Blockchain and Smart Contracts

Implications for Capital Project Supply Chains

Pete Dumont
CEO, PrairieDog
Chief Innovation and Digitalization Officer, AG&P

February 16, 2023

PRAIRIEDOG

PrairieDog is establishing new capital projects exchange that:

- **Enhances trust and collaboration**
- **Leverages an innovative consortium design**
- **Improves returns for asset developers**
- **Increases profitability for contractors and suppliers**
- **Allocates risk more equitably and transparently**
- **Reduces transactional waste**

The Capital Projects Marketplace for People Who Build.

Presenter:

Pete Dumont, P.E., MSE

CEO, PrairieDog
Chief Innovation and Digitalization Officer, AG&P

Background:

30 years of domestic & international experience in industrial & commercial engineering & construction

EXPERIENCE

Chief Innovation & Digitalization Officer
Managing Director, Americas
(03/22 – present) Houston, Texas — AG&P

CEO
(10/18 – present) Houston, Texas — PRAIRIEDOG

Advisory Board Member
(05/22 – present) Tucson, Arizona — WELDCHAIN

Advisory Board Member
(01/20 – present) London, United Kingdom — TEKNOBUILT

Executive Advisor
(10/18 – present) Cincinnati, Ohio — PREMIER RESOURCES GROUP

Manager of Construction
Director of Business Services
(09/20 – 03/22) Houston, Texas — lyondellbasell

Vice President, Global Strategic Projects
(07/15 – 10/18) Houston, Texas — nVent

Project Director
(07/11 – 07/15) Houston, Texas — PENTAIR

Director of Global Business Development
(06/09 – 07/11) Houston, Texas — tyco

Manager of Canadian Operations
(10/05 – 06/09) Edmonton, Alberta, Canada — TRACER

Special Projects Director
(01/00 – 10/05) Houston, Texas

Project Services Manager
(06/99 – 01/00) Houston, Texas — JACOBS

Quality Engineer
(07/98 – 06/99) Houston, Texas

Construction Engineer / Project Engineer /
Structural Engineer
(01/96 – 07/98) Houston, Texas — S&B

AREAS OF EXPERTISE

- Board Experience
- Successful Revenue and Profit (EBITDA) Growth
- Corporate Leadership and Strategy Development
- Proven Success in both Private & Public Companies
- Business Development & Value-Based Selling
- Performance Excellence in Global, Multi-Cultural Environments
- Extensive International Experience
- Modularization & Off-Site Fabrication
- End-to-End Digital Project Management Systems
- Lean Project Delivery (Lean Construction)
- Collaborative Contracting
- Construction Claims & Dispute Resolution
- Quality Management (Six Sigma Green Belt)
- Project Controls (Cost, Schedule, Progress)

EDUCATION

M.S.E., Construction Engineering & Project Management
The University of Texas at Austin, December 1995

B.S., Civil Engineering
University of Maine, May 1994

LICENSES / AFFILIATIONS / AWARDS

- Professional Engineer in North Carolina and Maine
- Past President, Construction Users Roundtable (CURT)
- Board of Trustees, CURT (thru Fall 2018)
- CURT Outstanding Service Award
- Board of Advisors, Teknobuilt
- Tyco International Chairman's Council Platinum Award
- Pentair Executive Development Program

PUBLICATIONS / SPEAKING ENGAGEMENTS

- Co-developer of Construction Industry Institute's (CII's) Project Definition Rating Index (PDRI)
- Author of over 35 articles in *ENR, The Voice, Construction Executive*, and other publications
- Presented at over 40 industry events / conferences
- Taught multiple classes at 4 universities

We are in a relationship business where nobody trusts each other.

Why Blockchain?

Why Now?

Did You Know?

Projects Not Meeting All Objectives	Average Margins	Lost Value Annually	Transactional Waste
95%	**2.7%**	**3.4T**	**41%**

Mega-Project Performance

	ROADS	BRIDGES/ TUNNELS	ENERGY	RAIL	DAMS	IT CHANGE	OLYMPICS
COST OVERRUN	25%	32%	36%	42%	90%	107%	156%
FREQUENCY OF COST OVERRUN	8 of 10	7 of 10	6 of 10	8 of 10	7 of 10	5 of 10	10 of 10
SCHEDULE OVERRUN	39%	22%	38%	42%	44%	39%	0%
BENEFITS SHORTFALL	7%	-7%	n/a	-51%	-11%	-24%	n/a
COST BLACK SWANS	8%	11%	7%	5%	10%	18%	5%
Ø duration (years)	5.6	8.0	5.3	8.2	8.2	3.3	7.0

40%
average cost overrun

34%
average schedule overrun

1 in 10
projects = cost Black Swan

Sources: Ansar et al. (2014, 2016), Budzier & Flyvbjerg (2013), Flyvbjerg (2015), Flyvbjerg et al. (2016), Pohler (2013)

Database as of July 2016

("Black Swan" ≥ 3x cost overrun)

Evolution of Information Technologies
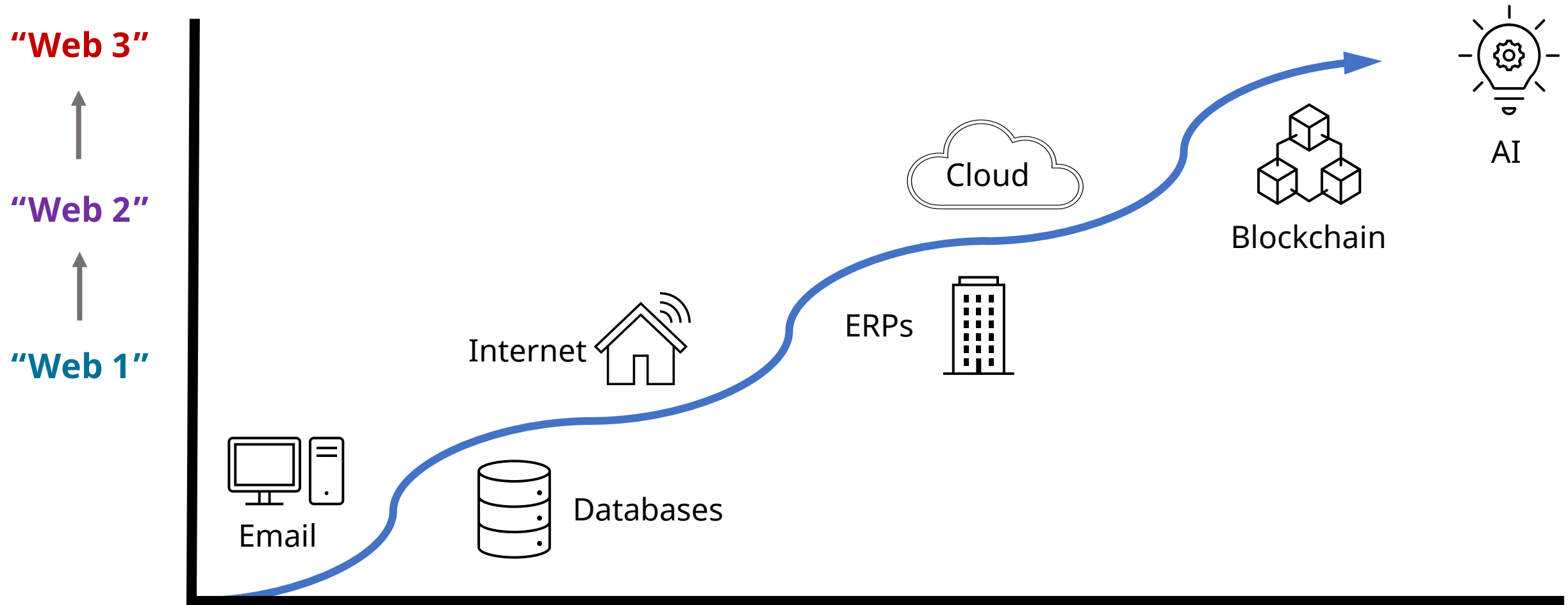
BLOCKCHAIN 101

