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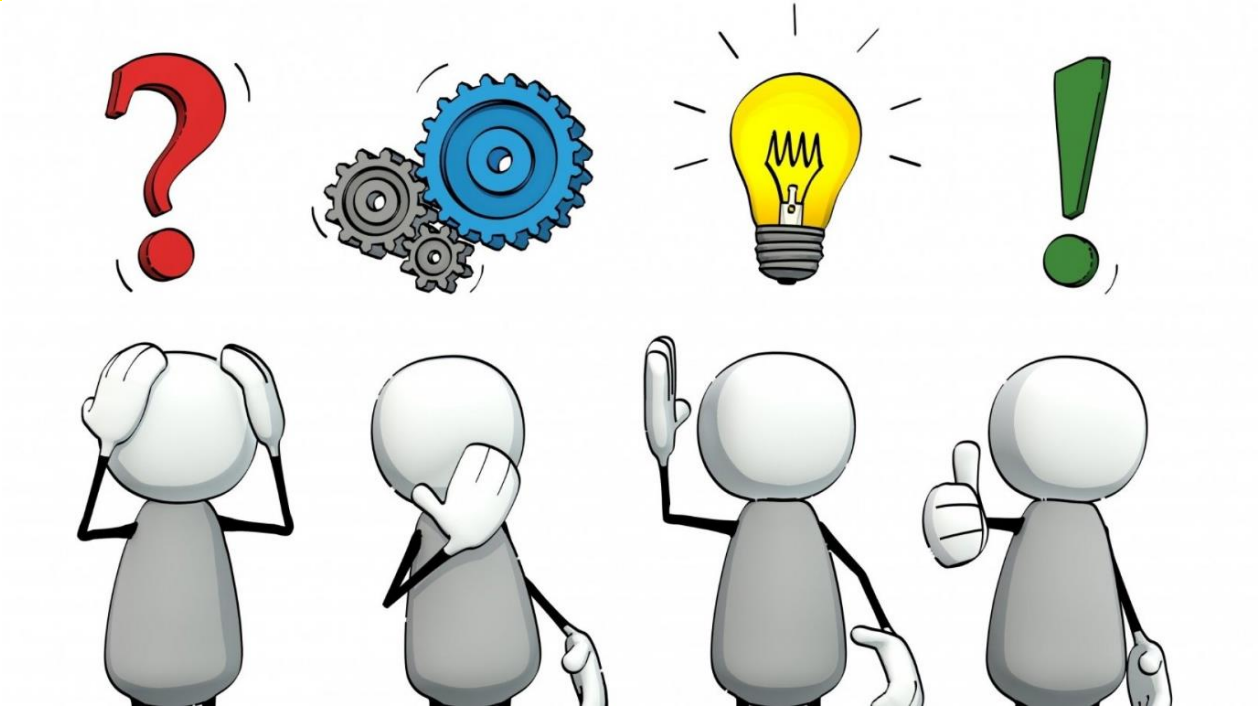
Process Planning

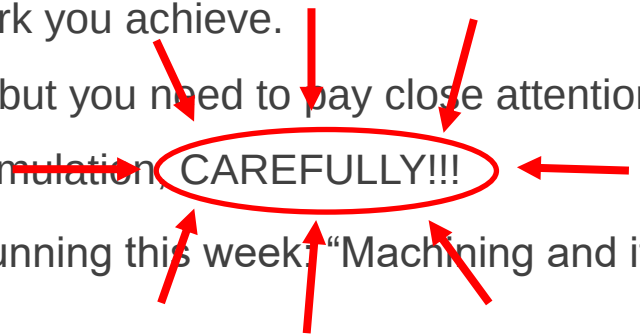


How are we feeling after our Flex Week break?

Total Results: 157

Announcements

- The CNC Machining Assessment peer review submission is due this (Week 7) Thursday at 09:00pm.
- It is entirely optional but it gives you a great opportunity to get feedback from your peers and see other student's CAM strategies
- Don't forget, if you pass the manufacturability review the first-time round, you get a bonus 7.5% to the mark you achieve.
  - This is not too hard but you need to pay close attention to your CAM programming
  - Review the entire simulation, CAREFULLY!!!
- Tutorials are up and running this week: "Machining and its Importance in Engineering"



Announcements

- I know that the panic can be super real sometimes so I will be organizing some additional open consultations

  - **Wednesday 17:00 (Additional Consult)**
  - **Thursday 11:00 (Additional Consult)**
  - **Thursday 21:00 (Last Minute Consult)**
  - **Friday 12:30 (SOS CONSULT)**

