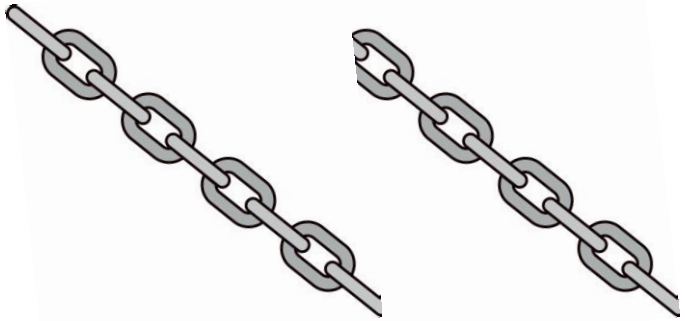
APQP & PPAP

A V Manivannan
Principal Consultant & Trainer

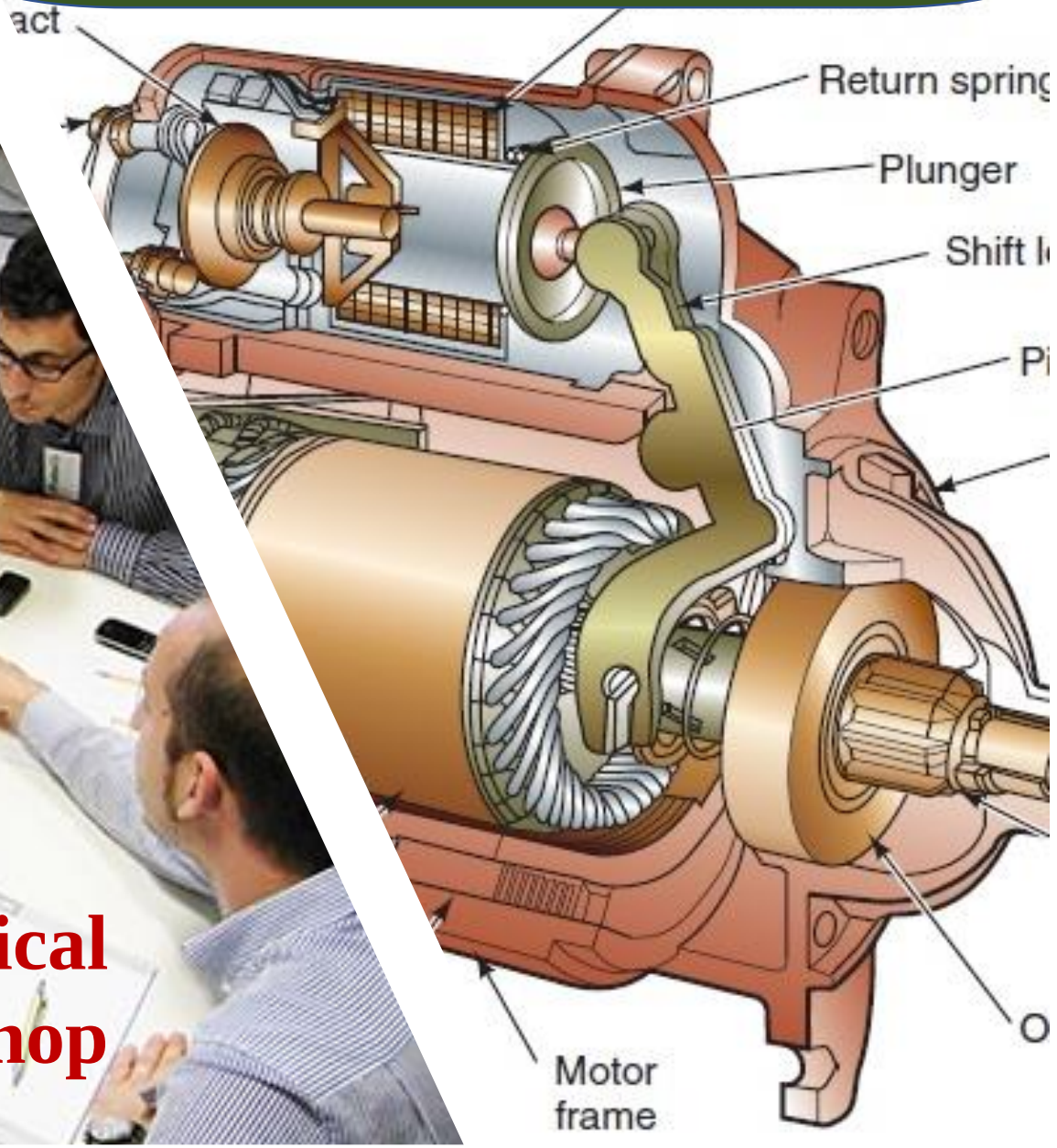


CSR

International Automotive Task Force

A new product development & approval process

A most practical workshop



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S O P for the Workshop on

APQP & PPAP (as per IATF 16949 : 2016) with a focus on CSR

Target participants : Engineers & above

Type of Program :-
- ■ Technical
- ■ Management
- □ Behavioral

	Min.	Max.
Hours	18	26
No. of Participants	10	20

Mixed Group : ■ Yes □ No

Program Objectives

To familiarize the participants to apply the concepts & Practices of Advanced Product Quality Planning & Control Plan (APQP) 2nd edition – Production Part Approval Process (PPAP) 4th Edition.

To provide the skill sets on new product development through APQP & PPAP methodologies.

Also to familiarize on linkages to IATF 16949:2016 requirements.

Performance Indicators

Short-term

- Performance during the team presentations
- Final Test Marks
- Exercise marks during the Program
- Program feed-back

Long-term

- Usage of APQP, PPAP & Control Plan Methodology
- Better focus on Customer requirements
- Enhanced skill index

Process

Methodology :

- Class Room discussions
- Team Exercises (20 exercises)
- Group Presentations
- Best practices on APQP & PPAP

Structure :

- Ice Breaking
- The whole course to cover all the phases with exercises
