The Evolving Role of MBD

at Northrop Grumman

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GLOBAL PRODUCT DATA INTEROPERABILITY

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ELYSIUM Parker Aerospace NORTHROP GRUMMAN BOEING

Propulsion System - Promontory, Utah
Defense Electronic Systems - Fort Worth, Texas

The focus of this presentation is based on the work done at

Flight Systems Group

Propulsion Systems
Promontory, Utah Division

Defense Systems Group

Defense Electronic Systems
Ft Worth, Texas Division

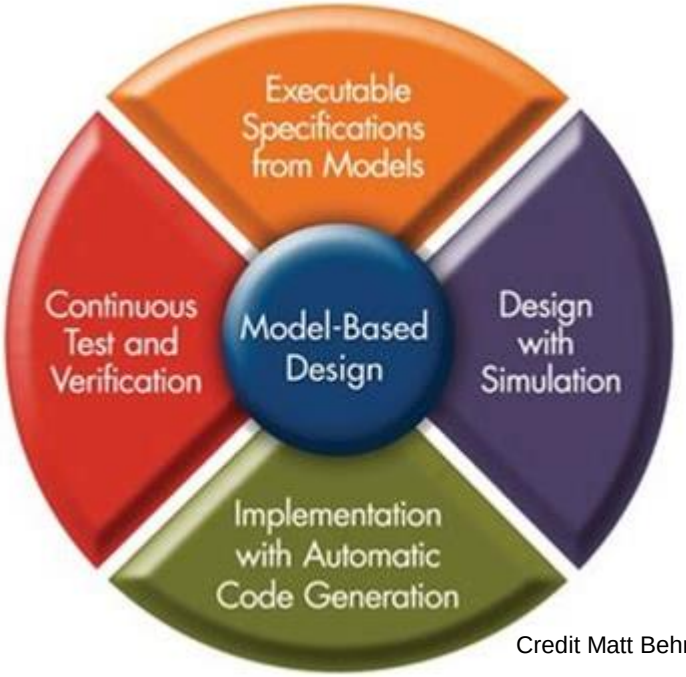
Agenda

- What is MBD
- History of CAD models at Propulsion Systems
- 2D Drawing Only
- 2D Drawing with Associated 3D Model
- 3D Annotated Model
- Future of CAD models at Propulsion Systems
- How MBD and the future of CAD are related
- The Hard Reality of MBD implementation
  (The Matt Johnston Story)
- A look at another sites Engineering, CAD, Mfg, and Planning
- Opportunities around us for growth with MBD

What is MBD

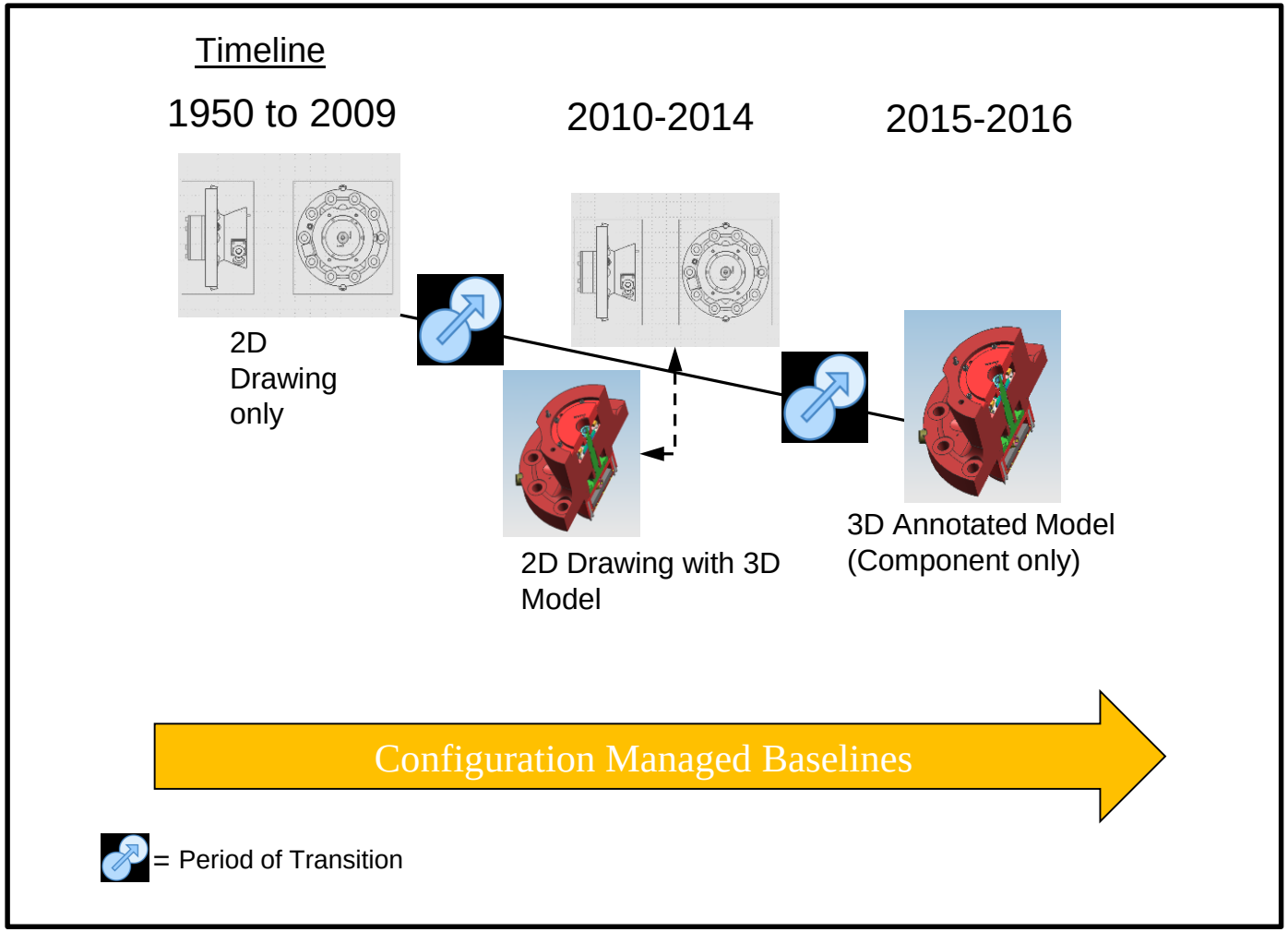
- Model-Based Design (MBD) has various definitions depending on industry and application
- For our aerospace discussion.