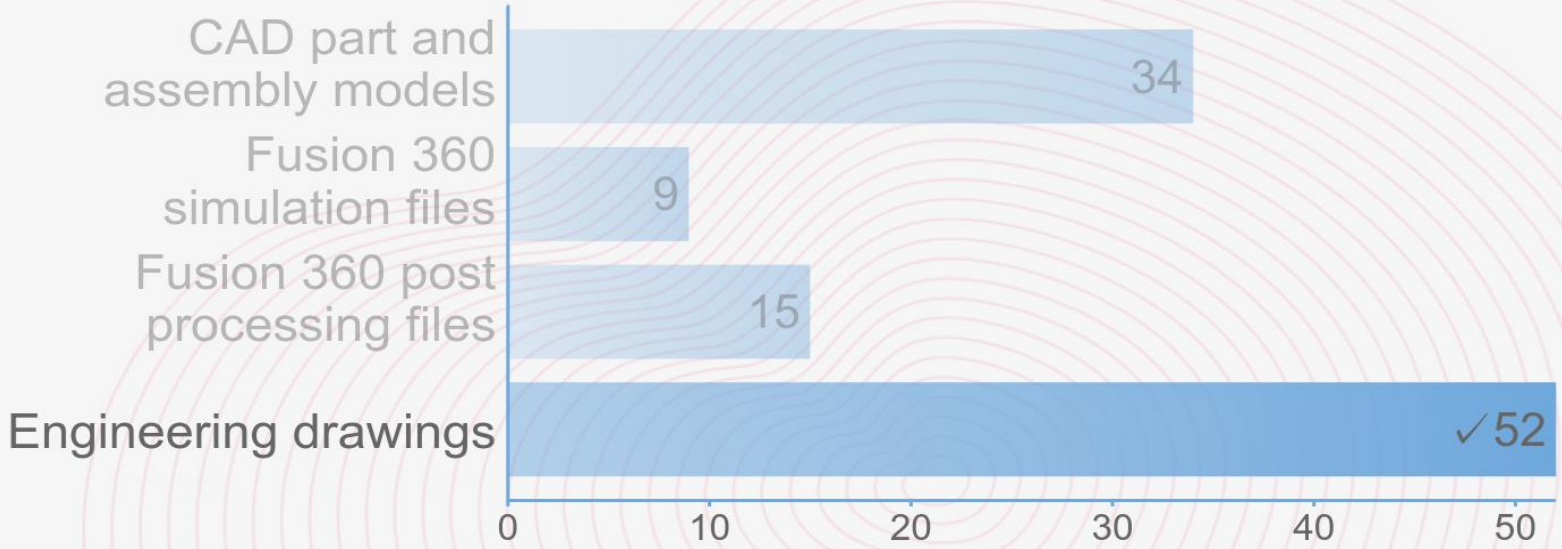
Topics

- Process Plans
- Component Drawings
- Assembly Drawings
- Bill of Materials
- Assembly Chart
- Routing Chart
- Work Method Sheet

Process Plans

- Process plans are a set of documents that the detail how to achieve a desired manufacturing outcome.
- You already have some experience in creating process plans, what do you think they would be?

Which of these are process planning documents/files?

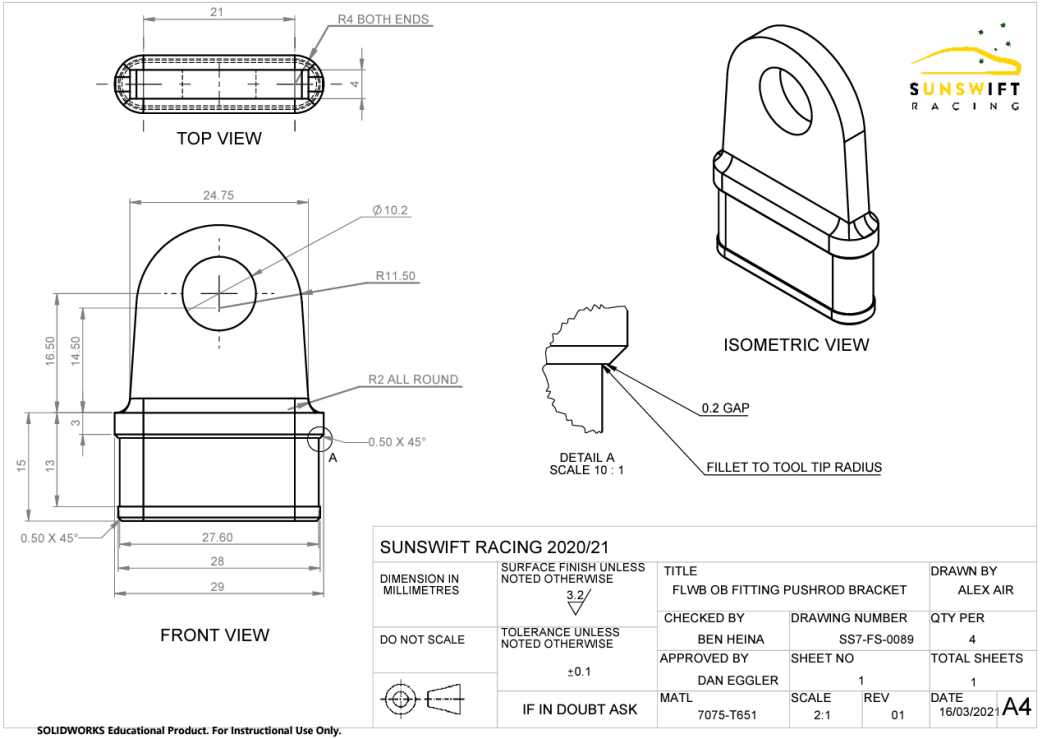


Process Plans

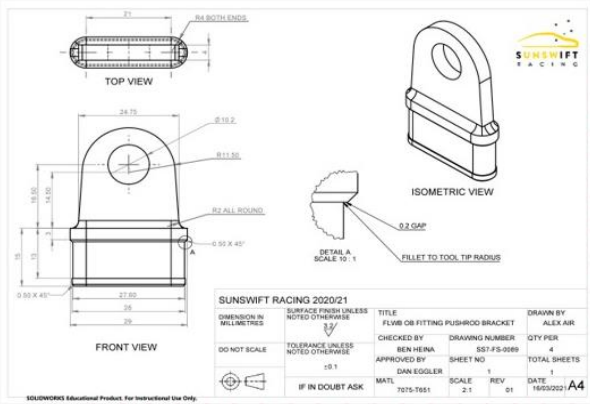
- Process plans are a set of documents that the detail how to achieve the manufacturing outcome.
- You already have some experience in creating process plans, what do you think they would be?
- Processing planning documents:
  - Component drawings
  - Assembly drawings
  - Bill of Materials
  - Assembly Chart
  - Work Method Sheet
  - Routing Chart

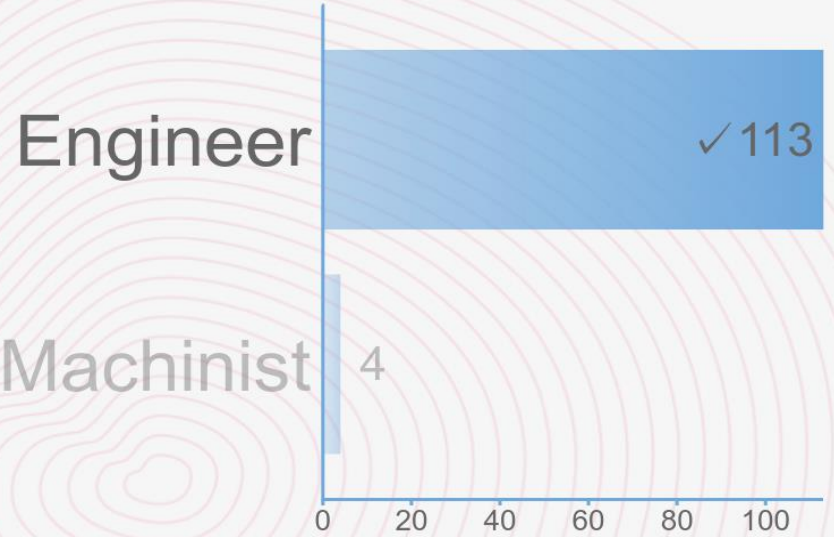
Component Drawings

- A component drawing focuses on an individual part
- It gives all the information needed to understand how to manufacture the component