- **What Blockchain is NOT (myths)**
  - Not the same as Bitcoin
  - Technically correct term is Distributed Ledger Technology (DLT), but 'Blockchain' is popular
  - Not all Blockchains are created equal

- **What is Blockchain?**
  - Digital record of transactions/data (ledger) that is…
    - …shared, distributed, replicated and synchronized across nodes
    - …validated by a consensus algorithm
   - …time-stamped, immutable, and with a secure, cryptographic audit trail

- **Smart (digital) Contracts**
  - Self-executing computer program that represents the commercial terms of the contract
  - Contains business logic of the natural language contract
  - Works for labor or materials; and for any commercial terms

WHAT DOES BLOCKCHAIN PROVIDE?

"Blockchain enables multiple separate entities involved in a transaction to know with certainty what happened, when it happened, and confirm other parties are seeing the same thing without the need for an intermediary and without the need to reconcile data afterwards"

Economy is Value Exchange
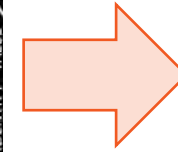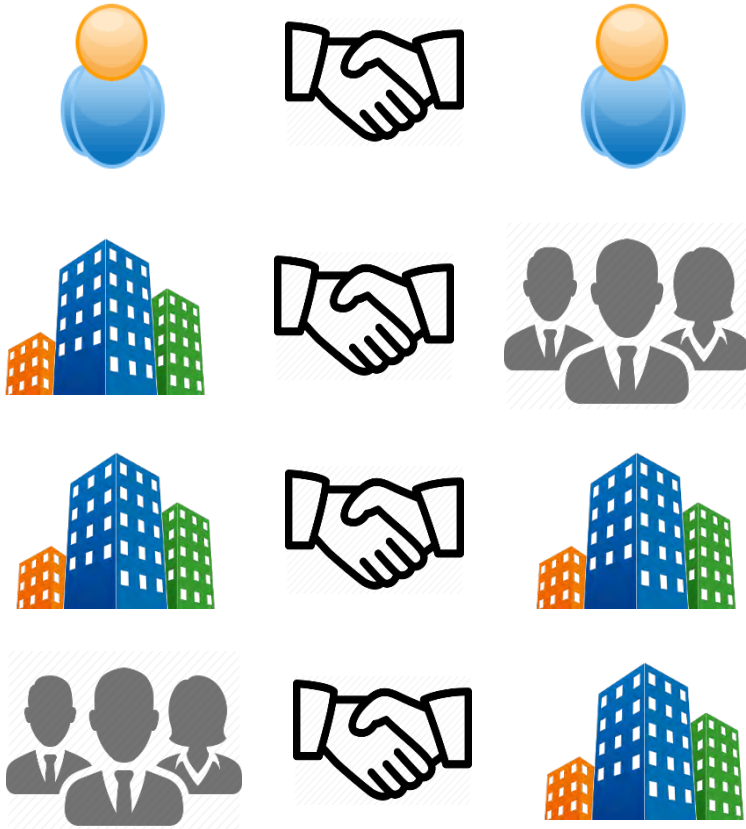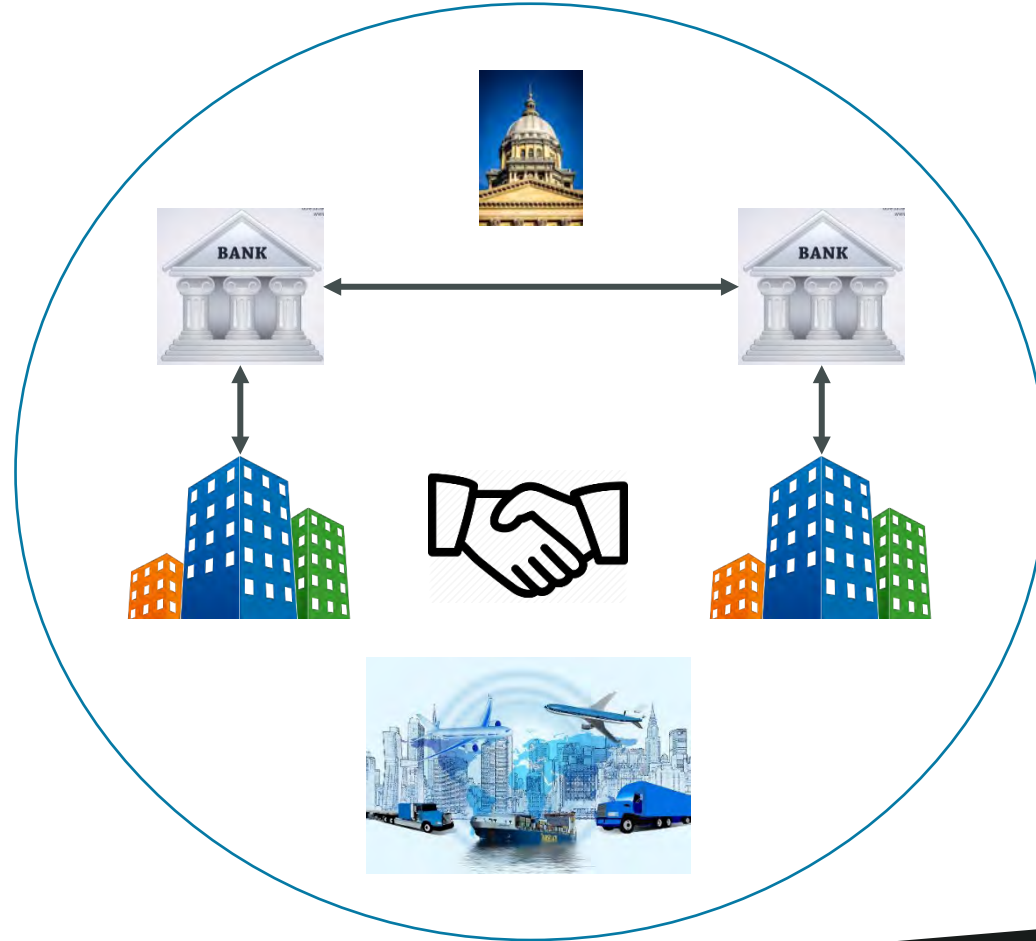
- Currency
- Goods
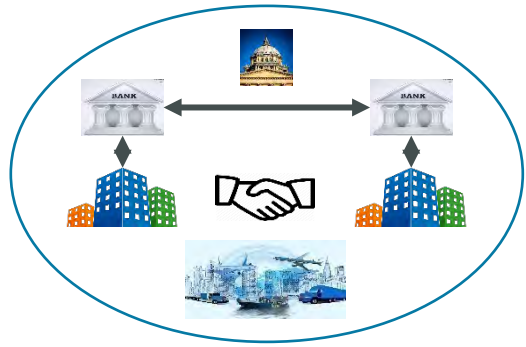- Services

