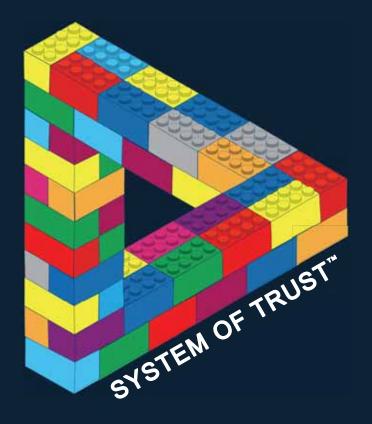
MITRE System of Trust

CORE TEAM. BOB MARTIN, BRIAN HALL, MIKE RIPLEY,
SEAN BARNUM, PAUL GARVEY, MICHAEL
AISENBERG, RON HODGE, KEITH HILL,
JUSTIN YEAGER, CHUCK LEWIS

March 03, 2021





Difficult Interactions for Supply Chain Participants Regarding Trust

(circa 2020)



Trustworthy SW/HW







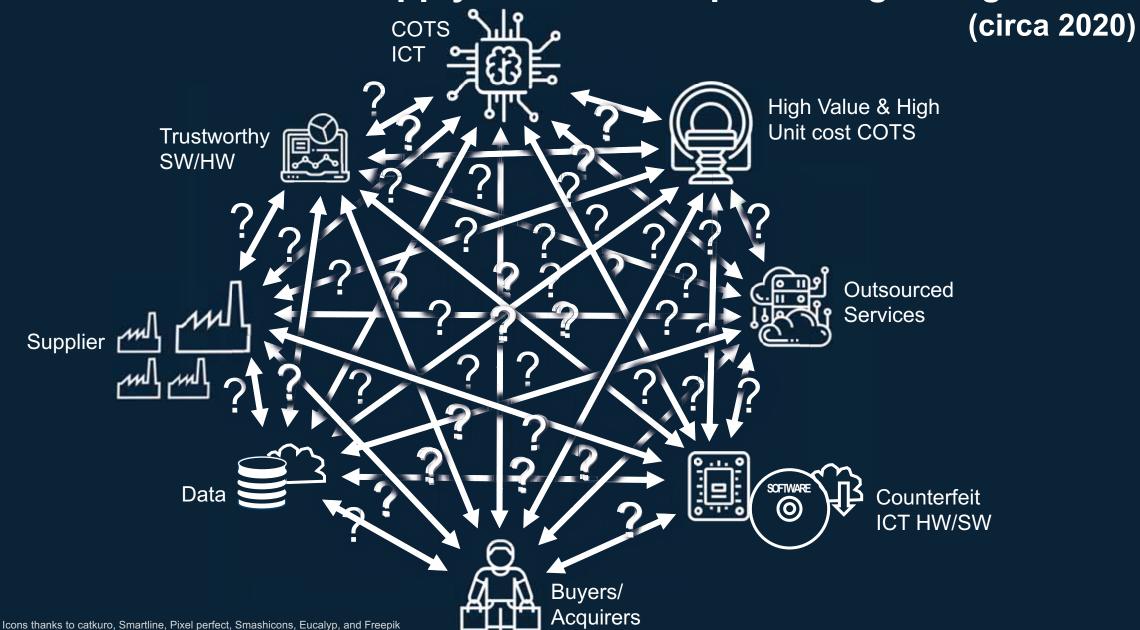








Difficult Interactions for Supply Chain Participants Regarding Trust



30+ Publicly Available Items on Supply Chain Security Risk Areas

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- 11. "Risk Management of Outsourced Technology Services". November 2000.
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 13. "Constructive Disruption White Paper: Exploiting Publicly Available Information to Address Today's Security Challenges", February 2019.
- 14. "Hardware Security and Supply Chain Risk Management", September 2019, Public Release Case number: 19-2459.
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 16. "Providing a Framework to Effective Software Quality Assessment A First Step in Automating Assessments", The First Annual Software Engineering & Economics Conference on Software Systems Modernization, April 1996.

- 18. "The Growing Threat to Air Force Mission-Critical Electronics: Lethality at Risk: Unclassified Summary", 2019.
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 NIST Draft NISTIR 8272, "Impact Analysis Tool for Interdependent Cyber Supply Chain Risks", March 2020
- 21. "Automated Source Code Quality Measures (ASCOM)", Version 1.0, January 2020.
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- The Open Group, "An Approach to Assessing Vendors to Lower Potential Risk of Outsourced Network Services", March 2020.
 The Open Group, "Securing the Network and Supply Chain with Industry-Driven Standards", January 2020.
- 25. Open Web Application Security Project (2019) OWASP Application Security Verification Standard 4.0.
- 26. Open Web Application Security Project (2014) OWASP Testing Guide 4.0.
- 27. Payment Card Industry (PCI) Security Standards Council (2019) Secure Software Lifecycle (Secure SLC) Requirements and Assessment Procedures Version 1.0.
- 28. SAFECode (2012) Practical Security Stories and Security Tasks for Aglie Development Environments.
 29. SAFECode (2019) Fundamental Practices for Secure Software Development: Essential Elements of a Secure Development Lifecycle Program, Third Edition
 30. SAFECode (2017) Managing Security Risks Interent in the Use of Third-Party Components.
- 31. SAFECode (2010) Software Integrity Controls: An Assurance-Based Approach to Minimizing Risks in the Software Supply Chain. Software Assurance Forum for Excellence in Code (2017) Tactical Threat Modeling.
- 32. "Supply Chain Decision Analytics: Application and Case Study for Critical Infrastructure Security", Proceedings of the 11th International Conference on Cyber Warfare & Security, March 2016.
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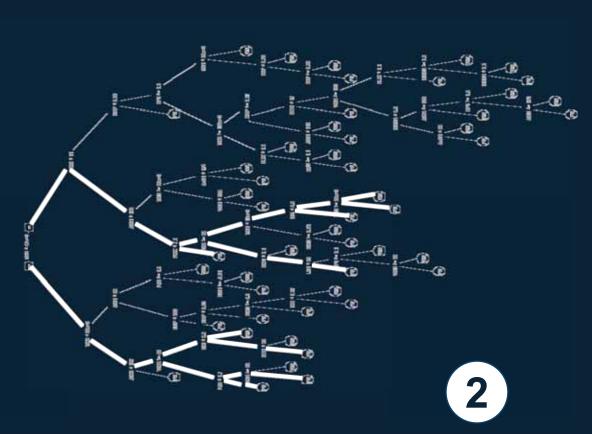
40+ MITRE Supply Chain Related Efforts and Past Endeavors



