DCNA Austria

Disaster Competence Network Austria

Austrian Disaster Research Days 2019

14.-15.Oktober 2019, Technische Universität Graz

Industrieanlagen im Visier von Hackern

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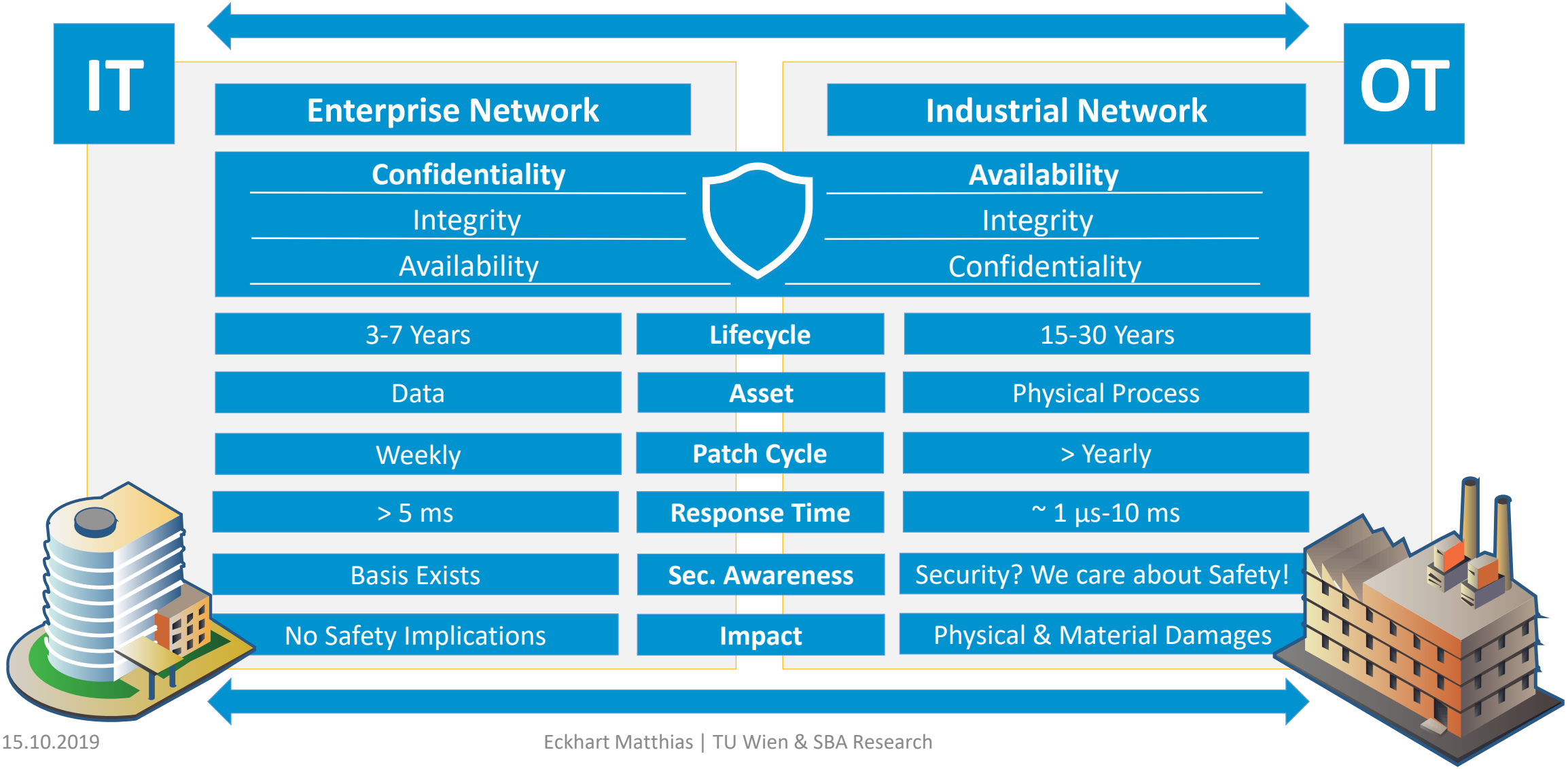
Maroochy Water Breach