  MBD is a mathematical and visual method of identifying and addressing problems.
- The mathematical and visual method is captured in 3D CAD



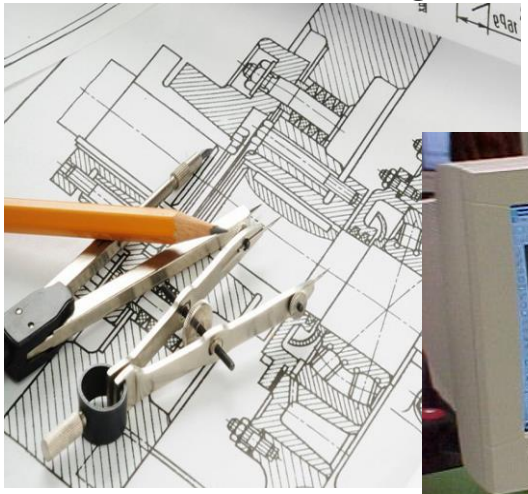
Credit Matt Behr

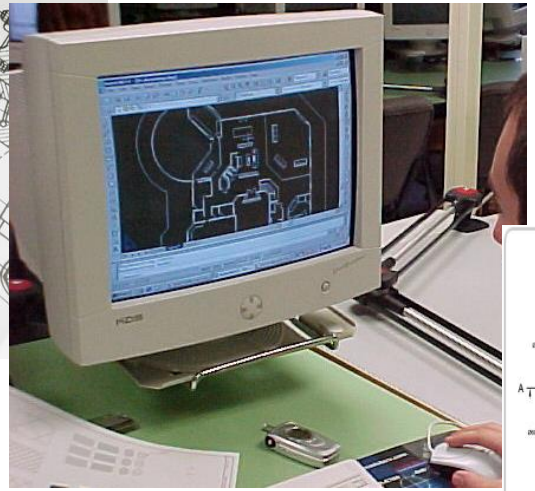
History of CAD models at Propulsion Systems

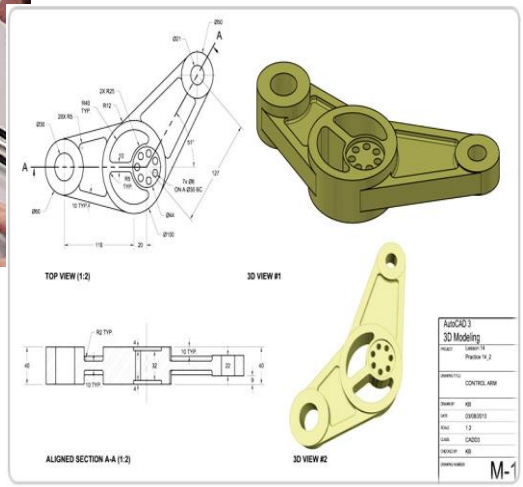


2D Drawing Only

1950-1980 -Board = Paper/Mylar
1980-2000 -2D Digital (Lines, Arcs, etc..) = Printed on demand
2000-2010 -3D Digital (Lines, Arch, etc.. + depth) = .pdf stored in PDM