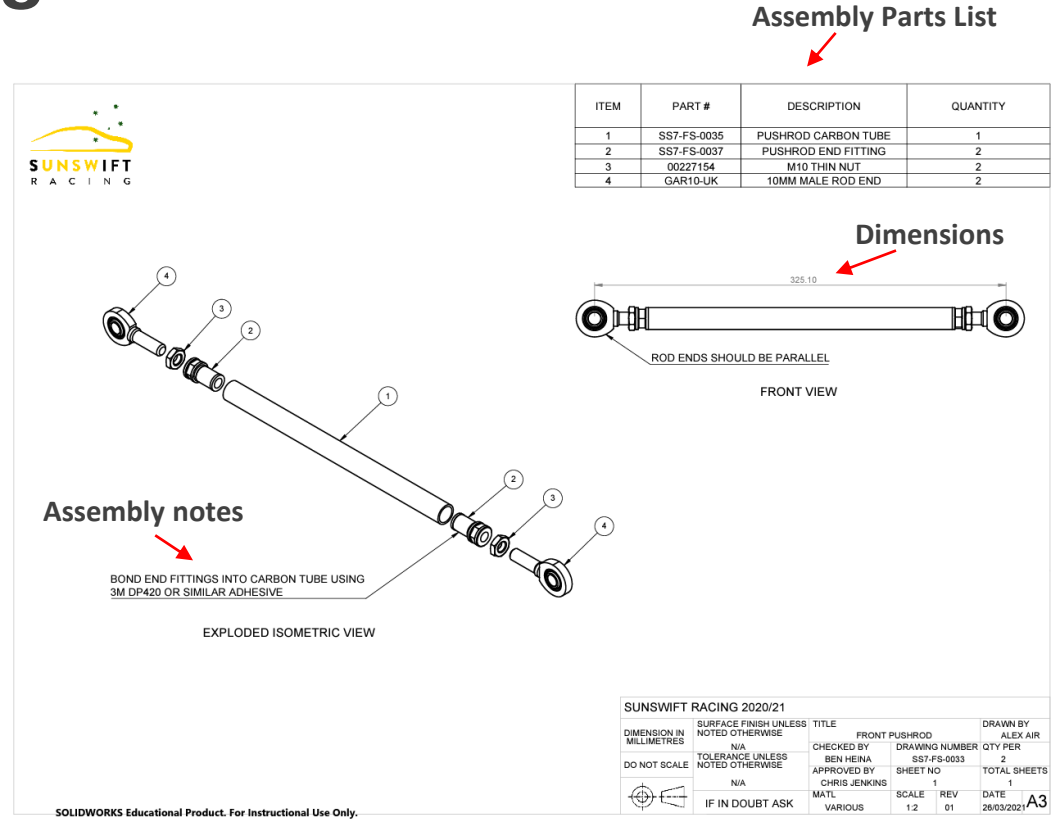
Who typically creates a component drawing?



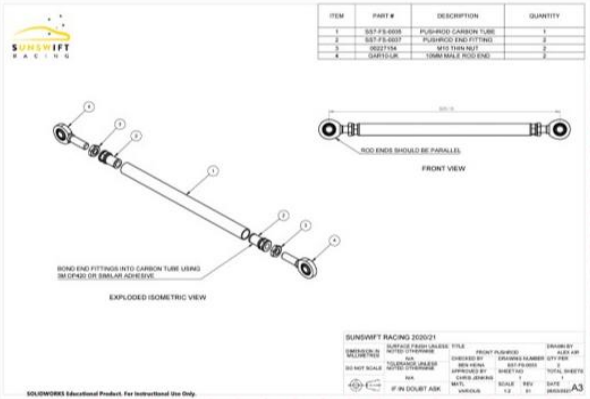


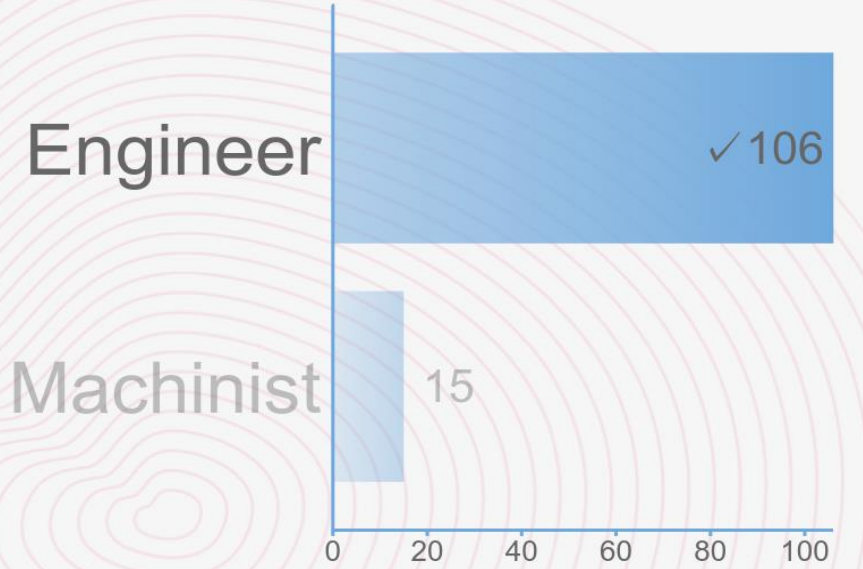
Assembly Drawings

- An assembly drawing provides all the information on how various component fit together
- They contain information to facilitate the assembly
- Assembly drawings are sometimes called “installation drawings”
- An exploded view is not strictly necessary but can assist with readability
- A table listing all the parts required for the assembly is usually included



Who typically creates an assembly drawing?





