



PL11589 – A PLM Case Study – Fanning the Flames of Innovation

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Class summary

Join us for an in-depth case study of Autodesk PLM 360's use with the development of Ember - Autodesk's Spark Powered, ultra high resolution 3D printer. <https://ember.autodesk.com/>

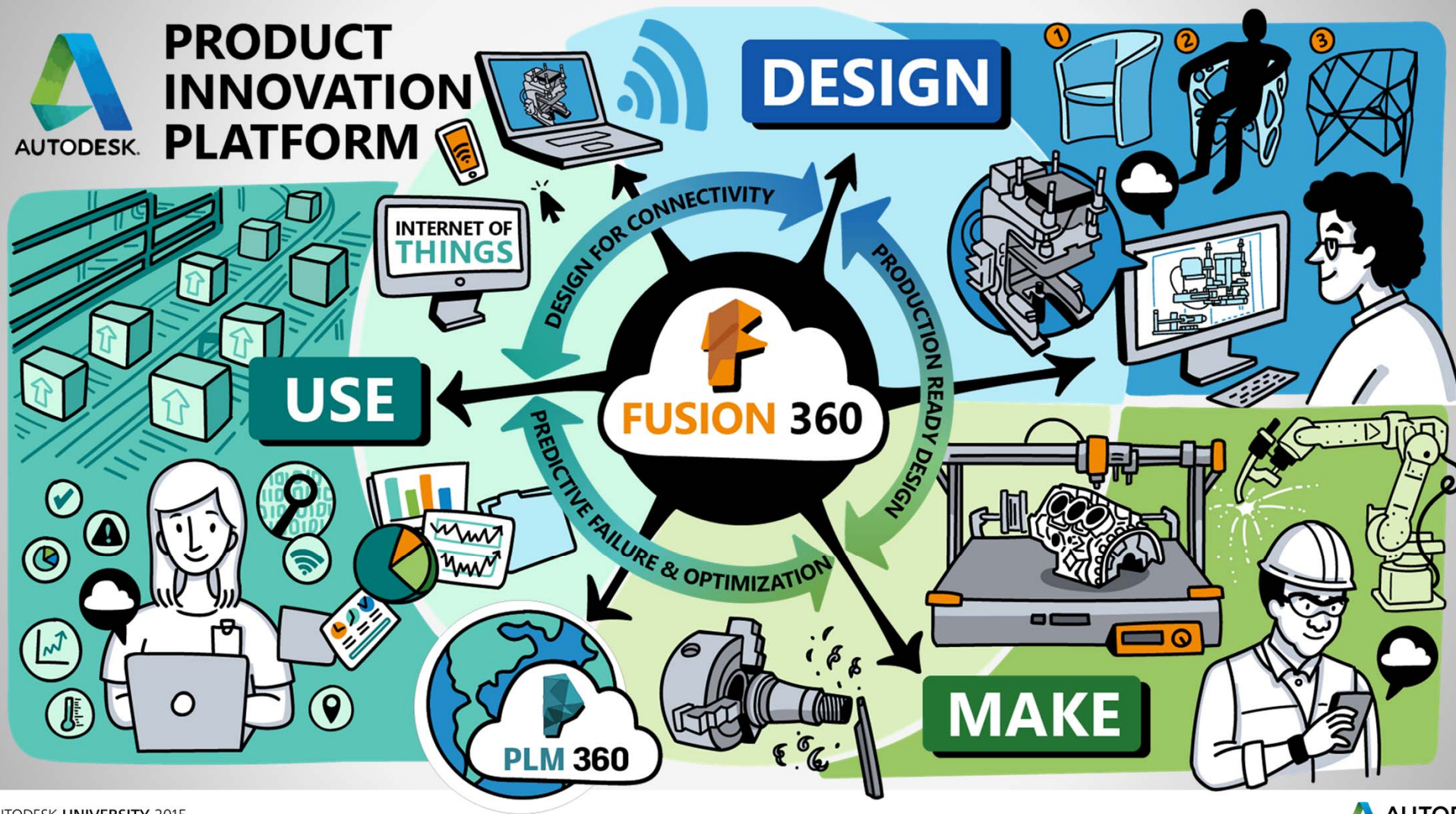
Key learning objectives

At the end of this class, you will be able to:

- See how Autodesk PLM 360 was quickly implemented and adopted for the Ember product
- Learn about Bill of Materials and Change Management during the Ember development process
- See how PLM 360 is used for Supply Chain, Quality, and Compliance tracking with the Ember
- Learn how Autodesk PLM 360 is well suited for next-generation customers