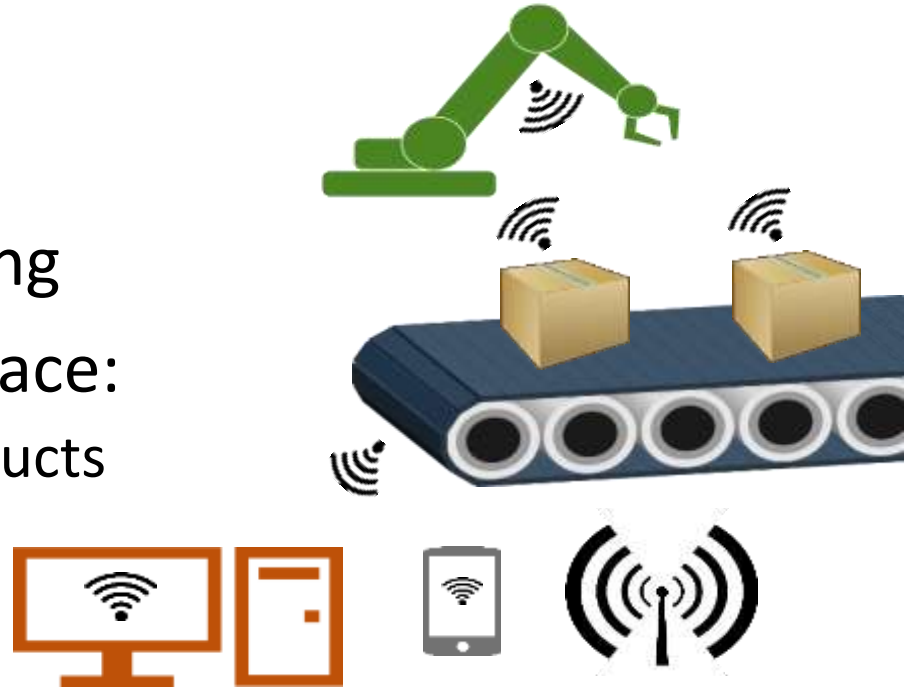
Image Source
(Wikimedia, 2006)

IT vs. OT (Industrial Control Systems, ICSs)

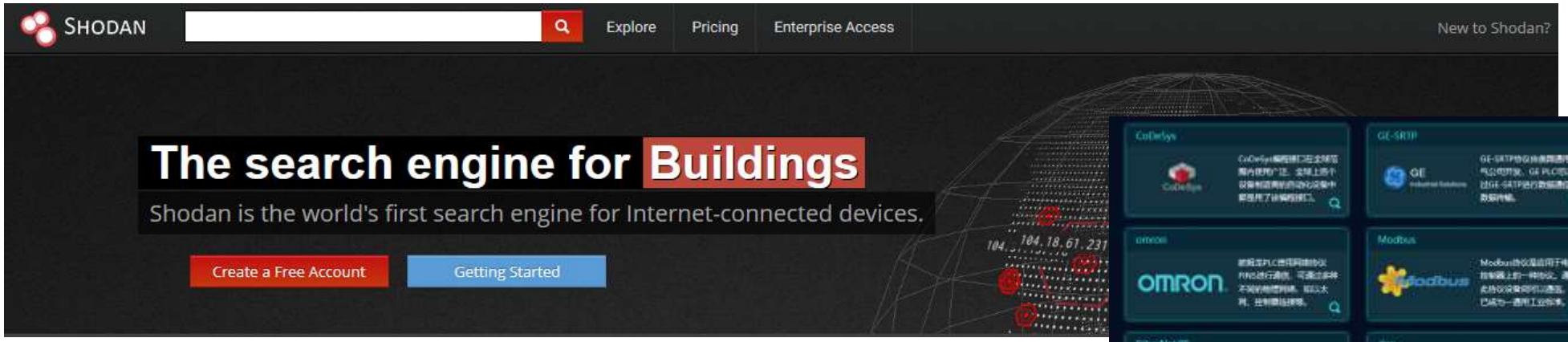


A Changing Threat Landscape

- The myth of “air gaps”
- New trends: Industry 4.0 & Smart Manufacturing
- Increasing connectivity expands the attack surface:
  - Interconnectivity of resources, processes, and products
  - Remote maintenance
  - Cloud & edge computing
- IT/OT convergence
- Legacy systems still in operation

