AUTODESK. UNIVERSITY

MFG323018

Fusion Lifecycle: The Future's So Bright We Gotta Wear Shades

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Dynamic Attractions

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Dynamic Structures

Learning Objectives

- Learn how to identify similar inefficiencies in your processes that can be improved with Fusion Lifecycle
- Discover why Fusion Lifecycle is needed beyond Vault
- Learn about which processes and metadata should be managed in Vault and Fusion Lifecycle compared to an MRP
- Learn why it is important for Vault, Fusion Lifecycle, and the MRP to share data

Description

Learn how to increase efficiency and traceability of your design review and approval processes. This class will show how Fusion Lifecycle software coupled with Vault software will address inefficiencies in existing processes at Dynamic Attractions. This includes a shift from project-based systems to product-based systems. We'll show why a clean-slate approach is needed to align our CAD, Vault, and Fusion Lifecycle data with a new material requirements planning (MRP) system. We'll explain why we plan to only migrate some cleansed library and product data. We'll also cover how we have overcome the cultural hurdles and barriers to improvements; we're excited to finally move forward with a product lifecycle management (PLM).

Speaker(s)

Curtis is the Product Data & Configuration Manager for Dynamic Attractions (DA). DA designs and builds amusement park rides and large telescope structures including many of those on Mauna Kea, Hawaii. Curtis has over 30 years of experience in design, manufacturing, integration and testing. He is a graduate in mechanical design from the BC Institute of Technology. He began his career in pneumatics/hydraulics and then moved on to steel fabrication for the mining and forest industries. Most of his career has been in the subsea industry designing & managing requirements/configurations of submarines, atmospheric diving suits and equipment for the tourist, oil & gas and military industries (including the US Navy). He has implemented multiple CAD & PDM/PLM systems; AutoCAD 9 was the first. He has been with DA since 2015. He has documented/improved DA engineering processes & trained staff. He will next lead a DA team to implement the Autodesk Fusion Lifecycle PLM to work with Vault and a new MRP/ERP.

Curtis Schmidt

Craig is the Lead Designer at Dynamic Structures where he is supervising the design team on the Thirty Meter Telescope Enclosure. He is actively involved in developing the company's approach to CAD Standards, Integration and Methodologies. He is helping coordinate the move to a Product Based Manufacturer from a Project Based one. He has previously held the positions of Engineering Systems Manager and Drawing Office Manager. With over 40 years experience in manufacturing for everything from bridges and material handling to arenas and telescopes, he has a wide background to call upon when determining the best way forward with a design. Craig works hard to ensure his experience, particularly in the field of astronomical equipment design is passed on to his younger co-workers in order to preserve it for future projects. An active participant in all things Autodesk, he remains current in the latest software products and willingly shares his views.

Craig Breckenridge

Table of Contents

Inefficiencies at Dynamic Attractions that Can Be Improved with FLC

This is a list of the major inefficiencies at Dynamic Attractions. These are pitfalls that should be avoided especially if you build repeat products that contain structures and complex electro mechanical systems.

Evolution from Projects to Products

Previously, the bulk of our work was one off projects that were fabrication centric like bridges. Our processes and enterprise software(s) were developed over many years to suit custom one-off projects. Drawing and part re-use was not a requirement.

Fig 1 – Seattle Amgen Helix Pedestrian Bridge

We have evolved and are now designing and building more complex "*Dynamic*" electro mechanical products. We now have product lines. Within a product line there are many parts that can be used again on the next project. The main project differences in our product lines occur at the facility interface which affects the site installation drawings. A good example of this is our Flying Theater Product Line with a total of 12 Flying Theaters worldwide. Over 90% of the parts and assemblies are the same between Flying Theater projects.

Fig 2 – Wuhan Flying Theater

Project based processes that worked well in the past are no longer working well in a Product based business model.

FLC can help Dynamic manage the combination of Products and Projects.

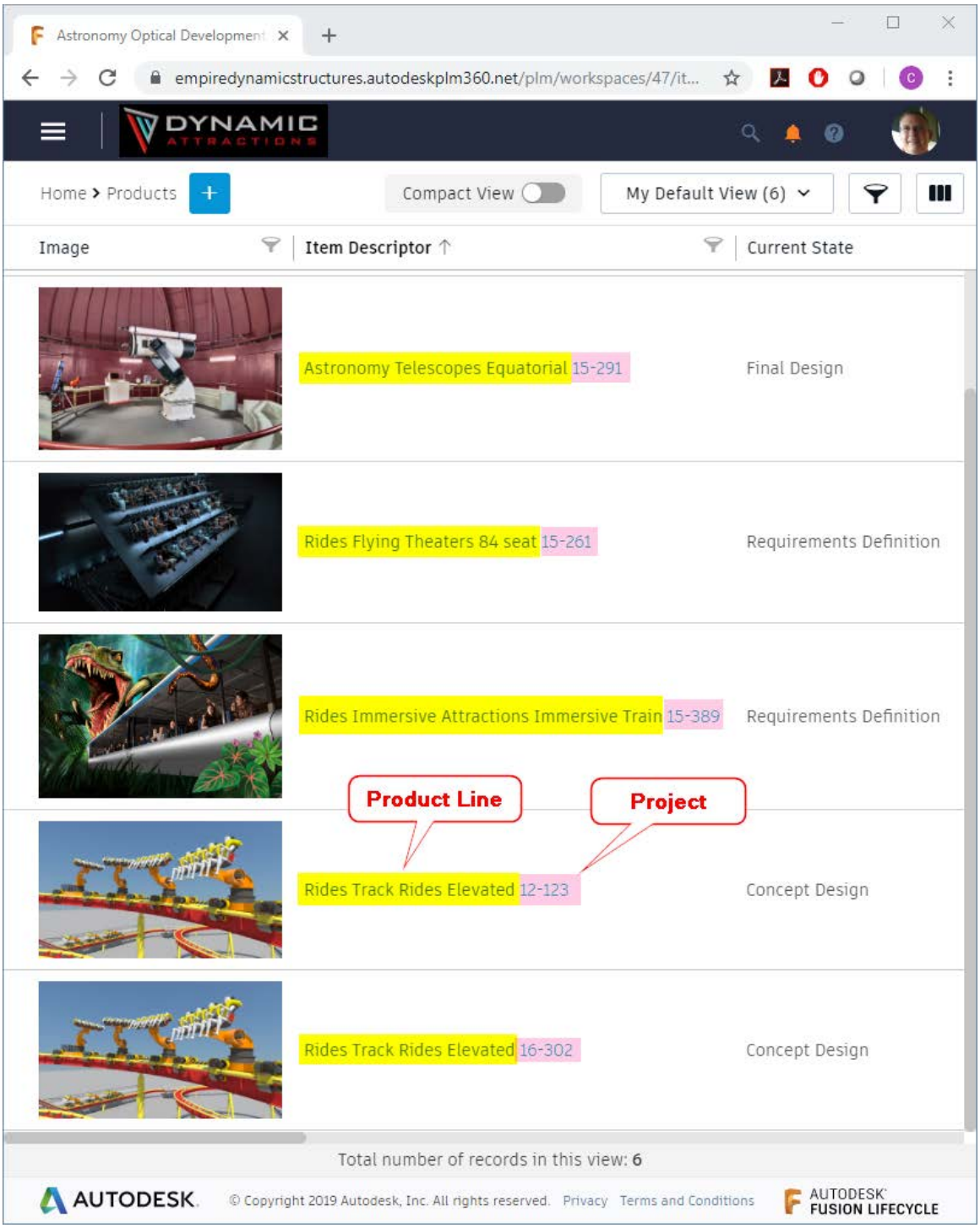

Fig 3 – Dynamic Attractions Proof of Concept FLC Tenant with Products/Projects

Unconventional Downstream Fabrication MRP Software

Many of current project based inefficiencies relate to our MRP system. We have a bad case of *The MRP Tail wagging the Engineering dog.* The MRP has some data input requirements that drives engineering to produce drawings and associated Meta data in unconventional manner. The following is a summary of some of the issues we will be addressing by implementing a new MRP in conjunction with FLC.

