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Customer Success Is Our Mission

Building an Integrated Aerospace Electronics Development Parametric Model from the Ground Up

Team Lead: David Bloom, Danny Polidi and Chrissy Kehl

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Building an Integrated Aerospace Electronics Development Parametric Model from the Ground Up

By David Bloom, Danny Polidi and Chrissy Kehl

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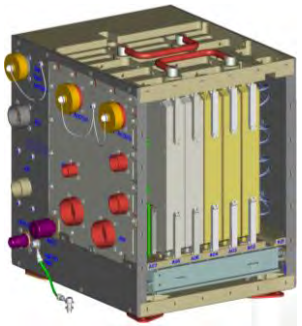
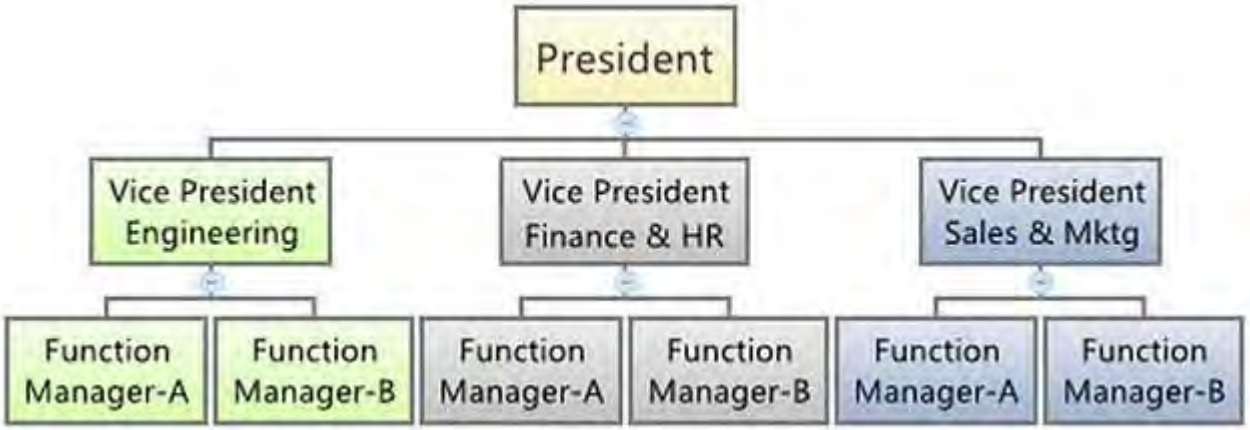
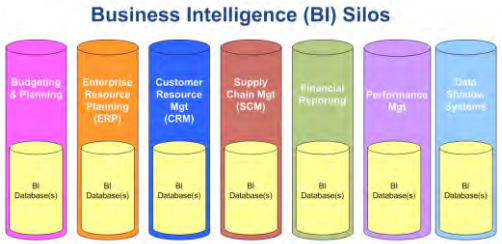
This paper presents the results of a multiple year effort to create a business specific set of integrated parametric cost models for complex electronics hardware development in such a way that all disciplines and activities that participate in that development process have a piece of the model and a stake in the data collection that drives the model. This "grounds up" approach provides that added benefit of cost allocation guidance once the development is approved.

Introduction

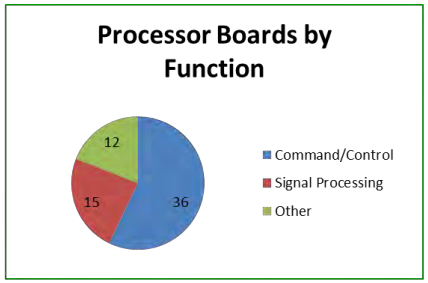
- All attempts to develop integrated Cost Models have failed
  - Until recently!
  - Functional Org composition antagonistic to integrated cost models
  - Organizational product integration extremely helpful
  - **Know What You Do!**

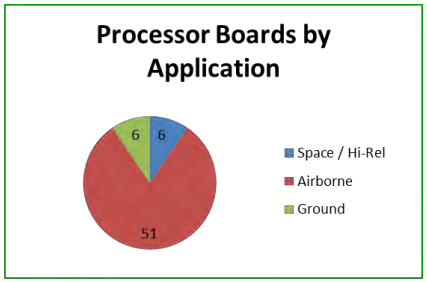


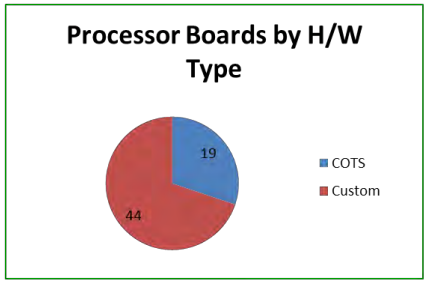


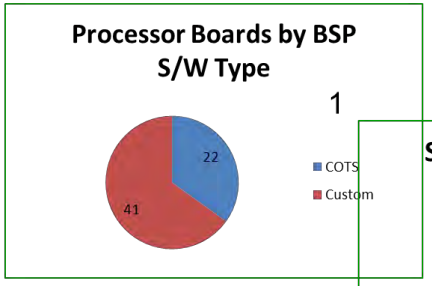


Know What You Do! Product Example



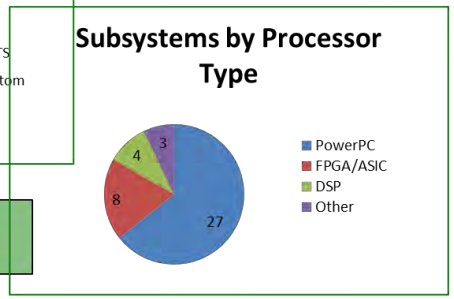






Census identified 63 unique processing boards implemented in SAS systems from 2000 to present

1



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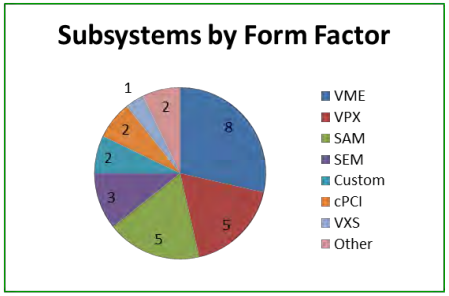

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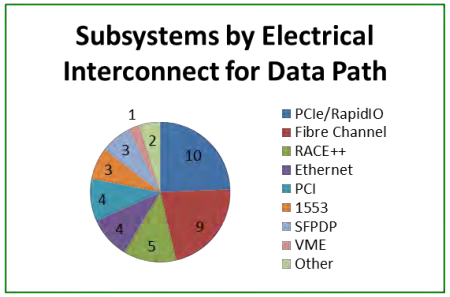

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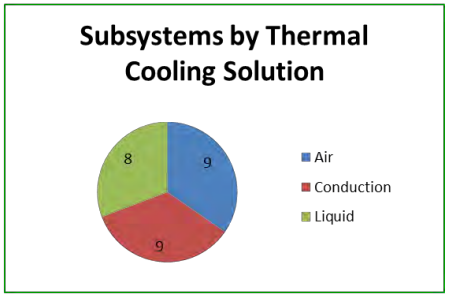
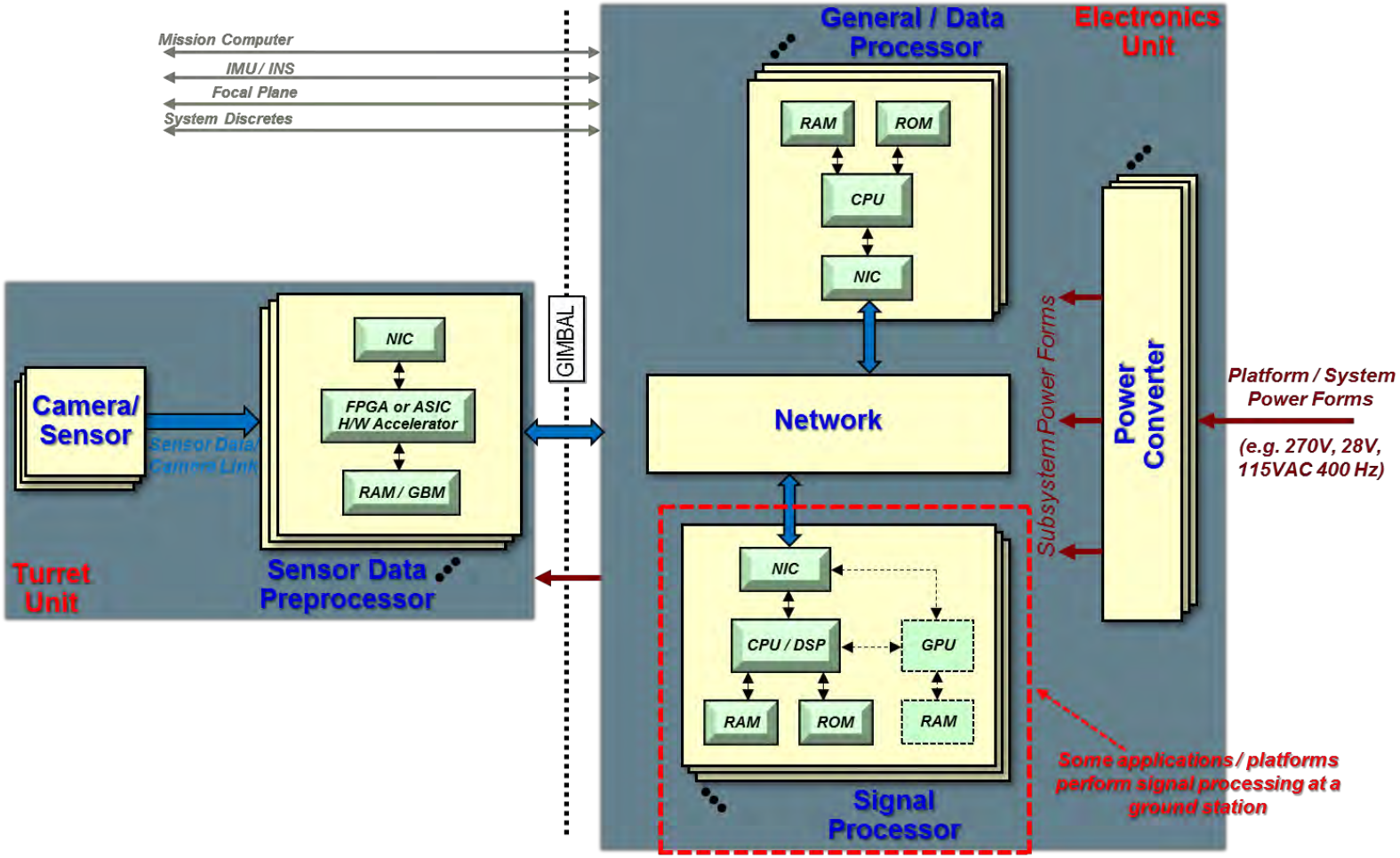