Bill of Materials

- This lists everything that is needed to manufacture and assembly your design
  - Contains much more detail for each component such as unit cost, supplier, manufacturer, order status, etc.
  - Very important when it comes to costing our products

Qty	Part Type	Designator	Footprint (Package type)	Description	Manufacturer	Supplier	Order Status (30/5/08)	R = Reflow W = Wave S H = Hand S N = Non	Cost per unit Ex GST	Total Cost Ex GST	N
1	22K	R43	0805(ACTUAL)	Res tk	Open:PHYCOMP 232273462203	Open:FEC: 9237798	Ordered: Farnell (RECEIVED) Sent to C.M: Entech		0.09	0.09	
1	39K	R44	0805(ACTUAL)	Res tk	Open:PHYCOMP 232273463903	Open:FEC: 9237828	Ordered: Farnell (RECEIVED) Sent to C.M: Entech		0.09	0.09	
1	74HC14 HEX SCHMITT	U7	SOIC14	HEX NON Inverting Schmitt Trigger	Open e.g: NXP Semiconductors: 74HC7014D	open e.g:Digikey: 568-1488-5-ND	Ordered: Farnell (RECEIVED) Sent to C.M: Entech	RoHS	1.15	1.15	
4	Jumper	JP2 JP4 JP3 JP1	JUMPER_2PIN	CON, JUMPER, Through Hole 0.1",	Open	Open e.g. FEC: 5217817 & 1098684	Ordered: Farnell (RECEIVED) Sent to C.M: Entech	RoHS	1.71	6.84	
1	99K	R45	0805(ACTUAL)	Res tk	Open:MULTICOMP MC 0.1W 0805 tk 99K	Open:FEC: 9333649	Ordered: Farnell (RECEIVED) Sent to C.M: Entech		0.06	0.06	
11	100K	R6 R12 R13 R46 R47 R11 R9 R3 R8 R10 R4	0805(ACTUAL)	Res tk	Open:PHYCOMP 232273461004	Open:FEC: 9237879	Ordered: Farnell (RECEIVED)		0.09	0.99	
22	100N	C16 C6 C15 C14 C24 C17 C7 C4 C8 C3 C5 C2 C12 C11 C9 C10 C21 C19 C1 C13 C20 C18	0805(ACTUAL)	Cap, 50V, 5%, NPO	Open: AVX 08051C104KAZ2A	Open:FEC: 1301805	Ordered: Farnell (RECEIVED)		0.83	18.26	
1	200R	R15	0805(ACTUAL)	Res tk	Open:MULTICOMP MC 0.1W 0805 tk 200R	Open:FEC: 9332758	Ordered: Farnell (RECEIVED)		0.06	0.06	
2	220u	C26 C25	SMD_CAP_CASE_G	Electrolytic 220u 50V +-20%	Open e.g:PANASONIC: EEEFK1H221P	Open e.g:FEC: FEC:9699366	Ordered: Farnell (RECEIVED)	RoHS	2.02	4.04	
14	510R	R22 R28 R27 R32 R29 R21 R20 R30 R31 R19 R25 R26 R24 R23	0805(ACTUAL)	Res tk	Open:MULTICOMP MC 0.1W 0805 tk 510R	Open:FEC: 9333312	Ordered: Farnell (RECEIVED)		0.06	0.84	
2	.	U2 U10	2981-RELAY-DRIVER	High Side Driver, Imax (Soruce) 500mA, Vmax 50V	ALLEGRO MICROSYSTEMS:A2982SLV-T	open e.g:Farnell:1329620	Ordered: Farnell 13/6/08 (RECEIVED) At BCS	RoHS	4.03	8.06	
1	ADM1232 BROWN OUT/TIMEOUT	U9	SOIC8	Adj voltage monitor 4.5V or 4.75V, Adj strobe monitor with 150ms, 600ms, 1.2s options	ANALOG DEVICES: ADM1232ARNZ	open e.g:FEC: 1438812	Ordered: Farnell (RECEIVED) Sent to C.M: Entech	RoHS	3.9	3.9	
2	BSS138	Q2 Q1	SOT23_MOS	MOSFET	Open:FAIRCHILD SEMICONDUCTOR BSS138...	Open:FEC: 9845330	Ordered: Farnell (RECEIVED) Sent to C.M: Entech		0.76	1.52	
2	DNP	C22 C23	0805(ACTUAL)	Cap	DNP	DNP	N/A			0	
1	DPDT REED RELAY	U6	OMRON-G6K-2F-5VDC	DPDT reed relay, Coil Voltage 5V, Pmax 10W, Ricoil 150R, Imax 0.5A	OMRON: G6K-2F-DC5	Farnell: 4963714	Ordered: Farnell (RECEIVED) Sent to C.M: Entech	RoHS	5.92	5.92	
1	Driver Connector	P1	IDC26VERT_LATCHED	Conn, Through, 26 Pin, IDC Keyed Boxed Header with Latch	MULTICOMP: MC1B132-2634, 3M: N3429-6302RB, HARTING: 0918 526 7904	open e.g:FEC:**3166508**, 1099029, 9838139, 1097009	Ordered: Farnell (RECEIVED) Sent to C.M: Entech	RoHS	1.7	1.7	
1	EPM7192SQC160-15N	U3	PQFP160	IC, PQFP, Programmable Logic Device (PLD)	Altera: EPM7192SQC160-15	open e.g:Digikey: EPM7192SQC160-15N	Ordered: Austest (RECEIVED) At BCS		52.5	52.5	
1	IDC_10PIN	P3	IDC10VERT	Conn, Through, 10 Pin, IDC Keyed Boxed Header, 0.1",	Open"	Open e.g. FEC: **1039254** , Electus: PP1100 (Non RoHS)	Ordered: Farnell (RECEIVED) Sent to C.M: Entech	RoHS	0.93	0.93	
1	L298 Motor Driver	U1	L298 MOTOR DRIVER	Dual H bridge motor driver, Vs up to 46V, Total DC Current 2A, Over temp protection	ST Microelectronics L298	open e.g:Digikey:**497-3624-1-ND**(Preffered), RS Components:370-6953, FEC:403295,	Ordered: Farnell (RECEIVED) Sent to C.M: Entech	RoHS	6.26	6.26	
1	LM6132	U11	SOIC8	IC SOIC8 DUAL OPAMP, Rail to Rail input, Rail to Rail output, 2.7V to 24V	NATIONAL SEMICONDUCTOR: LM6132AIM	open e.g:FEC:9490043	Ordered: Farnell (RECEIVED) Sent to C.M: Entech	RoHS	7.07	7.07	
1	Laser Diode Driver	S1	CON-DB15-FEMALE-VERTICAL	Conn, Through, DB15 Straight, Female	TYCO ELECTRONICS / AMP: 3-1634223-2	open e.g:FEC:5082067	Ordered: Farnell (RECEIVED) Sent to C.M: Entech	RoHS	4.14	4.14	
1	Over Temp Conn	J2	CON-MOLEX-3	Conn, Through, MOLEX KK 2.54mm, 3 Pin Straight	Molex: 22-27-2031	Open e.g. FEC: 9731156	Ordered: Farnell (RECEIVED) Sent to C.M: Entech	RoHS	1.56	1.56	
1	PBBA-2405C	U5	PBBA-2405C	Vin:24V, Vout:5V, Iout:1.2A, Pmax:6W,120-150mV ripple	Powerbox: PBBA-2405C	Powerbox: PBBA-2405C	Ordered: Farnell (RECEIVED) Sent to C.M: Entech		55	55	
							Ordered: Farnell (RECEIVED) Sent to C.M:				

