

How do you ensure your Connected Intelligent Products can be trusted?

CIMdata PLM Education Webinar

PLM Leadership

How do you ensure your Connected Intelligent Products can be trusted?

Deploy Knowledge Systems for Reliability Design

CIMdata PLM Leadership Webinar Series
15 December 2016
#cimdatawebinar

Venki Agaram, Director, Quality & Reliability Engineering Practice
email: v.agaram@cimdata.com
Tel: +1.734.668.9922

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www.CIMdata.com

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Venki Agaram, Ph.D., MBA

Director, Quality & Reliability Engineering Practice



- 25+ years of experience from industry & academia
- 16 years at Fiat Chrysler Automobiles
- Growing the Quality & Reliability Engineering Practice
- R&D, virtual engineering, complex material systems, controlled mechanical systems, design-for-six-sigma, structured innovation, regulatory compliance, process modeling, market strategy, and business transformation
- Technical & business background: ideally suited for leading industry transformation to improve the robustness of smart, connected products and processes
- Education: aerospace engineering, business strategy

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Our Mission...

Strategic management consulting for competitive advantage in global markets



CIMdata is the leading independent global strategic management consulting and research authority focused exclusively on the PLM market.

We are dedicated to maximizing our clients' ability to design and deliver innovative products and services through the application of PLM.

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Our Services...

Creating, disseminating, and applying our intellectual capital



Research

- Market research & analysis
- Technology research & analysis
- Reports & publications
- Market news
- Member services...

Education

- Executive seminars
- PLM Certificate Programs
- Technology seminars
- Int'l conferences & workshops
- Best practices training...

Consulting

- Strategy & vision
- Needs assessment
- Solution evaluation
- Best practices
- Quality assurance
- Program management
- Market planning...

Delivering strategic advice and counsel through a comprehensive, integrated set of research, education, and consulting services

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PLM Transformation

Services for Industrial Organizations—Improving your PLM-Related Processes

CIMdata's PLM consulting methodology—transforming your business for a competitive advantage!

A comprehensive set of services tailored to fit your specific needs...

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Our PLM Transformation Clients...

A sampling of CIMdata's international industrial clients (1 of 2)

A&D	Auto	Fab & Assembly	High-Tech

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Our PLM Transformation Clients...

A sampling of CIMdata's international industrial clients (2 of 2)

CPG/F&B/Process	Medical/Pharma	Emerging Ind.	Other

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Agenda

Towards Developing Knowledge System based Design-for-Reliability Capability

- Quality & Reliability Risks Today
- Three-Legged Stool for Connected Intelligent Products
- Connected PLM with Feedback Analytics
- Bridging Reliability Engineering & Systems Engineering
- Failure Knowledge Capture & Reuse
- Exploring the Business Opportunity
- Q&A

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Quality & Reliability Risks Today



Complexity of Electronically Controlled, Software-Intensive Products

Auto. SW Related Recalls	Med. Dev. SW Related Recalls
<input type="checkbox"/> 2005 – 2012: 32 recalls, 3.6 mn. veh.	<input type="checkbox"/> 2005: 14% of recalls
<input type="checkbox"/> 2013 – 2015: 63 recalls, 6.4 mn. veh.	<input type="checkbox"/> 2011: 25% of recalls
<input type="checkbox"/> 0.3% of recalls in 2005	<i>Trending upward since 1983</i>
<input type="checkbox"/> 4.3% of recalls in 6 months of 2015	<input type="checkbox"/> 1983 - 1991: 6% of recalls
NHTSA's Safety Complaints	<input type="checkbox"/> 1992 – 1998: 8% of recalls
<input type="checkbox"/> 2005 – 2009: 55 SW related	<input type="checkbox"/> 1999 – 2004: 11% of recalls
<input type="checkbox"/> 2010 – 2014: 197 SW related	<input type="checkbox"/> 2005 – 2011: 19% of recalls

Aerospace SW Related Issues

- Boeing 787: generator control unit (GCU) SW counter overflow after 248 days of continuous power resulting in loss of all electrical power regardless of flight phase
- F-35 Joint Strike Fighter: RADAR SW vulnerability to cyber-attacks, requires system reboot every 4 hrs of flight time while desired interval is 8 – 10 hrs of flight time