This kind of understanding requires deep dives into the product portfolio

Four key processing architectural elements identified

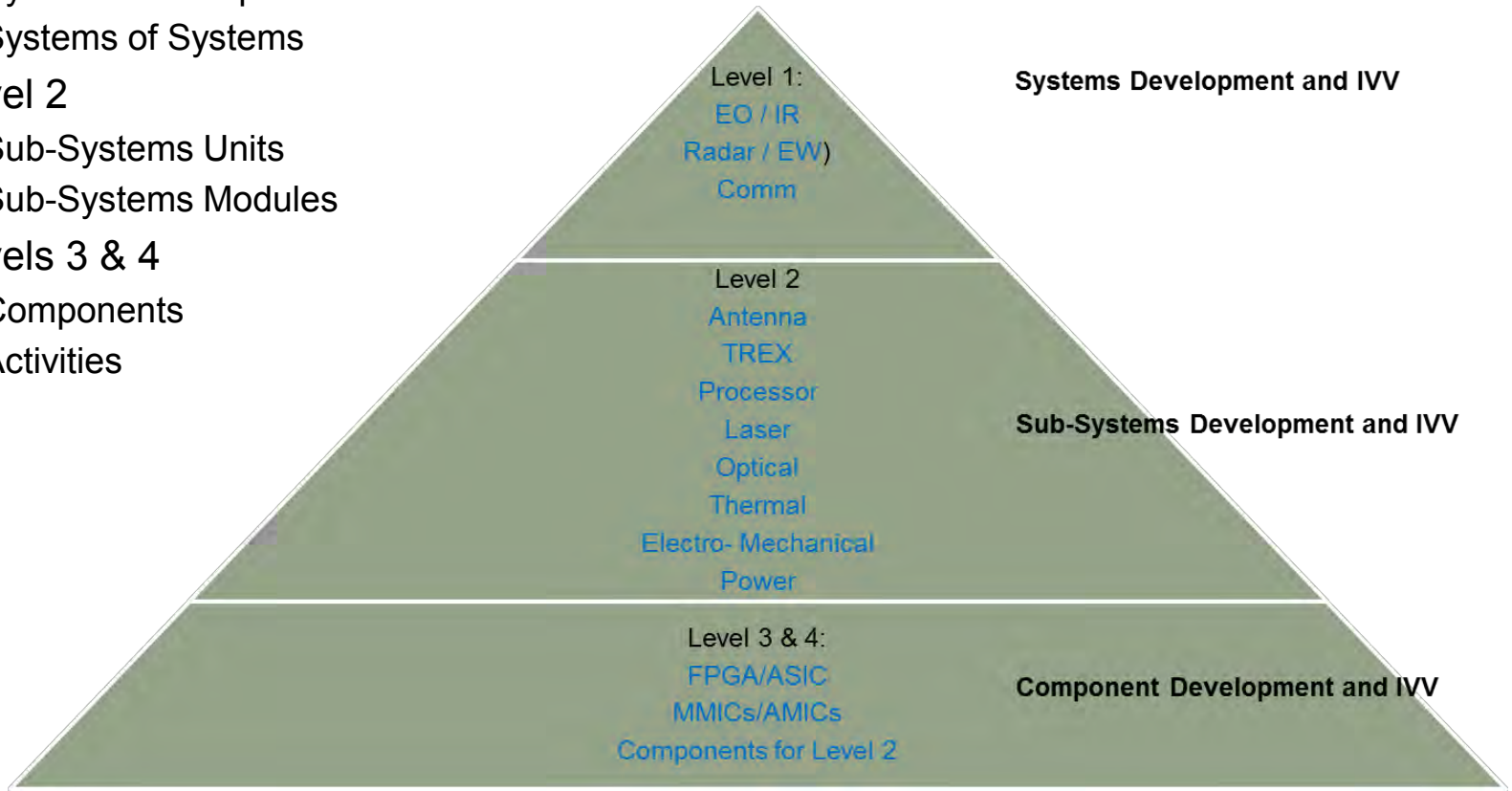
Know What You Do! Product Example 2

EO/IR Signal & Data ProcessingReference Architecture

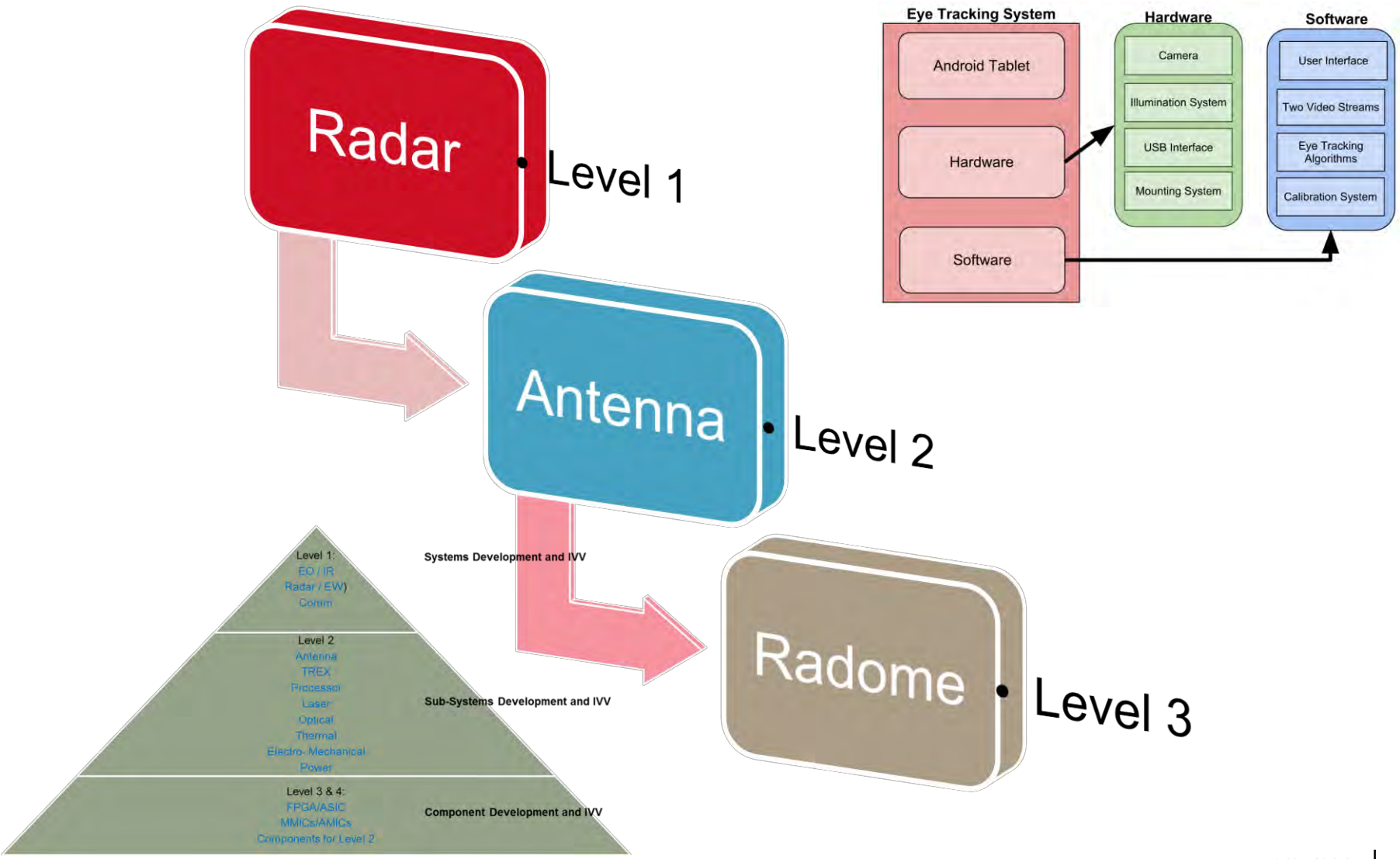


Product Pyramid (not Comprehensive)

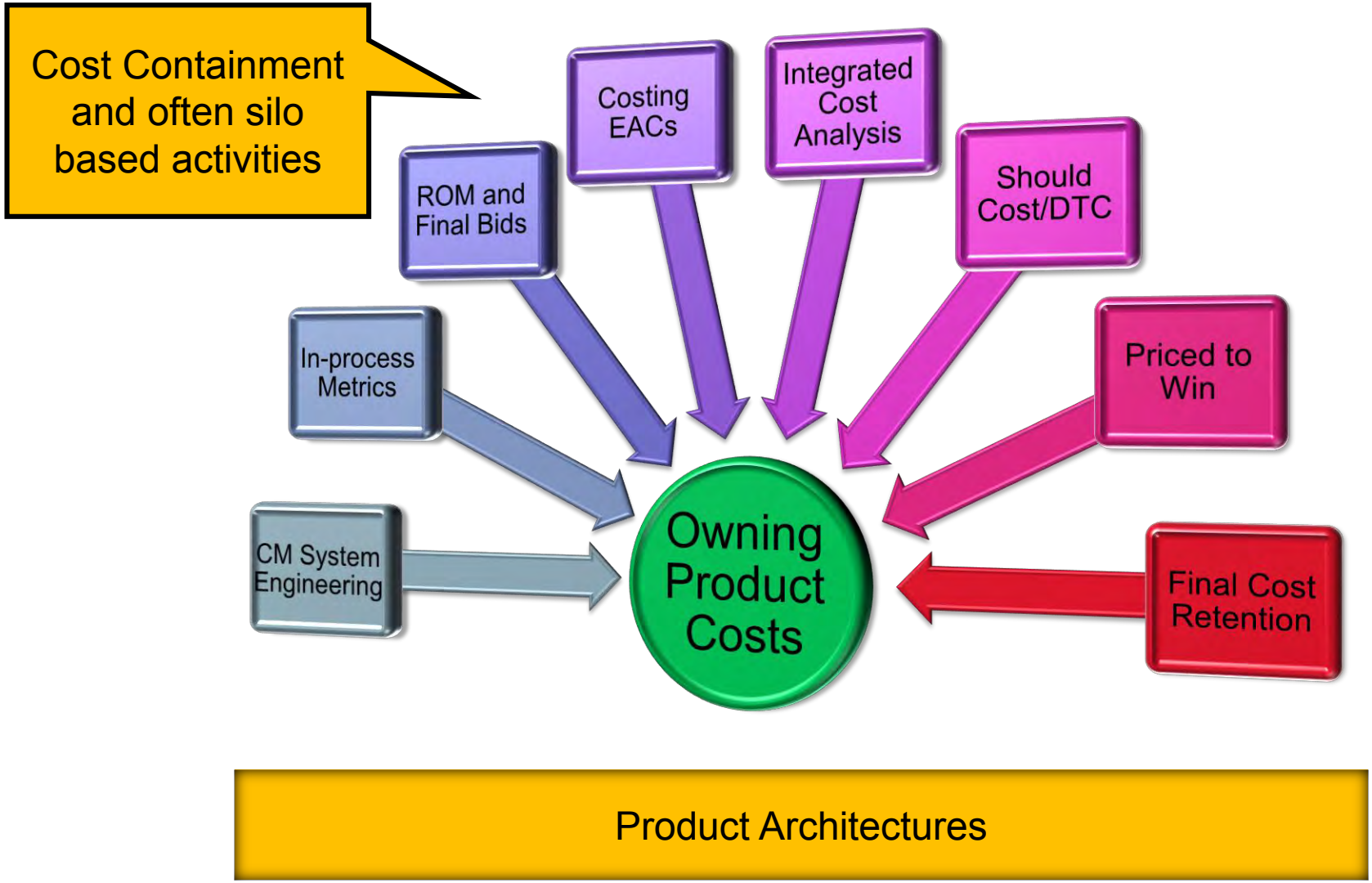
- Product Owner Decompositions
  - Level 1
    - Systems Development & IVV
    - Systems of Systems
  - Level 2
    - Sub-Systems Units
    - Sub-Systems Modules
  - Levels 3 & 4
    - Components
    - Activities