Assembly Chart

- An assembly chart shows the order of assembly.
  - This is given to factory workers in order to assemble a product.
- The assembly chart clearly groups the various parts that make up each sub-assembly.
- It is NOT an exploded view.

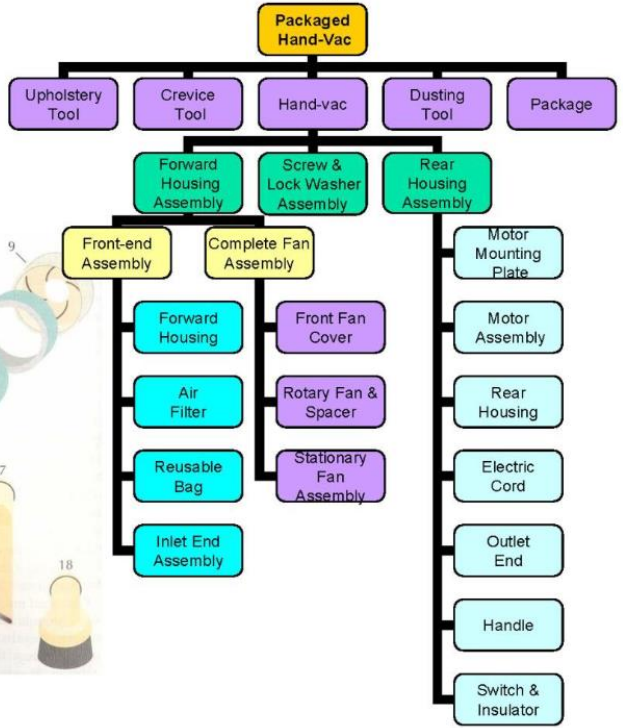
Assembly Chart

BOM

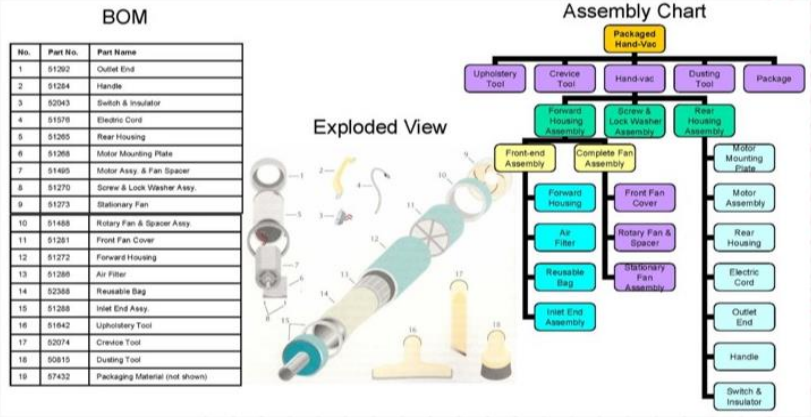
No.	Part No.	Part Name
1	51292	Outlet End
2	51284	Handle
3	52043	Switch & Insulator
4	51576	Electric Cord
5	51265	Rear Housing
6	51268	Motor Mounting Plate
7	51495	Motor Assy. & Fan Spacer
8	51270	Screw & Lock Washer Assy.
9	51273	Stationary Fan
10	51488	Rotary Fan & Spacer Assy.
11	51281	Front Fan Cover
12	51272	Forward Housing
13	51286	Air Filter
14	52388	Reusable Bag
15	51288	Inlet End Assy.
16	51642	Upholstery Tool
17	52074	Crevice Tool
18	50815	Dusting Tool
19	57432	Packaging Material (not shown)

Exploded View

Assembly Chart



Who typically creates an assembly chart?



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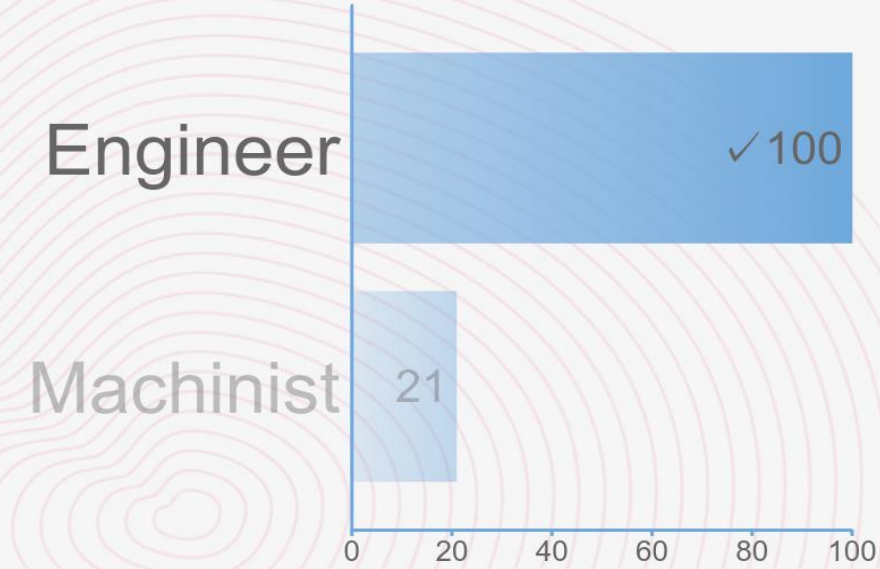
18	50815	Dusting Tool
19	57432	Packaging Material (not shown)