PRODUCT INNOVATION PLATFORM

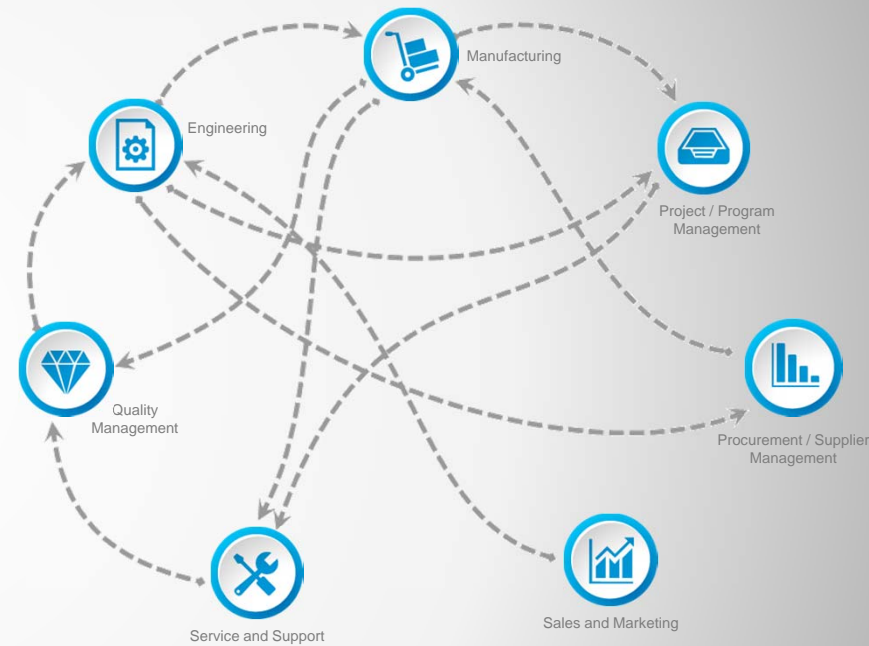


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PLM Explained: The Problem

- “What needs to be finished before we can move to mass production?”
- “Who knows where I can find that document?”
- “Do you know if this is the latest BOM?”
- “Why does our ECO process take so long?”
- “How much is this change going to cost?”
- “Does this failure happen often?”
- “Who has to approve this ECO?”
- “Have we ever audited that supplier?”
- “Who supplies this part to us and where is the spec?”
- “Can somebody update ERP with the latest? I need to issue a PO!”
- “How do I get people to follow the process that we’ve agreed to?”
- “Does anyone know if this spreadsheet from Engineering is current?”



PLM Explained: The Solution

- Find information easily and know that it is the right version
- Run reports and find trends in data to enable better decisions
- Drive visibility and accountability through ownership
- Collect and relate information without status meetings
- Automate review processes and approvals with workflow
- Automate part information into ERP
- Give engineering visibility into ERP data
- React to your customers' needs by integrating with CRM
- Easily find and re-use components/designs
- Collaborate easily across the entire organization



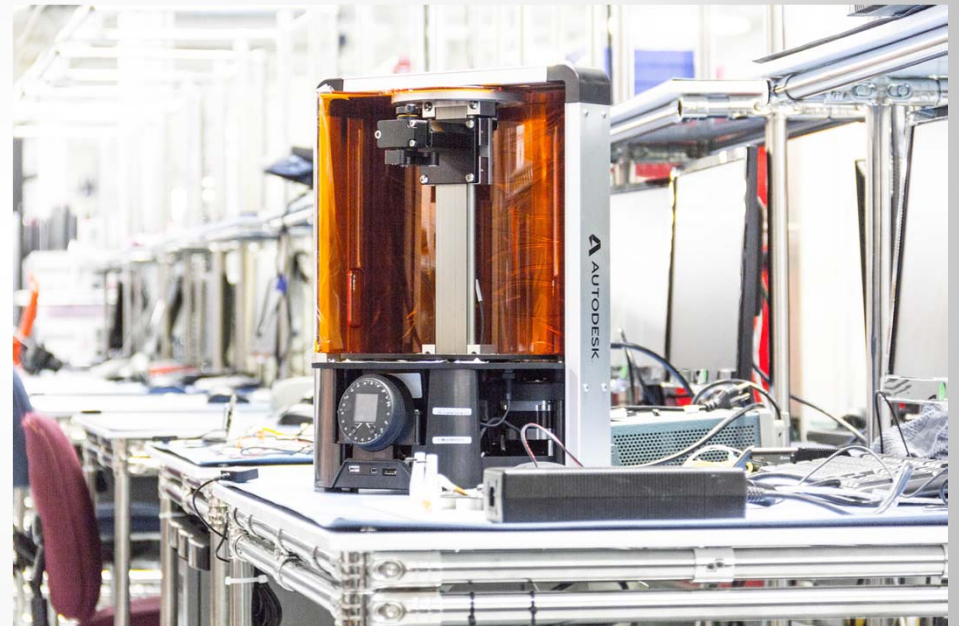
Autodesk PLM 360 Core Capabilities

BOM	Change	Supplier
Document Control	Change Orders	AVL / AML
Part Classification	Change Requests	Supplier Auditing
Effectivity	Deviations and Waivers	Supplier Part Costing
BOM Compare	Problem Reports	
Octopart Integration		
Product	Quality	Documents
Phase-Gate NPI	Customer Returns	Browser Access
Deliverables Tracking	Field Failure Reports	Check-in / Check-out
Status Dashboards	Non-Conformance Reports	Revision Controlled
	Corrective/Preventative Actions	Document History



