

Autodesk® Inventor® work flow for developing a top down manufacturing shop process

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MA-2525

Autodesk Inventor can be used to save time, money, and scrap in manufacturing. Successfully manufacturing a product is not only about the final product, it also includes how you get there. Use Inventor to work backwards to develop all the process steps of manufacturing a part. Design the finished part you need, then with iParts and iLogic you can engineer all steps needed to get from a block of steel to a finished part. We will show a workflow that takes advantage of the associative abilities of the "I" tools. As your finished product evolves all of the production steps change as well. This work flow enables you to develop documentation for inspection, fabrication, etc, work holding, fixturing, and machining 3D models of each progression. Stress analysis of parts in process can be used to assure the process won't damage the final product. We will also offer tips and tricks that help the manufacturing engineer incorporate Inventor on the shop floor.

Learning Objectives

After completing this class, attendees will be able to:

- Use iParts to describe process steps from start to finish.
- Incorporate tips and tricks relevant to Inventor and machining.
- Understand associative properties and parameters with regards to steps in a process.
- Build one typical model of a family, then automate the development steps for all variations.

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James has more than 26 years experience with Autodesk products. He currently works as an Applications Engineer for an Autodesk® reseller, Datamat Programming Systems, located in Norwalk, CT. James has helped many companies become more efficient by understanding their needs and developing techniques and strategies to better use Inventor. He also presents at each Autodesk® Users Group that Datamat provides quarterly in three different states. James has been a guest speaker at Rhode Island's SME chapter as well as several local engineering colleges.

Jeff Richlin - jrichlin@gmail.com

Jeff is an Autodesk® Inventor® certified Professional user. His company that has provided custom built machinery and automated systems for 32 years. His clientele includes companies that produce products used in every facet of our lives: Medical, Commercial, Aerospace, and Automotive. Jeff has been a featured speaker at several Autodesk events including AU and World Press Day. He is an animated speaker who teaches as well as entertains. In addition to designing machinery, he is a guest lecturer at SUNY Farmingdale University for CAD and CNC machining, on the board of advisers for the Engineering and Manufacturing curriculum, co-chairs an Autodesk user's group, and coaches a Robotics First team. Jeff is also an independent consultant offering training and engineering services.

Introduction

iParts can be used for more than just inserting members of a family on demand. This class will show how you can use iParts to create and then document a manufacturing process for a machined part from a blank casting.

The first concern when designing a part is its functionality. The part's features detail the part, not how you get there during manufacturing. In the manufacturing process there are steps that are required from the raw stock to the finished part. i.e.: Blank casting or block, roughing, finishing, drilling, tapping, polishing, and more. Each one of these steps needs to be represented as its own part. From these parts, detailed prints and process sheets are created.

Interim parts can be created via different work flows.

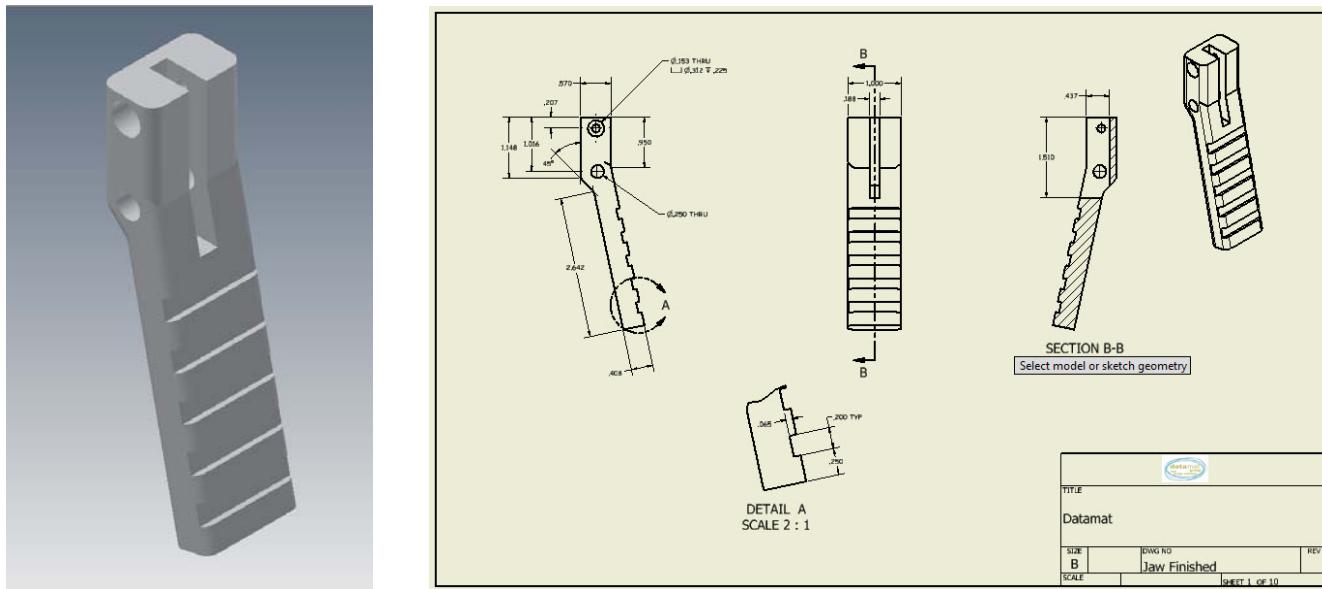
- **Individual Parts** created one at a time. This will take a lot of time. The results are not associative. And if changes are made, each part needs to be updated individually.
- **Derived Parts** have similar issues to Individual Parts.
- **iLogic** will create great results. However, it is more tool than is needed.
- **iParts** can be used with awesome results. Start with the finished part from engineering. Then using iPart functions you create a member for each manufacturing step. Each step is associative to the previous one. If global changes are needed they are easy to implement using the family scope setting. By using the member scope setting, individual members can be modified for manufacturing processes. i.e.: adding material to be rough machined from the raw casting.

Before we get to the iParts workflow we will cover some basics of Inventor functional design tools. These tools are part of the new workflow:

- Content Center (CC) – Quick review of CC along with tips about functions that you might have missed
 - Creating your own R/W library
 - Creating a new category
 - Publishing content to your library
- Bill of Material (BOM) – When working with parts, part families, parts lists, documentation and more, there are many times properties need to be modified. By using the BOM you can effect these changes quickly in a bidirectional way that saves a lot of time.
- iParts – a quick review along with tips to make the process faster and easier.

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The process starts with the model of the finished part.



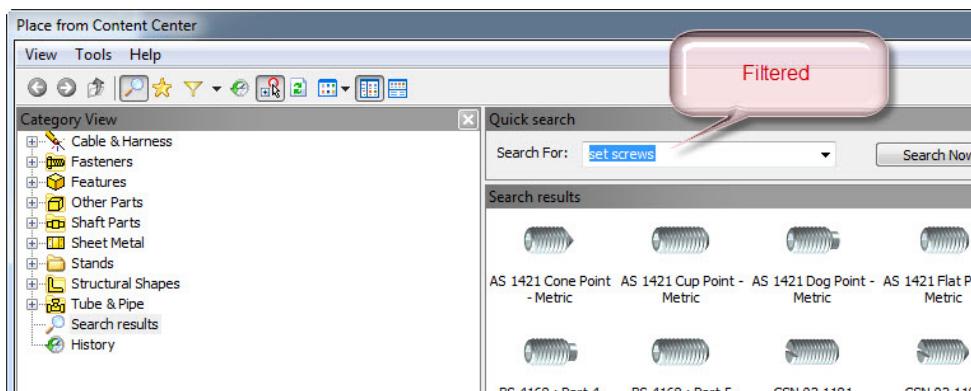
Finished Part

The finish will be a set of prints for mfg steps

Before we start on our part process let's take a few side trips to learn about tools we will need. Inventor has a number of functional design tools to create and add parts to assemblies in place: Frame Generator, Bolted Connections, Power Transmission, Content Center and more.

Lets explore some of what Content Center (CC) has to offer

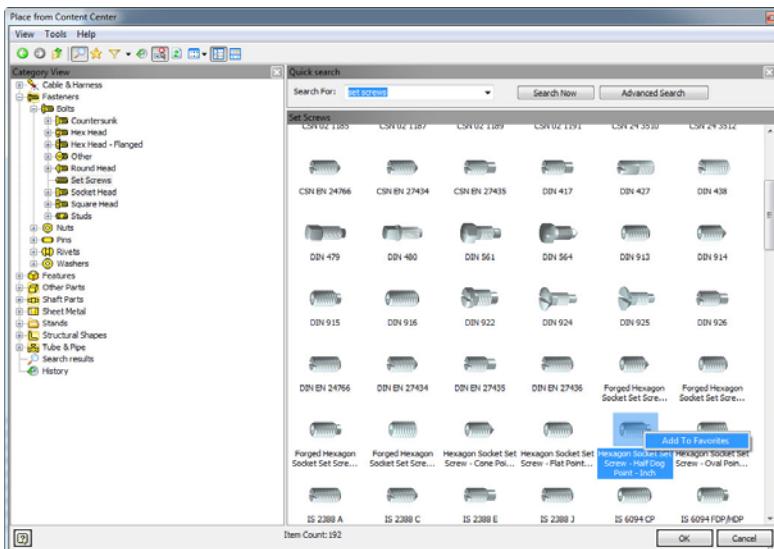
The model created for the class is missing a set screw. Lets drop a screw from the CC. Open CC. Then, filter the search for set screws. Using filters will make finding parts in the CC much quicker.



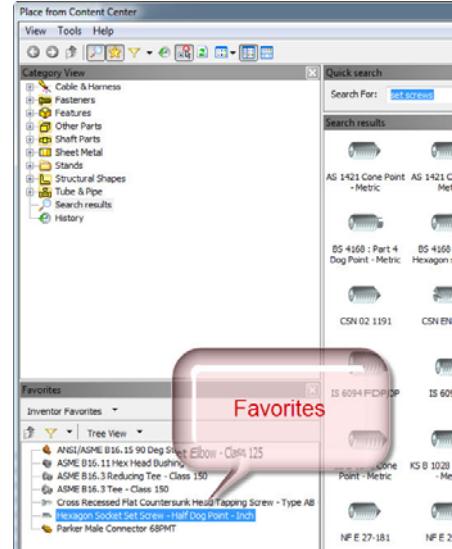
Content Center – filtered

Parts that you use over and over can be added to a “favorites” folder. This gives you quick access to them.

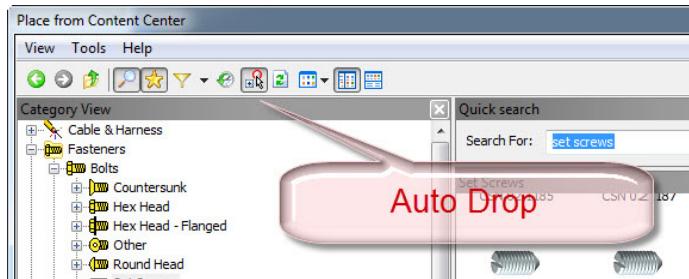
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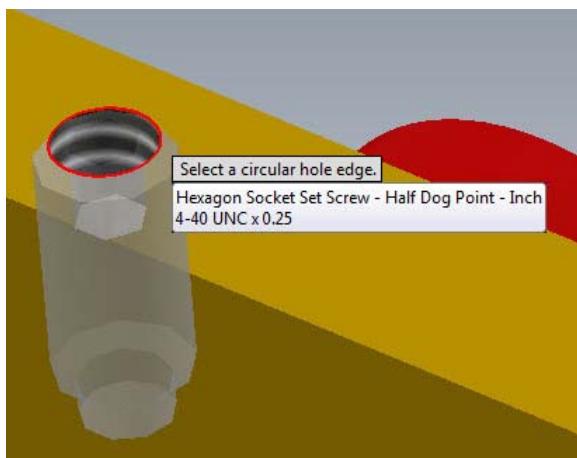
Right Click and **ADD TO FAVORITES**



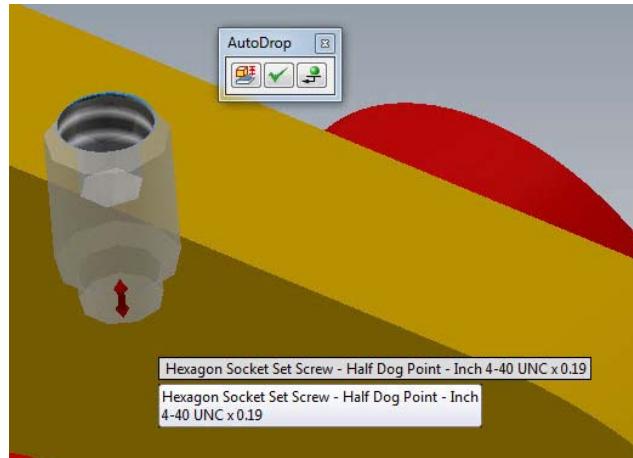
Favorites shown.



The **AUTO DROP** needs to be enabled, "ON" is the default setting. Use the **SELECT OTHER** tool to allow selecting in an assembly to add contraints



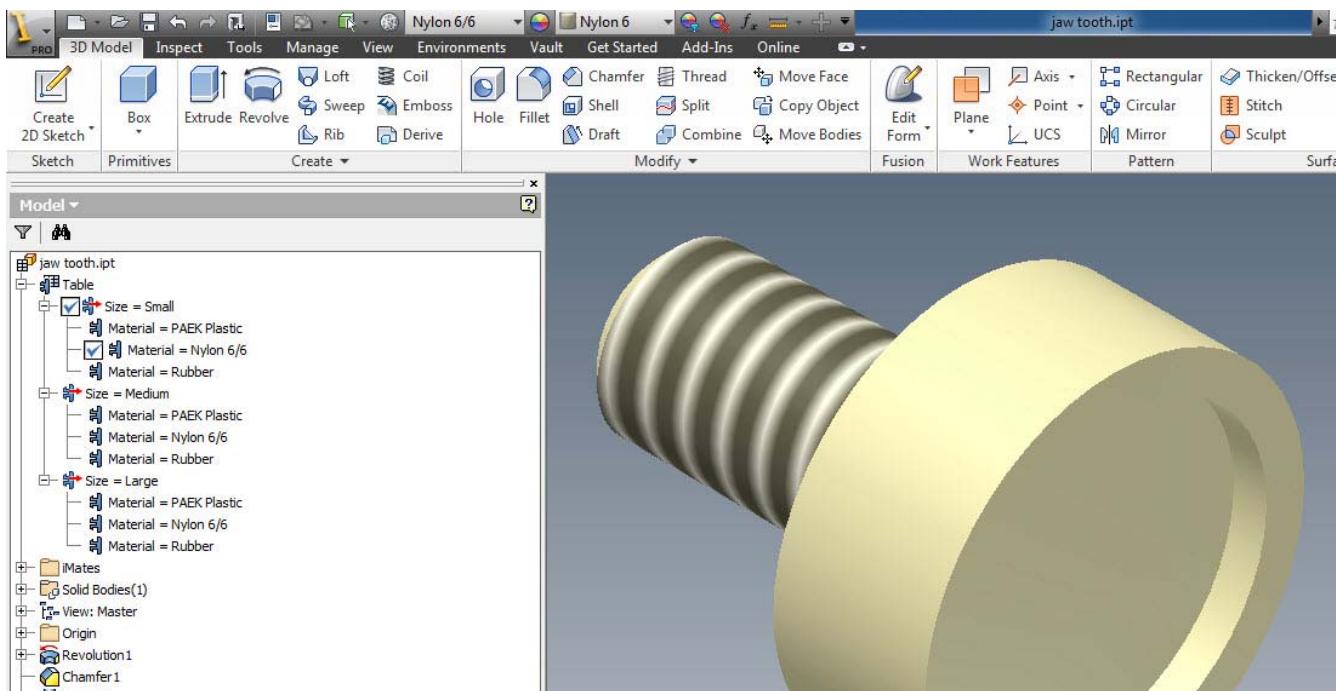
Hover over the geometry for it to self pick the size. Click on the edge of the hole. It will size and constrain the component to the part.



Click and drag for length selection.

The dropped part is constrained on the hole diameter. Adding a tangent constraint between the pin and the screw fixes its location. Now that we have seen some of the functionality of the CC we will move on to iPart functions.

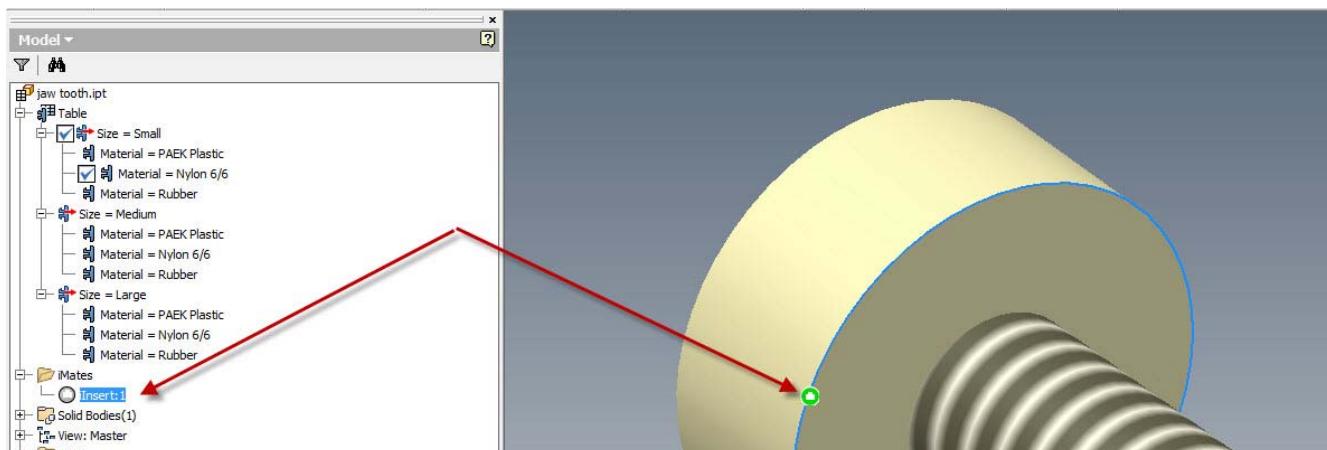
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This is a jaw tooth that we will be using, it has multiple configurations.

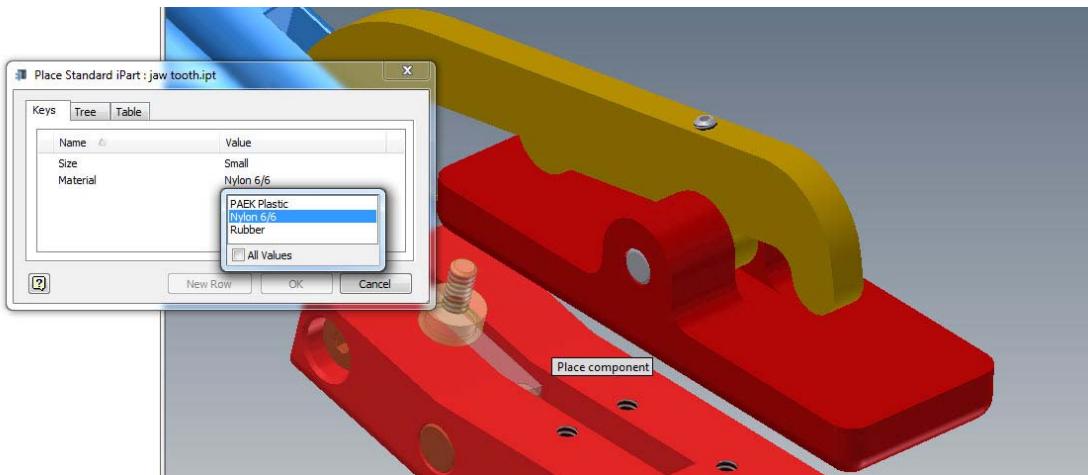
	Member	Part Number	d3	d12	Material	Size	Description
1	jaw tooth cc-01	jaw tooth cc-01	0.125 in	0.027 in	PAEK Plastic	Small	SMALL JAW TOOTH
2	jaw tooth cc-02	jaw tooth cc-02	0.125 in	0.027 in	Nylon 6/6	Small	SMALL JAW TOOTH

iPart Table with 2 primary keys defined.

