How to Predict the Next 'Big Thing' Your Customer Will Adopt and Embrace

Using System Evolution Patterns and Open Windows Tool

Howard Cooper
Innovation Engineer

INCOSE Mountain West Sept 9, 2021 Chapter Meeting

How to Predict the Next 'Big Thing' and Build it Now

Up to 18 Years Before Your Competitor

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WHY IS 'PREDICTING OR FORECASTING THE NEXT "BIG THING" YOUR CUSTOMER WILL ADOPT AND EMBRACE' IMPORTANT TO YOU OR YOUR COMPANY?

Because competition is fierce (need to be ahead of the competitor) and demands (expectations) are such that our customers want (and deserve) more.

We can’t think beyond our current capabilities, so we get trapped by past successes and ignore crucial disruption from other less familiar technologies.

We are resource-limited -- we can't pursue every "good" idea, because most times the Customer doesn't think most are "good", or they can't afford even if they are "good" for the mission.

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What is the biggest challenge or problem you face, when trying to predict or forecast the next "big thing"?

Difficult to predict what Government customers will want and what they will find budget for.

Trying to meet stakeholder requirements without hindering innovation.

How do you avoid the catch-22 situation where small companies with innovative new products get passed over by larger suppliers?

Limitations with existing technologies, cost of developing new technologies, reluctance to take risk, uncertain market demand.

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80/20 Rule of Failure in Product Development

A Year-long Capgemini Study in 2017 showed that;

- Govt. Funded Defense Projects, 2005 – 2015, 80% Failed (never made it to full rate production)
- Corp Innovation Centers, started 2005 – 2015, 84% failed and (facilities repurposed)
- VC Funded new start ups, 2005 – 2015, 80-85% Failed (shut down or bankrupt within 3-5 years)
- VC Firms that fail after funding only 2-3 Projects: 80%.

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My Experience After May 2010, Seems to Have Flipped or Eliminated the 80/20 Rule of Project Failures

Over the next 6 years, after that discovery, ….

I worked with **26 different development teams**, each claiming to have **an "unsolvable problem"**, which slowed down the project or limited customer value.

Using my discovery, "The 14 Stages of Innovative Improvement" and the tool I created, **all 26 teams were able to,** in a one-hour meeting, identify the correct system improvement principle(s) that could eliminate or mitigate their problem.

All 26 of their **improved systems** were then accepted in peer reviews and

All 26 improved systems were **Adopted by our Customer**, the **US Army**. **All 26 are now helping in the Battle Field**, saving **$233 million**, over the legacy systems they had been using.

That's 26 successes and 0 failures. Or a 4/96 failure/success ratio, vs. 80/20

So…? So What…?

After I show you how to 'predict the next big thing'…

- Maybe you'll do better than I did (maybe 30-50 succeses between failures)
- Maybe you'll do worse than I did…
- But if you do only half as well, ~15X more 'hits' than 'misses',
- That is an amazing "batting average" and it will better than **reversing** the **80/20** Rule of failure/success. It is **7/93**, or 7% failure and 93% successes.

That would put **your career** into high gear and make **your**

Organization - like #1 SE and **product developer in the nation!**

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So, Let's Get Started…

What are the 14 Stages of Innovative Product Development?

What is the 'Open Windows" Tool?

Why do I need both, in order to predict the next big thing?

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Origin of the 14 Stages of Innovative Product Development?

Genrich Altshuller, the Father of TRIZ

Studied over 200,000 patents to extract and verify these patterns (stages) of product improvement and the principles by which these improvements are made.

The TRIZ Associations of America and of Europe have now studied over 3 million patents, validating the set number of patterns and principles has not gone up.

What does this mean, to you?

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1878

1920

1960

1970

1982

1992

2002

2007 - 2021

INNOVATION

The First 7 of 14 Stages of System Improvement
(pretty well known)

SFR
1. Start with the end in mind…
2. Identify the function to be performed…
3. Identify multiple functions that could be performed…
4. Identify how it could be of greater value…

PDR
5. Check for system completeness (5-7 critical subsystems)
6. Identify power transfer through the system (E,M,I,P)
7. Load Balancing between subsystems.

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Second 7 of 14 Stages of System Improvement
(pretty much hidden and secret)

By CDR or TRR

8. Transmission lines grow shorter…
9. All systems tend toward Ideality… (function without cost)
10. The weakest or most limited subsystem limits the system… (technology)
11. Systems & components get smaller…
12. Components disappear into the Subsystem
    Subsystems disappear into the System and
    Systems disappear into the Supersystem… (trimming)
13. Systems become more automated…
14. Systems become more dynamically flexible…

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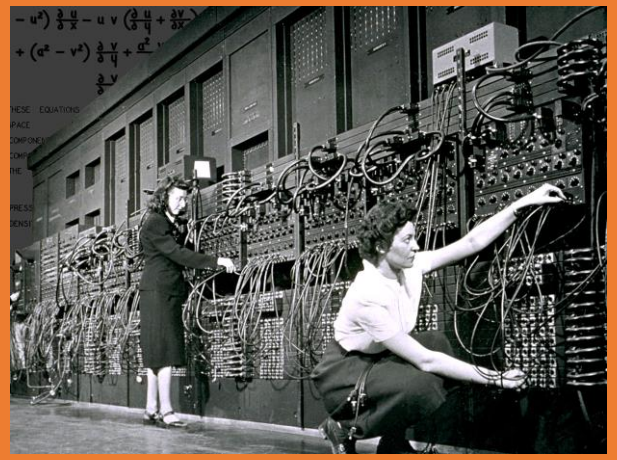
1936 Turing Machine