No Production Work Order

We have no production work order from our MRP; our drawings act like work orders. Drawings list project specific data like the project number and total project quantities. For a repeat product, we redo the complete drawing package even if 90% of the parts are the same between 2 different projects.

DO NOT SCALE DRAWING			DYNAMIC STRUCTURES			
UNITS: MILLIMETERS			1515 KINGSWAY AVE. PORT COQUITLAM, BC, V3C 1S2		TEL: 604-639-8200 FAX: 604-294-4550	
HOLES: N/A						
SHOP FINISH: N/A						
AFS NO:						
DRAWN: MS	12/6/2017	CUSTOMER: GenM				
CHECKED: FB	3/9/2018	PROJECT: ALIENS VS. PREDATOR				
APPROVED:		AREA: BOGIE				
DESIGNER: FPB		TITLE: BOGIE SPRING ADJUSTER ASSEMBLY 1				
FILE NAME:		PROJECT	CODE/SEQ. NO	DRAWING NO	SHEET NO	REV
14151-sa5067.idw		14-151	350/500	sa5067	1 OF 1	3

Fig 4 – Project Centric Title Block

BILL OF MATERIAL

LINE NO.	TOTAL QTY	QTY PER ASSY.	MARK	DESCRIPTION	FINISHED LENGTH (MM)
1	88	1	p3019	RB 114.3	185
2	88	1	p3020	RB 57.15	220
3	88	1	p4196	RB 63.5	17
4	88	1	p4198	RB 107.95	22
5	88	1	c103755	EPIC-E-71793	
6	88	1	c103756	EPIC-E-71792	
7	88	1	c104282	MCMASTER-98541A139	
8	616	7	b39093	MB M6-1.00 x 20 SHCS	
9	88	1	b39112	MB M8-1.25 x 25 SHCS	
10	88	1	b39133	MB M10-1.50 x 25 SHCS	

3

Fig 5 – BOM Project Total Quantities

Fabrication/Project-centric MRP

Our MRP is well suited to the steel fabrication industry but does not work well for mechanical, fluid or electrical/control systems. For instance, the default project KPIs in the MRP are all based on the weight of steel being processed.

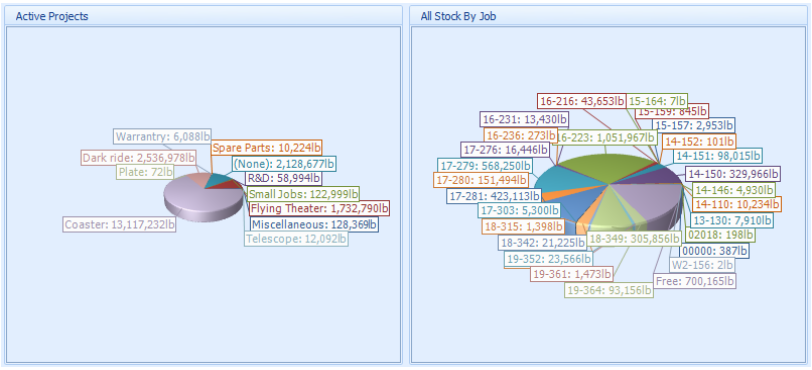

Fig 6 – MRP KPIs

MRP Material Database Does Not Index off Part Number

It indexes off type/size/grade. This works for structural shapes but does not work for mechanical, pneumatic/hydraulic and electrical/controls parts.