- Evaluation during the sessions
- Quiz
- Final Test & Evaluation
- Verbal Feed Back
- Written Feed Back

Deliverables

- Origin of APQP
- Basic concepts & Principles
- Linkages to IATF 16949:2016
- Techniques of APQP process
  - Quality Function Deployment (QFD)
  - Error proofing & PDCA cycle
  - Process Flow for Lean management
  - Characteristics matrix
  - M E O S T for product validation
  - Quality plan
  - Gantt chart
  - Quality planning sign-off
- Phase 4 of APQP : Linkage to PPAP
- Successful PPAP through structured APQP Process
- Five Phases of APQP – with exercises
- Control plan - Creation & management
- PPAP – How to interpret & Implement ?
- Situations Analysis on PPAP

APQP - Importance

APQP & Control Plan

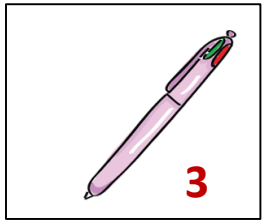
IATF 16949 : 2016

Clause 8

Clause 8.3
(inputs & outputs)

Phase 2 & 3
Product Design & Development

#	Elements of APQP	IATF Clause reference
1	Design FMEA	
2	Process FMEA	
3	Design Changes	
4	Control plan	



A glimpse

Advanced Product Quality Planning

0 CFT formation & Scope definition

Plan & Define

Product design & development

Process design & development

Product & Process validation

Feed-back, assessment & corrective action

Phase "0"

CFT formation & Scope definition

Phase 0

Phase 1

Phase 2

Phase 3

Phase 4

Phase 5

- ✓ **Prof. Yoji Akao**
- ✓ **1980s**
- ✓ **Introduced QFD technique**

APQP

Quality Function Deployment [Q F D]