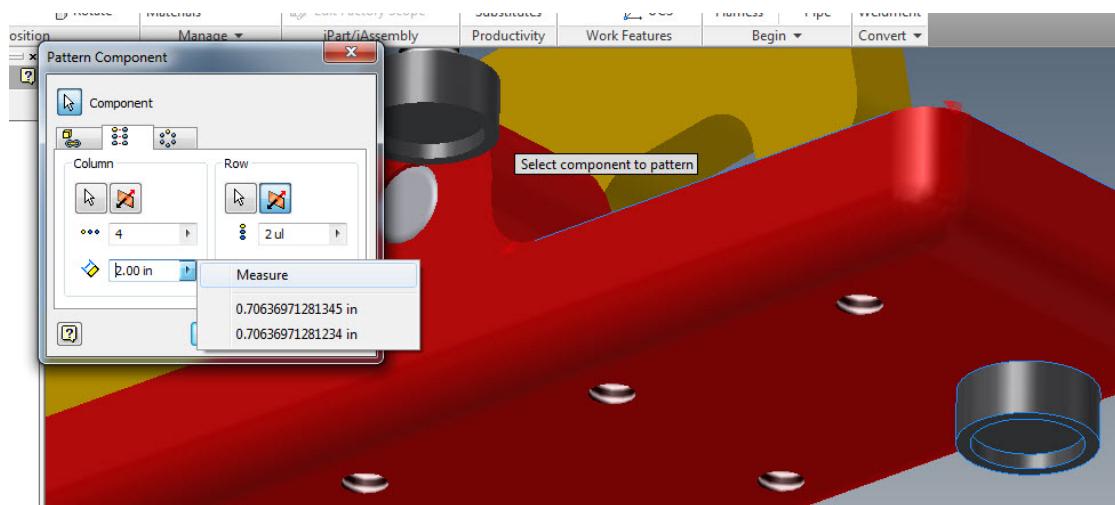


An iMate is added to the part for easy placement in assemblies.

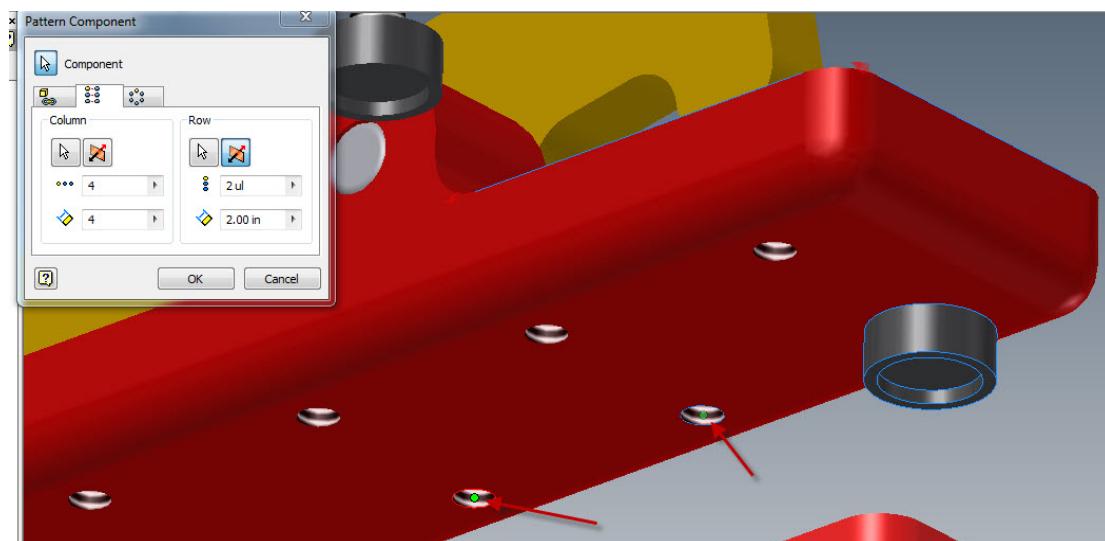
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See how an iPart works in an assembly. Place the part parent and choose the configuration. Use iMate to constrain – using ALT/drag method.



Next click on **PATTERN COMPONENT**.

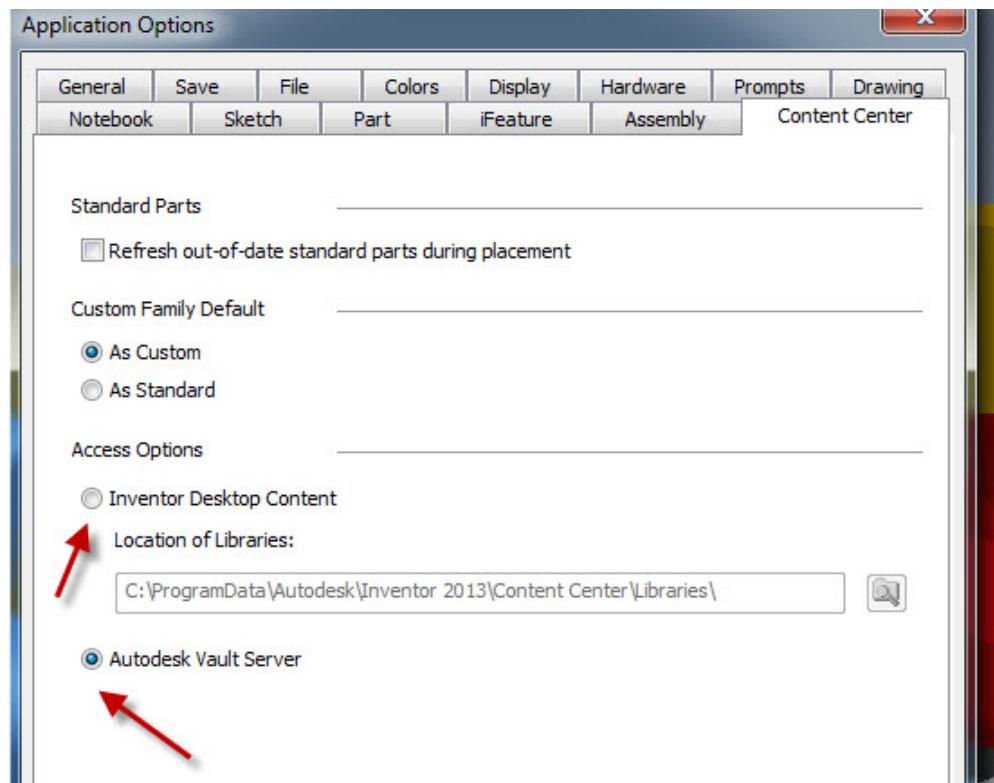


By using the **MEASURE** tool you get the pattern distance from the hole spacing.

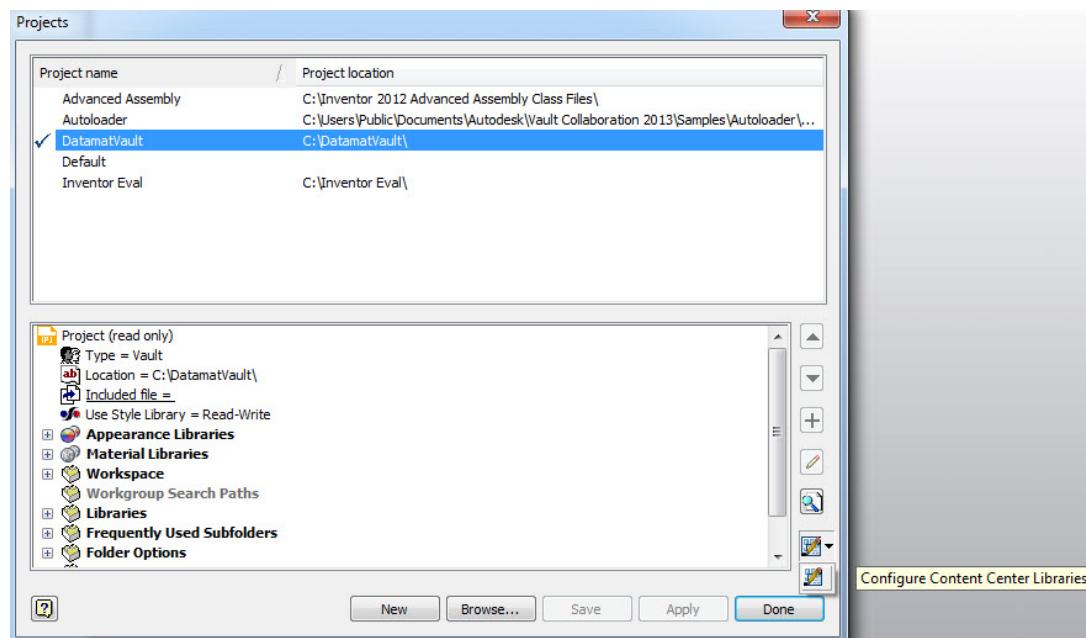
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Next publish the parts to the CC to create a more consistent work flow for company standard operations.

Publishing into the CC requires a R/W library. The CC can be configured to access content from either the Vault Server or the Desktop Content.

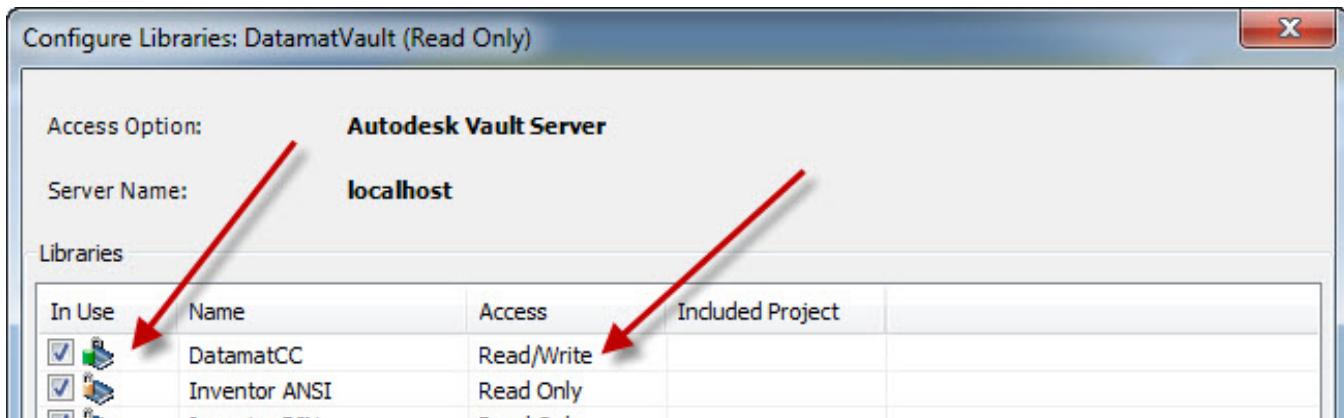


The **APPLICATION OPTIONS** is accessed from the **TOOLS** menu on the ribbon.



The **PROJECT PANEL** showing the **CONFIGURATION CC LIBRARY** button.

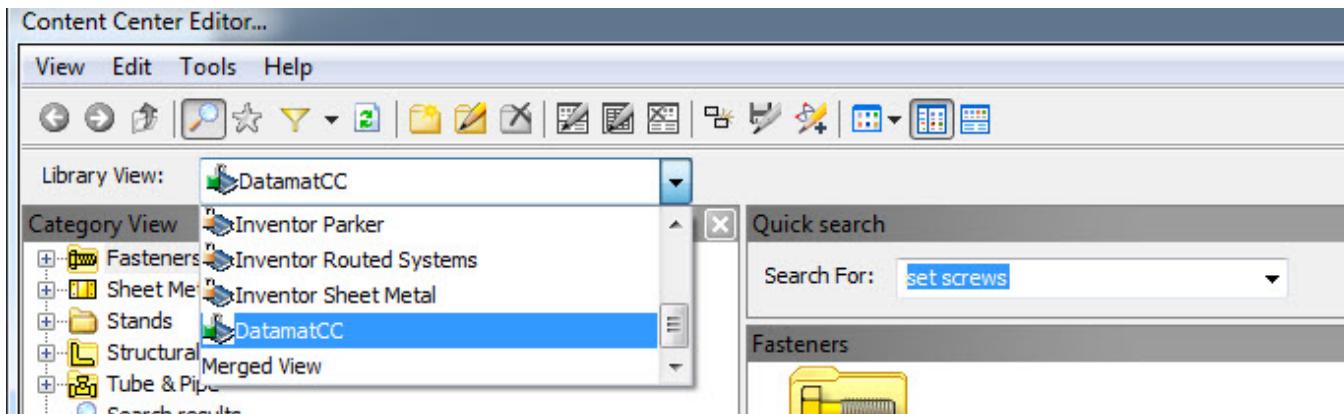
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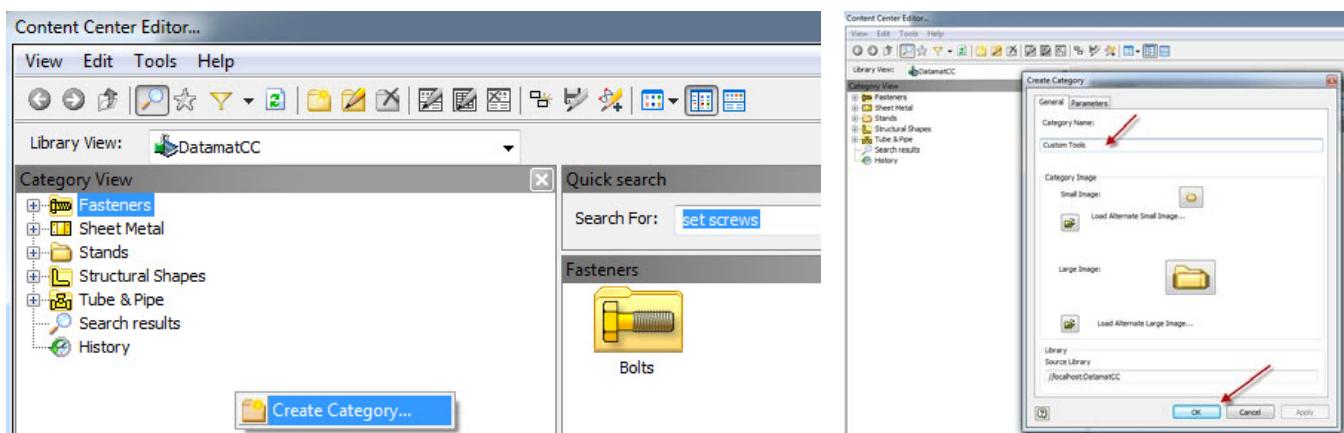
The library we will be using



Use the **CC EDITOR** to create a new category.



Set the **LIBRARY VIEW** to your R/W library if not defaulted already.

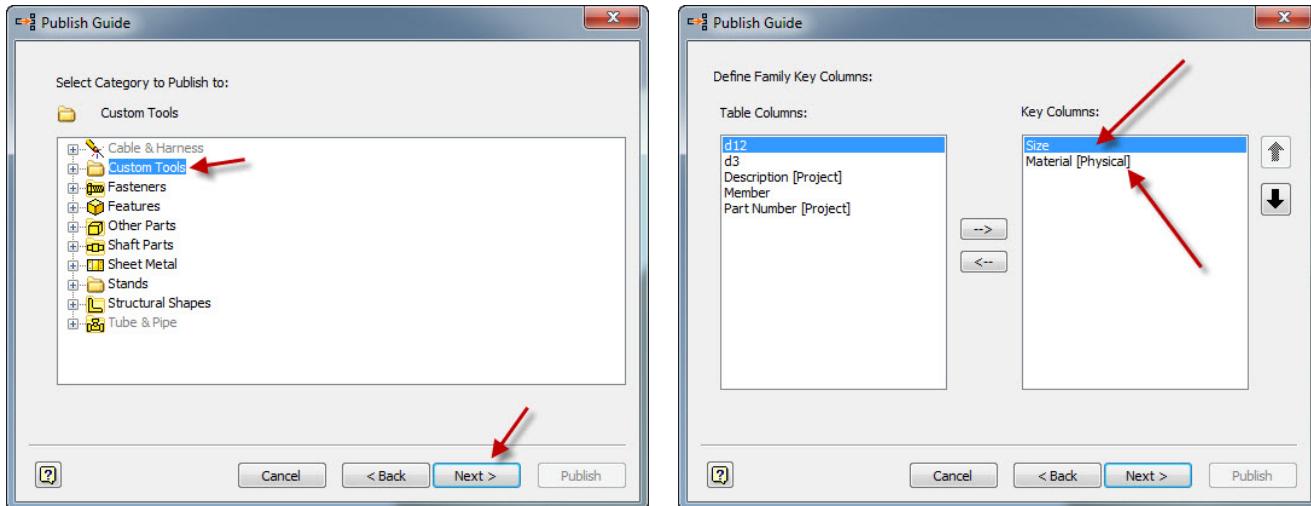


Create a top level category. This is different than creating a sub category.
Right click in the **CATEGORY VIEW AREA**. Then enter the category name.

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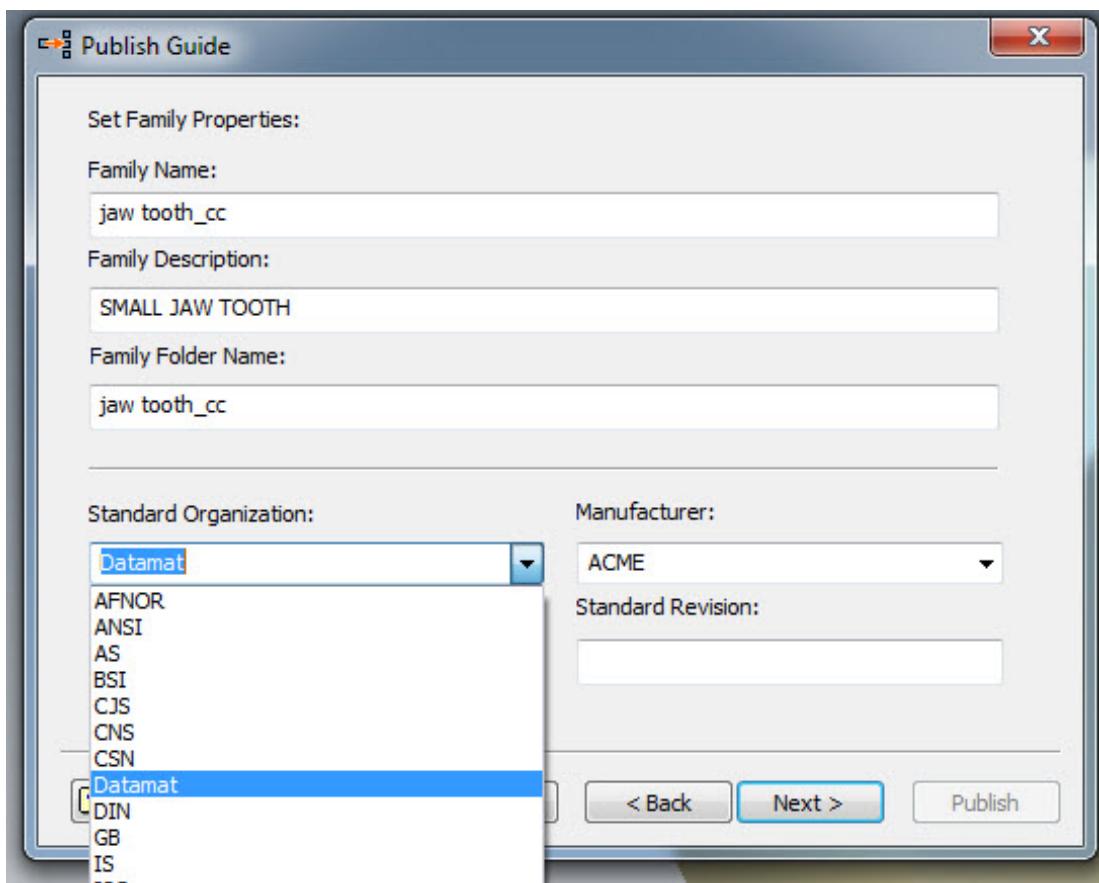


Next, click **PUBLISH PART**.



