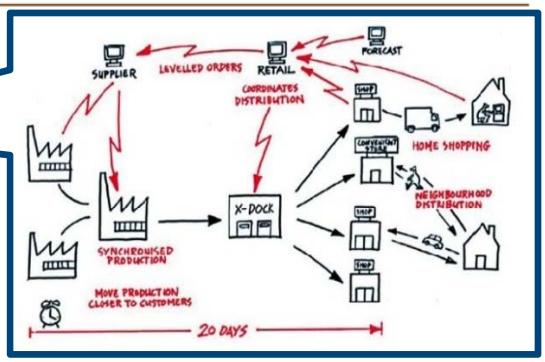

LOOKING TO THE FUTURE OF SUPPLY CHAINS

MIT Center for Transportation & Logistics

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MASSACHUSETTS INSTITUTE OF TECHNOLOGY

Themes – Friction in the Supply Chain

- Global unrest
- Anti-globalization
- Nationalism
- Dangers
- Challenging trends

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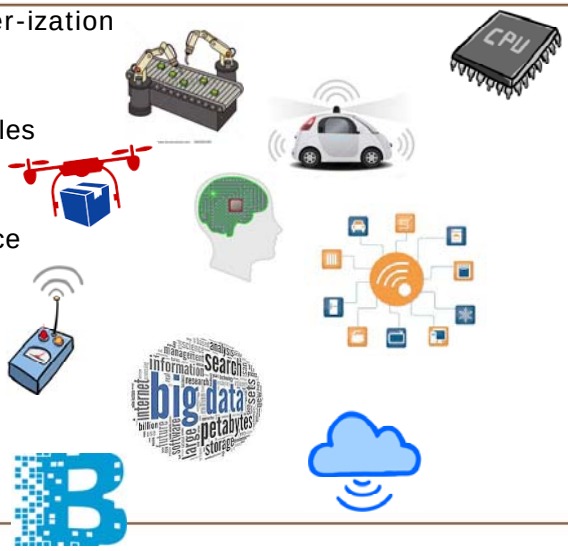
Themes – ICT Advances

- Digital control/Uber-ization
- Robotics/3D
- Autonomous vehicles
- Drones
- Artificial intelligence
- IoT
- Sensing
- Big data
- Cloud Computing
- Blockchain



Technologies – 3D Printing

Implications:

+ End of mass production? Hyper-customization?
+ Complexity is free
+ Speed up design/engineering
+ Impact on SC structures
  + Reduce number of suppliers
  + Reduce supply chain tiers

Extraction → Sub-supplier → Supplier → Supplier → OEM → Retailer → Consumer

Extraction → OEM → Retailer → Consumer

Extraction → Consumer

Technologies – 3D Printing

Implications:

+ End of mass production? Hyper-customization?
+ Complexity is free
+ Speed up design/engineering
+ Impact on SC structures
  + Reduce number of suppliers
  + Reduce supply chain tiers
+ Lower inventory levels (forget end-of-life)
+ (Almost) zero waste
- Impact on IP
- Cyber security
- Manufacture of illicit products
  - Drugs
  - Guns

Technologies – 3D Printing

What is status today (2016)?

- Additive manufacturing industry grew 26% CAGR in 2016 to $5.16B
- Many different methods and materials
  - Material Extrusion, Material Jetting, Binder Jetting, Vat Photopolymerization, Sheet Lamination, Power Bed Fusion, Directed Energy Deposition
  - Polymers, Composites, Metals, Ceramics, Sand Molds & Cores, Paper
- Expanded beyond hobby and prototyping uses
- GE acquired Sweden-based Arcam and Germany-based SLM Solutions (leaders in metal 3D printing) for $1.4B in 2016
- Siemens:
  - 30% cut in GHG
  - 63% cut in resources used
  - Shrinking time to market by > 75%

Technologies - ICT

- Cloud computing
  - What's new (SaaS redux?) (add: Infrastructure as a service (IaaS)?, platform as a service (PaaS?)
  - Emphasis on service; not technology
  - Need – identify service needs, consumption, patterns of use (peaking?)

