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Automotive Models in Practice

MASE Workshop
MODELS Conference

27 September 2015

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Principal Consultant

Ground Rules/Assumptions

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Content is Observations, not formal research

Ask questions (even during the talk)

This will be the least technical talk of the day

Introduction

Carnegie Mellon

Panasonic
Automotive

CloudOne

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(Some) Customers

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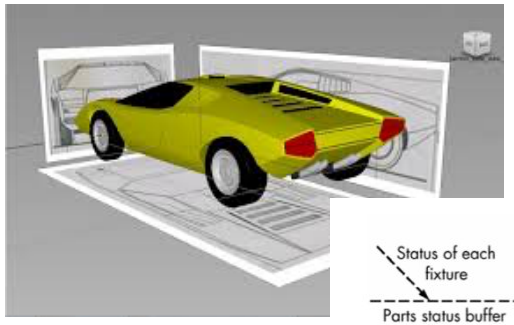
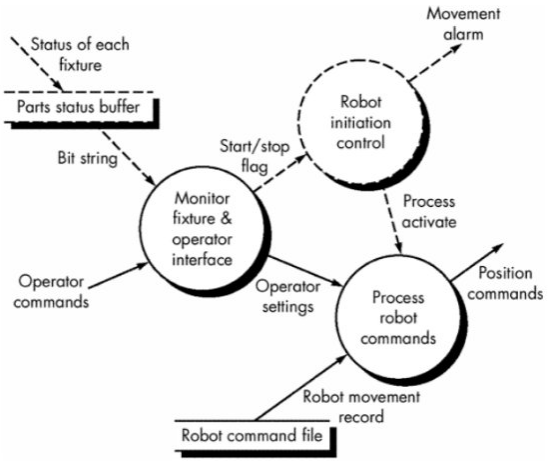
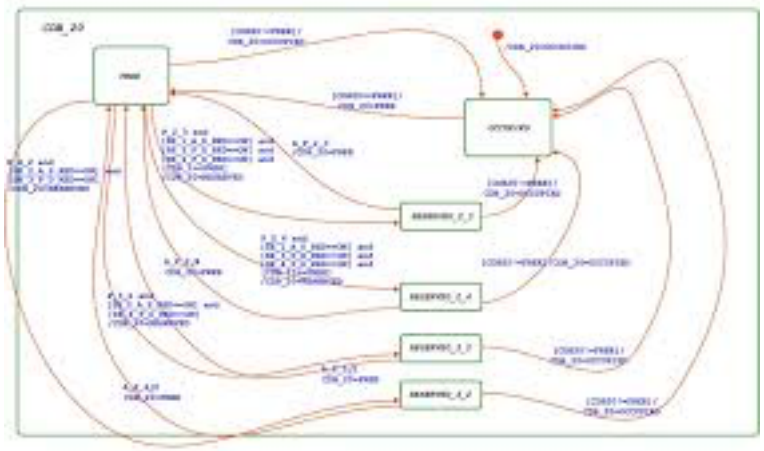
HOW DID WE GET HERE?

Models in The 90s

- Mechanical "Math Models"
- (Electrical) System Models
  - Static Models – Teamwork, Hatley-Pirbhai, …
  - Simulation Models without Deliverables
- Executable Models as Specifications
  - Designs used as requirements







Interesting the most valuable models at this time were often the environment

Development of Electrical Systems in the 90s

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Technology

Electrical Advances were Evolutionary

Technologies are Isolated Systems

Development Cycles were 6 years+

Evaluation was almost always with Physical Properties

Business

OEMs Spun off Internal Suppliers

Internet is forcing faster customer expectation of technology

Customers desire 3-4 year windows

Beginning of the Economic drag of manufacturing business

Most profound was that the character of vehicles was starting to be the software!

Challenges of the Business

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Algorithmic Complexity

Reduction of Development Time

Cross Product Reuse

(Lack of) Skilled Market Resources

The goal was to move faster, but more importantly to own Intellectual Property

Simplifying the Challenge

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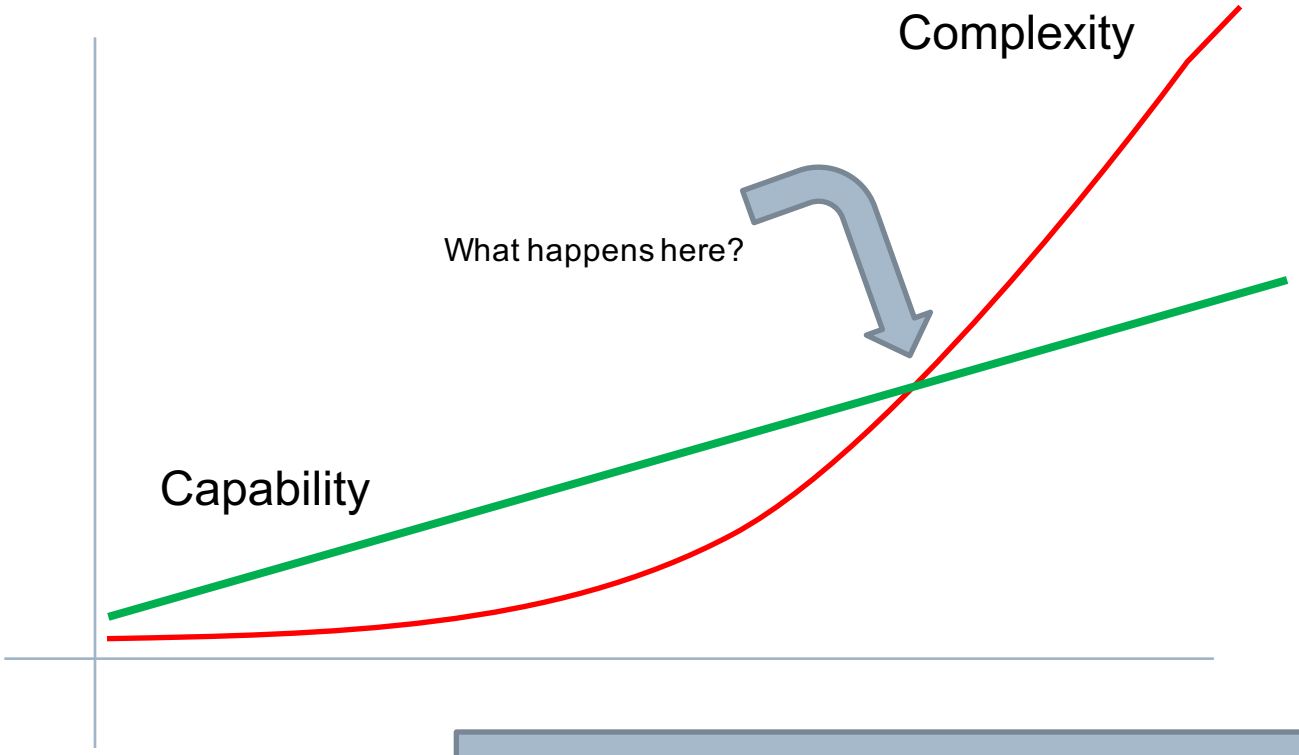