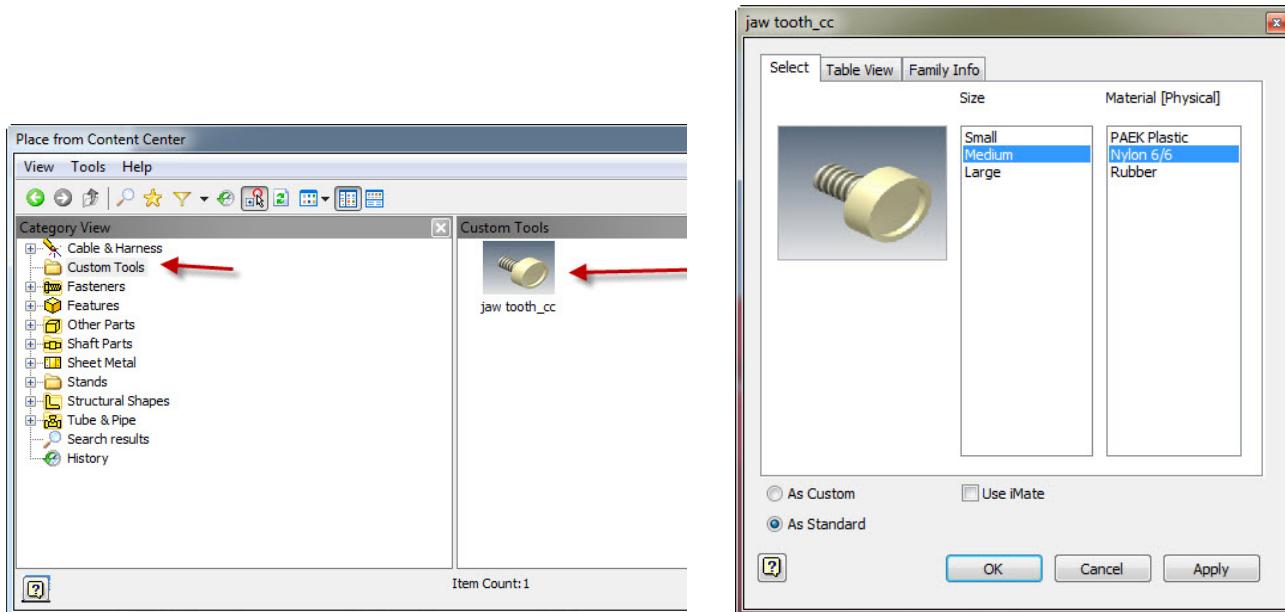
Select the category.

Primary keys are pre-defined from the iPart.



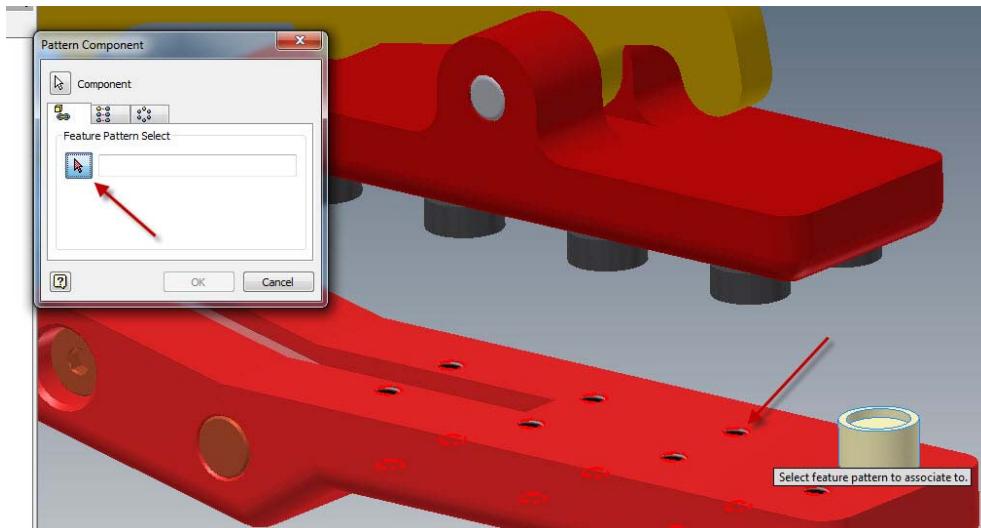
Change **STANDARD ORGANIZATION** and **MANUFACTURER**, then click **NEXT** to continue.

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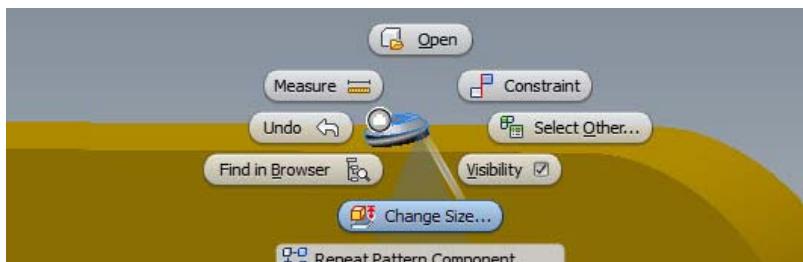
You can now place the new CC part as you would others. Select from the **CUSTOM TOOLS** folder.

Choose the size and the material. Use the iMate to constrain the part.

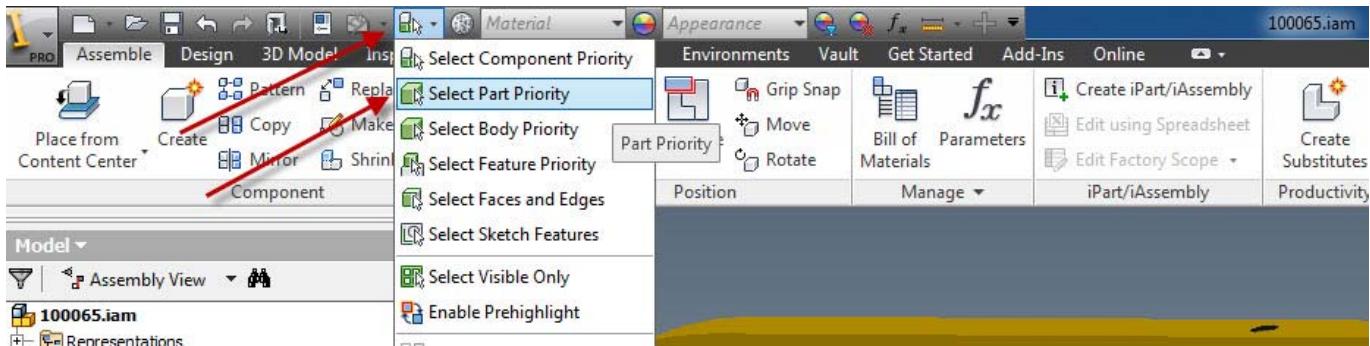


Use **COMPONENT PATTERN** with the **FEATURE PATTERN** select option.

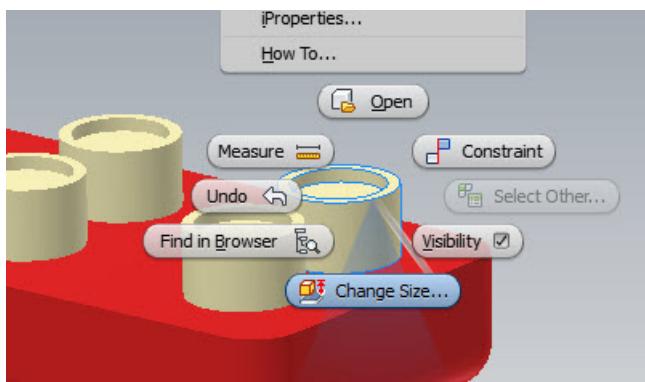
Lets take a look at the benefits of using the CC for iParts. All CC standard or custom parts have the same behavior. For example, if you want to change the size of the set screw, right click **CHANGE SIZE**.



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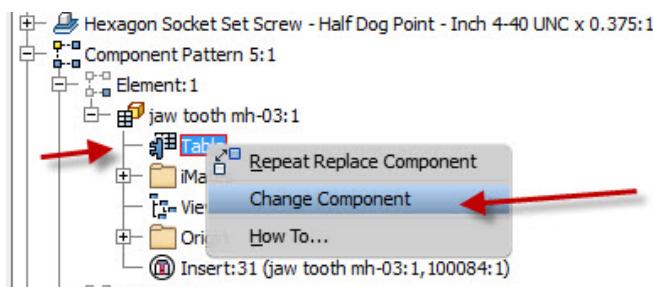


If needed, change a part that has been included as a patterned part. To replace the tooth in our jaw use the **SELECT PART PRIORITY** instead of having to go find the part in the assembly browser. This is faster and simpler.



Right click and change size and then choose a new member.

To change a standard part or iPart without the CC takes longer. We can still use the **SELECT PART PRIORITY**, but then we must find the part in the browser.



Find the part in the browser. Select (+) to expand, right click on the table, **CHANGE COMPONENT**

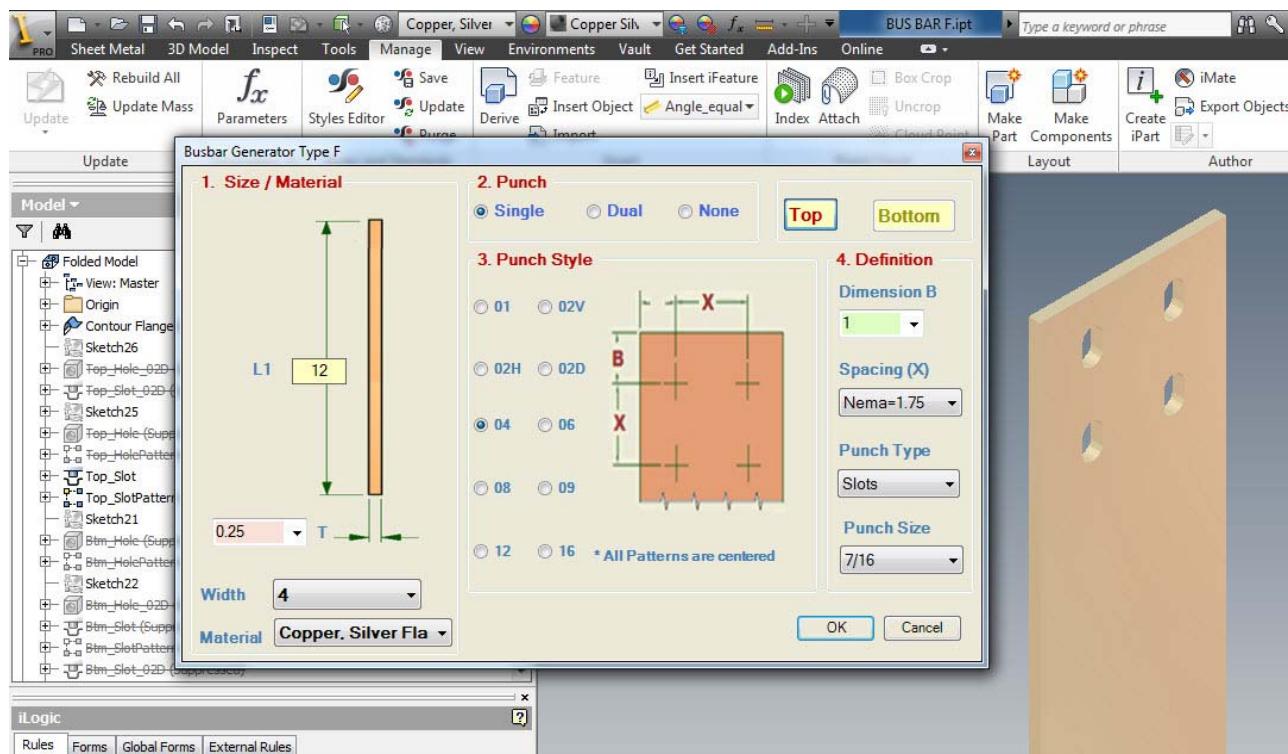
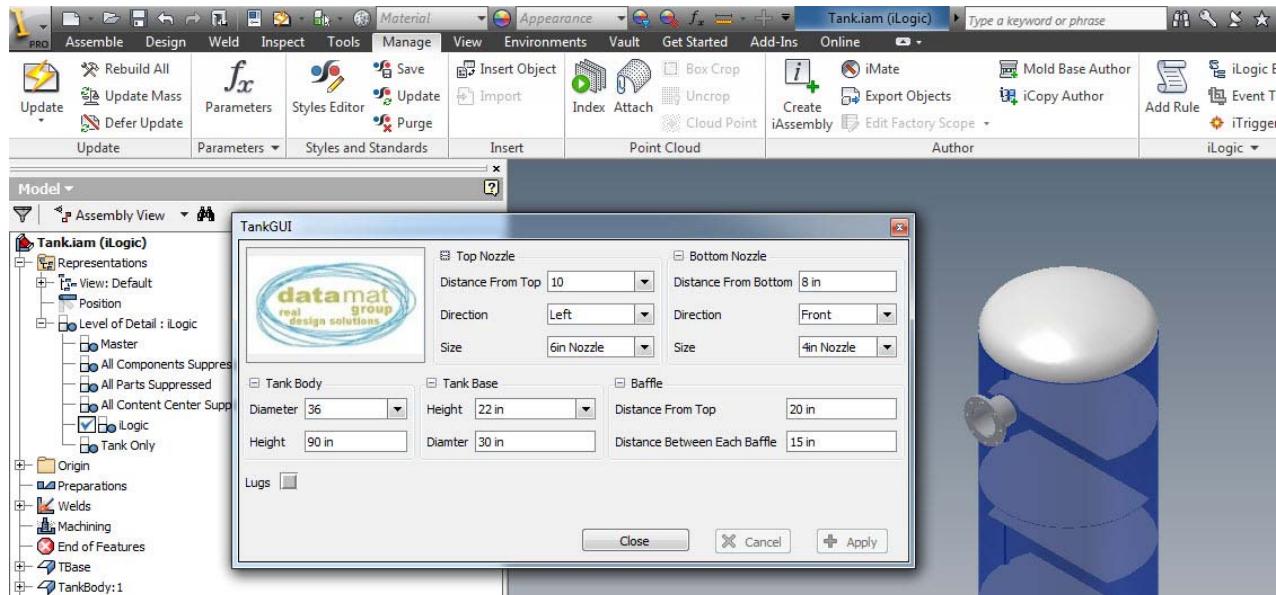
A work flow with iParts published into the CC is consistent. Not using iParts in CC requires more work. Picking one work flow for all company users makes training more productive. Publishing your iParts will make your company more productive overall.

iParts vs iLogic

Why use iParts when you could use iLogic or even Derived Parts?

First, let's make clear why you would choose to use iParts over iLogic. iParts are used when there are limited numbers of members. With our tooth example we might have up to a dozen variations i.e.: Material, Diameter, or Length. So it is fitting to use iParts.

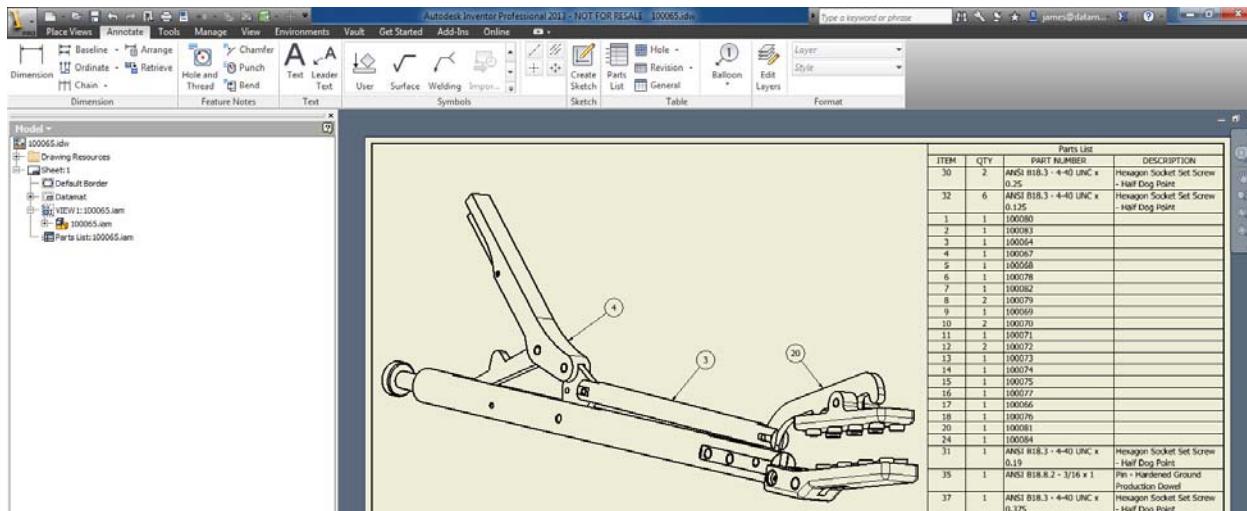
iLogic is used when the number of members is unknown and you will be using rules to control other parts whether they are iParts or not. Consider a part that has hundreds of possible variations. Go with iLogic.



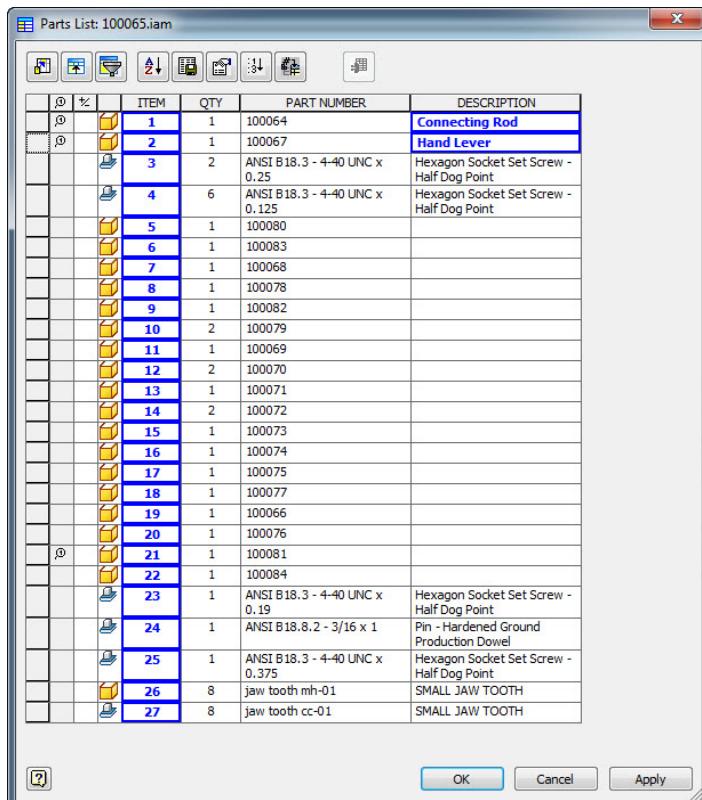
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Bill of Material

A quick look at some of the advantages of working with the BOM. Changes to part and assembly properties can be managed better and faster from the BOM

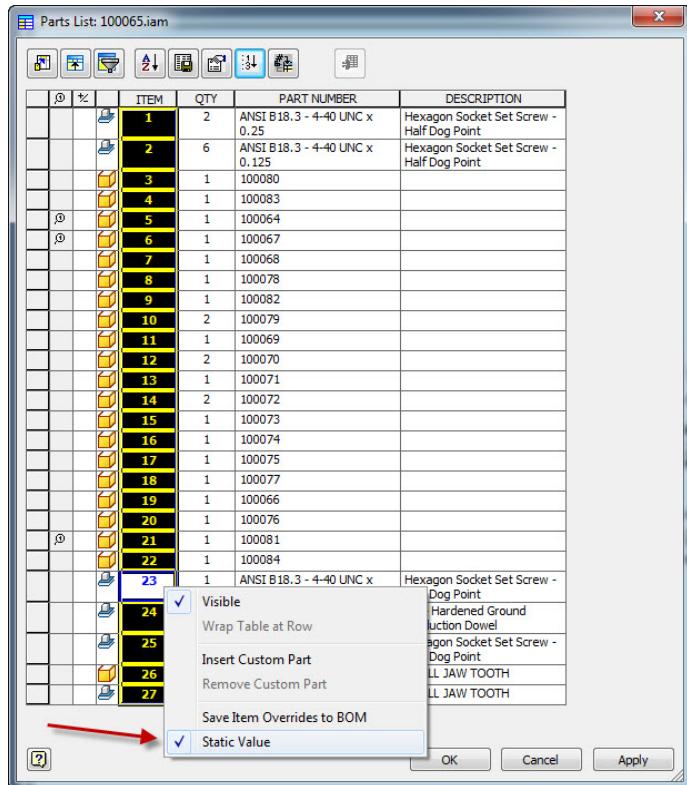


Lets take a look at a possible drawing created from our ManGrip assembly. In this drawing the balloons are out of sequence. Also notice that most of the parts do not have descriptions.