Challenges of moving away from 2D only

The move from 2D engineering definition to 3D definition isn't "similar"

Infrastructure – Everyone can print a .pdf what platform do you use for 3D

Culture – Many people can't see how to do their work with 3D models

Interruptions – May delay to day to day business

2D Drawing with Associated 3D Model

If eating the whole Elephant is too much, take small bites

Try to break down the problem into pieces that are recognizable and can be overcome

For us we decided to gain CM control of the model and release the 3D models with the 2D drawing*.

*Observe- It is more expensive than just releasing a drawing or just releasing a 3D annotated model. This was a price that was paid to gain acceptance.

Challenges and rewards of controlling models

Challenges:

- Culturally - The drawing was always so important, why is the model now all that important?
- Integrated model problems – if a single model crashed it affected the whole assembly
- Release of assemblies before piece parts highlighted some holes in the CM process.
- We had never had to keep track of what we were working on, just what we released.

Rewards:

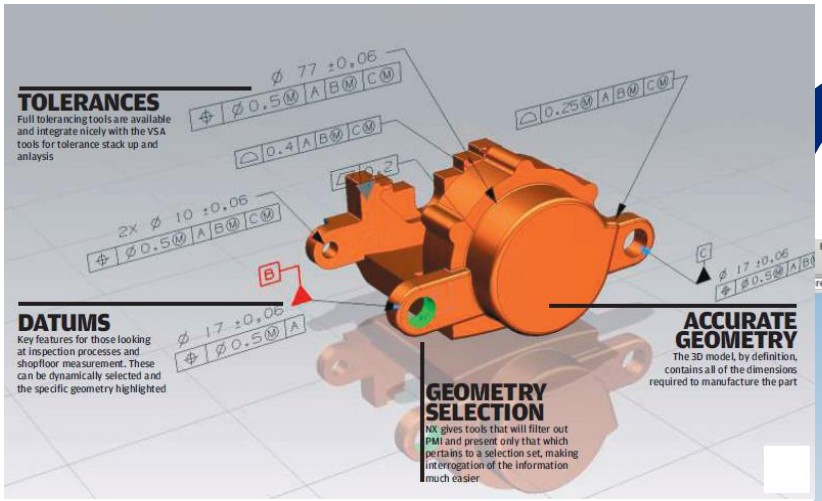
- Gave a stepping stone for people to used the 2D drawing but find value in the 3D model
- Opened the door to having production level trust in the 3D model
- Forced a cultural change to accept that models aren't just for creating drawing
- Forced new workflows to accommodate WIP

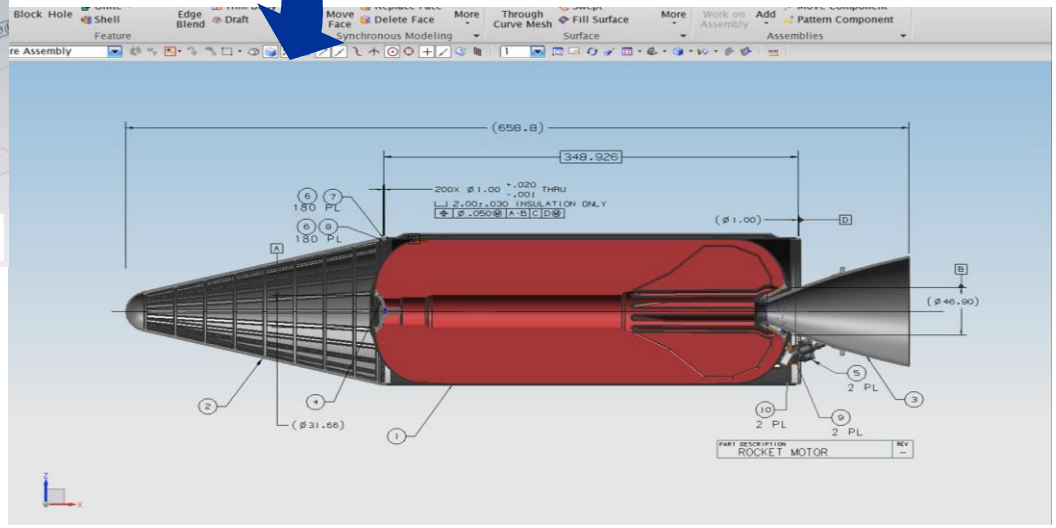
Work in process	For production use
-Frozen	-Validated
-Trade Study	-Released