This is the chart that funded investment in internalizing development!

Market Movement to Algorithm Modeling

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Motivation:

- Own the Intellectual Property
- Correct in construction
- Longevity in Application
- Remove the Supplier – OEM Cycle
- Minimize the need for Software Engineers

Solution:

- Move to Model Driven Engineering
- Leverage Algorithm Engineers over Software Engineers
- Develop Internal Reuse Strategies

Success In Algorithm Modeling

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From Models to Code Solutions had the same patterns

- Stable target environments (OS, MicroControllers)
- Specialized Code Generators for Targets (Size and Speed)
- Model Expressions Understandable by Users

Controls Systems

- Graphical Coding
- Commercial Code Generators

State Based Systems

- UML
- State Modeling Tools

90% of the code generation we observe is Simulink

State of Code Generation in Automotive

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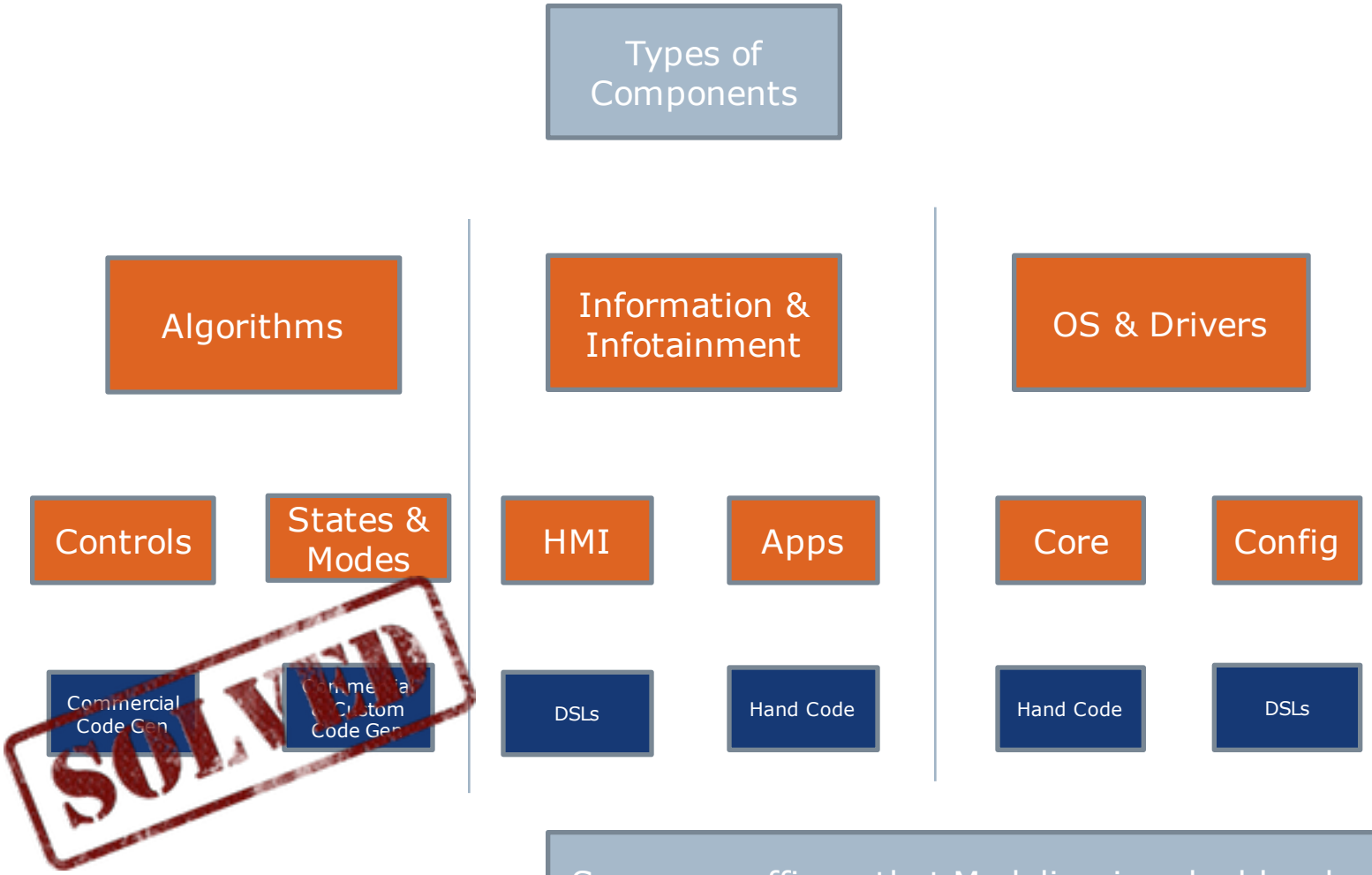

Success reaffirms that Modeling is valuable when used as a first order artifact and has derivative value.