Work Method Sheet

- A work method sheet shows in detail HOW a component is to be manufactured
- Individual operations required to manufacture a component are listed
- Important details for each operation are required such as:
  - Operation times
  - Required tools, fixtures, gauges
  - Machine set up
  - Risk assessment and OHS issues

Work Method Sheet

Part Name: Valve Body
Part No: 302
Customer Name: Midwest Valve Co.
Quantity: 15

Op. #	Process Description	Machine/Tools	Speed /Feed	Tooling	Time	Risk Assesm ent
10	Inspect forging, check hardness	Rockwell tester				
20	Rough machine flanges	Lathe No. 5				
30	Check Settings & Start	Lathe No. 5				
40	Bore & counter bore holes	Boring mill No. 1				
50	Turn internal groves	Boring mill No. 1				
60	Drill & tap holes	Drill press No. 2				
70	Grind flange end faces	Grinder No. 2				
80	Grind bore	Int. grinder No. 1				
90	Clean	Vapour degreaser				
100	Inspect	Ultrasonic tester				

Who typically creates a work method sheet?

Part Name:	Valve Body
Part No:	302
Customer Name:	Midwest Valve Co.
Quantity:	15

Op. #	Process Description	Machine/Tools	Speed /Feed	Tooling	Time	Risk Assesm ent
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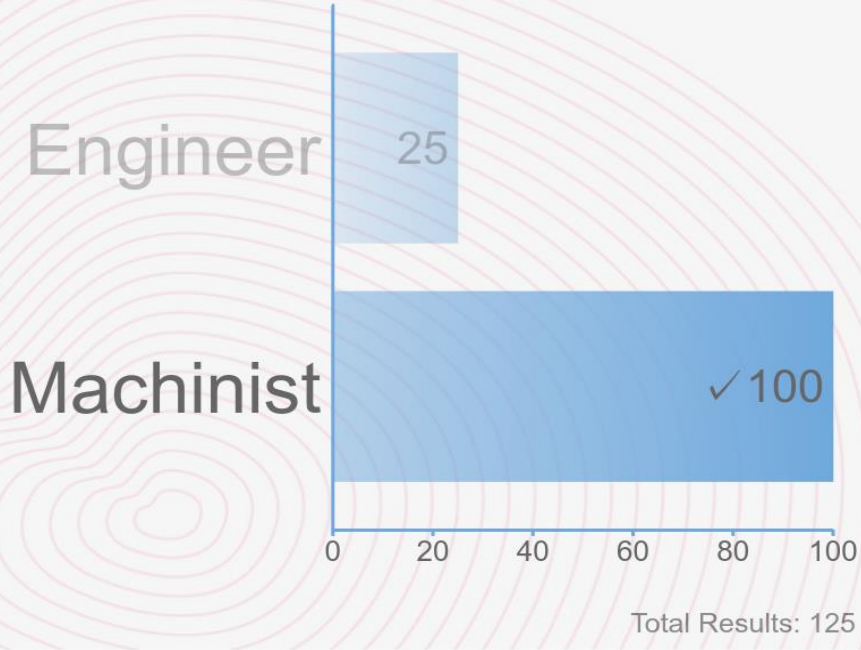
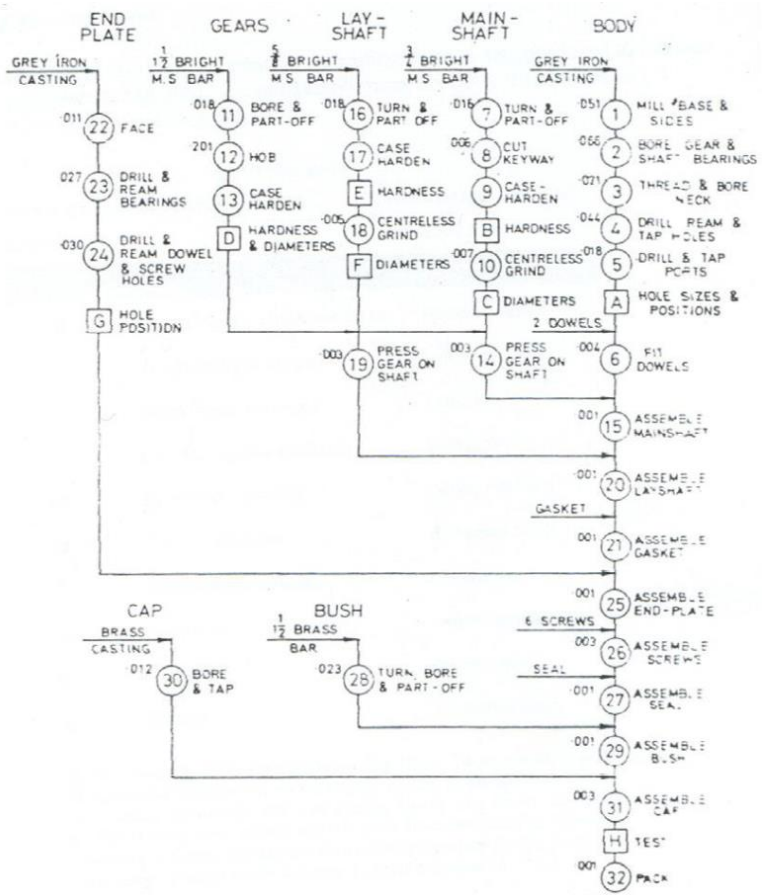
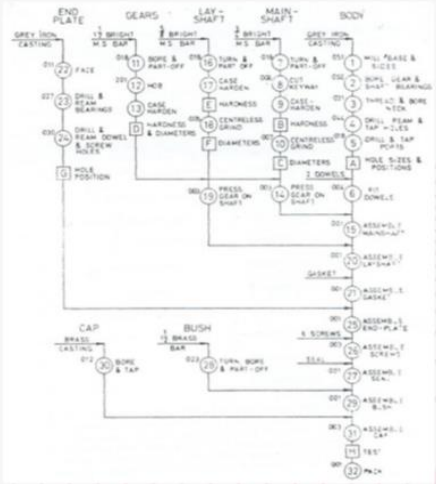


