



October 29-31, 2019 | Novi, MI

Innovations in Mobility

A REVOLUTIONARY TRANSFORMATION



A Blockchain-Backed Registry for Health-Ready Components & Systems

Ben Towne, PhD.
Senior Project Director

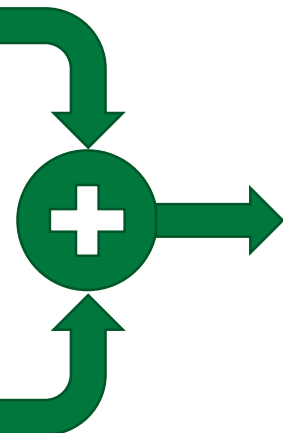
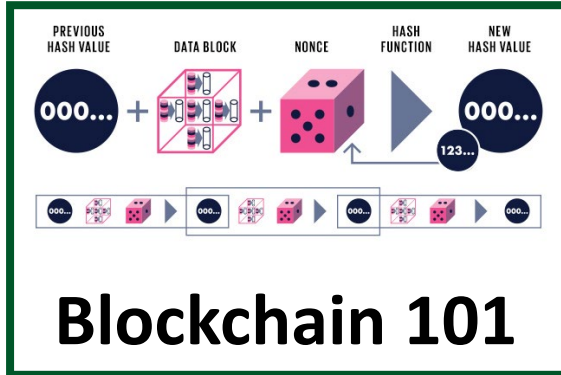
SAE ITC

October 31, 2019



***Collaborative Innovation.
Trusted Implementation.***

OUTLINE



SAE ITC Health-Ready Components & Systems (HRCS) Registry (Alpha)

SAE ITC > Health-Ready Components and Systems (HRCS) > Registry

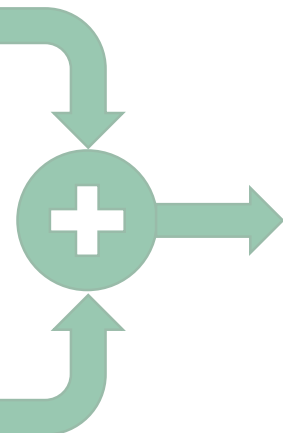
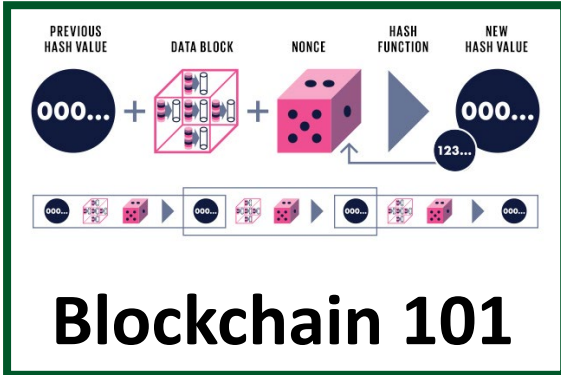
Part Name	Supplier Name	Sector	Certification Stage	Machine Readable Info Exchange	Machine Readable Conv of Input to Eng Units	Criticality of Failures	Data Acquisition & Manipulati... Coverage	Health Indicators ID'd	Relationship / Models ID'd	Diagnostic Metrics	State Detection & Health Assessment Coverage	Typical RUL Notice	Typical RUL Std Dev	Prognostic Metrics	Prognostics Assessment & Advisory Generation Coverage
Turbocharger	XYZ Co	Automotive	2	✓	✓	12345	✓	✓	?	70% - 90% Cdc 50% NTF	✓	60.0 Days	15.0 Days	99% TPR 90% FPR	✓
Antilock Brake Module	Stop Co	Aerospace	1	✓	✓	12345	✓	✓	⊗	10% - 20% NFF AMBIGUITY GROUP SIZE 1.9	✓	2.0 Weeks	1.0 Weeks	91% TPR 0.1% FPR	✓
Infotainment	Entertain Co	Aerospace	1	✓	✓	12345	✓	✓	⊗	20% - 30% NTF AMBIGUITY GROUP SIZE 4.0	✓	120.0 Hours	24.0 Hours	85% TPR 0.15% FPR	✓
Auxiliary Power System	Power Co	Aerospace	1	✓	✓	12345	✓	⊗	⊗	20% - 50% NFF 70% - 90% FDR	✓	80.0 Operation Hours	10.0 Operation Hours	75% TNR 0.4% FNR	✓
Landing Gear	Land Co	Automotive	2	?	✓	12345	✓	⊗	⊗	10% - 30% NTF	✓	240.0 Engine Hours	12.0 Engine Hours	66% PPV 4% NPV	✓
Power Take Off	Power Co	Off-Highway	1	✓	✓	12345	✓	⊗	✓	30% - 60% NTF	✓	3.0 Months	1.0 Months		✓

Showing 1 to 6 of 6.

Foundations in Prior Work

Q & A

OUTLINE



SAE ITC Health-Ready Components & Systems (HRCS) Registry (Alpha)
 SAE ITC > Health-Ready Components and Systems (HRCS) > Registry

Part Name	Supplier Name	Sector	Certification Stage	Machine Readable Info Exchange	Machine Readable Conv of Input to Eng Units	Criticality of Failures	Data Acquisition & Manipulation Coverage	Health Indicators ID'd	Relationship / Models ID'd	Diagnostic Metrics	State Detection & Health Assessment Coverage	Typical RUL Notice	Typical RUL Std Dev	Prognostic Metrics	Prognostics Assessment & Advisory Generation Coverage
Turbocharger	XYZ Co	Automotive	2	✓	✓	100%	100%	✓	?	70% - 90% CIC 50% NTF	60.0 Days	15.0 Days	99% TPR 90% FPR		
Antilock Brake Module	Stop Co	Aerospace	1	✓	✓	100%	100%	✓	✗	10% - 20% NFF AMBIGUITY GROUP SIZE 1.9	2.0 Weeks	1.0 Weeks	91% TPR 0.1% FPR		
Infotainment	Entertain Co	Aerospace	1	✓	✓	100%	100%	✓	✗	20% - 30% NTF AMBIGUITY GROUP SIZE 4.0	120.0 Hours	24.0 Hours	85% TPR 0.15% FPR		
Auxiliary Power System	Power Co	Aerospace	1	✓	✓	100%	100%	✗	✗	20% - 50% NFF 70% - 90% FDR	80.0 Operation Hours	10.0 Operation Hours	75% TNR 0.4% FNR		
Landing Gear	Land Co	Automotive	2	?	✓	100%	100%	✗	✗	10% - 30% NTF	240.0 Engine Hours	12.0 Engine Hours	66% PPV 4% NPV		
Power Take Off	Power Co	Off-Highway	1	✓	✓	100%	100%	✗	✓	30% - 60% NTF	3.0 Months	1.0 Months			