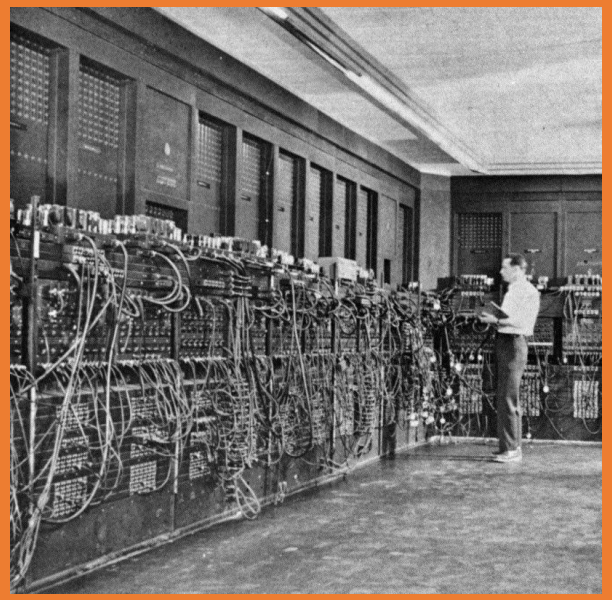


1946 ENIAC

1952-65
IBM 7000 & 360

1976 Cray-1
Super-Computer

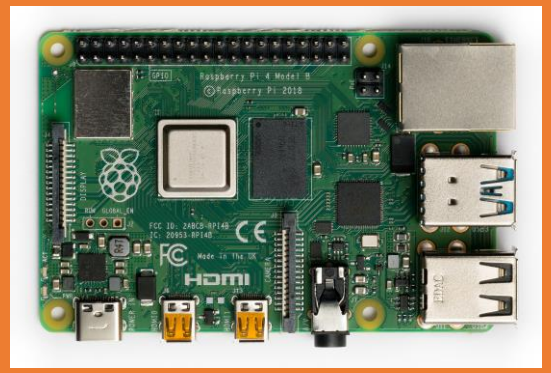
1946 ENIAC



1946 ENIAC

1965 DEC PDP-8

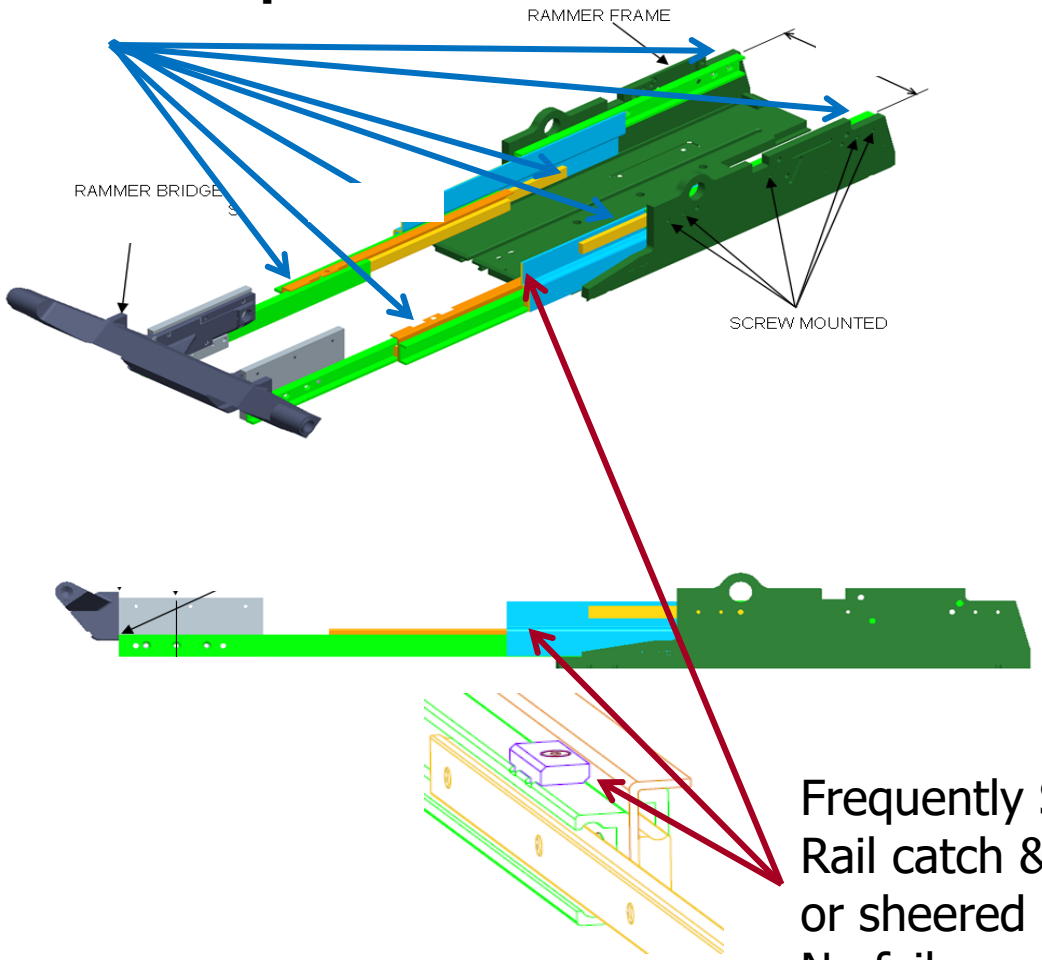
1975 Intel 8080



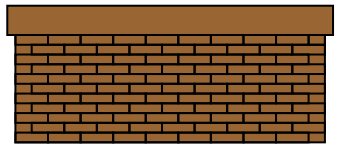
2015 SoC PoP - IoT

Problem: 7th of 8 “catch & drag” Stops on telescoping rails

7 of the 8 Stops - No Problem



Reoccurring Problem Since 2003



Adding Epoxy to screwed on Stop did not solve problem.

Frequently Seen Failure:
Rail catch & drag “stop“ in 7th position is forced or sheered off the rail.
No failures on opposite stop nor any other stops.