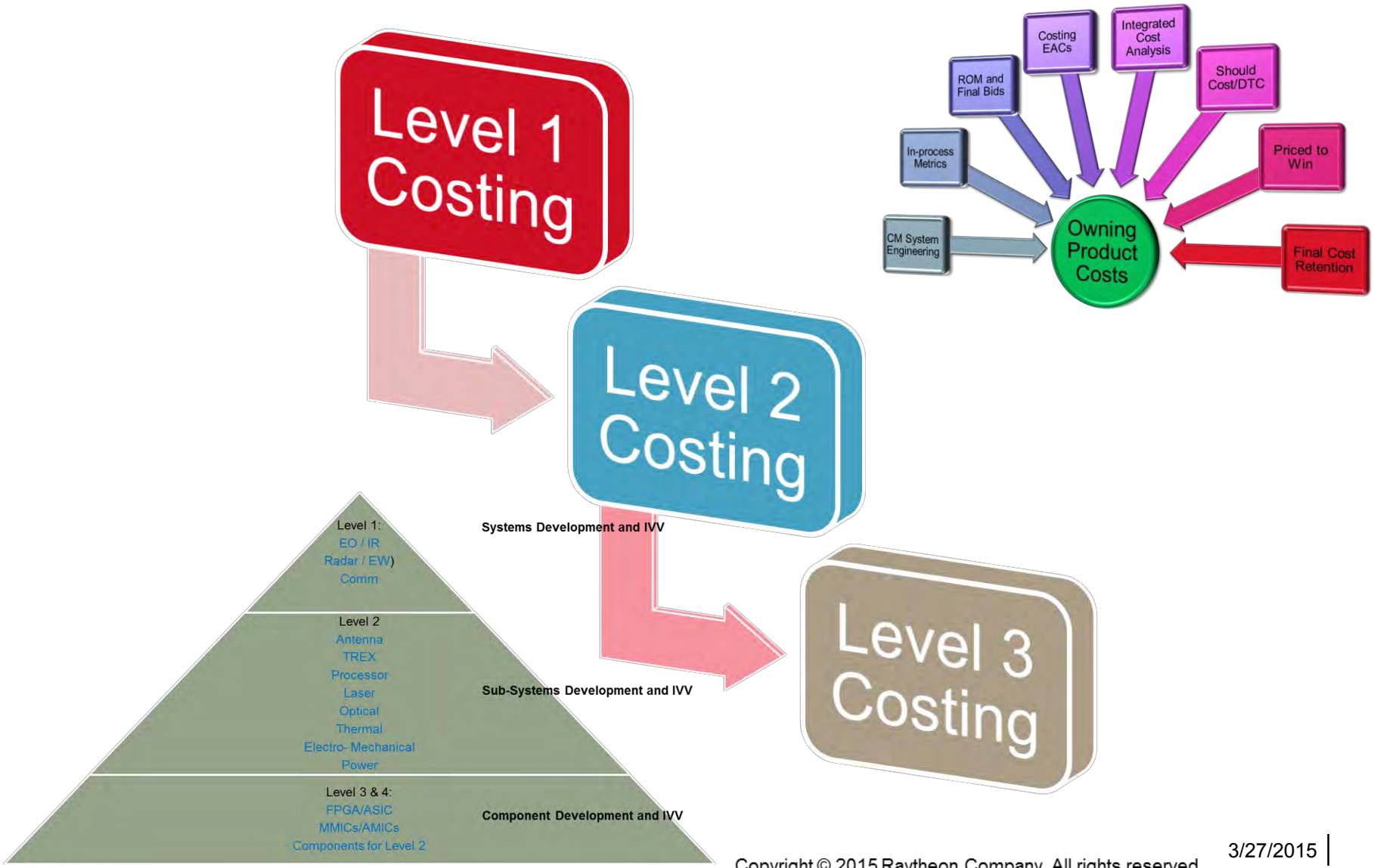
Example of Product Level Decomposition



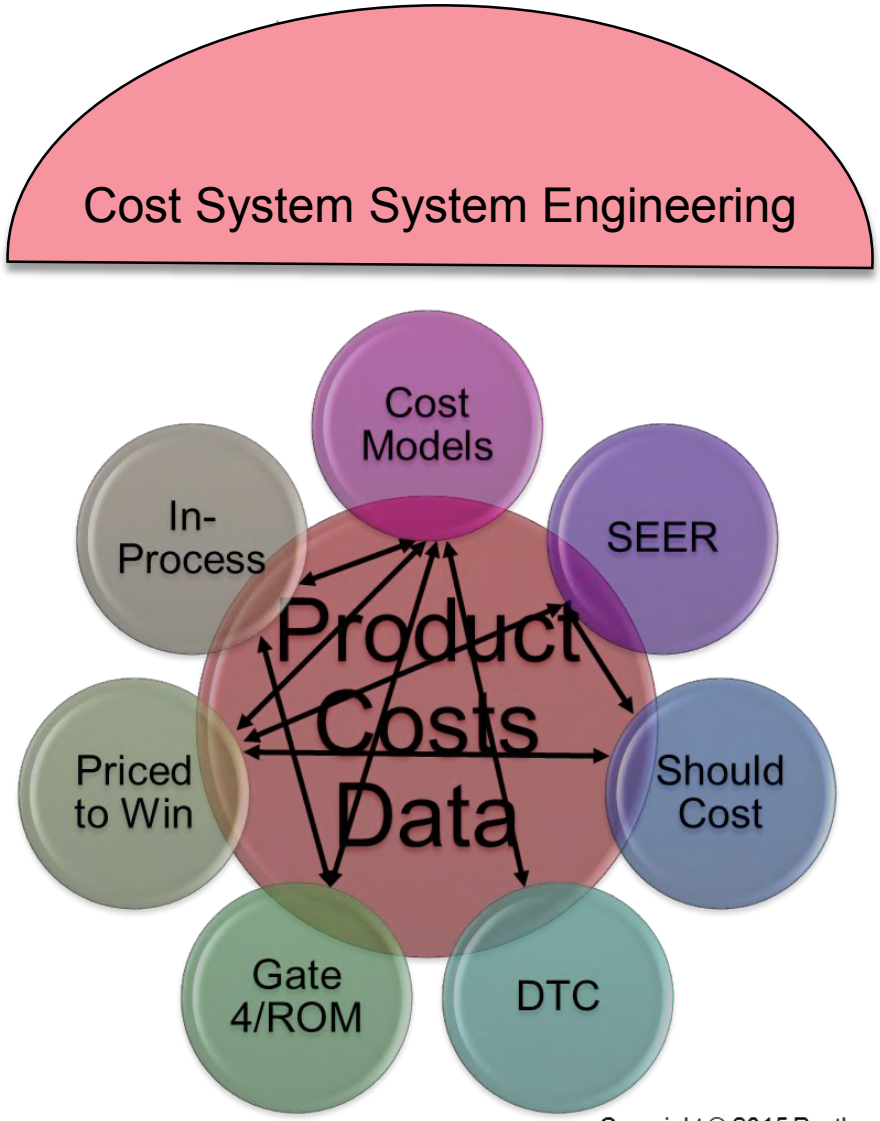
Responsibility Chart



Comments about Responsibility

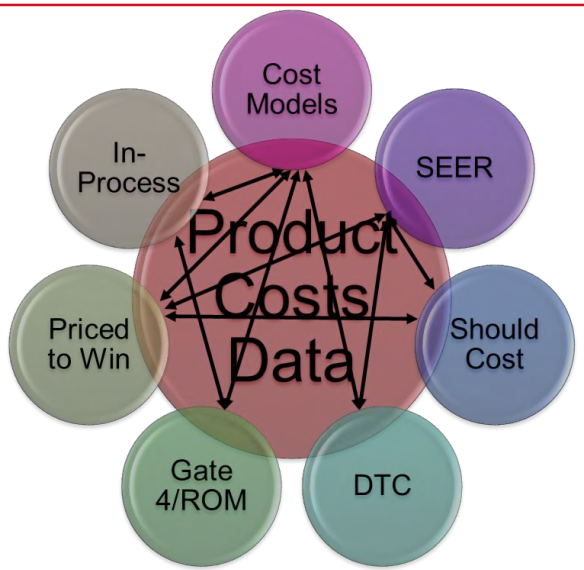


Normal Data Interaction Chart



Data Synergies

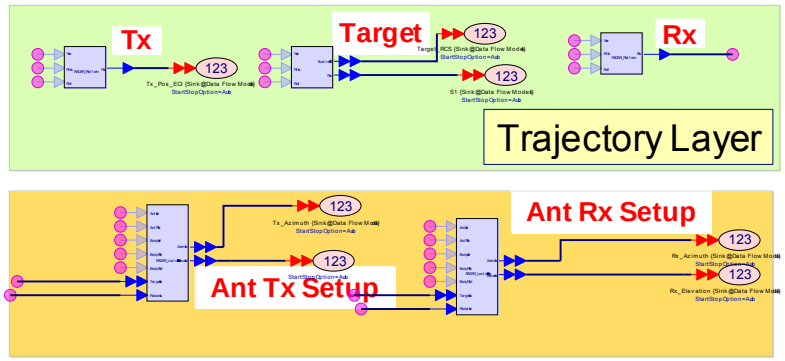
- Product Cost Data
  - Costs and Models POST System Engineering
    - Requirements Development,
    - Interconnects
    - System Modeling
  - Costing an Integrated Gate 4 Bid
    - Golden BOEs
    - Golden Gate Package
    - Gas Gauges
    - Parametric Model
    - Sim-To
  - Costing an Integrated Product ROM
    - Parametric Model
    - Sim-To
  - "Should Cost"/Designed to Cost
    - Internal Parametric
    - Commercial Parametric
  - Priced to Win
    - TBD (Commercial Tool)
  - Costing an Integrated EAC
    - ETC= EAC-ITD
    - Final Cost Collection Related
  - In-Process Productivity
    - Final Cost Collection Related
    - Integrated

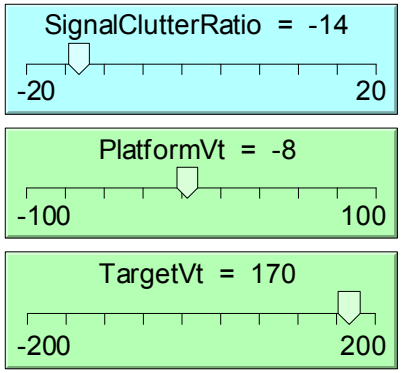


Use Case:
Antenna Product Owner needs to be able to quickly do design trades to be able to effectively bid recurring engineering, the most important cost of a bid.
Dependencies today are: **In-Process Productivity, Priced to Win, Should-cost, quick costing architectural trades, Gate 4 Bid**