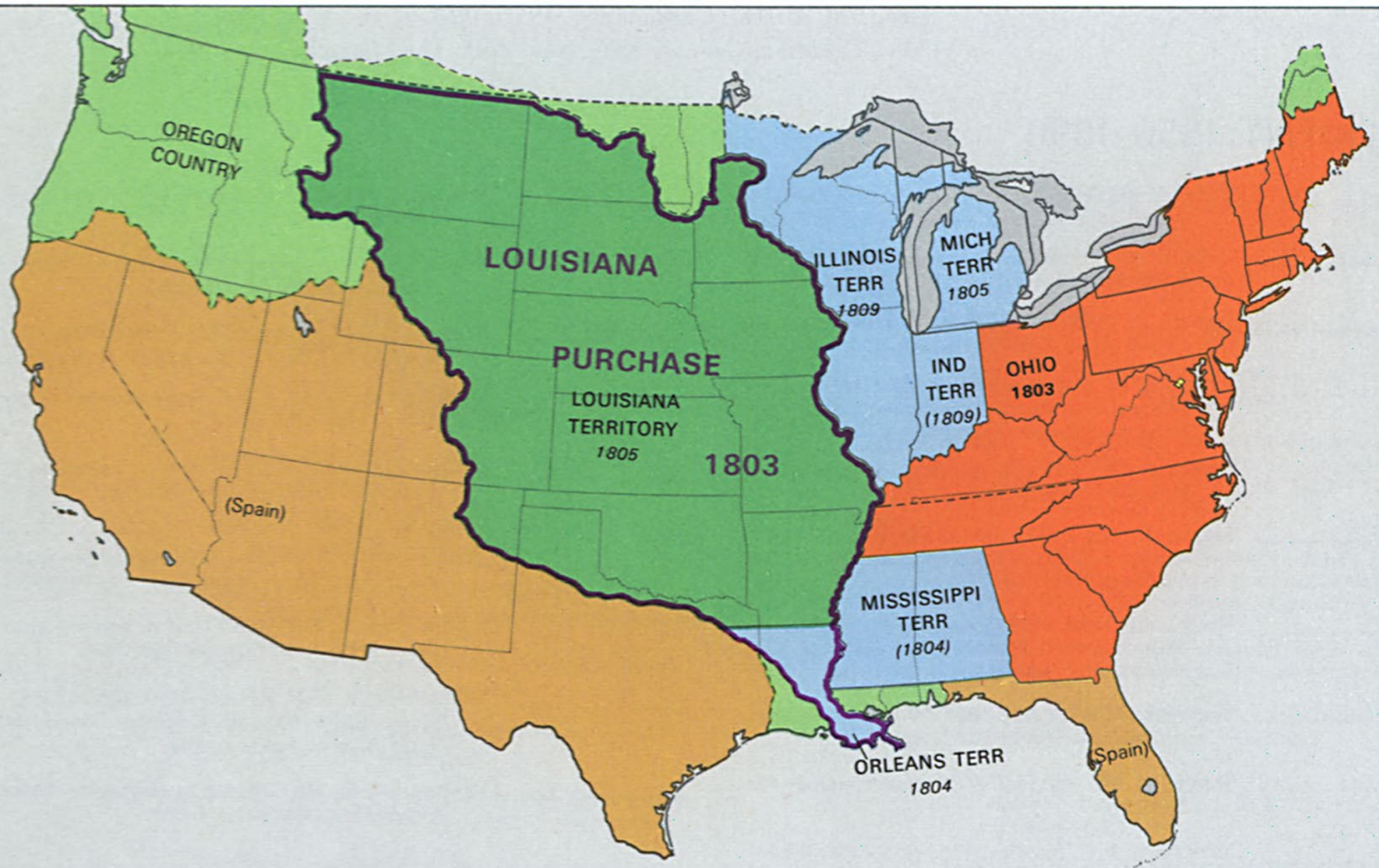
Showing 1 to 6 of 6.

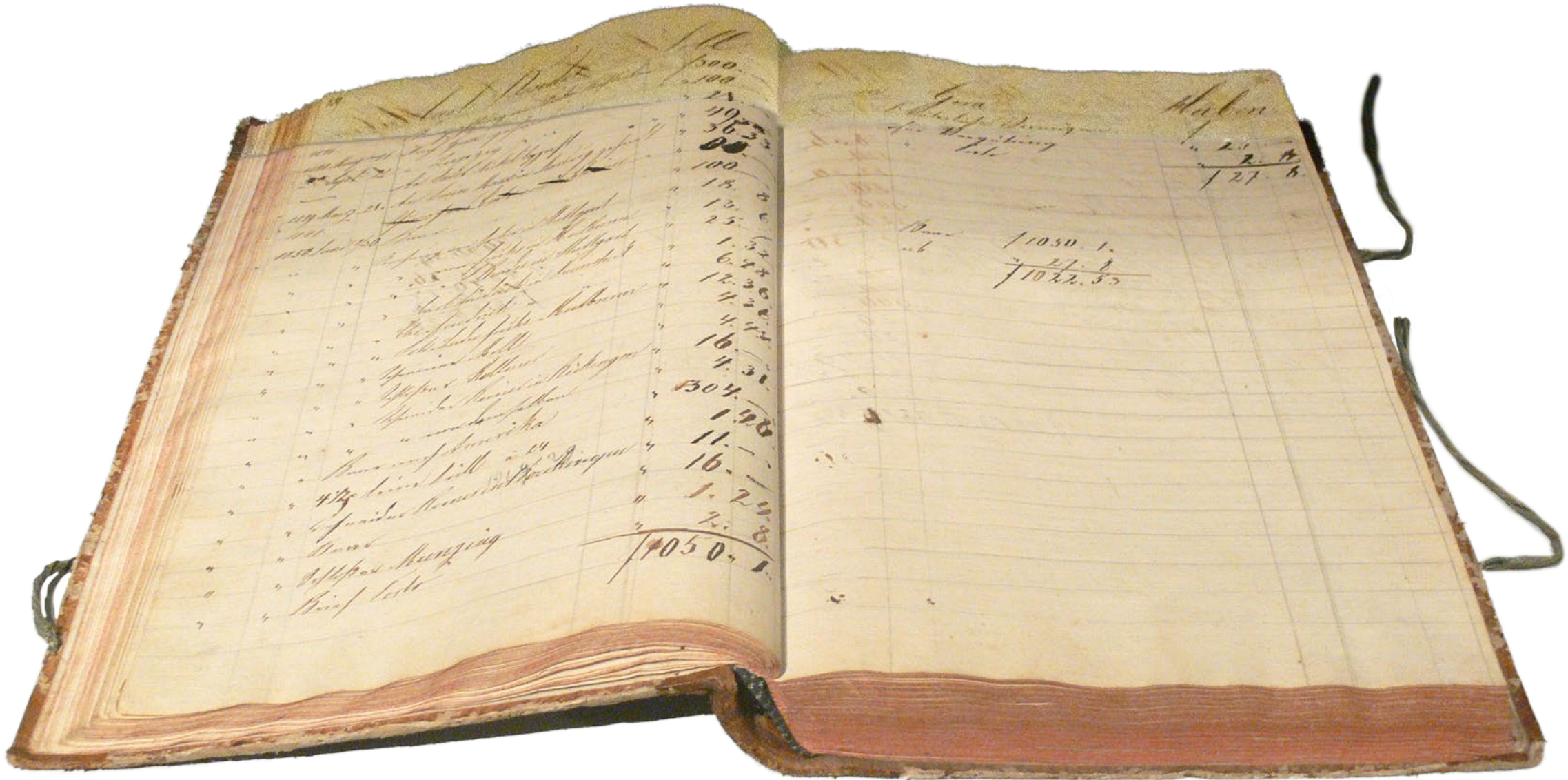
A Blockchain-Backed Registry for Health-Ready Components & Systems

