“Tools for Convincing Skeptics to Invest in DFMA”

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Design Producibility Engineering
L3 Technologies, Inc. – Communication Systems West

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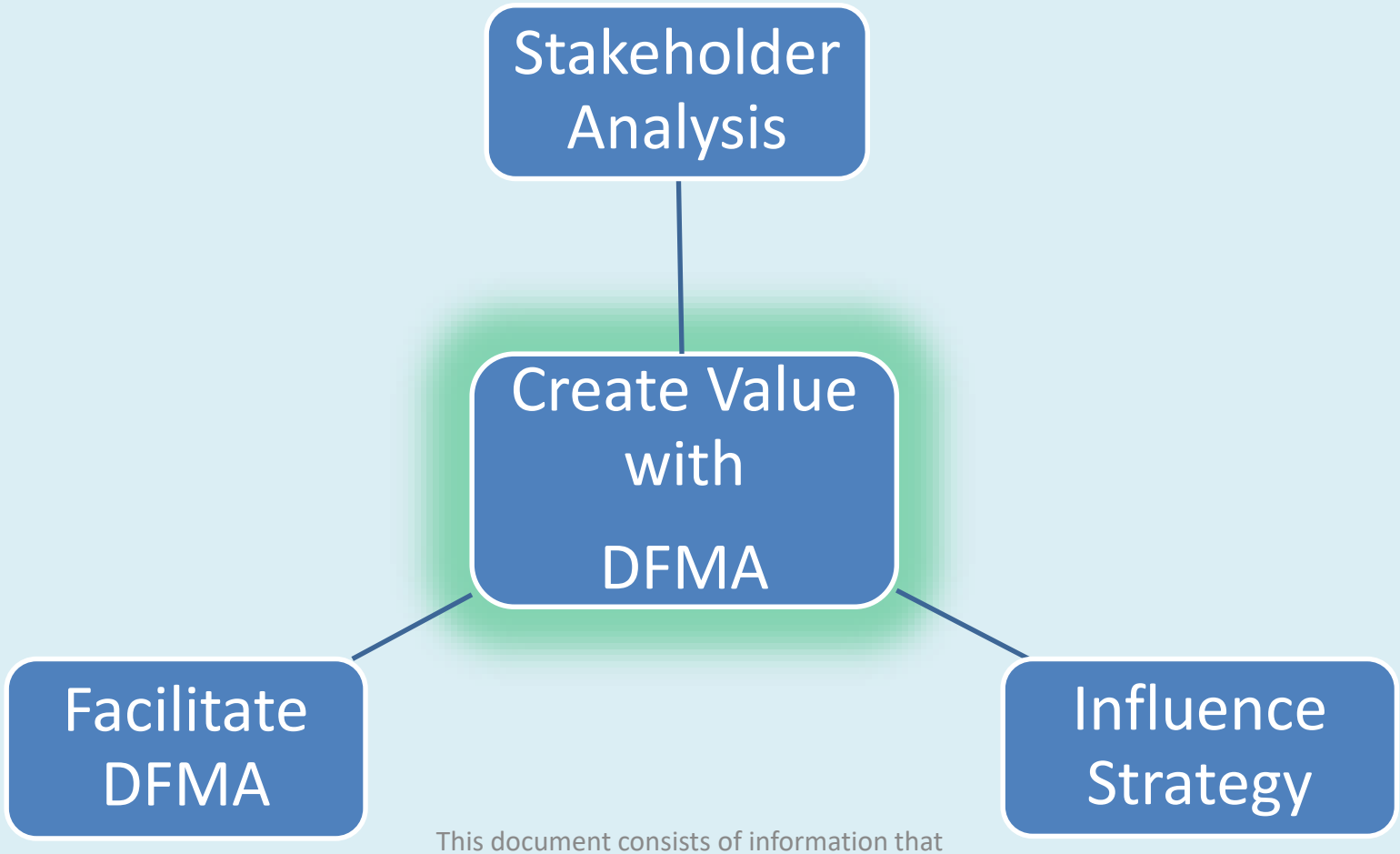
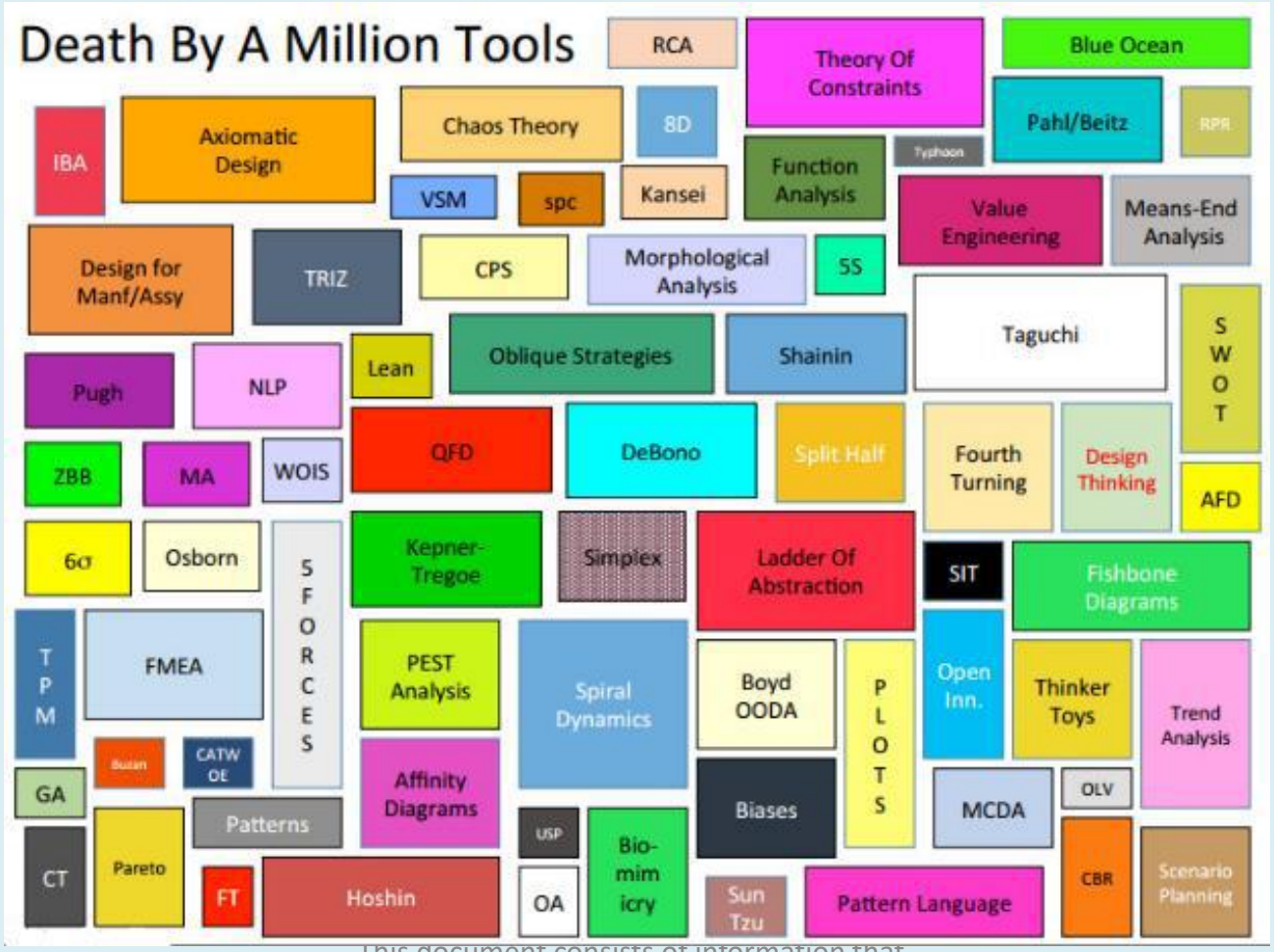
A Three- Part Approach to Create Value with DFMA