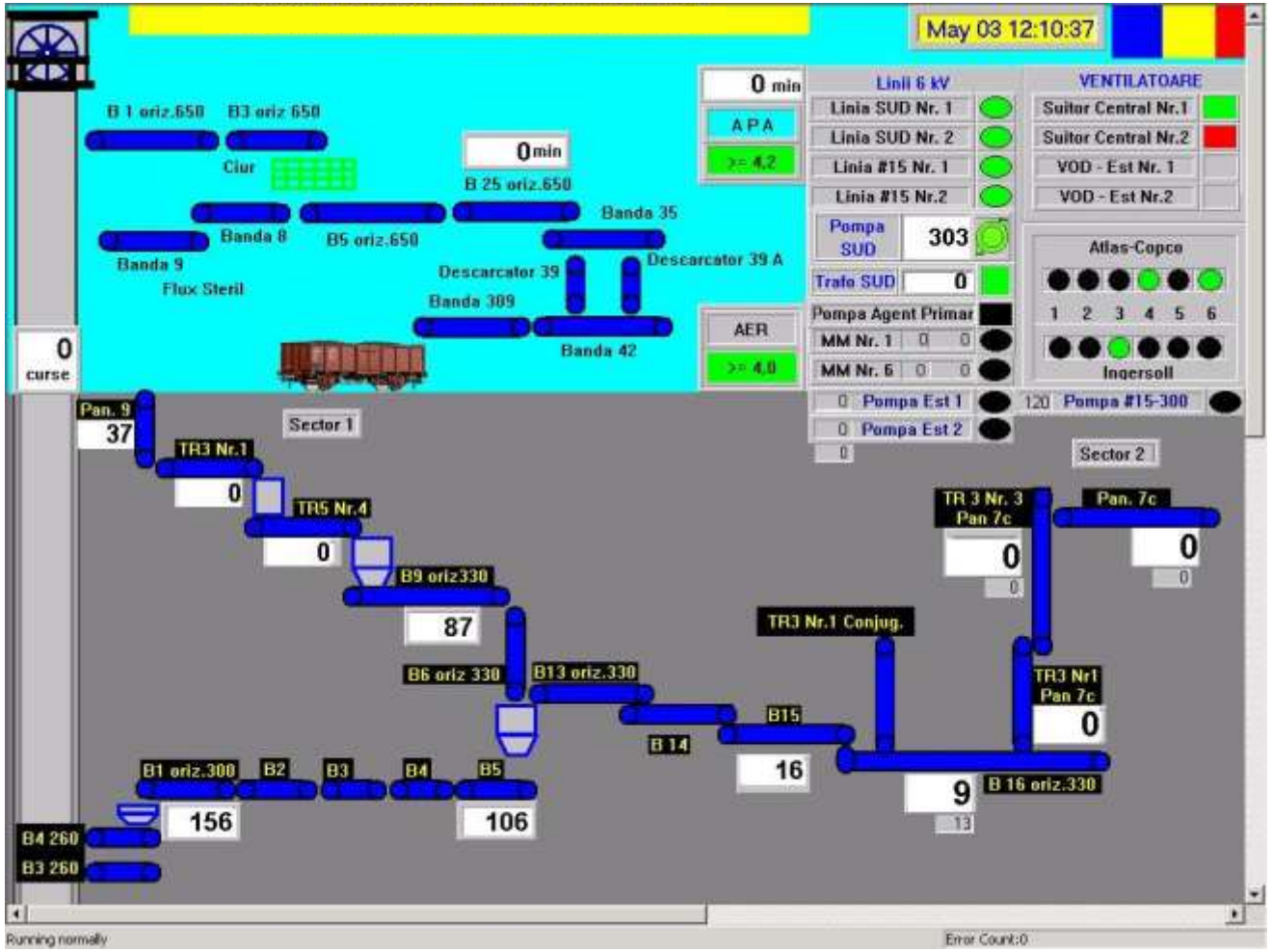


Internet-Exposed ICSs



- Search engines for Internet-connected devices
  - Shodan.io, FOFA.so, …
- Regularly scan the entire IP range
- Find:
  - ICSs, Traffic Lights, Webcams, Databases, IoT devices, …