Foundations in Prior Work

Q & A









From ▼

goldcustodian@usa.gov

To...

nyc-gold-owners@listserv.host

Cc...

Subject

Buying some land: 10,000 bars USA-> France

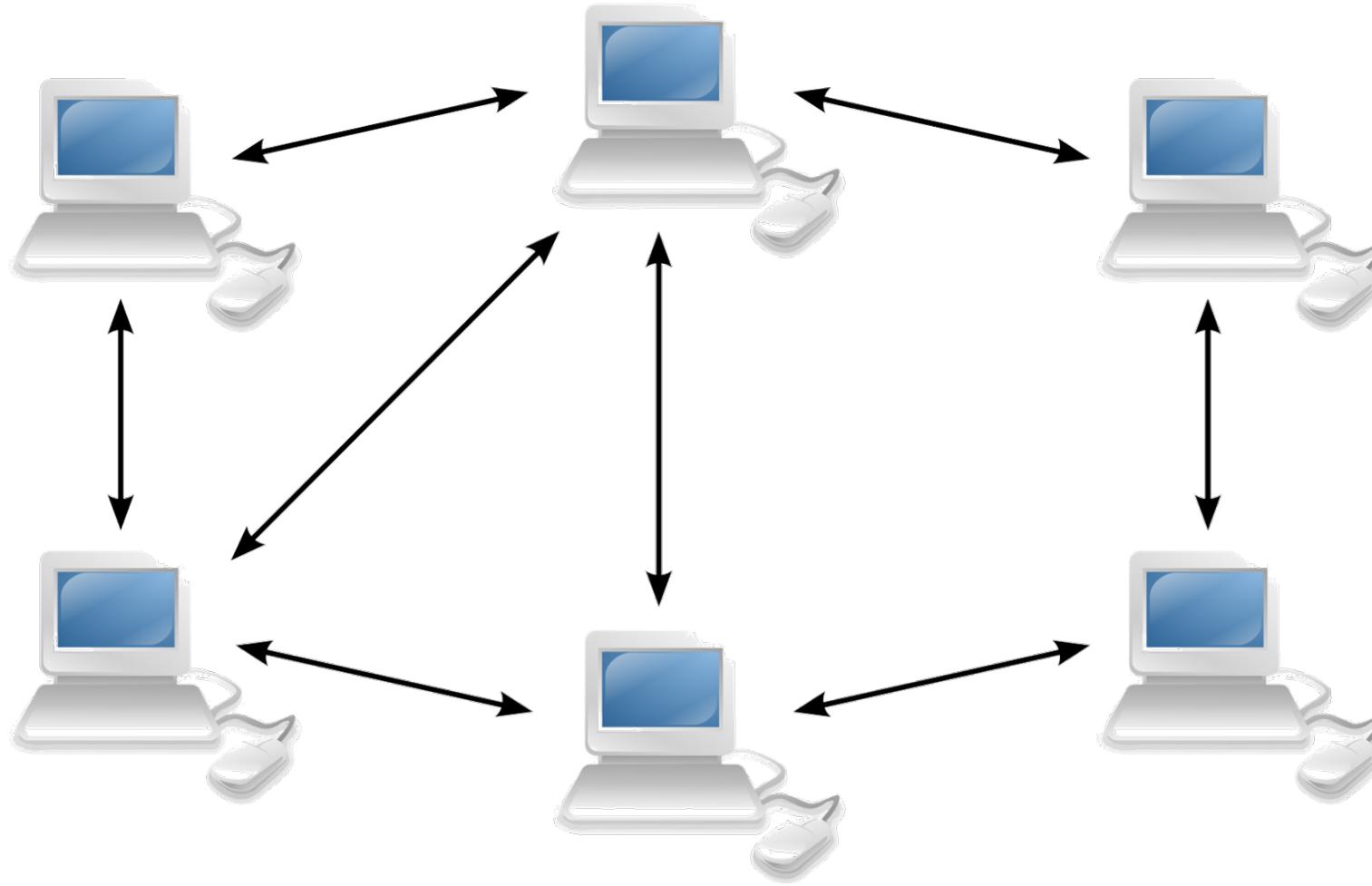
We, the United States, hereby give 10,000 gold bars to France.