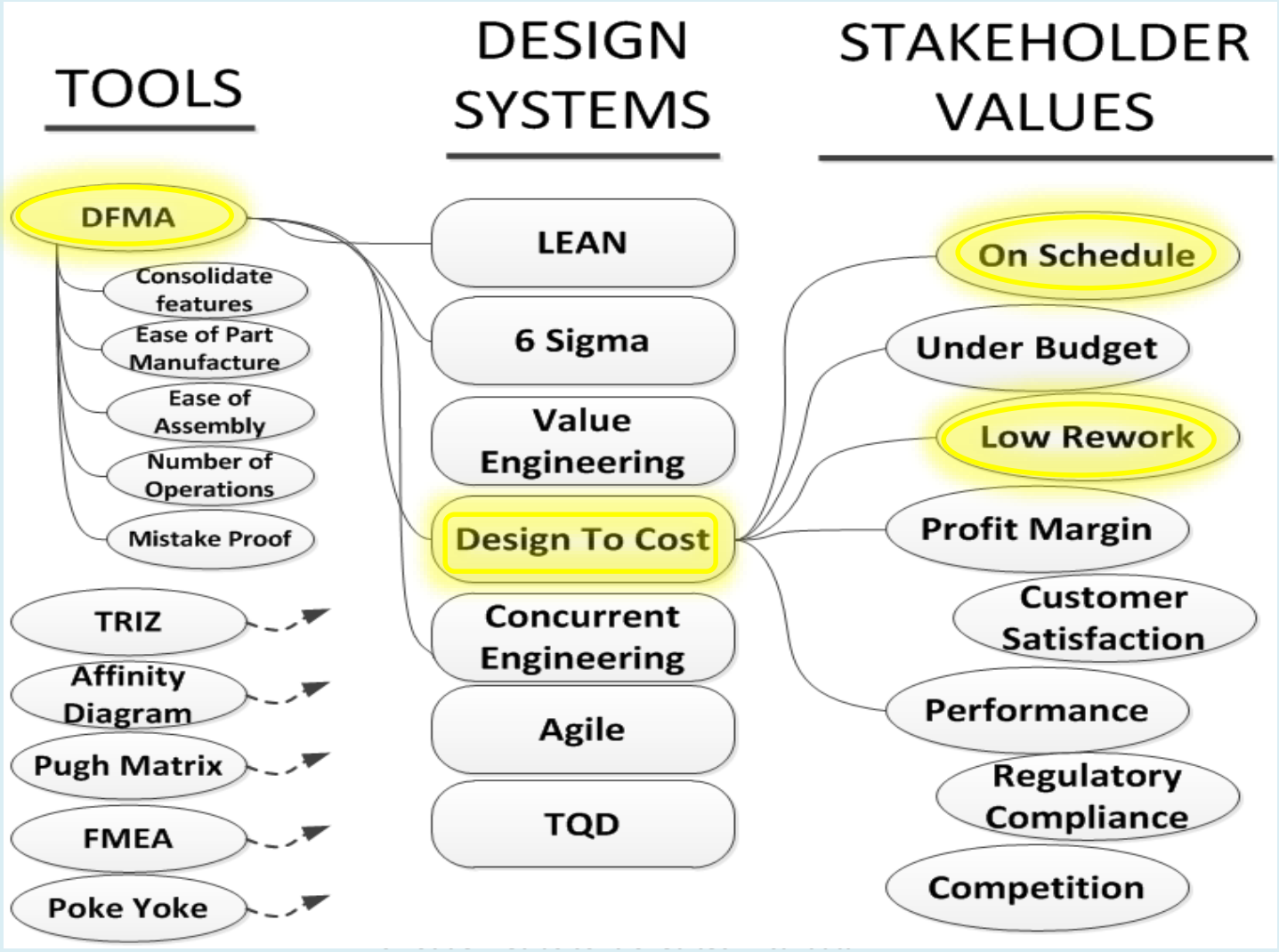


DFMA is among the Best Practices

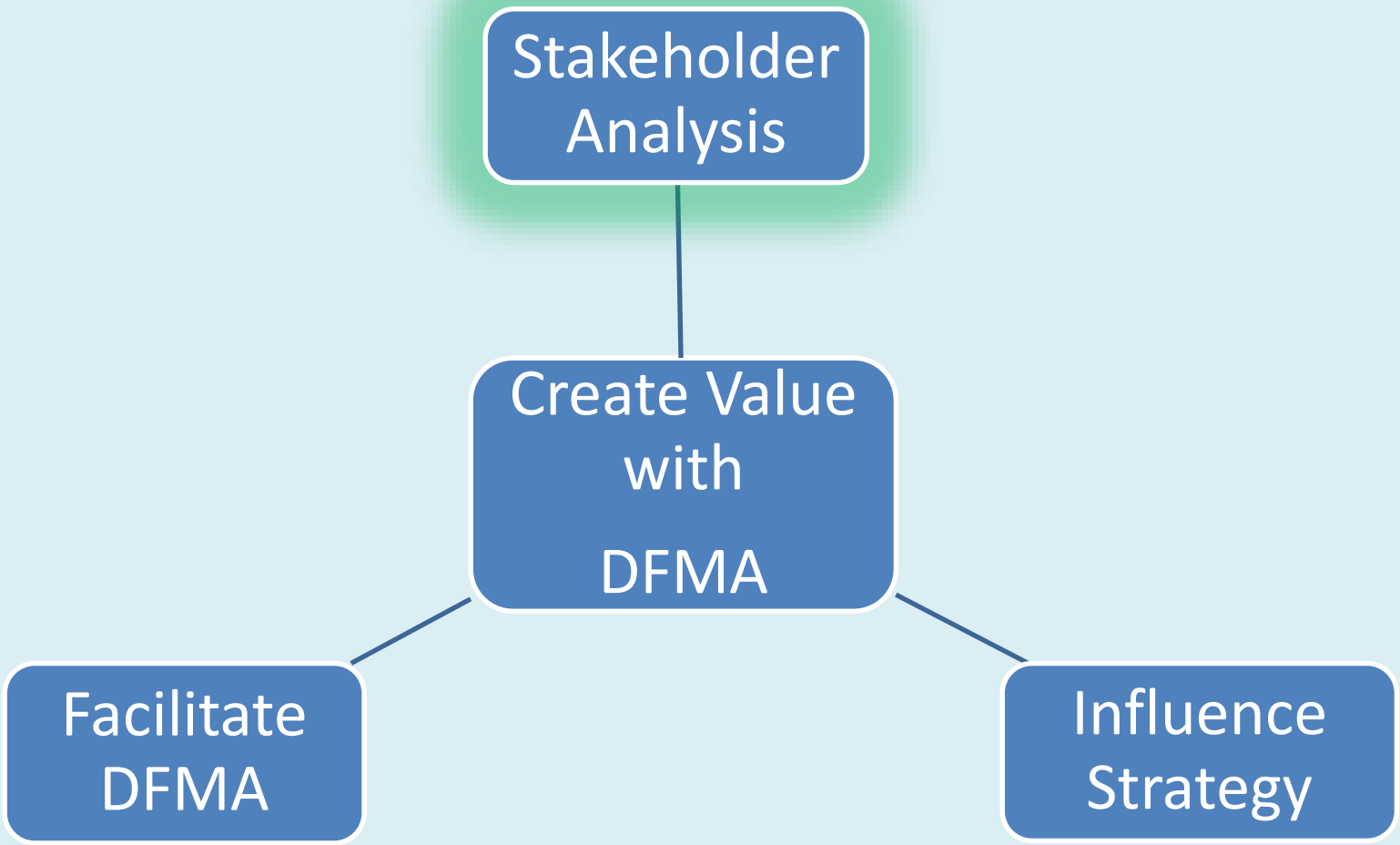
of Innovation, Quality, Value, and Profitability.



Leverage Design Systems to deploy DFMA



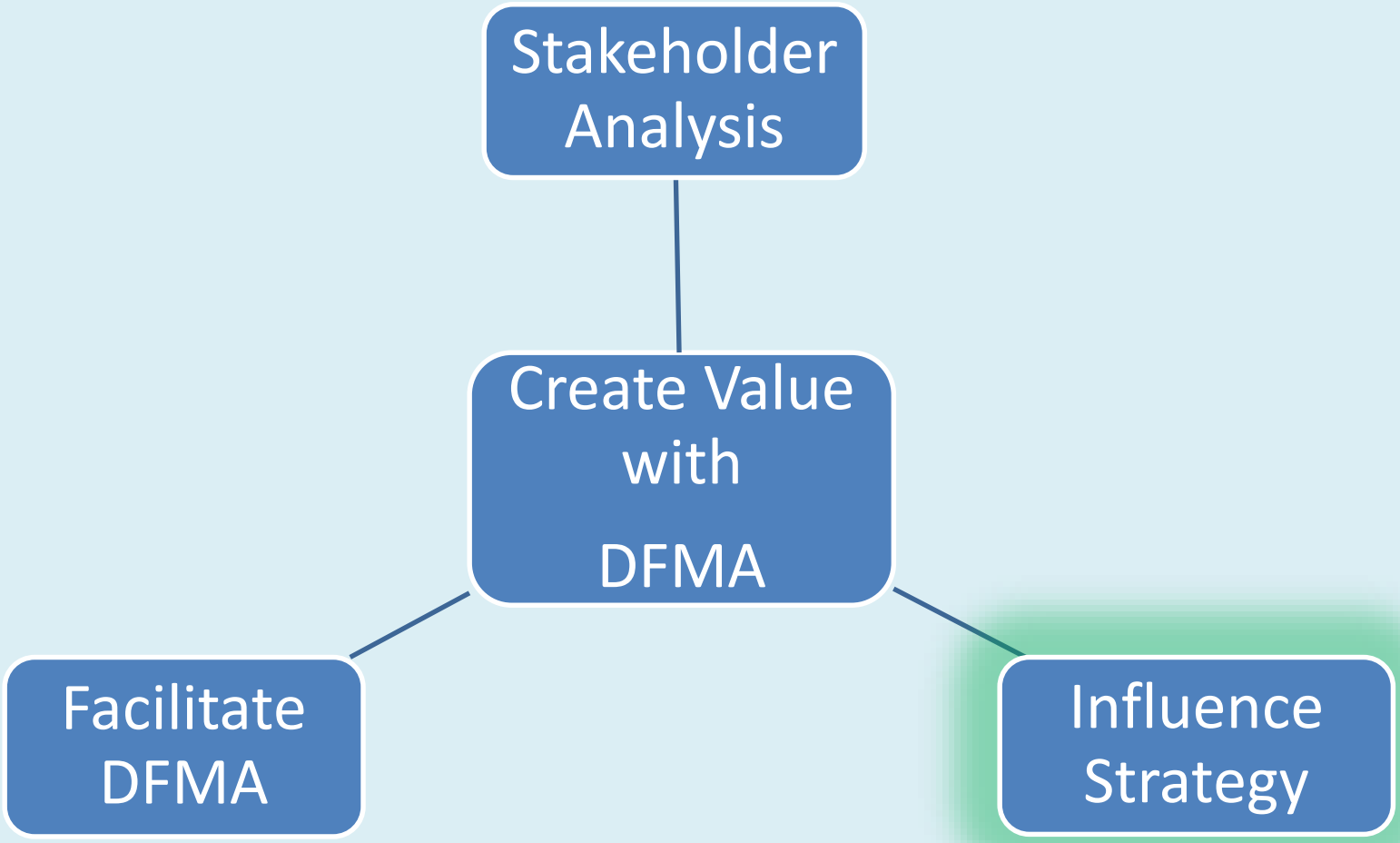
How does Stakeholder Analysis enable DFMA ?