Modeling Summary

Algorithm Modeling has been the primary success because of…

- Access to technology
- Robustness in process application
- Distance from decision by engineer to application (Immediacy)

Attempts for Modeling and Analysis that have not seen wide spread adoption include…

- Architecture Analysis
- Timing Analysis
- Optimization

Clear issues in other techniques relative to source data and the concluding results. Formal/Informal and Precision/Accuracy

THE INDUSTRY TODAY

News Shaping the Industry

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NHTSA Releases List of All Makes and Models Affected by Takata Air Bag Recalls

NHTSA has released the full list of vehicles (by model year, make and model) affected by the Takata air bag recalls. Consumers can also use NHTSA's VIN look-up tool to see if their Vehicle Identification Number matches one of the approximately 19 million vehicles from 12 auto manufacturers involved in the recall.

Toyota reaches $1.2B unintended acceleration settlement in criminal probe

REPORT TO BOARD OF DIRECTORS OF GENERAL MOTORS COMPANY REGARDING IGNITION SWITCH RECALLS

May 29, 2014

Anton R. Valukas

JENNER&BLOCK

The New York Times

As Volkswagen Pushed to Be No. 1, Ambitions Fueled a Scandal

Why so many issues with so great of impact?

It’s Still Complexity

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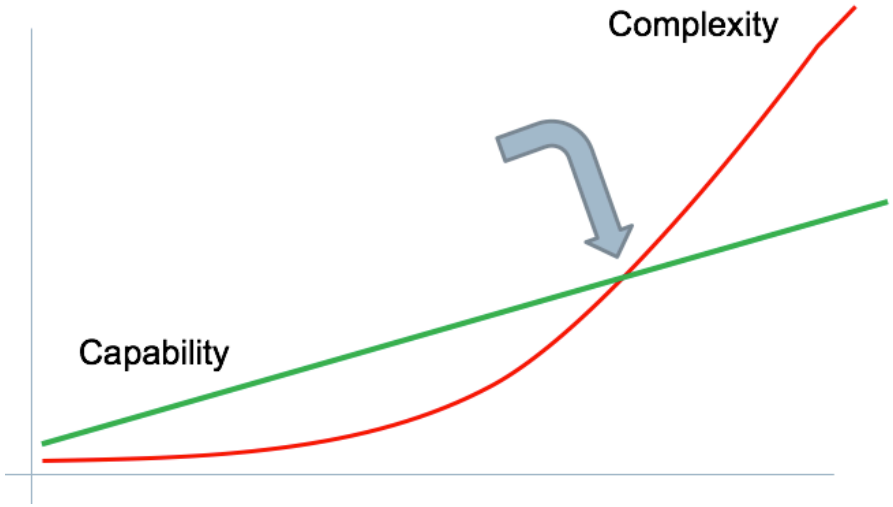
- Execution & Oversight
- Collaboration (Internal, OEM – Tier1, Tier1 – Tier2)
  - Workflows
  - Technology
- Reuse & Configuration
- Identifying Trends



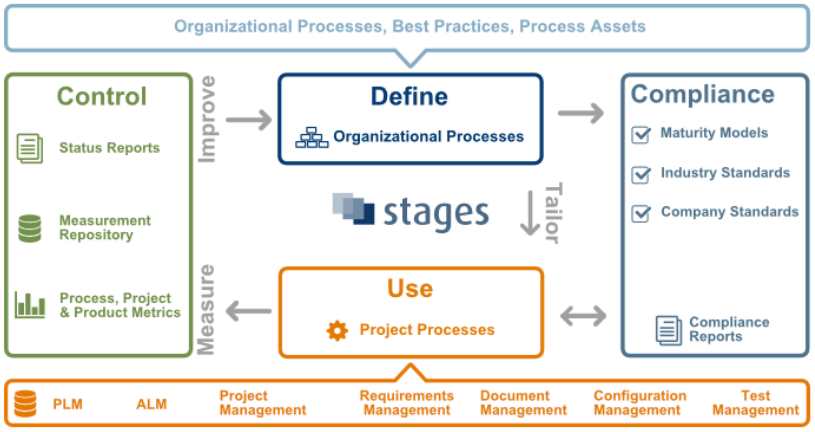
Complexity is what is driving the issues, and culture is driving the inability to identify and respond.

PROCESS MODELS

Process Models

Motivations:

- Consistency in Practice
  - "What should I do?"
  - "What should someone do if someone leaves?"
- Communicating Expectations & Culture
- Measuring Performance to expectations



Business Objectives:

- OEMs -> Protect their investment and practices
- Tier 1s -> Demonstrate effective practices

Might be the most important model of the next decade if it is executable.