-USA

|



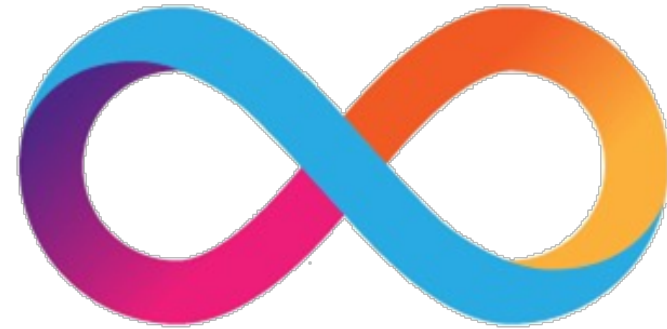
COMPUTERS AGREEING ON SHARED DATA



World Computers



ethereum



D F I N I T Y

“Private Key”

MySuperLongUnguessablePasswordThatNobodyElseKnows



(Public) Identifier/Account

0x1234567B89C0123D45678E98765f43210





DONALD E. KNUTH
COMPUTER SCIENCE DEPARTMENT
STANFORD UNIVERSITY
STANFORD, CA 94305-9045

90-8129/3211
189900038

371

DATE 05 Mar 08

PAY TO THE
ORDER OF

Charles Duan

\$ *15.36*

Fifteen and ~~~~~ 36/100

DOLLARS



Security Features
Included.
Details on Back.



LUTHER BURBANK SAVINGS
PALO ALTO BRANCH
2335 EL CAMINO REAL
PALO ALTO, CA 94306-1620

MEMO

E147², 149, 157, 161²

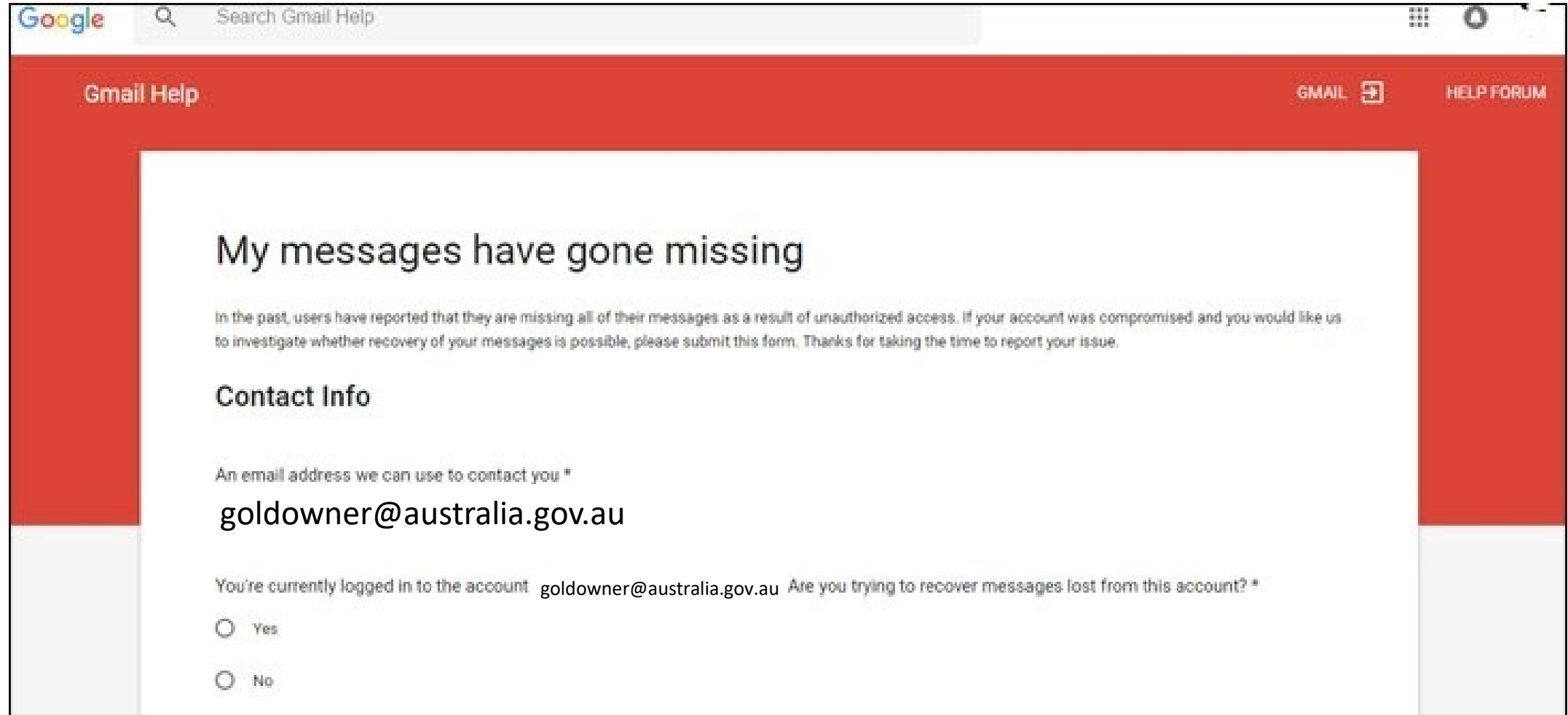
Donald Knuth

MP

⑆ 3 2 1 1 8 1 2 9 7 ⑆ 1 8 9 9 0 0 0 3 8 ⑆ 0 3 7 1

FINE LINE

SOLVING THE PROBLEM OF MISSING MAIL



The screenshot shows a web browser window with the Google logo and a search bar containing 'Search Gmail Help'. The page title is 'Gmail Help' and it includes links for 'GMAIL' and 'HELP FORUM'. The main heading is 'My messages have gone missing'. Below this, a paragraph explains that users have reported missing messages due to unauthorized access and asks for a report. The 'Contact Info' section contains a text input field with the email 'goldowner@australia.gov.au'. A question asks if the user is trying to recover messages from the currently logged-in account, with radio button options for 'Yes' and 'No'.

Google Search Gmail Help

Gmail Help GMAIL HELP FORUM

My messages have gone missing

In the past, users have reported that they are missing all of their messages as a result of unauthorized access. If your account was compromised and you would like us to investigate whether recovery of your messages is possible, please submit this form. Thanks for taking the time to report your issue.