Economy is Value Exchange

- Currency
- Goods
- Services

1. Generates
2. Is Governed By
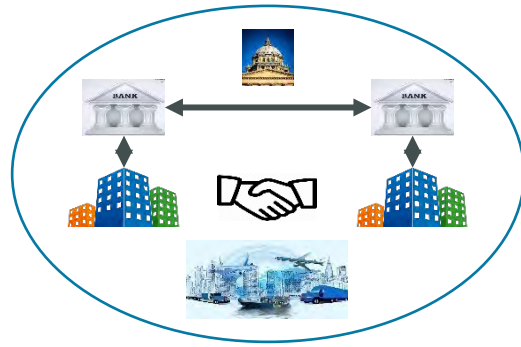3. Is Created By

DATA
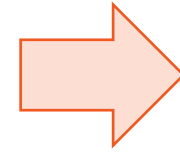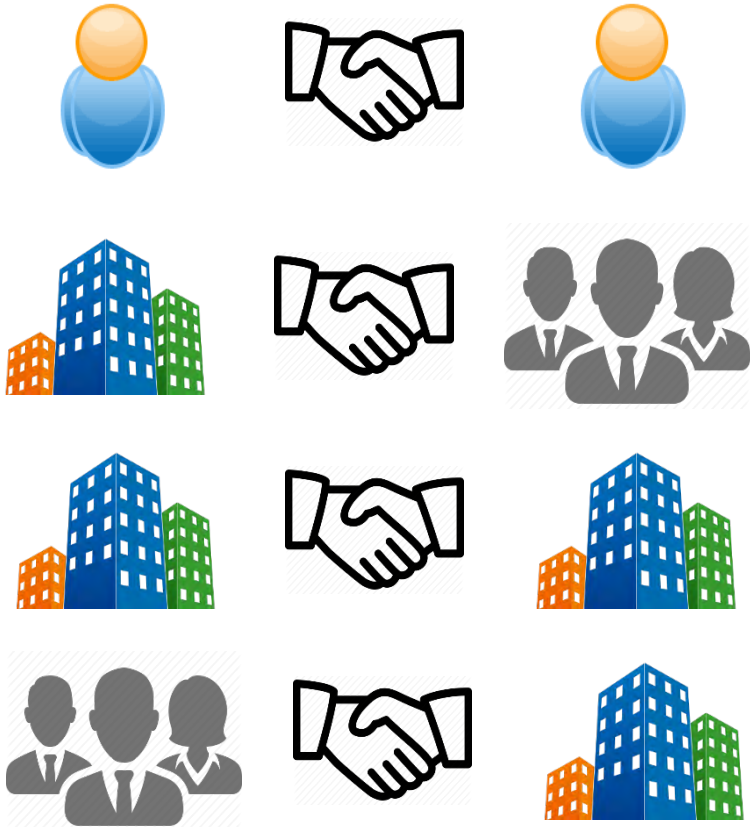
Many Parties are Involved

Even More Parties are Involved

Manufacturer - Wholesaler

Wholesaler – Distributor

Distributor – Retailer

Retailer – Consumer

Even More Parties are Involved

Manufacturer - Wholesaler   Wholesaler – Distributor   Distributor – Retailer   Retailer – Consumer
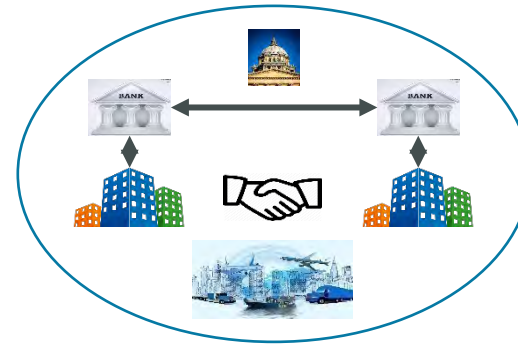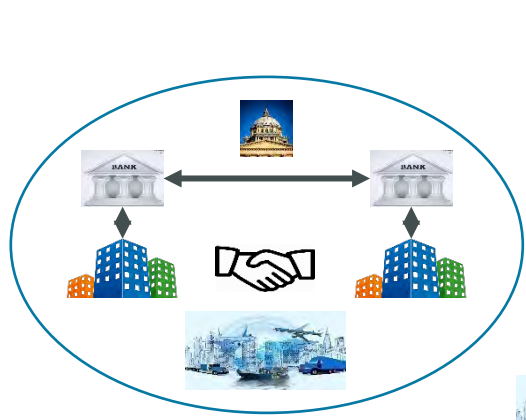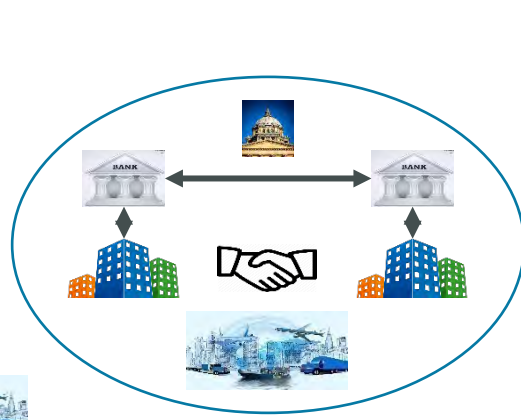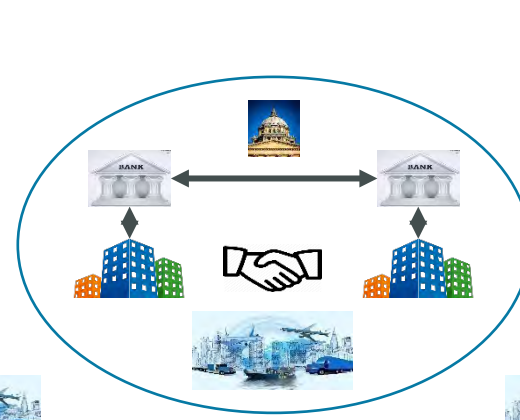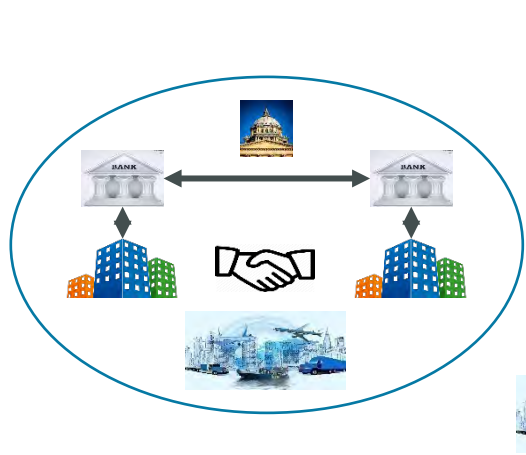
Even More Parties are Involved