Source(s): Automotive Warranty & Recall Blog 2015, USFDA Study 2013, <https://www.engadget.com/2015/05/01/boeing-787-dreamliner-software-bug/>, <https://www.rt.com/usa/335318-B5-radar-reboot-required/>

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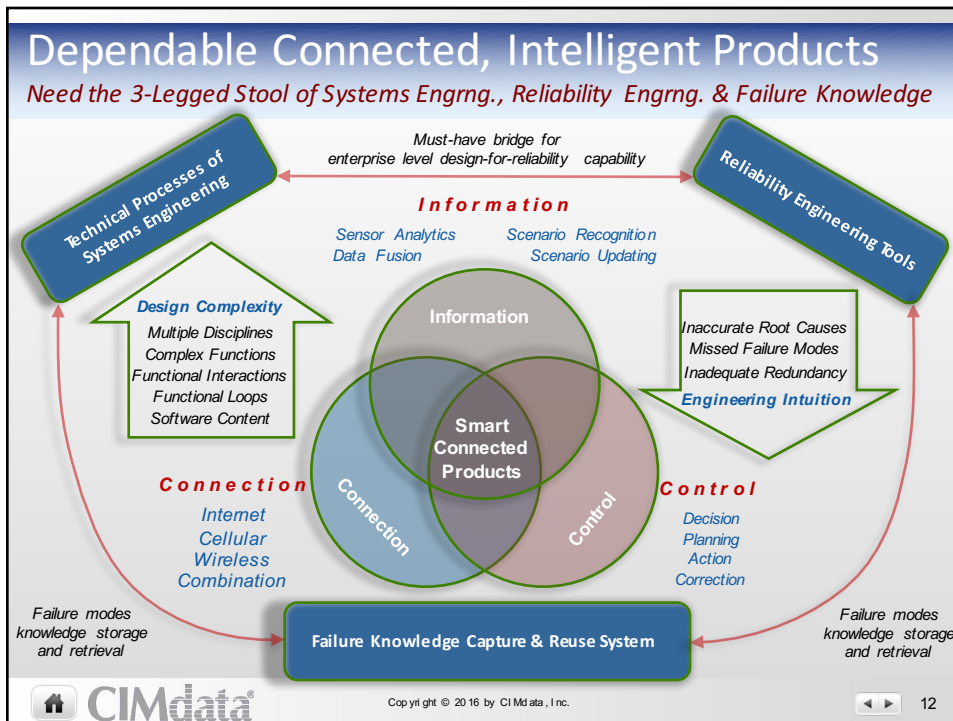
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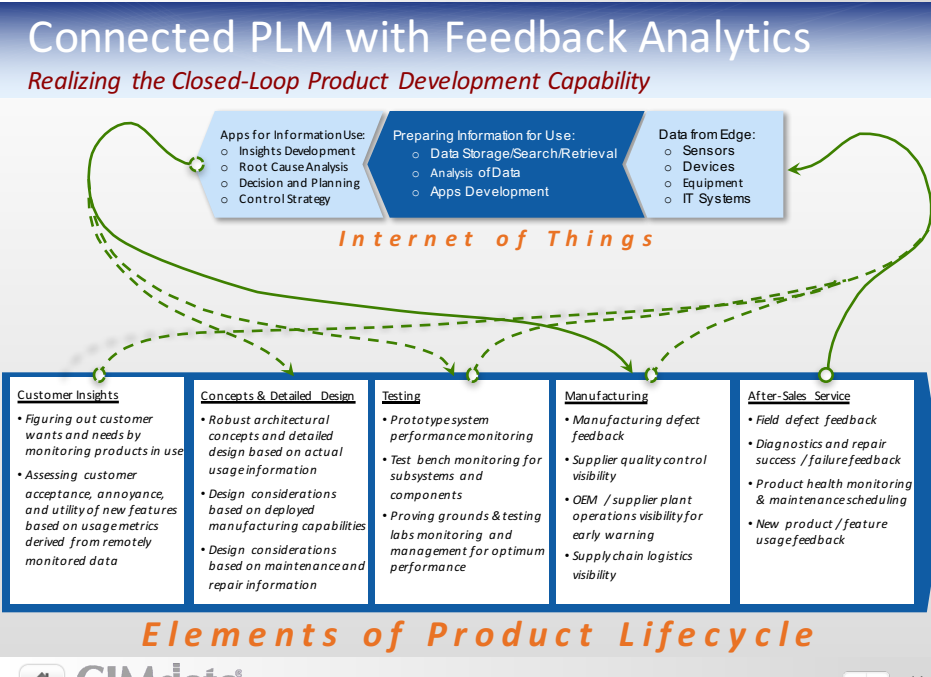
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Connected PLM with Feedback Analytics