3D Annotated Model

"Trust is hard to establish"

"The trust has to be there before people can see the relatively small step from 2D drawings to 3D annotated models"





Challenges and Rewards of PMI

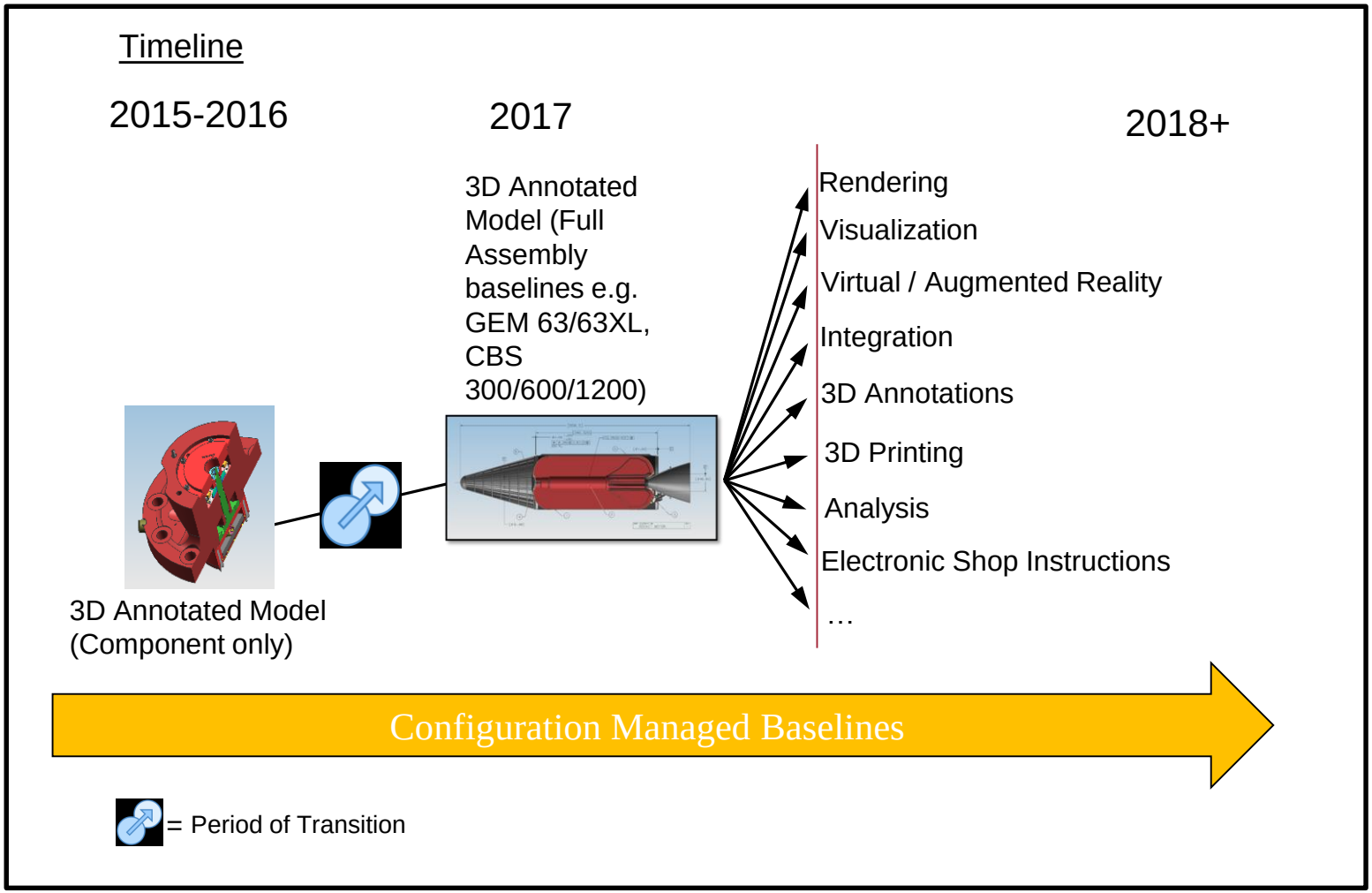
Challenges:

- Culturally – People were used to having a drawing
- Supply Chain – Didn't know how to get suppliers to react to only models; No bids; Unsure how to work with this new approach
- Software – PMI isn't perfected as unbelievable as it sounds
- New territory and unknown problems – We didn't know what we didn't know