Stakeholder Analysis

Role	Values / Performance Metrics	Perceived Constraints	Value-Add Strategy of DFMA
Program Manager	1.) On-time delivery 2.) NRE under Budget 3.) High Margin 4.) No Customer Returns	- DFMA is expendable - Extra design delays project - Assembly costs are invisible	- Reduces risk of schedule delays - R.O.I. >1 - Low costs = higher profit - Reduces returns' root cause
Engineer	1.) Comply with spec 2.) Robust Design 3.) Complete Milestones 4.) Elegant design	- Optimization takes time - DFMA requirements vague - Lower cost = less robust - Design ownership	- DFMA = Reliability = Robustness - DFMA now = less ECNs later - Shows efficient, creative design
Operations	1.) On-time shipments 2.) Low Rework 3.) Available Material 4.) Passes Inspect/Test	- Collaboration is inconvenient - Not the design expert - Late involvement	- Less variation = less rework = ship on-time - Improves drawings and instructions

What are ways to get Buy-In for DFMA ?



Methods of Influence, 1-9

1. Provide rational analysis 	2. Cite credible sources 	3. Reference legitimate policies, rules, or standards 
4. Establish urgency or scarcity 	5. Demonstrate pain & gain 	6. Build alliances and coalitions 
7. Use social proof 	8. Initiate reciprocation or exchange 	9. Encourage commitments & consistency 

Methods of Influence, 10-18

10. Present striking comparisons or contrasts 	11. Add impact to your ideas 	12. Align with shared values or principles 
13. Connect to strategy or high level goals 	14. Build rapport, relationship, and trust 	15. Like and be likeable 
16. Request help or advice 	17. Be influenceable 	18. Lead by example 

Which Method of Influence to use ?

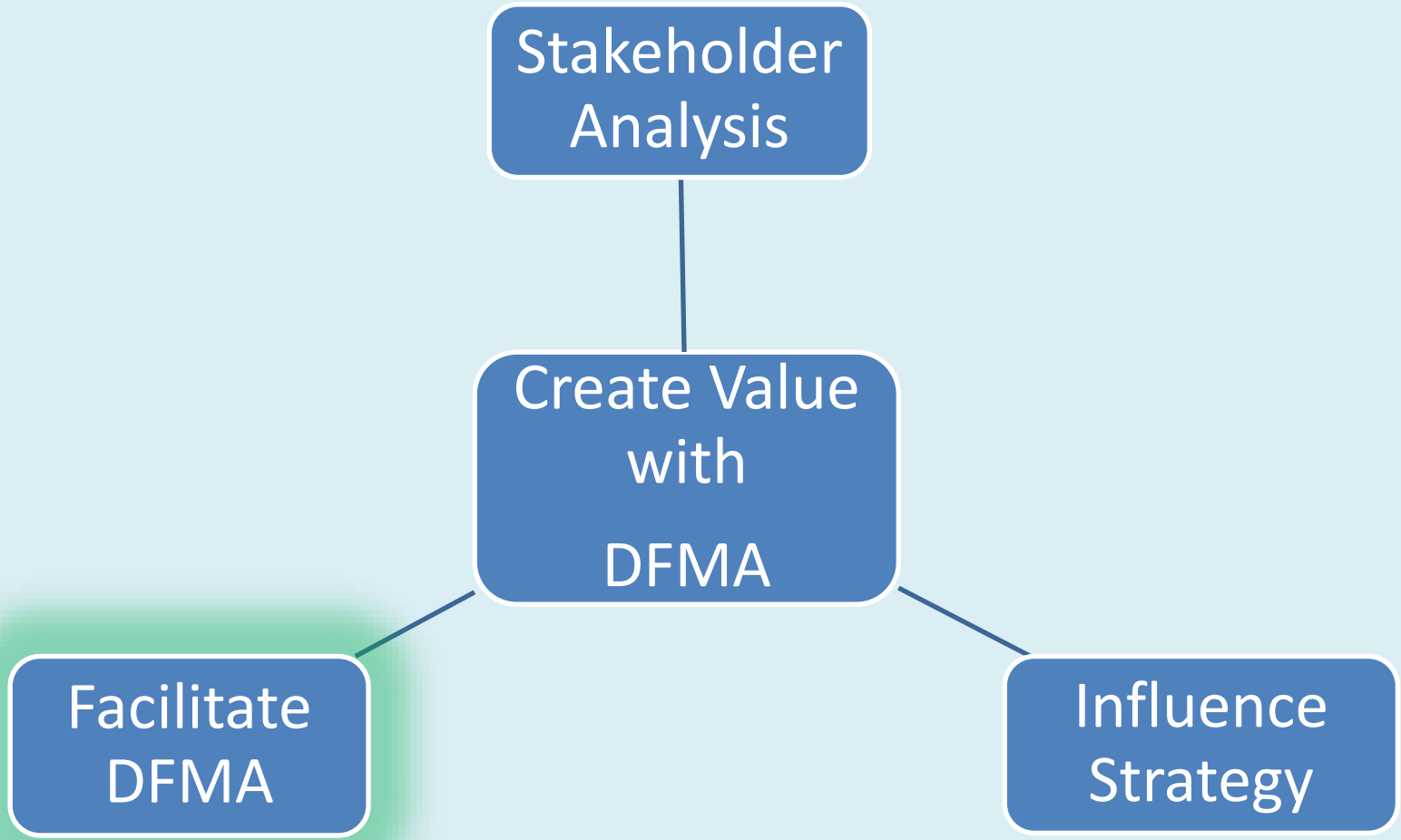
Foundation
1. Provide Rational Analysis
3. Reference Legitimate Policies and standards
12. Align with shared values, principles or purposes
13. Connect to strategy or high level goals

Risk Impact
4. Establish urgency or scarcity
5. Demonstrate Pain and Gain
10. Present striking comparisons or contrast
11. Add impact to your ideas