Example 1 of Data to Collect: Generic Architecture

Simulation of Airborne, Space-Borne and Ship Based Radar Systems

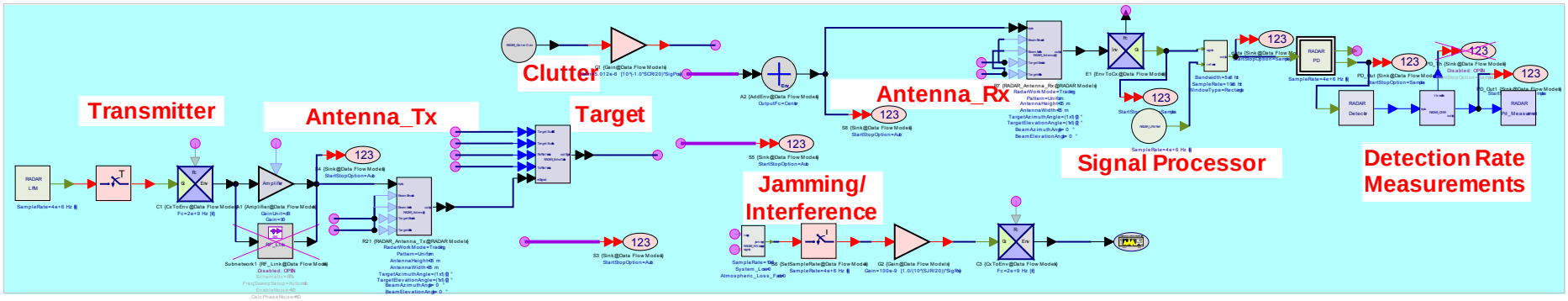




Range w/o SP= 16650 M
velocity w/o SP= 175.7813 M/sec

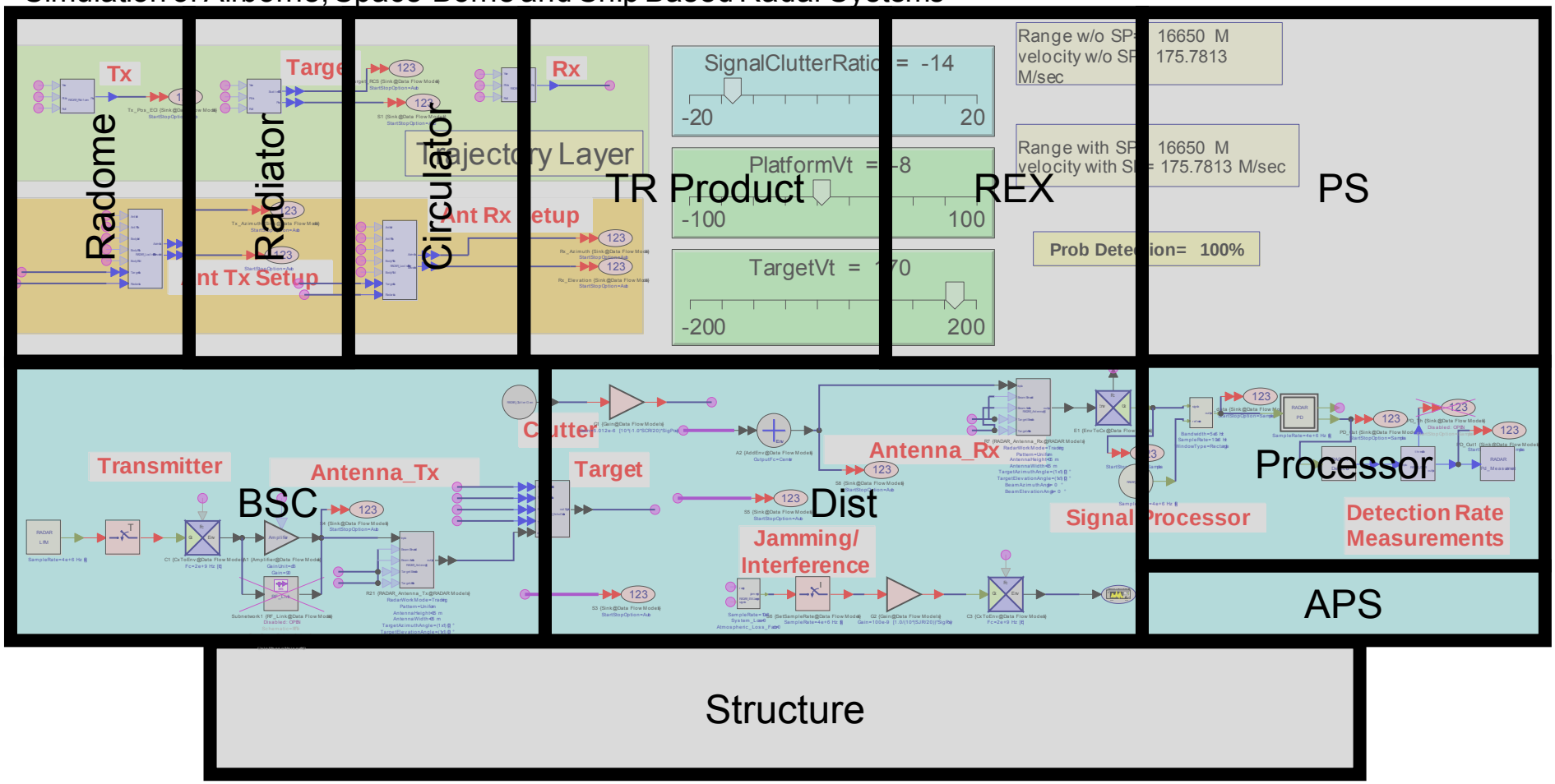
Range with SP= 16650 M
velocity with SP= 175.7813 M/sec