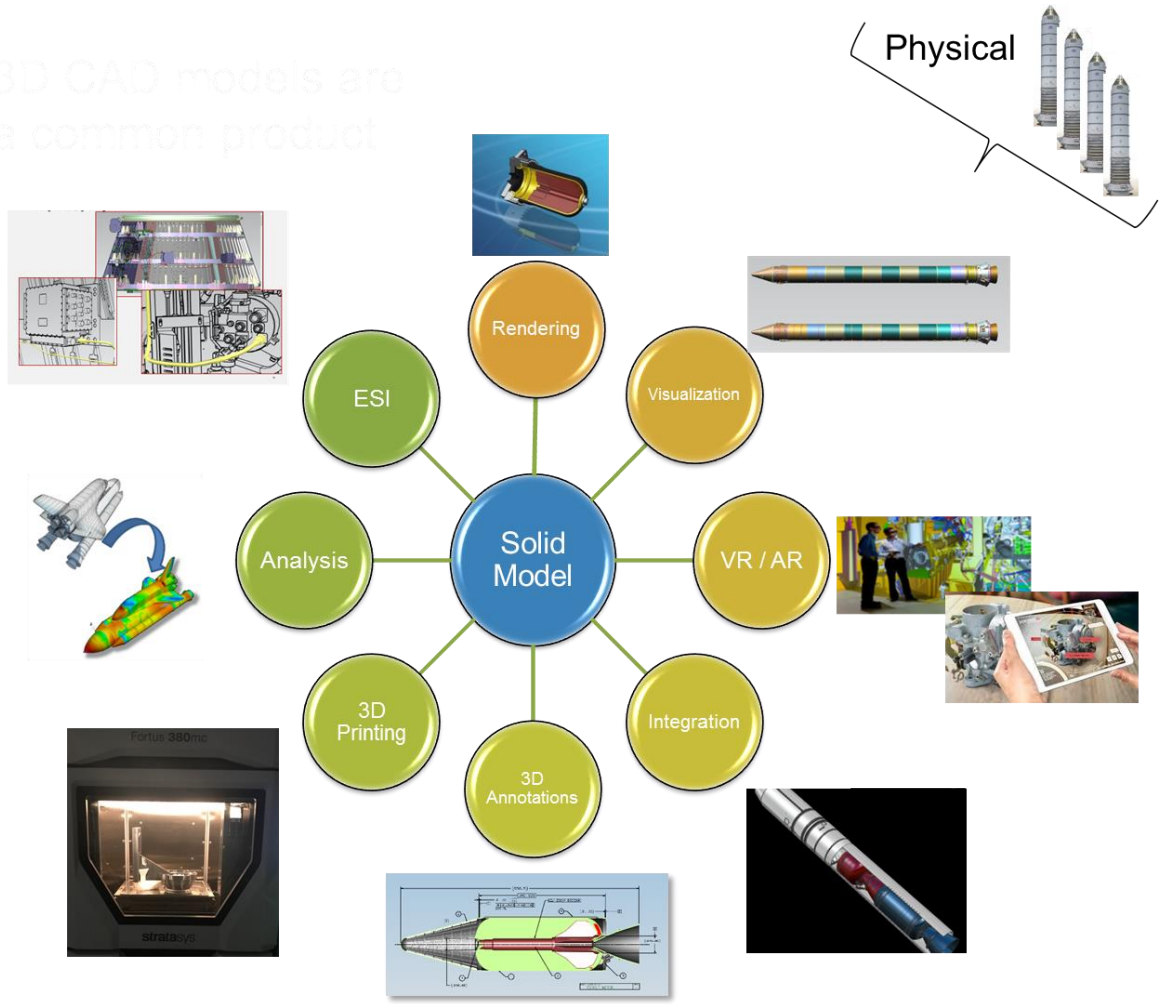
Rewards:

- ROI that we recognize from using PMI
- We have run several programs at lower cost and have had better outcome because of PMI
- Fully exposed our workforce to 3D models. That knowledge base have found many previously unknown uses for the 3D models

Future of CAD models at Propulsion Systems



How the future of CAD realizes MBD



The Hard Reality of MBD implementation

Matt Johnston was the Design Manager at Propulsion Systems and was highly instrumental in getting MBD established.