Address Chaos, Align & Organize

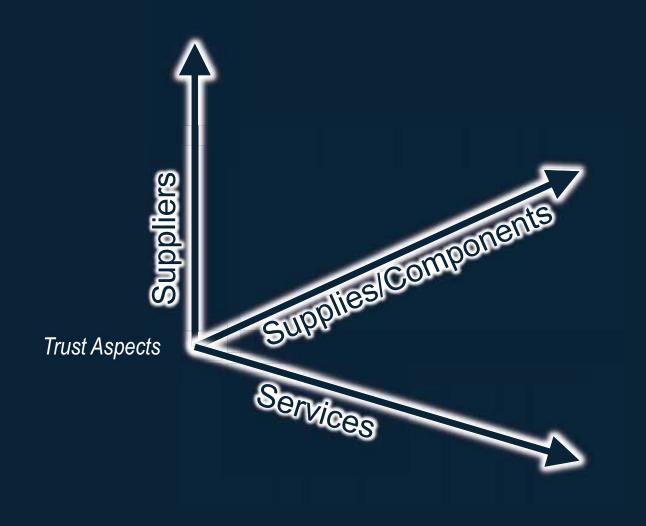


Address Chaos, Align & Organize



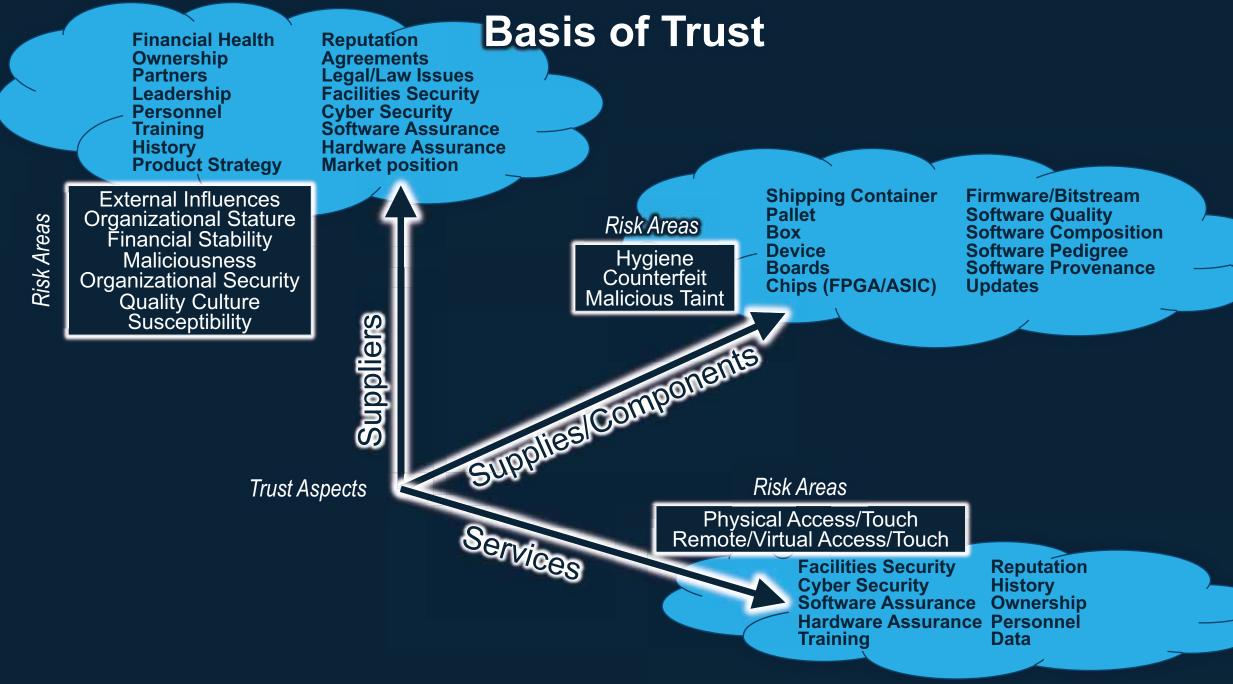
Simplify, Tailor & Make Usable

Basis of Trust



Basis of Trust

External Influences Organizational Stature Financial Stability Risk Areas Risk Areas Maliciousness Hygiene Counterfeit Organizational Security **Malicious Taint** Quality Culture Susceptibility Suppliers Supplies/Components Trust Aspects Risk Areas Physical Access/Touch Remote/Virtual Access/Touch Services



Basis of Trust Reputation **Ownership** Agreements Legal/Law Issues **Facilities Security** Leadership **Cyber Security** Per nnel **Software Assurance** Tran mg Hist **Hardware Assurance** Product Strategy **Market position Shipping Container** Firmware/Bitstream External Influences Pallet **Software Quality** Risk Areas Risk Areas **Software Composition** Box Financial Stability **Software Pedigree Device** Maliciou Pss Organizational Scrurity Hygiene **Software Provenance** Boards Counterfeit Chips (FPGA/ASIC) **Updates** Quality Culture **Malicious Taint** Susceptibility Suppliers Supplies/Components Risk Areas Trust Aspect Physical Access/Touch Services Remote/Virtual Access/Touch

MITRE

Facilities Security

Training

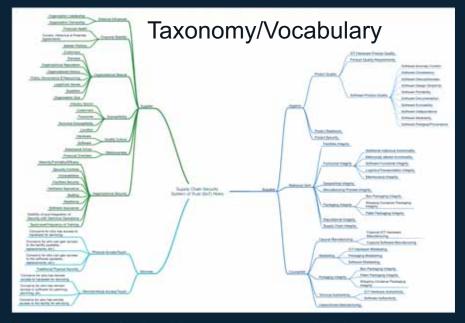
Cyber Security
Software Assurance

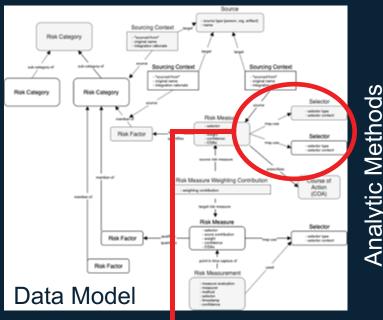
Hardware Assurance Personnel

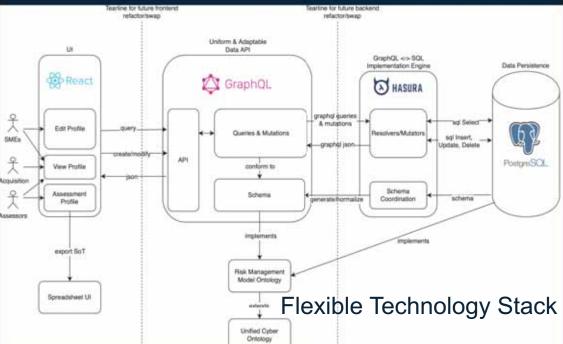
Reputation

History **Ownership**

Data





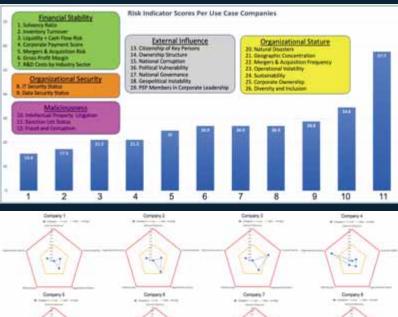


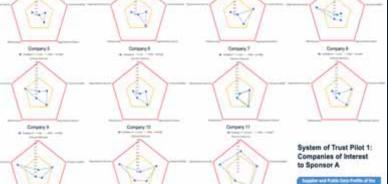
Linkage to future automated data retrievals from 72 identified Commercial, Open Source, and Government only Data sources for ad-hoc or periodic assessments

Export to Spreadsheet for "Offline" Assessment









三 Overview









Type of Acquisition Issues

- COTS ICT
- Trustworthy SW/HW
- Supplier
- ☐ High Value & High Unit cost COTS
- Outsourced Services
- Counterfeit ICT HW/SW

Assessment Scope, Skills & Means

- Open Source Information
- Purchased Data Sources
- Written Questions
- Oral Discussions
- Sampling of Components
- Software Analysis
- ☐ Intelligence Service Investigation

Pilot 1 Supplier with Purchased & Public Data Profile [notional]

Acquiring Organization

- US Federal Government
- US Military
- State/Local
- □ Tribal
- US Critical Infrastructure
- ☐ US DIB
- Commercial
- Small Business

- Time Period
 - Weeks
 - o Days
 - Hours
- Monies for Data Purchase
- ☐ Investigative Staff Available

Pilot 2 Supplier and Service with Purchased & Public Data Profile [notional]











Type of Acquisition Issues

- COTS ICT
- ☐ Trustworthy SW/HW
- Supplier
- ☐ High Value & High Unit cost COTS
- Outsourced Services
- ☐ Counterfeit ICT HW/SW

Acquiring Organization

- US Federal Government
- US Military
- State/Local
- □ Tribal
- US Critical Infrastructure
- ☐ US DIB
- Commercial
- □ Small Business

Assessment Scope, Skills & Means

- Open Source Information
- Purchased Data Sources
- → Written Questions
- Oral Discussions
- Sampling of Components
- Software Analysis
- ☐ Intelligence Service Investigation

- Time Period
 - Weeks
 - o Days
 - Hours
- Monies for Data Purchase
- ☐ Investigative Staff Available



Pilot 3 Analysis of Software Supply Item Profile [notional]