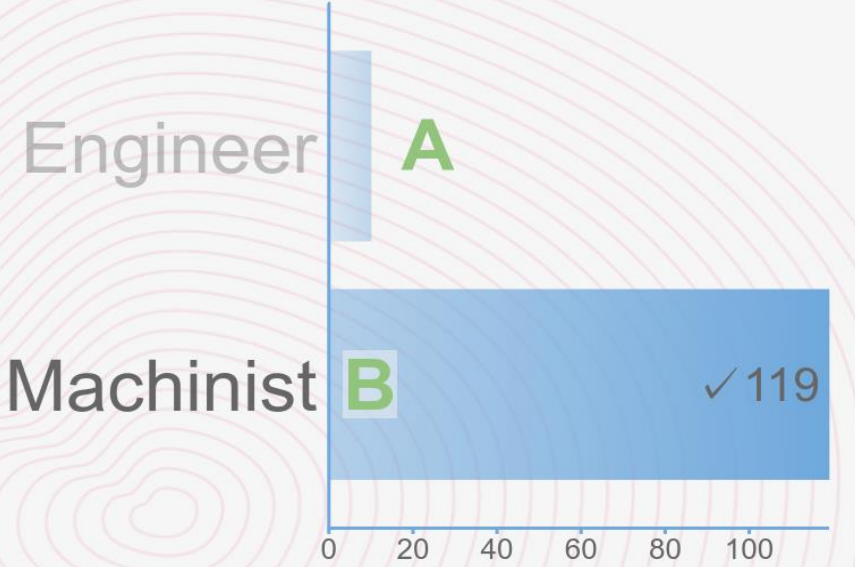
Routing Chart

- A routing chart is a graphical representation of the entire manufacturing process.
- It is used in conjunction with the work method sheet.
  - The operation number provides more information for a given stage in the routing chart.



Who typically creates a routing chart?



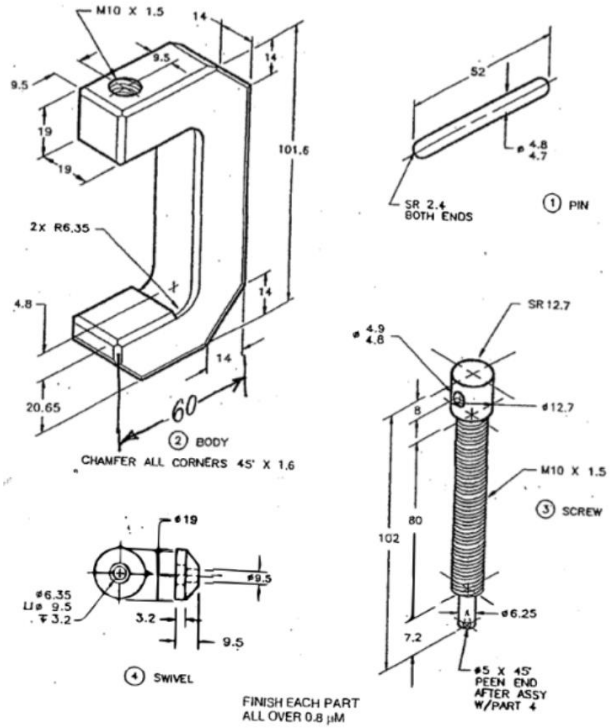


Let’s See How it Works for a Case Study

- We have know covered off a range of process planning documents.
- These allow us (in theory) to successfully manufacture parts in an efficient and effective manner.
- Let’s consider a very simple product, a G-clamp!

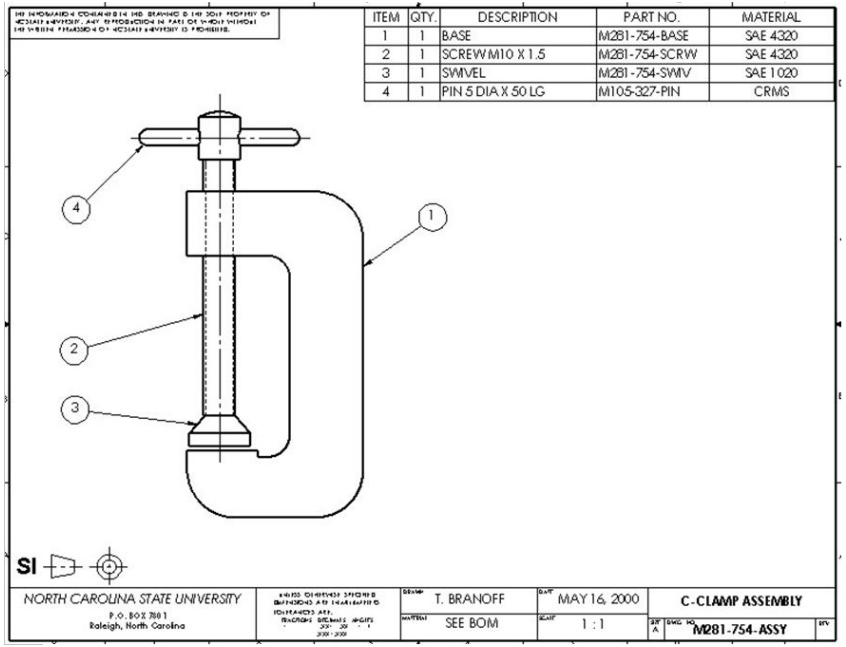
Process Planning for a G-clamp

- First, we would need some engineering drawings!
- Here is an example of the various drawings needed for the clamp assembly!