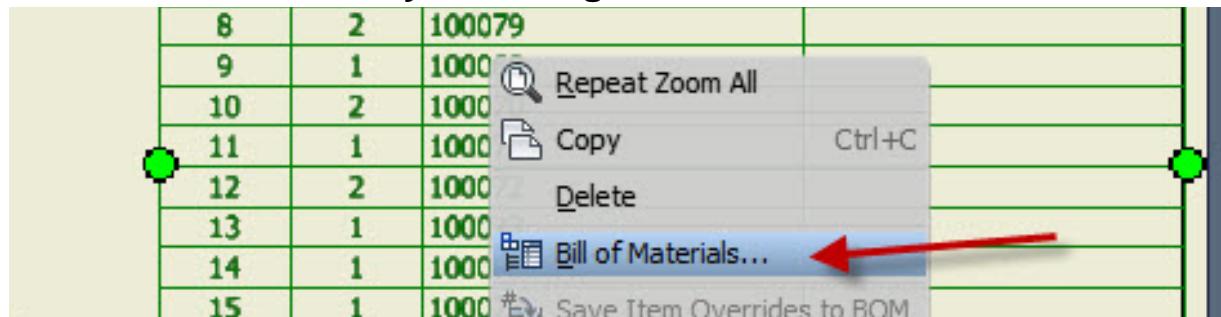
Above is the opened parts list for the assembly on this sheet.. You can change the order and add descriptions here. DO NOT DO THIS! Go to the next page.

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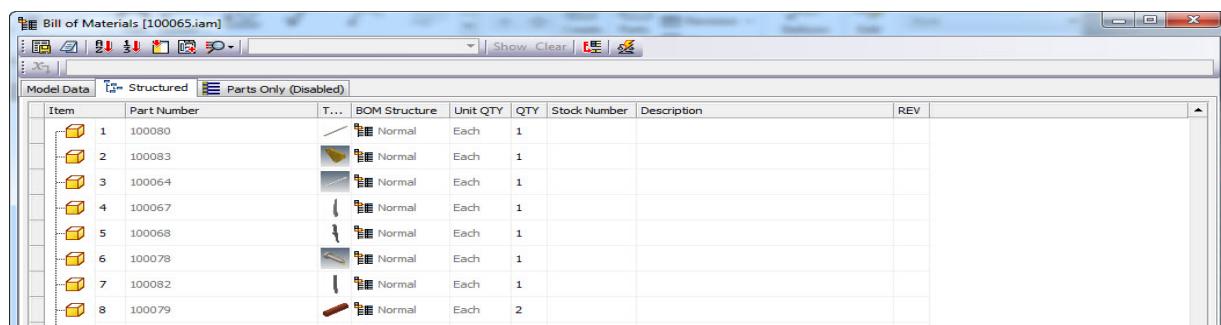


If the changes are made in the drawing parts list they are static. Static is BAD. Well not really bad, just bad karma. Data changed in the parts list is only on the sheet being worked on. Changing in the BOM fixes both the part and drawing issues. Bidirectional changes are so much better than static ones.

Use the BOM to make your changes.



Remove the static values, then right click the parts list to go to the BOM.



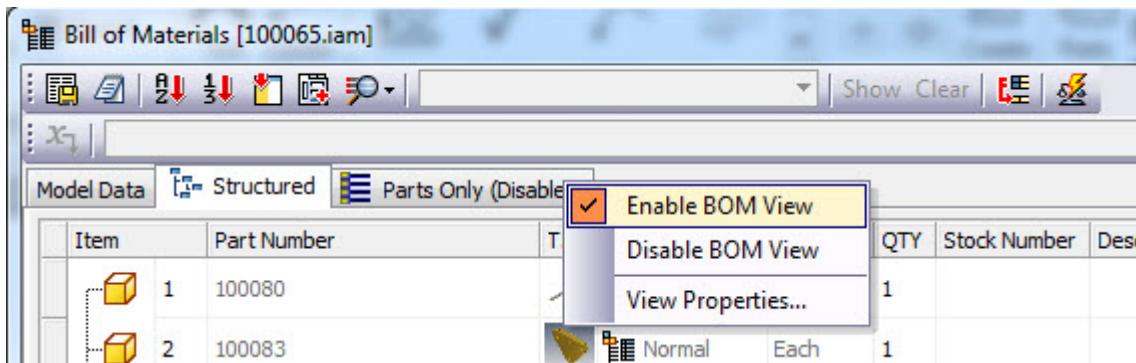
BOM has three tabs: **MODEL DATA**, **STRUCTURED** and **PARTS ONLY**

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MODEL DATA – is a true representation of what makes up the assembly including reference components, phantom connections from bolted connections, ect,

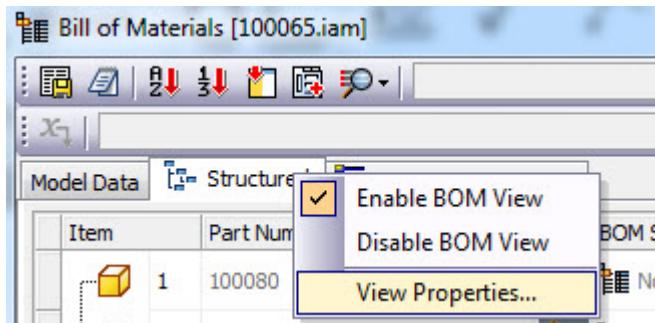
STRUCTURED TAB – representative of what will be displayed in the parts list, top level components and sub assemblies.

PARTS ONLY TAB – breaks the structure down and displays only parts, even within subassemblies. By default **PARTS ONLY** is disabled.

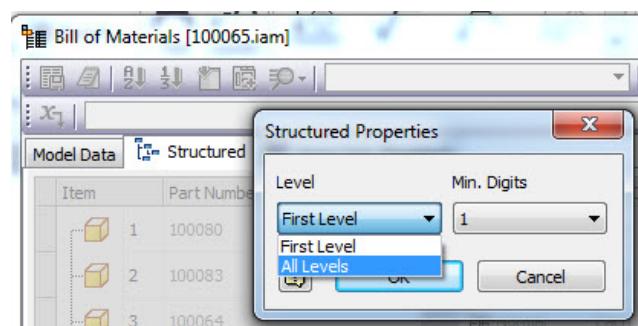


Use right click on the **PARTS ONLY** tab to enable it.

The **STRUCTURE TAB** shows first level components and sub assemblies. If you want to show sub assembly parts in the parts list and drawing, you must configure the **STRUCTURE TAB** to display all levels.



Right click to **VIEW PROPERTIES**



Drop down and display **ALL LEVELS**.

In **STRUCTURE TAB** you will see your parts. If they are grayed out, they are not checked out from vault. You can add descriptions in BOM (if the parts are checked out) and it will change component properties – ie description, part number, material. You can also reorder parts in BOM. This will change the order in the parts list. Grab and move the part up or down the list. If you do not see the column you want to change, then use the **CHOOSE COLUMNS** button:

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The screenshot shows the Autodesk Inventor Bill of Materials (BOM) dialog box. At the top, there are two tabs: "Model Data" (selected) and "Structured". Below the tabs is a toolbar with various icons. A red arrow points from the "Model Data" tab to the toolbar icon for "Choose Columns". Another red arrow points from the "REV" column header in the BOM table to a "Customization" dialog box on the right. The "Customization" dialog box lists several fields: Item QTY, Keywords, Manager, Mass, Material, Mfg. Approved By, and Mfg. Approved By Date. The BOM table lists 18 items, each with a part number, description, and material information. Buttons for Import..., Export..., and Done are at the bottom.

Item	Part Number	T...	BOM Structure	Unit QTY	QTY	Stock Number	Description	REV
4	100067		Normal	Each	1		Hand Lever	
3	100064		Normal	Each	1		Connecting Rod	
1	100080		Normal	Each	1			
8	100079		Normal	Each	2			
9	100069		Normal	Each	1			
10	100070		Normal	Each	2			
11	100071		Normal	Each	1			
12	100072		Normal	Each	2			
13	100073		Normal	Each	1			
14	100074		Normal	Each	1			
17	100066		Normal	Each	1			
18	100076		Normal	Each	1			
7	100082		Normal	Each	1			
16	100077		Normal	Each	1			
24	100084		Normal	Each	1			
20	100081		Normal	Each	1		Moveable Jaw Arm	
2	100083		Normal	Each	1			
15	100075		Normal	Each	1			

Click and drag **MATERIAL** to the header of the BOM to display.

Change material here. It is much faster than opening each part individually. You can even copy and paste values.

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The screenshot shows the Autodesk Inventor Bill of Materials dialog box for the file "100065.iam". The table lists five parts:

Item	Part Number	BOM Structure	Unit QTY	QTY	Stock Number	Description
4	100067	Normal	Each	1		Hand Lever
3	100064	Normal	Each	1		Connecting Rod
20	100081	Normal	Each	1		Moveable Jaw Arm
1	100080	Normal	Each	1		
8	100079	Normal	Each	2		

Once you have rearranged the parts into the order you want, use the **RENUMBER ITEMS** button.

The screenshot shows the Autodesk Inventor Bill of Materials dialog box for the file "100065.iam". The table now includes a "Material" column:

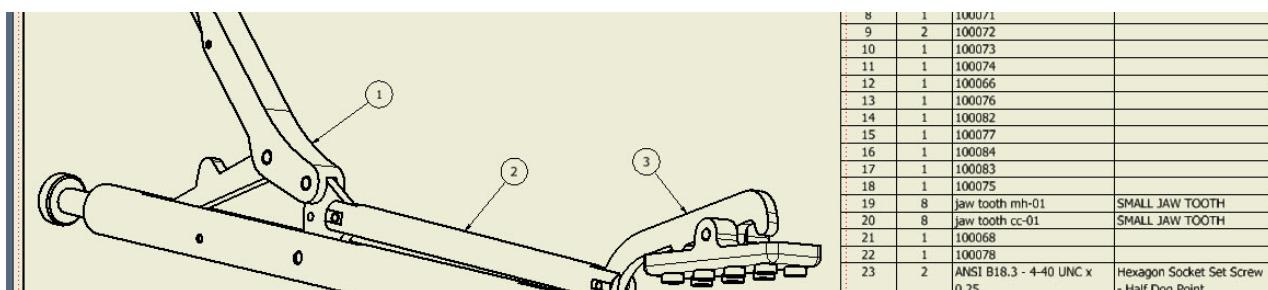
Item	Part Number	BOM Structure	Unit QTY	QTY	Stock Number	Description	Material	REV
1	100067	Normal	Each	1		Hand Lever	Stainless Steel	
2	100064	Normal	Each	1		Connecting Rod	Stainless Steel	
3	100081	Normal	Each	1		Moveable Jaw Arm	Stainless Steel	

The parts list is up to date, with no static values, Yippy!

The screenshot shows the Autodesk Inventor Parts List dialog box for the file "100065.iam". The table is identical to the one in the BOM dialog:

ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	100067	Hand Lever
2	1	100064	Connecting Rod
3	1	100081	Moveable Jaw Arm
4	1	100080	

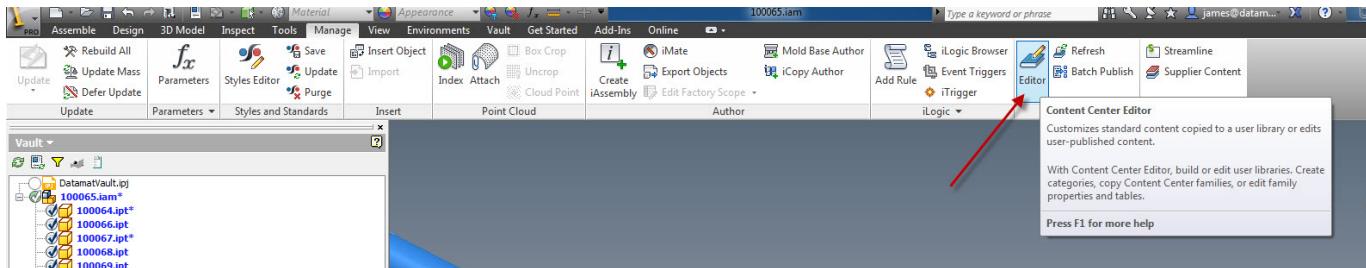
Changes in the BOM bidirectionally automatically updates the parts list.



Note: Balloons also automatically update

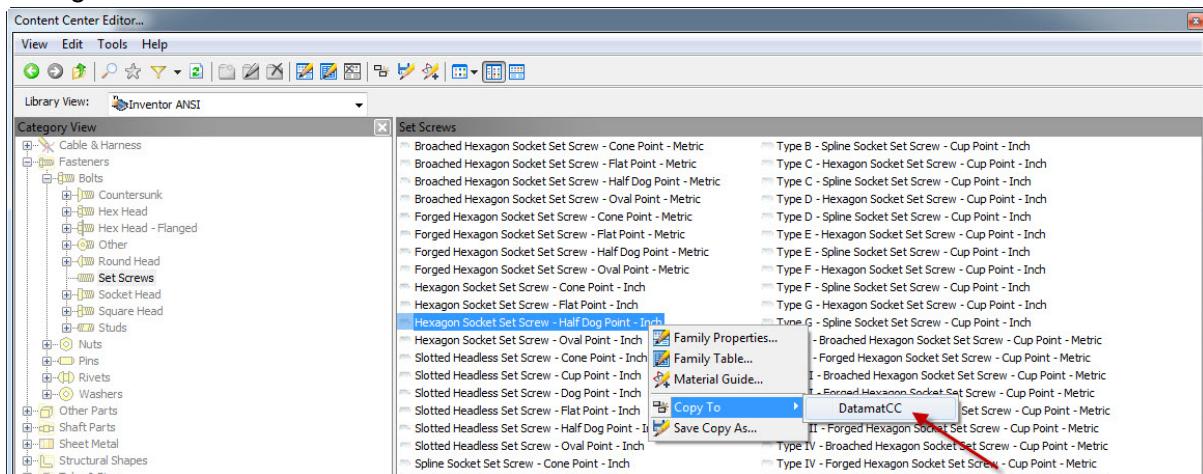
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Continuing with the BOM, CC parts come over with predefined part numbers determined by Autodesk/industry standards, not yours. Create CC parts that adhere to your standards.

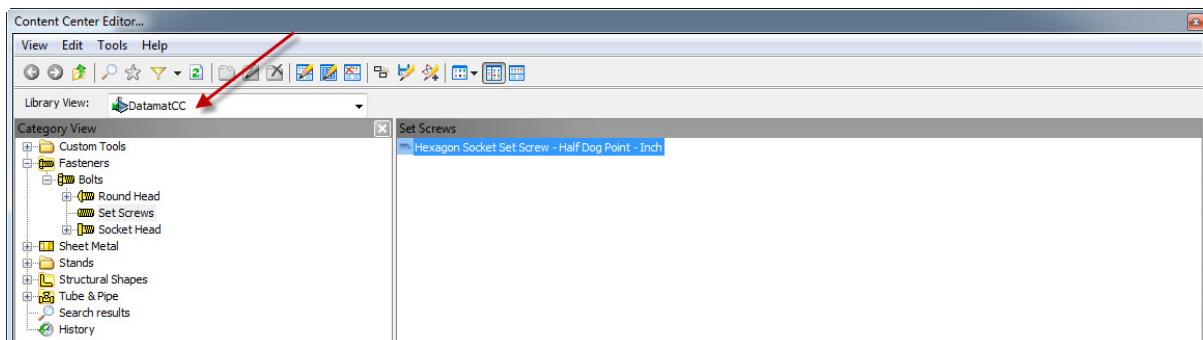


To change part numbers go to **CONTENT CENTER EDITOR**.

Original cc content is grayed out - it cannot be changed. Copy a family to your R/W library to make changes.

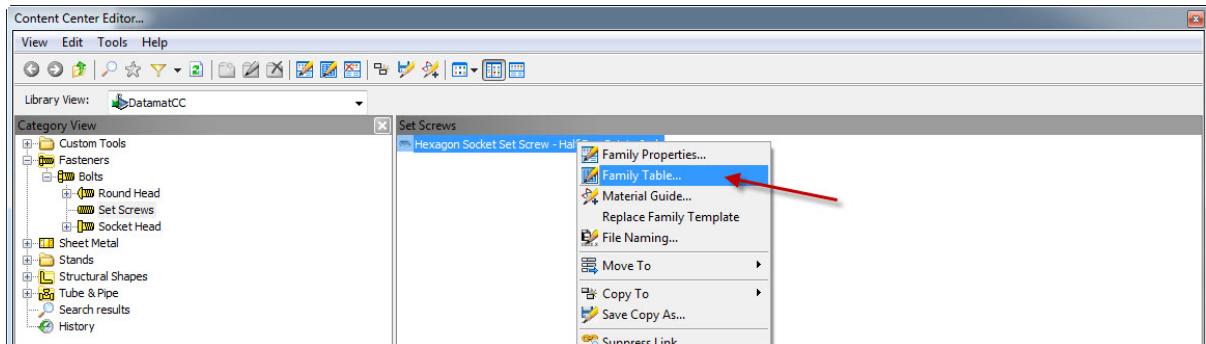


Find the family you want to change, right click it, then use **COPY TO**.



Use **LIBRARY VIEW** to select your R/W library.

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Go to family table. Right click the **FAMILY MEMBER** to get to **FAMILY TABLE**.

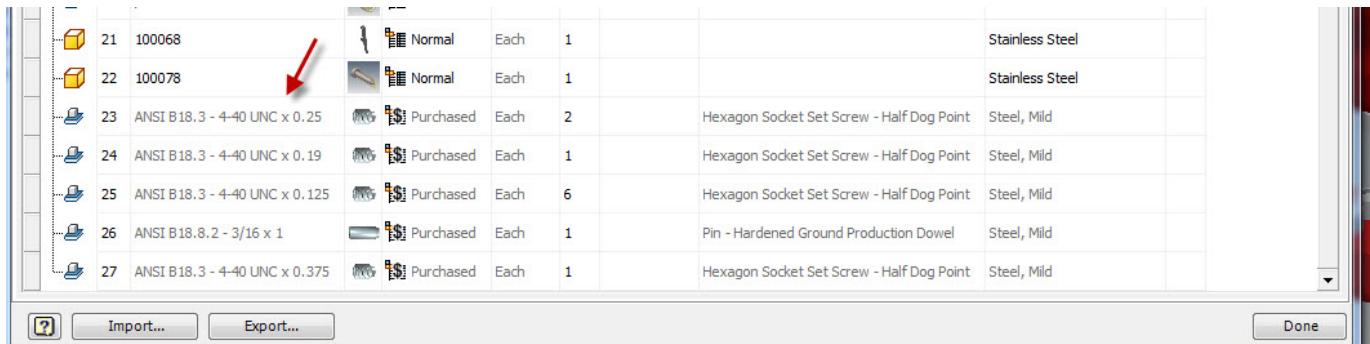
Family Table: Hexagon Socket Set Screw - Half Dog Point - Inch						
RowStatus	Thread description	Nominal Diameter [inch]	Nominal Length [inch]		Pitch Diameter [inch]	Ang [deg]
1	0-80 UNF	0.06	0.125		0.0446641	90
2	0-80 UNF	0.06	0.188		0.0446641	90
3	0-80 UNF	0.06	0.25	0.028	0.05	0.0125

Use the filter to reduce clutter and go to **IProperties COLUMN ONLY**.