Prob Detection= 100%

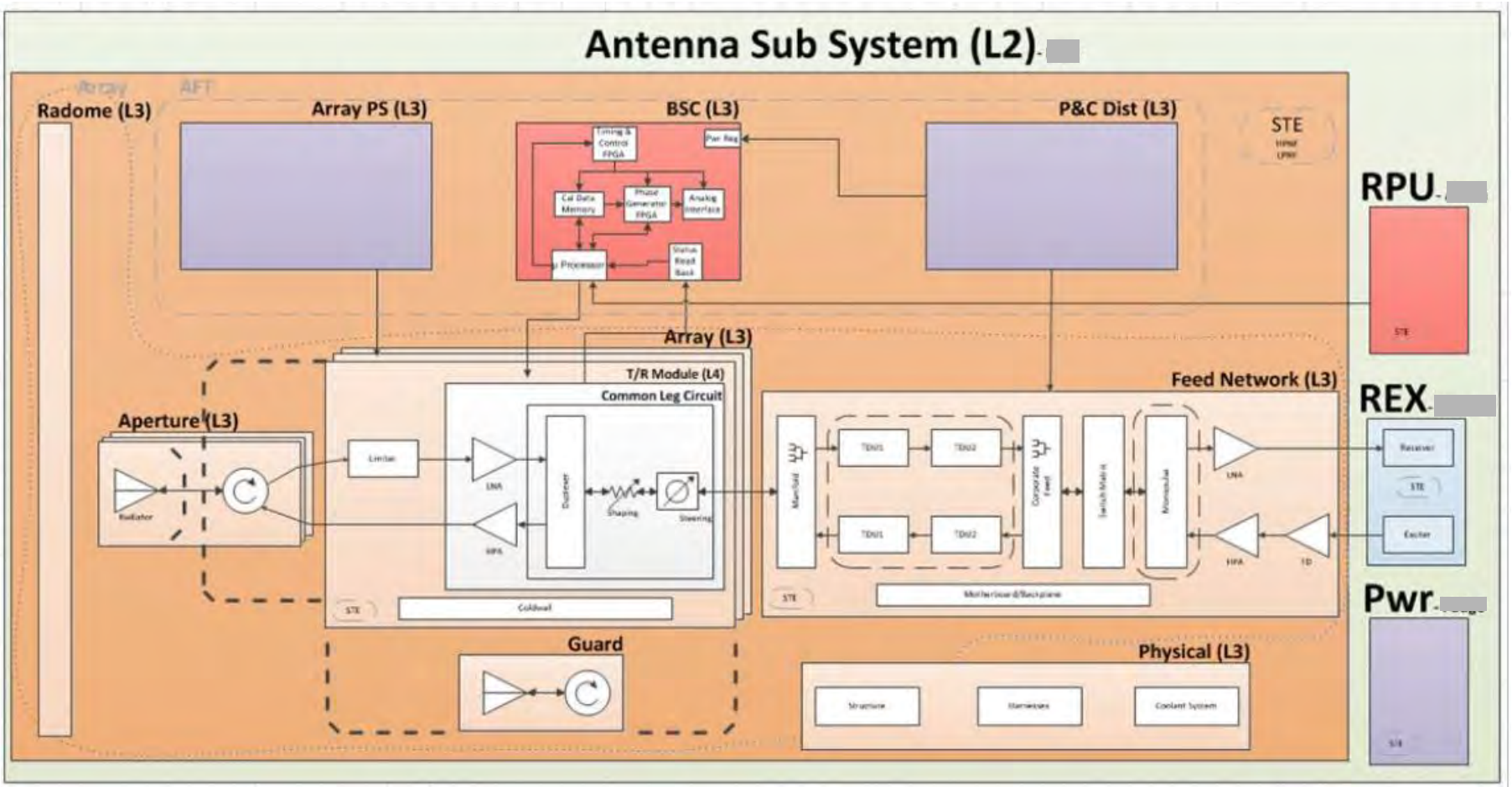


Example 1 of Data to Collect: Generic Hardware

Simulation of Airborne, Space-Borne and Ship Based Radar Systems



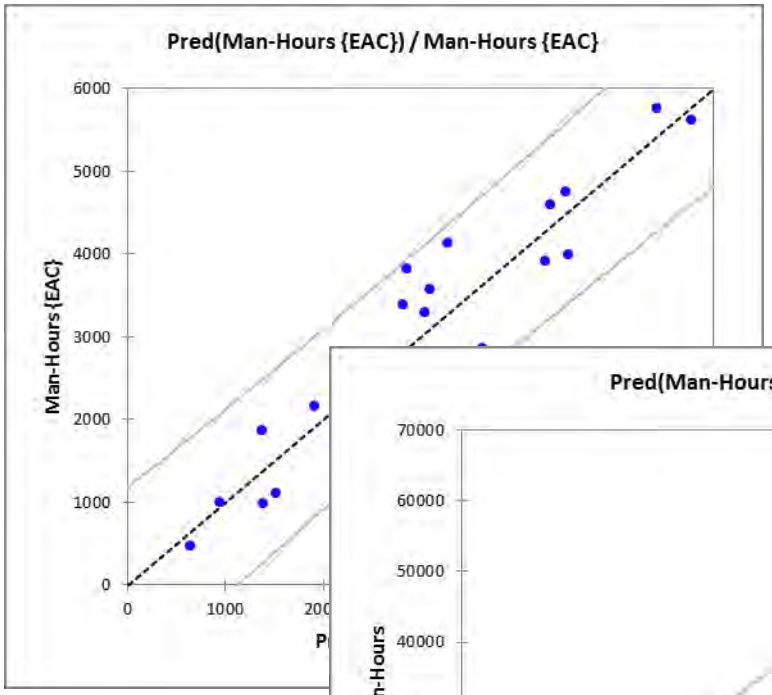
Example 1 of Data to Collect

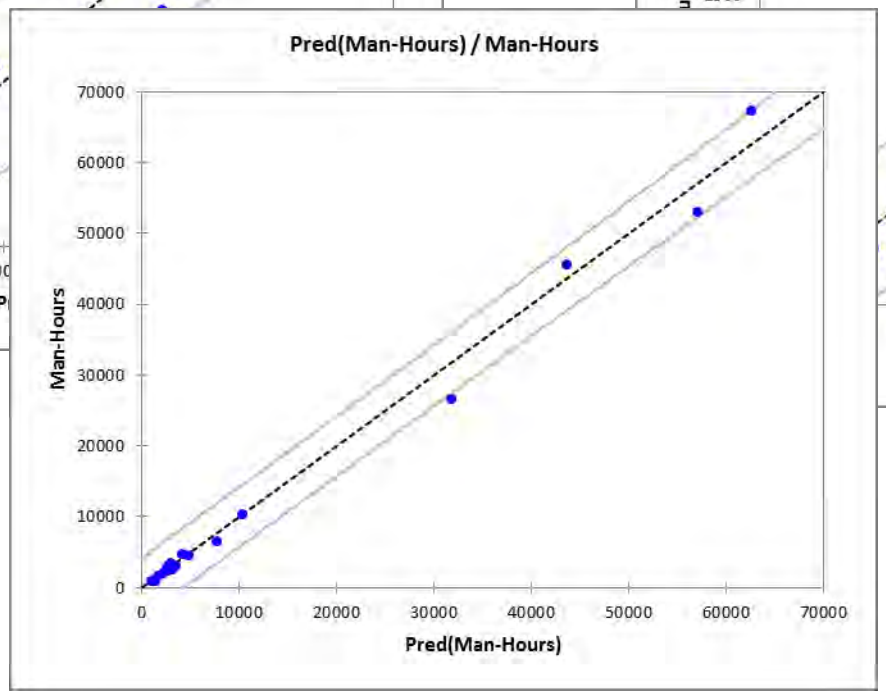


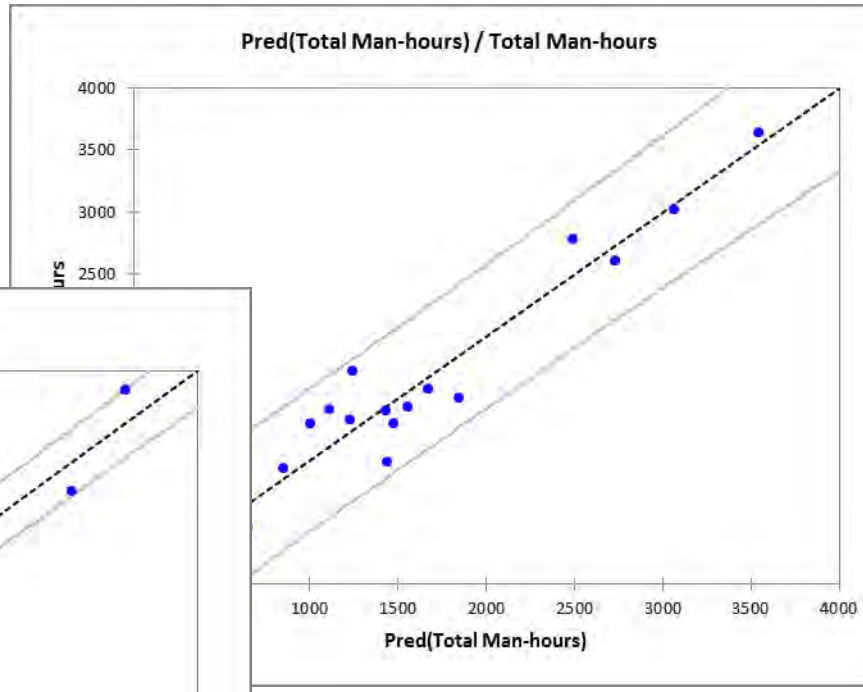
Identifying the Activities in the Products

RCCC code	Bid Detail	Part of Product Bid and BOE (Y/N)	Bidder(s)
	EEC Center		
Dx	EE Design	Yes	
GA?	EE Support	No	
FG	Component Engineering	No	
	MOEC Center		
MD	ME Design	Yes	
MA	ME Analysis (Thermal & structural)	No	
MF	ME STE	No	
MC	ME Cable	No	
MD	PWB CAD	No	
????	ME Support	No	
FF	Materials and Processes	No	
EE	Planning	No	
EF	Tooling	No	
EB	Manufacturing Eng	No	
GB	Radiation Effects	No	
	SDC Center		
BY	Requirements Flow Down	No	
GA	Supportability	No	
GC	Reliability/ Maintainability	No	
GD	Safety	No	
Gx?	**System Integrity (as needed)**	No	
	SVC Center		
DR	Test Eng	No	
FA	HW CM	No	
FA	SW CM	No	
IntLab?	**Integration Labs**	No	
DwgChk?	**Drawing Check**	No	
	SWEC		
CY	SWEC Design - Board Support Package	No	
	Mission Assurance		
FC	HW Quality	No	
FC	SW Quality	No	
	Operations		
EC	Assy Time	No	
ED	Production Control		
EG	Touch Labor (+POD and EDM builds)	No	
EY	OPS Mgmt	No	
EnvTest?	**Environmental Tests**	No	
	Supply Chain Management		
FD	SCM Buyer (POD and EDM parts purchase)	No	
FD	SCM MPM	No	

Analyzing the Data, Building the Equations





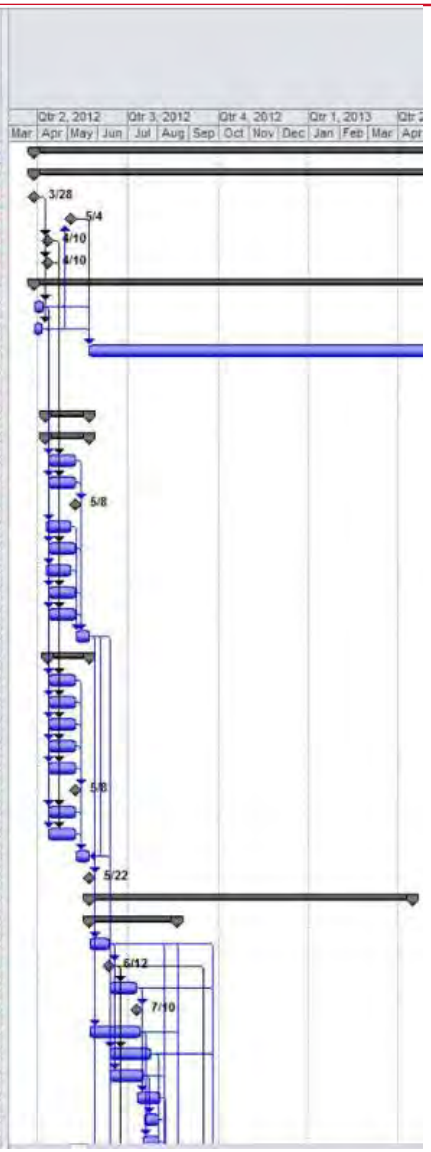


Building from the Bottom

	Driver	Value
EE DM Design	Number of Terminations	5000
	% Reuse	40-60%
	Environment	Tech Demo/Commercial
	Digital to Analog Ratio	Infinite (all digital)
	Technology	Low, Normal, High
	Replication (Design Uniquness)	100%
	Obsolescence	Yes
	Level of knowledge of design	Low
	Level of conformance required	Low
	DM EE Design Hours	
DM Electronics Packaging	Square Feet of Drawing (Reused Square Footage Not Included)	250
	Environment	Space/Vacuum
	Hardware Level	1
	Percent Re-Use	0-20%
	Technology	High Speed Digital
	Density	1d
	Prior Design Leverage	PDL Category 1
	Gate Review Depth	Top Level
	Concept Volatility Tolerance	CVT Category 1
	Design Type	Module
	DM Electronics Packaging Hours	
DM Component Engineering	Total part count (including new and reuse parts)	200
	Reuse percentage (number of reused parts / number of total parts)	50%
	Classification	Classified
	Hardware Level	1
	Program Maturity	Redesign
	Control Drawings Required	Minimal
	Scope Change	Y-Scope
	APMPL	Y-APMPL
	Small Part Count (<200)	Y-SPC
	Deployment Variation	Y-DV
	DM Component Engineering Hours	
DM CCA Design	Choose CCA Type	High Speed Digital Design
	Estimated # of Layers	10
	Complexity	High
	Schematic Done by CAD	No
	New/Reroute	New
	DM CCA Design Hours	
DM Materials and Processes	**DM Electronics Packaging Hours (Materials and Processes)**	
DM Thermal Analysis	Thermal Analysis Inculded	Yes
	Thermal Analysis (Complexity)	Medium Complexity
	DM Thermal Analysis Hours	
DM Structural Analysis	Structural Analysis Included	Yes
	Structural Analysis (Complexity)	Low Complexity
	Structural Analysis (Similarity Leveraged)	Similarity Leveraged
	Durability - Vibe Analysis Included	Yes
	Durability - Vibe Analysis (Complexity)	High Complexity
	Durability - Vibe (Includes Thermal-Elasticity Analysis)	Does not Include Thermal-Elastic Analysis
	DM Structural Analysis Hours	
DM Doc Check	DM Doc Check Included	Yes
	# of D Size Drawings	20
	# of Documents	
	# of Revisions	
	DM Doc Check Hours	
Total Hours	**Total Hours**	

Allocating Costs to a Schedule

	PDS Stage ID - Level 1	PDS Phase ID - Level 2	PDS Phase ID - Level 3	SAS RCCC Level 5 Standard Work Element Code	Task Name	Verb	Adjective	Hours	Duration	Start	Finish
1					<XYZ> Digital Unit Development Schedule Template			10,654 hrs	329.5 days	Wed 3/28/12	Tue 7/2/13
2	2-00				Program Leadership, Management and Control			486 hrs	329.5 days	Wed 3/28/12	Tue 7/2/13
3					Receive SWA upon Contract Award from PMO			0 hrs	0 days	Wed 3/28/12	Wed 3/28/12
4					Receive Program Start-Up Review Approval			0 hrs	0 days	Fri 5/4/12	Fri 5/4/12
5					Receive Initial <XYZ> Digital Unit Product Requirements from SDC			0 hrs	0 days	Tue 4/10/12	Tue 4/10/12
6					Receive Initial <XYZ> Digital Unit Verification Rqmts from SVC			0 hrs	0 days	Tue 4/10/12	Tue 4/10/12
7		2-03			Program Start-Up, Execution and Closure			486 hrs	329.5 days	Wed 3/28/12	Tue 7/2/13
8			2-03.04	DF23A	<XYZ> Digital Unit Eng Mgmt Start-up Plans	Establish		56 hrs	8 days	Wed 3/28/12	Fri 4/6/12
9			2-03.04	MD23A	<XYZ> Mech_Elec_Pkg Eng Project Detail Planning	Establish		48 hrs	6 days	Wed 3/28/12	Wed 4/4/12
10			2-03.04	DF23B	<XYZ> Digital Unit Eng Execution Mgmt	Monitor / Status		288 hrs	290 days	Tue 5/22/12	Tue 7/2/13
11			2-03.04	DF23C	<XYZ> Digital Unit Final Archive	Perform		92 hrs	12 days	Fri 6/14/13	Tue 7/2/13
12					<XYZ> Digital Unit Development Complete			0 hrs	0 days	Tue 7/2/13	Tue 7/2/13
13	3-00				Requirements and Architecture Development			1,681 hrs	32 days	Mon 4/9/12	Tue 5/22/12
14		3-03			Product Requirements Definition			636 hrs	32 days	Mon 4/9/12	Tue 5/22/12
15			3-03.01	DF33A	<XYZ> Digital Unit Scenarios and Environment	Establish		4 hrs	20 days	Wed 4/11/12	Tue 5/8/12
16			3-03.02	DF33B	<XYZ> Digital Unit Rqmts Assessment & Flowdown	Perform		276 hrs	20 days	Wed 4/11/12	Tue 5/8/12
17					Handoff: Digital Unit Lower Level Requirements Documents			0 hrs	0 days	Tue 5/8/12	Tue 5/8/12
18			3-03.03	DF33C	<XYZ> Digital Unit Interface Rqmts	Develop		16 hrs	20 days	Mon 4/9/12	Fri 5/4/12
19			3-03.04	DF33D	<XYZ> Digital Unit Verif & Validation Rqmts	Update		16 hrs	20 days	Wed 4/11/12	Tue 5/8/12
20			3-03.05	DF33E	<XYZ> Digital Unit Cost Assessment	Perform		44 hrs	20 days	Mon 4/9/12	Fri 5/4/12
21			3-03.06	MD33C	<XYZ> Mech_Elec_Pkg Product Requirements Definition; Concept Design	Develop		40 hrs	20 days	Wed 4/11/12	Tue 5/8/12
22			3-03.06	DF33F	<XYZ> Digital Unit Models & Sim	Develop		160 hrs	20 days	Wed 4/11/12	Tue 5/8/12
23			3-03.07	DF33G	<XYZ> Digital Unit Rqmts Review	Perform		80 hrs	10 days	Wed 5/9/12	Tue 5/22/12
24		3-04			Product Architecture			1,045 hrs	30 days	Wed 4/11/12	Tue 5/22/12
25			3-04.01	DF34A	<XYZ> Digital Unit Functions & Algorithms	Establish		20 hrs	20 days	Wed 4/11/12	Tue 5/8/12
26			3-04.02	DF34B	<XYZ> Digital Unit Functional Analysis	Perform		60 hrs	20 days	Wed 4/11/12	Tue 5/8/12
27			3-04.03	DF34C	<XYZ> Digital Unit Physical Analysis	Perform		40 hrs	20 days	Wed 4/11/12	Tue 5/8/12
28			3-04.03	MA34A	<XYZ> Thermal_Stru Anal Product Architecture Development	Perform		120 hrs	20 days	Wed 4/11/12	Tue 5/8/12
29			3-04.03	MC34B	<XYZ> Mech_Cables Product Physical Analysis	Perform		392 hrs	20 days	Wed 4/11/12	Tue 5/8/12
30					Handoff: Mech Cables Requirements to Mech Cables Component Design			0 hrs	0 days	Tue 5/8/12	Tue 5/8/12
31			3-04.03	MD34B	<XYZ> Mech_Elec_Pkg Product Physical Analysis	Perform		309 hrs	20 days	Wed 4/11/12	Tue 5/8/12
32			3-04.04	DF34D	<XYZ> Digital Unit Architecture	Finalize		24 hrs	20 days	Wed 4/11/12	Tue 5/8/12
33			3-04.05	DF34E	<XYZ> Digital Unit Architecture Review	Perform		80 hrs	10 days	Wed 5/9/12	Tue 5/22/12
34					Handoff: Digital Unit BOM (Non-Std, Long-Lead), Initial to SCM			0 hrs	0 days	Tue 5/22/12	Tue 5/22/12
35	4-00				Design and Development			7,299 hrs	233.5 days	Wed 5/23/12	Mon 4/15/13
36		4-01			Preliminary Design			2,405 hrs	63.5 days	Wed 5/23/12	Mon 8/20/12
37			4-01.02	DF41A	<XYZ> Digital Unit Prelim Design Drawings & Parts List	Generate		152 hrs	14.5 days	Wed 5/23/12	Tue 6/12/12
38					Handoff: Digital Unit Schematics, Layout: Preliminary			0 hrs	0 days	Tue 6/12/12	Tue 6/12/12
39			4-01.02	DF41B	<XYZ> Digital Unit Prelim Design Specs	Generate	Initial	200 hrs	20 days	Tue 6/12/12	Tue 7/10/12
40					Handoff: Digital Unit Test Requirements, Preliminary			0 hrs	0 days	Tue 7/10/12	Tue 7/10/12
41			4-01.02	MC41B	<XYZ> Mech_Cables Product Preliminary Design	Generate	Initial	470 hrs	38 days	Wed 5/23/12	Fri 7/13/12
42			4-01.02	MD41B	<XYZ> Mech_Elec_Pkg Product Preliminary Design	Generate	Initial	357 hrs	30 days	Tue 6/12/12	Tue 7/24/12
43			4-01.05	DF41C	<XYZ> Digital Unit Design Trades / Analysis	Perform/Update		104 hrs	25 days	Tue 6/12/12	Tue 7/17/12
44			4-01.05	DF41D	<XYZ> Digital Unit Circuit Analysis / Sims	Perform/Update		136 hrs	17 days	Tue 7/10/12	Thu 8/2/12
45			4-01.05	DF41E	<XYZ> Digital Unit Prelim Analysis	Perform		92 hrs	11.5 days	Tue 7/17/12	Wed 8/1/12
46			4-01.05	MC41F	<XYZ> Mech_Cables Product Model/Simulation, Producibility and Design Analysis	Perform	Initial	235 hrs	13 days	Mon 7/16/12	Wed 8/1/12