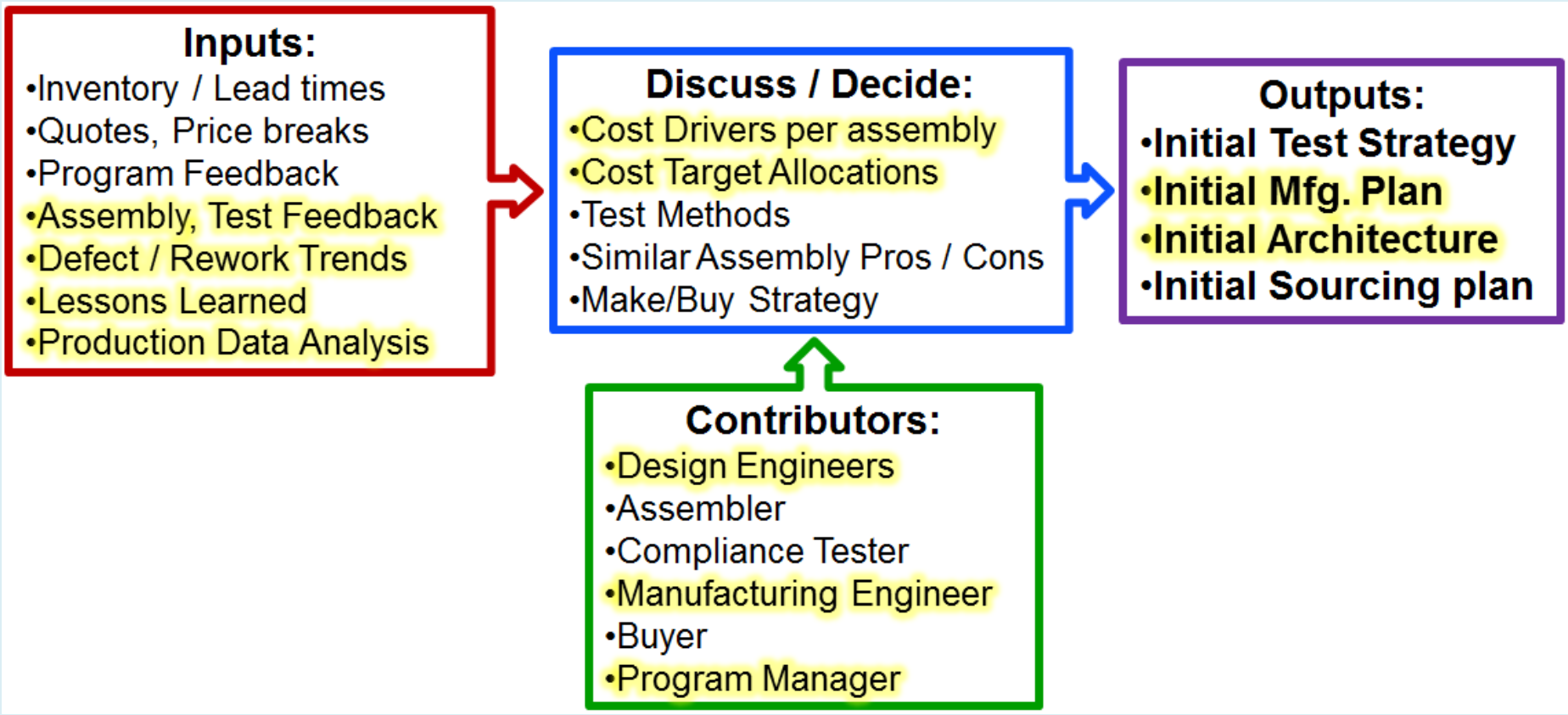
Social Network
2. Cite credible Sources
6. Build alliances and coalitions
7. Use social Proof
9. Encourage commitments and consistency

Personal Trust
8. Initiate reciprocation or exchange
14. Build rapport relationships and trust
15. Like and be likeable
16. Request help or advice
17. Be influenceable
18. Lead by Example

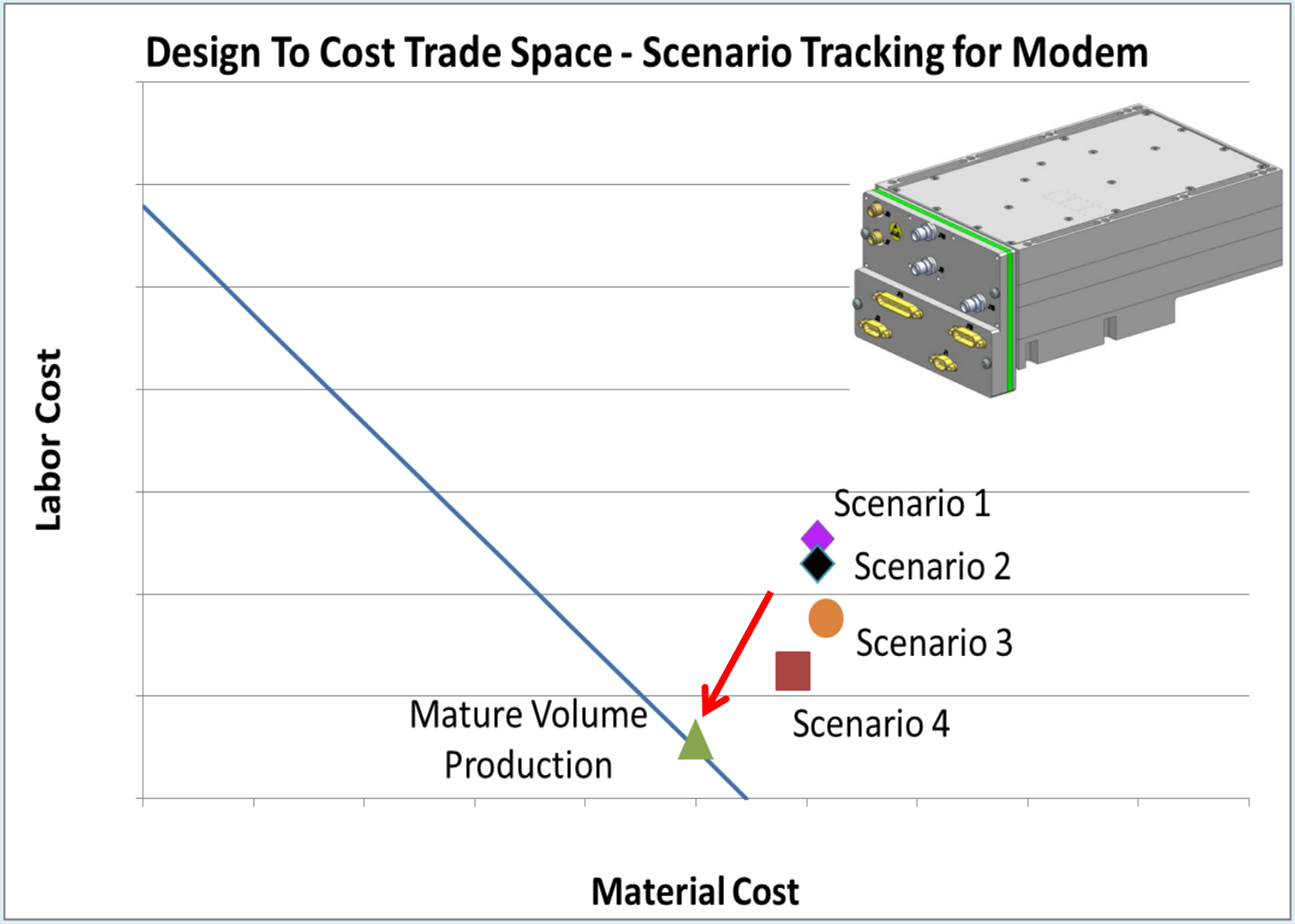
How to Facilitate DFMA ?