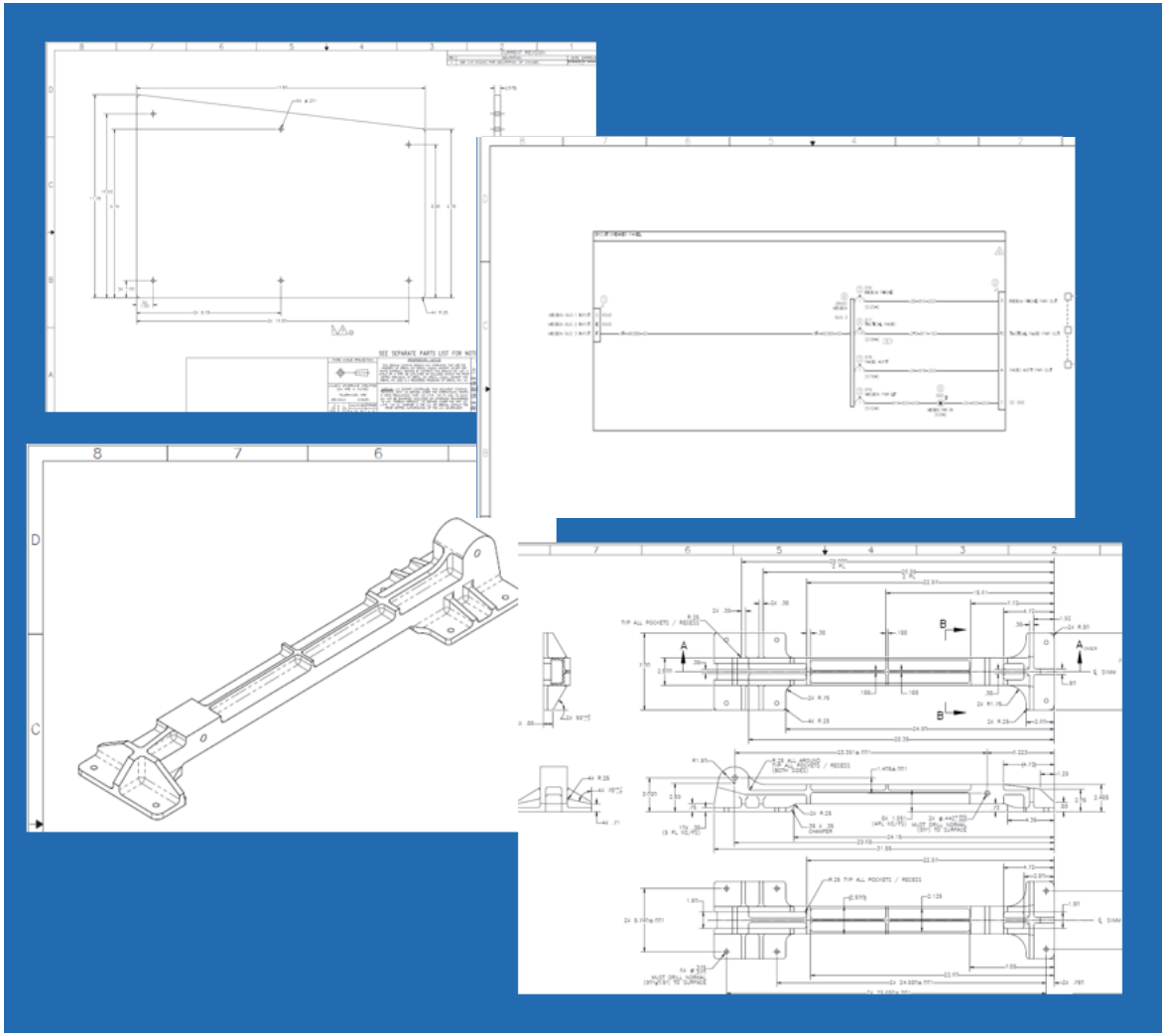
For family reason Matt moved to Ft Worth TX but stayed with NG and took on a roll at Defense Electronic Systems

He quickly found out …..