- Internet of Things
  - What's new? (RFID redux?) (sensors everywhere?)
  - Getting to the consumer/home level? Alexa?
  - Increased in-transit visibility? (cloud-based GPS + RFID)
    - Pedigree (pharma), fake products, CSR
  - Insight into consumer use of product (?)
  - Collect huge data
    - Use big data analytics to find hot spots (asset loss, component failure, delays, temperature in cold chain,…)
    - Optimize inventory in real time

Technologies - AI

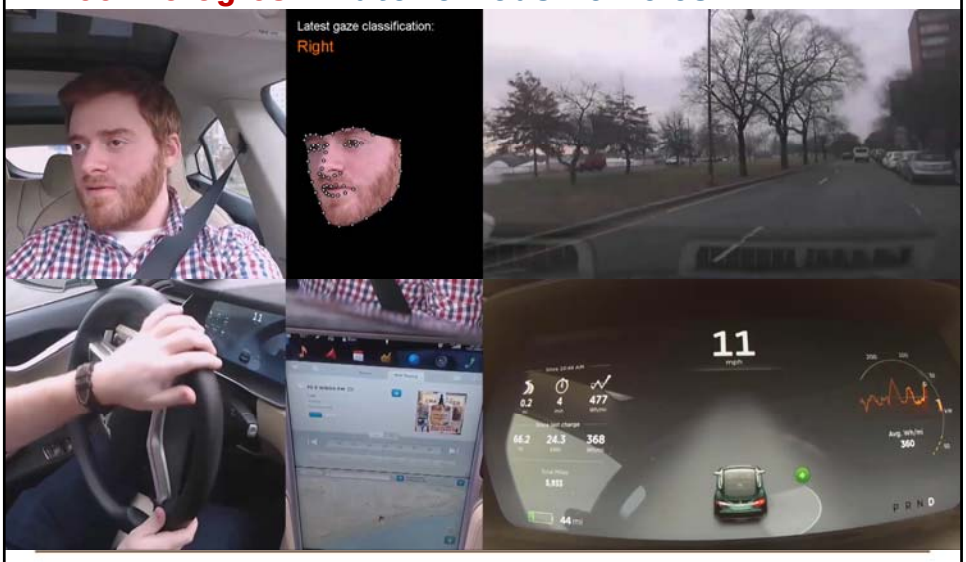
- Basic components:
  - Algorithms
  - Computing power
  - Training on data
- Amazon leads
  - Understanding demand
  - At individual consumer level
  - "Needs" before they materialize (tie to inventory placement)
  - Alexa
- The (benign?) overlord

Technologies - Autonomous vehicle

(Coupled with ride sharing)

+ Better flows
+ Lower costs
+ Safety – reduction in highway death and injuries
- Cyber terror opportunity
- Future of automotive companies – who will buy cars? (Power shift in the chain?)

Technologies - Autonomous vehicles



Technology – Autonomous Trucks

- Short term:
  - Operator still behind the wheel
  - Fuel efficiency - platooning
  - Longer operating hours (14 instead of 11)
- Long term:
  - Fully autonomous
  - E2E autonomous operation
  - City delivery (electric tractor?)
  - Many new “truck stops”

Technologies – Block Chain

What?

- A data structure that makes it possible to create a digital ledger of transactions and share it among a distributed network of computers. It uses cryptography to allow each participant on the network to manipulate the ledger in a secure way without the need for a central authority
- Once a block of data is recorded on the ledger, it is difficult to change or remove. If a participants in the network wants to add to it, the majority of nodes have to agree by running algorithms to evaluate and verify the change (e.g., it has to match the history). When approved, a new block is added
- Bitcoin is “permission-less” – anybody can join. With supply chain, likely “permissioned” block chains – allowing only known participants

Blockchain - How it Works?

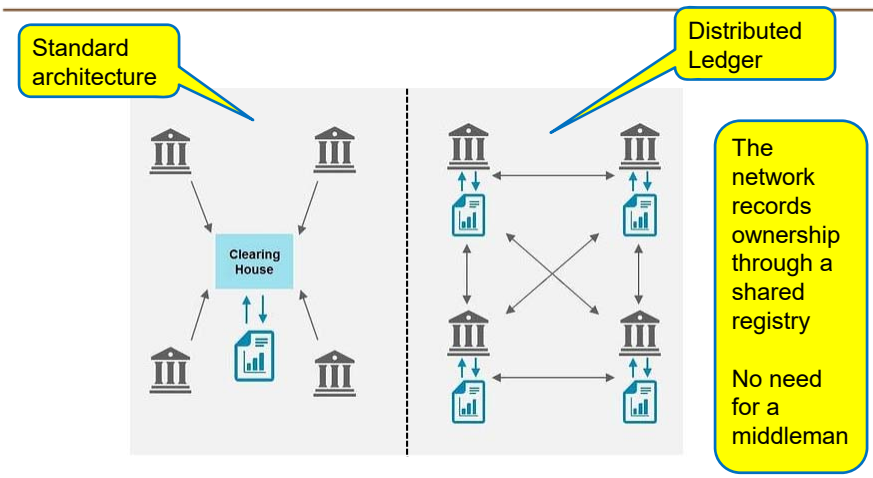
- ✓ Assume an organization has 10 transactions per second.
- ✓ Each of those transactions receives its own digital signature.
- ✓ Using a tree structure, those signatures are combined and given a single digital fingerprint — a unique representation of those transactions at a specific time.
- ✓ That fingerprint is sent up the tree to the next layer of infrastructure, such as a service provider or telecom company.
- ✓ This process happens for every organization in the network until there is a single digital fingerprint that encompasses all the transactions as they existed during that particular second.
- ✓ Once validated, that fingerprint is stored in a blockchain that all the participants can see.
- ✓ A copy of that ledger is also sent back to each organization to store locally
- ✓ Those signatures can be continuously verified against what is in the block-chain, giving companies a way to monitor the state and integrity of a particular asset or transaction.