Contact Info

An email address we can use to contact you *

goldowner@australia.gov.au

You're currently logged in to the account goldowner@australia.gov.au Are you trying to recover messages lost from this account? *

Yes

No

STANDARD PAGE #45

Prior page summary, copied in: 0x0000000000000914545152468514665418946789243

Arbitrary number (nonce): 1234567890

Page #: 45

Date/Time	Prior Owner	New Owner	Amount
27 Mar 18 19:22:36 GMT	USA	France	10,000
29 Mar 18 15:54:19 GMT	France	Spain	500
30 Mar 18 16:18:22 GMT	France	Germany	900
01 Apr 18 08:27:31 GMT	France	Greece	650
06 Apr 18 09:16:49 GMT	Germany	Italy	400
06 Apr 18 11:57:36 GMT	France	Japan	2,500
09 Apr 18 02:14:03 GMT	Japan	China	300

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Prior page summary, copied in: 0x0000000000000914545152468514665418946789243

Arbitrary number (nonce): 1234567890

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06 Apr 18 11:57:36 GMT	France	Japan	2,500
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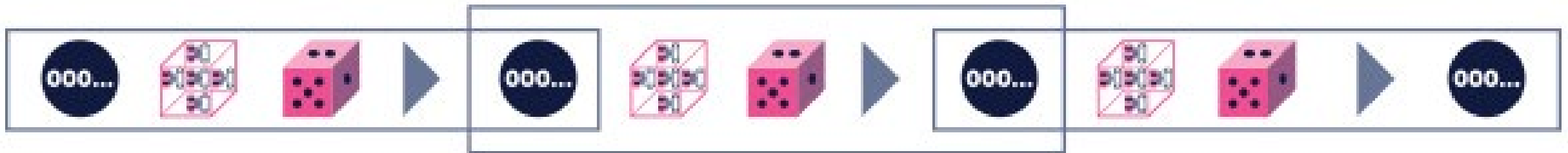
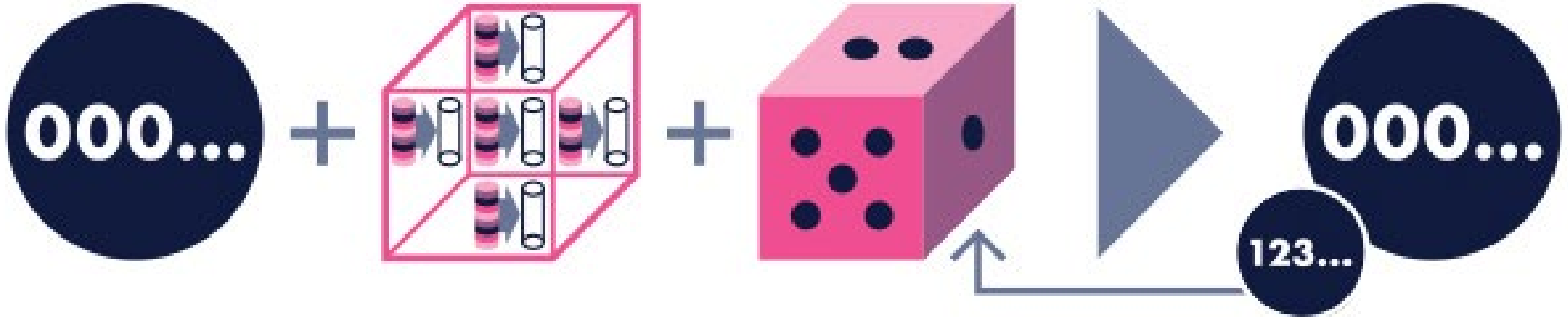
PREVIOUS
HASH VALUE

DATA BLOCK

NONCE

HASH
FUNCTION

NEW
HASH VALUE



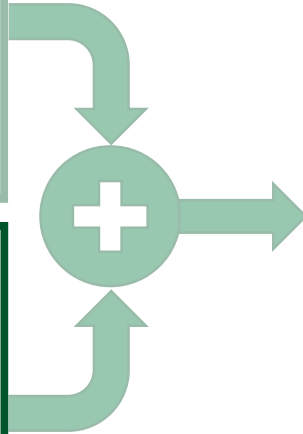
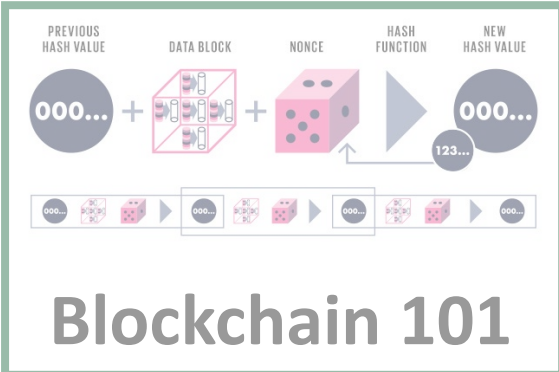




HRCS FOCUS: MOBILITY (ALSO APPLICABLE TO FIXED-BASE EQUIPMENT, E.G., MFG.)



OUTLINE



SAE ITC Health-Ready Components & Systems (HRCS) Registry (Alpha)
SAE ITC > Health-Ready Components and Systems (HRCS) > Registry

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Antilock Brake Module	Stop Co	Aerospace	1	✓	✓	100%	100%	✓	✗	10% - 20% NFF AMBIGUITY GROUP SIZE 1.9	2.0 Weeks	1.0 Weeks	91% TPR 0.1% FPR		
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Auxiliary Power System	Power Co	Aerospace	1	✓	✓	100%	100%	✗	✗	20% - 50% NFF 70% - 90% FDR	80.0 Operation Hours	10.0 Operation Hours	75% TNR 0.4% FNR		
Landing Gear	Land Co	Automotive	2	?	✓	100%	100%	✗	✗	10% - 30% NTF	240.0 Engine Hours	12.0 Engine Hours	66% PPV 4% NPV		
Power Take Off	Power Co	Off-Highway	1	✓	✓	100%	100%	✗	✓	30% - 60% NTF	3.0 Months	1.0 Months			

Showing 1 to 6 of 6.