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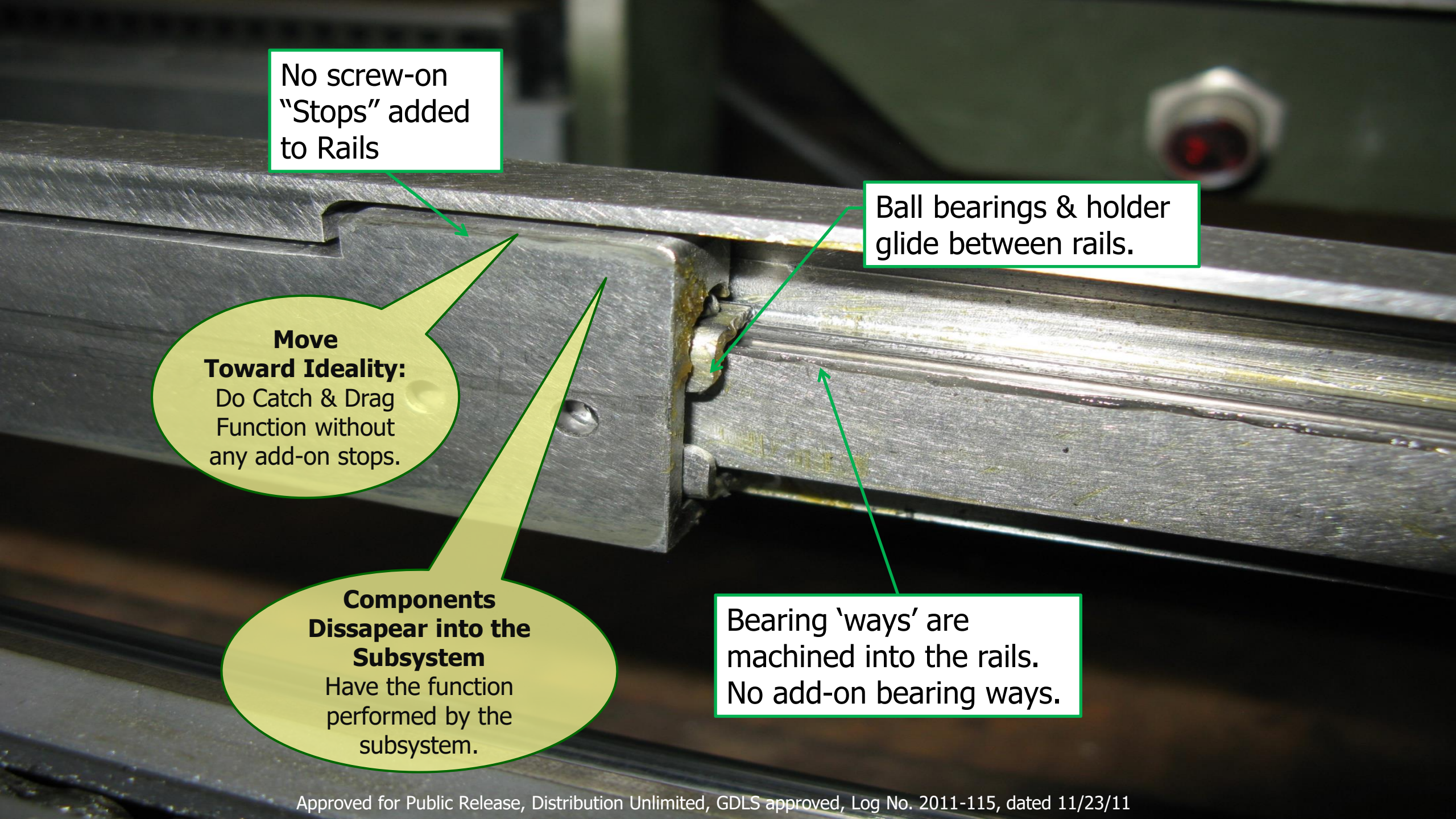

Mark Petrotta,

DFSS Master Black Belt

Quality & Six Sigma

General Dynamics Land Systems

"After 8 years struggling with occasional safety critical failures of an ammunition handling system, the US Army demanded we re-design. Your coaching the engineers through a one-hour innovation session produced two optional solutions. Both passed all verification tests and the more elegant solution yielded 4-to-1 part count reduction, 4-to-1 savings in assembly labor and Reliability savings of $658,242.00 per year"

How Can These Trends Help You Predict, Forecast or Motivate Your Current or Next Better Product?

If 3,000,000 patents studied show these are the ways products and systems improve, do you think you are going to come-up with a better or different way to improve your's?

Might you use these as a guide or solution set to move your current project forward? Or, use each trend as a stage to see (predict or forecast) the next product or system your customer will adopt and embrace?

As the Mandelorian would say, "This is the way!"

Open Window Tool (Structured Thinking)

What are the 14 Stages of Innovative Product Development?

What is the ‘Open Windows” Tool?

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Open Windows

	Past	Present	Future
Super System			
System		Problem / Opportunity	
Sub System(s)			

Open Windows Turns the 14 Stages into Steping Stones

Keys to Altshuller's TRIZ

- 200,000 patents revealed:
- 14 Stages of Innovative Evolution
- 40 Principles (How to make the change)
- Open Windows (let you see better)

My BIG Discovery
This is it!

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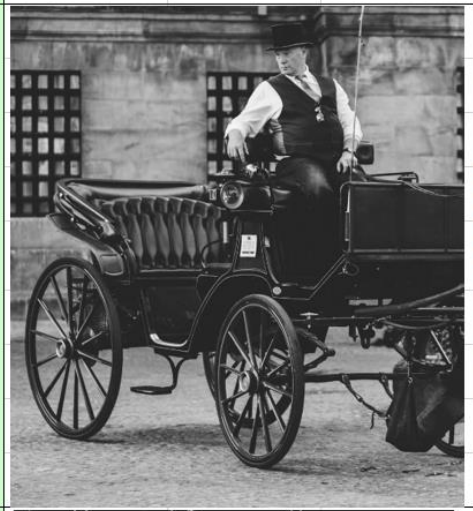
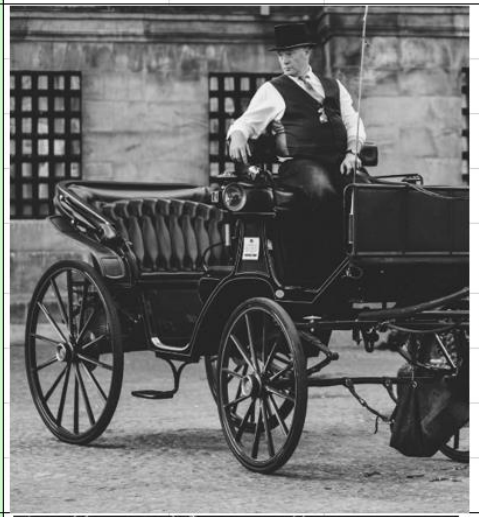
Open Windows

	Past	Present	Future
Super System			
System		Problem / Opportunity Transmission lines grow shorter… Systems become more automated…	
Sub System(s)			

Open Windows

	Past	Present	Future
Super System			
System			Transmission lines grow shorter… Systems become more automated…
Sub System(s)			

Open Windows

	Past	Present	Future
Super System			
System			
Sub System(s)			 

Summary: Answer All 3 Questions…

What are the 14 Stages of Innovative Product Development, or System Evolution Patterns?

What is the ‘Open Windows” Tool?

Why do I need both, in order to predict the next big thing?