Ember Defined

- SLA DLP Projector based 3D printer
- Showcases Autodesk Spark initiative
- Resin based, open source project
 - Cures in layers 10 to 200 microns depending on materials



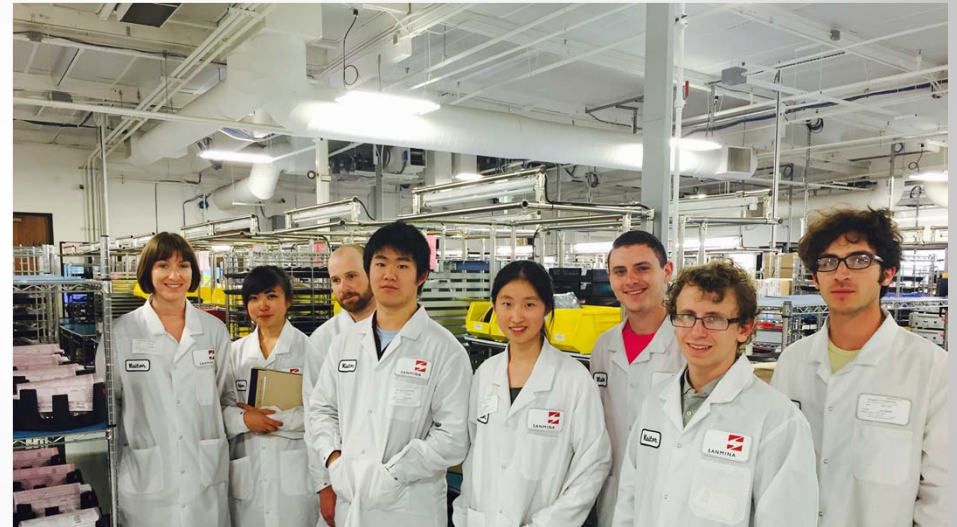
Why Hardware?

- To learn the connecting points from Design and Engineering...
- ...to a finished Consumer product



Why PLM 360?

- 576 Components
- 55 Assemblies
- 8 Versions (so far)
- 31 Engineering Change Orders
- 100+ Suppliers
- Team of 10+ Engineers
- Multiple locations



Life Before PLM 360

- Spreadsheets
- Google Docs
- Email
- Tribal knowledge
- And confusion

Excel interface showing a Bill of Materials (BOM) table for a printer assembly.