Type of Acquisition Issues

- COTS ICT
- Trustworthy SW/HW
- Supplier
- ☐ High Value & High Unit cost COTS
- Outsourced Services
- Counterfeit ICT HW/SW

Acquiring Organization

- US Federal Government
- US Military
- State/Local
- □ Tribal
- US Critical Infrastructure
- ☐ US DIB
- Commercial
- □ Small Business

Assessment Scope, Skills & Means

- Open Source Information
- □ Purchased Data Sources
- → Written Questions
- Oral Discussions
- Sampling of Components
- Software Analysis
- ☐ Intelligence Service Investigation

- Time Period
 - Weeks
 - o Days
 - Hours
- Monies for Data Purchase
- Investigative Staff Available



Pilot 4 Supplier with Purchased & Public Data Profile [notional]











Type of Acquisition Issues

- COTS ICT
- Trustworthy SW/HW
- Supplier
- ☐ High Value & High Unit cost COTS
- Outsourced Services
- ☐ Counterfeit ICT HW/SW

Acquiring Organization

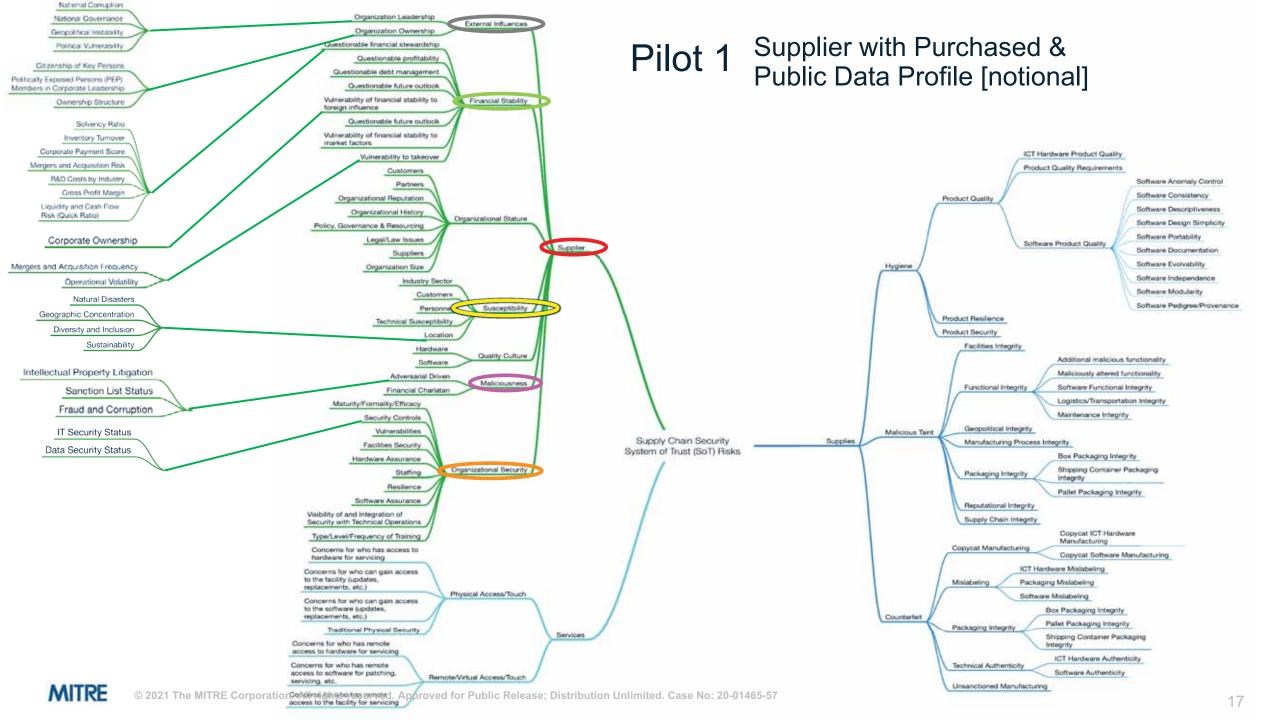
- US Federal Government
- US Military
- State/Local
- □ Tribal
- US Critical Infrastructure
- ☐ US DIB
- Commercial
- □ Small Business