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Proj #	PS #	Team/Project (Coached by Howard Cooper) 2010-2016	Net Savings
1	777	Implement Structured Innovation into GDLS IPS Process	$1,810,452
2	1078	Abrams Motion Control Unit Critical FM Mitigation	$7,186,001
3	1055	Abrams Power Distrib. Unit eHPDU Critical FM Mitigation	$1,199,702
4	1052	Abrams Hull Control Unit Critical FM Mitigations	$174,043
5	1051	Abrams Turret Control Unit Critical FM Mitigation	$295,741
6	1058	Abrams Analog Input Module Critical FM Mitigation	$107,844
7	1056	Abrams Driver's Control Panel Critical FM Mitigation	$1,341,229
8	1053	Abrams Gunner Control Panel Critical FM Mitigation	$1,894,781
9	1057	Abrams Common Remote Switching Mechanism Critical FM Mitig	$879,602
10	1074	Abrams CDU Display Critical FM Mitigation	$3,242,866
11	659	Stryker SMOD Doors Hatches & Grills Critical FM Mitigation	$216,950
12	660	Stryker SMOD Processors Controls & Displays Critical FM Mitigati	$1,744,935
13	661	Stryker SMOD Environmental Controls Critical FM Mitigation	$66,230,803
14	662	Stryker SMOD Propulsion Cooling Critical FM Mitigation	$13,575,346
15	663	Stryker SMOD Engine FEAD Critical FM Mitigation	$47,148
16	664	Stryker SMOD Exhaust System Critical FM Mitigation	$36,925
17	665	Stryker SMOD Fuel System Critical FM Mitigation	$217,576
18	658	Stryker SMOD Power Generation Critical FM Mitigation	$46,997,418
19	666	Stryker SMOD Seating Systems Critical FM Mitigation	$376,181
20	657	Stryker SMOD Power Distribution Critical FM Mitigation	$26,065,073
21	667	Stryker SMOD Suspension System Critical FM Mitigation	$174,072
22	668	Stryker SMOD Brakes Systems Critical FM Mitigation	$2,146
23	669	Stryker SMOD Steering System Critical FM Mitigation	$60,172
24	670	Axiomatic Design of Reliability-DFR IPS Process	$89,180
25	1050	DFMEA Preparation, FBI-Diag, P-Diag, FH-Decomp Table	$4,205,817
26	1251	Design Engineer's DX Databook Cleanup Process Improvement	$54,713,216
Total		**Six Sigma Net Savings: H Cooper Coached Innovations**	**$232,885,219**

Per Project	**Savings:**
Largest:	$66,230,803
Smallest:	$2,146
Average:	**$8,957,124**

“You can wait a hundred years for enlightenment or you can solve the problem in 15 minutes, using these principles.”

Genrich Altshuller

End

- Take last questions:
- Get 'Open Windows' Excel Tool: www.i3day.com/INCOSE-MW
  - Along with the 14 Stages of Systems Evolution
  - This Powerpoint presentation & my notes
- Get 'L-FMEA License & Tools: www.i3day.com/INCOSE-FMEA
  - Complete FMEA activity in 1/3rd the time
  - Without missing any critical failure modes

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What is the biggest challenge or problem you face, when trying to predict or forecast the next "big thing"?

Difficult to predict what Government customers will want and what they will find budget for.

Trying to meet stakeholder requirements without hindering innovation.

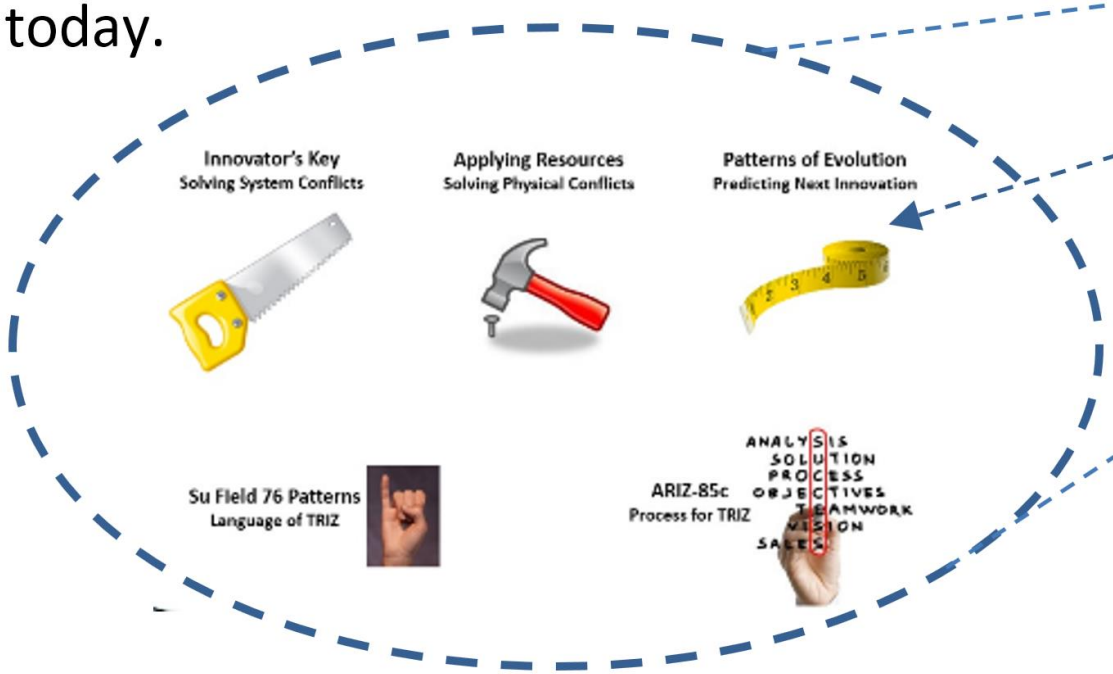
How do you avoid the catch-22 situation where small companies with innovative new products get passed over by larger suppliers?