Level	Line Item	Part Description	Manufacturer	Manufacturer Part Number
0	001-ASY-0001	Top level printer in packaging	Sanmina	001-ASY-0001
1	001-DOC-0001	Packaging Assembly Document	-	-
1	001-PKG-0001	Shipping Box	Xpedex	001-PKG-0001
1	001-PKG-0002	Packing Tape	Sanmina	-
1	001-PKG-0003	Foam Set	Xpedex	001-PKG-0003
1	001-PKG-0004	Accessory Box	Xpedex	001-PKG-0004
1	001-PKG-0005	Box Top	Xpedex	001-PKG-0005
1	001-PKG-0006	Box Bottom	Xpedex	001-PKG-0006
1	001-PKG-0007	Shipping Label	Xpedex	001-PKG-0007
1	001-PKG-0008	Printer Bag	Xpedex	001-PKG-0008
1	001-DOC-0073	Quick Start Guide	Sanmina	001-DOC-0073
1	001-ASY-0035	PDMS Window with Gasket Assembly	Sanmina	001-ASY-0035
2	001-DOC-0107	PDMS Window with Gasket Assembly Procedure	-	-
2	001-ASY-0003	PDMS Window Assembly	Albright	-
3	001-OPT-0001	Glass Slide Window	XF Photonics	XF-W140124
3	001-OPT-0002	PDMS Window	Albright	LUMISIL® LR 7600/50, 60, 70, 80 A & B
2	001-STR-0002	Resin Tray window adhesive gasket	Sanmina	001-STR-0002
1	001-ASY-0002	Resin Tray Assembly	Sanmina	001-ASY-0002
2	001-DOC-0003	Resin Tray Assembly Procedure	-	-
2	001-STR-0001	Resin Tray	Sanmina	001-STR-0001
1	001-ASY-0038	Build Head Assembly	Sanmina	001-ASY-0038
2	001-STR-0058	Kinematic Balls, 3/16"	McMaster Carr	92125A130
2	001-DOC-0072	Build Head Assembly Procedure	-	-
2	001-STR-0023	Build Head	Sanmina	001-STR-0023
2	001-STR-0024	Build Plate	Sanmina	001-STR-0024
2	001-FST-0008	M3 x 10mm Screw socket countersink	McMaster Carr	92125A130
2	001-STR-0054	Build Head Magnets	KJ Magnetics	D44
2	001-STR-0055	Build Head Magnet Adhesive	Sanmina	-
1	001-ELC-0056	Power Supply	Mean Well	GS120A12-R7B
1	001-ELC-0056	Power Supply	Mean Well	GS160A12-R7B
1	001-ELC-0057	AC Power Cord	Qualtek	312007-01
1	001-ELC-0058	USB Cable	Molex	88732-8602
1	001-ASY-0004	Assembled Printer	Sanmina	001-ASY-0004
2	001-DOC-0006	Printer Assembly Procedure Documentation	-	-
2	001-FST-0002	3mm x 8mm Self Tap - Pan-pozDrive	TR Fastenings	W-3-B-PRA230-SF
2	001-ASY-0037	Complete Base Assembly	Sanmina	001-ASY-0037
3	001-DOC-0095	Complete Base Assembly Procedure	-	-
3	001-FST-0002	3mm x 8mm Self Tap - Pan-pozDrive	TR Fastenings	W-3-B-PRA230-SF
3	001-FST-0034	M3 x 10mm Socket Button ISO7380	TR Fastenings	W/M3/10/BHA2MC/SF
3	001-FST-0034	M3 x 10mm Socket Button ISO7380	McMaster Carr	92095A182
3	001-ASY-0005	Base Sub Assembly	Sanmina	001-ASY-0005
4	001-DOC-0096	Base Sub Assembly Procedure	-	-
4	001-ASY-0006	Base Moulding Assembly (with inserts)	Sanmina	001-ASY-0006
5	001-STR-0003	Base Moulding	Sanmina	001-STR-0003
5	001-FST-0001	M4 Brass Insert	TR Fastenings	W/M4/-/HE/BRSO/SF
5	001-FST-0001	M4 Brass Insert	Penn Engineering	IUTB-M4
5	001-FST-0007	M3 Brass Insert	TR Fastenings	W/M3/-/HE/BRSO/SF
5	001-FST-0007	M3 Brass Insert	Penn Engineering	IUTB-M3
4	001-ASY-0007	Fan assembly, LH	Sanmina	001-ASY-0007
5	001-ELC-0001	60x 60x 20mm Fan	Qualtek	FAD1-06020CSAW11
5	001-ELC-0001	60x 60x 20mm Fan	Sunon	HA60151V4-000U-999
5	001-ELC-0002	1.25MM CLIK-MATE series, Wire-to-Board Housing, Single Row, Pin	Molex	502380-0200
5	001-ELC-0003	1.25MM CLIK-MATE series, Wire-to-Board Crimp Terminal, Reel	Molex	502381-0000
5	001-ASY-0008	Fan assembly, RH	Sanmina	001-ASY-0008
5	001-ELC-0001	60x 60x 20mm Fan	Qualtek	FAD1-06020CSAW11
5	001-ELC-0001	60x 60x 20mm Fan	Sunon	HA60151V4-000U-999
5	001-ELC-0002	1.25MM CLIK-MATE series, Wire-to-Board Housing, Single Row, Pin	Molex	502380-0200
5	001-ELC-0003	1.25MM CLIK-MATE series, Wire-to-Board Crimp Terminal, Reel	Molex	502381-0000

Full BOM +

Normal View Ready

Item and Bill of Materials - Importing

- Good news! The Import tool to the rescue
 - Core part of PLM 360
 - Reads .xls(x) directly
 - Note: *some* formatting was needed – your mileage will vary