Finding Interesting Things with Shodan



- Mine in Romania
  - VNC
  - Authentication disabled
  - Control:
    - Air supply
    - Pumps
    - …

Insecure by Design

> "64% of 2017 ICS-related vulnerability patches don't fully eliminate the risk because the components were insecure by design." – Dragos, 2018

- Security weakness discovered (and patched):
  - Still exploitable until end of life?
- Proprietary protocols & inherently insecure protocols often used
- Vulnerability management is difficult
- Time to rethink engineering (process)
- **Objective:** Establish security as a `first-class citizen` in the engineering process

Securing the Engineering Process

Engineering process is highly complex

Artifacts are created, managed, edited

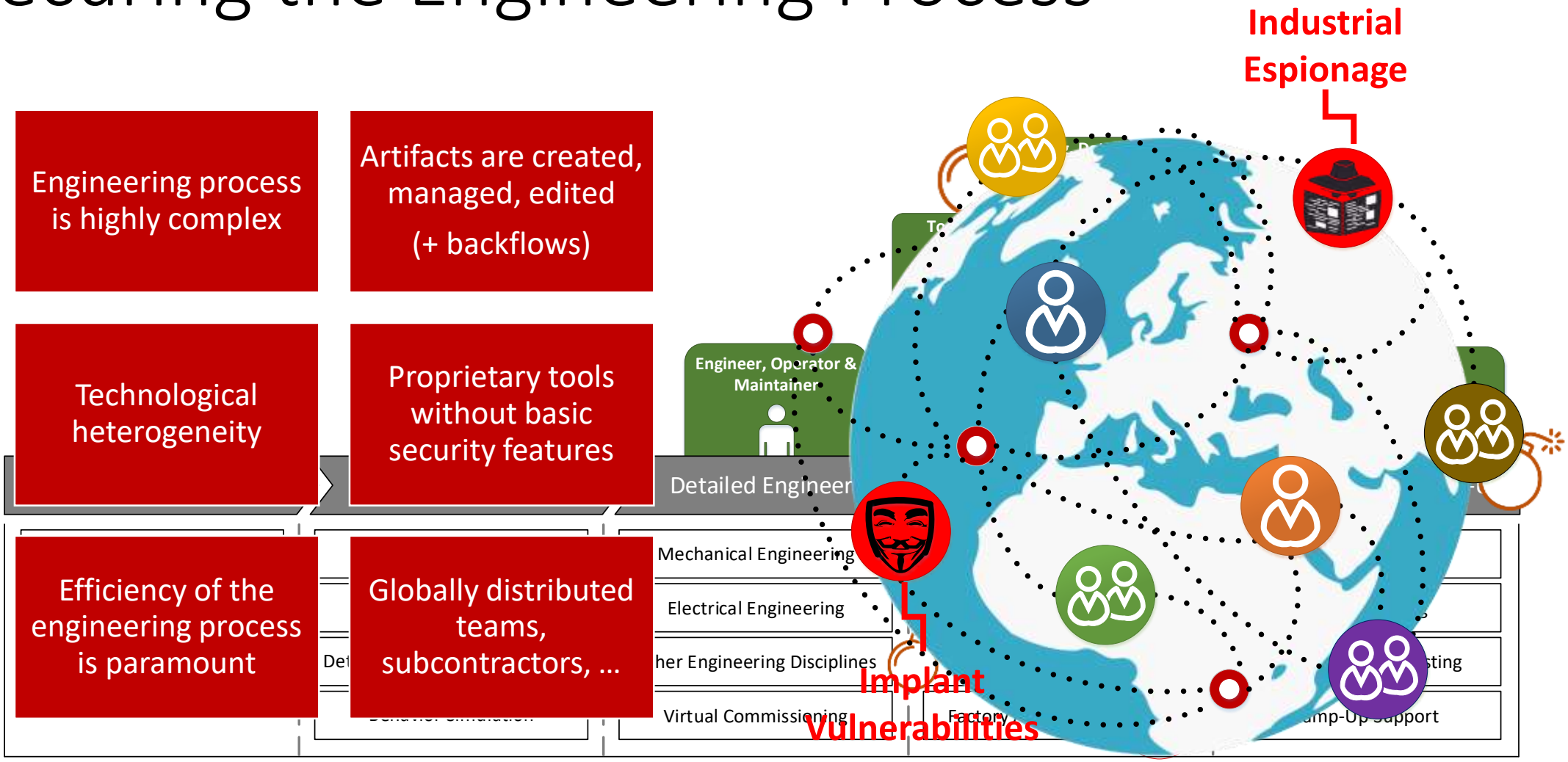
(+ backflows)