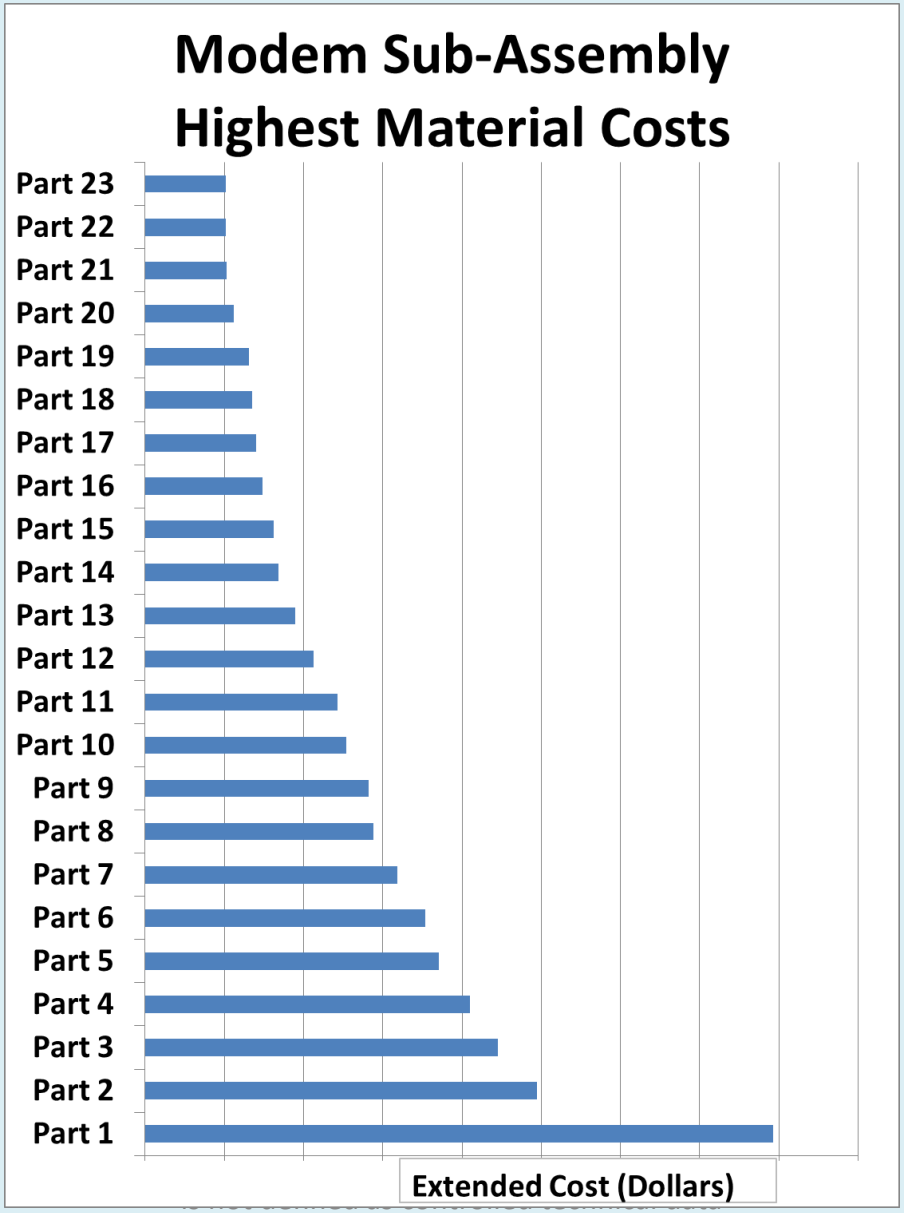
Facilitating DFMA in Concept Phase



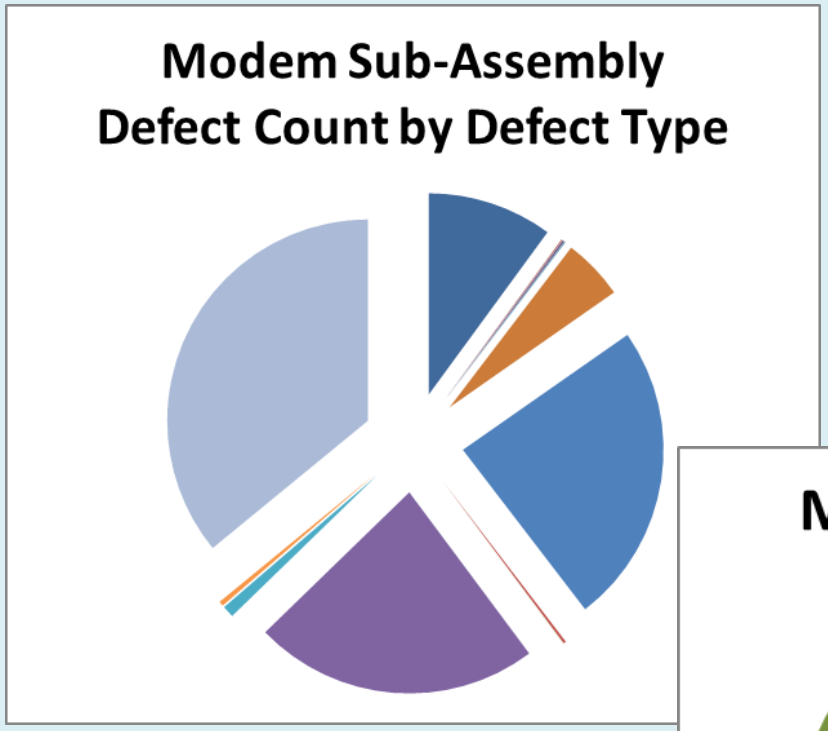
Target Costing

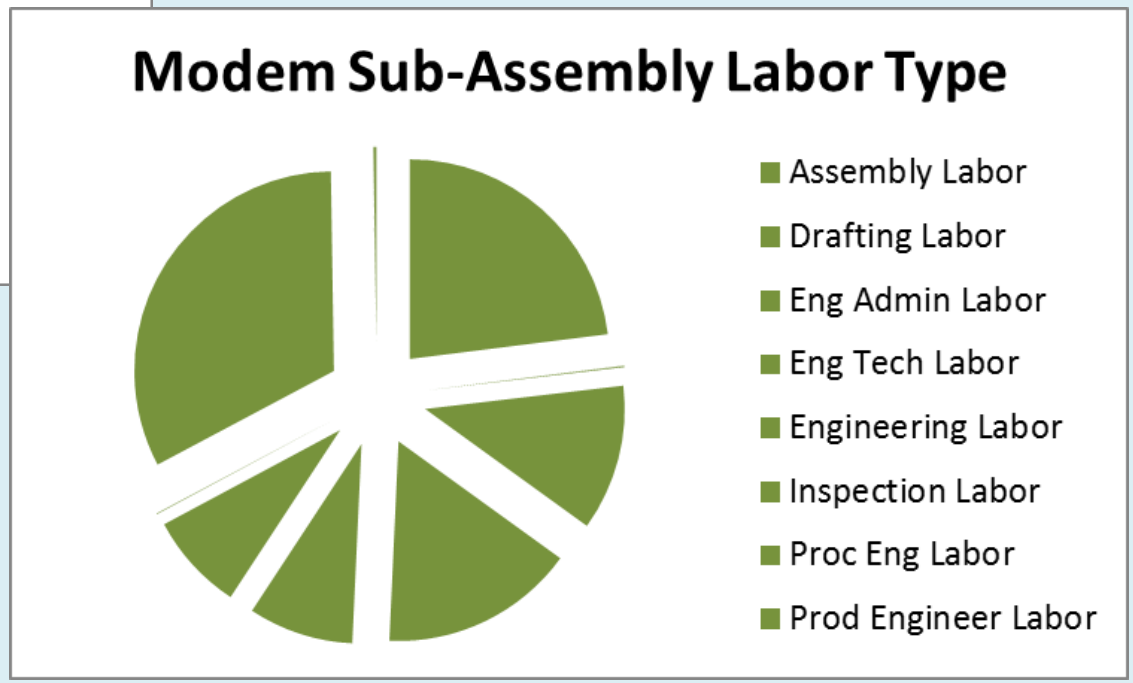


Prioritize Material Cost Drivers

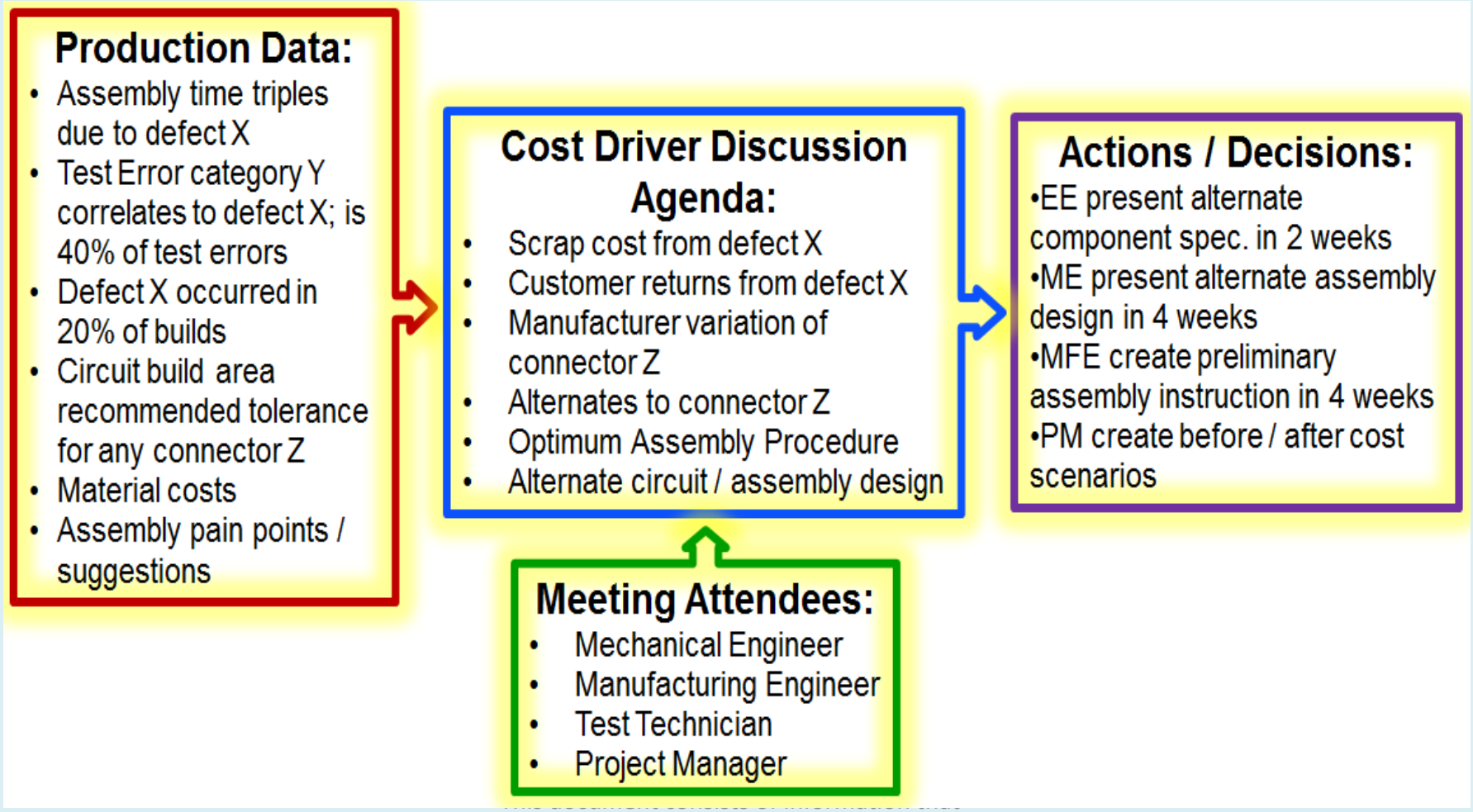


Prioritize Labor Cost Drivers

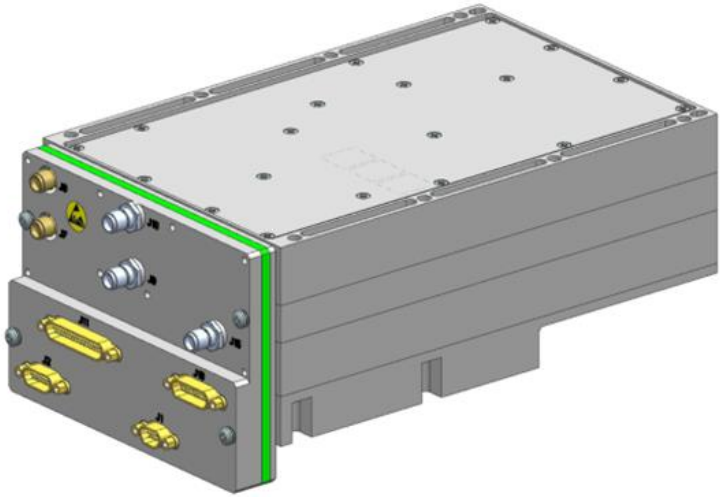


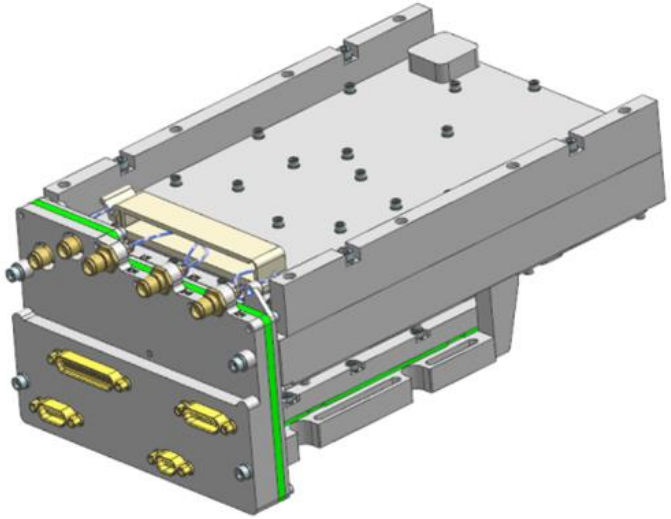