A Blockchain-Backed Registry for Health-Ready Components & Systems

Foundations in Prior Work

Q & A

ORIGINATING DOCUMENT: SAE JA6268™



SURFACE VEHICLE/AEROSPACE RECOMMENDED PRACTICE	JA6268™	APR2018
	Issued	2018-04
Design & Run-Time Information Exchange for Health-Ready Components		

RATIONALE

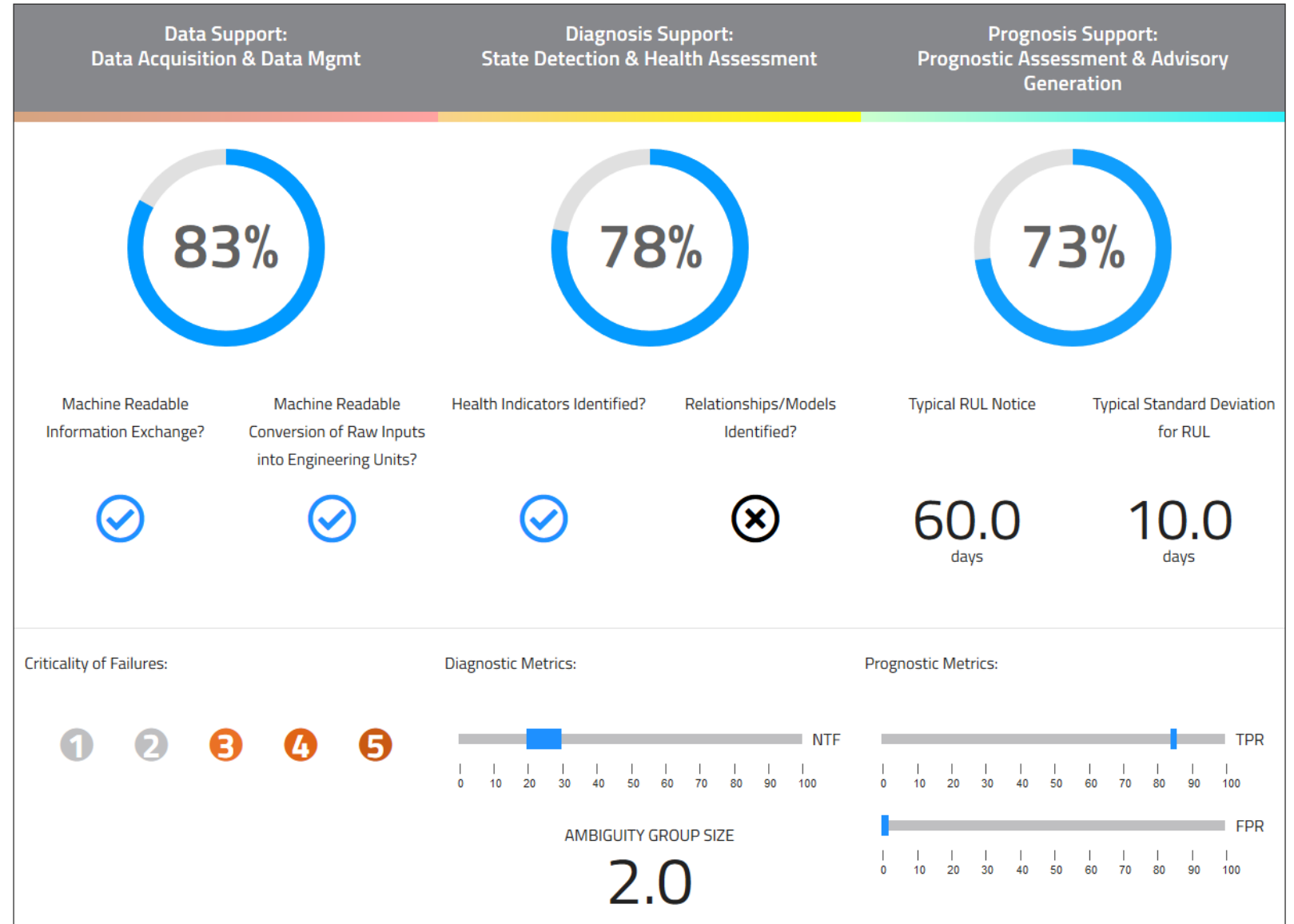
This Surface Vehicle & Aerospace Recommended Practice was created to help reduce existing barriers to the successful implementation of Integrated Vehicle Health Management (IVHM) technology into the aerospace and automotive sectors by introducing health-ready components. Health-ready components are augmented either to monitor and report their own health or, alternatively, ones where the supplier provides the integrator sufficient information to accurately assess the component's health via a higher-level system on the vehicle. The principal motivation for health-ready components is to facilitate enhanced IVHM functionality in supplier-provided components that better meet the needs of end users and government regulators in a cost-effective manner. Underlying this motivation is the assumption that market forces will drive the need to achieve IVHM's benefits, which will in turn drive new requirements that suppliers must ultimately meet. This recommended practice has two primary objectives: (1) to encourage the introduction of a much greater degree of IVHM functionality in future vehicles at a much lower cost, and (2) to address legitimate intellectual property concerns by providing recommended IVHM design-time and run-time data specification and information exchange alternatives in an effort to help unlock the potential of IVHM.

Source: https://www.sae.org/standards/content/ja6268_201804/

Part Name	Supplier Name	Sector	Stage	Machine Readable Info Exchange	Machine Readable Conv of Input to Eng Units	Criticality of Failures	Data Acquisition & Manipulation Coverage	Health Indicators ID'd	Relationship / Models ID'd	Diagnostic Metrics	State Detection & Health Assessment Coverage	Typical RUL Notice	Typical RUL Std Dev	Prognostic Metrics	Prognostics Assessment & Advisory Generation Coverage
Turbocharger	XYZ Co	Automotive	2	✓	✓	12345		✓	?	70% - 90% CdC 50% NTF		60.0 Days	15.0 Days	99% TPR 90% FPR	
Antilock Brake Module	Stop Co	Aerospace	1	✓	✓	12345		✓	✗	10% - 20% NFF AMBIGUITY GROUP SIZE 1.9		2.0 Weeks	1.0 Weeks	91% TPR 0.1% FPR	
Infortainment	Entertain Co	Aerospace	1	✓	✓	12345		✓	✗	20% - 30% NTF AMBIGUITY GROUP SIZE 4.0		120.0 Hours	24.0 Hours	85% TPR 0.15% FPR	
Auxilliary Power System	Power Co	Aerospace	1	✓	✓	12345		✗	✗	20% - 50% NFF 70% - 90% FDR		80.0 Operation Hours	10.0 Operation Hours	75% TNR 0.4% FNR	
Landing Gear	Land Co	Automotive	2	?	✓	12345		✗	✗	10% - 30% NTF		240.0 Engine Hours	12.0 Engine Hours	66% PPV 4% NPV	
Power Take Off	Power Co	Off-Highway	1	✓	✓	12345		✗	✓	30% - 60% NTF		3.0 Months	1.0 Months		