Industry Reference Model Examples

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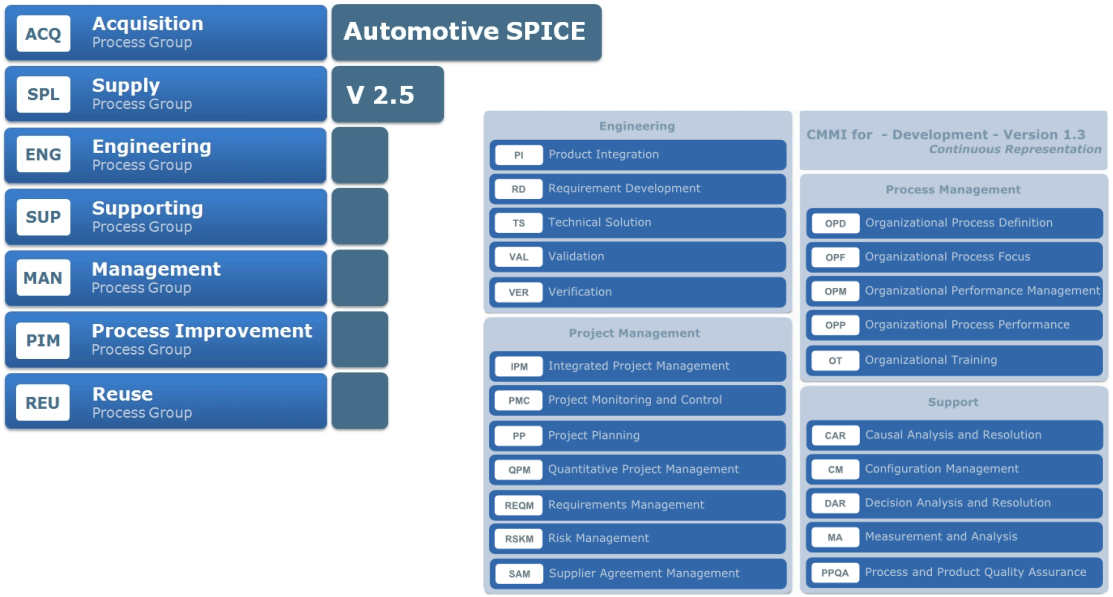

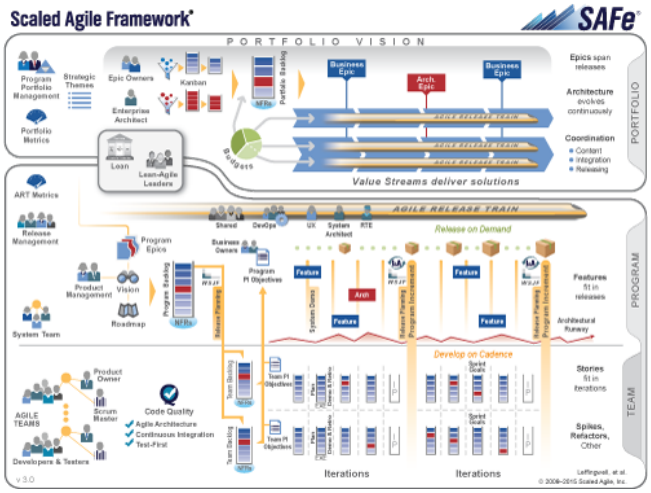

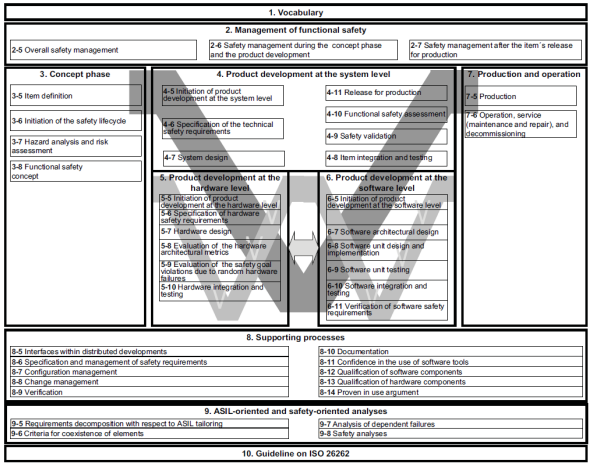

Each Reference Model has its own unique perspective and value proposition

Usage of Process Models

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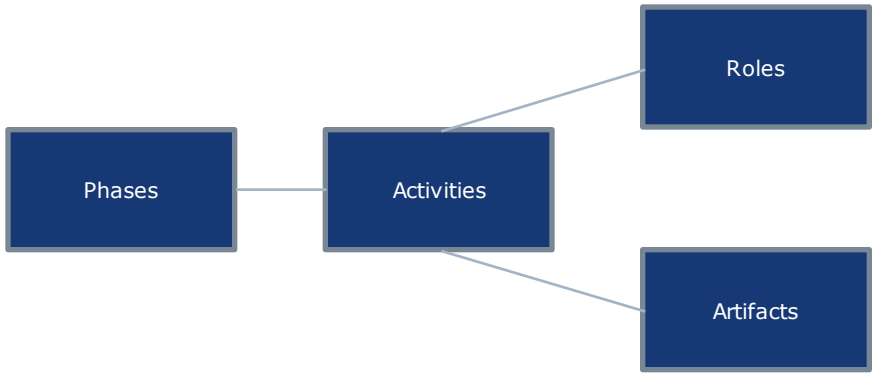
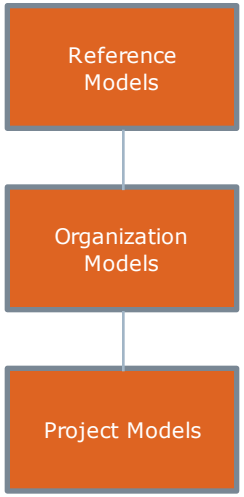
Process Models
- Simple
- Custom

Process Must Be Tailored
- For an Organization
- For a Project

Process Must Be Evaluated
- For Coverage/Compliance
- For Status





Process Model Adoption can be correlated to the value to the organization and the enactments that enable engineers to understand and use rapidly.