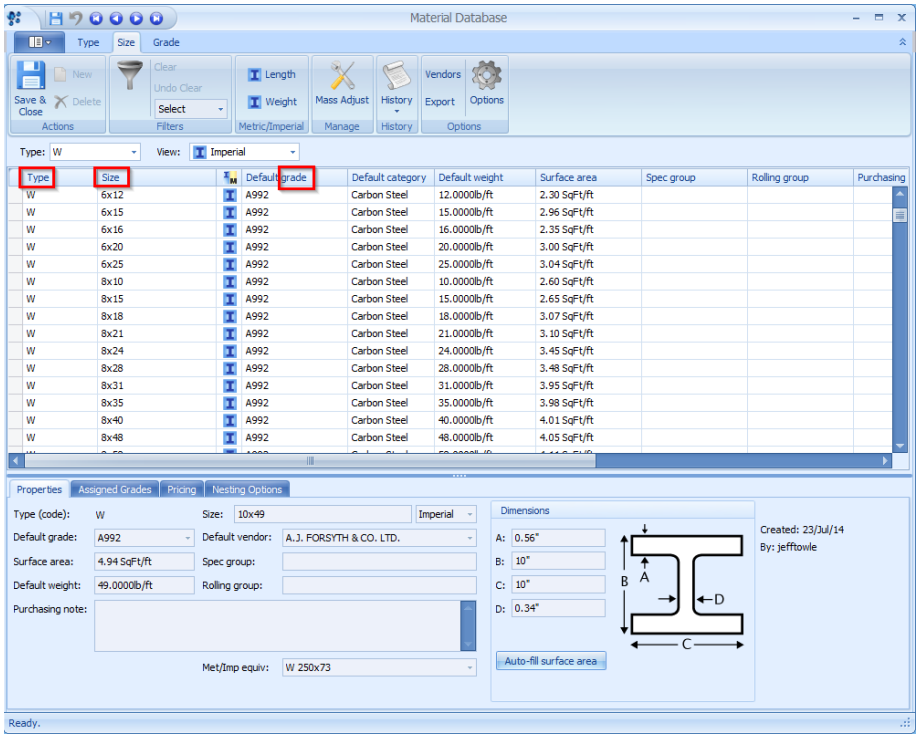

Fig 7 – MRP Wide Flange Structural Shape Example

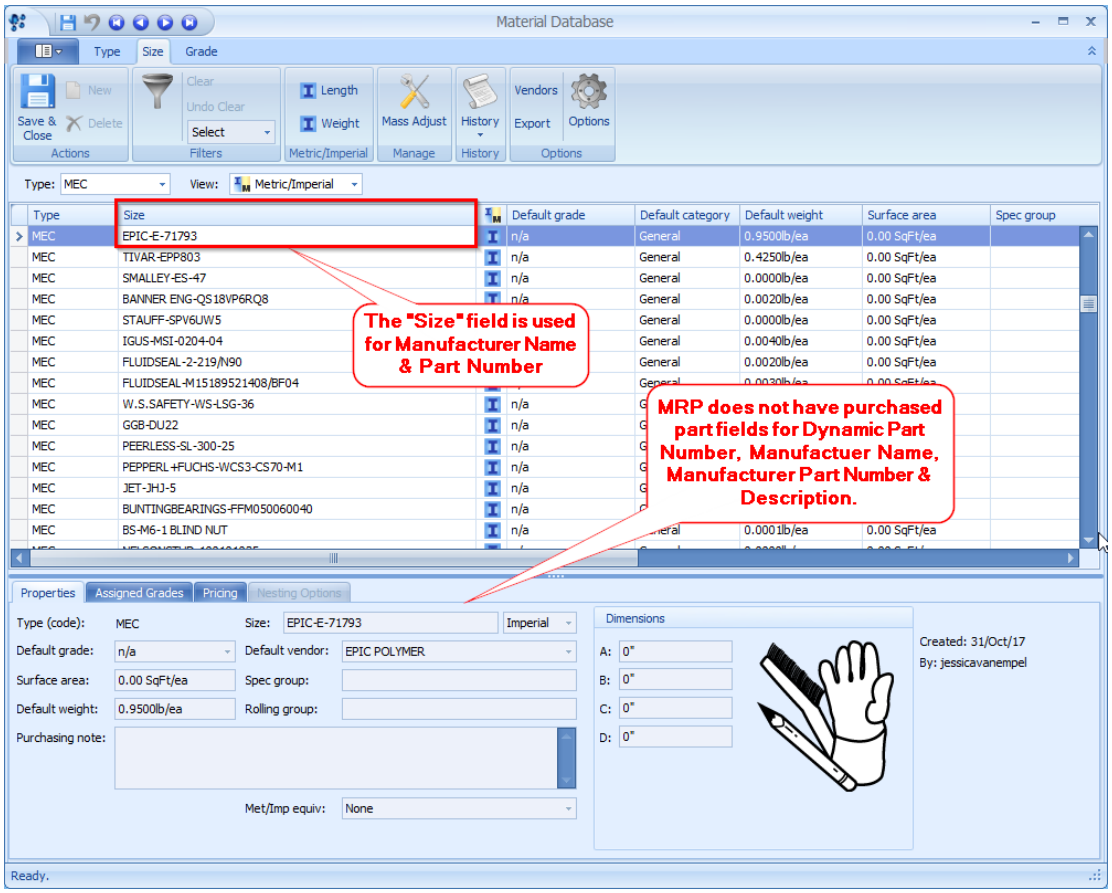

Fig 8 – MRP Purchased Items

MRP has Caused an Unconventional Data Structure in Drawings & Vault

An example is manufacturer names and part numbers. They are in the BOM descriptions of our commercial off the shelf (COTS) purchased parts. This is because our current MRP does not have separate fields for the Dynamic Attractions part # or the manufacturer name and part #. The BOM description maps to the Size field in the MRP. The description is the unique identifier rather than the Dynamic Attractions part (mark) #.

BILL OF MATERIAL

LINE NO.	TOTAL QTY	QTY PER ASSY.	MARK	DESCRIPTION	FINISHED LENGTH (MM)	WEIGHT EACH (KG)	COMMENTS	GRADE
1	88	1	p3019	RB 114.3	185		MACH, UT	4340 A434 CL BD
2	88	1	p3020	RB 57.15	220		MACH, UT	4340 A434 CL BD
3	88	1	p4196	RB 63.5	17		MACHINE	1144 A311 CL B
4	88	1	p4198	RB 107.95	22		MACHINED	1144 A311 CL B
5	88	1	c103755	EPIC-E-71793		0.095	PRE-LOADED SPRING	--
6	88	1	c103756	EPIC-E-71792		0.171	BUMPSTOP SPRING	--
7	88	1	c104282	MCMASTER-98541A139		0.001	RING EXTERNAL- 32 mm	--
8	616	7	b39093	MB M6-1.00 x 20 SHCS		0.007	DIN 912	CLASS 8.8 FLZN
9	88	1	b39112	MB M8-1.25 x 25 SHCS		0.017	DIN 912	CLASS 8.8 FLZN
10	88	1	b39133	MB M10-1.50 x 25 SHCS		0.028	DIN 912	CLASS 8.8 FLZN

Yellow fields are enerted into MRP Material Database

MRP Material Database has no provision for Pink fields

Fig 9 – Drawing BOM with COTS Items

Using the downstream MRP system to track the drawing review, approval and release process

Our Document control team uses the MRP system to track the drawing approval and release process. Most engineers and designers do not use the MRP, so they lack visibility on where we are in the review/approval process. Note – we are taking steps to track this in Vault using lifecycles instead of the MRP.

BOMs Must Be Imported to MRP

The fastest way to generate a list of drawings to be reviewed/approved is to import the BOMs that list all the drawings. BOMs are imported manually one at a time using a fabrication industry standard text file called the KISS file.

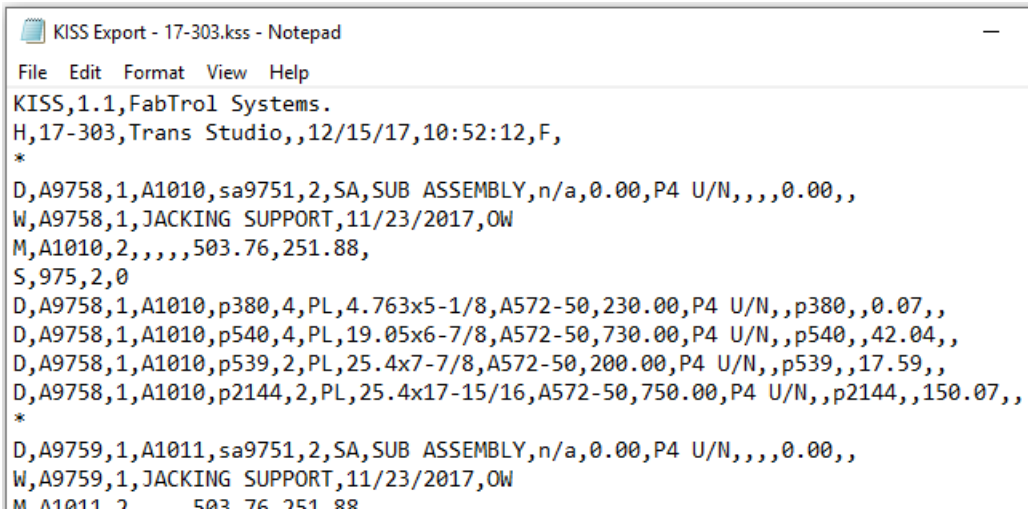

Fig 10 – Portion of a KISS File

We will be replacing this manual importation process with a Jitterbit connection between FLC and a new MRP.

Manual Notification & Tracking Process

There is no automated notification. Notification happens manually via email. The list of drawings to be reviewed is generated using the transmittal functionality in the MRP. Tracking of each step is entered manually in MRP.

RECEIVED
21-Oct-2019 - Rec.772
DOCUMENT CONTROL
darren.malanchuk; 8:47:09 AM

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REQUEST FOR ENGINEERING REVIEW & APPROVAL

Job number: 14-151

ISSUE # 2781

Date Issued: Friday, 11 October 2019

Project name Trick Coaster (SFX2)

Respond by: Thursday, 17 October 2019

Purpose: Engineering Approval

From: Darren Malanchuk
604-449-5790
darren.malanchuk@DynamicAttractions.com

To: John Yang @ Dynamic Attractions (1)
1765 Coast Meridian Road
Port Coquitlam BC V3C 3T7

Cc: Adrian Ostrowka @ Dynamic Attractions, Port Coquitlam BC (1)
Document Control @ Dynamic Attractions, Port Coquitlam BC (1)
Michael Leeb @ Dynamic Attractions, Port Coquitlam BC (1)
Paul Ritter @ Dynamic Attractions, Port Coquitlam BC (1)

Approvals (sign & date & return to sender)

Project Technical Lead: John Yang 2019/10/21
Mechanical Engineer: K. Kaminski 2019/10/11
Structural Engineer:
Electrical Engineer:

Notes: CODE 500

Remarks: AR2780 - ICN 6884

Drawing & Attachments 1 = Approved 2 = Approved as Noted 3 = Revise & Resubmit

	Type	Drawing no	Revision	Date	Drawing title
1	**Fabrication**	sa5001	6	19/Sep/19	VEHICLE FULL CHASSIS COMPLETE
	Fabrication	1			
1	**Part**	p101269	A	18/Sep/19	CLEVIS PIN
	Part	1			

Drawing Count: 2

Fig 11 – MRP Transmittal for Drawing Approval

Rev	Released	Imported	Request for A...	At PS Review	PS Reviewed	PS Reviewed ...	At Eng. Appro...	PTL Approved	PTL Approved...	PTL Revise an...	Request for S...	Released for fab
A		06/Mar/18	06/Mar/18	06/Mar/18	15/Mar/18		15/Mar/18		29/Apr/18			
1	07/May/18										07/May/18	08/May/18

Fig 12 – MRP Drawing Log with Approval Tracking

Process is slow

Due to multiple manual steps and back and forth tracking with Document Control the overall process is slow. FLC has functionality to automate BOM importation and the approval tracking process. This functionality is explained later in this document.