Realizing the Closed-Loop Product Development Capability



Apps for Information Use:

- o Insights Development
- o Root Cause Analysis
- o Decision and Planning
- o Control Strategy

Preparing Information for Use:

- o Data Storage/Search/Retrieval
- o Analysis of Data
- o Apps Development


Data from Edge:

- o Sensors
- o Devices
- o Equipment
- o IT Systems

Internet of Things

Elements of Product Lifecycle

Customer Insights	Concepts & Detailed Design	Testing	Manufacturing	After-Sales Service
<ul style="list-style-type: none"> • Figuring out customer wants and needs by monitoring products in use • Assessing customer acceptance, annoyance, and utility of new features based on usage metrics derived from remotely monitored data 	<ul style="list-style-type: none"> • Robust architectural concepts and detailed design based on actual usage information • Design considerations based on deployed manufacturing capabilities • Design considerations based on maintenance and repair information 	<ul style="list-style-type: none"> • Prototype system performance monitoring • Test bench monitoring for subsystems and components • Proving grounds & testing labs monitoring and management for optimum performance 	<ul style="list-style-type: none"> • Manufacturing defect feedback • Supplier quality control visibility • OEM / supplier plant operations visibility for early warning • Supply chain logistics visibility 	<ul style="list-style-type: none"> • Field defect feedback • Diagnostics and repair success / failure feedback • Product health monitoring & maintenance scheduling • New product / feature usage feedback

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Bridging Reliability Eng. & Systems Eng.

First step towards building a Knowledge System based Design-for-Reliability

Relationship between Reliability Tools and Systems Engineering Processes



Systems Engineering Technical Processes	Reliability Engineering Tools																													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Stakeholders' Requirements Definition	1																													
System Requirements Definition	2																													
System Architectural Design	3																													
System Elements Definition	4																													
System Analysis	5																													
System Elements Realization	6																													
System Elements Integration	7																													
System Design Verification	8																													
Verified System Transition	9																													
System Performance Validation	10																													
System Operation	11																													
System Maintenance	12																													
System Disposal	13																													

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Failure Knowledge Capture & Reuse

Developing Machine-Readable Failure Knowledge for Reuse

- Problems posed by complex, software-intensive products:
 - Root causes of failures are hard to find because they exist at the interfaces between different subsystems, and at the intersection of different disciplines of engineering
 - Prior knowledge about failure modes often exists in the language of the expert community, not immediately accessible, and in particular, cannot be acquired from conventional databases
- Potential Solution:
 - Step I: Establish a common understanding of domain specific failure modes without need for interpretation. Example – Ontology applied to failure knowledge
 - Step II: Make failure knowledge explicit, machine-readable/-searchable.
 - Step III: Establish enterprise level connection between the machine-readable/-searchable failure knowledge capture and reuse system, the systems engineering technical processes, and the reliability engineering tools