Manufacturer - Wholesaler   Wholesaler – Distributor   Distributor – Retailer   Retailer – Consumer

DATA   DATA   DATA   DATA

Even More Parties are Involved

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DATA   DATA   DATA   DATA
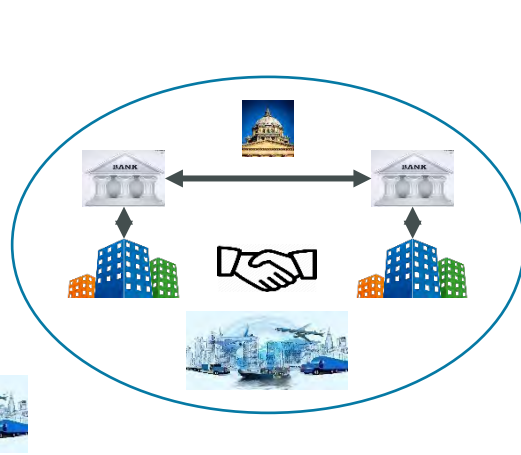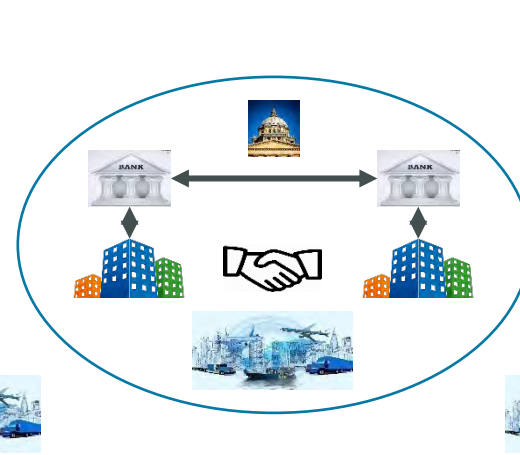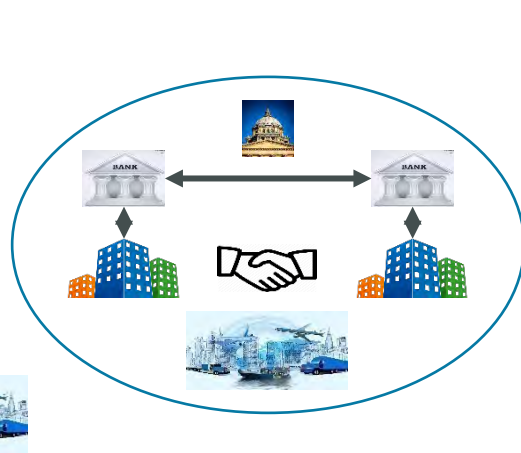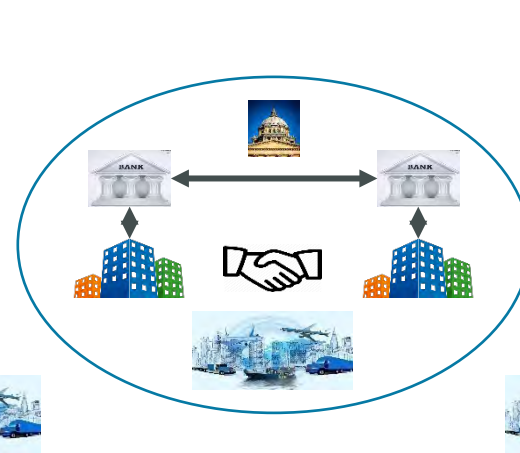
Sources of Inefficiency in Construction Value Exchange

Today's Commercial Models …

- Currency
- Goods
- Services

DATA
1. Generates
2. Is Governed By
3. Is Created By
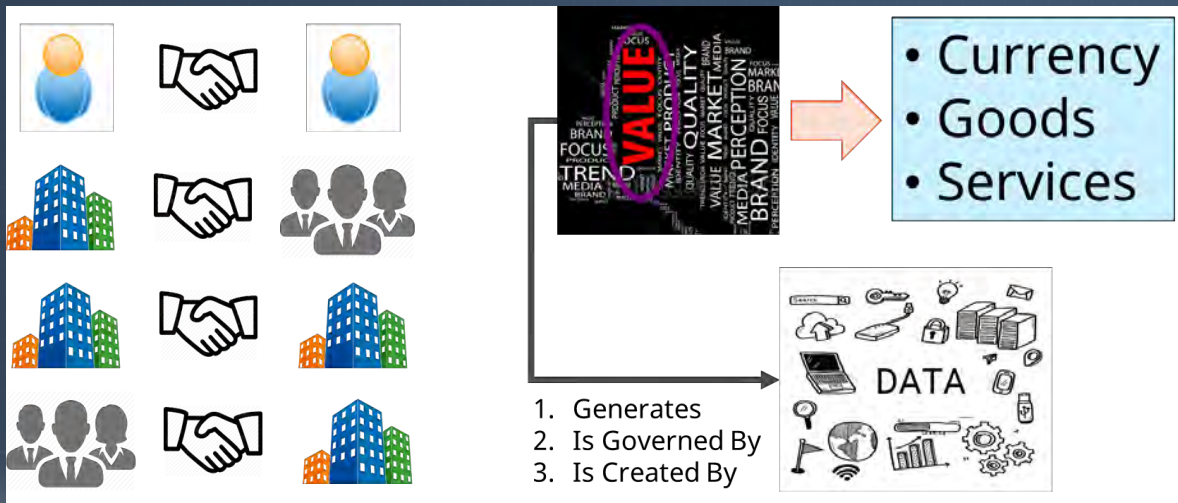
… are Characterized by these 7 Inefficiencies

1. Time to settle transactions
2. Fees paid to third parties for non-value activities
3. Data-related (the **3Rs** of value exchange waste):
   - **R**edundant work,
   - **R**ework, and
   - **R**econciliation work
4. Constraints from governmental regulations and other non-governmental rules
5. Fraud
6. Privacy trade-off
7. Data security risks