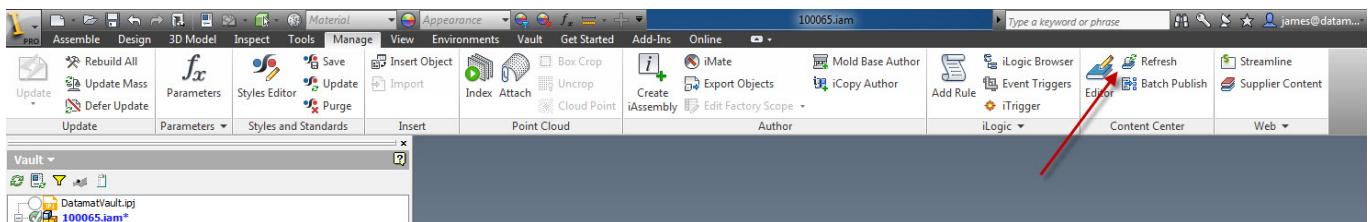
Family Table: Hexagon Socket Set Screw - Half Dog Point - Inch				
RowStatus	Size Designation	File Name	Material	Part Number
70	3-48 UNC x 0.84	ANSI B18.3 - 3-4...	Steel, Mild	ANSI B18.3 - 3-48 UNC x 0.84
71	3-56 UNF x 0.84	ANSI B18.3 - 3-5...	Steel, Mild	ANSI B18.3 - 3-56 UNF x 0.84
72	3-48 UNC x 0.875	ANSI B18.3 - 3-4...	Steel, Mild	ANSI B18.3 - 3-48 UNC x 0.875
73	3-56 UNF x 0.875	ANSI B18.3 - 3-5...	Steel, Mild	ANSI B18.3 - 3-56 UNF x 0.875
74	3-48 UNC x 1	ANSI B18.3 - 3-4...	Steel, Mild	ANSI B18.3 - 3-48 UNC x 1
75	3-56 UNF x 1	ANSI B18.3 - 3-5...	Steel, Mild	ANSI B18.3 - 3-56 UNF x 1
76	4-40 UNC x 0.125	ANSI B18.3 - 4-4...	Steel, Mild	12345-1
77	4-48 UNF x 0.125	ANSI B18.3 - 4-4...	Steel, Mild	ANSI B18.3 - 4-48 UNF x 0.125
78	4-40 UNC x 0.19	ANSI B18.3 - 4-4...	Steel, Mild	12345-2
79	4-48 UNF x 0.19	ANSI B18.3 - 4-4...	Steel, Mild	ANSI B18.3 - 4-48 UNF x 0.19
80	4-40 UNC x 0.25	ANSI B18.3 - 4-4...	Steel, Mild	12345-3
81	4-48 UNF x 0.25	ANSI B18.3 - 4-4...	Steel, Mild	ANSI B18.3 - 4-48 UNF x 0.25
82	4-40 UNC x 0.32	ANSI B18.3 - 4-4...	Steel, Mild	ANSI B18.3 - 4-40 UNC x 0.32

Find the sizes you want to rename, and change the part number to meet company standards.

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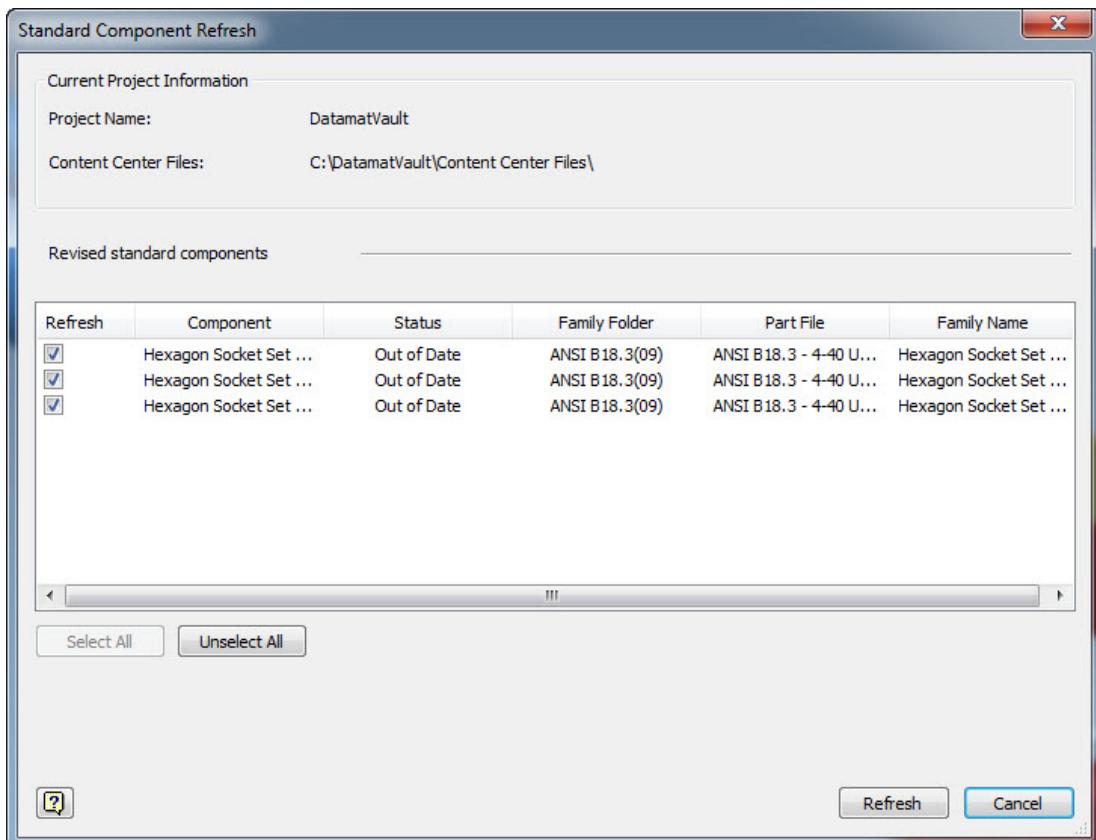


The changes will not show immediately in BOM.



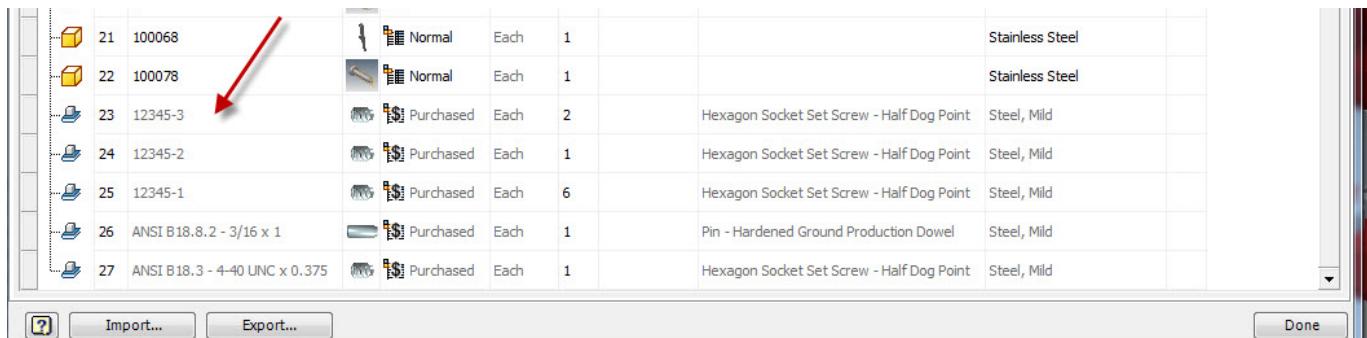
Synchronization needs to take place with previously used content and updates to the family tables.

We do that with a **REFRESH**



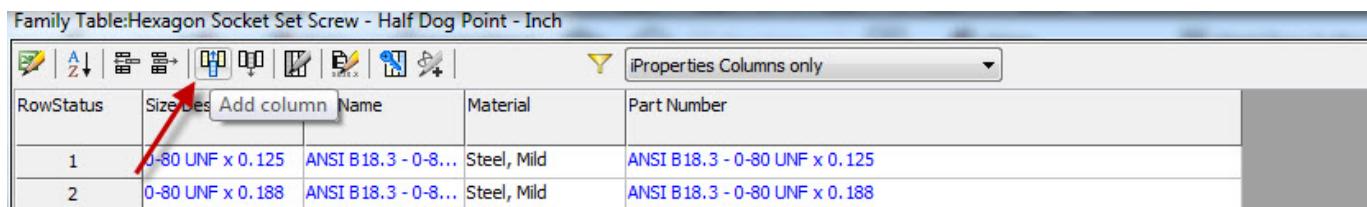
Autodesk® Inventor® work flow for developing a top down manufacturing shop process

You should see the **STANDARD COMPONENT REFRESH** window showing the CC components that are out of sync with libraries. Click **REFRESH**.

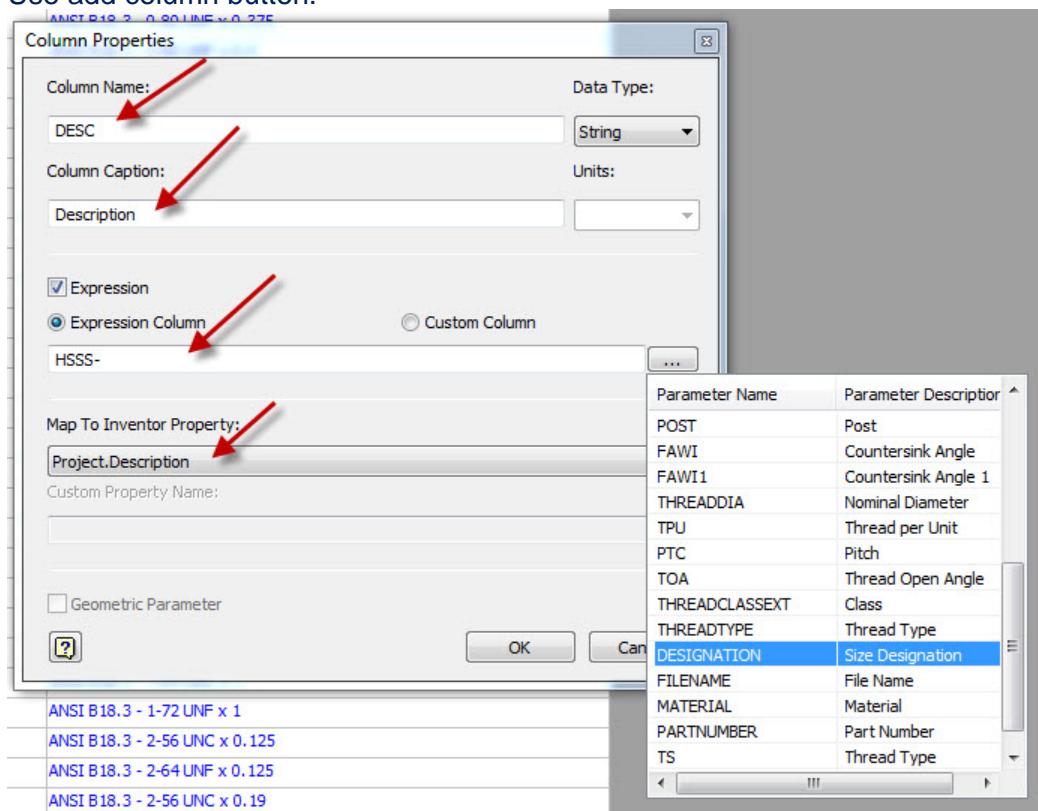


Updated BOM.

If the descriptions are also to be changed, a column needs to be added. Do this in the **CONTENT CENTER EDITOR. FAMILY TABLE EDIT**. Add a new column and map to **DESCRIPTION PROPERTY**.

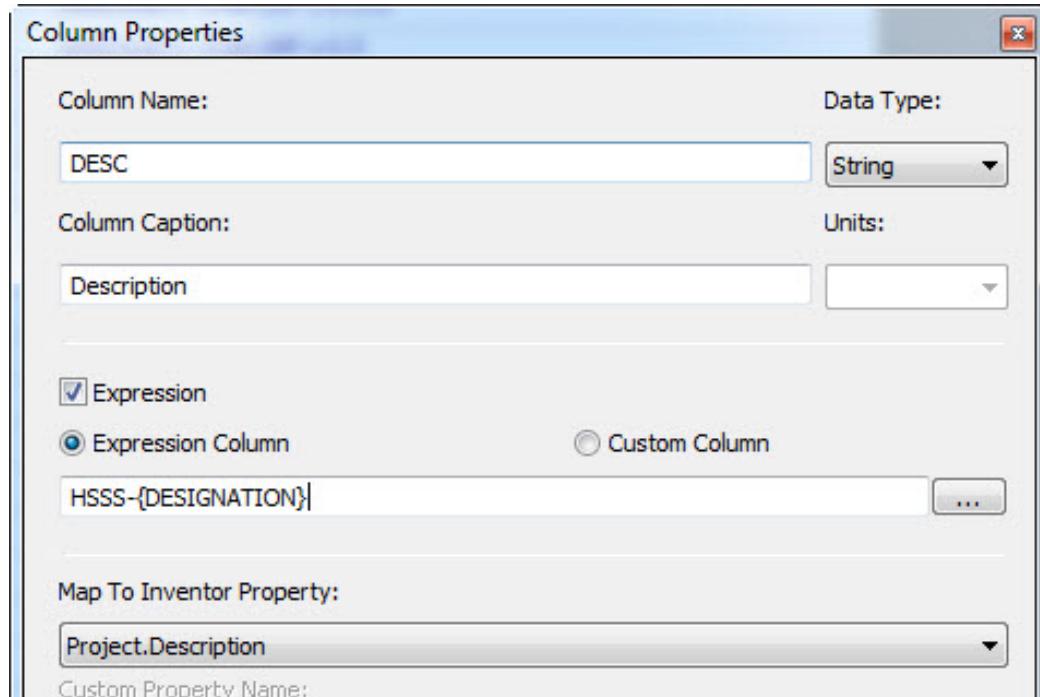


Use add column button.



Autodesk® Inventor® work flow for developing a top down manufacturing shop process

Set the column name, description, and an expression. Notice the expression is made from a prefix of HSSS- and then data from the size designation.



The completed form.

Family Table:Hexagon Socket Set Screw - Half Dog Point - Inch					
RowStatus	Size Designation	File Name	Material	Part Number	Description
73	3-56 UNF x 0.875	ANSI B18.3 - 3-5...	Steel, Mild	ANSI B18.3 - 3-56 UNF x 0.875	HSSS-3-56 UNF x 0.875
74	3-48 UNC x 1	ANSI B18.3 - 3-4...	Steel, Mild	ANSI B18.3 - 3-48 UNC x 1	HSSS-3-48 UNC x 1
75	3-56 UNF x 1	ANSI B18.3 - 3-5...	Steel, Mild	ANSI B18.3 - 3-56 UNF x 1	HSSS-3-56 UNF x 1
76	4-40 UNC x 0.125	ANSI B18.3 - 4-4...	Steel, Mild	12345-1	HSSS-4-40 UNC x 0.125
77	4-48 UNF x 0.125	ANSI B18.3 - 4-4...	Steel, Mild	ANSI B18.3 - 4-48 UNF x 0.125	HSSS-4-48 UNF x 0.125
78	4-40 UNC x 0.19	ANSI B18.3 - 4-4...	Steel, Mild	12345-2	HSSS-4-40 UNC x 0.19
79	4-48 UNF x 0.19	ANSI B18.3 - 4-4...	Steel, Mild	ANSI B18.3 - 4-48 UNF x 0.19	HSSS-4-48 UNF x 0.19
80	4-40 UNC x 0.25	ANSI B18.3 - 4-4...	Steel, Mild	12345-3	HSSS-4-40 UNC x 0.25
81	4-48 UNF x 0.25	ANSI B18.3 - 4-4...	Steel, Mild	ANSI B18.3 - 4-48 UNF x 0.25	HSSS-4-48 UNF x 0.25

The new column with the new descriptions.