Blockchain - How it Works?

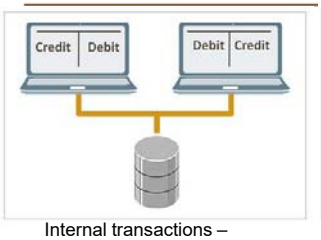
- ✓ Anytime a change to data or an asset is proposed, a new, unique digital fingerprint is created.
- ✓ That fingerprint is sent to each client node for validation.
- ✓ If the fingerprints don't match, or if the change to the data doesn't fit with the network's agreed-upon rules, the transaction may not be validated.
- ✓ This setup means the entire network, rather than a central authority, is responsible for ensuring the validity of each transaction.

Downside:
Concentration of power owing to:
- Computing capacity
- Storage capacity

Blockchain – Shared Registry

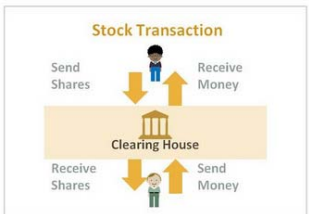


Existing IT Architectures vs. Block Chain

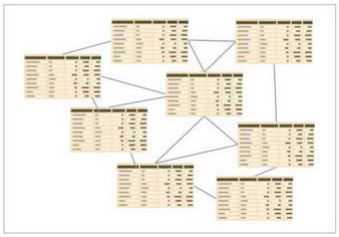


Internal transactions – Central, internal database

Secure inter-party massaging middleware



Third party agent-in-possession



Distributed ledger with cryptographic integrity

Blockchain Technology - Supply Chain Implications

Use:

- Recording the quantity and transfer of assets - like pallets, trailers, containers, etc. - as they move between supply chain nodes
- Tracking purchase orders, change orders, receipts, shipment notifications, or other trade-related documents
- Assigning or verifying certifications or certain properties of physical products; for example determining if a food product is organic or fair trade
- Linking physical goods to serial numbers, bar codes, digital tags like RFID, SenseAware, etc.
- Sharing information about manufacturing process, assembly, delivery, and maintenance of products with suppliers and vendors

Blockchain Technology - Supply Chain Implications

Benefits:

- Enhanced Transparency. Documenting a product's journey across the supply chain reveals its true origin and touchpoints, which increases trust and helps eliminate the bias found in today's opaque supply chains. Manufacturers can also reduce recalls by sharing logs with OEMs and regulators.
- Greater Scalability. Virtually any number of participants, accessing from any number of touchpoints, is possible.
- Better Security. A shared, indelible ledger with codified rules could potentially eliminate the audits required by internal systems and processes.
- Increased Innovation. Opportunities abound to create new, specialized uses for the technology as a result of the decentralized architecture.

Blockchain Technology - Supply Chain Implications

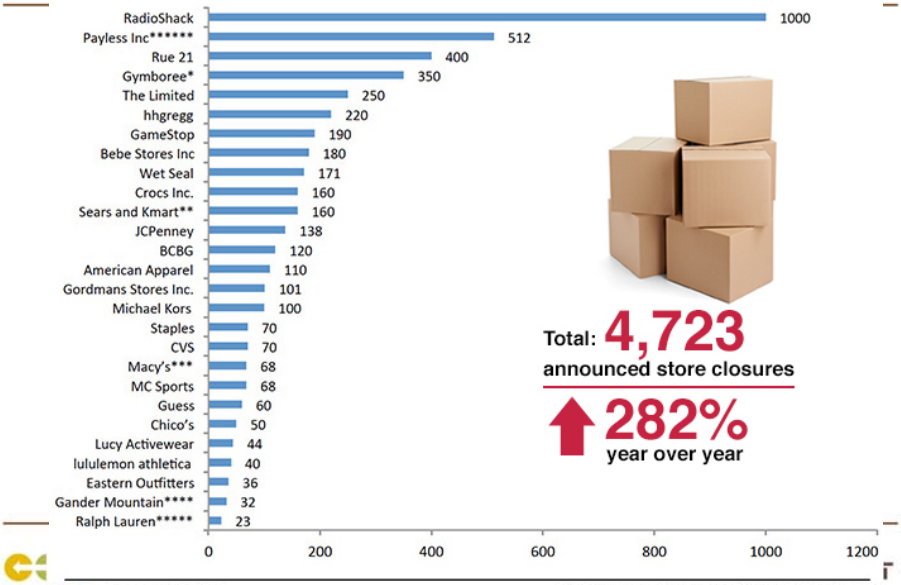
- Traditional supply chain: multiple bilateral contractual links joined together to form a chain
- Blockchain supply chain: formation of an open ecosystem for collaboration
- Issues addressed:
  - Lack of open and trustworthy information technology across the supply chain
- Reasons
  - Trust between partners
  - Technology gaps
  - Legacy practices