Blockchain Addresses Fundamental Challenges

7 Inefficiencies with Today's Transactions:

1. Time to settle transactions
2. Fees paid to 3rd parties for non-value activities
3. Data-related (the **3Rs** of value exchange waste):
   - **R**edundant work,
   - **R**ework, and
   - **R**econciliation work
4. Constraints from governmental regulations and other non-governmental rules
5. Fraud
6. Privacy trade-off
7. Data security risks

Blockchain Provides:

1. Quicker settling of transactions
2. Fewer 3rd parties; lower transaction fees
3. Peer-to-peer network where all parties have the same data. Smart Contracts increase transparency. Transactional data is recorded one time.
4. Trustless networks with transparent rules
5. Tamper-proof, self-auditing ledger
6. Individual level privacy and agency
7. No central database to breach or corrupt

IMAGINARY BLOCKCHAIN METAPHOR

Google

1. Imagine a Google spreadsheet we can all access (**Network**)

2. We all own co-equal copies (**Decentralization**) (single point of <u>truth</u> and vulnerability)

3. We can only add additional information (can't change) (**Immutable**)

4. We all must agree on the information, and it automatically stays in sync (**Consensus)**

5. Everyone sees all the same data (**Transparency**) – No data silos

6. Our co-equal copies of the information also can include code that self executes when conditions are met so digital workflows are guaranteed (**Smart Contracts**) – Math/Deterministic

Blockchain Types

	ACCESS (to ledger)	CONTROL	JOIN / READ	WRITE	EXAMPLE APPLICATIONS	BLOCKCHAIN EXAMPLES
DLT	OPEN (Public)	Permissionless	Everyone	Everyone	Currencies Betting Video Games Arcade	Bitcoin, Ethereum
		Permissioned	Everyone	Authorized participants	Voting Whistleblower ATM	Stellar, Ripple, Alastria, Sovrin, R3 Corda Network, EOS
	CLOSED (Private)	Consortium (semi-private)	Authorized Participants	Authorized participants	Supply Chain Corporate Financial Reporting Banking Country Club	Shared ledger within a company, Enterprise Ethereum Alliance
		Permissioned	Authorized Participants	Authorized participants	Tax Returns Construction Transactions Defense Employee Database	R3 Corda Private networks HyperLedger Fabric Quorum

Although **BLOCKCHAIN** may be a "hammer," not everything is a *nail*
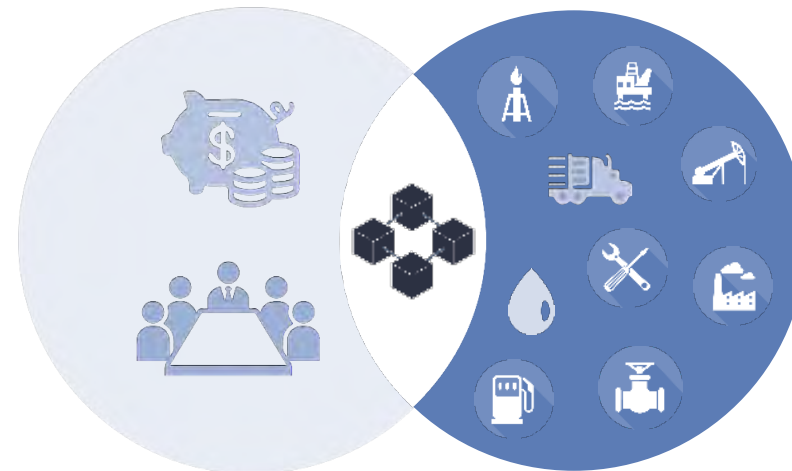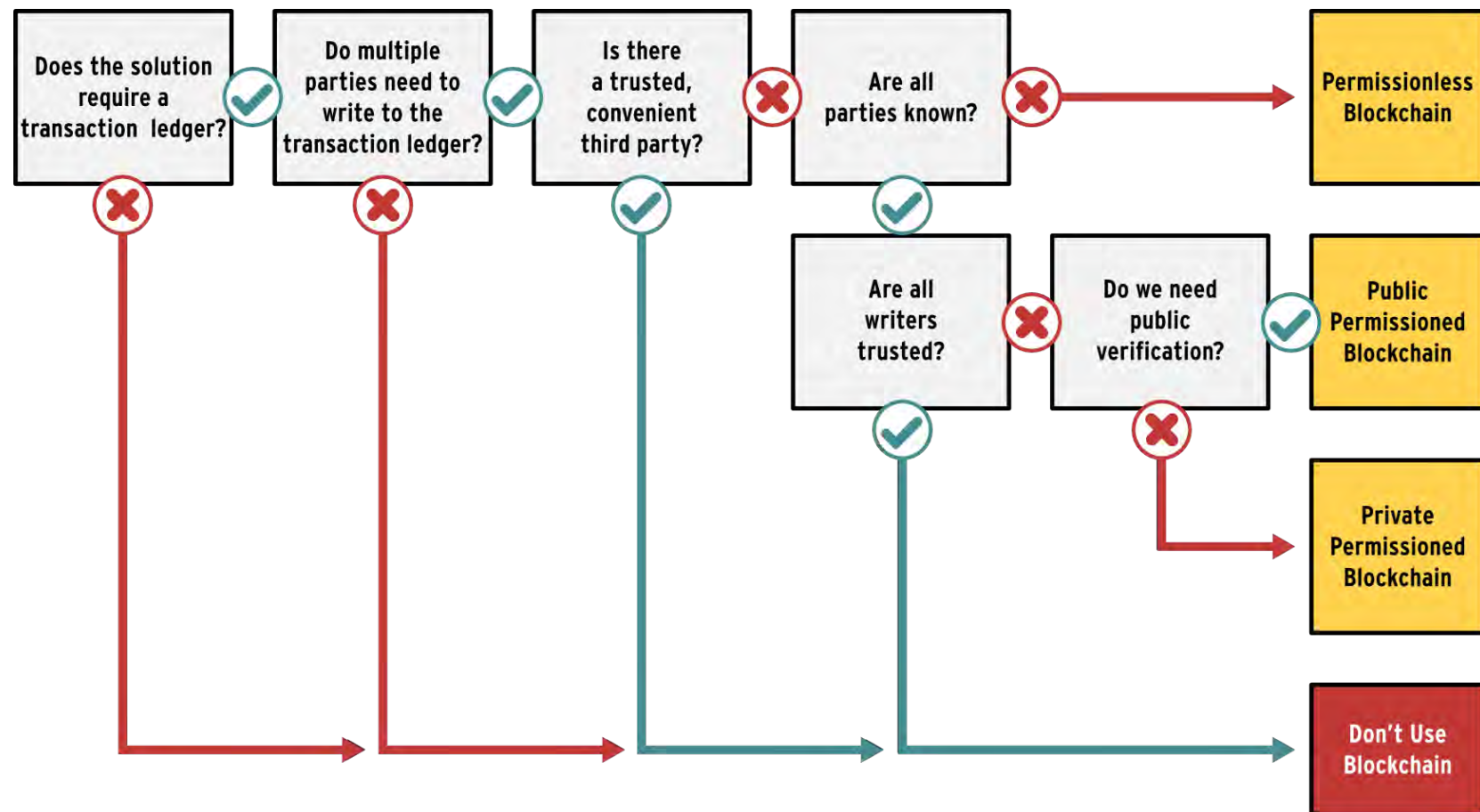
Blockchain is Relevant in Many Aspects of Society
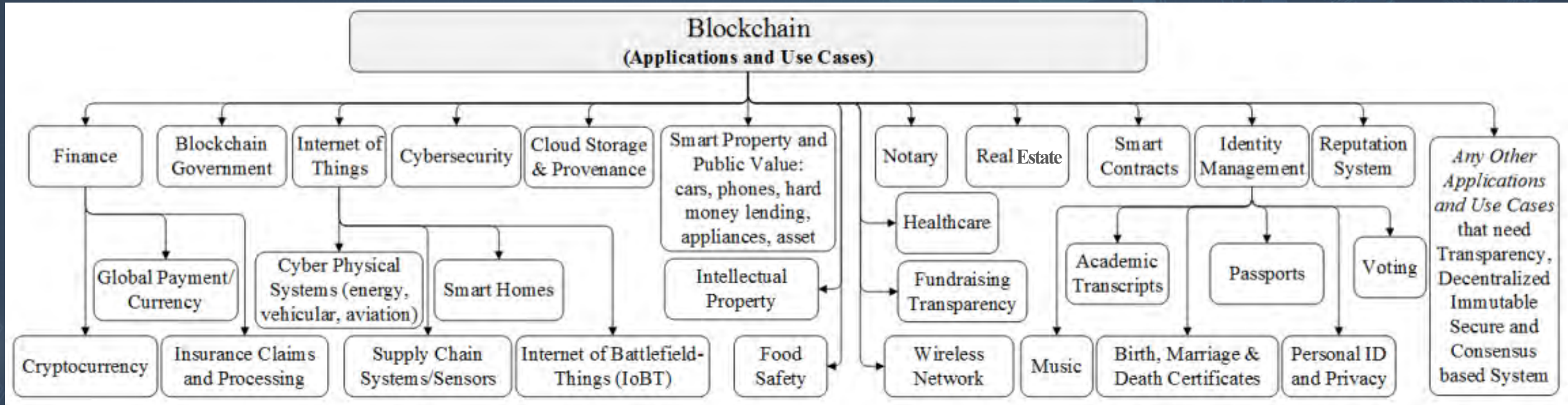
BLOCKCHAIN CONSORTIA