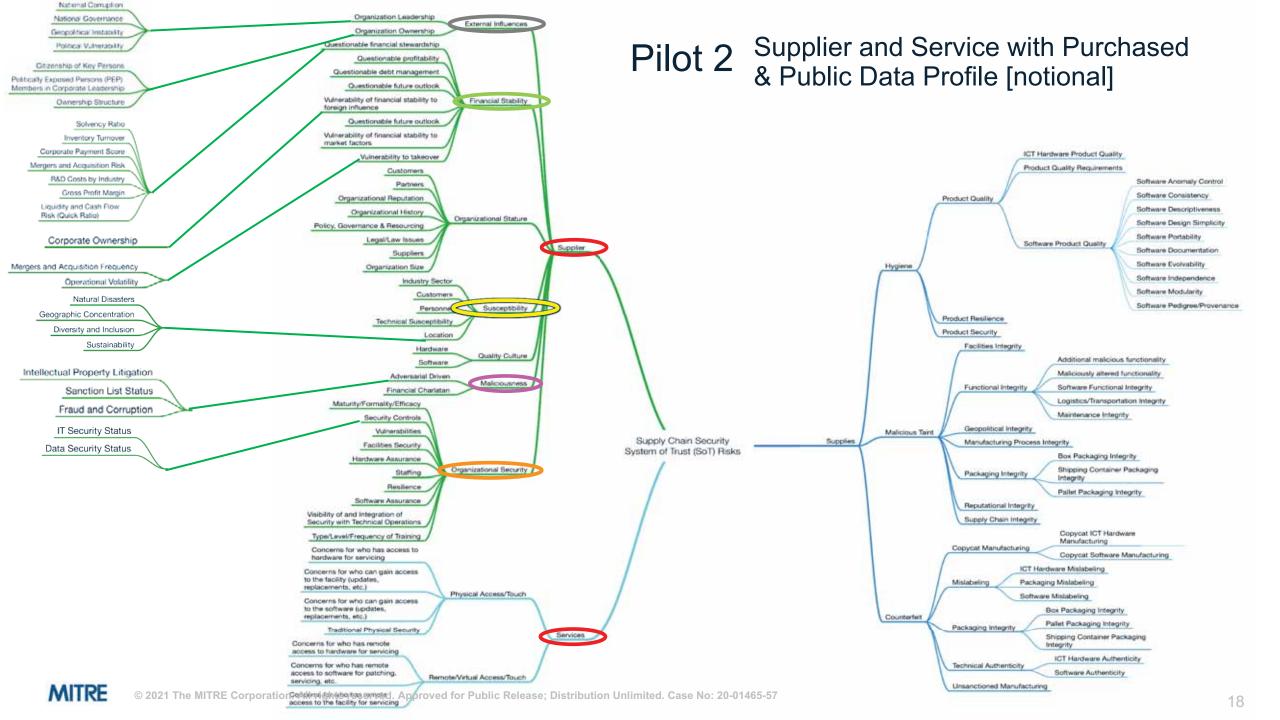
Assessment Scope, Skills & Means

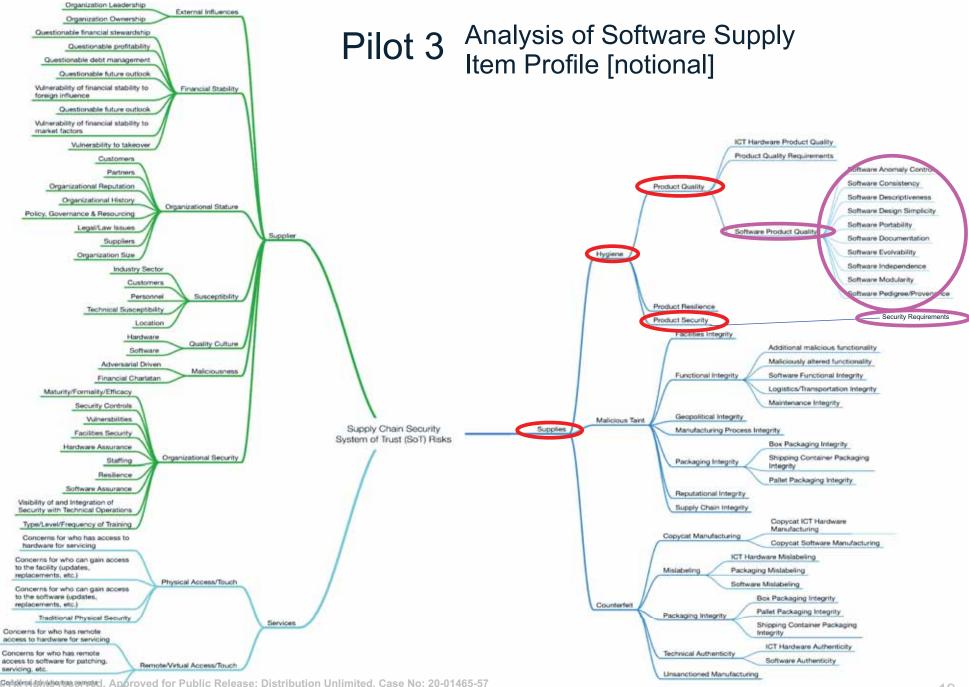
- Open Source Information
- Purchased Data Sources
- → Written Questions
- Oral Discussions
- Sampling of Components
- Software Analysis
- ☐ Intelligence Service Investigation

- Time Period
 - Weeks
 - o Days
 - Hours
- Monies for Data Purchase
- ☐ Investigative Staff Available