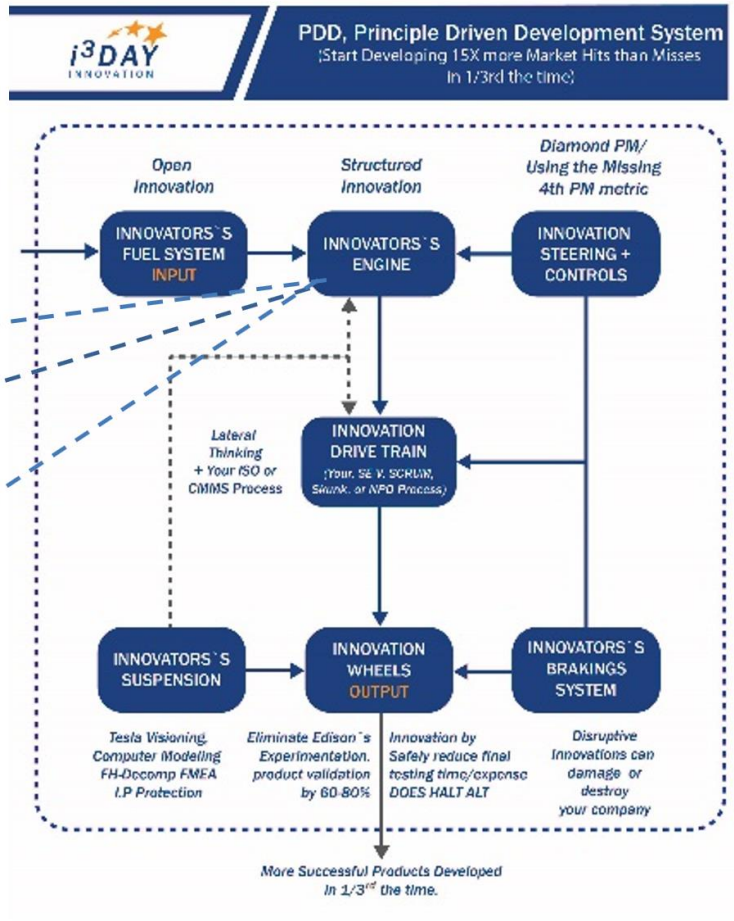
Limitations with existing technologies, cost of developing new technologies, reluctance to take risk, uncertain market demand.

We often can’t think beyond our current capabilities, so we get trapped by past successes and ignore crucial disruption from other less familiar technologies.

Abstract

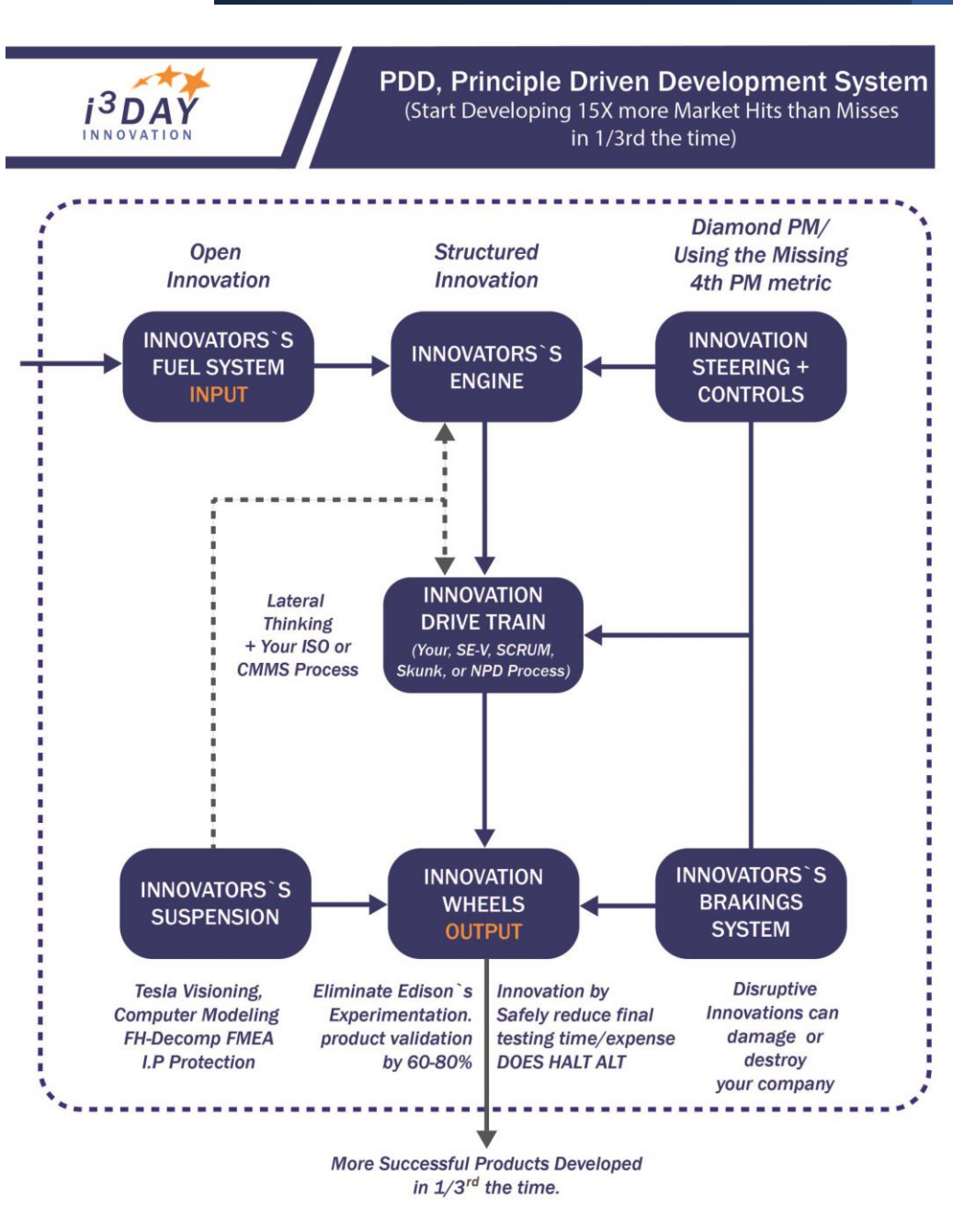
This presentation introduces a model-based, structured approach to isolate and identify the way(s) your legacy or current product/system will need to improve, in order to lead the market and provide the value your customer will be looking for in the future. So, you can begin making tomorrow today.