	CONSORTIUM	SECTOR	# MEMBERS	EXAMPLE MEMBERS	WEBSITE
1	MOBI	Auto manufacturers	37 founders in 2018	GM, Ford, Honda, BMW	dlt.mobi
2	BiTA	Transporting Goods	> 500	FedEx, BNSF, UPS, Shaw, J.B. Hunt, US Express	bita.studio
3	Contour	Banking	>50	HSBC, BNP Paribas, BBVA, Scotiabank, Mizuho, BBVA	contour.network
4	TradeLens	Supply Chain / Logistics	> 300	Maersk, MSC, CMA CGM	tradelens.com
5	Synaptic Health Alliance	Healthcare	>10	Aetna, Humana, Optum, Quest, United Healthcare	synaptichealthalliance.com
6	Industry IoT Consortium	Manufacturing, Retail etc.	> 150	Dell, Huawei, Microsoft, Mitsubishi, Electric, NEC, Toshiba	iiconsortium.org
7	IBM Food Trust	Food & Beverage	> 40	Wal-Mart, Nestle, Carrefour, Dole, Golden State Foods	ibm.com
8	B3i	Insurance	>20	Allianz, AXA, Liberty Mutual, Munich RE, Swiss RE	b3i.tech
9	reciChain	Recycling	>10	BASF, NOVA Chemicals, Recycle BC, London Drugs	basf.com
10	Electron Energy Consortium	Utilities	> 20	National Grid, Siemens, EDF Energy, Northern Power Grid	electron.net
11	Marco Polo Network	Trade Finance	> 25	Credit Agricole, ING, MasterCard, Commerzbank	marcopolonetwork.com
12	PharmaLedger	Pharmaceuticals	> 25	GSK, Novartis	pharmaledger.eu
13	Alastria	Cross-Sector	> 500	Companies, Universities, Government Institutions	alastria.io
14	Aura	Luxury Goods	5	LVMH, Prada, Cartier, Bulgari, Hublot	auraluxuryblockchain.com
15	MediLedger	Life Sciences	10	Bayer, Amgen, Gilead, McKesson, Genentech	mediledger.com

VIPART

CONNECTING OEMs WITH THE DoD

BOEING

NAVAIR

Boeing is using blockchain to register and track components in an immutable and non-repudiable way to verify provenance for U.S. NAVY critical parts and detect potential failure points in the supply chain.

Support for multiple blockchain bindings using an interface and adapters (Hyperledger & Quorum).

CONTAINER TRACKING

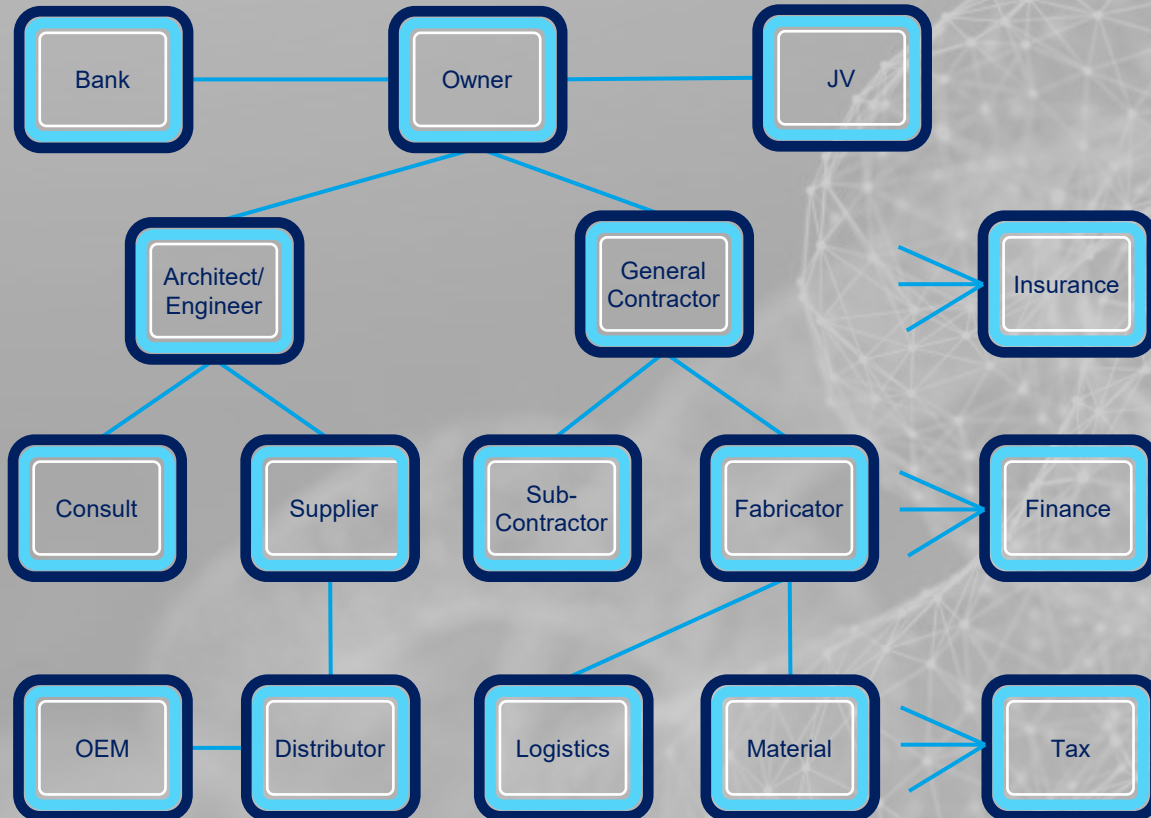Tracking and counting containers was extremely costly and time-consuming for Caterpillar.