CFT formation & Scope definition

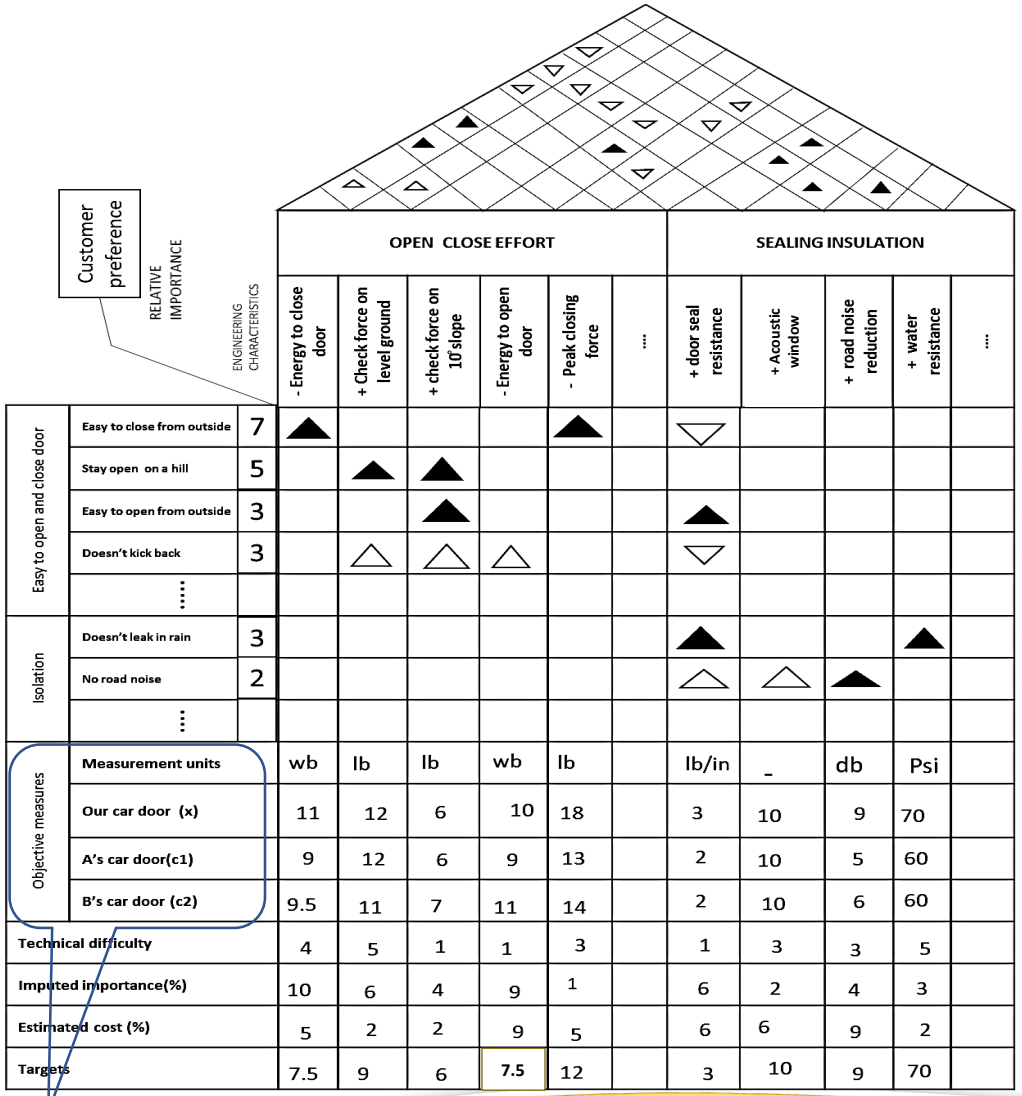
Phase 0
Phase 1
Phase 2
Phase 3
Phase 4
Phase 5

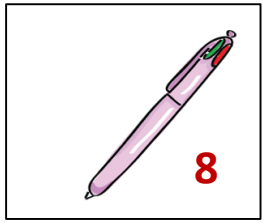
LEGENDS

lb - pounds
wb -weber
Psi - pounds per square inch
db - decibel
lb/in -pounds per inch

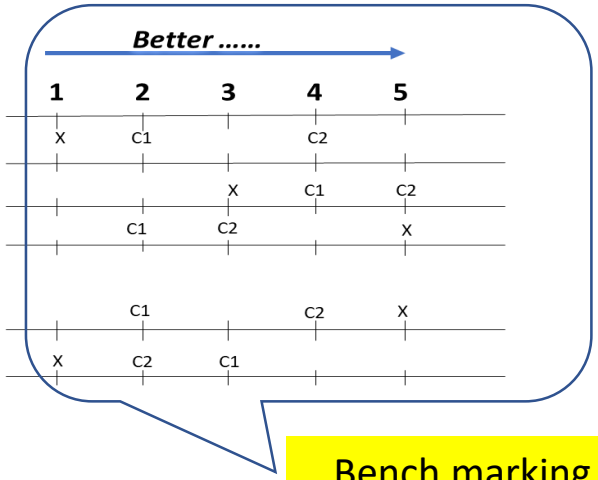
RELATIONSHIP

▲ - strong positive
△ - Weak positive
▼ - Strong negative
▽ - Weak negative





CUSTOMER PERCEPTIONS



Bench marking 1

X – our car
C1 – competitor one
C2 – competitor two

Harvard business review case study

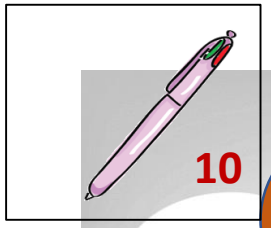
Bench marking 2

Quality Function Deployment [Q F D]

A P Q P

CFT formation & Scope definition

Phase 0
Phase 1
Phase 2
Phase 3
Phase 4
Phase 5



Voice of Customers (V O C)