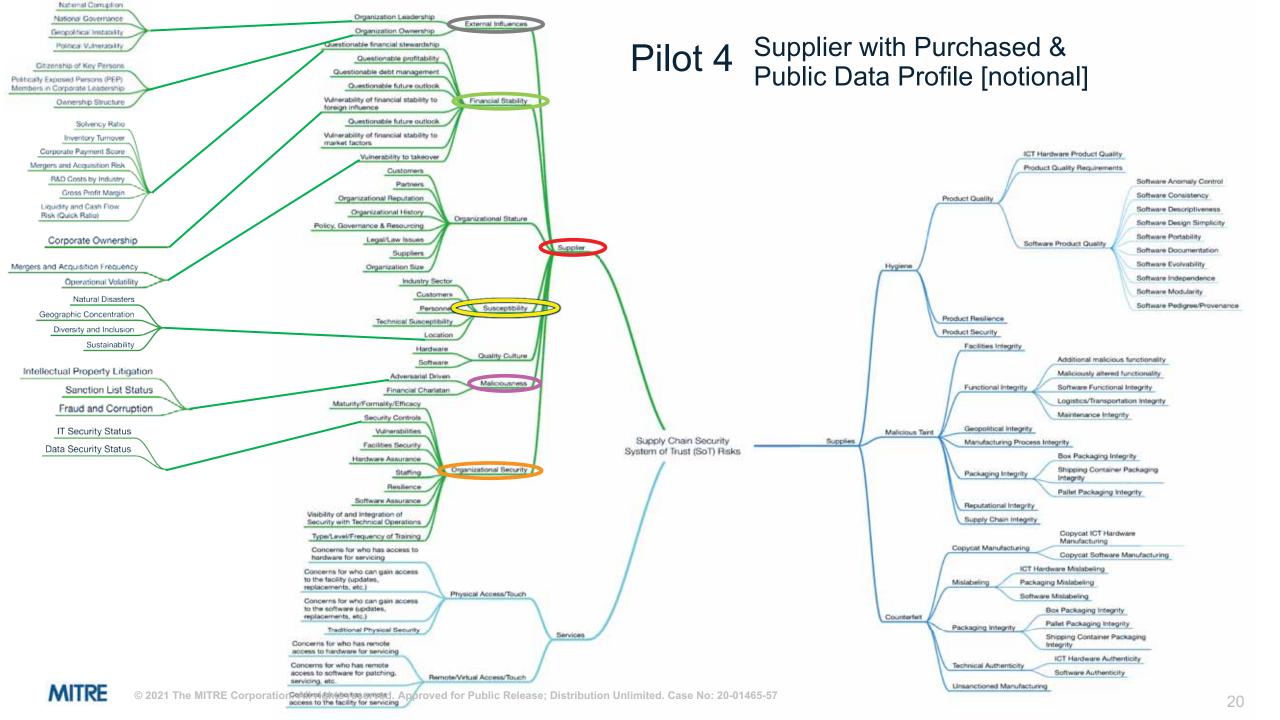






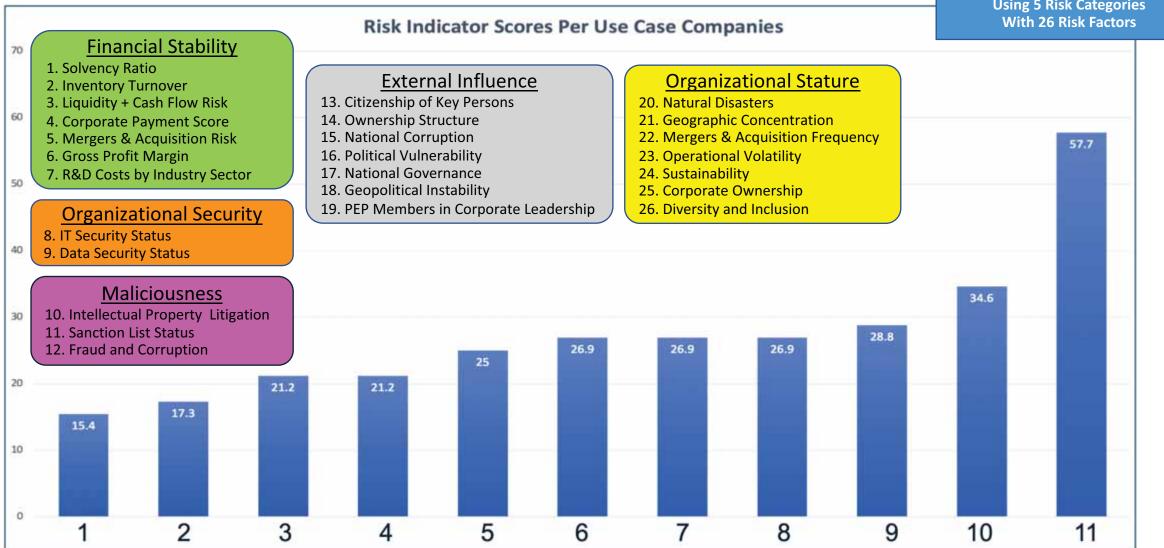






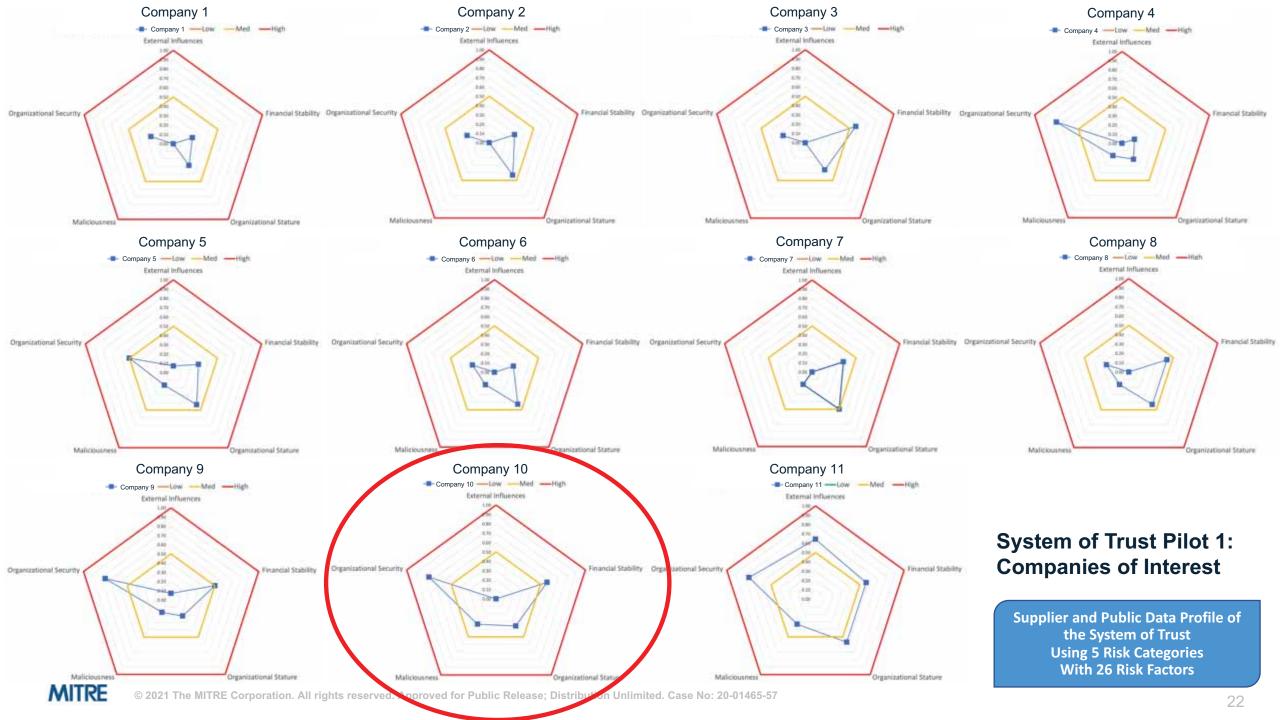
SoT Pilot 1: Companies of Interest

Supplier and Public Data Profile of the System of Trust Using 5 Risk Categories With 26 Risk Factors



Risk scorecard based on the preliminary System of Trust scoring methodology for 5 top-level concern areas and 52 risk measure questions for 26 risk factors.





Company 10 **Supplier and Public Data Profile of** the System of Trust **External Influence Using 5 Risk Categories** 13. Citizenship of Key Persons External Influences With 26 Risk Factors 14. Ownership Structure 15. National Corruption 16. Political Vulnerability 17. National Governance 0.70 18. Geopolitical Instability 0.60 19. PEP Members in Corporate Leadership 0.50 Organizational Security Financial Stability 0.30 0.20 Financial Stability 0.10 **Organizational Security** 1. Solvency Ratio 0.00 8. IT Security Status 2. Inventory Turnover 9. Data Security Status 3. Liquidity + Cash Flow Risk 4. Corporate Payment Score 5. Mergers & Acquisition Risk 6. Gross Profit Margin 7. R&D Costs by Industry Sector Organizational Stature Maliciousness **Organizational Stature** Maliciousness 20. Natural Disasters 21. Geographic Concentration 10. Intellectual Property Litigation 11. Sanction List Status 22. Mergers & Acquisition Frequency 23. Operational Volatility 12. Fraud and Corruption 24. Sustainability 25. Corporate Ownership 26. Diversity and Inclusion MITRE © 2021 The MITRE Corporation. All rights reserved. Approved for Public Release; Distribution Unlimited. Case No: 20-01465-57

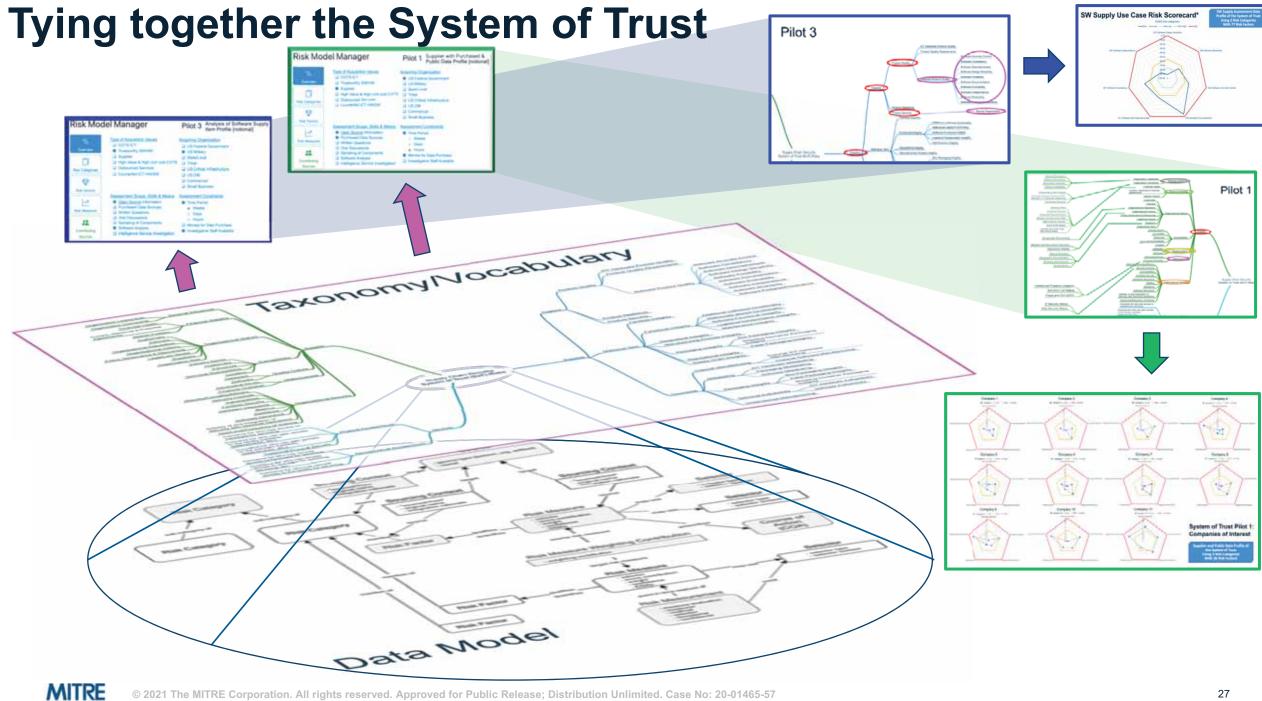
Concern Areas Data Sources	External	Financial	Organizational	Susceptibility	Quality	Maliciousness	Organizational	Hygiene	Counterfeit	Malicious Taint	Physical	Remote/Virtual
Bloomberg	Influences	Stability	Stature		Culture		Security				Access/Touch	Access/Touch
Regulatory DataCorp, Inc. (RDC)												
Dunn and Bradstreet												
Pitchbook												
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Government-Industry Data Exchange Program (GIDEP)												
Independent Distributors of Electronics Association (IDEA)												
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Thompson Reuters												
Yahoo! Finance System for Award Management (SAM)												
Office of Foreign Assets Control (OFAC)												
World Bank Listing of Ineligible Firms												
Five Eyes Alliance												
United Nations Security Council Sanctions List Canada Terrorists List												
Better Business Bureau												
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AFLCMC/IN (Acquisition Intelligence)												
Govini												
Deloitte Electronic Resellers Association International (ERAI)												
Bloomberg												
Interos												
Govini IBM												
Virtual Knowledge												
Semantic Al												
Expanse								-	-			
Fortress IBAT (Industrial Base Analysis Tool)												
SERA (Sustainment Engineering Risk Assessment)												—
RMC / SOLAS												
IBIDS (Industrial Base Integrated Data System) BDP (Big Data Picture)												
DIBnow (Defense Industrial Base-Now)												
CIBAT (Critical Industrial Base Assessment Tool)												
AWARE (Alerts, Warnings, Advice, Resolutions, and Experience)							1		l .	1		

Risk Categories and Data Sources for Supplier Profile Assessment (Pilots 1, 2, & 4)

_												
Concern Areas	External	Financial	Organizational	<u> </u>	Quality		Organizational				Physical	Remote/Vir
Data Sources	Influences	Stability	Stature	Susceptibility	Culture	Maliciousness	Security	Hygiene	Counterfeit	Malicious Taint	Access/Touch	Access/To
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Analysis of Software Supply Item Profile Assessment (Pilot 3)