DFMA Discussions and Actions for the Modem Sub-Assembly

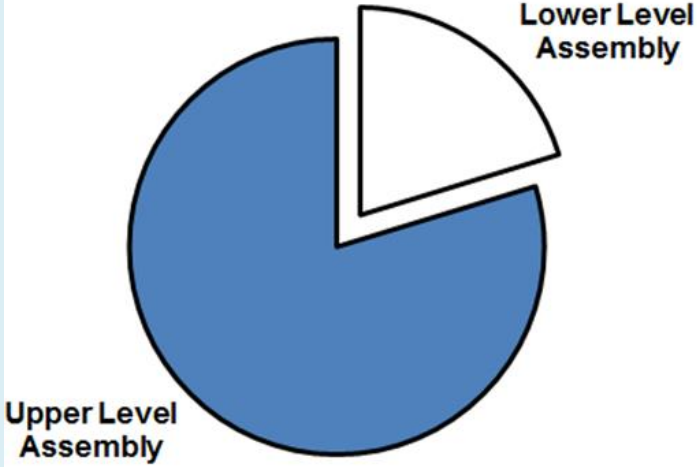


Modem Sub-Assembly Redesign



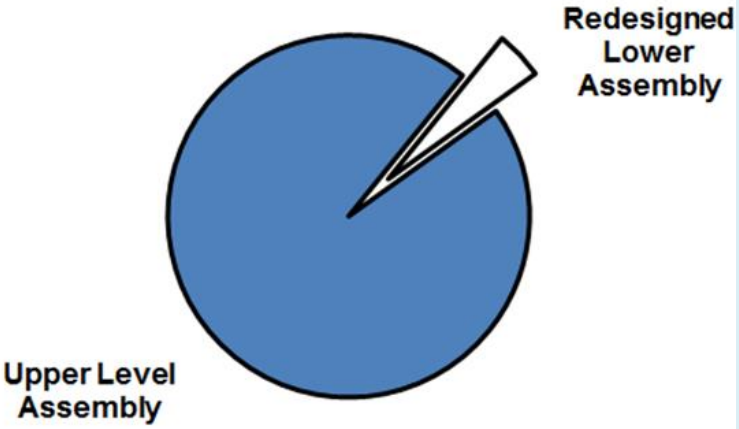


Modem Labor Breakout

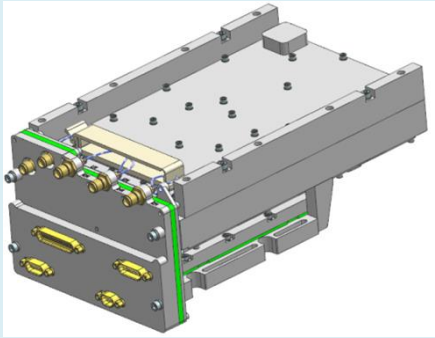


After DFMA

Estimated Labor Breakout of Redesigned Modem



Modem Sub-Assembly DFMA Case Study Summary

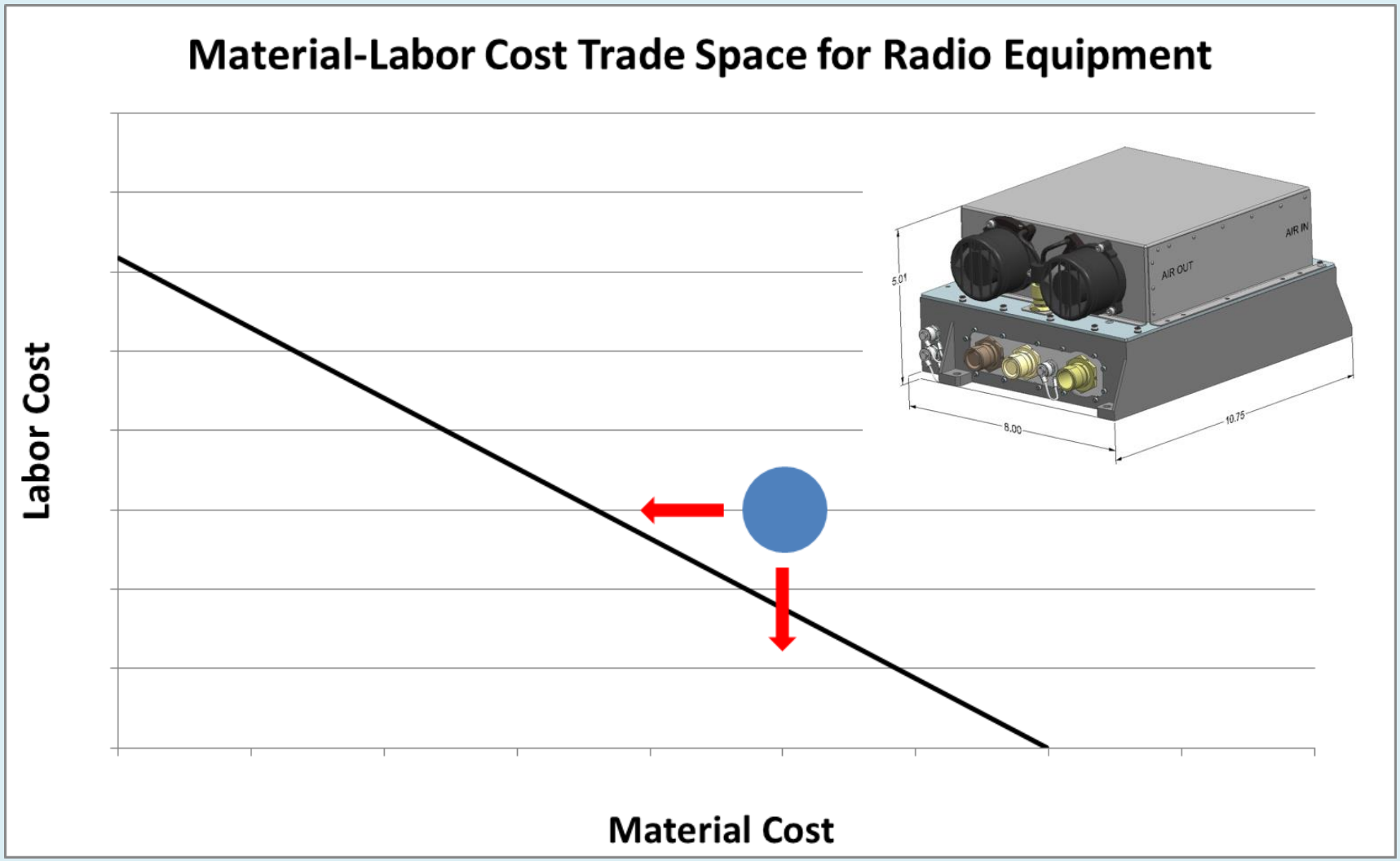


Projected Value of DFMA effort:

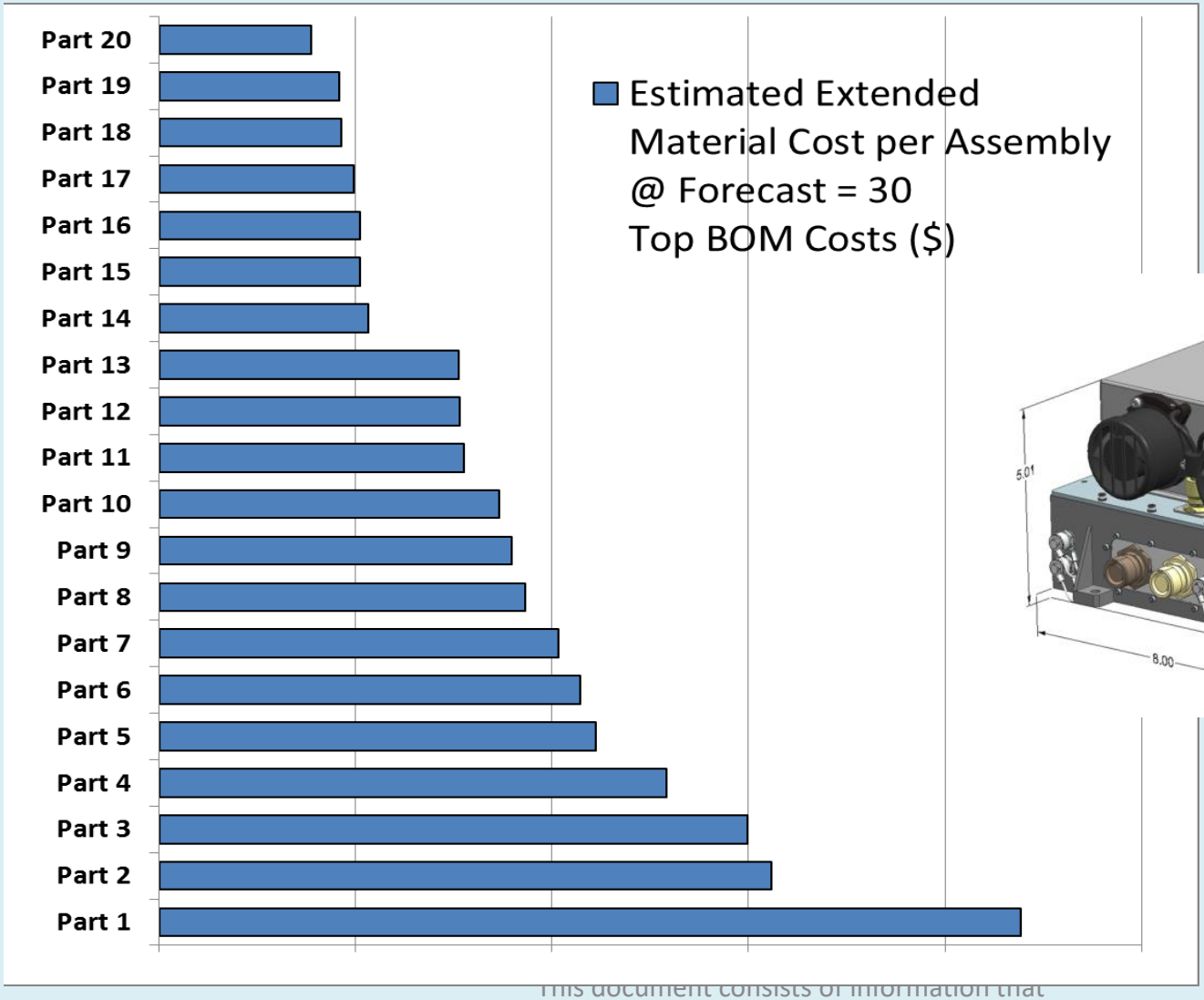
1. Reduced some Material Cost
2. Reduced Assembly Constraints = Reduced Defects = Reduced Labor

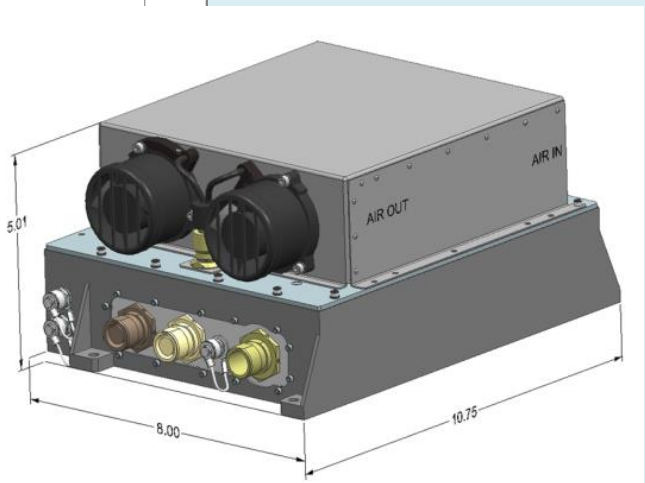
- **Facilitation Approach**
  - Met with Test Engineer to correlate defect data to design features
  - Reviewed design features and assembly steps with Manufacturing Engineer, Design Engineer and Drafter
- **Stakeholder Analysis**
  - Program Manager valued reduction of product cost by DFMA
  - Engineer valued collaboration legwork to improve / validate his design
  - Operations / Test had a say in defect prevention to improve yield
- **Influence Strategy**
  - Impactful Data presentation, siting procurement and production sources; changed component choices and design features. Reciprocity and asking advice, encouraged collaboration to reach shared goals.

Radio Equipment Case Study

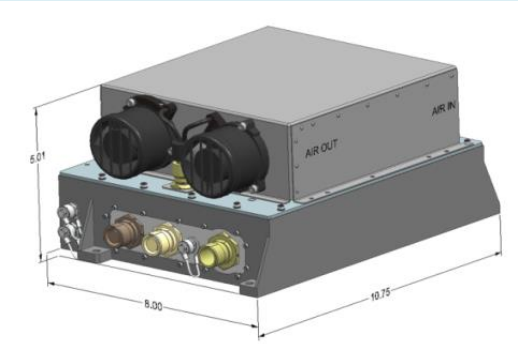


Radio Equipment
Prioritized Material Cost Drivers





Radio Equipment Case Study Summary



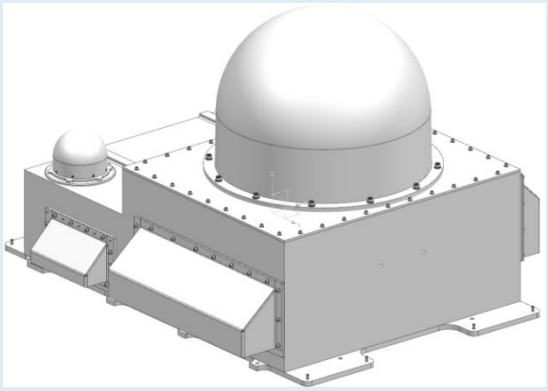
Projected Value of DFMA effort:

1. Replaced an expensive heat exchanger and electronic components
2. Reduced projected transition-to-production labor

- **Facilitation Approach**
  - Reviewed 3D print and solid model with Design Engineer and Manufacturing Engineer, resulting in nine improvements to drawings, and assembly sequence and tools.
  - Provided lead time and price breaks on alternate components
- **Stakeholder Analysis**
  - Program Manager wanted non-recurring expenses (NRE) in control
  - Engineer valued collaboration to reduce transition-to-production labor
  - Operations / Test had a say in defect prevention to improve yield
- **Influence Strategy**
  - Impactful Data presentation, Urgency, Social Proof from senior engineer.
  - Reciprocity and asking Advice, and task follow-up to reach shared goals.