Separate Home Brewed Unconnected Systems

We have separate unconnected or semi-connected systems for NCRs, Change Control, Requisitions, Production Tracking, QC Inspection & Logistics. The Change Control system does not communicate with Vault. The NCR system does not communicate with Change Control system when preventive actions lead to change requests. Part numbers & descriptions are manually entered in the Requisition system

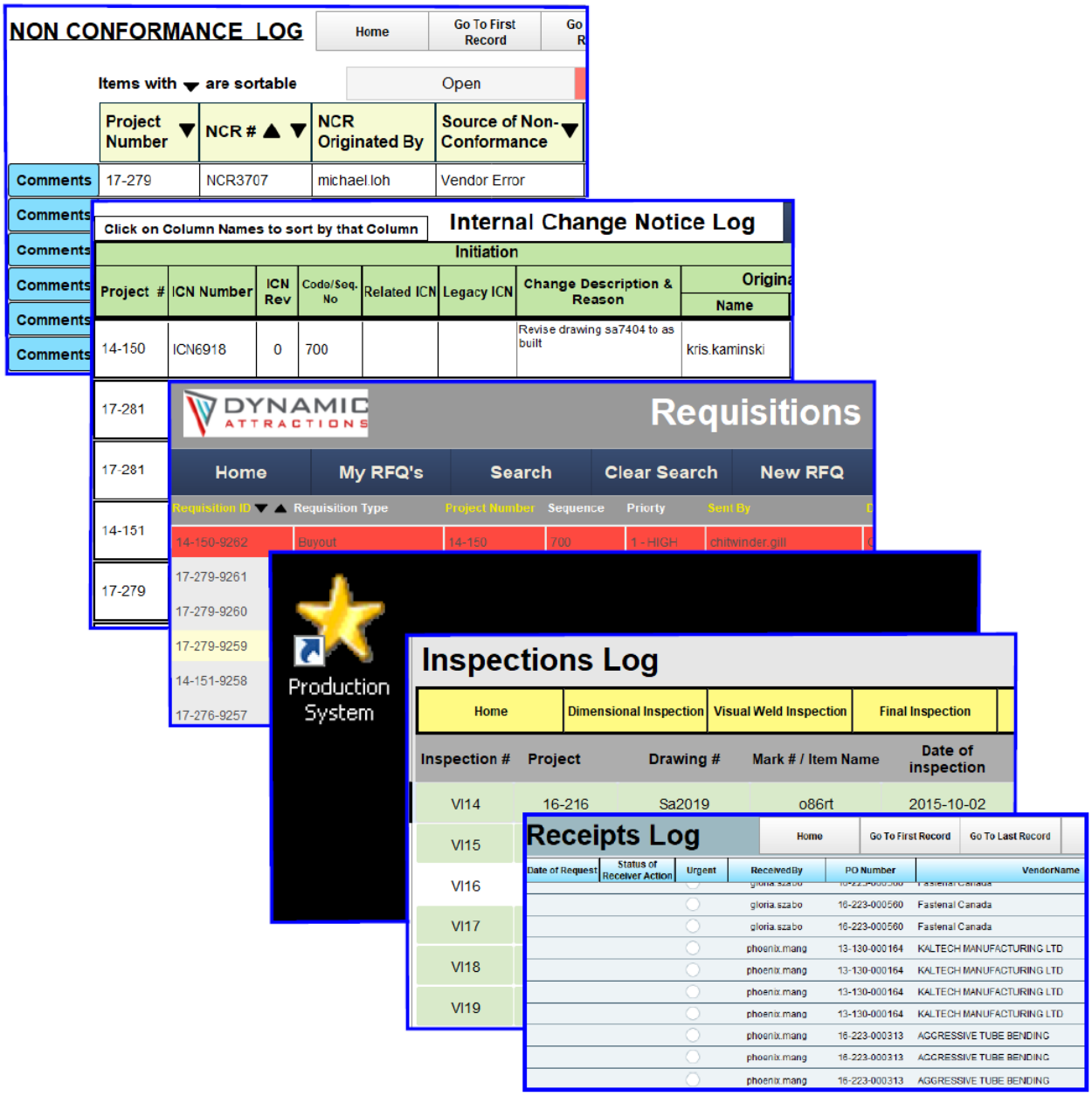

Fig 13 – Examples of Home Brewed Systems at Dynamic Attractions

Our Previous Senior Management Team Chose to Home Brew

We were not leveraging industry best practices and robust database programming built in to a software like FLC. The management team lacked exposure to other MRPs and had never used a PLM. Implementing real improvements was difficult in this culture.

Fig 14 – Clip courtesy of Get On Board Australia

New Senior Management Team has Chosen to replace Home Brewed Systems

Fortunately there has been a change in the senior management team. The new team understands why we need PLM and a new MRP; they have used multiple PLM and MRP solutions. So I am no longer spinning my wheels trying to justify the need. It is no longer a matter of if we will implement FLC; it is now a matter of when. It has been decided the MRP will come first; this will overcome *The MRP Tail wagging the Engineering dog.*

Fig 15 – Gaining Traction Clip courtesy of Direct Marketing Partners

Our existing processes don't scale well

Processes that worked well with a small team sitting together in a single building no longer work.

- Our engineering team previously consisted of people mostly from the structural discipline plus some from mechanical
- Our team is now a more equal blend of structural, mechanical, electrical and controls.
- Our engineering team has grown from 20 to 130 in the last 8 years.
- Our engineering team in Vancouver is spread across 5 buildings in a 1 km radius.
- We also have a sales and engineering team in Orlando
- Our parts and service department is in Texas
- We have engineers at multiple sites supporting installation and commissioning all over the world.

Fig 16 – Clip courtesy of LinkedIn SlideShare

Discover why Fusion Lifecycle is needed beyond Vault

The following is a summary of features that are important to Dynamic. These are out of the box in features in FLC that are not in Vault.

Project teams

FLC has approval lists for setting up different project teams. The project teams are the people required to participate in the approval workflow associated with design stage gate reviews and the engineering change request & change order process.