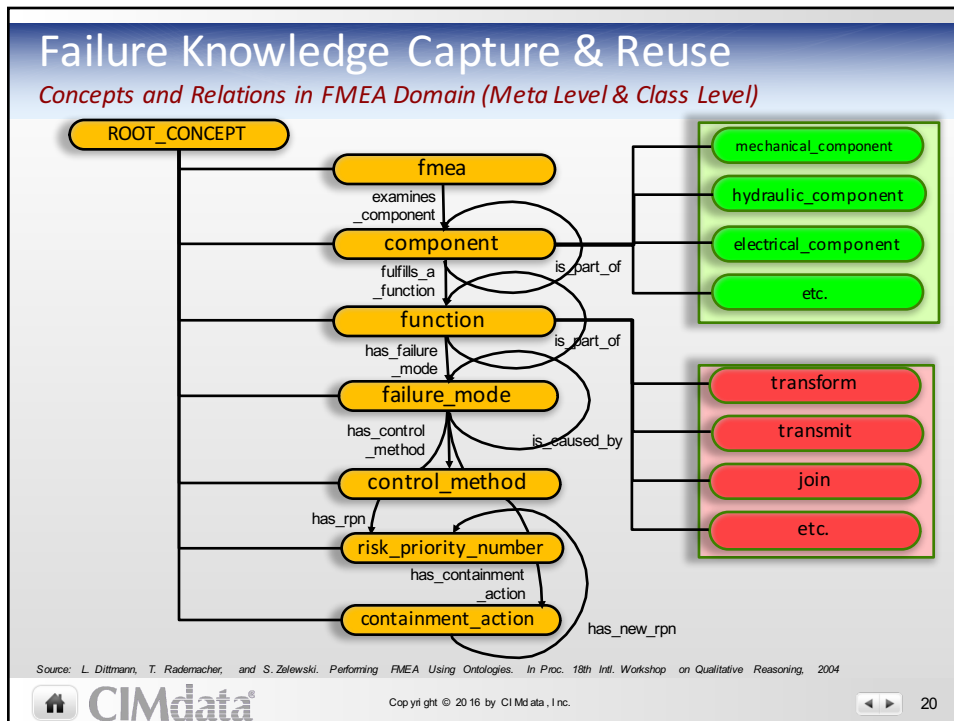
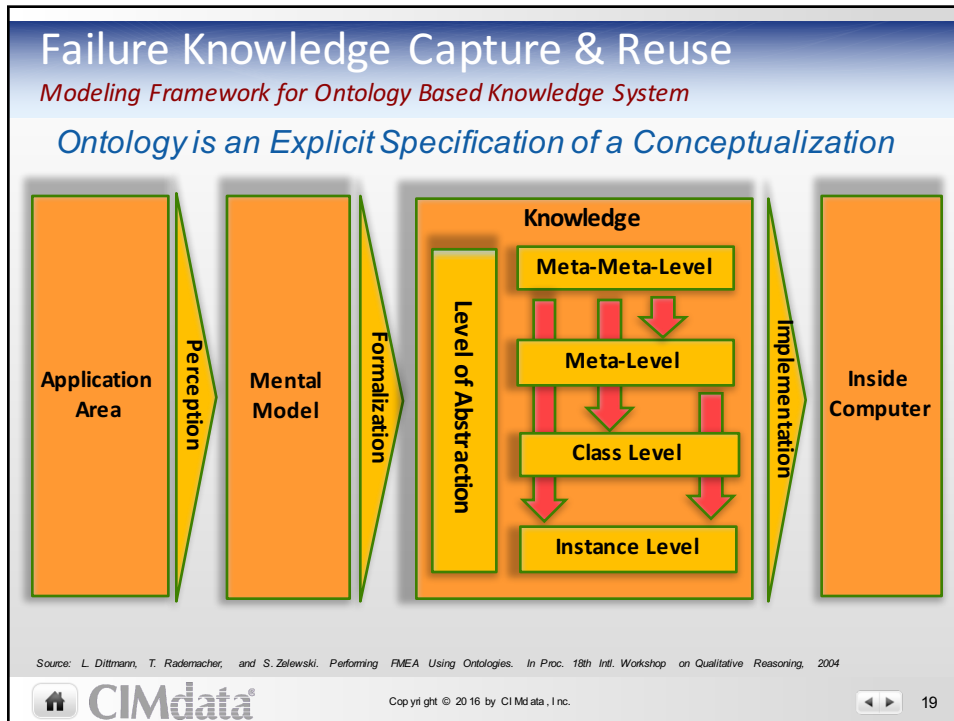
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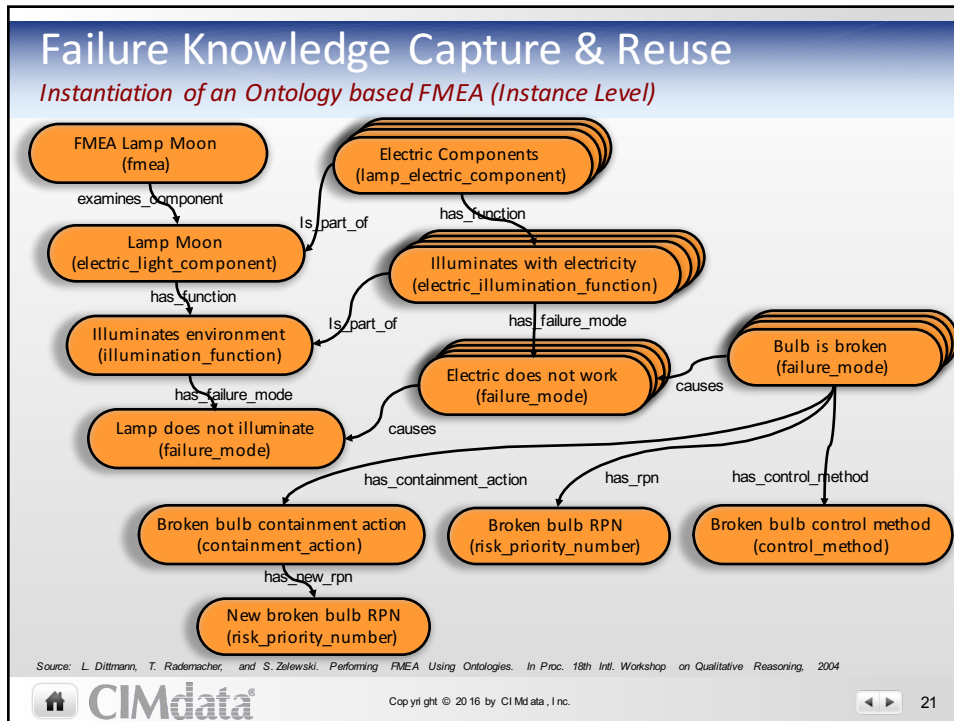