With the PDD-System You Can;

- 1. Use 'Open-Windows' to Predict, forecast and develop the next 'big thing,' customers will adopt and do it before the competition does.
- 2. Solve long-standing system problems and engineering design constraints, using the PDS-Generator, to add value without going over budget nor causing costly delays.
- 3. Find needed subsystems or components you need. Save the time and expense 're-inventing the wheel' and do it without losing your big idea or I.P. to vendors or suppliers, along the way.
- 4. Change your culture and definition of "development" from "figure out how to build this thing" to "show how to dramatically improve the value of this thing as we build it." Adding value always improves sales and profit margins.
- 5. Teach these new PDD-Skills to your product development specialists and put the skills to work on your projects, with our coaching to assure the desired effects and improve your project success ratio (from 80/20 to 7/93).
- 6. Use FH-Docomp tables to help stakeholders reveal the most critical challenges to be overcome, then turn your most critical potential failures modes, safety hazards and functional gap risks into successes with IfX tools.



With the PDD-System You Can also;

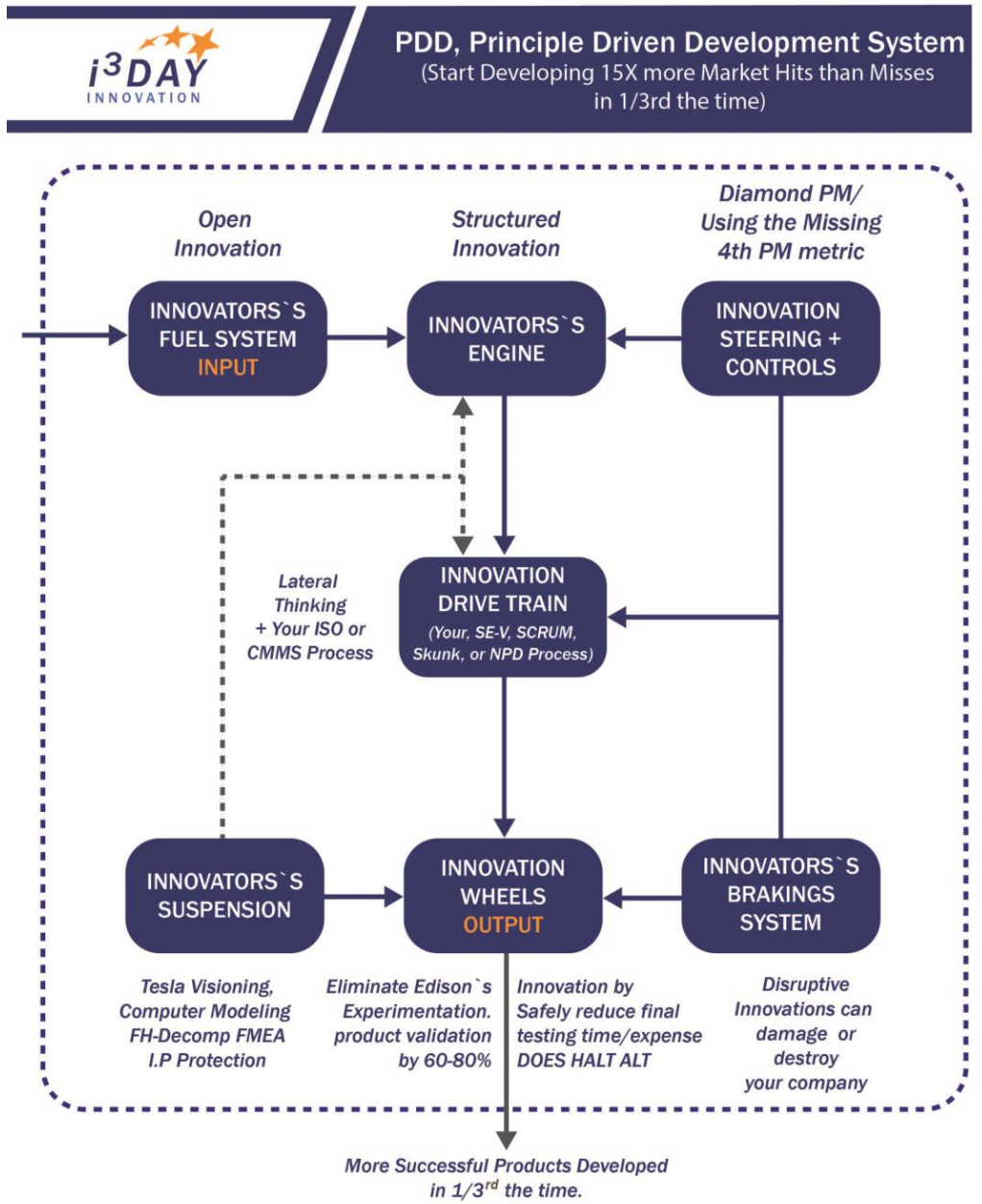
- 7. Manage projects to optimal market value by adding one simple project management metric.
- 8. Install an adequate 'braking system' for your team, development process, or innovation center so you can slow down or stop to manage disruptive innovations to your continued success, rather than let them disrupt, damage or destroy your business.
- 9. Keep momentum, 'vector logic' so that good ideas don't 'die in committee', stagnate in round table discussions, or get killed by company politics. (Every good vehicle needs a drivetrain.)
- 10. Quickly overcome safety, reliability, productivity, usability and other specialty engineering problems with IfX tools, to boost customer value and your profits.
- 11. Master the missing 4th metric, to ensure your daily development efforts result in lower costs, improved functionality and customer value, so your sales can soar and profits pill-up, empowering future projects.
- 12. Use Tesla modeling principles and DOES Tools to eliminate 70-80% of the labor, time and expense of system Verification and Product Validation Testing that normally occurs and often kills a project before full rate production.

Register at: www.i3dayInnnovation.com/PDD

Watch the 40 min. Webinar and

Discovery how we might customize PDD to propel real innovation

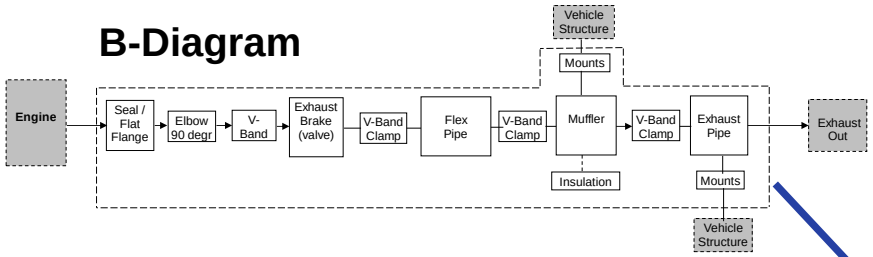
into your development process.