COLLABORATION MODELS

(Models of) Collaboration

Pace and content of collaboration has accelerated, but the methods haven't

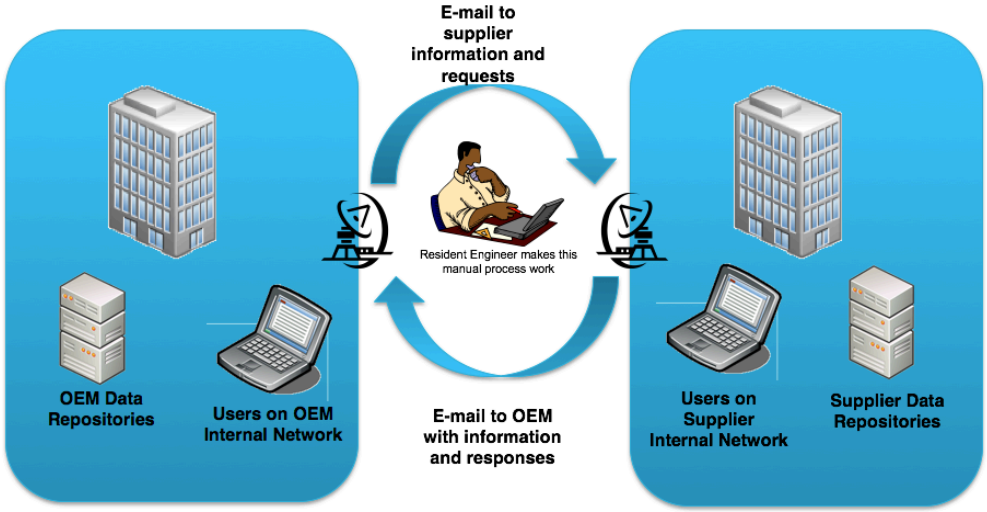
Collaborative Workflows

- Issue
- Change
- Question

Collaborative Assets

- Requirements
- Designs
- Implementations

Methods and technologies are significantly behind the needs



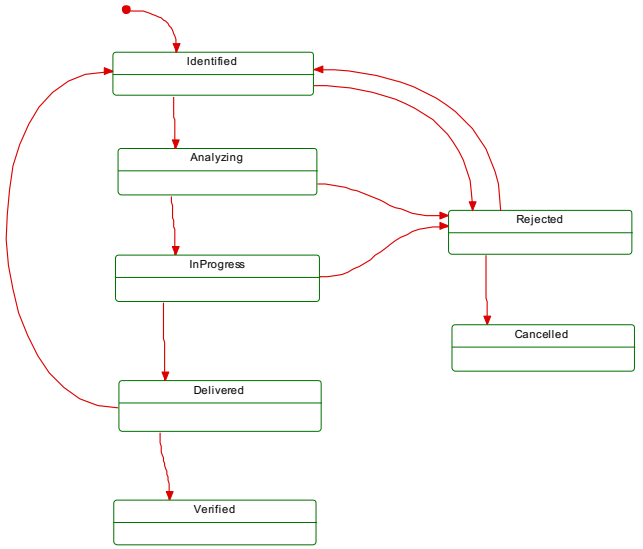
Workflow Collaboration

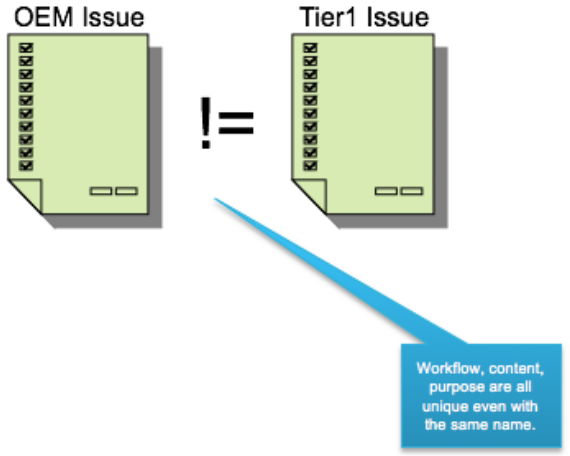
Workflow collaboration centers around exchange of communication

Content of Communication is simple

Complexity is in

- Security
- Alignment
- Volatility of Data and Schemas
- Mapping of State and Content