Technological heterogeneity

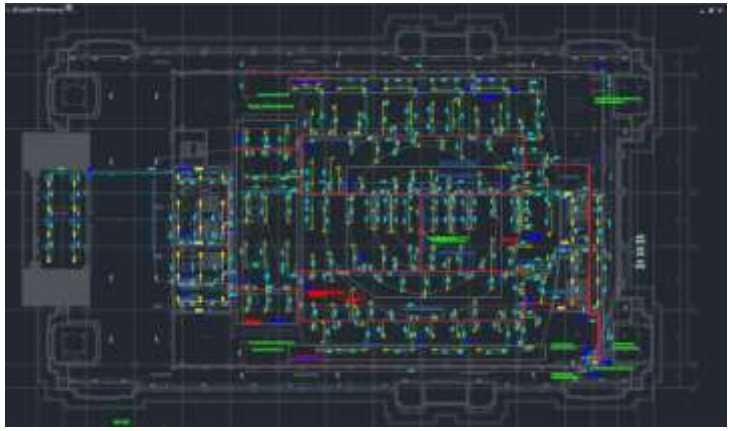
Proprietary tools without basic security features

Efficiency of the engineering process is paramount

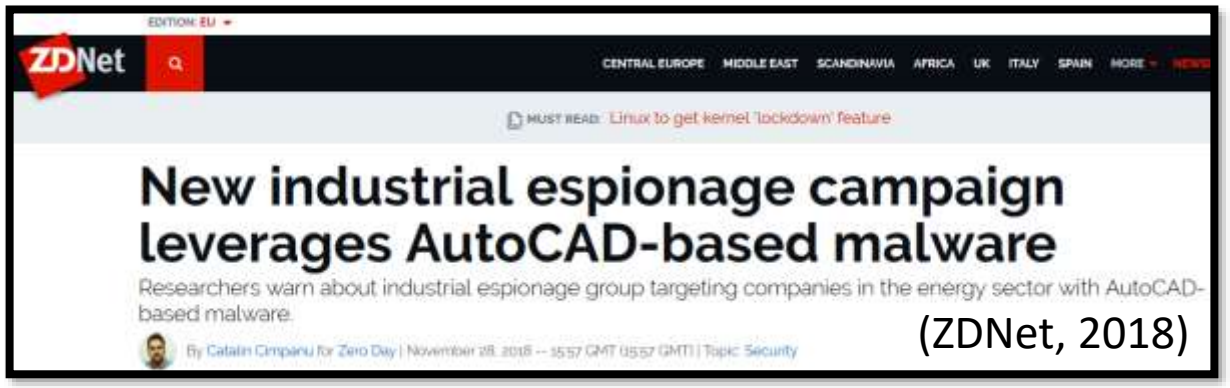
Globally distributed teams, subcontractors, …