Process Planning for a G-clamp

- Next, let's get an assembly drawing



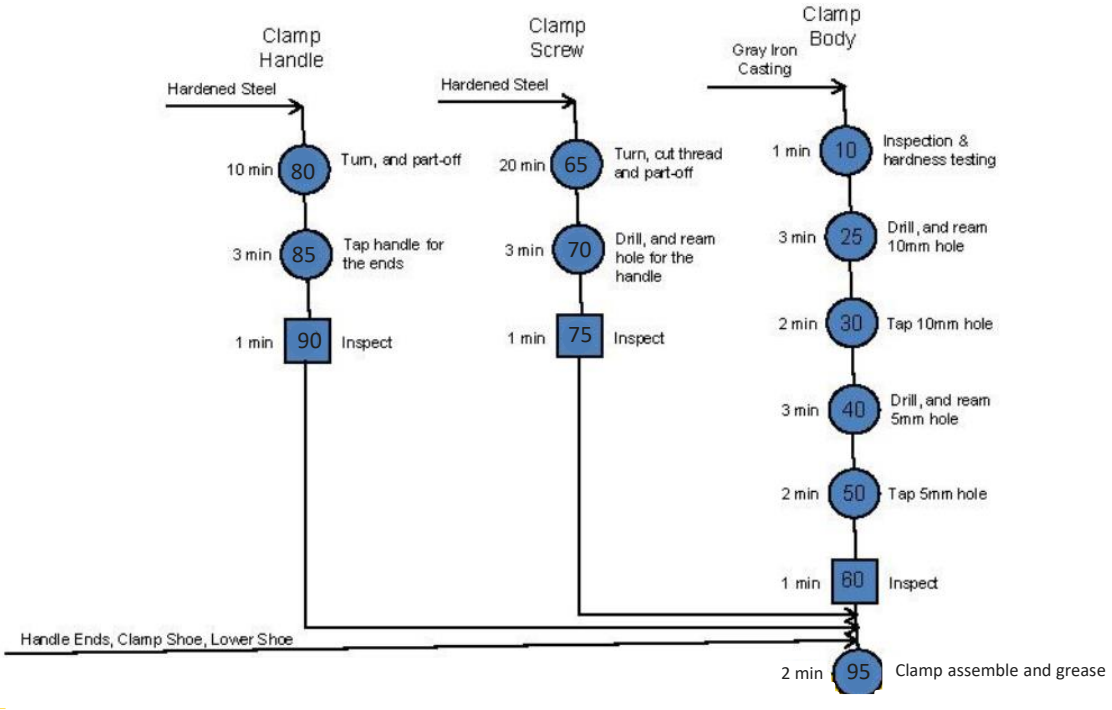
ITEM	QTY.	DESCRIPTION	PART NO.	MATERIAL
1	1	BASE	M281-754-BASE	SAE 4320
2	1	SCREW M10 X 1.5	M281-754-SCRW	SAE 4320
3	1	SWIVEL	M281-754-SWIV	SAE 1020
4	1	PIN 5 DIA X 50 LG	M105-327-PIN	CRMS

NORTH CAROLINA STATE UNIVERSITY
P.O. BOX 7801
Raleigh, North Carolina

T. BRANOFF | MAY 16, 2000 | C-CLAMP ASSEMBLY
SEE BOM | 1 : 1 | A | M281-754-ASSY

Process Planning for a G-clamp

- Once we are ready to begin preparing for manufacture we can create a routing chart.
- This assists in visualising the required manufacturing processes.

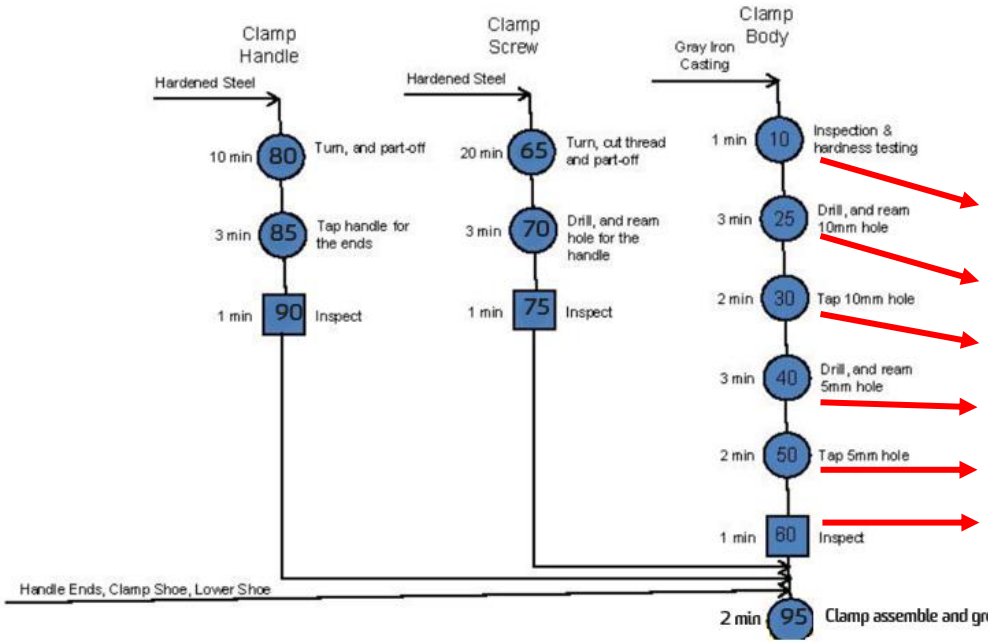


Process Planning for a G-clamp

- Finally, a work method sheet would be generated for each component to be used by workshop staff.

Part Name: Clamp Body Part No: 302 Customer Name: Midwest Valve Co. Qty: 100						
Op. #	Process Description	Machine/Tools	Speed /Feed	Tooling	Time (min)	Risk Assesm ent
10	Inspect casting, check hardness	Rockwell tester			1	
25	Drill 10mm hole for clamp screw	Drill press No.2	500 rpm	10 mm twist drill bit	3	
30	Tap M10 for the clamp screw hole	Drill press No.2	500 rpm	M10 tapping bit	2	
40	Drill 5 mm hole for lower shoe	Drill press No.2	500 rpm	5mm twist drill bit	3	
50	Tap M5 for the lower shoe hole hole	Drill press No.2	500 rpm	M5 tapping bit	2	
60	Inspect	Calipper			1	

Process Planning for a G-clamp



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40	Drill 5 mm hole for lower shoe	Drill press No.2	500 rpm	5mm twist drill bit	3	
50	Tap M5 for the lower shoe hole hole	Drill press No.2	500 rpm	M5 tapping bit	2	
60	Inspect	Calipper			1	