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Exploring the Business Opportunity

Realizing Enterprise Knowledge System based Design-for-Reliability

- Systems engineering helps in dealing with product complexity of intelligent, connected products
- Verification and validation iterations in systems engineering are opportunities for new learning about the failure modes of complex, intelligent, connected products
- Reliability engineering tools are needed to leverage product failure knowledge and they are mostly disconnected from systems engineering tools
- Bridging the tools and processes used in systems engineering and reliability engineering while leveraging failure knowledge capture and reuse is imperative to minimize recall and launch risks



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Exploring the Business Opportunity

Realizing Enterprise Knowledge System based Design-for-Reliability

- All tools used in systems engineering, reliability engineering, and failure knowledge capture and reuse will not likely be provided by a single software provider
- System integrators are likely to play a major role in closing the loop between reliability engineering, systems engineering, and knowledge capture and reuse
- CIMdata believes that connected products will enable closed-loop quality based product development but will additionally need failure knowledge capture and reuse
- CIMdata would like to collaboratively explore with OEMs, suppliers, and solution providers, a maturity model pertaining to “Knowledge Systems based Design-for-Reliability”



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Quality & Reliability Engineering Output

What is coming from CIMdata's QRE Consulting Practice?

- Survey to be filled by OEMs/Suppliers, SIs and SW Providers
 - Topic: Knowledge Systems Based Design-for-Reliability, December 2016
- Whitepaper:
 - Quality & Reliability Engineering – Knowledge Systems based Design-for-Reliability
 - January 2017
- Knowledge Council Kick-off:
 - February 2017
- Education Webinars
 - February 9, 2017
 - July 13, 2017
 - November 9, 2017

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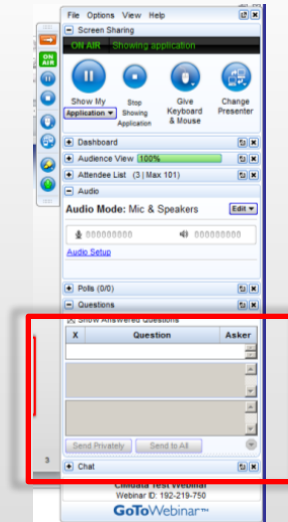
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World Headquarters
3909 Research Park Drive
Ann Arbor, MI 48108 USA
Tel: +1.734.668.9922
Fax: +1.734.668.1957

Main Office - Europe
Oogststraat 20
6004 CV Weert, NL
Tel: +31 (0) 495.533.666

Main Office - Asia-Pacific
Takegahana-Nishimachi 310-31
Matsudo, Chiba 271-0071 JAPAN
Tel: +81.47.361.5850
Fax: +81.47.362.0472

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