Part Name	Supplier Name	Sector	Stage	Machine Readable Info Exchange	Machine Readable Conv of Input to Eng Units	Criticality of Failures	Data Acquisition & Manipulation Coverage	Health Indicators ID'd	Relationship / Models ID'd	Diagnostic Metrics	State Detection & Health Assessment Coverage	Typical RUL Notice	Typical RUL Std Dev	Prognostic Metrics	Prognostics Assessment & Advisory Generation Coverage
Electric Power Steering	Nexteer Automotive	Automotive												99% TPR 90% FPR	
Turbocharger with Electric Boost - 891839-0001	Garret	Automotive										30.0 days	10.0 days	91% TPR 0.1% FPR	
Turbocharger with Variable Nozzle Turbine - 873767-50015	Garret	Automotive										60.0 days	10.0 days	85% TPR 0.15% FPR	
Turbocharger with Variable Nozzle Turbine - 830323-50035	Garret	Automotive										60.0 days	10.0 days	85% TPR 0.15% FPR	
Turbocharger with Variable Nozzle Turbine - 830323-50065	Garret	Automotive										60.0 days	10.0 days	85% TPR 0.15% FPR	

<https://hrcs.sae-itc.org/previewAtIIM2019>




https://
hrcs.sae-itc.org/
previewAtIIM2019

SAE ITC Health-Ready Components & Systems (HRCS) Registry (Alpha)

SAE ITC > Health-Ready Components and Systems (HRCS) > Registry > Electric Power Steering Nexteer Automotive

Data Support: Data Acquisition & Data Mgmt Diagnosis Support: State Detection & Health Assessment Prognosis Support: Prognostic Assessment & Advisory Generation

Assembly Details [X]

Component Name Electric Power Steering			
Known Aliases EPS	Catalog Reference Number(s)	Primary Validation Approach Combined Design & Run-Time Info	Format of Health-Ready Information MS Word templated tables
Supplier Name Nexteer Automotive	Sector Automotive	Date Validation Certified 3/25/2019	Date Validation Expires 3/25/2024
DUNS Number 00-025-7923	CAGE Number N/A	Validating OEM/Integrator/Operator	
<div style="border: 1px solid #ccc; padding: 5px; margin-bottom: 5px;"> <p>Supplier Contact</p> <p>Matt Tompkins @ matthew.tompkins@nexteer.com +1 (989) 757-4992</p> <p>3900 E. Holland Rd. Saginaw, MI 48601</p> </div>		<div style="border: 1px solid #ccc; padding: 5px; margin-bottom: 5px;"> <p>General Motors Company</p> <p>Yat-Chung Tang @ Yat-chung.tang@gm.com +1 (586) 907-3059</p> <p>29755 Louis Chevrolet Rd. Warren, MI 48093</p> </div>	

Machine Information Criticality of Failure TPR FPR

Part: NEW PART

Endorser: + -

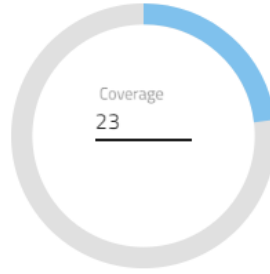
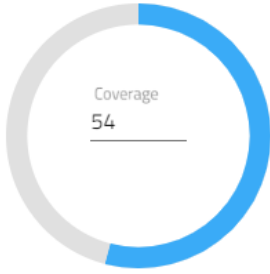
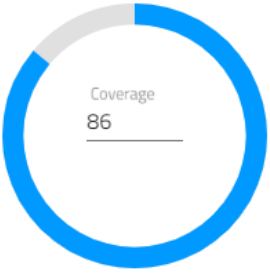
Stage:

Date Validation Certified: X Date Validation Expires: X

Data Support: Data Acquisition & Data Mgmt

Diagnosis Support: State Detection & Health Assessment

Prognosis Support: Prognostic Assessment & Advisory Generation



Machine Readable Information Exchange?



Unknown

Machine Readable Conversion of Raw
Inputs into Engineering Units?



No

Health Indicators Identified?



Yes

Relationships/Models Identified?



Unknown

Typical RUL Notice

Typical Standard Deviation for RUL

Criticality of Failures:

- 1
- 2
- 3
- 4
- 5

Diagnostic Metrics: +

Prognostic Metrics: +

Building on experience with blockchain-backed database technology

LIVE SYSTEM:

<https://ts200.sae-itc.org/>

PAPER ABOUT IT:

<https://saemobilus.sae.org/content/2019-01-1343/>

ASPQP
Aerospace Standards Part Qualification Program
A Program of SAE ITC

ENGINE AND AIRFRAME STANDARDS
TS200 Qualified Manufacturers for SAE ITC Aerospace Industry Standard Parts (Beta)

Home About ASPQP Standards **TS200 Database** Supplier Qualification Contact

SAE ITC
An SAE International Affiliate

Apply Filter Reset Filter

AS27862 Search

Showing 1 - 4 of 4 results Per Page: 10

Manufacturer (4 Options)

- Arconic Fastening Sy... (1)
- Bristol Industries (1)
- LISI Aerospace - Bla... (1)
- SPS Technologies - T... (1)

Tech Spec (1 Options)

- TS8 (4)

Certificate # (4 Options)

- TSSC #6 (1)
- TSSC #9 (1)
- TSSC #17 (1)
- TSSC #86 (1)

Expiry Date (4 Options)

- 2021 (2) ^
 - April (1)
 - November (1)
- 2020 (2) ^
 - February (1)
 - October (1)

Nut, Self Locking, Shank, Flange Restrained, Heat & CR Steel A286, Silver Coated All Over, Classification Rm ≥ 1100 MPa (160,000 lbf/in²) @ TA / +650°C

Part Number: [AS27862](#)
Manufacturing Route Comment: --
First Qualified date: Dec 1983
Expiry Date: Feb 2020
Technical Specification: [TS8](#)
Manufacturer: Bristol Industries
Location(s): 630 East Lambert Road, Brea, California, USA, 92821
Certificate TSSC #: [86](#)

Nut, Self Locking, Shank, Flange Restrained, Heat & CR Steel A286, Silver Coated All Over, Classification Rm ≥ 1100 MPa (160,000 lbf/in²) @ TA / +650°C