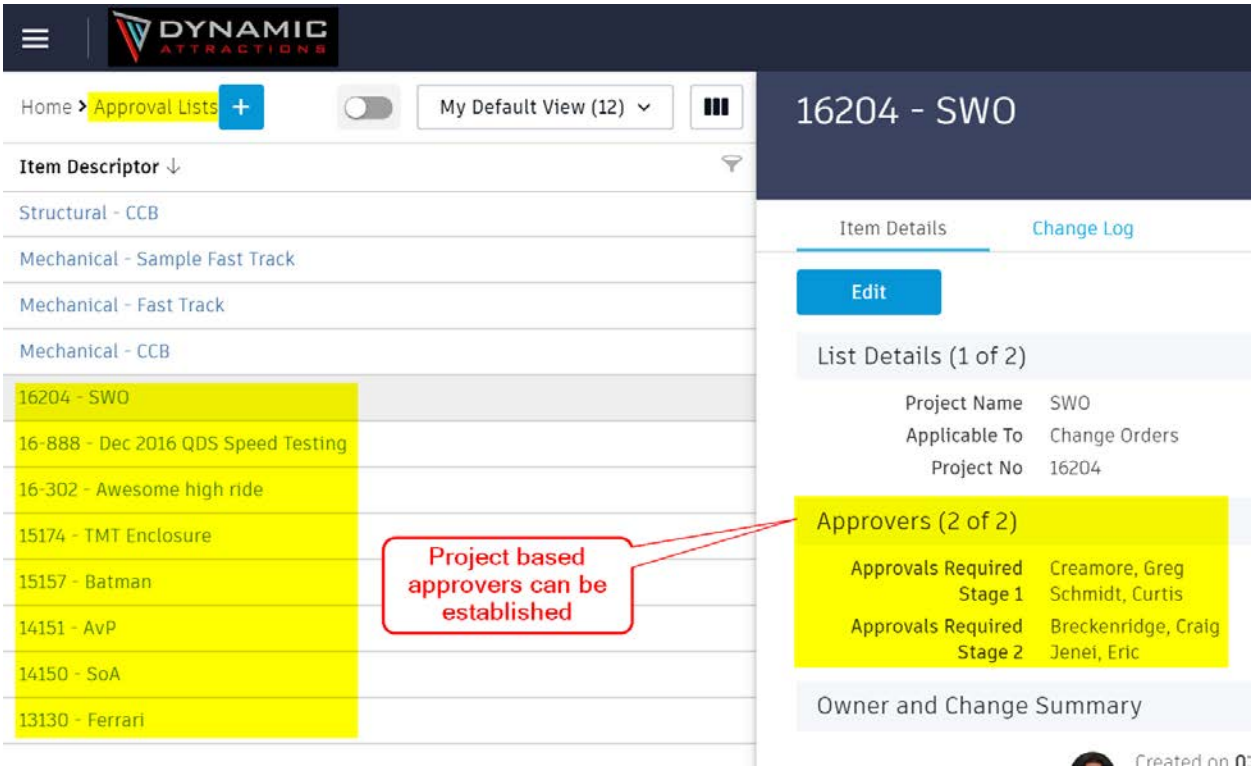

Fig 17 – Dynamic Attractions Proof of Concept FLC Tenant - Approval Lists

Ad Hoc Approvers

FLC has provision to add extra approvers beyond the predefined approval list.

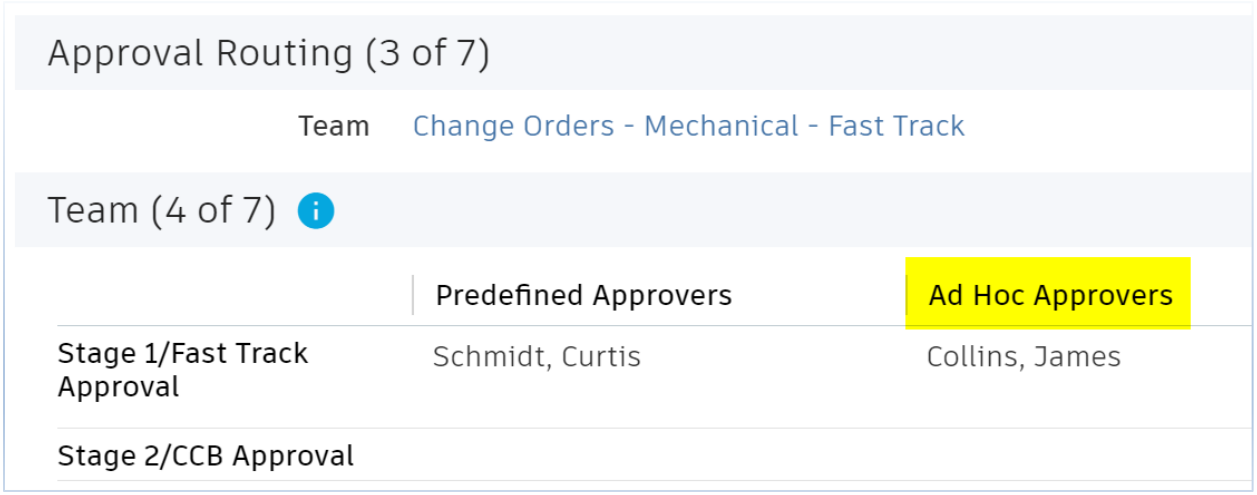

Fig 18 – Dynamic Attractions Proof of Concept FLC Tenant – Ad Hoc Approvers

Delegations

FLC has provision to delegate your work when you are on vacation or an extended absence.

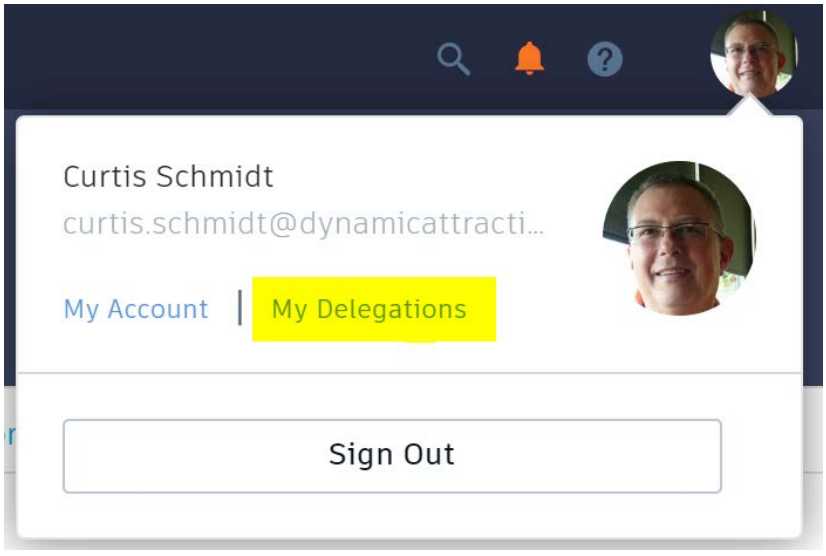

Fig 19 – Dynamic Attractions Proof of Concept FLC Tenant – Delegations

Automated Notifications

FLC has automated email notifications for review/approval tracking based on the project teams.

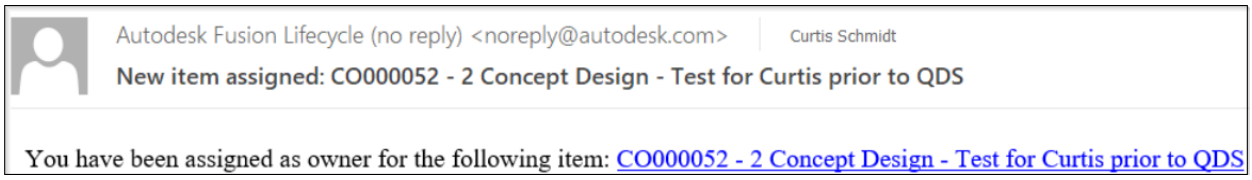

Fig 20 – Dynamic Attractions Proof of Concept FLC Tenant – Notifications

Management of Project Tasks

FLC has provision to manage a work breakdown with project tasks and Gantt Charts. The associated tasks can be assigned to individuals.