They turned to blockchain to provide traceability, immutability, and visibility into movement of returnable containers to improve their supply chain efficiency.

From Paper-Based to Digital Thinking

Myriad Systems & Contracts   vs.   **Shared, Single Source of Truth**

26
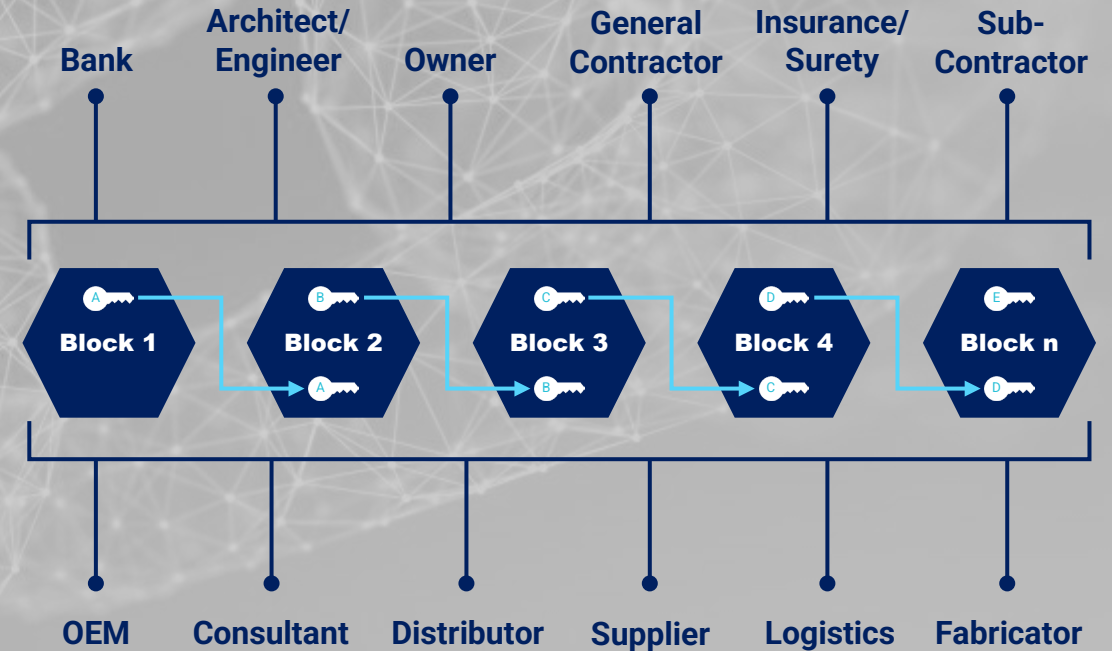
Smart Contracts + Blockchain: Capital Projects
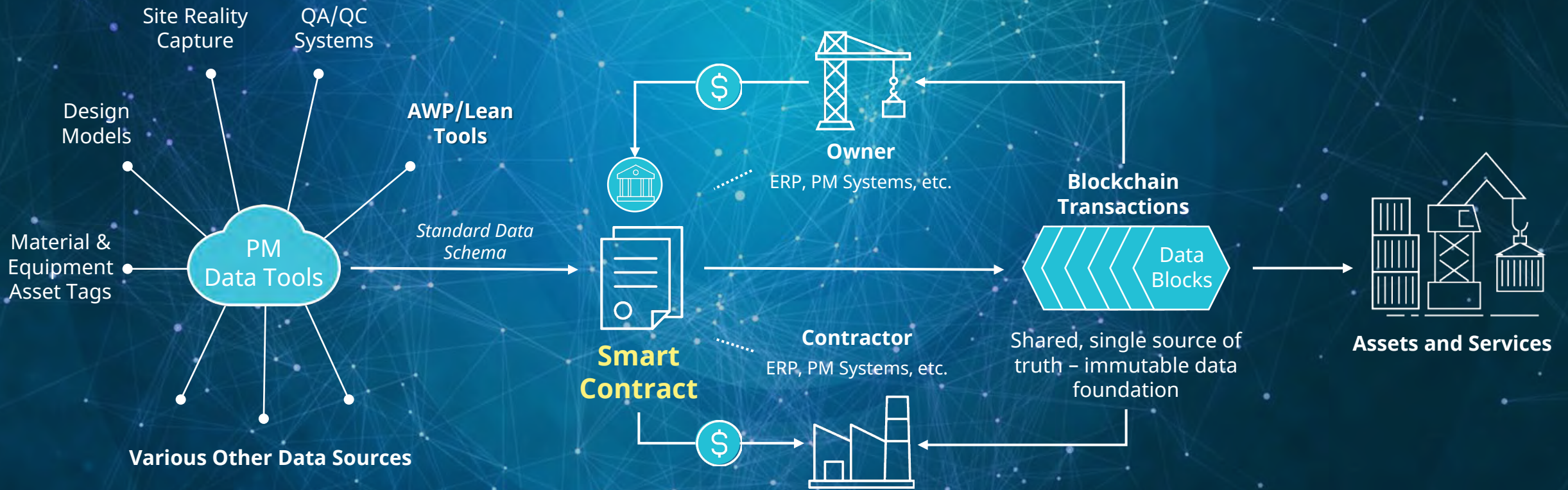
The Power of Smart Contracts
Touchless Transactions