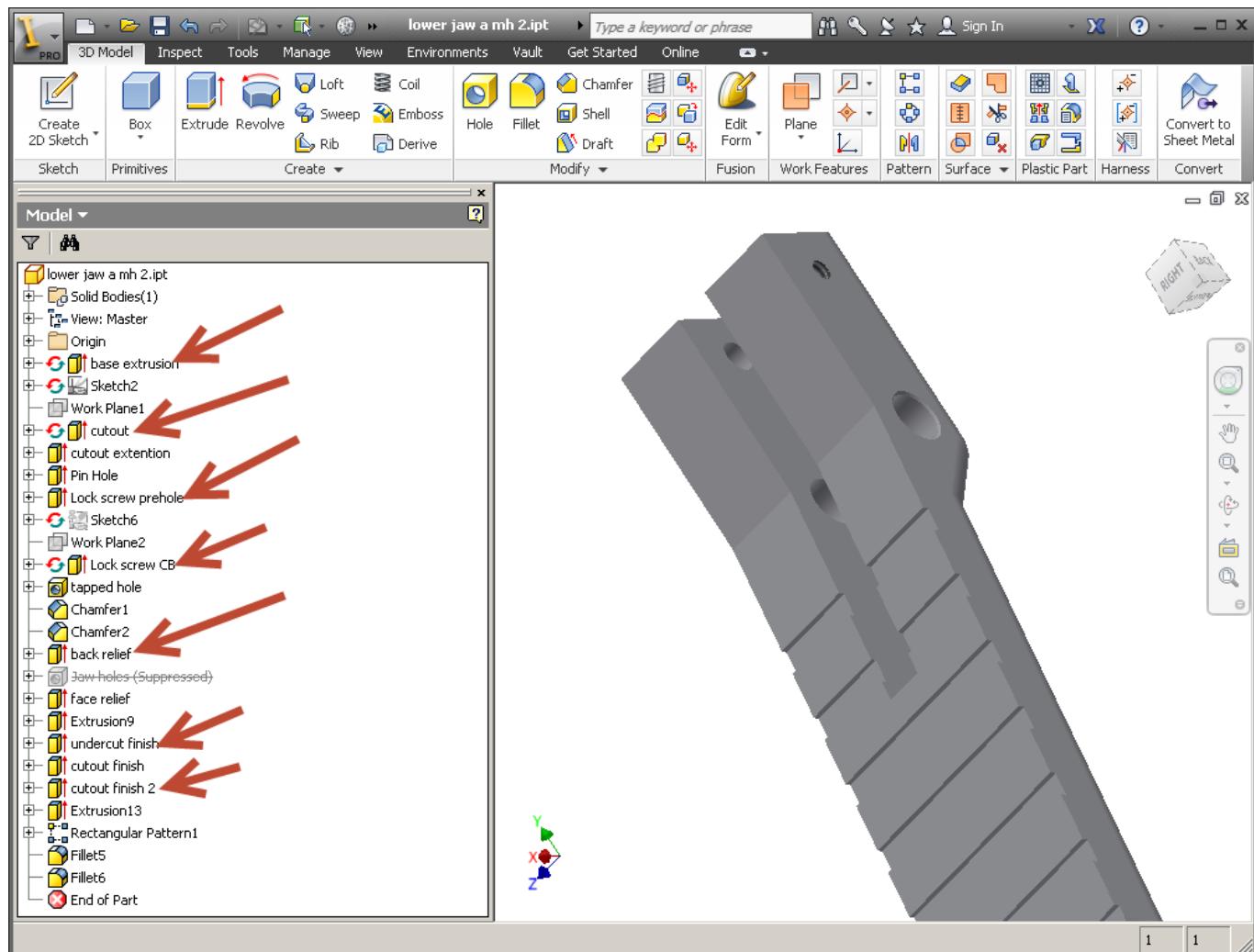
Click **REFRESH CONTENT CENTER** to update changes from the libraries to the components.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180	181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	209	210	211	212	213	214	215	216	217	218	219	220	221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240	241	242	243	244	245	246	247	248	249	250	251	252	253	254	255	256	257	258	259	260	261	262	263	264	265	266	267	268	269	270	271	272	273	274	275	276	277	278	279	280	281	282	283	284	285	286	287	288	289	290	291	292	293	294	295	296	297	298	299	300	301	302	303	304	305	306	307	308	309	310	311	312	313	314	315	316	317	318	319	320	321	322	323	324	325	326	327	328	329	330	331	332	333	334	335	336	337	338	339	340	341	342	343	344	345	346	347	348	349	350	351	352	353	354	355	356	357	358	359	360	361	362	363	364	365	366	367	368	369	370	371	372	373	374	375	376	377	378	379	380	381	382	383	384	385	386	387	388	389	390	391	392	393	394	395	396	397	398	399	400	401	402	403	404	405	406	407	408	409	410	411	412	413	414	415	416	417	418	419	420	421	422	423	424	425	426	427	428	429	430	431	432	433	434	435	436	437	438	439	440	441	442	443	444	445	446	447	448	449	450	451	452	453	454	455	456	457	458	459	460	461	462	463	464	465	466	467	468	469	470	471	472	473	474	475	476	477	478	479	480	481	482	483	484	485	486	487	488	489	490	491	492	493	494	495	496	497	498	499	500	501	502	503	504	505	506	507	508	509	510	511	512	513	514	515	516	517	518	519	520	521	522	523	524	525	526	527	528	529	530	531	532	533	534	535	536	537	538	539	540	541	542	543	544	545	546	547	548	549	550	551	552	553	554	555	556	557	558	559	560	561	562	563	564	565	566	567	568	569	570	571	572	573	574	575	576	577	578	579	580	581	582	583	584	585	586	587	588	589	590	591	592	593	594	595	596	597	598	599	600	601	602	603	604	605	606	607	608	609	610	611	612	613	614	615	616	617	618	619	620	621	622	623	624	625	626	627	628	629	630	631	632	633	634	635	636	637	638	639	640	641	642	643	644	645	646	647	648	649	650	651	652	653	654	655	656	657	658	659	660	661	662	663	664	665	666	667	668	669	670	671	672	673	674	675	676	677	678	679	680	681	682	683	684	685	686	687	688	689	690	691	692	693	694	695	696	697	698	699	700	701	702	703	704	705	706	707	708	709	710	711	712	713	714	715	716	717	718	719	720	721	722	723	724	725	726	727	728	729	730	731	732	733	734	735	736	737	738	739	740	741	742	743	744	745	746	747	748	749	750	751	752	753	754	755	756	757	758	759	760	761	762	763	764	765	766	767	768	769	770	771	772	773	774	775	776	777	778	779	780	781	782	783	784	785	786	787	788	789	790	791	792	793	794	795	796	797	798	799	800	801	802	803	804	805	806	807	808	809	810	811	812	813	814	815	816	817	818	819	820	821	822	823	824	825	826	827	828	829	830	831	832	833	834	835	836	837	838	839	840	841	842	843	844	845	846	847	848	849	850	851	852	853	854	855	856	857	858	859	860	861	862	863	864	865	866	867	868	869	870	871	872	873	874	875	876	877	878	879	880	881	882	883	884	885	886	887	888	889	890	891	892	893	894	895	896	897	898	899	900	901	902	903	904	905	906	907	908	909	910	911	912	913	914	915	916	917	918	919	920	921	922	923	924	925	926	927	928	929	930	931	932	933	934	935	936	937	938	939	940	941	942	943	944	945	946	947	948	949	950	951	952	953	954	955	956	957	958	959	960	961	962	963	964	965	966	967	968	969	970	971	972	973	974	975	976	977	978	979	980	981	982	983	984	985	986	987	988	989	990	991	992	993	994	995	996	997	998	999	1000	1001	1002	1003	1004	1005	1006	1007	1008	1009	1010	1011	1012	1013	1014	1015	1016	1017	1018	1019	1020	1021	1022	1023	1024	1025	1026	1027	1028	1029	1030	1031	1032	1033	1034	1035	1036	1037	1038	1039	1040	1041	1042	1043	1044	1045	1046	1047	1048	1049	1050	1051	1052	1053	1054	1055	1056	1057	1058	1059	1060	1061	1062	1063	1064	1065	1066	1067	1068	1069	1070	1071	1072	1073	1074	1075	1076	1077	1078	1079	1080	1081	1082	1083	1084	1085	1086	1087	1088	1089	1090	1091	1092	1093	1094	1095	1096	1097	1098	1099	1100	1101	1102	1103	1104	1105	1106	1107	1108	1109	1110	1111	1112	1113	1114	1115	1116	1117	1118	1119	1120	1121	1122	1123	1124	1125	1126	1127	1128	1129	1130	1131	1132	1133	1134	1135	1136	1137	1138	1139	1140	1141	1142	1143	1144	1145	1146	1147	1148	1149	1150	1151	1152	1153	1154	1155	1156	1157	1158	1159	1160	1161	1162	1163	1164	1165	1166	1167	1168	1169	1170	1171	1172	1173	1174	1175	1176	1177	1178	1179	1180	1181	1182	1183	1184	1185	1186	1187	1188	1189	1190	1191	1192	1193	1194	1195	1196	1197	1198	1199	1200	1201	1202	1203	1204	120

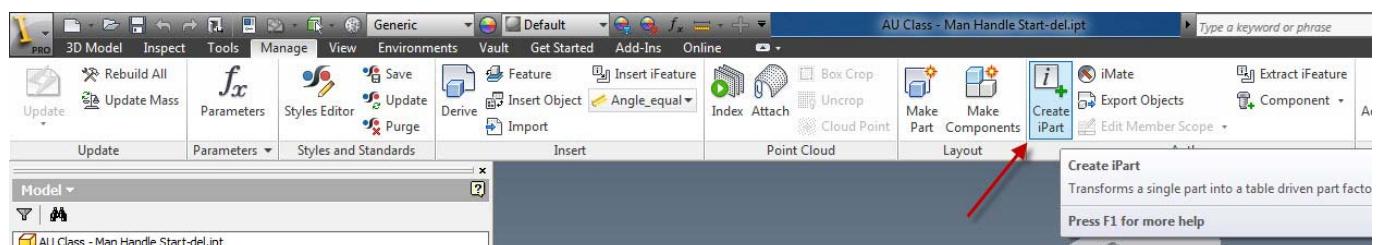
Autodesk® Inventor® work flow for developing a top down manufacturing shop process

Use iParts to create part process steps and drawings

Before we start, rename the features of the part so they will be easier to work with when they are suppressed to create steps in the processes.

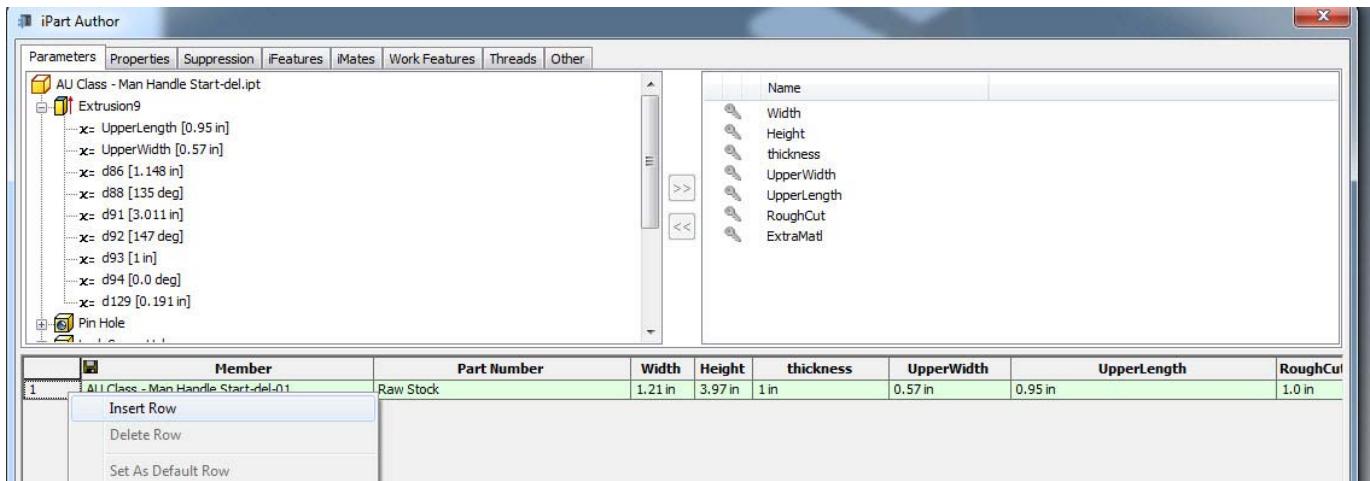


Note: This part is not used in this class. It is here to represent changes to the feature's names.

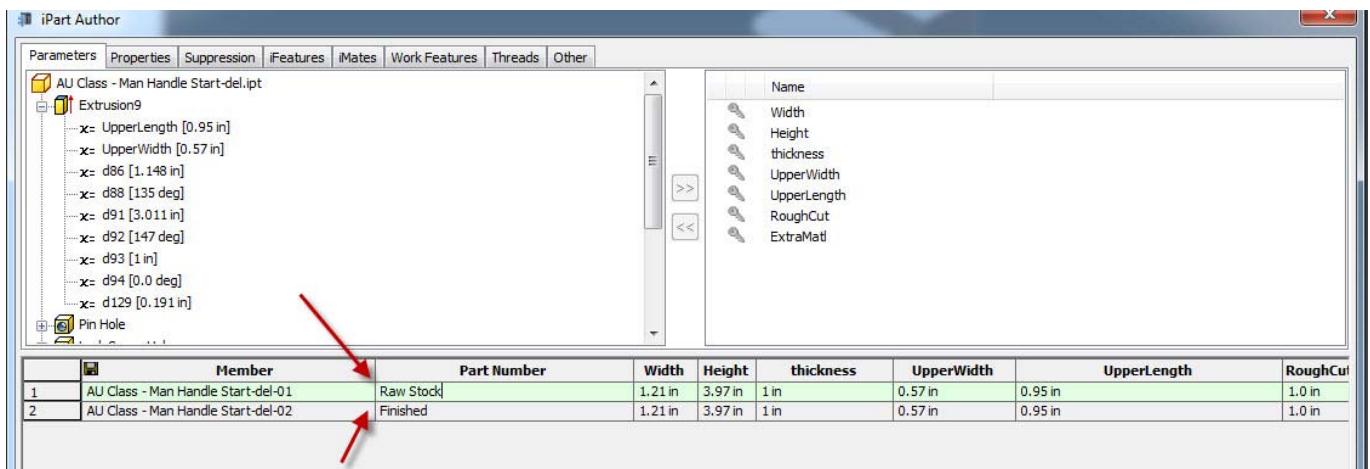


We will start with the finished part, and turn it into an iPart.

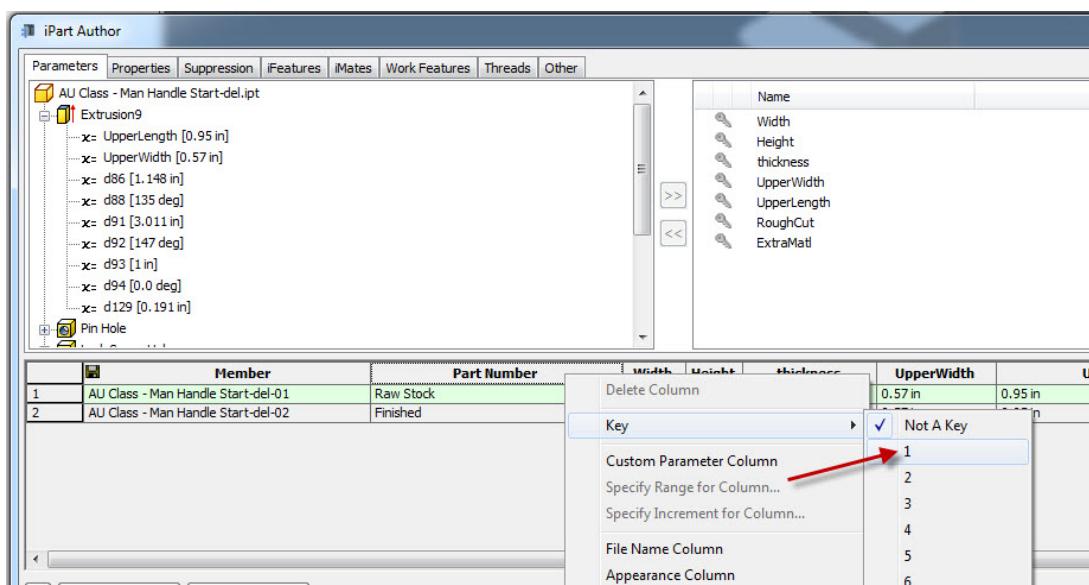
Autodesk® Inventor® work flow for developing a top down manufacturing shop process



Click **OK**, then right click the only member to create a new row.



Change part numbers as shown.

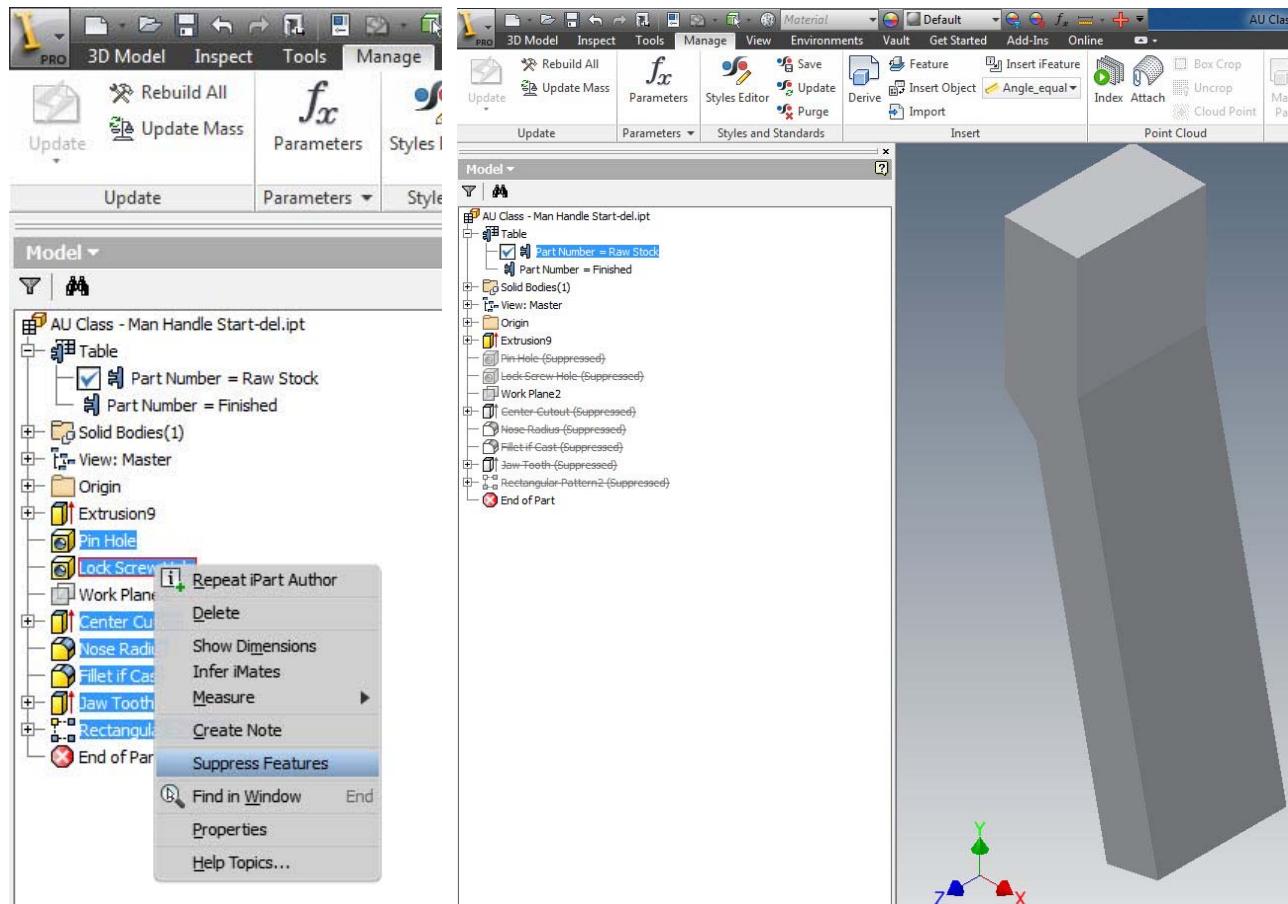


Make the part number column a primary key.

Autodesk® Inventor® work flow for developing a top down manufacturing shop process

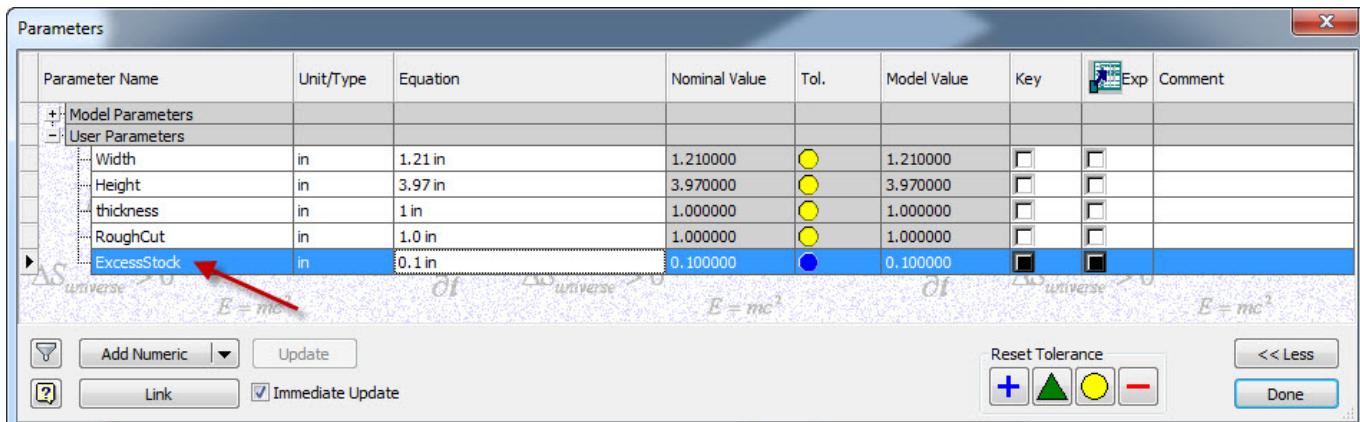
Set to **MEMBER SCOPE**. This is important since the changes to be made from now on are made to only the item being modified. Not all the members in the family. Changing individual members is a major part of this work flow.

Lets repeat: Using iParts allows us to change each member individually to create the modifications needed for each process step. Next we will create the rough part (casting) member. It is the finished part with only the first extrusion unsuppressed plus material added to create the blank casting. This philosophy is what drives this work flow. Choosing the correct scope setting allows modifications to specific members or the entire family.