Bom level	AutoDesk Part Number	Designator	Quantity	Value	Comment	Description
3	001-ASY-0012		1		Isaac UI PCBA	Isaac UI PCBA 520-0003-003 Rev A
4	001-ELC-0322		1		Isaac UI PCBA Bare PCB	Isaac UI PCBA Bare PCB: Source: "Isaac UI_410-0003-003_2014-09-
4	001-ELC-0323	C1, C13, C18	3	4.7uF	CAP 4.7uF 50V 0805(2012)	CAP 4.7uF 50V ±20% 0805 (2012 Metric) Thickness 1.45mm SMD
4	001-ELC-0324	C2	1	10nF	10nF 50V 0603(1608)	CAP 10nF 50V ±10% 0603 (1608 Metric) Thickness 1mm SMD
4	001-ELC-0325	C3, C7, C12	3	0.1uF	CAP 0.1uF 50V 0603(1608)	CAP 0.1uF 50V ±10% 0603 (1608 Metric) Thickness 1mm SMD
4	001-ELC-0326	C4, C5, C19	3	0.1uF	CAP 0.1uF 6V3 0402	CAP 100nF 6.3V ±20% 0402 (1005 Metric) Thickness 0.6mm SMD
4	001-ELC-0327	C8	1	4.7uF	TAJB475K020R	Capacitor, Tantalum, 4.7uF 10% 20V MCCT-8 (3528)
4	001-ELC-0328	C9, C10	2	1.0uF	CAP 1.0uF 16V 0603(1608)	CAP 1.0uF 16V ±10% 0603 (1608 Metric) Thickness 1mm SMD
		C11	1	10uF	CAP 10uF 25V 0805(2012)	CAP 10uF 25V ±10% 0805 (2012 Metric) Thickness 0.8mm SMD
4	001-ELC-0329					
		C14	1	120pF	CAP 120pF 50V 0402	CAP CER 120PF 50V 5% NPO 0402
4	001-ELC-0330					
4	001-ELC-0331	C17	1	10nF	CAP 10nF 50V 0603(1608)	CAP 10nF 50V ±10% 0603 (1608 Metric) Thickness 1mm SMD
		D1, D2, D3, D4, D5, D6, D7, D8, D9, D10, D11, D12, D13, D14, D15, D16, D17, D18, D19, D20, D21	21		LTST-C170AKT	LED ORANGE CLEAR 0805 SMD
4	001-ELC-0332					
4	001-ELC-0333	D22, D23	2		PMEG3010CEH	very low VF MEGA Schottky barrier rectifiers
4	001-ELC-0334	D24	1		BAT54	Schottky Barrier Diode
4	001-ELC-0335	DISPLAY	1		DD-128128FC-6A	Univision UG2828GDEDF11 Display (mechanical only)
4	001-FIC-0336	FB1	1		BLM15PD1215N1D	FERRITE 120OHM @ 1GHZ 1300MA SMT 0402

	Bom level	AutoDesk Part Number	Revision	Lifecycle State	Release Date	Ref Des
	1	001-ASY-0012	3	Prerelease	2014-11-04	
	2	001-ELC-0322	0	Production	2014-11-04	
	2	001-ELC-0323	0	Production	2014-11-04	C1, C13, C18
	2	001-ELC-0324	0	Production	2014-11-04	C2
	2	001-ELC-0325	0	Production	2014-11-04	C3, C7, C12
	2	001-ELC-0326	0	Production	2014-11-04	C4, C5, C19
	2	001-ELC-0327	0	Production	2014-11-04	C8
	2	001-ELC-0328	0	Production	2014-11-04	C9, C10
	2	001-ELC-0329	0	Production	2014-11-04	C11
	2	001-ELC-0330	0	Production	2014-11-04	C14

Item and Bill of Materials – Part Numbering

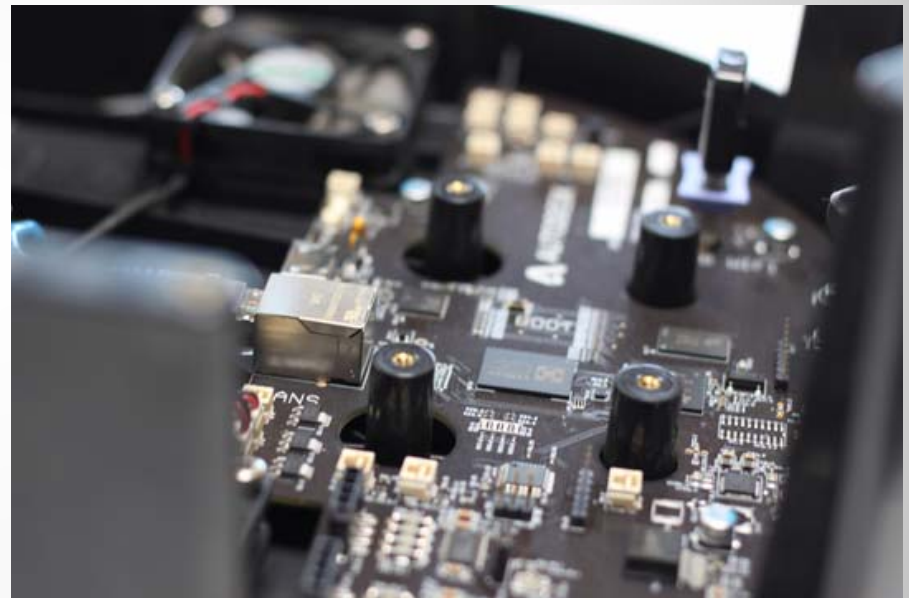
- Manual part numbering is error prone
- Watch out for ‘smart numbering’
- PLM 360 can take on automatic numbering