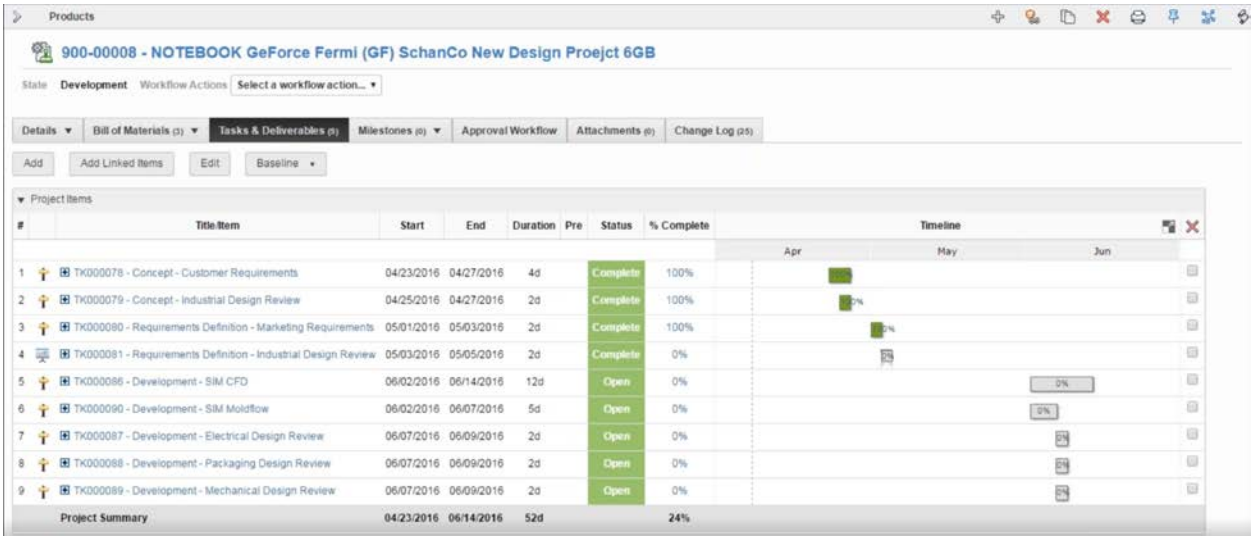

Fig 21 – Dynamic Attractions Proof of Concept FLC Tenant – Work Breakdown Tasks

Dashboard to Manage Tasks

FLC displays all open tasks for a user. This includes all task originating from all workflows including change requests, change orders, NCRs & project tasks. Users can manage tasks from using only their dashboard or a combination of the dashboard and automated email notifications. FLC also has provision to escalate overdue tasks to supervisors/managers when tasks become overdue.

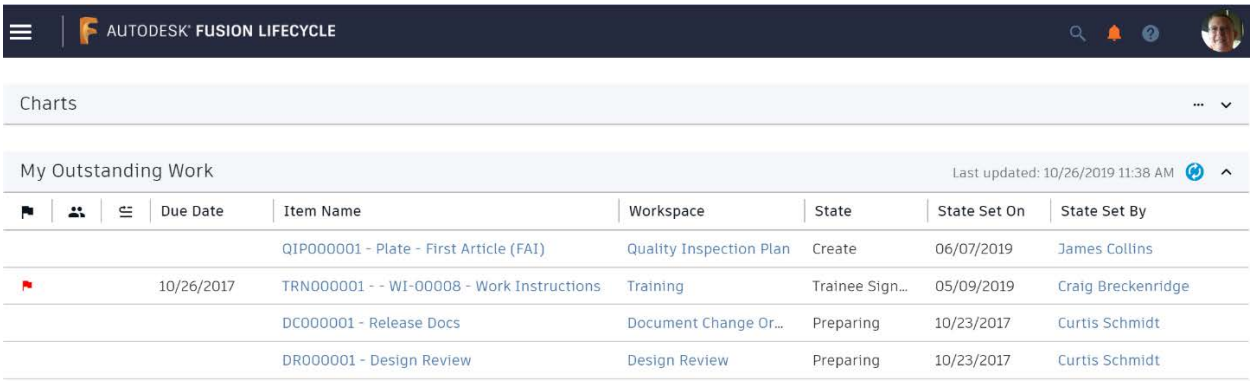

Fig 22 – Dynamic Attractions Proof of Concept FLC Tenant – User Dashboard Tasks

Products and Projects

FLC has a workspace for classification of products and related projects.

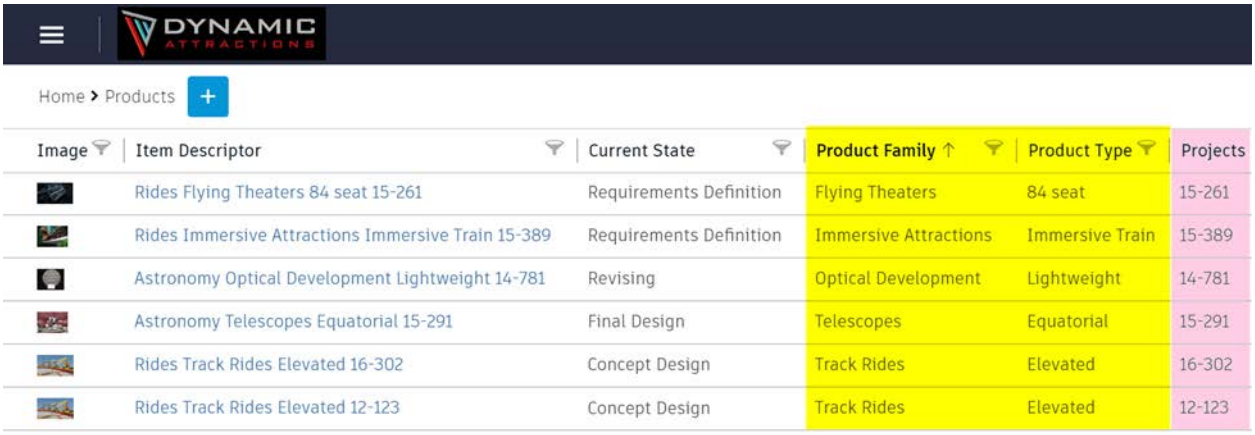

Fig 23 – Dynamic Attractions Proof of Concept FLC Tenant – Products

Project Phases/Stages

FLC is better suited for managing the multiple stages of a project lifecycle. Vault can manage the workflow of a model/drawing change but it is not well suited to manage project stages. In FLC it is easy to modify the project lifecycle approval workflow to match your company standards. FLC can be used to enforce cross functional design reviews in a stage gate process.

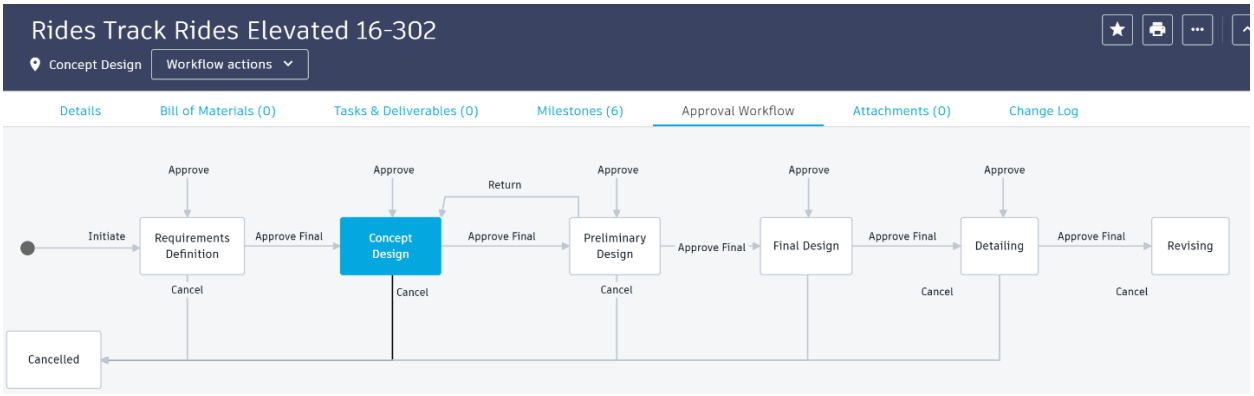

Fig 24 – Dynamic Attractions Proof of Concept FLC Tenant – Product Stages Workflow

Non-Conformances

FLC has an NCR process; Vault does not. FLC NCR preventive actions also tie in to the change request process.