Simple data concepts but robust techniques and architectures must be applied

Patterns of Collaboration

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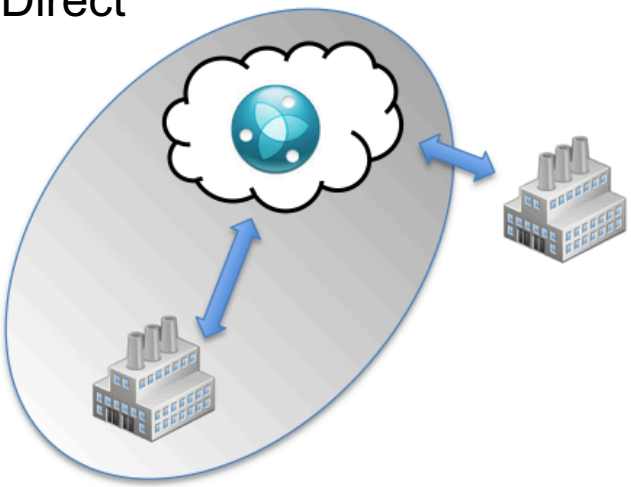
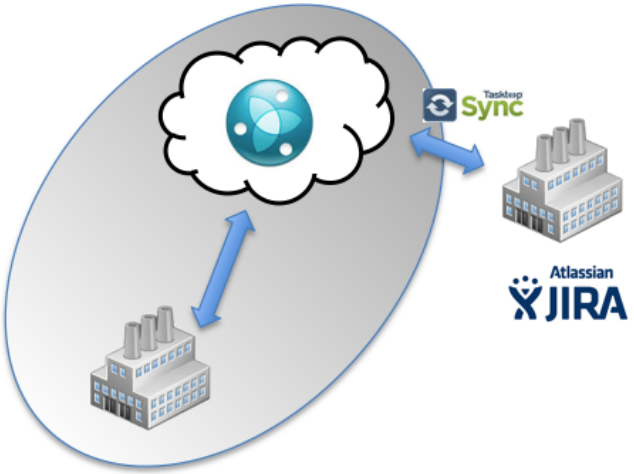
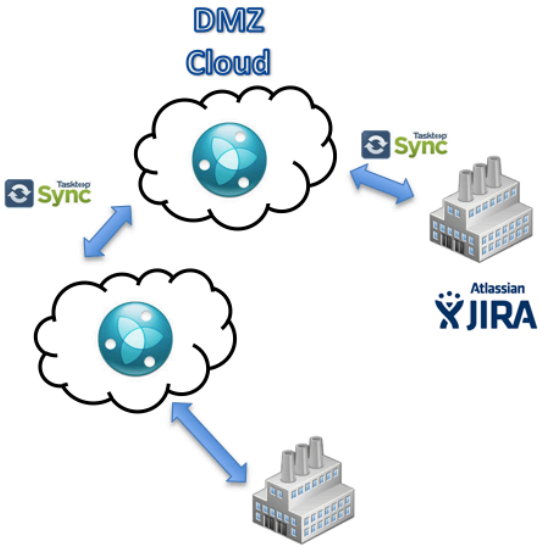
Direct



Synchronization





Indirect Synchronization

A layer of the issue with collaboration is that of security (or perceived security)

Asset Collaboration (AUTOSAR, ODX, etc.)

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Automotive is moving to structured formats for exchange

Formats designed for serialization and delivery

Gaps in

- Collaboration/Iteration
- Security
- Perspectives/Slicing
- Variance

Significant focus of the North American AUTOSAR User Group

*Note: Requirements is a similar issue

PLANNED REUSE

Reuse & Configuration

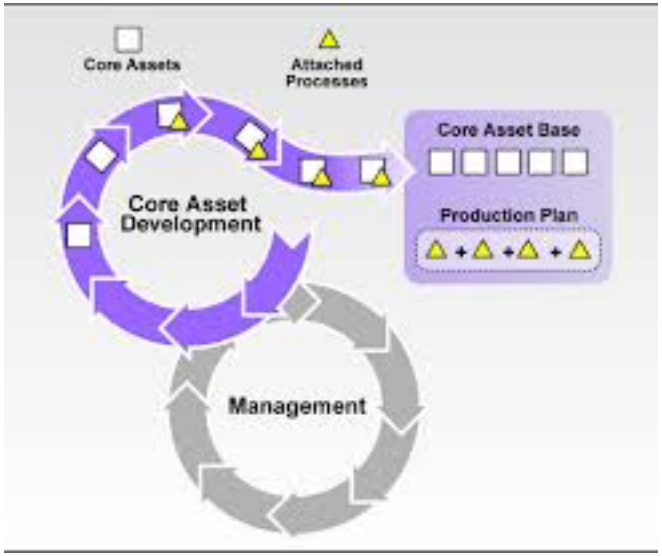
Product Line Engineering is a dominate objective in the industry

Needs are based on:

- Consistency
- IP Investment
- Fast to Market

Challenges

- Maturity of Organizations
- Build to Contract Culture
- Asset Management



Feature Modeling

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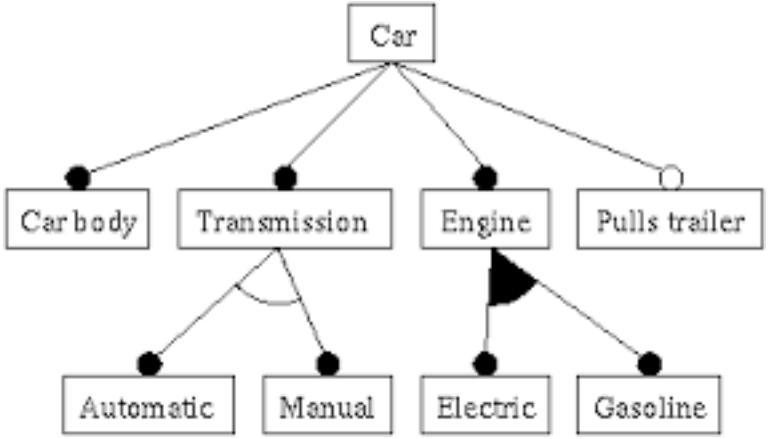
Common method of expression of content and relationship

Challenges are

- Pervasive nature of the method
- Large investment in organization culture
- Expression of the asset binding
- Tool integration