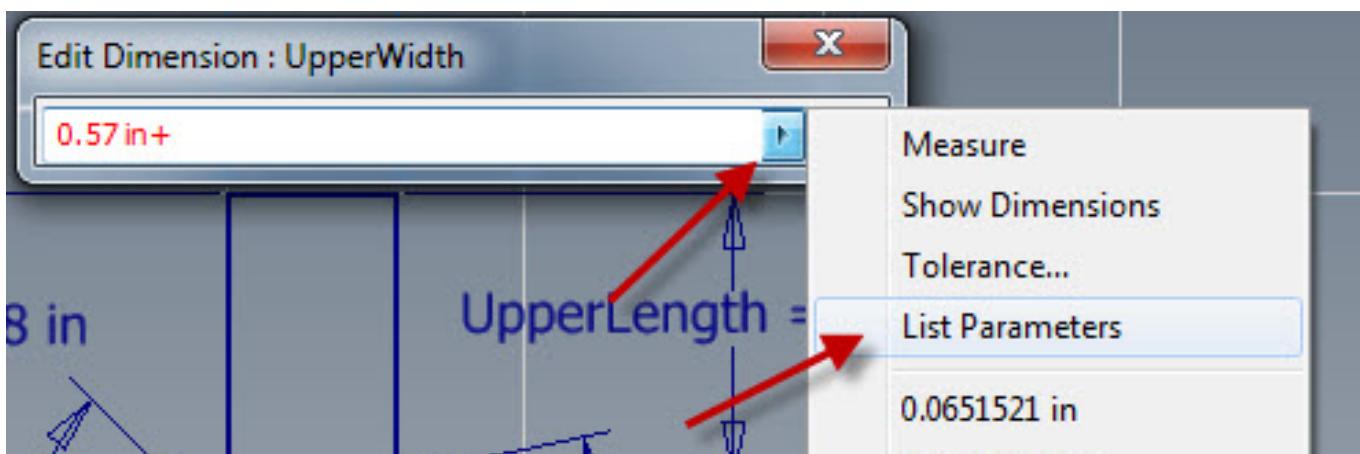


Select the *Raw Stock* member. Then suppress all the features except the first one. What will be left is the first extrusion without any of the finishing details. We need to add material to this to bring it to the size required to begin the rough machining operations.

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To add uniform material around the part we create a new parameter. This is so that if we want to change the roughing material, it can be done easily. In the parameters dialog box click **ADD NUMERIC**. Enter the name "ExcessStock". Here we have given it a value of .1"

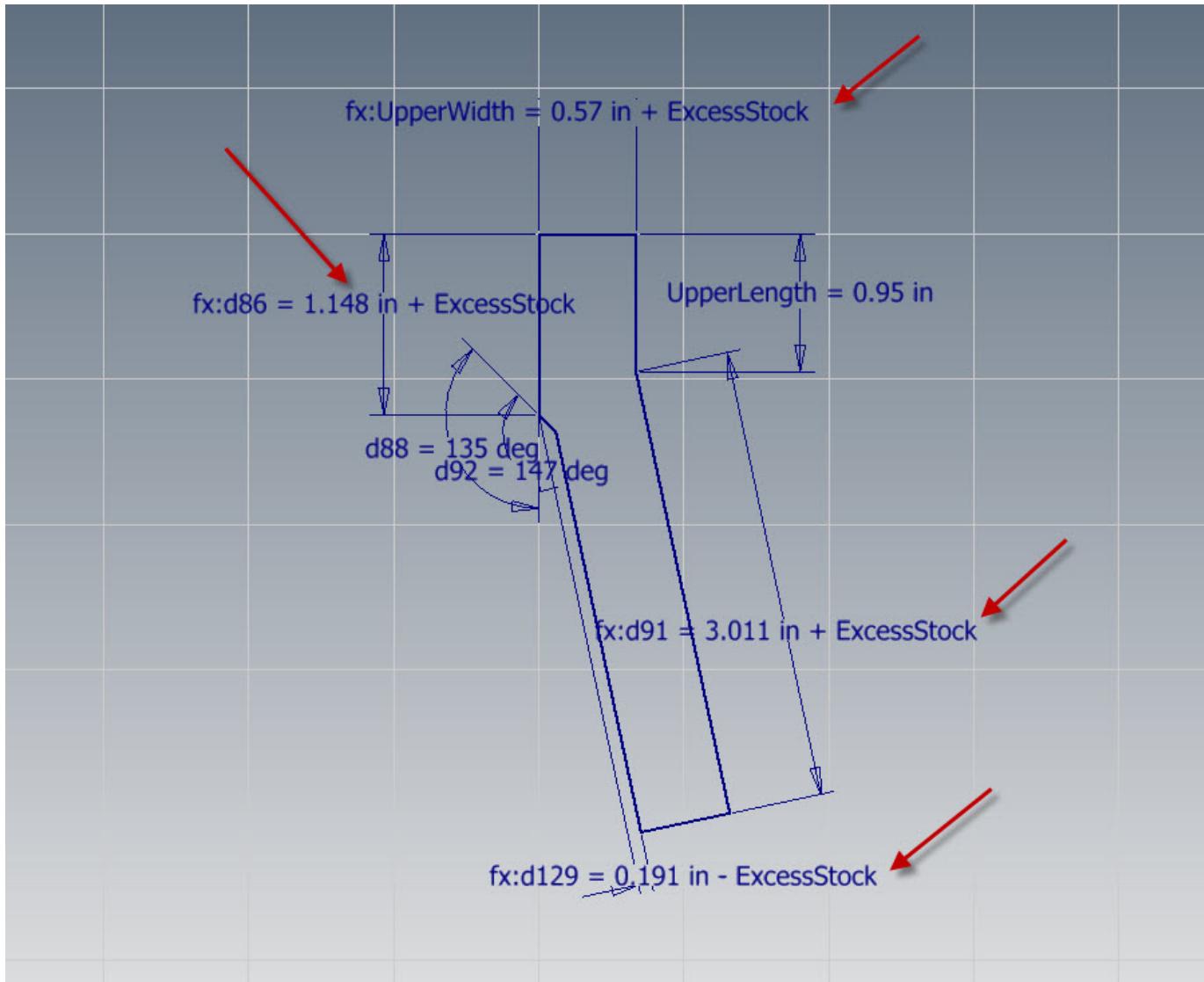


Make adjustments so that the part will be that much larger all around. Open the feature sketch. Edit the sketch dimensions. By adding and subtracting the parameter value, as needed, the part will grow.

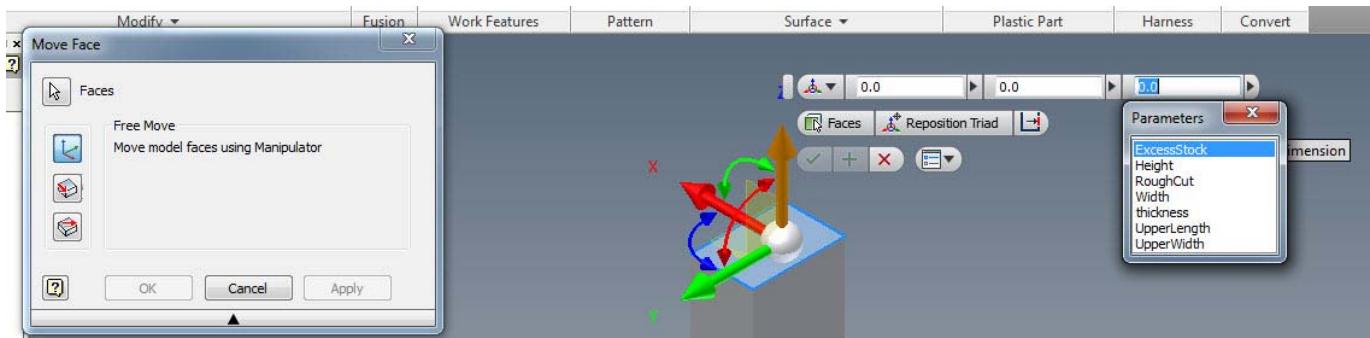


Here you see the UpperWidth parameter with the original value plus the ExcessStock value.

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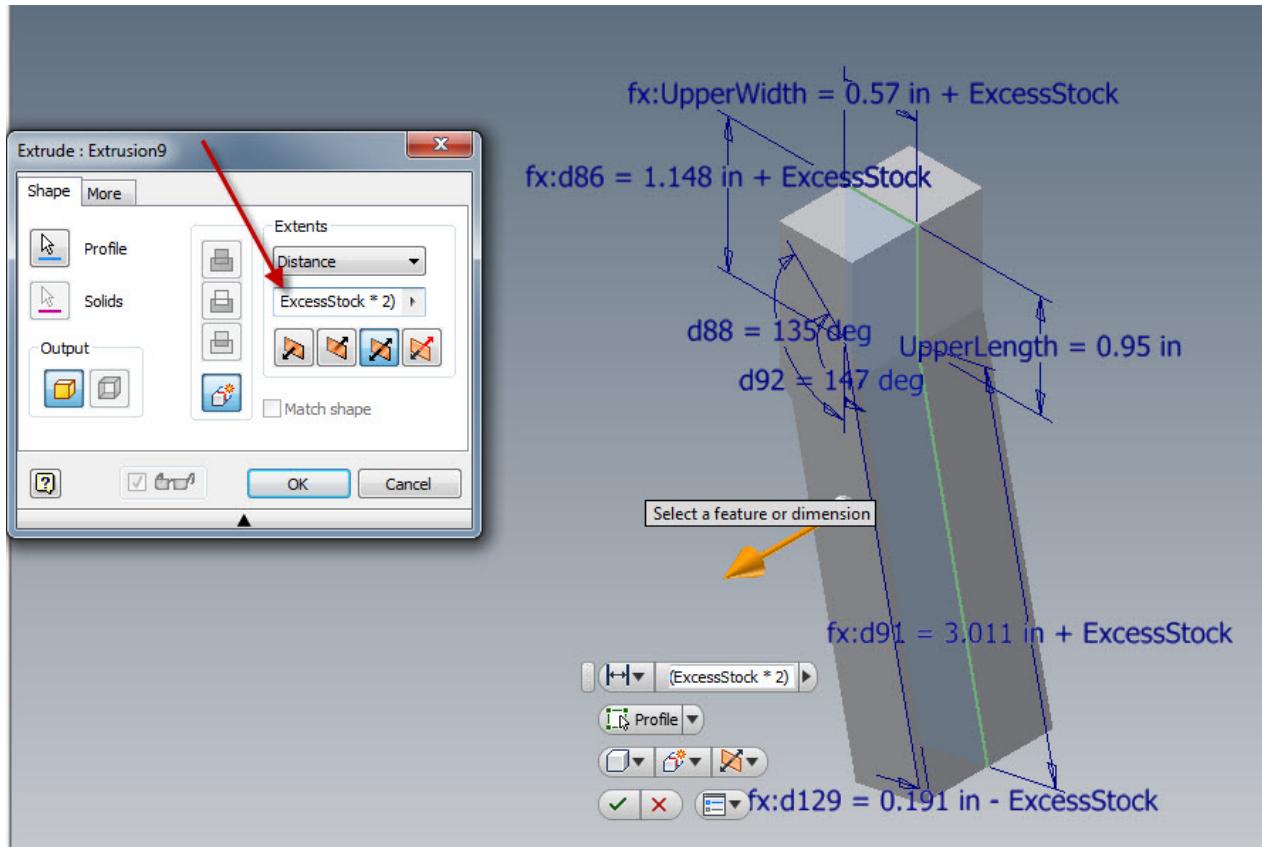


Sketch with changed dimensions.

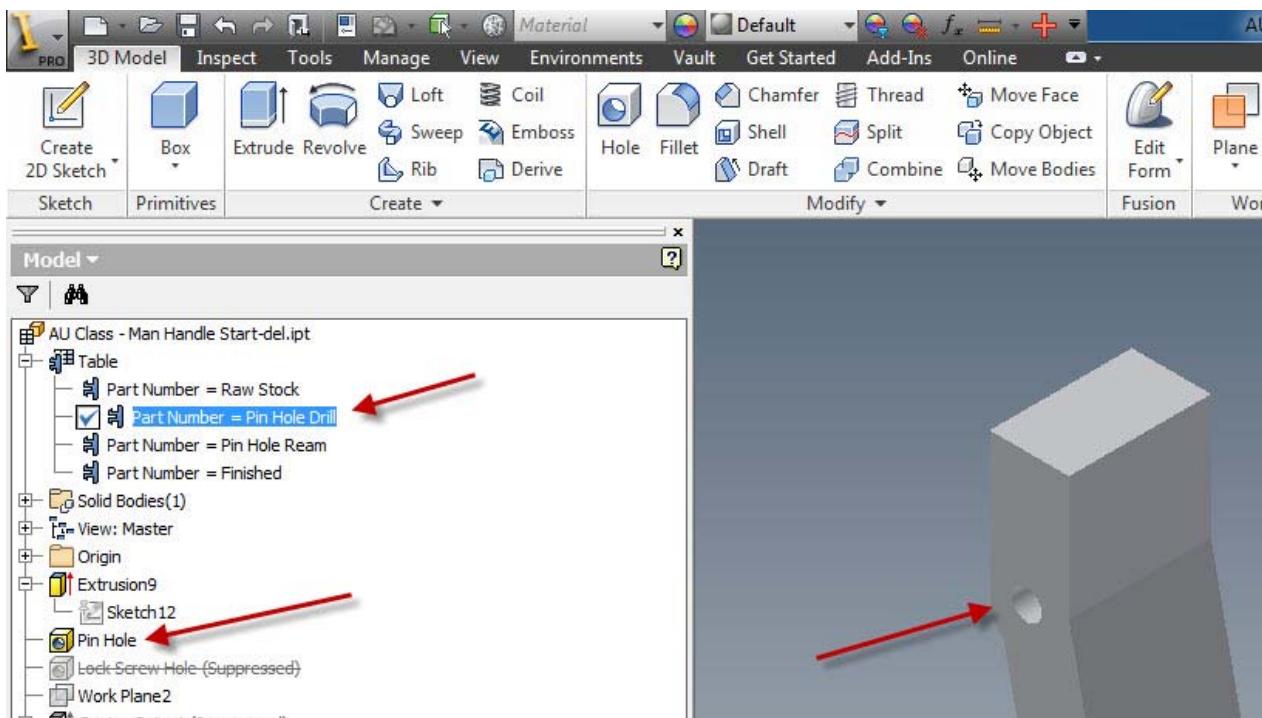


Use the **MOVE FACE** command where we could not modify the sketch. Remember, we are not adding a new feature to the part, we are modifying an existing one!

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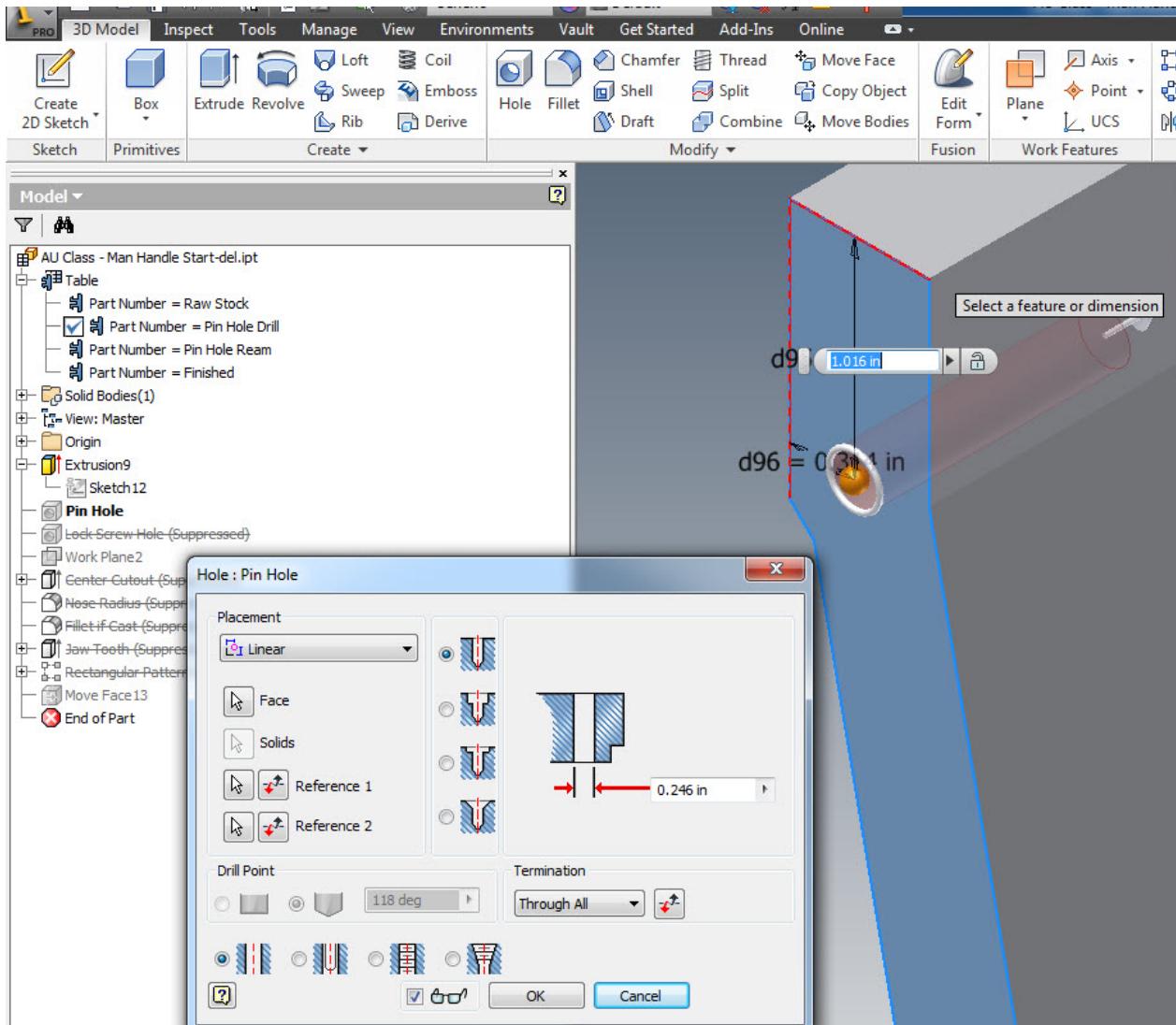


Edit the feature for the width by adding the excess stock to the extrusion * 2.



Add the next two members to the iParts family. First will be drilling for the Pin Hole and then reaming it to get to the finished size. There is one family member for each operation.

Autodesk® Inventor® work flow for developing a top down manufacturing shop process



For the drilled hole, make the pin hole a little smaller. When the “Pin Hole Drill” member is active, edit the feature to change the drill size. The “Pin Hole Ream” member does not need to be changed since it is already the correct size.

Edit the table and insert a new member: Name it “Lock Screw Hole”

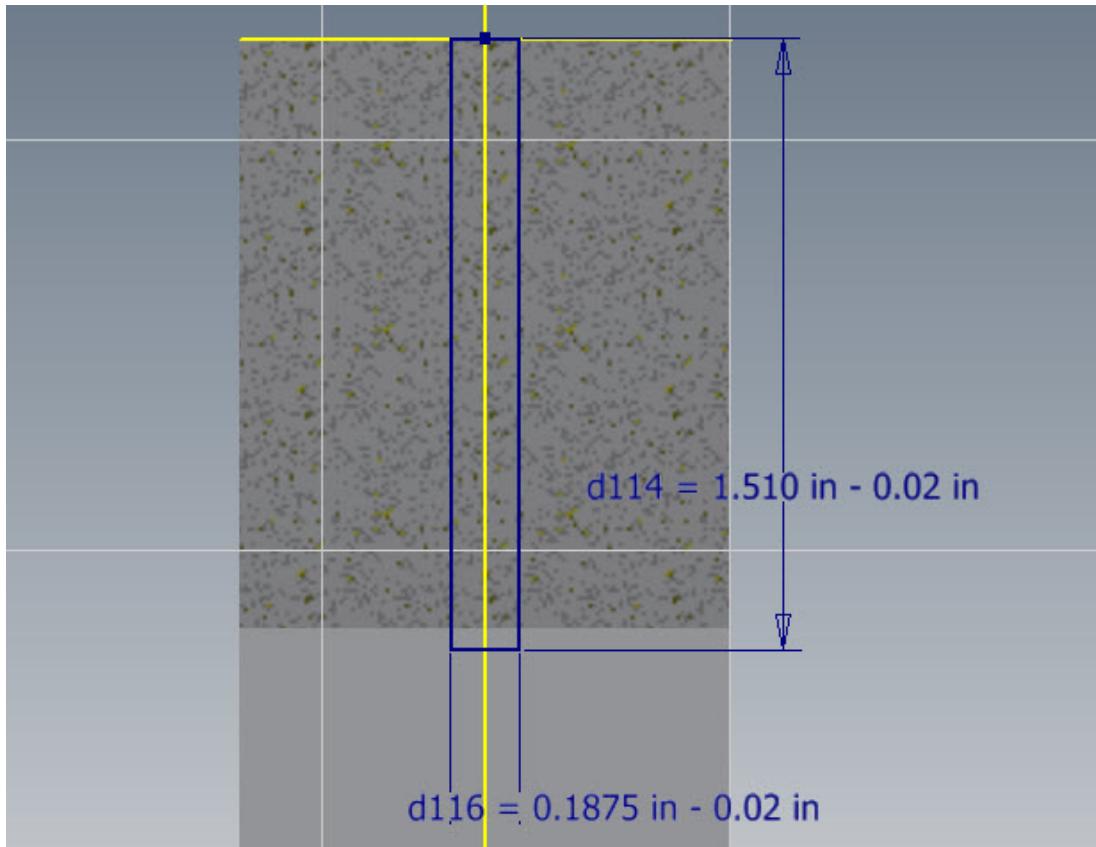
Activate the new member and unsuppress the “Lock Screw Hole” feature.