Building the Portfolio

RF Module Integrated Cost Model

Analog Mixed Module Integrated Cost Model

Power Module Integrated Cost Model

FPGA Integrated Cost Model

Program:

AMIC_SOC Integrated Cost Model

Program: Program Name

Digital Unit Integrated Cost Model

Program: Program Name

RF Unit Integrated Cost Model

Program: Program Name

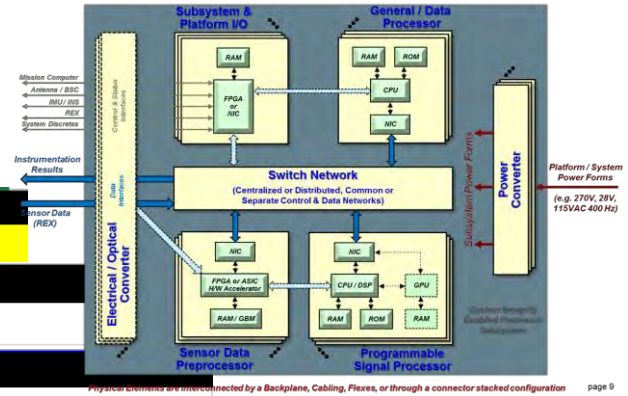
Analog Power Unit Integrated Cost Model

Cable Design Cost Model

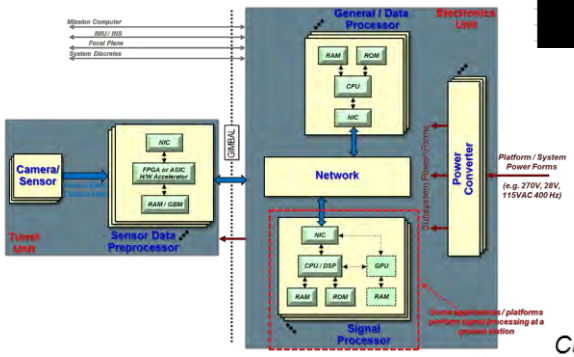
Program:	Program Name	
Cable Name:	Module Name	
Unit Name:	Unit Name	Start Date
System Name:		
Date:	Date of most recent update	End Date
Name(s):	Person who filled in this worksheet	# of Days

	Driver	Value
RF Unit Cable Design	Sq. Feet of Drawings	50
	Environment	Space / Vacuum
	Hardware Level	Two
	Routing Requirements	3D Model / Flat Patterning
	Technology	Copper