Part Number: [AS27862](#)
Manufacturing Route Comment: --
First Qualified date: Apr 1978
Expiry Date: Oct 2020
Technical Specification: [TS8](#)
Manufacturer: SPS Technologies - T.J. Brooks
Location(s): 191 Barkby Road, Troon Industrial Area, Leicester, United Kingdom, LE4 9HX
Certificate TSSC #: [17](#)

Nut, Self Locking, Shank, Flange Restrained, Heat & CR Steel A286, Silver Coated All Over, Classification Rm ≥ 1100 MPa (160,000 lbf/in²) @ TA / +650°C

Part Number: [AS27862](#)
Manufacturing Route Comment: --
First Qualified date: Jun 1994
Expiry Date: Apr 2021
Technical Specification: [TS8](#)
Manufacturer: Arconic Fastening Systems and Rings - Fullerton Operations
Location(s): 800 South State College Blvd, Fullerton, California, USA, 92831
Certificate TSSC #: [6](#)

Nut, Self Locking, Shank, Flange Restrained, Heat & CR Steel A286, Silver Coated All Over, Classification Rm ≥ 1100 MPa (160,000 lbf/in²) @ TA / +650°C

Part Number: AS27862

RELATED WORK: CREDENTIAL VERIFICATION

Certificate of Completion

Bailey Smith

has completed the requirements for

First Aid for Public Safety Personnel
(Title 22)

conducted by
American Red Cross Academy Permanente, LLC

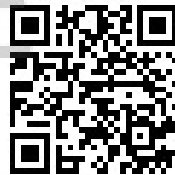
Date completed: 04/26/2015

Validity period: 2 Years

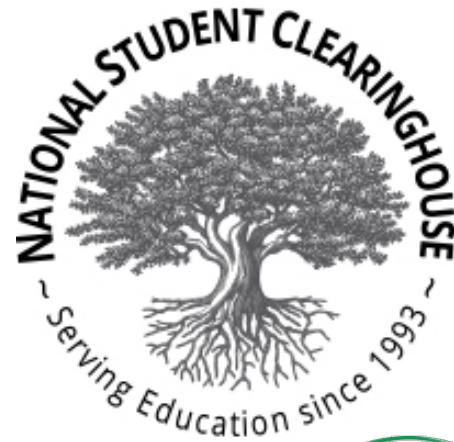
Certificate ID: GRLNTX



American
Red Cross



Scan code or visit:
redcross.org/confirm



WORLD EDUCATION SERVICES

Blockcerts — An Open Infrastructure for Academic Credentials on the Blockchain



MIT Media Lab Learning Initiative
Oct 24, 2016 · 4 min read

Malta to Store Education Certificates On a Blockchain

Credential Evaluation Tools & Advice Help Center Institutions



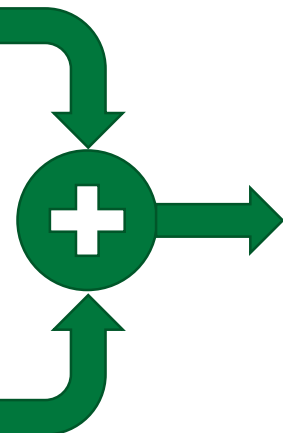
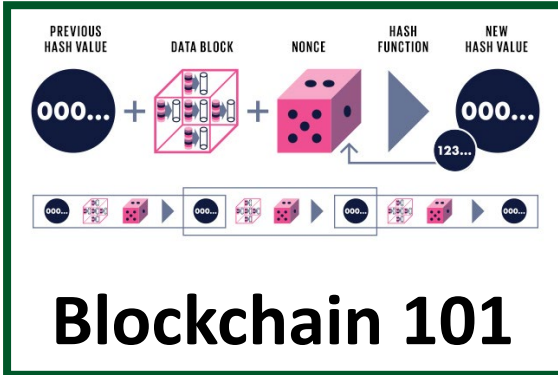
CIO East Africa (Nairobi) »

20 DECEMBER 2016

Kenyan Government Embraces Blockchain Technology Set to Implement a Blockchain Based Education Management System

World Education Services Pilots Blockchain-Based Digital Badges for Internationally Educated Students and Professionals

SUMMARY



SAE ITC Health-Ready Components & Systems (HRCS) Registry (Alpha)

SAE ITC > Health-Ready Components and Systems (HRCS) > Registry

Part Name	Supplier Name	Sector	Certification Stage	Machine Readable Info Exchange	Machine Readable Conv of Input to Eng Units	Criticality of Failures	Data Acquisition & Manipulati... Coverage	Health Indicators ID'd	Relationship / Models ID'd	Diagnostic Metrics	State Detection & Health Assessment Coverage	Typical RUL Notice	Typical RUL Std Dev	Prognostic Metrics	Prognostics Assessment & Advisory Generation Coverage
Turbocharger	XYZ Co	Automotive	2	✓	✓	12345	✓	✓	?	70% - 90% Cdc 50% NTF	✓	60.0 Days	15.0 Days	99% TPR 90% FPR	✓
Antilock Brake Module	Stop Co	Aerospace	1	✓	✓	12345	✓	✓	⊗	10% - 20% NFF AMBIGUITY GROUP SIZE 1.9	✓	2.0 Weeks	1.0 Weeks	91% TPR 0.1% FPR	✓
Infortainment	Entertain Co	Aerospace	1	✓	✓	12345	✓	✓	⊗	20% - 30% NTF AMBIGUITY GROUP SIZE 4.0	✓	120.0 Hours	24.0 Hours	85% TPR 0.15% FPR	✓
Auxiliary Power System	Power Co	Aerospace	1	✓	✓	12345	✓	⊗	⊗	20% - 50% NFF 70% - 90% FDR	✓	80.0 Operation Hours	10.0 Operation Hours	75% TNR 0.4% FNR	✓
Landing Gear	Land Co	Automotive	2	?	✓	12345	✓	⊗	⊗	10% - 30% NTF	✓	240.0 Engine Hours	12.0 Engine Hours	66% PPV 4% NPV	✓
Power Take Off	Power Co	Off-Highway	1	✓	✓	12345	✓	⊗	✓	30% - 60% NTF	✓	3.0 Months	1.0 Months		✓

Showing 1 to 6 of 6.

Foundations in Prior Work

Q & A