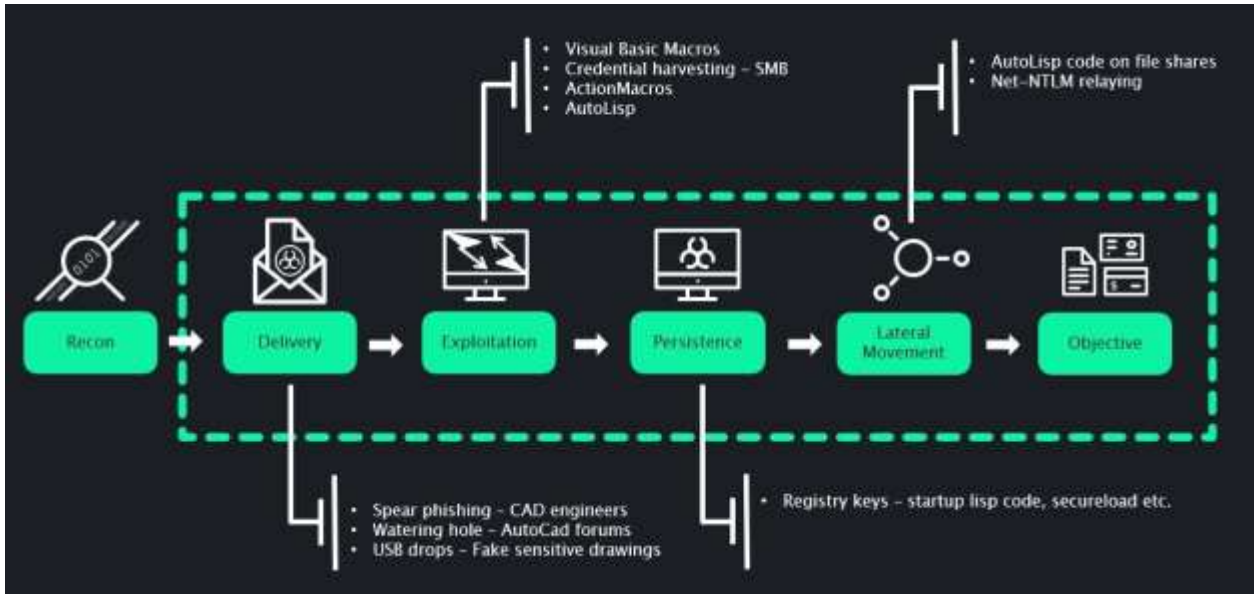
Malware in Engineering Artifacts – In the Wild



(Forcepoint, 2018)



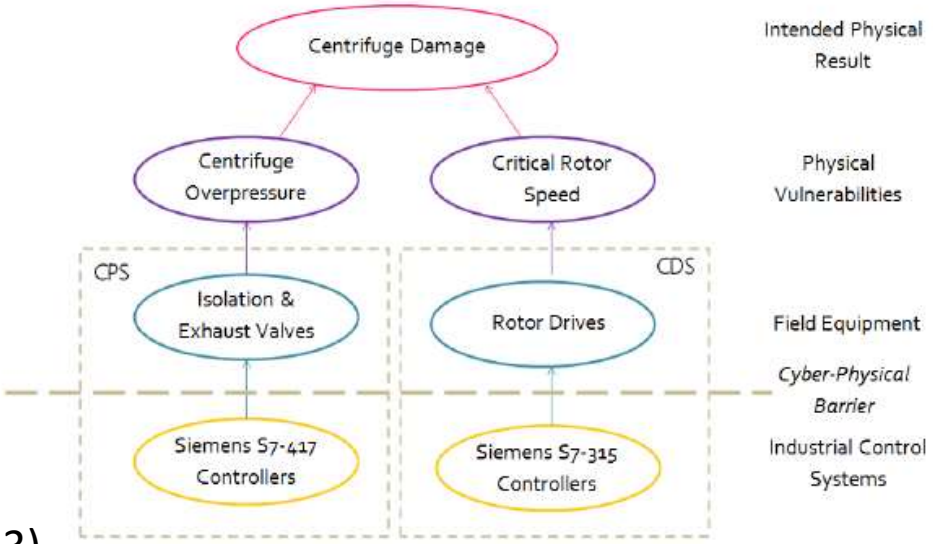
(ZDNet, 2018)



(F-Secure Labs, 2019)

Stuxnet

- Target: Iran's nuclear enrichment facility at Natanz
- 2 attacks executed periodically:
  - Overpressure attack:
    - Interfere with the Cascade Protection System (CPS) that is used for isolating unreliable centrifuges
    - Manipulation of exhaust valve to relieve overpressure
    - Record & replay 21 seconds of normal operation during attack
  - Rotor speed attack:
    - Interfere with Centrifuge Drive System (CDS) that controls motor speed
    - Overspeed rotors (normal: 63k rpm, Stuxnet: 84.6k rpm) for ~15 minutes
- Utilized multiple 0-days
- Attackers *tried* to avoid catastrophic damage
- Creators: NSA & Israel's Unit 8200?