The accomplishments of one site does not always equate across all the company

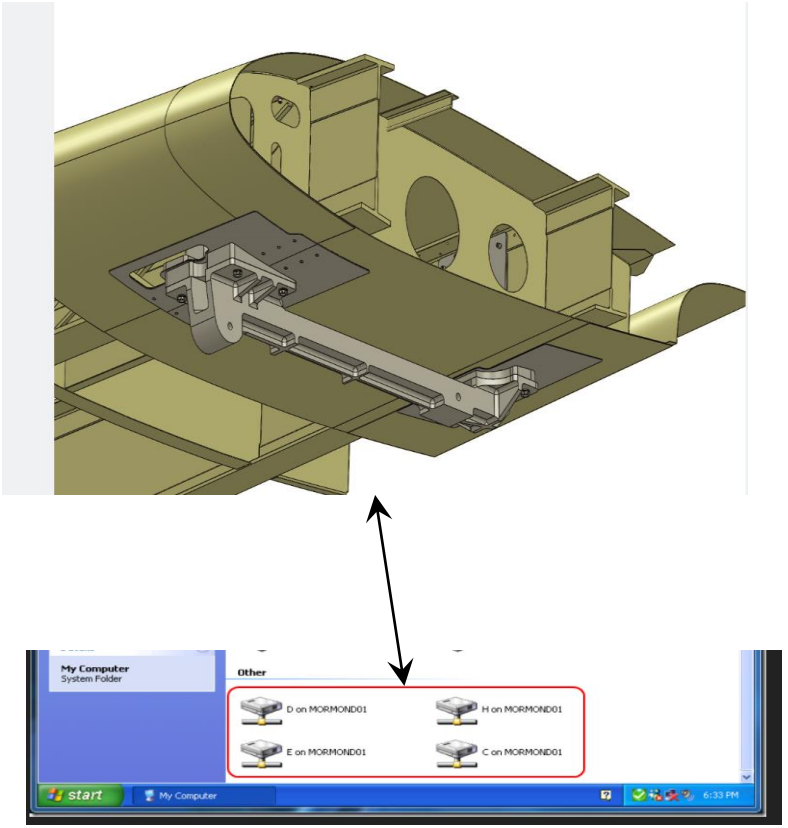
What was happening with Engineering

- 2D Only Mechanical and Electrical Drawings for Engineering
- No GD&T – All Square Dimensioning
- No Harness Drawing Just A Schematic
- No length of harness just “cut to fit” based on planning notes