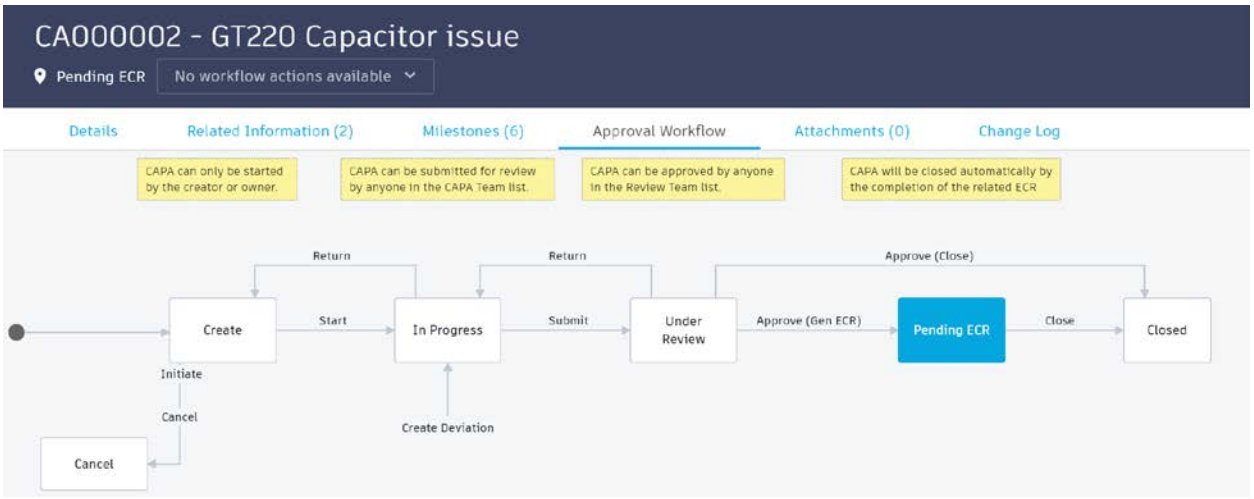

Fig 25 – Dynamic Attractions Proof of Concept FLC Tenant – NCR to ECR Workflow

Items and BOMs

FLC is better suited for managing items and BOMs when drawings/models do not exist. Vault is best suited for managing the physical files and their relationships. Vault does have the Item Master to help manage this. However if you plan to implement FLC and do not yet use the Vault Item Master, it is better to plan to use FLC for managing items and BOMs. It becomes more complex to keep Vault and FLC in sync when you have both Vault and FLC managing items and BOMs.

- We plan to use Vault as a PDM to manage our physical files including models, drawings and engineering documents. This includes automated lifecycle workflow to control the revisions.

- We plan to use the FLC PLM to manage all other engineering Meta data including items and BOMs that are generated prior to the creation of models and drawings. In certain cases there may not be a need to ever generate a model & drawing. A project spares parts list is an example; we plan to manage these BOMs in FLC.

Fig 26 – Vault vs FLC courtesy of Brian Schanen – Autodesk

Processes and Data that Should Be Managed in Vault and FLC Compared to a MRP

Dependent Mostly on Where Majority of Related Data Originates

It is important to understand the single source or truth; this is where the master data originates. The following is a high level summary.

Vault and FLC are for Managing Engineering Data and Processes

- Models, drawings, EBOMs
- Drawing approval and rev control
- Engineering change control and configuration management
- Control/tracking of engineering stage gates such as concept, prelim and final design
- Quality Requirements such, level of material traceability needed, testing required, special assembly instructions, etc.

MRP is for Managing Cost Data and the Production & Logistics Processes

Generally, if there is related cost data or if the process controls production or logistics workflow, then MRP is the better system to use as the Master source. Examples include:

- Accounting and timesheets
- Production Planning
- Purchase Orders, Production Work Orders
- Logistics & inventory control
- Objective Quality Evidence such as material certs, test results, actual torque values, etc.

Fig 27 – MRP Overview clip courtesy of Infor CloudSuite

Items That Can Straddle The Fence

There are some workflows that do not fall cleanly in realm or PDM/PLM versus MRP such as NCRs and manufacturing BOMs.

NCRs

- NCRs are discovered during the production part of the lifecycle. People in the production and QC departments will use the MRP as their primary enterprise tool. Almost all MRPs have NCR capability. The MRP will be used to ensure the corrective action & disposition is complete to WIP & inventory.
- PLM is better place to track preventive actions that spawn engineering change requests that lead to ECOs and design changes.
- NCRs are a good example of where data sharing between the MRP and PLM is ideal. You may want to initiate the NCR in the MRP and deal with corrective action & disposition there. You may want to deal with preventive actions and change requests in the PLM.

MBOMs (manufacturing BOMs)

MBOM is a type of bill of materials (BOM). Unlike Engineering bill of materials (EBOM), which is organized with regards to how the product is designed, the MBOM is focused on the parts that are needed to manufacture a product. ... An MBOM is not the same as "as manufactured" or "as built"
-Wikipedia

Both the PLM and the MRP are typically capable of managing MBOMs.

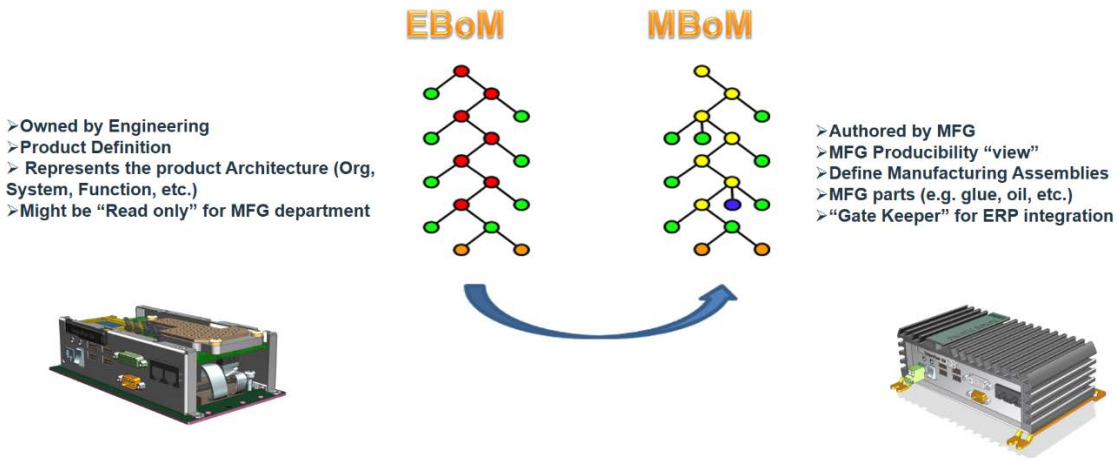

Fig 28 – EBOM vs MBOM Clip courtesy of TATA Technologies

How to Decide which System is the Master

Deciding whether to use the PLM or the MRP is dependent on which system you implement first coupled with which one best suits your business needs. For instance, your organization may have a large number design engineering staff and a small number of manufacturing engineers. In this case if you implement PLM first you may want to use the PLM to manage your NCRs and EBOMs.