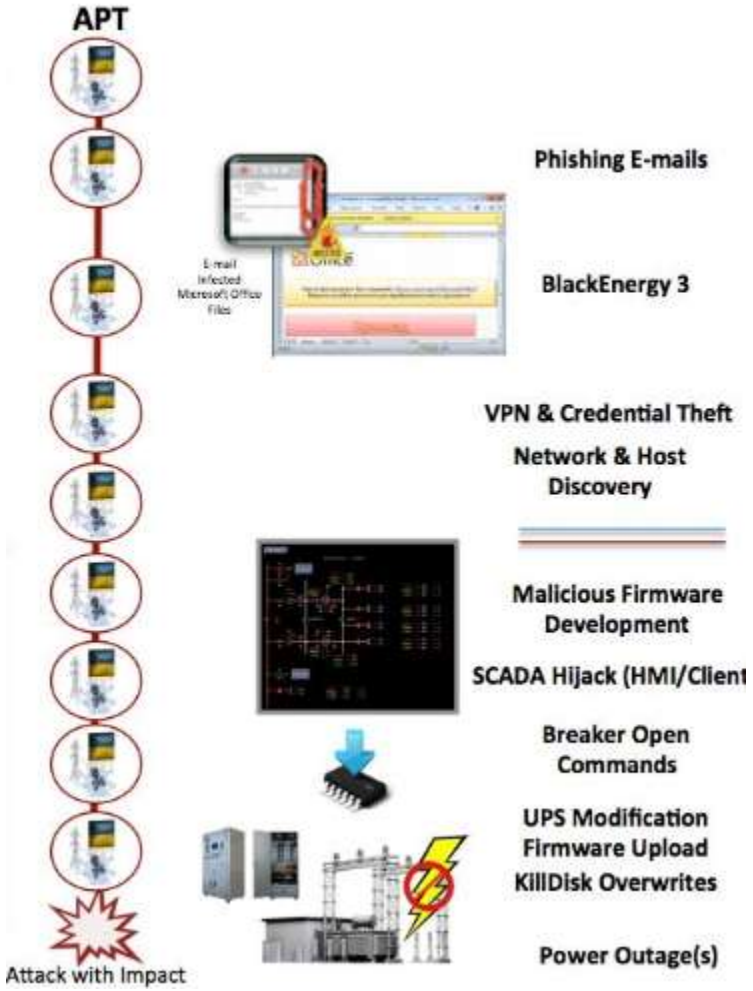


(Langner, 2013)

Cyber Attack against the Ukrainian Power Grid

- Attack on SCADA distribution management system
- Caused power outage in December 2015
  - Lasted several hours
  - Affected 225,000+ customers
- Malware enabled the attack and caused restoration delays
- Involved direct interaction with ICSs by adversaries

(Lee et al., 2016)



Cyber Insurance

(Financial Times, 2019)

- Growing importance of risk transfer
- Mondelez vs Zurich case:
  - NotPetya attack (2017)
  - Mondelez had an all-risk property insurance policy
  - $100MM claim
  - Policy exclusion: *"a hostile or warlike action"* by a "government or sovereign power"
- Attribution of cyber attacks is difficult
- Silent cyber exposure:
  - Non-affirmative cyber risks: risks implicitly included in policies
  - Claims for cyber attacks on non-cyber policies
- cf. Prudential Regulation Authority SS4/17
- Reducing silent cyber: cyber insurance for ICSs
- Opportunity: Incentivizing security

(PRA, 2017)