#	Item
1	001-ELC-0314 - CRYSTAL 32.768KHZ 12.5PF SMD [REV:1]
2	001-ELC-0315 - OSC 24.576MHZ 3.3V SMT [REV:1]
3	001-DOC-0145 - Build Head with Brass Inserts Assembly Procedure [REV:1]
4	001-ELC-0312 - CRYSTAL 24.000MHZ 18PF SMD [REV:1]
5	001-ELC-0313 - XTAL 25MHZ 30PF SMT [REV:1]
6	001-ELC-0311 - EEPROM 256Kb I2C SOIC8 [REV:1]
7	001-DOC-0150 - Projector Serial Number Label [REV:1]
8	001-DOC-0151 - Resin Tray Serial Number Label [REV:1]
9	001-ELC-0367 - Non-Inverting Buffer / CMOS Logic level Shifter with LSTTL-Compatible Inputs [REV:1]
10	001-ELC-0309 - IC INVERTER SINGLE 1INPUT SC705 [REV:1]
11	001-ELC-0310 - DUAL BUFFER/DRIVER WITH 3-STATE OUTPUTS [REV:1]
12	001-ELC-0307 - MAX6818 Octal DeBounce [REV:1]



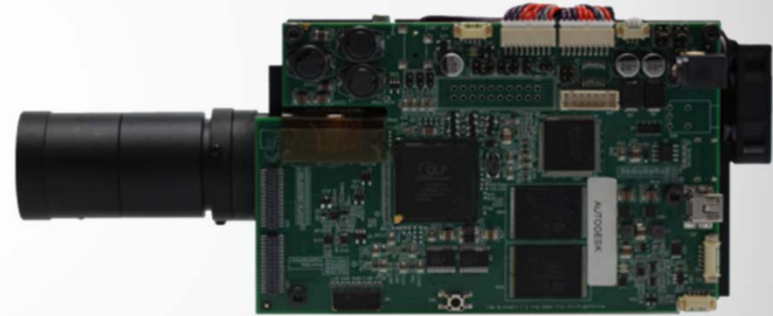
Item and Bill of Materials – Configuring Fields

- Field, property, metadata flexibility
- Out of the box, user defined, system fields
- Hint: examine the column names in sample xls files for influence to tailor PLM 360



Item and Bill of Materials – Revision Management

- Revision and Lifecycle management is core to PLM 360
- Revision history, Release process, BoM compare, all necessary during and after product development



Before PLM 360

- Change was manually tracked
- Spreadsheet based, emailed

Related Change Information Attached *(must use as part of the ECR review and release process and must be completed to receive approval for ECR)*

<input type="checkbox"/> Marked/revised drawing	<input type="checkbox"/> User Manual	<input type="checkbox"/> Test system(s)
<input type="checkbox"/> Marked BOM	<input type="checkbox"/> Standard Operation Guide	<input type="checkbox"/> Assembly/process
<input type="checkbox"/> Circuit design/Gerber	<input type="checkbox"/> Appearance/ID	
<input type="checkbox"/> Production tooling (Please describe) _____	<input type="checkbox"/> Other (please describe) _____	

ITEMS AFFECTED *(check all items that might apply) - ECR*

<input type="checkbox"/> Engineering (Design Functionality)	<input type="checkbox"/> Packaging	<input type="checkbox"/> Service Requirements
<input type="checkbox"/> Tooling	<input type="checkbox"/> Labeling	<input type="checkbox"/> Supplier Tooling/Instrumentation
<input type="checkbox"/> Fixtures & Equipment	<input type="checkbox"/> Performance Spec	<input type="checkbox"/> BOM
<input type="checkbox"/> Gages	<input type="checkbox"/> Safety	<input type="checkbox"/> Documentation
<input type="checkbox"/> Validation	<input type="checkbox"/> Volumes	<input type="checkbox"/> Work Instructions/Procedures
<input type="checkbox"/> Piece Cost	<input type="checkbox"/> Material Specs	<input type="checkbox"/> Environmental Impact
<input type="checkbox"/> Obsolescence	<input type="checkbox"/> Mass/Size	<input type="checkbox"/> Floor Space/ Storage
<input type="checkbox"/> Standards (i.e. MFG, Bluetooth SIG Certs etc.)	<input type="checkbox"/> Warranty	<input type="checkbox"/> Test Systems
<input type="checkbox"/> Certification/Compliance (i.e. FCC, CE, CCC etc.)	<input type="checkbox"/> Prototype	<input type="checkbox"/> Provisioning Systems
<input type="checkbox"/> Shipping/Receiving	<input type="checkbox"/> Dimensional/Tolerance	<input type="checkbox"/> Other (Describe) _____
<input type="checkbox"/> Inventory	<input type="checkbox"/> Styling/Appearance/Color	