Radar Signal & Data Processing Reference Architecture

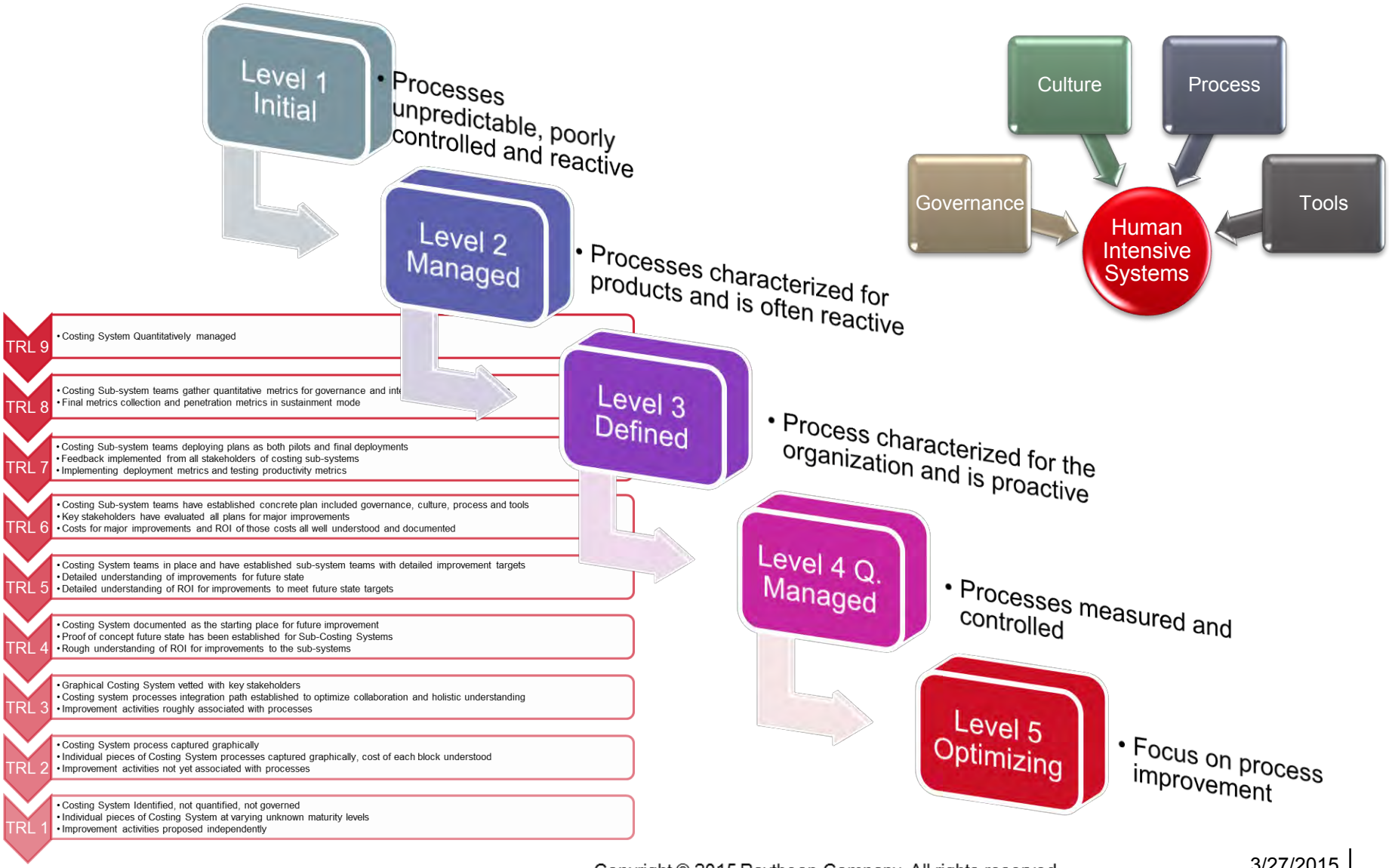


EO/IR Signal & Data ProcessingReference Architecture



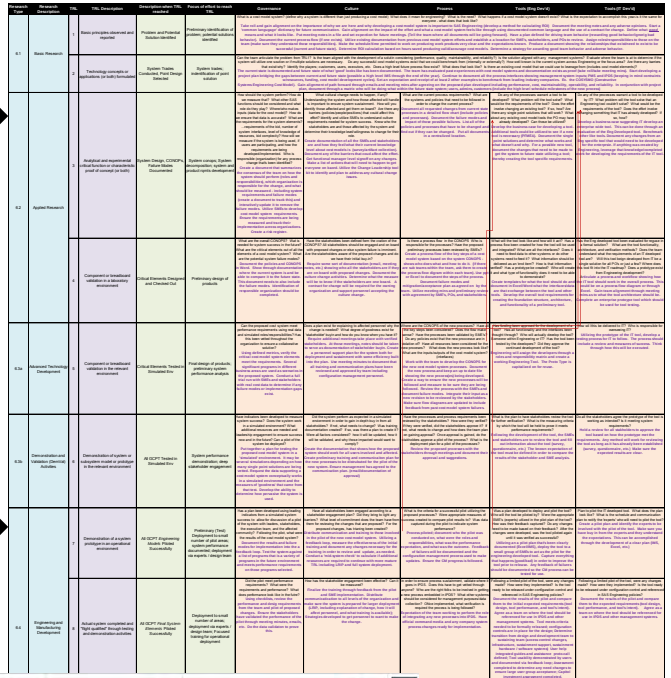
page 10

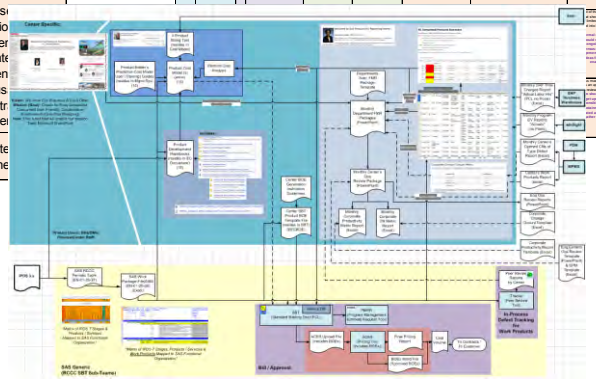
Path to Improvement



Maturing the Cost System Engineering

TRL	TRL Description	Description when TRL reached	Focus of effort to reach TRL	Governance	Culture	Process	Tools (Eng Dev'd)	Tools (IT Dev'd)
1	Basic principles observed and reported	Problem and Potential Solution Identified	Preliminary identification of problem; potential solutions identified	Problem identified; potential solutions identified; potential ROI identified				
2	Technology concepts or applications (or both) formulated	System Trades Conducted, Point Design Selected	System trades; indentification of point solution	Problem and potential solutions well-defined and documented; System trade study complete; System point solution formally identified				
3	Analytical and experimental critical function or characteristic proof of concept (or both)	System Design, CONOPs, Failure Modes Documented	System conops; System decomposition; system and product rqmts development	System elements defined; product rqmts defined; system performance rqmts defined	Cultural change rqmts defined; cultural elements identified; change toolkit templates completed	Process rqmts defined; Process changes / developments identified	Tool rqmts defined; Tool changes / developments identified	Tool rqmts defined; Tool changes / developments identified
4	Component or breadboard validation in a laboratory environment	Critical Elements Designed and Checked Out	Preliminary design of products	Critical elements poc demo	Discussions and preliminary buyin with stakeholders	Process conops, flow, key steps defined; Successful preliminary review	Preliminary tool prototype or mock-up; Tool-process preliminary integration flow	Preliminary tool prototype or mock-up; Tool-process preliminary integration flow
5	Component or breadboard validation in the relevant environment	Critical Elements Tested in Simulated Env	Final design of products; preliminary system performance analysis	Critical elements advanced poc demo	Discussions and detailed buyin with stakeholders	Process conops, flow, steps defined; successful design review	Tool design complete; tool tested by developers; successful review	Tool design complete; tool tested by developers; successful review
6	Demonstration of system or subsystem model or prototype in the relevant environment	All GCPT Tested in Simulated Env	System performance demonstration; deep stakeholder engagement	Components shown to meet performance rqmts; System meets expected perrormance	Stakeholder engagement plan in place; POC with pilot stakeholders successful	Stakeholder review and approval of process; process meets performance rqmts	Stakeholder review and approval of tool; tool meets performance rqmts	Stakeholder review and approval of tool; tool meets performance rqmts
7	Demonstration of a system prototype in an operational environment	All GCPT *Engineering Models* Piloted Successfully	Preliminary (Test) Deployment to small number of pilot areas; system performance documented; deployment via experts / design team	System shown to meet performance rqmts; deployment plan/metrics defined	Proto training proven effective; stakeholder engagement effective; Lessons learned incorporation plan	Process successfully piloted; preliminary process performance metrics reported	Tool successfully piloted; may include significant use of experts	Tool successfully piloted; may include significant use of experts
8	Actual system completed and "flight qualified" through testing and demonstration activities	All GCPT *Final System Elements* Piloted Successfully	Deployment to small number of areas; deployment via experts / design team; Focused training for operational deployment	System shown to meet performance rqmts	Final training proven effective; stakeholder engagement effective; lessons learned incorporation in place	Process fully integrated into IPDS; Process released into management system; Process rqmts compliance demonstrated thru user deployment	Tool released, under configuration control, referenced appropriately within mangement system; Tool usability demonstrated via users	Tool released, under configuration control, referenced appropriately within mangement system; Tool usability demonstrated via users
9	Actual system "flight proven" through successful mission operations	All GCPT in LRIP	Limited deployment according to written deployment plan; deployment via operational team	System performance metrics recorded and monitored as part of standard metrics set	Final training proven effective; stakeholder engagement effective; lessons learned incorporation in place	Process fully integrated into IPDS; Process released into management system; Process rqmts compliance demonstrated thru user deployment	Tool released, under configuration control, referenced appropriately within mangement system; Tool usability demonstrated via users	Tool releas configuratio referer appropriat mangemen Tool us demonstr use
"10"	System Deployed, Operational, and Effective	All GCPT in Production / Sustainment	Ongoing pervasive deployment and maintenance	Ongoing deployment; Ongoing performance measurement	Minor Training Package Updates as necessary	Minor updates as necessary	Minor updates and bug fixes as necessary	Minor update fixes as ne





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Developing the Costing System Roadmap

Research Type	Research Description	TRL	TRL Description	Description when TRL reached	Focus of effort to reach TRL	SFA 1 - Costs and Models System Engineering	SFA 2 - In-Process Productivity Reporting	SFA 3 - Costing an Integrated Gate 4 Bid	SFA 4 - Costing an Integrated Product ROM	SFA 5 - Costing an Integrated EAC	SFA 6 - Integrated Parametric Cost Data Analysis	SFA 7 - Preparing a "Should Cost" bid	SFA 8 - Preparing a competitor's estimate	SFA 9 - Final Costs Records Retention	
6.1	Basic Research	1	Basic principles observed and reported	Problem and Potential Solution Identified	Preliminary identification of problem; potential solutions identified	Maturity level 1 for this SFA entails graphically capturing the current Cost Estimation system in place. Generally this entails a flow diagram that captures every step in the cost estimation and execution business process.	At Maturity Level 1, Current in-process productivity processes have been captured in a flow diagram.	At Maturity Level 1, Current costing and integrated gate 4 bidding processes have been captured in a flow diagram.	At Maturity Level 1, Current integrated ROM bidding processes have been captured in a flow diagram.	At Maturity Level 1, Integrated EAC processes have been captured in a flow diagram.	At Maturity Level 1, documented parametric cost data processes have been captured in a flow diagram.	At Maturity Level 1, documented "should cost" processes have been captured in a flow diagram.	At Maturity Level 1, documented competitors analysis processes have been captured in a flow diagram.	At Maturity Level 1, data retension processes have been captured in a flow diagram.	What is a co Take roll 'common means behavior) team (ma
		2	Technology concepts or applications (or both) formulated	System Trades Conducted, Point Design Selected	System trades; indentification of point solution	Maturity Level 2 for this SFA entails the ability to identify each step of the flow Cost Estimation diagram and associate the average costs with completing each step in addition to identifying the inefficiencies of each step.	Maturity Level 2 for SFA 2 entails a detailed cost analysis for each step in the productivity reporting process. Further at Maturity Level 2, a reasoned estimate of reporting penetration and productivity accuracy is established.	Maturity Level 2 for SFA 3 entails an average cost analysis for each step in the Gate 4 bidding process. Further at Maturity Level 2, a reasoned estimate of bidding accuracy is established.	Maturity Level 2 for SFA 4 entails an average cost analysis for each step in the ROM bidding process. Further at Maturity Level 2, a reasoned estimate of bidding accuracy and cost is established.	Maturity Level 2 for SFA 4 entails an average cost analysis for each step in the EAC process. Further at Maturity Level 2, a reasoned estimate of EAC accuracy is established.	Maturity Level 2 entails an average cost analysis for each step in the parametric cost data analysis process.	Maturity Level 2 entails an average cost analysis for each step in the "should cost" analysis process.	Maturity Level 2 entails an average cost analysis for each step in the competitors estimate process.	Maturity Level 2 entails an average cost analysis for each step in the records retention process.	Can the tean system will The curren project pla Systems En
6.2	Applied Research	3	Analytical and experimental critical function or characteristic proof of concept (or both)	System Design, CONOPs, Failure Modes Documented	System conops; System decomposition; system and product rqmts development	At Maturity Level 3, each of the blocks in the system flow diagram have a current state ConOps documented. In addition to the current state ConOps for each block being documented, there is a documented process of what should be accomplished for effective cost estimation but cannot (or is not) due to lack of tools or efficient processes (failure modes).	At Maturity Level 3, an improvement plan is made to increase penetration and insure accuracy. An estimate is made of "should be" penetration and accuracy measurements. Remember that the plan must include an "integrated approach" to in-process cost collection.	At Maturity Level 3, an improvement plan is made to increase effeciency and bid accuracy. An estimate is made of "should be" proposal costs and accuracy measurements. Remember that the plan must include an "integrated approach" to Gate 4 bidding.	At Maturity Level 3, an improvement plan is made to increase effeciency and bid accuracy. An estimate at the ROM level needs to be top down (or explained why it is not) in a way that is compatible with the bottoms up approach in Gate 4 bidding. Further, in the ROM bidding space, efficiency in the technical/cost trades needs to play a key role in the bid efficiency.	At Maturity Level 3, an improvement plan is made to increase effeciency and EAC accuracy.	At Maturity Level 3, an overall user efficiency established. EAC metrics are well defined and agreed upon by key stakeholders.	At Maturity Level 3, an overall user efficiency established. Should cost metrics are well defined and agreed upon by key stakeholders.	At Maturity Level 3, an efficiency established. Competitors estimate metrics are well defined and agreed upon by key stakeholders.	At Maturity Level 3, an plan is made eciency and acy.	How should we meas functions sh role do the inputs (data we ensure tha the requireme ...requirer system inte resources, measure if users are req develop responsible chang Create a c the consens system sh responsibili responsible should be m requiren (create a d interativel failure mode cost mod Ensure the mea implementa Cre
		4	Component or breadboard validation in a laboratory environment	Critical Elements Designed and Checked Out	Preliminary design of products	For Maturity Level 4, each of the failure modes of the current system are identified and a solution is initiated. As most improvements follow spiral design processes, a break-down of capability cost ROI is calculated. As this is still early in the solution process, it is understood that these calculations are "best attempt" estimates. Low hanging fruit is identified by Level 4 as is a pareto chart of hours saved per dollar spent.	At Maturity Level 4 for SVA 2, a proof of concept integrated product level productivity reporting environment has been established for integrated cost and productivity collection and reporting and is being tested for efficiency and assessed for collaboration and reuse among all product owners	At Maturity Level 4 for SVA 3, a proof of concept for integrated product level costing for Gate 4 level bids methods have been established for all key components of Gate 4 bids (integrated hours estimate, BOE, Gas Gauges and IMS) is being tested for efficiency and assessed for versatility, collaboration and reuse among all product owners	At Maturity Level 4 for SFA 3, a proof of concept for integrated product ROM bids method has been established for and is being tested for efficiency and assessed for versatility, collaboration and reuse among all product owners. An evaluation has been performed on efficiency and the ability to perform quick cost/technical trade studies	At Maturity Level 4, a proof of concept for integrated EACs has been established for and is being tested for efficiency and assessed for versatility, collaboration and reuse among all product owners. An evaluation has been performed on efficiency and the ability to perform quick and accurate EACs.					el 4, a proof ystem and n established ng tested for assessed for boration and all product aluation has rmed on the ability to uick and d analysis.	What are th needed for s What are the elements of are the pote Document in Word. Sh where the able to con This docum the failure responsibi
6.3a	Advanced Technology Development	5	Component or breadboard validation in the relevant environment	Critical Elements Tested in Simulated Env	Final design of products; preliminary system performance analysis	By Maturity Level 5, productivity improvements through tool development and process standardization has begun. Most of the time these are spiral developments, but in each case an ROI is documented in each spin of the spiral. Often, EIO projects have been proposed and approved by this maturity level and work [illegible] the efficiency improvements	At ML 5 for SFA 2, the integrated product level productivity reporting environment has been tested and changes incorporated along with [illegible]	At ML 5 for SFA 3, the Costing of an Integrated Gate 4 bid methods have been tested and changes incorporated along with overall user efficiency established. Bidding [illegible]	At ML 5 for SFA 4, the Costing of ROM bid methods have been tested and changes incorporated along with overall user efficiency established. [illegible]	At ML 5, integrated EACs have been tested and changes incorporated along with overall user efficiency established. EAC metrics are well defined and agreed upon by key stakeholders.					rocesses of st records m have been changes along with efficiency d. Final cost records retention metrics are well defined and agreed upon by key stakeholders.	Can the p performance and simulat this be organizatio Using de critical co meet the significa business are the propos trial run wi with real co failure mod