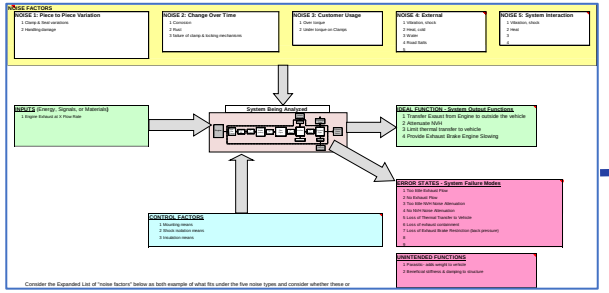
L-FMEA-Generator

The Worlds' First Lovable FMEA is generated for you.

B-Diagram



P-Diagram

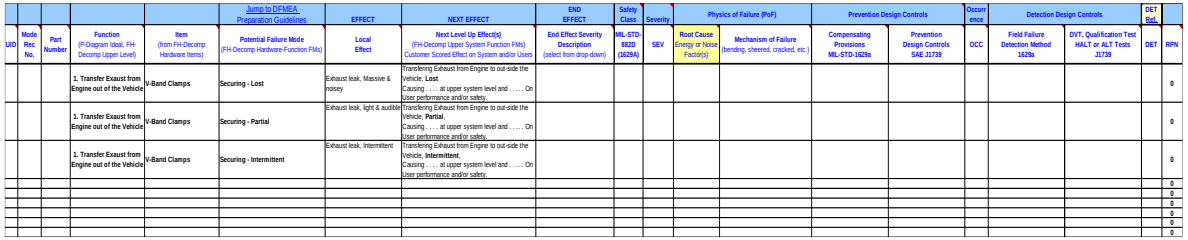


FH-Decomp Table

Function to Hardware Decomposition Table (with Maximum Criticality Scored)

"Design" Functions: (Ideal Functions from P-Diagram / Functions (lines crossing boundary of B-Diagram "Design".)		1. Transfer Exaust from Engine out of the Vehicle			2. Attenuate NVH	3. Limit Thermal transfer to vehicle	5. Exhaust Brake Engine Slowing
Hardware Functions:	Likelyhood of Failure: 1 - 5	Secure	Contain Exhaust	Provide Flow	Attenuate NVH	Contain Heat	Restrict Exhaust
Hardware: Severity:		3	5	4	3	2	3
V-Band Clamps	5	15					
Exaust Pipe	2		10	8			
Flat Flange	2	6					
Seals	2		10				
Muffler	4		20	16	12		
Insulation	1				3	2	
Isolation Mounts	3	9			9		
Exaust Brake	2		10	8			6
Flex Pipe	2		10	8			
Elbow	1		5	4			

L-FMEA Generator



UID	Mode Rec. No.	Part Number	Function (P-Diagram Ideal, FH-Decomp Upper Level)	Item (from FH-Decomp Hardware Items)	Jump to DFMEA Preparation Guidelines: Potential Failure Mode (FH-Decomp Hardware-Function FMs)	EFFECT: Local Effect	NEXT EFFECT: Next Level Up Effect(s) (FH-Decomp Upper System Function FMs) Customer Scored Effect on System and/or Users	END EFFECT: End Effect Severity Description (select from drop-down)	Safety Class: MIL-STD-882D (1629A)	SEV	Physics of Failure (PoF): Root Cause Energy or Noise Factor(s)	Mechanism of Failure (bending, sheered, cracked, etc.)	Prevention Design Controls: Compensating Provisions MIL-STD-1629a	Prevention Design Controls SAE J1739	Occurrence: OCC	Detection Design Controls: Field Failure Detection Method 1629a	DVT, Qualification Test HALT or ALT Tests J1739	DET Ref.	DET	RPN
			1. Transfer Exaust from Engine out of the Vehicle	V-Band Clamps	Securing - Lost	Exhaust leak, Massive & noisey	Transfering Exhaust from Engine to out-side the Vehicle, **Lost** Causing . . . . at upper system level and . . . . On User performance and/or safety.													0
			1. Transfer Exaust from Engine out of the Vehicle	V-Band Clamps	Securing - Partial	Exhaust leak, light & audible	Transfering Exhaust from Engine to out-side the Vehicle, **Partial,** Causing . . . . at upper system level and . . . . On User performance and/or safety.													0
			1. Transfer Exaust from Engine out of the Vehicle	V-Band Clamps	Securing - Intermittent	Exhaust leak, Intermittent	Transfering Exhaust from Engine to out-side the Vehicle, **Intermittent,** Causing . . . . at upper system level and . . . . On User performance and/or safety.													0
																				0
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																				0

L-FMEA

L-FMEA helps you quickly build the 3 Models (at left), needed for peer reviews, management and customer reviews. L-FMEA then generates and fills in the FMEA for final engineering review, scoring, or updates. Export to Excel as a customer contract deliverable or legal due diligence document.

FMEA, DFMEA, FMECA or PFMEA

L-FMEA is a data driven MBSE tool that can save $1,000 - $5,000 in preparing and updating each FMEA. 'Do FMEA in 1/3rd the time while not missing any critical failure modes. It also suggests proven innovation principles to eliminate or mitigate your most critical and risk prone failure modes and critical safety hazards. Double or triple your system reliability, reducing warrantee expenses and avoid safety hazard lawsuits. Exports various FMEA / FMECA formats for final review, product enhancement and deliverables reporting.

FMEA Case study – Motion Control Unit

An electrical engineering team had just finished their FMEA, Failure Mode Effects Analysis on a new MCU, smart Motion Control Unit. The FMEA revealed the most critical potential failure modes within their design. But, the engineer's claimed, 3 times, these critical failure modes could not be removed nor mitigated! So, I guided them through an 'innovation session' using these Principles. The team discovered how to mitigate the failure modes without even changing the design. The savings were $7,186,001 in annual support savings, over the legacy system.