INVENTORY PLANNING *(required for ECR)*









<input type="checkbox"/> Supplier(s) bank required before change	Units	Unit Cost	Extended cost	<input type="checkbox"/> Running change (use until depleted)
<input type="checkbox"/> Internal/CM bank required before change	N/A	N/A	N/A	<input type="checkbox"/> Rework All inventory (immediate)
<input type="checkbox"/> No effect	-	\$	0.00	<input type="checkbox"/> Rework All inventory (after ECR complete)
<input type="checkbox"/> Scrap material				<input type="checkbox"/> Coordinated change
<input type="checkbox"/> VIP (date code change)				

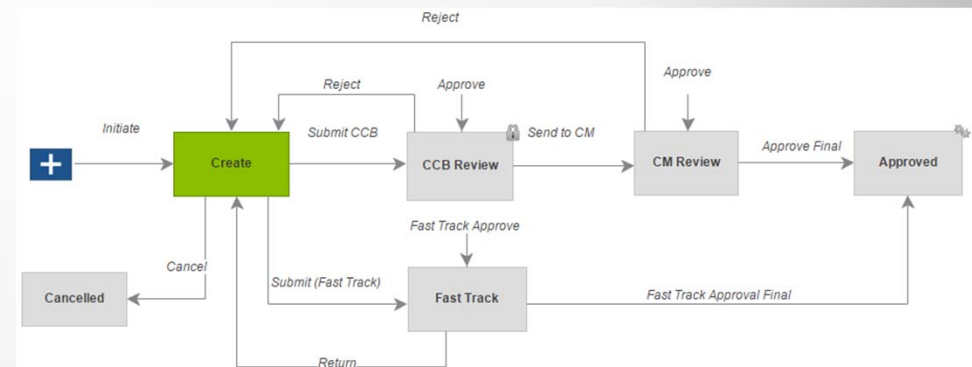
APPROVALS (ECR & ECR):

	Name:	Signature:	Date:
Originator:			
Project Manager:			
Manufacturing Ops:			
CM			
Client Representative:			
Industrial Engineering Lead:			
Mechanical Engineering Lead:			
Electrical Engineering Lead:			

Managing Engineering Change – Forms & Workflow

- Change Order Workspace only slightly modified
 - Affected Items tab
 - Change Reason Code
- Existing ECO Workflow map retained

From	To	Change Reason	Change Request	Action
1	OBS	Part Retired	This part is being retired. Please send scrap to Pier 9.	 
1	OBS	Part Retired	This part is being retired.	 
	1	New Part	Please add 1 unit to the finishing kit. CONSIGNED PART	 
	1	New Part	Please add 2 units to the finishing kit. CONSIGNED PART	 



Managing Engineering Change – Print Views

<https://spark.autodeskplm360.net/advancedPrintViewPr>

- Each Workspace has ability for ‘print friendly views’
- Compiles, formats for printing & sending
- Ideal for those not in PLM yet

Summary			
Number	CO000014		
Title	Update AML 001-ELC-0054		
Routing Type	Normal		
Priority	MED		
Details			
Change Reason Code	Functional Fix		
Description of Change	Change AML of 001-ELC-0054		
Linked Items			
#	Item	Change Reason	Change Request
1	001-ASY-0001 - Top level printer in packaging [REV:7]	Children Change	
2	001-ASY-0015 - Central Moulding and Motor Assembly [REV:10]	Children Change	
3	001-ELC-0054 - 6" Cat5e Ethernet Cable [REV:2]	AML Change	
4	001-FST-0073 - Torx M3.12 x 8mm Length Thread-Forming Screw for Plastics [REV:2]	AML & Description Change	
5	001-FST-0074 - 3mm x 12mm Pozl Pan Head Plastite Screws [REV:2]	AML Change	
6	001-FST-0075 - M3 x 22mm Socket Button ISO7380 [REV:1]	New Part	
7	001-FST-0076 - No.4 x 0.312 Imperial Flat Washers [REV:2]	AML & Description Change	
8	001-FST-0077 - M3 x 10 Countersunk Screw [REV:1]	New Part	
9	001-PKG-0013 - Rotating Window Shipping Tape [REV:2]	AML Change	