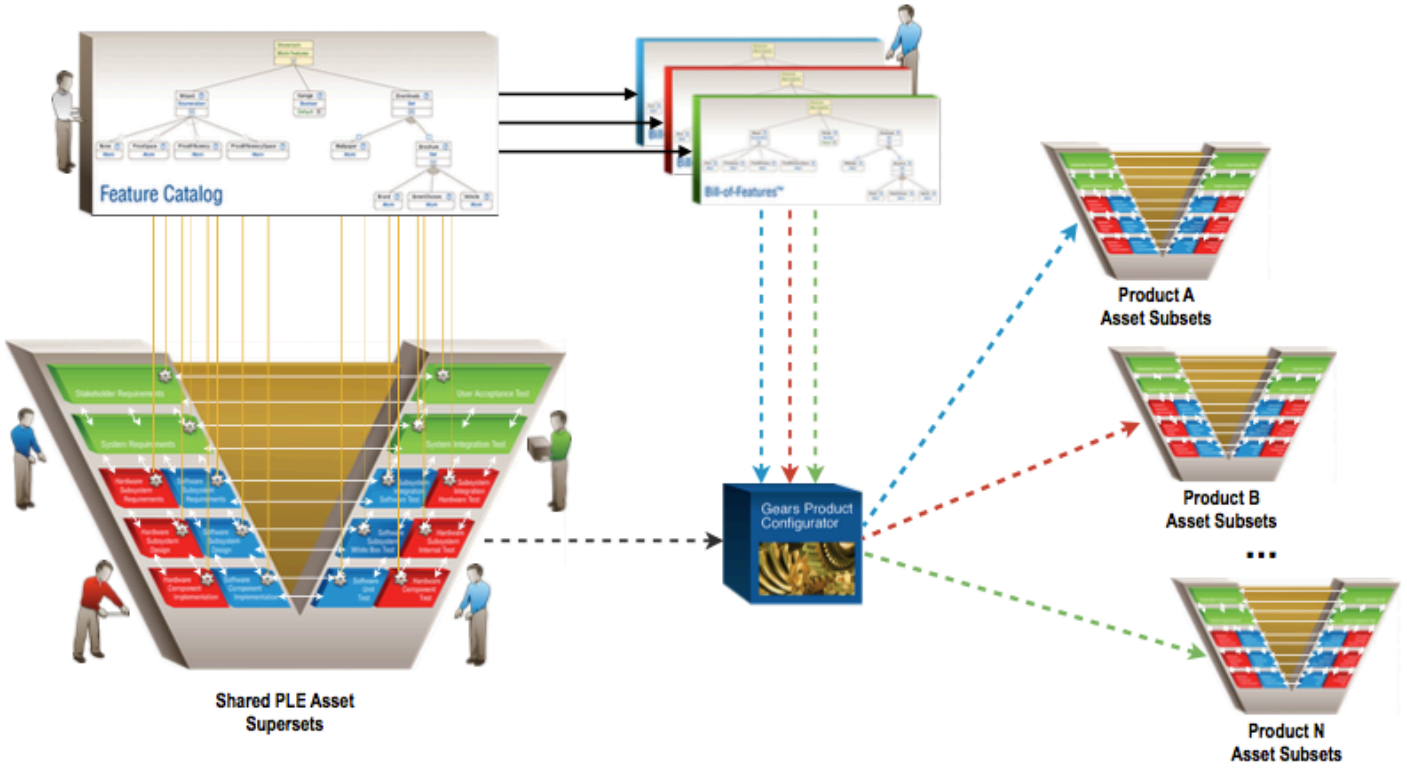
pure·systems

BigLever Software, Inc.

Leveraging Feature Models

Value in feature modeling is in the leveraging of superset assets

From a single superset asset base generating multiple unique product bases



Observed significant more progress on the OEM side than the Tier 1 side.

TRENDING INFORMATION

Identifying Trends in Information

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Internet of Things is the simple integration of silos of information that can be used for a greater value than on it's own.

Connected Diagnostics: Data Analytics

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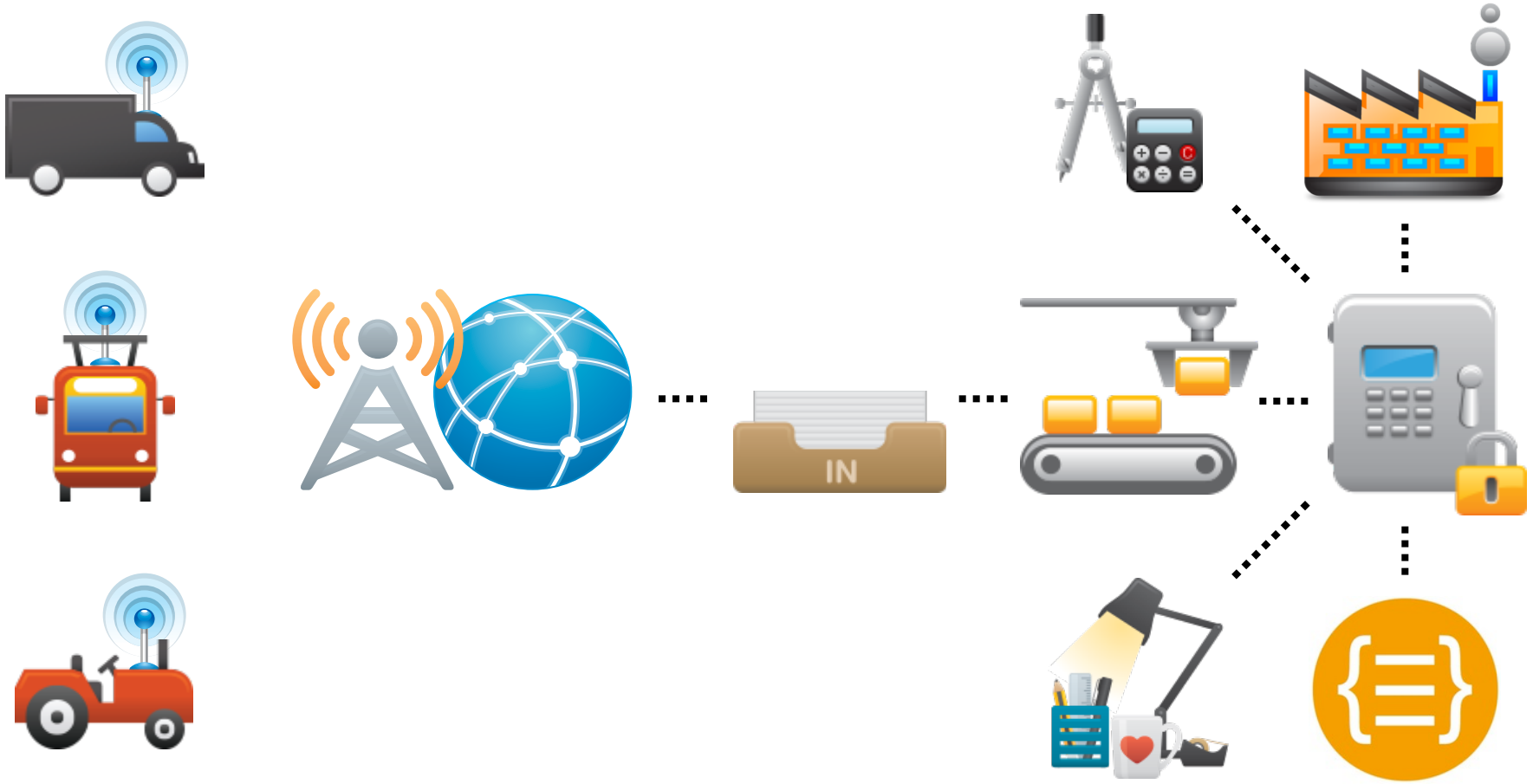