The L-FMEA Generator

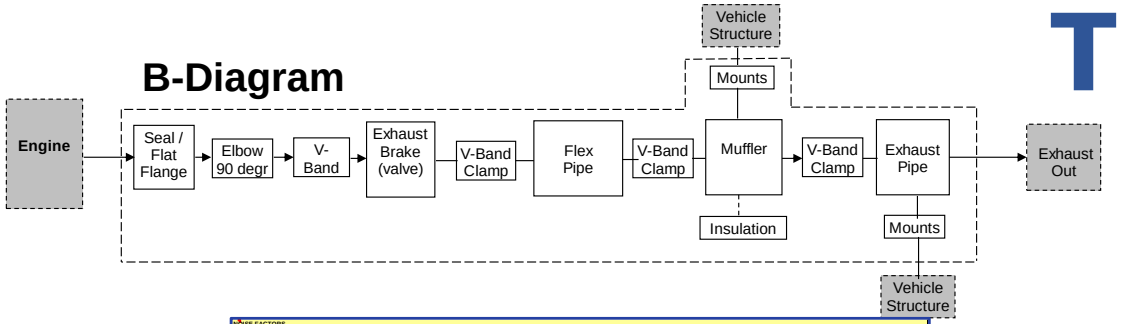
The Worlds' First Lovable FMEA

It's generated for you.

Also, helps you quickly build the 3 Models (at left), needed for peer reviews, management and customer reviews.

Then, L-FMEA generates and populates your DFMEA or PFMEA, DVP&R, etc. for your final review. 'So you don't miss any critical failure modes.

B-Diagram



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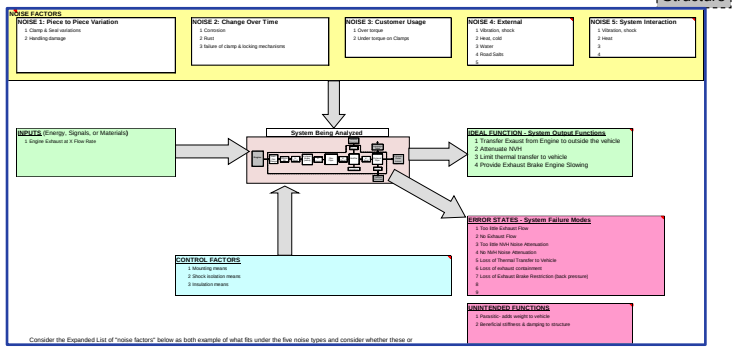

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L-FMEA-Generator

The Worlds' First Lovable FMEA

Because the FMEA is generated for you.

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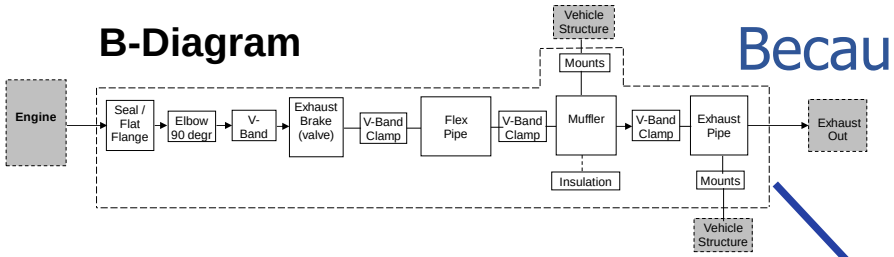

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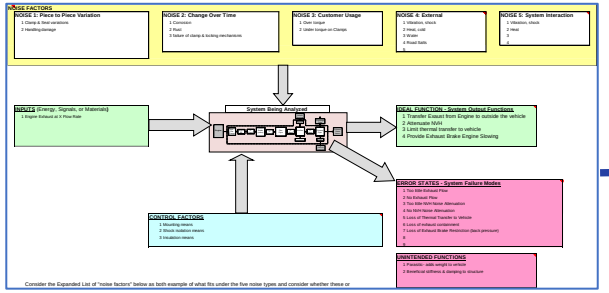

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V-Band Clamps	5	15					
Exaust Pipe	2		10	8			
Flat Flange	2	6					
Seals	2		10				
Muffler	4		20	16	12		
Insulation	1				3	2	
Isolation Mounts	3	9			9		
Exaust Brake	2		10	8			6
Flex Pipe	2		10	8			
Elbow	1		5	4			

L-FMEA Generator

UID	Mode Rec. No.	Part Number	Function (P-Diagram Ideal, FH-Decomp Upper Level)	Item (from FH-Decomp Hardware Items)	Jump to DFMEA Preparation Guidelines: Potential Failure Mode (FH-Decomp Hardware-Function FMs)	EFFECT: Local Effect	NEXT EFFECT: Next Level Up Effect(s) (FH-Decomp Upper System Function FMs) Customer Scored Effect on System and/or Users	END EFFECT: End Effect Severity Description (select from drop-down)	Safety Class: MIL-STD-882D (1629A)	SEV	Physics of Failure (PoF): Root Cause Energy or Noise Factor(s)	Mechanism of Failure (bending, sheered, cracked, etc.)	Prevention Design Controls: Compensating Provisions MIL-STD-1629a	Prevention Design Controls SAE J1739	Occurrence: OCC	Detection Design Controls: Field Failure Detection Method 1629a	DVT, Qualification Test HALT or ALT Tests J1739	DET Ref.	DET	RPN
			1. Transfer Exaust from Engine out of the Vehicle	V-Band Clamps	Securing - Lost	Exhaust leak, Massive & noisey	Transfering Exhaust from Engine to out-side the Vehicle, **Lost** Causing . . . . at upper system level and . . . . On User performance and/or safety.													0
			1. Transfer Exaust from Engine out of the Vehicle	V-Band Clamps	Securing - Partial	Exhaust leak, light & audible	Transfering Exhaust from Engine to out-side the Vehicle, **Partial,** Causing . . . . at upper system level and . . . . On User performance and/or safety.													0
			1. Transfer Exaust from Engine out of the Vehicle	V-Band Clamps	Securing - Intermittent	Exhaust leak, Intermittent	Transfering Exhaust from Engine to out-side the Vehicle, **Intermittent,** Causing . . . . at upper system level and . . . . On User performance and/or safety.													0
																				0
																				0
																				0
																				0
																				0

L-FMEA

L-FMEA helps you quickly build the 3 Models (at left), needed for peer reviews, management and customer reviews. L-FMEA then generates and fills in the FMEA for final engineering review, scoring, or updates. Export to Excel as a customer contract deliverable or legal due diligence document.

FMEA, DFMEA, FMECA or PFMEA

L-FMEA is a data driven MBSE tool that can save $1,000 - $5,000 in preparing and updating each FMEA. 'Do FMEA in 1/3rd the time while not missing any critical failure modes. It also suggests proven innovation principles to eliminate or mitigate your most critical and risk prone failure modes and critical safety hazards. Double or triple your system reliability, reducing warrantee expenses and avoid safety hazard lawsuits. Exports various FMEA / FMECA formats for final review, product enhancement and deliverables reporting.