Some ERP/MRP systems also offer PDM/PLM solutions. We are choosing Vault/FLC for our PDM/PLM because they provide more functionality than the ERP/MRP solutions. The native PDM is typically best at managing its native CAD data. Since Inventor is our primary CAD system Vault is best suited to manage our CAD data. Autodesk develops Vault and Inventor in unison. Whereas non-Autodesk PDMs development/releases lag behind new releases of Inventor.

Learn why it is important for Vault, Fusion Lifecycle, and the MRP to share data

Current Dynamic Attractions Data Transfer Process is Labor Intensive & Data Synchronization is Difficult to Maintain

We currently waste much time keeping our MRP database in sync with our drawing BOMs & Vault purchased part Meta data

- BOMs are imported manually to MRP one at a time via KISS text file.
- Purchased items are created in Vault and then manually re-entered in the MRP. There is no method of importing purchased part in to our existing MRP.
- If there is a mismatch in the description of a purchased item (like an extra space), that must be fixed at the time the parent BOM is imported. That often means editing the drawing BOM so we can generate a new KISS file.

Plans for Future Automated Process

Adding FLC will mean there is another database to keep synchronized compared to our current Vault and MRP databases. We do not want another layer of manual data entry. We plan to automate data synchronization based on Vault/FLC lifecycle driven events. Based on recommendations from Autodesk we plan to use the following middleware tools:

coolOrange Vault/FLC Connector

Dynamic Attractions participated in developmental testing of the coolOrange connector in March thru June 2019 before it was released.

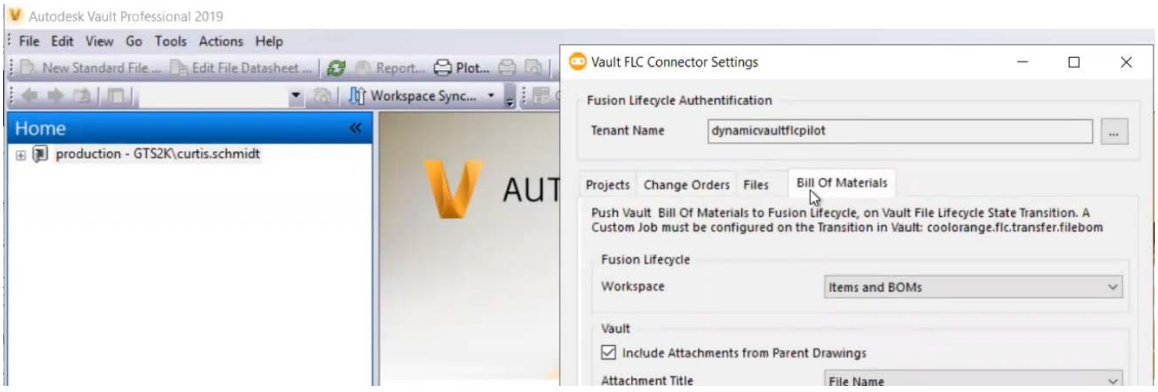

Fig 29 – Dynamic Attractions Testing of coolOrange Vault-FLC Connector

- It works well for sending data to FLC that originates in Inventor/Vault.
- We submitted feature requests for:
  - Creating Items and BOMs in FLC and pushing them down to Vault
  - Hyperlinks in FLC back to files in Vault. We want a single source of truth rather than storing the same file in different databases.

Jitterbit FLC to MRP Connector

Jitterbit has proven success connecting many different MRPs including Cloud based ones. We have narrowed our MRP selection to either SAP or Infor Cloud Suite (aka Syteline). Jitterbit has proven connectivity to both MRPs.

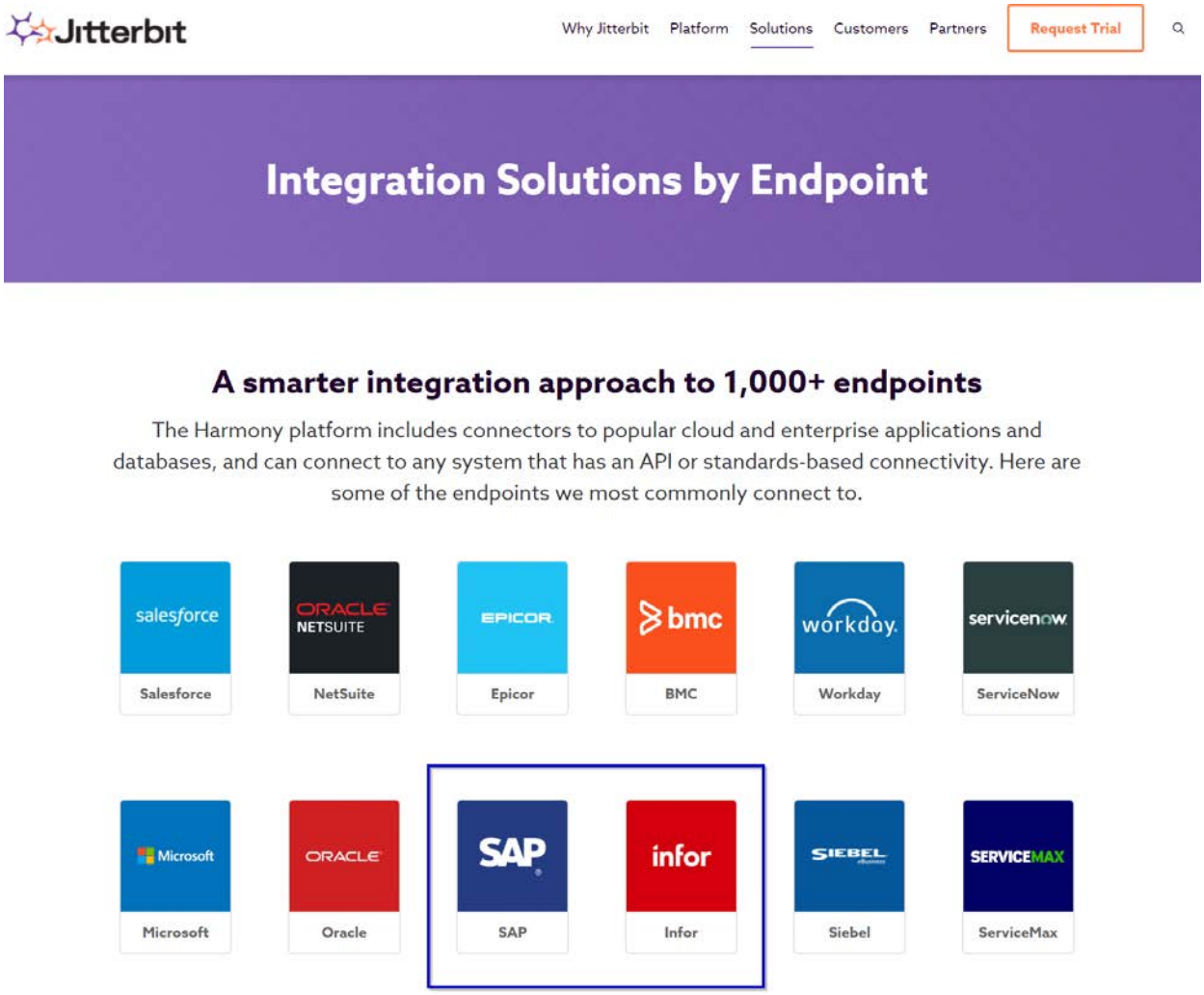

Fig 30 – Clip courtesy of Jitterbit