Example: Cummins Connected Diagnostics

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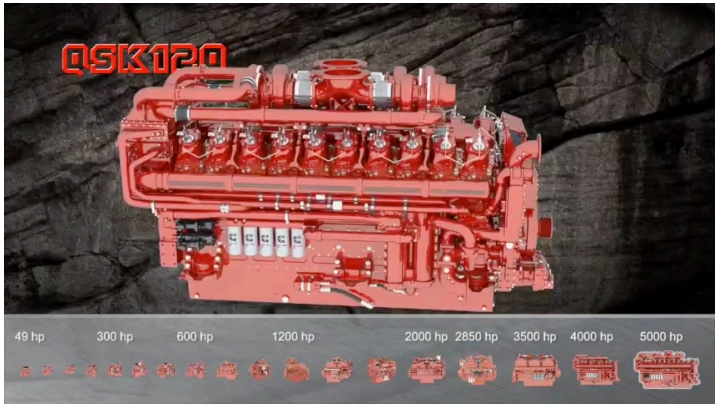

Connected Diagnostics™

Connected Diagnostics YouTube Video

Summary of Impacts

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Everything is a Model

Process Model Adoption

- Will Drive Culture Changes

Collaboration Success

- Will Accelerate Business
- Enable Validation Across Boundaries

Planned Reuse

- Will Push for Tooling Changes
- Will Drive to New Process Capability Patterns

Internet of Things

- Will Change our Assumptions on Design (nothing is static)

Tier 1 Staff Engineer "Hopes for a change in culture to assume open unless told otherwise"

FUTURE OF MODELS

Expected Victories

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Executable Process

- Process at the Organization forefront, in the background of the developer

Cross Enterprise collaboration

- Of Workflow
- Of Assets

PLE as a Common Practice

Not including code generation since it is “Solved”

Expected Challenges

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Tooling

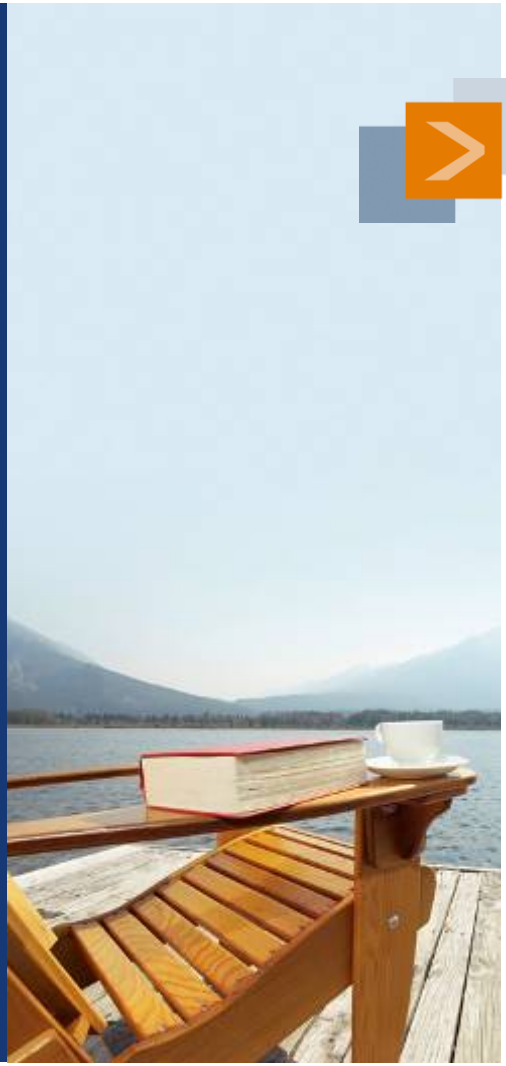
- Client side to server side
- Tool integrations

Pervasive Data Models

- Data Warehouses, Linked Data, …
- Consistency and Coherence

Field Robustness

- QoS field guarantees with field evolution of software



Thank you
for your attention!