Result:
- An eco-system where information flows openly and securely between permissioned participants
- Reduced the assumed risk => lower costs
- Increased agility and adaptiveness

Themes – Future of Retailing

- Electronic commerce
  - Fraction of e-commerce?
  - End of high street?
- Consumer expectations
  - No settling!
  - In stock
  - Faster
  - Anywhere
  - Customized

Year-to-Date+ 2017 Major US Store Closure Announcements



Retailing

Traditional retailing

Electronic commerce
- Basic
- Repetitive
- Little differentiation

Store experience
- Premium
- Personal
- Immersive
- Educational
- Fun

SEPHORA

WILLIAMS-SONOMA, INC.

Retail Delivery

The new competitive landscape:

- Inexpensive
  - Free delivery
- Fast
  - Within hours
- Customized
  - GSK – tailored medicines
  - 3D-printed
- Anywhere
  - Japan – delivery to transit stations
  - Nike – during the Boston Marathon

Retail Experience

- The US has five time the Sq. ft. of retail space per person compared to other developed countries
  - Doom and gloom may be simply retrenchment and getting out of a non-viable situation
- Not all brands/stores are declining
  - The differentiator: customer experience
- Deep product expertise in the store
  - fashion advice
  - DIY help
  - fun experience
  - Walmart movie nights

Retail of the Future

- Automatic replenishment
- Picture – identify – compare – buy
- No down time for retailers
- Retail competition is for the consumer's wallet
  - Consumers are spending more on experiences and less on "stuff"
    - Only 60% of today's 18-year-olds have a driver's license, compared with 80% in the 1980s
    - "Must have" item car => smart phone
  - 2016 - U.S. apparel industry last year grew 3%, while the U.S. domestic travel industry grew 5%
  - For the first time, American consumers spent in 2016 more at bars and restaurants than on groceries

Product Servicization

- Product centric - extraction of more utility from a product
  - Inventory management
  - Maintenance and repair
  - Spare parts support
  - Training and certification
  - Testing and audit

Whole product services

- Customer centric – providing expertise, resources, alliance
  - Customization
  - Consulting
  - Business development
  - Integration & turnkey projects
  - Outsourcing and managed services

Value creation services

Why Servicizing?

- Growth:
  - Stimulating product sales by selling additional services
  - Competitive advantage through differentiation
  - Higher barriers to entry
  - Protection against product reverse-engineering/imitation
- Margins
  - High capacity utilization
  - Service markets have superior margins
  - Avoid price competition
  - Protection against demand shocks
- Relationship
  - Increased “stickiness”
  - Understanding customer needs better and learning about it fast
  - Fast penetration of innovation/new technology to the market

Servicization -

NETAFIM™ GROW MORE WITH LESS

Drippers company

Managed Services for specific verticals:
- Green houses
- mining

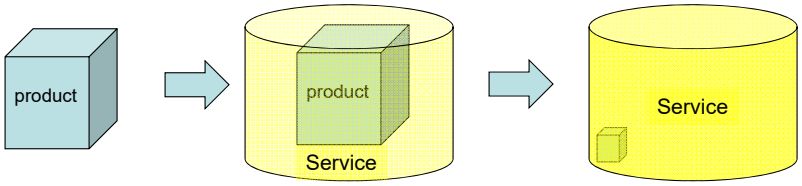
Professional Services:
- Consulting
- Integration
- Project management

Expertise:

Feasibility Study → Detailed Design → Procurement → Implementation → Training & Support

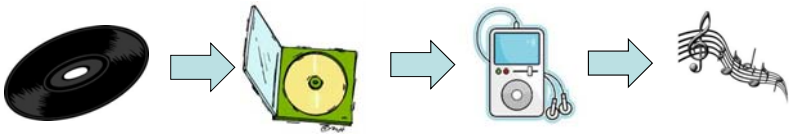
Value:

From Product to Service



Example: On Star

Music example:



Vinyl CD Download Streaming

The Future…

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