FIELD	CONTRACTOR OFFICE	CUSTOMER SYSTEMS

Today's Typical Process — 60–120 days

Daily/Weekly Timesheet	Progress Measurement Tracking	Digital Verification of Completed Work	Approvals and Signatures	Field Office	Home Office	Month-End Consolidation	Pro-Forma Invoice	Dispute and Recycle	Final Invoice	Invoice System	B2B System	Customer Project Accounting	Customer Reconciliation and Finance	Customer Approval	Wait per Commercial Terms (30-60+ days)	Pay

Data Gumbo + PrairieDog — 1 day

Digital Verification of Completed Work

Data Gumbo + PrairieDog
Smart Contract

Auto Pay

ACH — ERP Debit / ERP Credit

Example of Achievement

98%	Accurate Transactions	74 Days	Faster payments

28

Benefits of
Smart Contracts on Capital Projects

Buyers

— **receive early pay discounts**

— **pay only for what is received**

— **reduce overhead costs**

— **achieve lower billing rates**

— **achieve full digital twin**

— **be seen as a "client of choice"**

— **attract best companies & teams**

— **minimize disputes**

— **demonstrate provenance & traceability**

— **verify quality inspection history**

— **evidence ESG in supply chain (carbon)**

Sellers

— **get paid much faster**

— **free up working capital**

— **reduce overhead costs**

— **automate the invoicing process**

— **eliminate contract leakage**

— **improve client relationships**

— **benefit from trust and transparency**

— **minimize disputes**

— **digital asset tracking**

— **avoid reinspection**

— **automate documentation**

Example Smart Contract Use Cases

Current & Upcoming Use Cases	Company Type	Counter-Parties
1. **Procurement of ready-mix concrete**	• **General contractor / Subs**	• **Contractor – Subs – Batch Plant**
2. Procurement of bulk materials	• Specialty contractor	• Contractor – Supplier / Distributor
3. EV charging station installations for DoE	• Various	• Multiple
4. EPC of engineered equipment (offshore)	• Oil & Gas Owner	• Owner - OEM
5. Inter-company transactions for services	• General contractor	• Department – Department
6. Specialty engineering services	• Engineering firm	• Owner – Engineer
7. Specialty consulting services	• Consultant	• Architect – Consultant
8. Construction rental equipment	• General contractor	• Contractor – Rental Company
9. Procurement of subcontract services	• General contractor	• Contractor – Subcontractor
10. Water treatment and carbon credit tracking	• Technology firm	• Technology firm – Owner

A **CONCRETE** Example

- **Scope:** Procurement and installation of reinforced concrete for an automotive plant

- **Multi-party contract:**
  1. Asset developer (owner)
  2. General contractor
  3. Concrete subcontractor
  4. Rebar supplier
  5. Rebar installer
  6. Concrete supplier (batch plant)
  7. 3rd party inspector

- **Features:**
  - ✓ Automates cascading payments
  - ✓ Microsoft Environmental Product Declarations (EPD) carbon tracking
  - ✓ Tracking performance and payment bonds, including riders with contract growth
  - ✓ Recording and tracking quality documents (inspections, test results, batch information, etc.)
  - ✓ Document submittals and approvals

- **Flexible template** (customizable for different applications)

Other Near-Term Blockchain Applications

Treated vs Untreated

- Contractor and supplier pre-qualification data in <u>one trusted location</u>
- Validation of company credentials (e.g., HUB verification)
- Documenting company performance history (think "Uber ratings")
- Recording critical work scope (welds, QA docs, turnover pkgs, etc.)
- Verifying individual worker credentials (e.g., welder qualifications, training, employment history, education, experience, etc.)
- Documenting / recording key project decisions over time
- Verifying licensure for individuals and organizations
- Validating insurance enrollments and coverage levels
- Augmenting existing technologies (e.g., material tracking asset tags, drones, AI/MR, decision support tools, etc.)
- Marriage of AWP (work packages/batches) with smart contracts
- **Risk assessments and more accurate/timely cost tracking**

Business Impact: Smart (digital) Contracts

Reduction in Indirects / Overheads

10-15%

Cost Savings from Faster Payments

2-5%

Reduced Contract Leakage

5-8%

Workflow Efficiency Gains

~30%

5-20% cost savings opportunity

How Can Blockchain Improve Cost Management?

Immutable, distributed **system of record** for all cost-related transactions

Shared Ledger

Smart Contracts

Business terms automatically executed with transactions – **"from accruals to actuals"**

Ensuring appropriate visibility; data is secure, authenticated & verifiable

Privacy

Consensus

All parties can use their own systems, but blockchain becomes the single source of cost truth

Blockchain for Capital Projects
Value Summary

REDUCE LATE PAYMENTS, REMEDIATIONS, DISPUTES	IMPROVE CASH FLOW	REDUCE BILLING RATES, OVERHEADS AND INDIRECTS	IMPROVE COST & PROGRESS MEASUREMENT
BIM + BLOCKCHAIN = SINGLE SOURCE OF TRUTH	MATERIAL PROVENANCE AND TRACEABILITY	ESG COMPLIANCE (TRACK CARBON FOOTPRINT)	REDUCED RISK AND COST OF INSURANCE
COST, SCHEDULE, AND RISK QUANTIFICATION ("BIDDING")	SUPPLIER CAPABILITY & CAPACTIY INSIGHTS	VERIFIED / TRUSTED PERFORMANCE HISTORY	

KEY
TAKEAWAYS

Proven Technology

Begin Now vs. Future

No Need to Rip and Replace
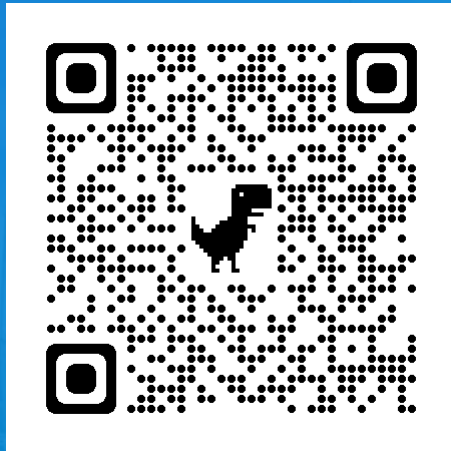
Nominal Upfront Costs

Fast Time to Value
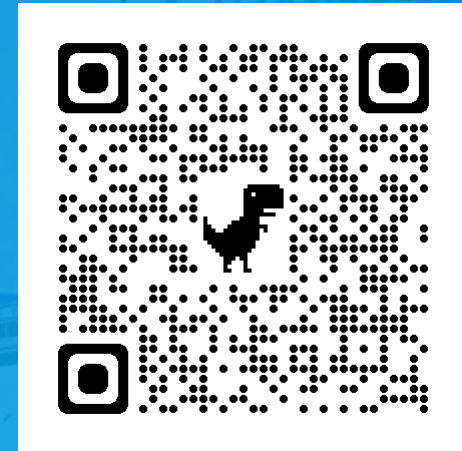
Find Out More

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LinkedIn