Concern Areas	External	Financial	Organizational	Susceptibility	Quality	Maliciousness	Organizational	Hygiene	Counterfeit	Malicious Taint	Physical	Remote/Virtual
Data Sources Bloomberg	Influences	Stability	Stature	,	Culture		Security	,8			Access/Touch	Access/Touch
Regulatory DataCorp, Inc. (RDC)												
Dunn and Bradstreet												
Pitchbook												
Bureau van Dijk (BvD) - Orbis & Zephyr												
Electronic Resellers Association International (ERAI) Government-Industry Data Exchange Program (GIDEP)												
Independent Distributors of Electronics Association (IDEA)												
Securities and Exchange Commission (SEC) Electronic Data Gathering,												
Analysis, and Retrieval system (EDGAR)												
USASpending												
U.S. Department of Labor, Employment and Training Administration, Office of Foreign Labor Certification												
Global Legal Entity Identifier Foundation (GLEIF)												
Thompson Reuters												
Yahoo! Finance												
System for Award Management (SAM) Office of Foreign Assets Control (OFAC)												
World Bank Listing of Ineligible Firms												
Five Eyes Alliance												
United Nations Security Council Sanctions List												
Canada Terrorists List												
Better Business Bureau Defense Legistics Agency (DLA) Commercial and Covernment Entity												
Defense Logistics Agency (DLA) Commercial and Government Entity (CAGE) website												
NIST National Vulnerability Database												
Small Business Innovation Research (SBIR) & Small Business												
Technology Transfer												
Bureau of Industry and Security (BIS), U.S. Department of Commerce		·										
denied entities												
Company Check (Europe) Companies House (UK)												
Australian Department of Foreign Affairs and Trade												
Federal Risk and Authorization Management Program (FedRAMP)												
International Criminal Police Organization (INTERPOL)												
Myvisajobs												
Office of Financial Sanctions Implementation; HM Treasury												
Canadian Office of the Superintendent of Financial Institutions (OFSI)												
Global Research Centre for Research on Globalization												
GuruFocus												
Macrotrends												
RevenuesAndProfits Statista												
U.S. Securities and Exchange Commission Trading Suspensions												
Wikipedia "List of data breaches."												
Wisconsin Dept of Agriculture, Trade and Consumer Protection Data												
Breaches												
State of California Department of Justice Privacy Rights Clearinghouse												
U.S. Trade Representative Priority Watch List												
U.S. Department of the Treasury Sanctions List												
Software Quality Assurance Evaluation (SQAE)										7		
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Defense Intelligence Agency SCRM Threat Assessment Center (DIA TAC)												
Sandia National Labs												
Joint Federated Assurance Center (JFAC)												
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AFLCMC/IN (Acquisition Intelligence) Govini												
Govini Deloitte					<u> </u>							
Electronic Resellers Association International (ERAI)												
Bloomberg												
Interos												
Govini IBM												
Virtual Knowledge												
Semantic Al												
Expanse												
Fortress												
IBAT (Industrial Base Analysis Tool)												·
SERA (Sustainment Engineering Risk Assessment) RMC / SOLAS												
IBIDS (Industrial Base Integrated Data System)												
BDP (Big Data Picture)												
DIBnow (Defense Industrial Base-Now)												
CIBAT (Critical Industrial Base Assessment Tool) AWARE (Alerts, Warnings, Advice, Resolutions, and Experience)												
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View •

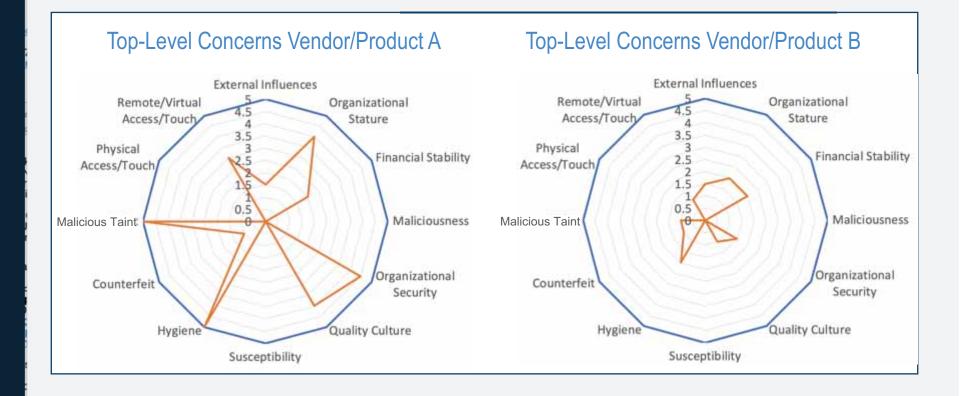
View

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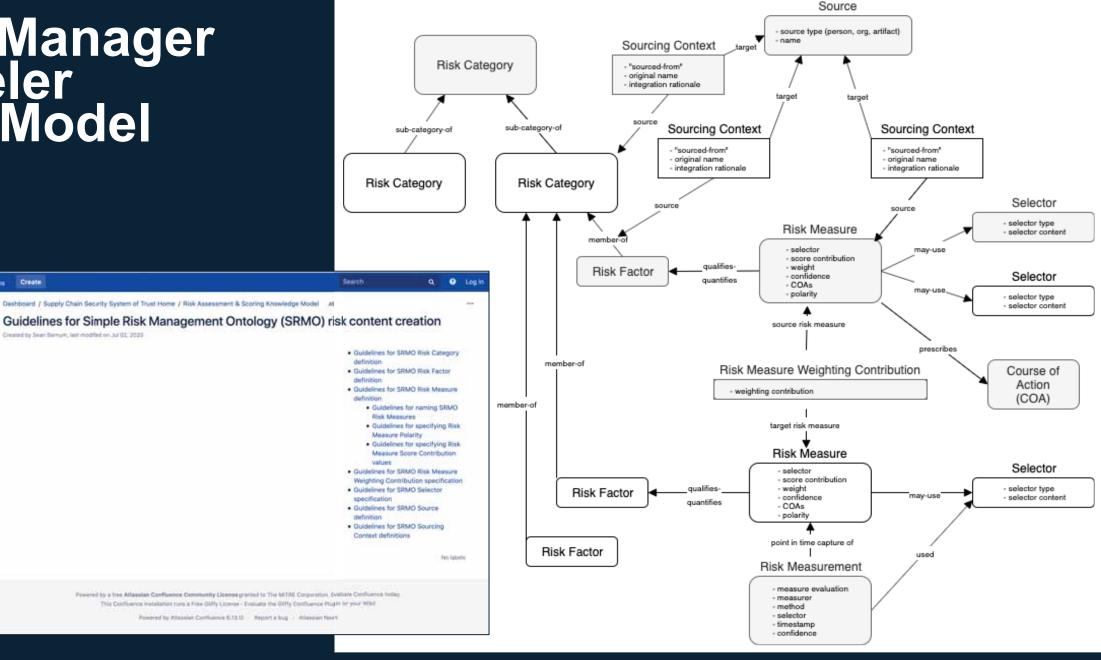
Risk Scoring [notional]





Risk Manager Modeler Data Model

Created by Seen Barnum, last modified on Jul 92, 2020



Supply Chain Security

P SCS System of Trust Sharepoint

Risk Assessment & Scoring Knowle

+ DRAFT: Risk Model formal (RDF)