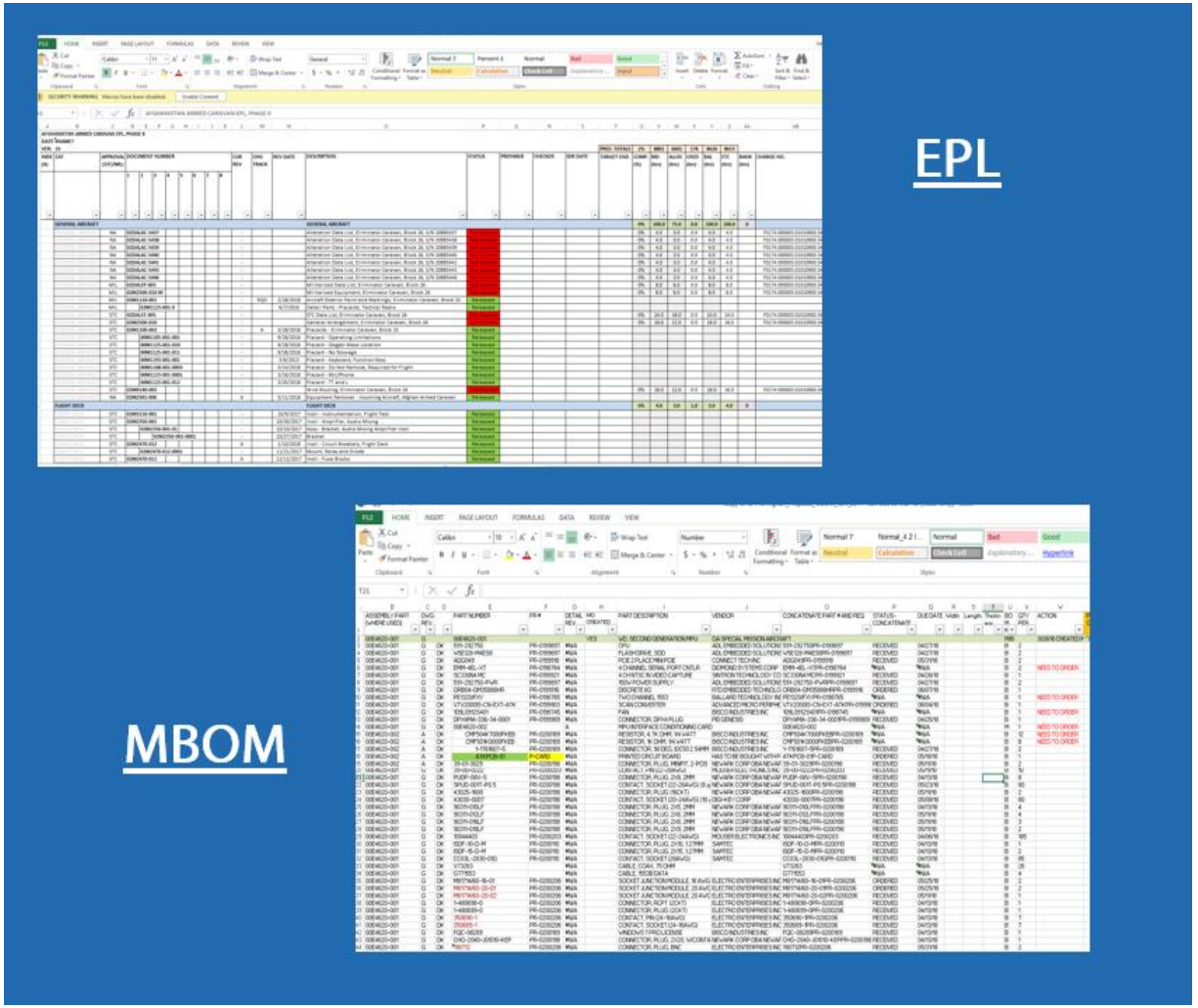
What was happening with CAD

- 3D Models not Controlled and just used for 2D Drawings
- Models are not released or locked
- Models were not validated or trusted
- Models are kept on Engineers “Shared Drive”



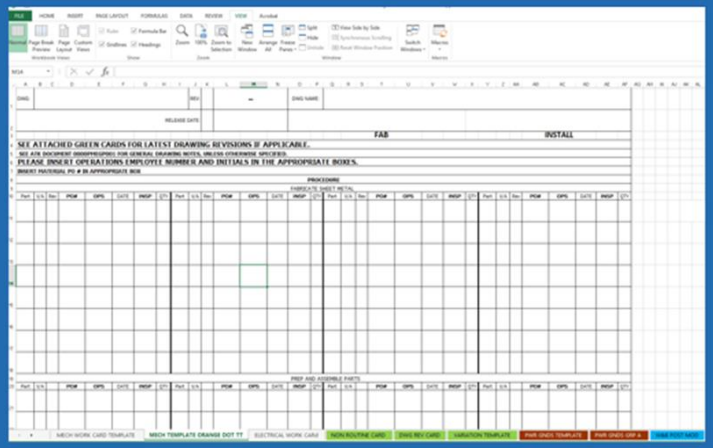
What was happening with Manufacturing

- EPL/MBOM
  - Created in Excel
  - Maintained on "Shared Drive"



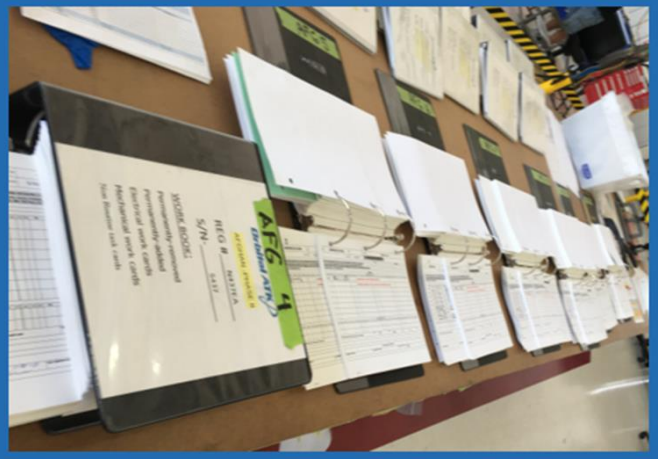
What was happening with Planning

- Planning
  - If Digital it was Created in Excel
  - Maintained on “Shared Drive”
- Time consuming to update
- Everything Manual



Planning

Work Books



The Hard Reality

Matt said in his own words
“I went from Excellence to Excel”

“After a while the Whitesnake song came into my head”

Opportunities for Change

Immediate Opportunities:

- Teamcenter Visualization for Drawing Compares and Viewing Models
- Releasing Native CAD with Drawing in Teamcenter
- Create and Release .stp files for Machined Parts
- Cost Point Routing Module for Manufacturing Planning
- Cost Point Manufacturing Order used for Labor Collection (barcode)
- MBOM Creation in Cost Point

Future Opportunities:

- Use 3D Annotated Models for all Machined parts
- Implement Teamcenter for control of Models, Drawings and Parts List
- Utilize Teamcenter for E/MBOM
- Implement TIPQA for Inspection Planning and MRB
- Create Harnesses Drawings from 3D Models
- Route Harnesses in Aircraft 3D Model

Conclusion

- **This is a journey it is never just a project with a beginning or completion date**
- **This journey is rewarding and discouraging all at the same time**
- **We are happy to help and share this journey with all of you!**

Thank you

Questions??