The “Center Cutout” is done in two steps. We will create two new members as we did with the *Pin Hole*. Change the member name and feature values as needed.

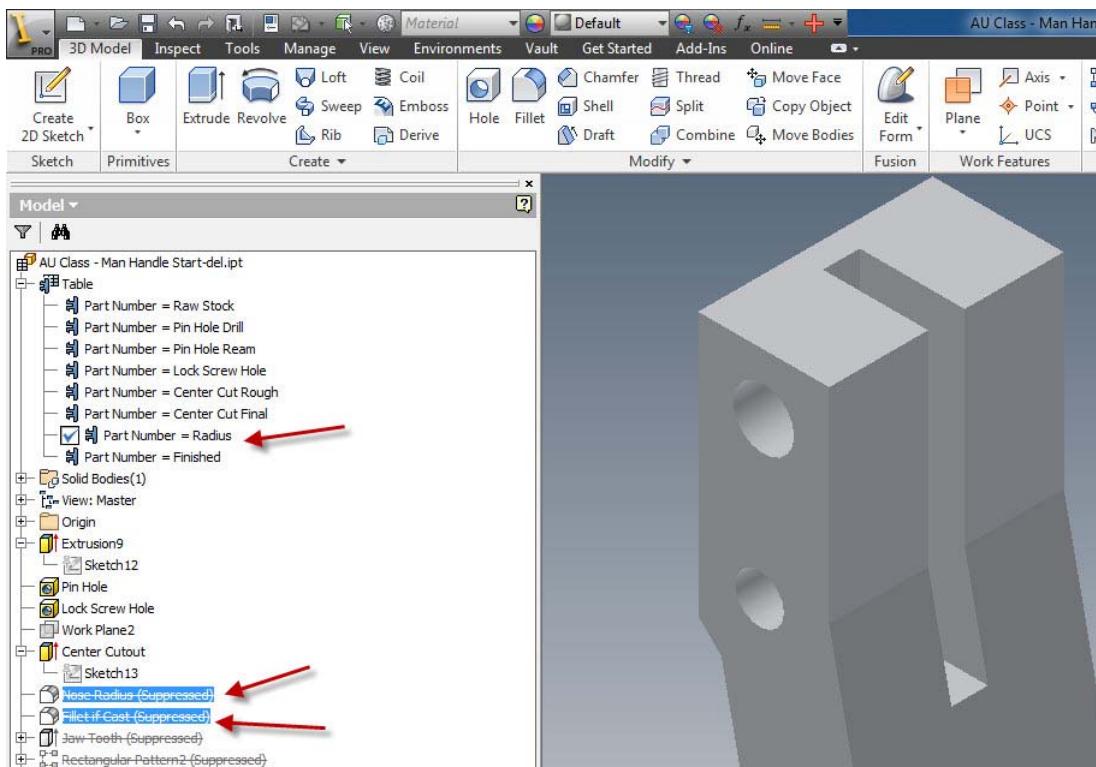
First, add the new member, in the table – change the name to “Center Cut Rough”
Activate the member and unsuppress the feature.

Second, add another new member – “Center Cut Final”. Done in this order, the cutout is active, and the size needs to be changed only in the “Center Cut Rough” member.

Autodesk® Inventor® work flow for developing a top down manufacturing shop process

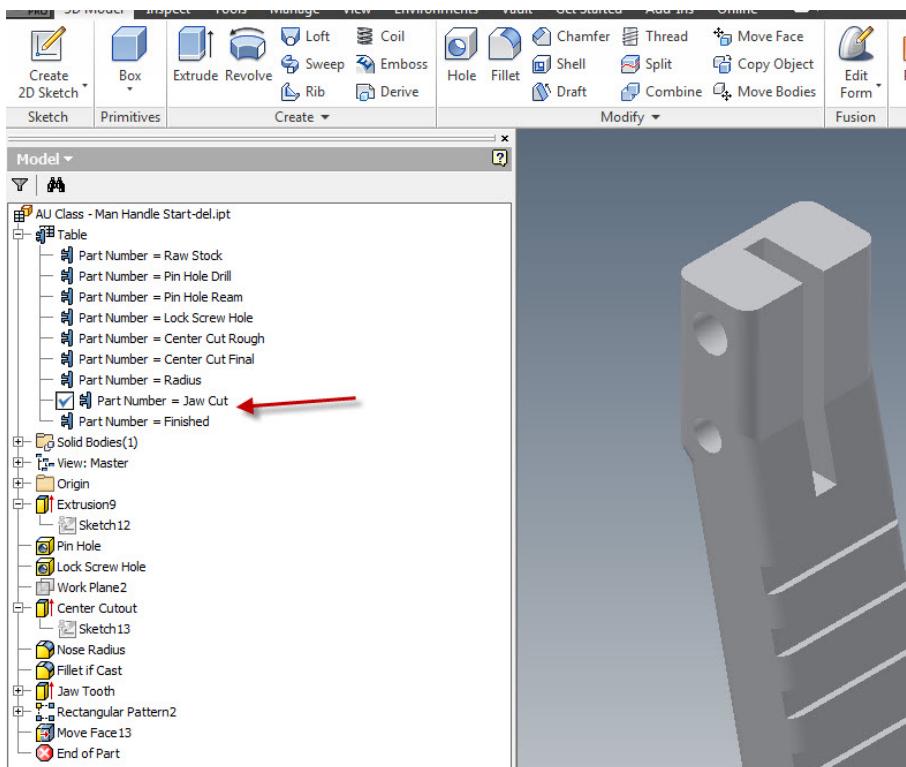


Edit the *Center Cut Rough* sketch by reducing it .02" in both width and length.

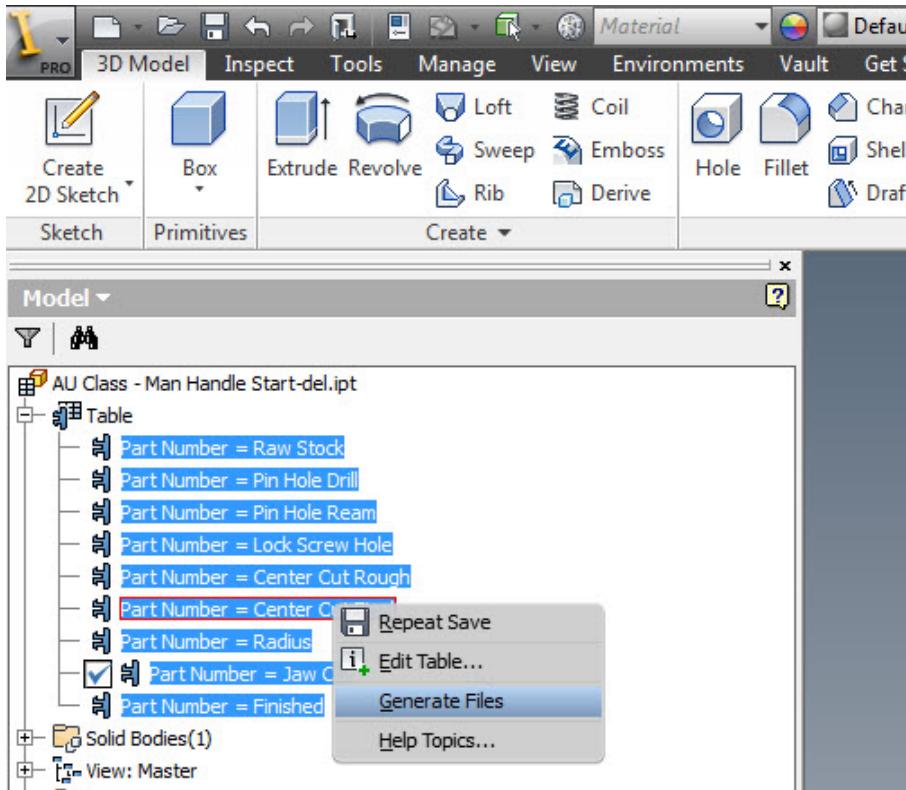


The radius features are next. Make a new member for the radius operations.
Then unsuppress the radius features in the new member.

Autodesk® Inventor® work flow for developing a top down manufacturing shop process



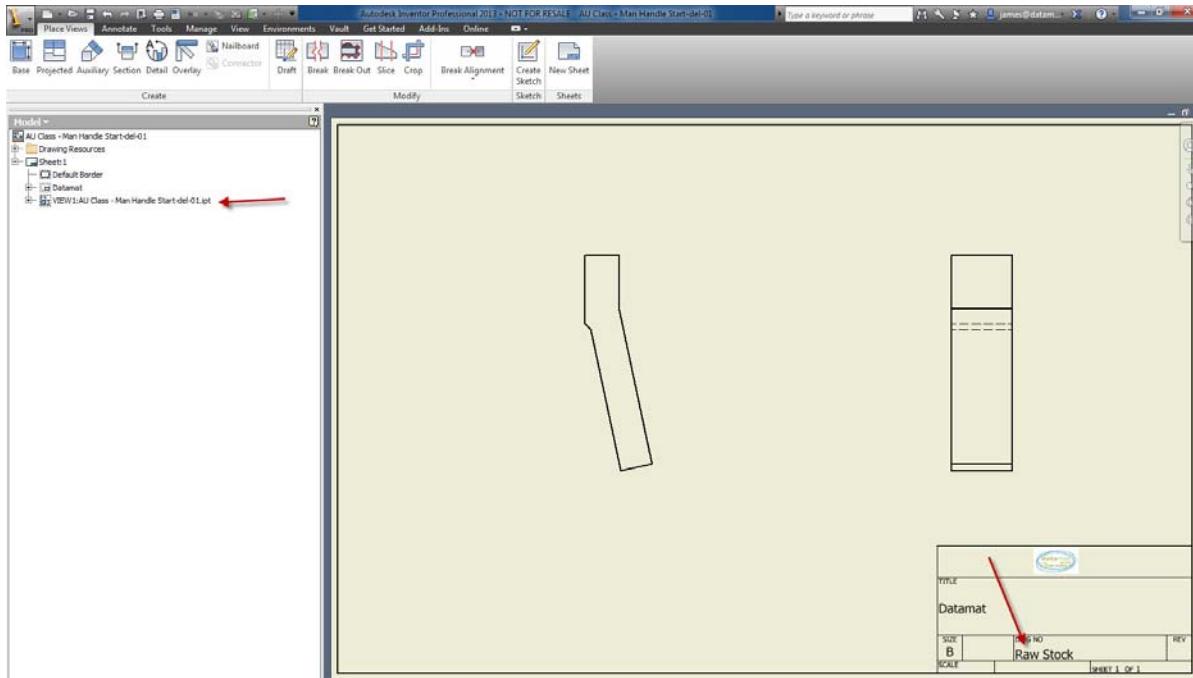
If no other operations are needed you are done. Remember we started with the finished part.



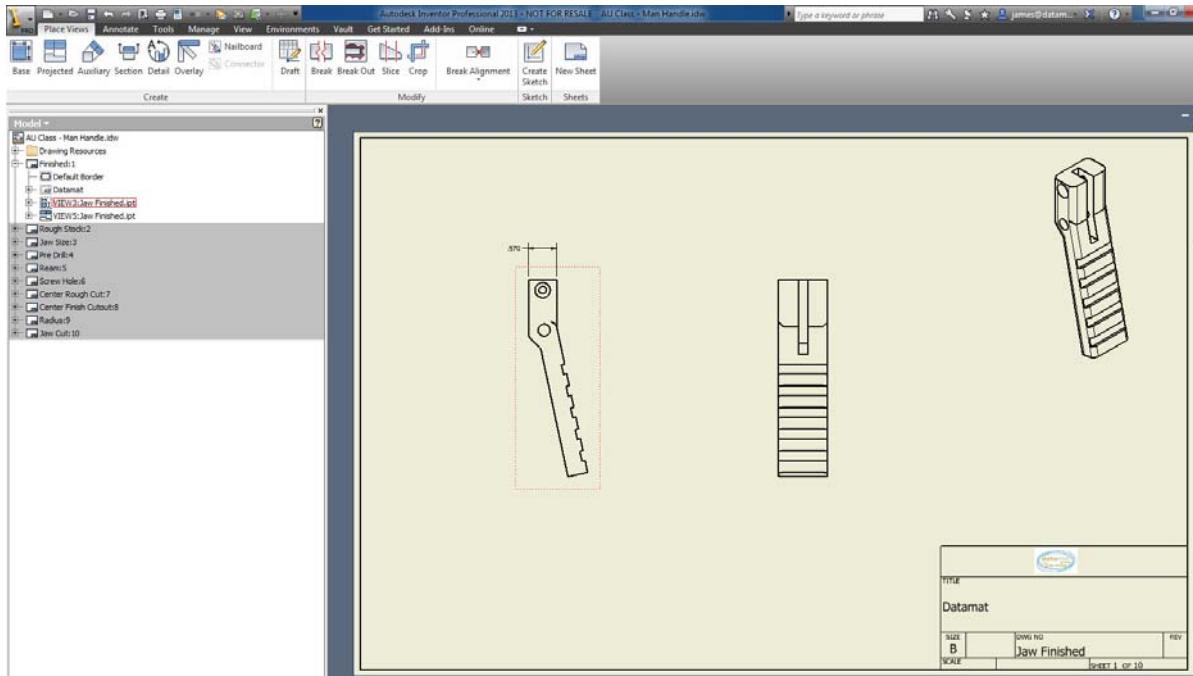
Be sure to generate all the member files from the parent. Everything is done from the parent. It does not matter how many members there are.

Now to the documentation

Create a new drawing



Drop the first part (*raw stock*) into your drawing, notice the member name in the browser. In the drawing we set the title block to show the model part number (this is dependent on your template file).



Create a new sheet, Drop the next member.

Rename sheets accordingly (good area for an ap – next year's class)

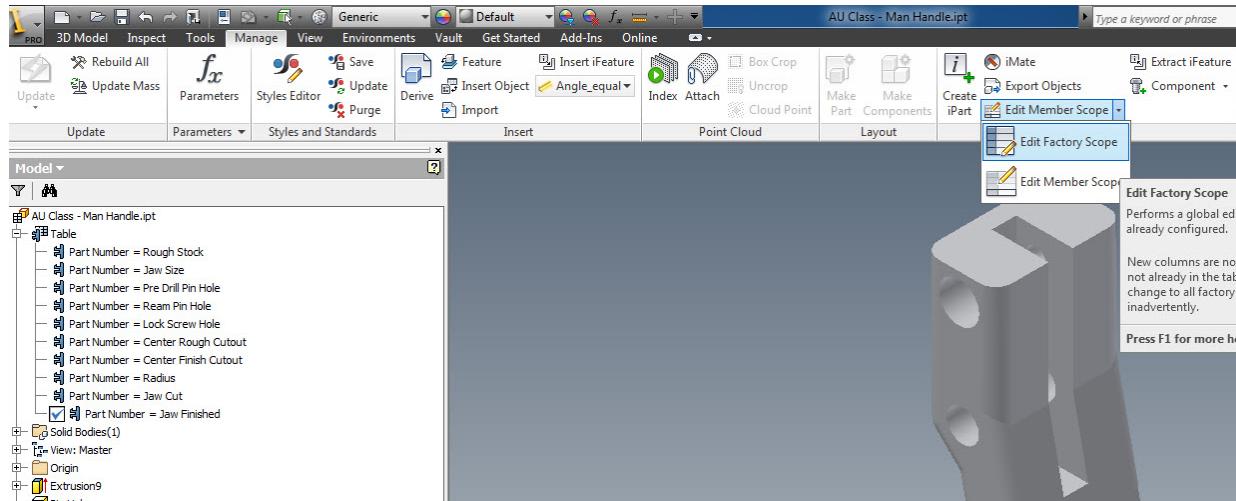
Above you see a completed document with all sheets renamed.

Why iParts vs Derived Parts

The advantage of iParts is you are working with a single file, the parent will control all of its members. Derived Parts need to be created and derived from each previous successive step to create the next process. Resulting in a lot of files to manage.

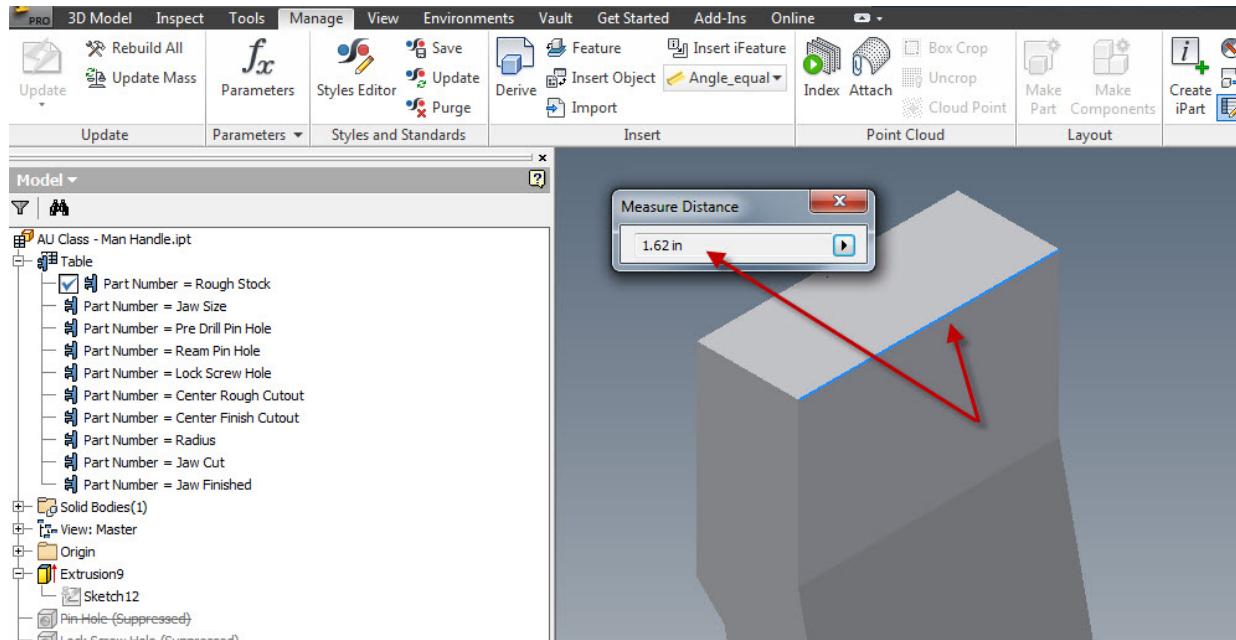
Creating a new family from the one we just made.

Lets make a change to the parent of our iPart jaw – change the width. Copy and rename the parent.



First set the member scope to “Edit Factory Scope”

Open the Rough Stock member, Edit the feature for width from 1 to 1.5



The change propagates through the hole family. We do not have to open each and make changes.

Notes