnering up with key players to build portfolio of use cases and trust as a reliable provider, also demonstrating the benefits of the technology to a wider audience (i.e. airport operators, rail operators, government organisations)

Focus on the full data integrity benefits of ParallelChain™ in addition real-time performance attributes (i.e. full data deletion, transparency) to differentiate from competition.

Target suitable markets where data privacy and handling is strictly regulated and high performing solutions are required to protect individual's data (i.e. not in China and Middle East)

Source: Arthur D. Little analysis

Use Case 5

Preventive Security

Arthur D Little

Digital Transaction

Blockchain technology may act as panacea to inside and outside data breaches – significant advantage over central database is not yet proven

Introduction to use case value add

Burning platform:

- **Data breach: increasing shift towards inside threats** (misuse / abuse authorized access or steal sensitive data); **outside risks** (hackers etc.) still existent
- **Serious consequences**, e.g. loss of customer trust, regulatory fines, disclosure of trade secrets
- **Firms lack visibility into user behaviour –** further control over user activities are necessary

Blockchain impact:

- ✓ *Storage of user activity in a decentralized, encrypted manner (e.g. hashing) – prevents hackers from compromising large data volumes*
- ✓ *Multi-factor authentication prevents unauthorized access – in a proactive manner*
- ✓ *Monitoring of user behaviour to prevent misuse and leaking of sensitive data*

Blockchain features

Source: Arthur D. Little analysis

Prominent players like in the media industry currently test a blockchain-based Digital Rights Management (DRM) to enhance data security

Use Case solution

- Digital Rights Management (DRM) solutions build on blockchain enable right holders to control distribution of "copyrighted" work
- Digital "watermarks" on content prevent execution of transactions, e.g. copying, downloading, or editing without the owner's permission

Pain points addressed:

- *Traditional DRM solutions are vulnerable (hacking)*
- *Fixes current DRM issue to identify the "rightful owner"*

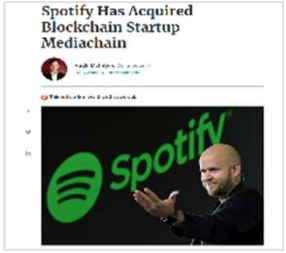
Blockchain impact:

- *Immutable information blocks regarding data transaction* ✓
- *Proof of ownership is "difficult to falsify"* ✓

DRM examples in the media industry

1) Sony blockchain DRM solution

Sony develops a rights management system for digital content, that utilizes blockchain's inherent security mechanism for authenticating and sharing of copyright data.



2) Spotify / Mediachain DRM solution

Spotify acquired Mediachain Labs, which uses blockchain for digital media tracking. The DRM-solution gives owners the ability to automate discovery of content usage.

Evaluation: Currently, using a blockchain for DRM can be considered as an experiment. It has yet to be proven if blockchain technology can improve today's issues in a DRM system and offers significant advantage over a centralized database.

Source: Arthur D. Little, SONY, Forbes

Digital Transaction

We recommend that insider trading should not be a focus for DTL as challenging for ParallelChain™ performance to shine

Key recommendations according to our analysis

- Stopping insider trading means ensuring there is no information asymmetry
- In ParallelChain™'s architecture with multiple parallel chains to process transactions, they are not synchronized in real-time but rather they are synchronized (i.e. shared across the network) later which means information asymmetry can remain
- Only by sharing information instantly across the whole network, to reach consensus, can this asymmetry be eliminated (i.e. Bitcoin)
- While "latency for avoiding insider trading" is a selling point for ParallelChain™ we do not consider it a unique selling point and should not be a priority focus for DTL
- We would recommend resources are better allocated to other opportunities

