

MBSE: Failing Faster Earlier Once

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Doing the math...





Nodes = 30, potential links = 435, unique configurations = 2^{435} Number of atoms in the universe est. between 2^{158} and 2^{246}

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Integrated MBSE Vision

MBSE is about prediction Do you see the problem?





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Integrated MBSE Value: Unforeseen Cross-domain Impacts

"...recalls SUVs because drivers are accidentally turning them off while driving". Placement of transmission selection/radio next to each other (\$1.4M in direct costs)

NHTSA reports 47m vehicles recalled in 2018

25% are never repaired





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Do you see the problem?





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Case Study: Fuel Pump Control Module



Fuel pump control module bad placement...

- Resulting in Bi-Metal Corrosion, failed ECU
- 86,000 vehicles recalled.. \$8.6M direct costs



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How about now? Even when you were evaluating places to put it





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Recent Headlines from other industries...

SIEMENS Ingenuity for life



Siemens PLM Software

Here's signals

This S8

red

PEOPLE + MACHINES

A future of work even REGISTER

TRENDING NOW

NOV 4

08/20/19

How do we learn the lessons from the threads? SIEMENS How to store/recall from somewhere so we don't repeat them

Problem resurface metric: how long does a problem once solved take to come back

- Auto: ~3 years
- High Tech ~6 mo.
- Aero ~15 years



a. di

Cross-Domain problems result from: Integrated Siloed/Disconnected Decisions Form follows function, Problems follow furFunctions Everyone involved, including purchasing Collaborative **Disconnected requirements** Requirements Uncommunicated change Change/Synch Happen at domain/organizational boundar Interfaces Migrate with people (overt or covert) Missing/disconnected product architecture "Water on the knee"

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Ingenuity for life

Integrated MBSE Shift left...



SIEMENS Ingenuity for life

Where are we? Our Murphy-risk profile?



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|--------------|-------------------|
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| Capability Assessment: | Basic | Low | Medium | High | Advanced |
|-------------------------------|--|---|---|--|--|
| MBSE Process Maturity Level 4 | D | isintegrated | Integr | -Integrated | |
| System Modeling/Architecture | PPT in docs | Disconnected Visio models | Sys Models with Simulations | Multiple model exchange/optimize | Integrated architecture models for cross-domain sim/optimize |
| PLE/Configuration (variation) | None | Variation documents, spreadsheets | Disconnected variation rules | Integrated variation rules | PL variation definition built into into architecture decisions |
| Technical Risk (RAMS, cost,) | None | Risk documents, spreadsheets | Integrated Risk Management Plans with aspects of RAMS | Standalone RAMS with FMECA Dash boards | Integrated RAMS, continuous risk assessment/alarms with dashboards |
| MBSE Process Maturity Level 3 | | | | | |
| Interface Management | ICD in docs | Managed interfaces | Standard-based Interface library | Reused interfaces | Functions/logical allocation drives interface definitions |
| Logical Modeling | Logical description documents | Logical hierarchy | Isolated logical behavior models | Integrated logical behavior modeles | Logical architecture with allocation with traceability |
| Parameter Management | Unmanaged spreadsheets | Managed spreadsheets | Parameter library | Integrated with functions | Reusable parameter library with traceability |
| MBSE Process Maturity Level 2 | 1 | | | | |
| Feature/Functional Modeling | Functional description docs | Function hierarchy | isolated functional behavior models | Integrated functional modeling | Functional arch with allocations & Traceability |
| Characteristic/Target Mgmt | None | Uncontrolled Excel/Docs | Controlled targets | Distributed targets/constraints | Integrated targets, budgets, with compliance reports |
| Change Management | Document-based change process | Isolated models included in change | Impact analysis & suspicion mgmt | Metrics with History for improvement | Project level reuse, starting point for next project |
| MBSE Process Maturity Level 1 | 1 | | | | |
| Requirement Management | Uncontrolled spreadsheets & docs | Managed Docs | Standalone solutions (disconnected) | RM/traceability exchange | Connected, configured, cross- domain traceability with reuse |
| Model Management | Uncontrolled, rules- of-thumb, hieristics | Uncontrolled, behaivor models | Shared model repository | Integrated, component library | Model reuse with controlled parameters |
| Verification & Validation | Minimum to no planning | Manually testing everything | Isolated validation simulations | Integrated simulation (HIL, SIL) | Focused testing, reuse results, swap out models |
| Design Management | unmanaged Cax/SW models | Locally Mananged CAX/SW | Enterprise repositories | Integrated models (MIL, SIL) | Cross-domain design/optimization |

Where is Wasatch Chapter per WSRC?

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Dishonesty/Meta-Dishonesty

"Semmelweis Reflex"

"...to dismiss/reject out of hand any information, automatically, without thought, inspection, or experiment"

Fore-ordained answers ...will the answer provided by SE tools be accepted

Don't waste your time on the wrong answers, unless...



Dr. Ignaz Semmelweis (1818-1865)

Early Germ Theory



Wash Your Damn Hands

[http://en.wikipedia.org/wiki/Semmelweis] 15 Siemens PLM Software

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Organization SDB's (Self-Defeating Behaviors)...



- No process for the tools to work within
- No time/money to use tools
- No backing for resources
- No training on tools
- Expecting tools to run themselves
- Thinking tools are static
- Not convincing the customer of the tool benefits
- No mechanism for using tool results
- Applying the tool to everything
- Funneling everything through a gate keeper
- Expecting "paper" results from tools
- "where's the hardware?"
- Rewarding fire-fighters vs. fire-preventers
- Blockading support organizations (...they cost too much, etc.)



...next year you will have a 90% probability of this failure...but you will do nothing about it!

Dr. Stephen Wheelwright (Harvard Business School)

[Covey 1995, Sampson 2000]

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Organizational SDB's continued...



How prepared is your organization?

Culture change vs. getting lucky...



| | _ | _ |
|---|---|---|
| SE tool management acceptance checklist | Y | Ν |
| Did the tool support group help with the proposal? | | |
| Has the manger forecast time & money for tool usage? | | |
| Did the project manager help get the tools for his project? | | |
| Has the manager forecast time & money for tool training? | | |
| Is the manager willing to let the tools be upgraded mid | | |
| project or are we stuck at this tool version? | | |
| Is the manager willing to let his tool power users share | | |
| lessons learned, be involved with user groups, etc.? | | |
| Is the manager active in convincing his customer or the | | |
| benefits of the tools? | | |
| Are the tools used during customer reviews? | | |
| Is there a development process being followed on the | | |
| project? | | |
| Is there a mechanism for doing something with the results | | |
| of the tools? | | |
| Is the manager involved with defining requirements? | | |
| Does the manager see "one or two" engineers managing | | |
| the product requirements? | | |
| Does the manager have a "lets get something built" before | | |
| requirements are defined mentality? | | |
| Does the manager think the value of the tool is in its | | |
| paper generation capability? | | |
| Does he want/let the engineering automation support his | | |
| project? | | |
| [Sampson, 2000, Von Wodtke, 1993] | | |
| s 17 | | |

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Cows drink...





Thank you