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SC5 SoT Example Content

 SCS SoT Risk Categories SCS SoT Use Case Plots

SCS SoT Validation Activities

. View Profile brainstorming

Supply Chain Risk Management La

System of Trust

All: Terms

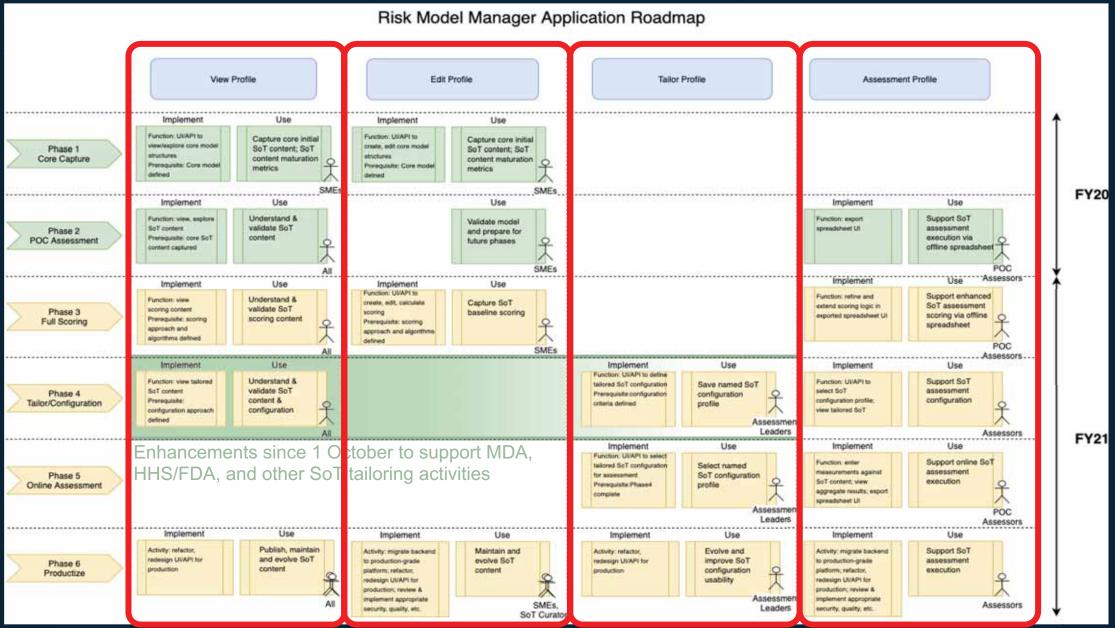
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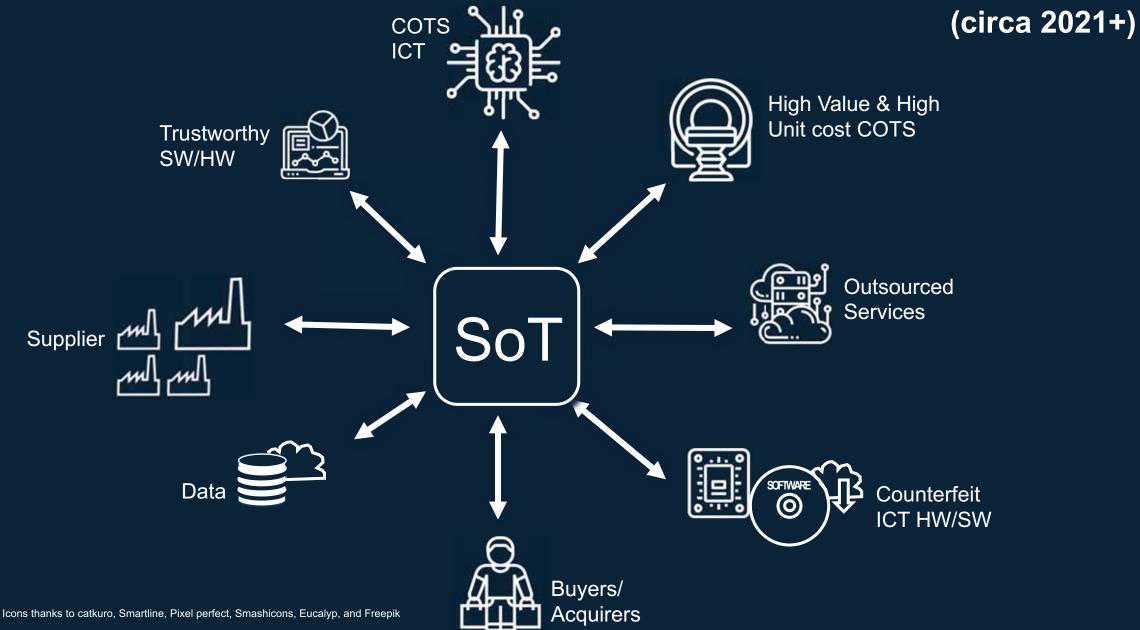
Activities and Plans

Outcomes and Products

System of Trust Risk Model Manager* Application Roadmap



Effective Supply Chain Trust Interactions



Next Steps – SoT Opportunities with Sponsors and Industry





Assessments for Sponsors and Industry by MITRE SoT teams



Training Sponsors and Industry on the SoT methodology, content, and platform



Standards and best practices



No-Cost* Licensing RMM tool SoT content to Industry for integration in their own assessment practices and offerings

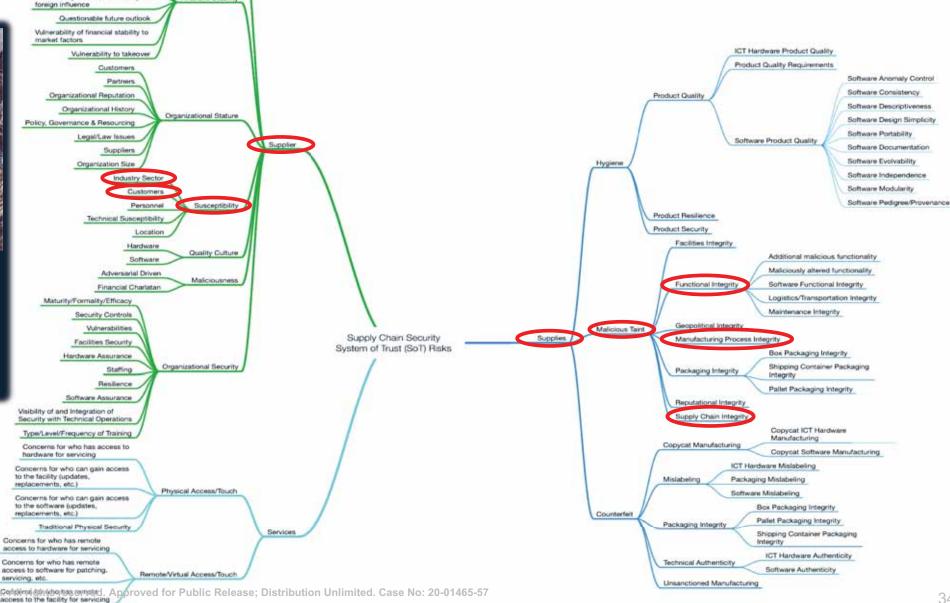
Outreach and Engagement

- American Bar Association (ABA) Technology Meeting Industry Technology & Innovation Roundtable
- **MITRE Technical Centers Engineering Council**
- DHS CISA NRMC & SNL "Company/ICT Element Scorecard" Team
- MITRE CyberSecurity Days
- **Open Group July Member Meeting Plenary**
- **DHS OPO Director and Team**
- **DHS CISA NRMC Risk Analysis Branch & SNL Team Members**
- MITRE Supply Chain Security Summit II
- **ABA IoT National Institutes Panel**
- **DoD/DoE NNSA Software Assurance Community of Practice**
- **DHS S&T FVEYES Supply Chain Workshop**
- System of Trust Biomed Deeper Dive
- SoT Methodology for Industrial Base Reviews
- EOP/OMB Maria Roat (Dep Fed CIO at OMB)/ Camilo Sandoval (Fed CISO)
- SoT Methodology for Military Industrial Base Review
 System of Trust as the 3rd Party Supply Chain Risk Framework for Boards/Officers
 EOP/OMB w/Lesley Field / Mathew Blum / Jeremy McCrary OFPP Team
- Raytheon Technologies Product Cybersecurity Tech Exchange
- Senate Homeland Security and Governmental Affairs Committee staff
- **ODNI SCRM Leadership**
- SoT to VA C-SCRM Lead
- **IIC Winter 2020 Quarterly Member Meeting**
- House Homeland Security Committee staff
- ABA SciTech Lawyer article on System of Trust and the Pandemic Winter 2021 Issue
- DHS CISA NRMC on SoT progress and plans
- **Treasury OCIO Team**
- **GAO Supply Chain Report Authoring Team**
- ATIS 5G/SC Working Group
- **House Armed Services Committee staff**
- **CISA NRMC Team**
- **MDA Supply Chain Team**
- Senate Armed Services Committee staff
- DHS CISO
- House Oversight Committee staff