Antenna System Case Study

Eleven Principles associated with DFMA:

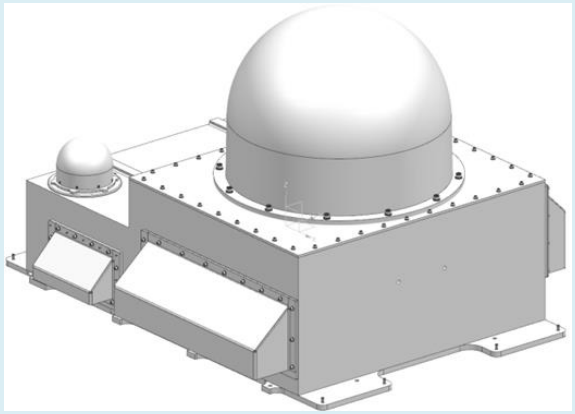


1. Mistake-proof the design
2. Minimize the number of parts
3. Minimize the use of fasteners
4. Minimize reorientation during assembly
5. Provide accessibility
6. Use modular subassemblies
7. Standardize parts and processes
8. Use self-locating features
9. Minimize operations and process steps
10. Make tolerances as liberal as possible
11. Avoid the need to make adjustments

Antenna System Assembly Scoring

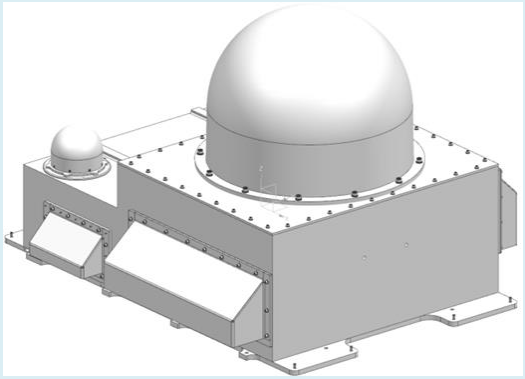
Task (e.g. Fasten to XYZ)	Total Repeats (if > 1)	Approach	Fastening	Comments	Operation Score	Assy Time (sec)
Install cable plate b/w main and small box	6	Side with hold	Screw, stud, connector	Brazed Box starts upside down, inlet facing you	45	90
Install cable plate to side of PS enclosure	8	Side with hold	Screw, stud, connector		45	120
Install big inlet plate	15	Side with hold	Screw, stud, connector	partial screws	45	225
Install small inlet plate	7	Side with hold	Screw, stud, connector	partial screws	45	105
fasten cables to RFE	7	Side with hold	Screw, stud, connector	outside of box	45	105
install RFE	4	Top without hold	Screw, stud, connector	counterweight or support underneath RFE if the box tips	70	48
connect and route RFE cables	7	Side with hold	Screw, stud, connector	4 tie downs?	45	105
Install fan tubes over RFE fans		Side with hold	Snap together	spin brazed box on table 180, outlets face you	75	6
fasten small outlet plate	3	Side with hold	Screw, stud, connector	partial screws	45	45
fasten big outlet plate	11	Side with hold	Screw, stud, connector	partial screws	45	165
install outlet fans	2	Side with hold	Screw, stud, connector		45	30
install PS module	6	Top with hold	Screw, stud, connector		60	90
install control module	10	Side without hold	Screw, stud, connector	(perhaps mount PS and control modules after inlet plates)	50	120
connect outlet fan power cable	1	Side with hold	Screw, stud, connector		45	15
connect, route power cables	7	Side with hold	Screw, stud, connector	6 tie downs?	45	105
connect, route control cables	3	Side with hold	Screw, stud, connector	3 tie downs?	45	45
Install small antenna	6	Top with hold	Screw, stud, connector	flip brazed box upside up	60	90
Install big antenna	5	Top with hold	Screw, stud, connector		60	75
fasten antenna rivets and nuts	2	Top with hold	Screw, stud, connector	swivel antenna	60	30
Install big antenna cover	12	Top without hold	Screw, stud, connector		70	144
connect and route antennna cables	4	Side with hold	Screw, stud, connector		45	60
fasten cover of brazed box	38	Top with hold	Screw, stud, connector		60	570
fasten small inlet cover	9	Side with hold	Screw, stud, connector	fasten covers as one of the last steps	45	135
fasten big inlet cover	14	Side with hold	Screw, stud, connector	fasten covers as one of the last steps	45	210
fasten small outlet cover	7	Side with hold	Screw, stud, connector	fasten covers as one of the last steps	45	105
fasten big inlet cover	13	Side with hold	Screw, stud, connector	fasten covers as one of the last steps	45	195
fasten small bottom plate	26	Top without hold	Screw, stud, connector	Can be done earlier, after small antenna cable fastened to antenna	70	312
fasten big bottom plate	48	Top without hold	Screw, stud, connector	ONE of the last steps, requires flipping the heavy box back over	70	576
All cable tie downs	13	Bias(angle) with hold	Snap ring, cable tie	min. 13 tie downs, depending on vibes and cable assy standard	45	234

Antenna System
DFMA Design Changes



1. Reduced the type and count of fasteners
2. Planned efficient cable lengths and assembly
3. Accommodated testing access
4. Reduced assembly steps
5. Added threaded bosses for a rotating fixture
6. Created concept of rotating fixture
7. Beveled edges for smoother part mate and avoid connector damage

Antenna System
Case Study Summary

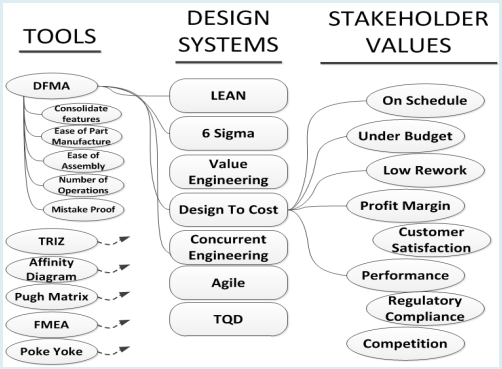


Projected Value of DFMA effort:

1. Reduced significant labor in Assembly and Testing

- **Facilitation Approach**
  - Discussed assembly steps with Design Engineers, Mfg Engineer, Assembler, Fixture maker; aided by solid model and 3-D prototype.
- **Stakeholder Analysis**
  - Design Engineers and Program Manager had a pressing schedule but were open to the cost savings of DFMA and facilitated collaboration.
  - Production was willing to research assembly fixture options for the chance to make assembly easier.
- **Influence Strategy**
  - Used tight schedule and model flexibility to create urgency.
  - Asked opinions, encouraged research, built rapport, led by example, cited DFMA best practices
  - Aligned with shared purpose.

Conclusion



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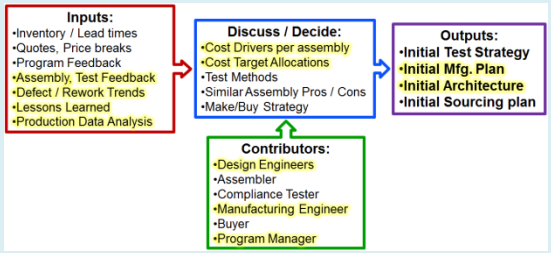
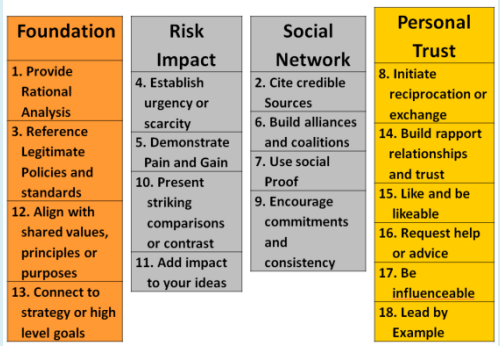
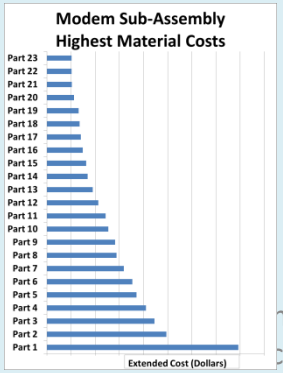
Operations	1.) On-time shipments 2.) Low Rework 3.) Available Material 4.) Passes Inspect/Test	- Collaboration is inconvenient - Not the design expert - Late involvement	- Less variation = less rework = ship on-time - Improves drawings and instructions

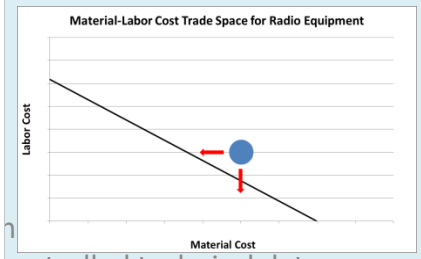
Create Value with DFMA





Facilitate DFMA





Influence Strategy