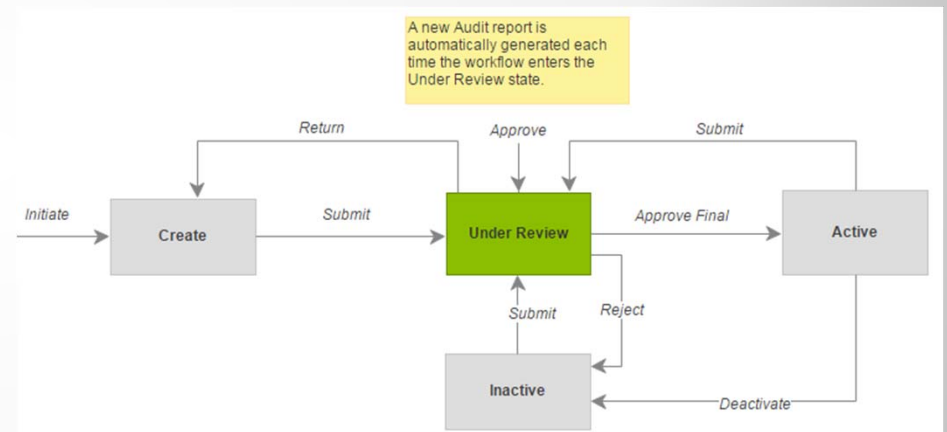
Managing Engineering Change – Compare, Redline

- Compare proposed changes from production to working version
- Comparisons by date
- Compare Items to themselves or other BoMs

31	3.3	Change	To	001-DOC-0145	1	Build Head with Brass Inserts Assembly Procedure	false	true	0.0	Ea			Prerelease
32	3.3	Change	From	001-DOC-0145	WIP	Build Head with Brass Inserts Assembly Procedure	false	true	0.0	Ea			Working
33	3.4			001-FST-0083	1	M3 Brass Insert - 4.74 x 12mm	true	false	2.0	Ea			Production
34	2.10	Change	To	001-FST-0077	1	M3 x 10 Countersunk Screw	true	false	2.0	Ea			Production
35	2.10	Change	From	001-FST-0077	WIP	M3 x 10 Countersunk Screw	true	false	2.0	Ea			Working
36	2.11			001-STR-0056	1	Epoxy Adhesive	true	false	0.0	oz	-	-	Production

Supplier Management

- Tracking Suppliers with PLM 360
 - Record which are used as suppliers
 - Approved Manufacturers List (AML)
 - Historic record or who NOT to use, and why



Compliance Tracking

- PLM used for tracking component compliance
 - RoHS
 - REACH
 - Conflict Minerals

Main Menu - Reports Tools - Administration -						
compliance		Items and BOMs				
Item Descriptor*	Lifecycle	Ver...	RoHS 2 Compliant	RoHS 2 Exempt	REACH	Conflict Minerals
001-STR-0061 - EMI Shield	Production	8	Yes	No	No	No
001-STR-0060 - 3/16" x 1/4" Neodymium Magnet	Production	0	Yes	No	No	No
001-STR-0059 - 1/16" x 1/4" Dowel Pin	Production	1	Yes	No	No	No
001-STR-0057 - LCD Foam Pad	Production	8	Yes	No	No	No
001-STR-0056 - Epoxy Adhesive	Production	1	Yes	No	Yes	No
001-STR-0055 - Build Head Magnet Adhesive	Production	0	Yes	No	Yes	No
001-STR-0054 - Build Head Magnets	Production	0	Yes	No	No	No
001-STR-0053 - Metal A Badge Adhesive	Production	0	Yes	No	Yes	No
001-STR-0052 - Nylon bushing	Production	0	Yes	No	No	No
001-STR-0051 - 1/4 Turn Shaft	Production	0	Yes	No	No	No
001-STR-0050 - 1/4 Turn Lever	Production	0	Yes	No	No	No
001-STR-0047 - Build Arm Mounting Plate	Production	0	Yes	No	No	No
001-STR-0045 - Foam Door Stop Pad	Production	8	Yes	No	No	No
001-STR-0043 - Spill Glass Bezel	Production	8	Yes	No	No	No
001-STR-0042 - Door Magnet Adhesive	Production	0	Yes	No	Yes	No
001-STR-0041 - Magnet 1/8" x 1/8" x 1/4"	Production	1	Yes	No	No	No
001-STR-0040 - Rotating Window Moulding	Production	8	Yes	No	Yes	No
001-STR-0039 - 1/4" wide, 1/8" thick Foam Gasket Strip	Production	1	Yes	No	No	No
001-STR-0038 - Middle Plate	Production	8	Yes	No	No	No
001-STR-0037 - Vat Support Plate Spacer	Production	8	Yes	No	No	No
001-STR-0036 - Vat support plate magnet adhesive	Production	0	Yes	No	Yes	No
Total number of records in this view: 202						

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Quality Management

- Integrate Quality link to Change Management
 - Returned Merchandise
 - Non conformance Reports