DELIVER UNCOMPROMISED: SECURING CRITICAL SOFTWARE PROPOSAL TO ESTABLISH AN END-TO-END FRAMEWORK FOR SOFTWARE SUPPLY CHAIN INTEGRITY by Charles Clancy, Joseph Ferraro, Robert Martin, Adam Pennington, Christopher Sledjeski, and Craig Wiener

Analysis of Software Supply Chain Integrity Profile [notional]





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Organization Leadership

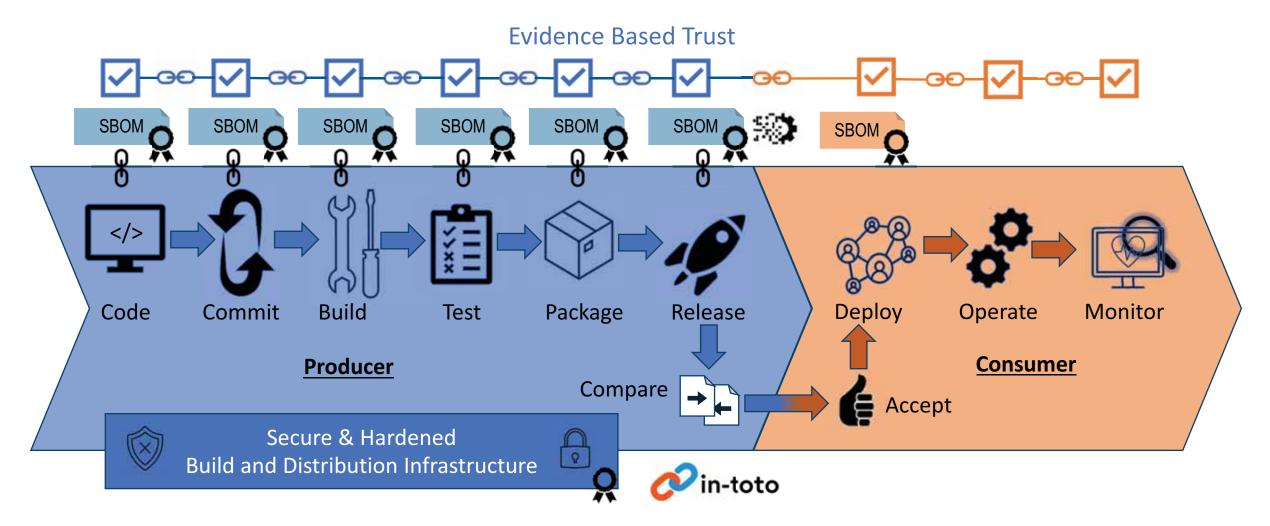
Organization Ownership

Questionable financial stewardship Questionable profitability

Questionable debt management Questionable future outlook Vulnerability of financial stability to External influences

Financial Stability

Software Supply Chain Integrity







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D'THELINUX FOUNDATION

About Specifica

@in-toto

The Software Package Data Ex (SPDX®)

An open standard for communicating software bill of information, including components, licenses, copyrig references. SPDX reduces redundant work by providi format for companies and communities to share impl thereby streamlining and improving compliance.

LEARN MORE



About ♥ Community ♥ Get started ♥ Learn more ♥

A framework to secure the integrity of software supply chains

Provenance and Pedigree

DEFINITIONS

- Provenance*
 - 1. The origin, or source of something
 - 2. The history of ownership of a valued of literature
- ▶ Pedigree*
 - 1. A register recording a line of ancestors
 - 2. An ancestral line: lineage The origin and the history of something history

CONFUSION

▶ Many use "Provenance" for both mea The provenance of a piece of data is both the cu lineage of processing and/or derivation that led

*Definitions (from Merriam-Webs

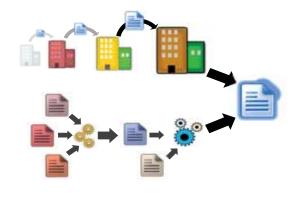
Separating Provenance and Pedigree

Provenance

Captures *chain of custody* of an Artifact. Document or Record

Pedigree

Captures the *history* of how an Artifact or Document was produced or derived





O GitHub



The SciTech Lawyer WINTER 2021

Business Technology Journal

Management, Innovation, Transformation

Vol. 33, No. 5 2020 • REPRIN

"A system of trust needs to have a pervasive, holistic approach to everything that can be of concern and needs to be truly effective in supporting our management of all items of concern."

The Supply Chain Security System of Trust:

A Framework for the Concerns Blocking Trust in Supplies, Suppliers, and Services

by Robert A. Martin

In this article, Robert A. Martin addresses the complete ecosystem involved in the procurement of products and services. What does it mean to trust that what you buy, and the organizations that sell to you, meet all the conditions required to merit your trust? Martin describes the elements of a system of trust for supply chain security that is currently under development and is based on collecting information from a wide community of procurement departments and standards organizations.

TR ALL

DEFINING A SYSTEM OF TRUST (SoT) AS A KEYSTONE TOOL FOR SUPPLY CHAIN SECURITY TRUSTING OUR SUPPLY CHAINS: A COMPREHENSIVE DATA-DRIVEN APPROACH



Trust and trustwerthiness of supply chains is an issue confronting communities around the world, including U.S. government agencies and the thousands of commercial enterprises that support them.

The COVID-19 penderric has brought supply chain security (SCS) into sharpened focus, and many inadequacies have surfaced regarding timely access to display the personal protective equipment, medical disvices, and food supplies, to name a few.

This is not a new challenge, in the 2000s, many U.S. government practices related to supply chair logistics namagement, define from the Cold Warera, were extended into the broader commercial information and communications technology (ICT) marketplace as those technologies and the efficiencies they brought to business and government became key anablem of the information economy.

MITRE

For many suppliers providing the Department of Defense with commercial goods, the concept of a "cleared industry partner" became part of their way of the

At the same time, the computerization of everything given time to pressive cycler threats — including those stemming than violensibilities inherent in reportpoint software of other dubicus; provinces. Further complicating this picture is the increasingly gibbilitard value of service support the KCT systems. Our adversaries seek to inject themselves into every conceivable stage of technology development, for both disruptive and intelligence objectives.

Congressional Actio

Since 2013, Congress has passed several National Defense Authorization Acts and laws that contain more than 100 references to supply chain security Many of these still remain to be implemented by their target agencies. More recently, in 2018, the executive branch and Congress worked to pass new legislation to improve executive branch coordination supply chain information sharing, and actions to address supply chain risks. The Federal Acquisition Supply Chain Security Act of 2008 (Title II of Pull.) L. 115-3905, signed into law on December 21, 1018, established the Federal Acquisition Security Council (FASC). The FASC is an executive branch interagency council, chaired by a senior-level official from the Office of Management and Bodget (DMB). and includes representatives from the General Services Administration, Department of Homeland Security, Office of the Director of National Intelligence, Department of Justice, Department of Defense, and Department of Commerce. This new interagency council, with its multiagency leadership and broad mandate for both cyber and SCS policy. could become the much-needed coordinating mechanism for federal agencies seeking to arrower questions about vendor and product



DELIVER UNCOMPROMISED: SECURING CRITICAL SOFTWARE SUPPLY CHAINS

PROPOSAL TO ESTABLISH AN END-TO-END FRAMEWORK FOR SOFTWARE SUPPLY CHAIN INTEGRITY

by Charles Clancy, Joseph Ferraro, Robert Martin, Adam Pennington, Christopher Sledjeski, and Craig Wiener

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https://www.mitre.org/sites/default/files/publications/pr-21-0278-deliver-uncompromised-securing-critical-software-supply-chains.pdf

https://www.cutter.com/offer/supplychain-security-system-trust

Questions?

https://www.mitre.org/publications/technic al-papers/trusting-our-supply-chains-acomprehensive-data-driven-approach