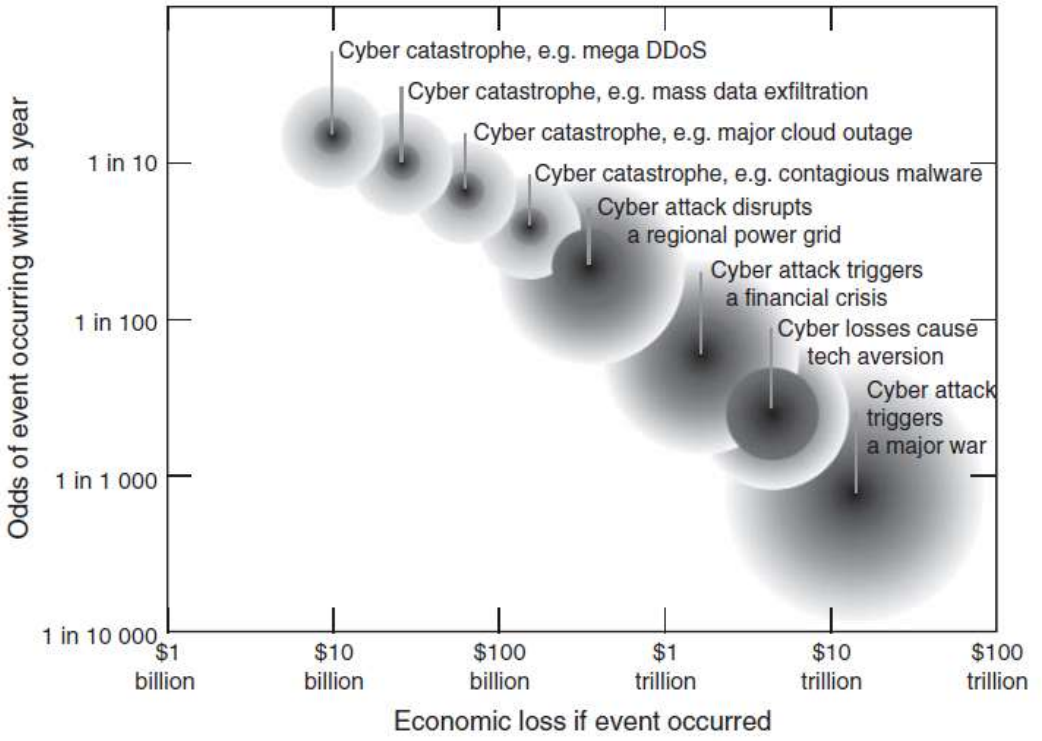
(JLT, 2019)

Managing the Cyber Black Swan

Image Source
(Wikipedia, 2009)

Cyber Accumulation

- Global spreading could lead to a <u>cyber catastrophe</u>
  - Cyber risk not geographically bound
  - Interdependencies among vulnerabilities, services, companies, …
  - Attackers & vulnerabilities are highly dynamic variables
- Cyber losses can cascade
- $3bn (re)insurance industry loss caused by NotPetya
  - Direct and consequential business loss: > $10bn (Coburn et al., 2019)
- Multiple reinsurers cannot deal with accumulated events
- Collapse of the insurance industry?
  - Devastating impact on economy
- Pressing research issues: quantification methods, cyber risk models, accumulation control strategies



(Coburn et al., 2019)

Ongoing Research Efforts in ICS Security @ CDL-SQI & SBA Research

Quant. Security Risk Assessments	Security of Engineering Data Exchange	Security by Design for Industry 4.0	Digital Twins	Blockchain

• Security Modeling in Production Systems Engineering
• Automated Risk Identification based on Engineering Artifacts
• Cyber Risk Quantification
• Cyber Insurance
	• Protecting Engineering Data in Transit and at Rest
	• Focus: AutomationML
	• Secure Interfaces for Engineering Tools
	• Security Technical Debt Analysis
		• Security Development Lifecycle for Cyber-Physical Production Systems
		• Designing ICSs with Security in Mind
		• Strongly Connected to Risk Assessment Research
			• Generation of Virtual Replicas
			• State Replication
			• Security-enhancing Use Cases
			  • Intrusion Detection
			  • Secure Design
			  • Attack Simulation
				• Analysis of Risky Design Decisions
				• Blockchain-based Engineering Data Logistics
				• Distributed Randomness
				• More details: https://blockchain.sba-research.org/

Conclusion

- Time to change our attacker model:
  - Attackers know everything about the physical process under control (or at least enough to cause disastrous consequences)
- Past has shown:
  - Attacks against ICSs are high-impact, low-frequency (HILF) events
  - However, frequency continuous to increase
- Time to rethink our engineering approach:
  - “Security by Design” & securing the engineering process
- Emerging cyber insurance market, but many open challenges
- Multidisciplinary research approach required

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