Source: Arthur D. Little Analysis

Digital Transaction

Contents

1 Introduction to distributed ledger technology

2 ParallelChain™: Architecture and features

3 Business use cases: in-depth assessment of selected market opportunities

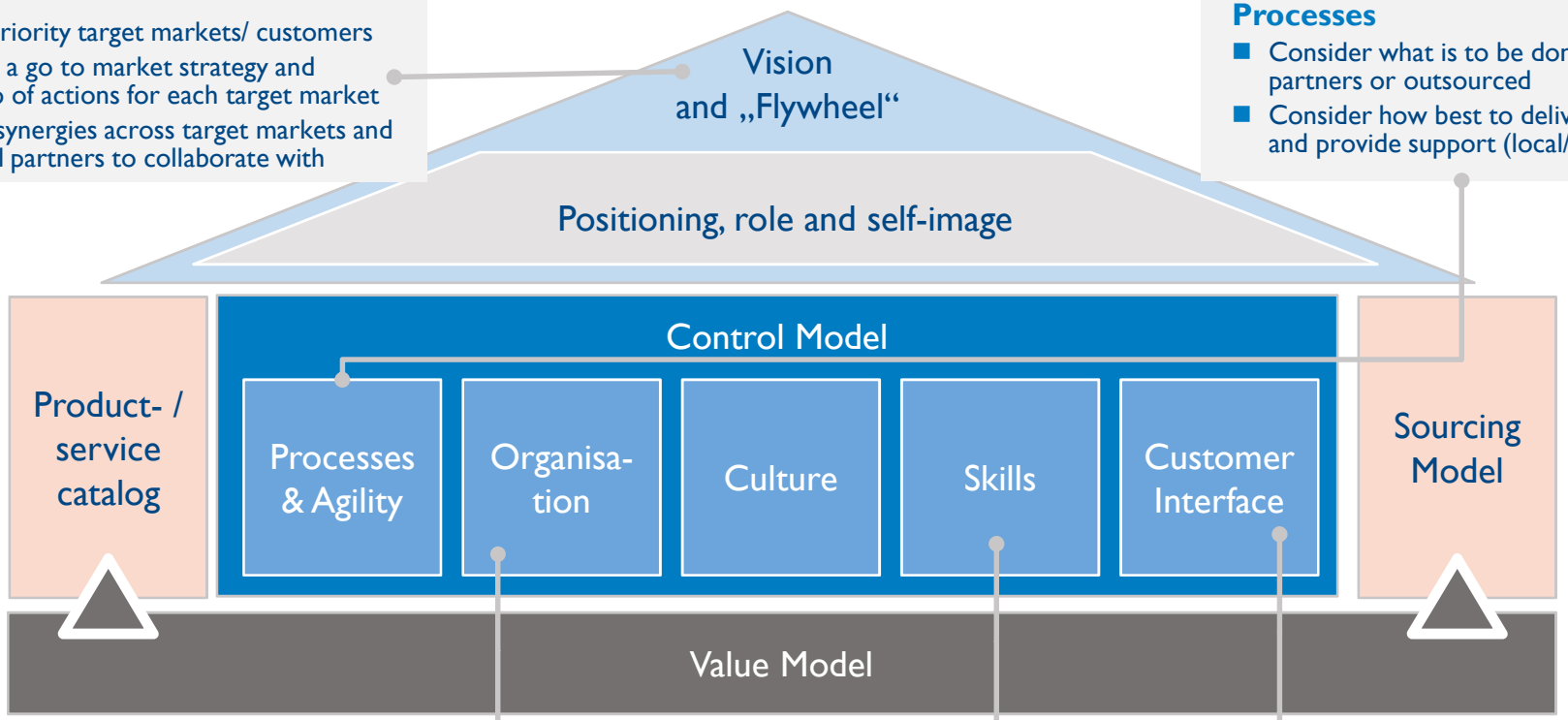
4 Implications for Digital Transaction Limited

Ten core dimensions are relevant for the strategic development of blockchain service providers - we identify areas for improvement

Recommended areas for future attention

Strategy
- Define priority target markets/ customers
- Develop a go to market strategy and roadmap of actions for each target market
- Identify synergies across target markets and potential partners to collaborate with

Processes
- Consider what is to be done by DTL, partners or outsourced
- Consider how best to deliver solutions and provide support (local/remotely)



Organisation & Culture
- Establish organisation structure for expansion, that delegates responsibility
- Define core roles in an expanded organisation and KPIs
- For each target market, consider different geographies to achieve business plan

Capabilities/ Capacity
- Strengthen management capacity & capability for expansion, reduce single point dependence
- Introduce new skills/competencies aligned to the business plan (i.e. fintech, property, KYC, airport)

Customer Interface
- Strengthen marketing & customer relationship capacity to “hit hard” in target markets

Arthur D Little

Digital Transaction

Arthur D. Little has been at the forefront of innovation since 1886. We are an acknowledged thought leader in linking strategy, innovation and transformation in technology-intensive and converging industries. We navigate our clients through changing business ecosystems to uncover new growth opportunities. We enable our clients to build innovation capabilities and transform their organizations.

Our consultants have strong practical industry experience combined with excellent knowledge of key trends and dynamics. Arthur D. Little is present in the most important business centers around the world. We are proud to serve most of the Fortune 1000 companies, in addition to other leading firms and public sector organizations.

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