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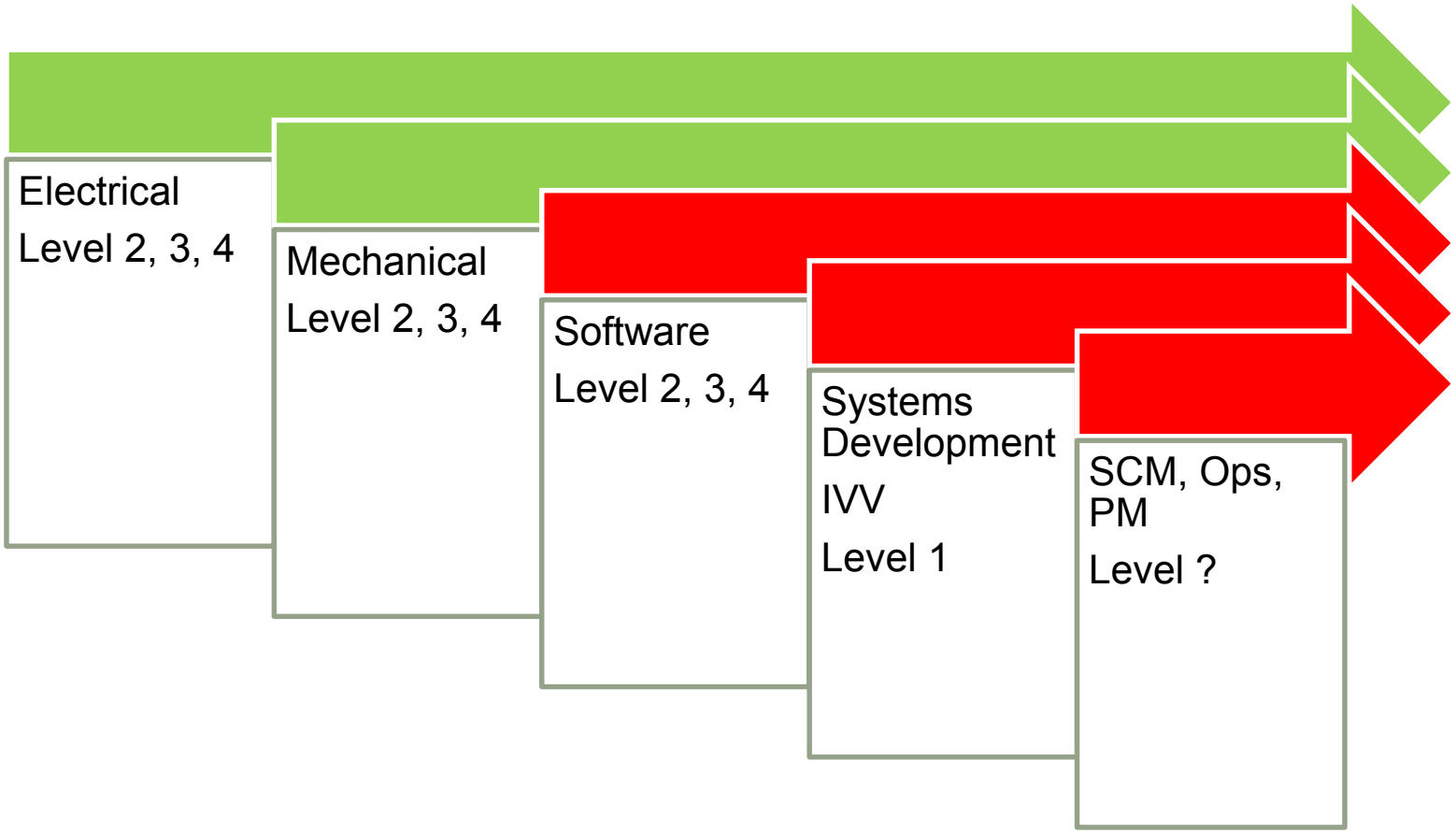
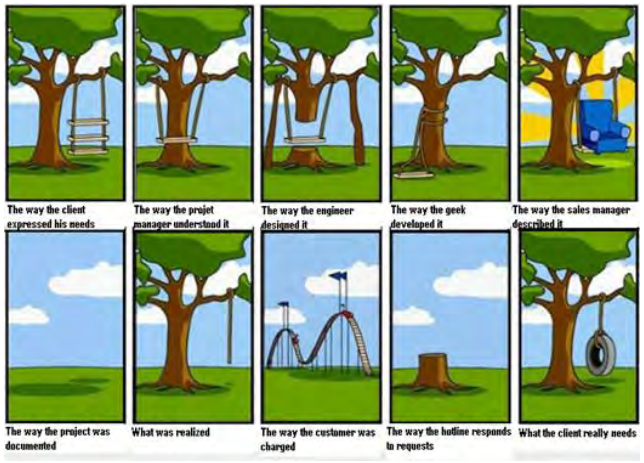
Defining the Costing Systems Teams

Description	SFA 1 - Costs and Models System Engineering	SFA 2 - In-Process Metrics Reporting	SFA 3 - Costing Integrated Gate 4 and ROM Bids	SFA 4 - Costing an Integrated EAC	SFA 5 - Integrated Parametric Cost Data Analysis	SFA 6 - Should Cost / Design to Cost	SFA 7 - Priced to Win	SFA 8 - Final Costs Records Retention
Sub Focus Area Team High Level Description	This would consist of a team of passionate contributors toward the development of the Costs and Models System made up of both Costs and Models experts and GCPT assurance team members.	This team would consist roughly of the same individuals who prepare the MCoP reports plus those of the CMSE team tasked with making sure all data collection activities are synergistic. The lead of this team would be the champion for the In-Process reporting of the organization (both Engineering and non-Engineering)	This team would consist of a core group of Gate 4 and GCPT experts. The lead of this team would be a champion for the efficient and effective bidding of Gate 4 programs.	This team would consist of a core group of EAC and GCPT experts. The lead of this team will be considered the champion for effective and efficient EAC developments.	This team would consist of a core group of Parametric Cost Data Analysis and GCPT experts. The lead of this team will be considered the champion for effective and efficient Parametric Cost Data Analysis.	This team would consist of a core group of Should Cost/Design to Cost and GCPT experts. The lead of this team will be considered the champion for Should Cost/Design to Cost development.	This team would consist of a core group of Priced to Win and GCPT experts. The lead of this team will be considered the champion for effective and efficient Priced to Win practices.	This team would consist of a core group of Final Cost and GCPT experts. The lead of this team will be considered the champion for effective and efficient Final Cost Records Retention. The goal is to insure that upon completion of any job, sufficient information has been saved and documented in a way that is compatible with all Costing activities.
Sub Focus Area Team Responsibilities	This team is responsible for the initial generation of roadmap of Sub Focus Area maturity improvement for each Costing Sub Focus Area. This team is responsible for insuring that all data structures are synergistic (for exampl that final cost collections are built on in process cost collections and EAC) and that all data structures are compatible.	This team is responsible for creating the In-Process productivity reporting process flow diagram. This team is responsible for insuring that this flow diagram is compatible with product level productivity reporting as well as individual discipline based productivity reporting. This team is tasked with insuring that the in process data gathering is compatible with and synergistic to EAC development and Final costing and productivity disposition.	This team is responsible for the development of the requirements and implementation of effective and synergistic Gate 4 integrated product level bidding. This team is tasked with insuring that the BOEs, cost estimation methods, gas gauges and architectures are compatible and integrated across each product and product level. In addition this team is tasked with insuring that bidding and bidding data is synergistic across all organizations SAS as well as providing representation to Corporate teams that are attempting the same efficiencies.	This team is responsible for creating the Integrated EAC process flow diagram. This team is responsible for insuring that this flow diagram is compatible with product level productivity reporting as well as individual discipline based productivity reporting. This team is tasked with insuring that the EAC data gathering is compatible with and synergistic to in-process metrics reporting and Final costing and productivity disposition as well as meeting the needs of the business reporting.	This team is responsible for creating the standards for using parametric data in bids as well as creating the parametric cost development flow diagrams. One of the important responsibilities is to provide governance for all parametric models used for bidding (e.g. R squared, F probability, coefficient update calendar etc).	This team is responsible for creating the "Should Cost/Design to Cost" flow diagram. This team is responsible for insuring that this flow diagram is compatible with advancing the bidding process for Gate 4 bids and ROM as well as participating in the parametric development to insure that quick turn architectural evaluation is possible. This team will actively engage the architecture roarmaps as well as the price to win activities.	This team is responsible for creating the Priced to Win flow diagram. This team is responsible for insuring that this flow diagram is compatible with advancing the bidding process for Gate 4 bids and ROM as well as participating in the parametric development to insure that quick turn architectural evaluation is possible. This team will actively engage the architecture roarmaps as well as the price to win activities.	This team is responsible for creating the Priced to Win flow diagram and sets the requirements for all final state costing records retention. This team is responsible for insuring that this flow diagram and data retention is compatible with all costing activitiese.
Sub Focus Area Team Mission Statement (primary activity)	The primary activity of this team is to provide the systems thinking for the maturity improvement of all other Sub Focus Areas.	The primary activity of this team is the development of a collaborative environment in which all in-process productivity reporting data structures are input and accessed in a way that is synergistic to all other Costing Sub-Focus Areas.	The primary activity of this team is to develop the processes and list of verified artifacts that insure that Gate 4 bids are integrated and convincing. One example of this mission would be that a Gate 4 bid would use data from the same program at all levels of the integrated bid.	The primary activity of this team is the development of all EAC data structures, methods and tools such that EACs are synergistic to all other Costing Sub-Focus Areas and compatible with each business reporting needs.	The primary activity of this team is insuring that parametric models are developed correctly and implemented correctly in bids.	The primary activity of this team is insuring broad "should cost/design to cost" capability meets industry standards as well as participates in corporate expectations.	The primary activity of this team is insuring broad Priced to Win capability meets industry standards as well as participates in corporate expectations.	The primary activity of this team is insuring that the final state of conpleted job data is compatible and available for all activities that require the data. For example, there is compatible size and cost information to those activities that require internally developed parametric models as well as commercial models.
Sub Focus Area Vision (Near, Mid, Long)	The vision of this team will be written by the team members, but it should include near term (easy	The vision of this team will be written by the team members, but it should include near term (easy	The vision of this team will be written by the team members, but it should include near term (easy	The vision of this team will be written by the team members, but it should include near term (easy	The vision of this team will be written by the team members, but it should include near term (easy	The vision of this team will be written by the team members, but it should include near term (easy	The vision of this team will be written by the team members, but it should include near term (easy	The vision of this team will be written by the team members, but it should include near term (easy

Where are We on the Path?



Concluding Remarks



- 6 Years into the process
  - Many roadblocks in functional organizations
  - Trend toward finding a product owner helpful
  - Document where we are, where we are going
  - Data is the key!
  - **Know What You Do!**

Backup Slides