Customer Inputs

Marketing Priorities

Field Conditions

External factors

Success of an NPD process

Internal factors

Mfg. Feasibility

Designers' Competence

QMS strength

Top Management Focus

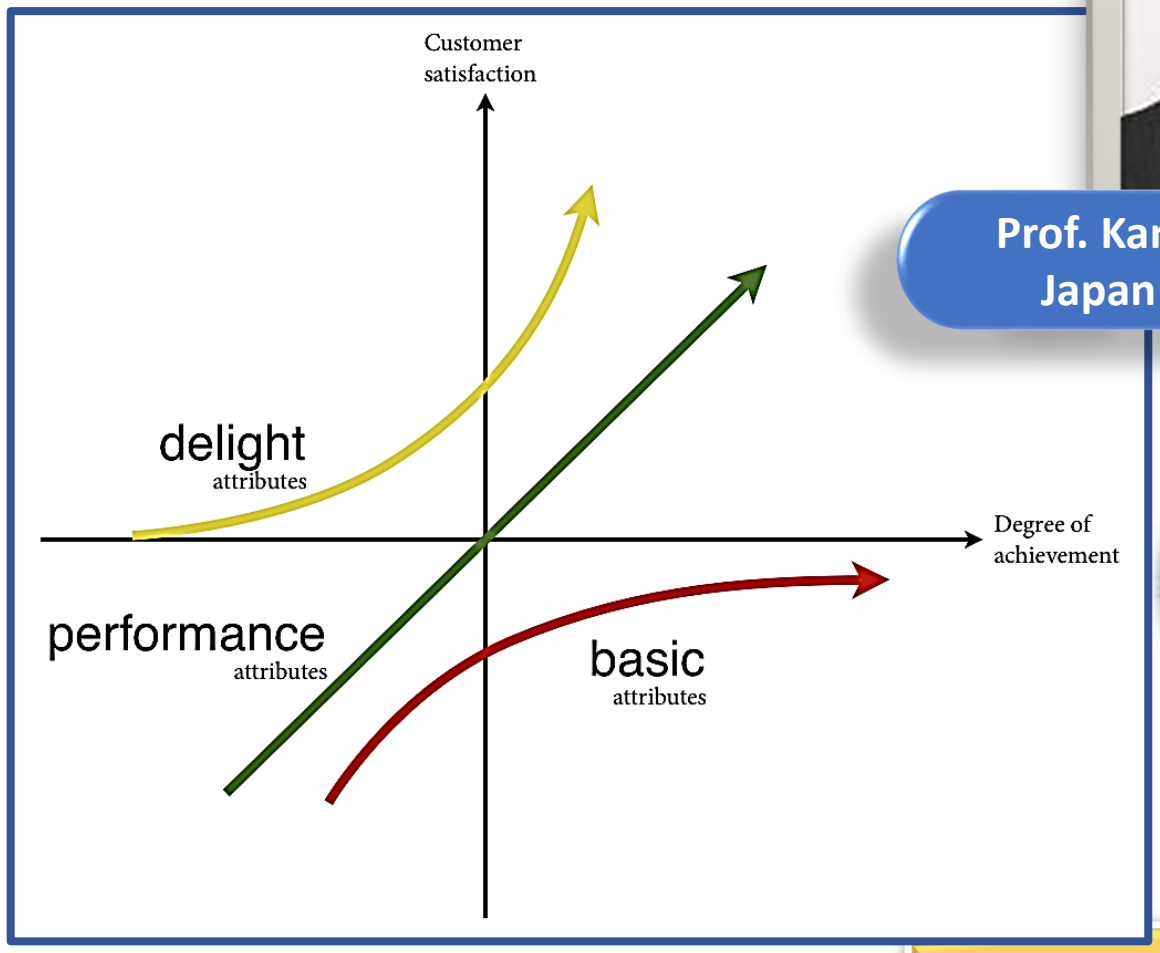
Success factors

A P Q P

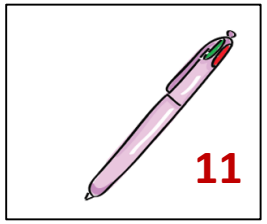
CFT formation & Scope definition

Phase 0
Phase 1
Phase 2
Phase 3
Phase 4
Phase 5

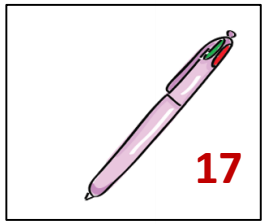
APQP

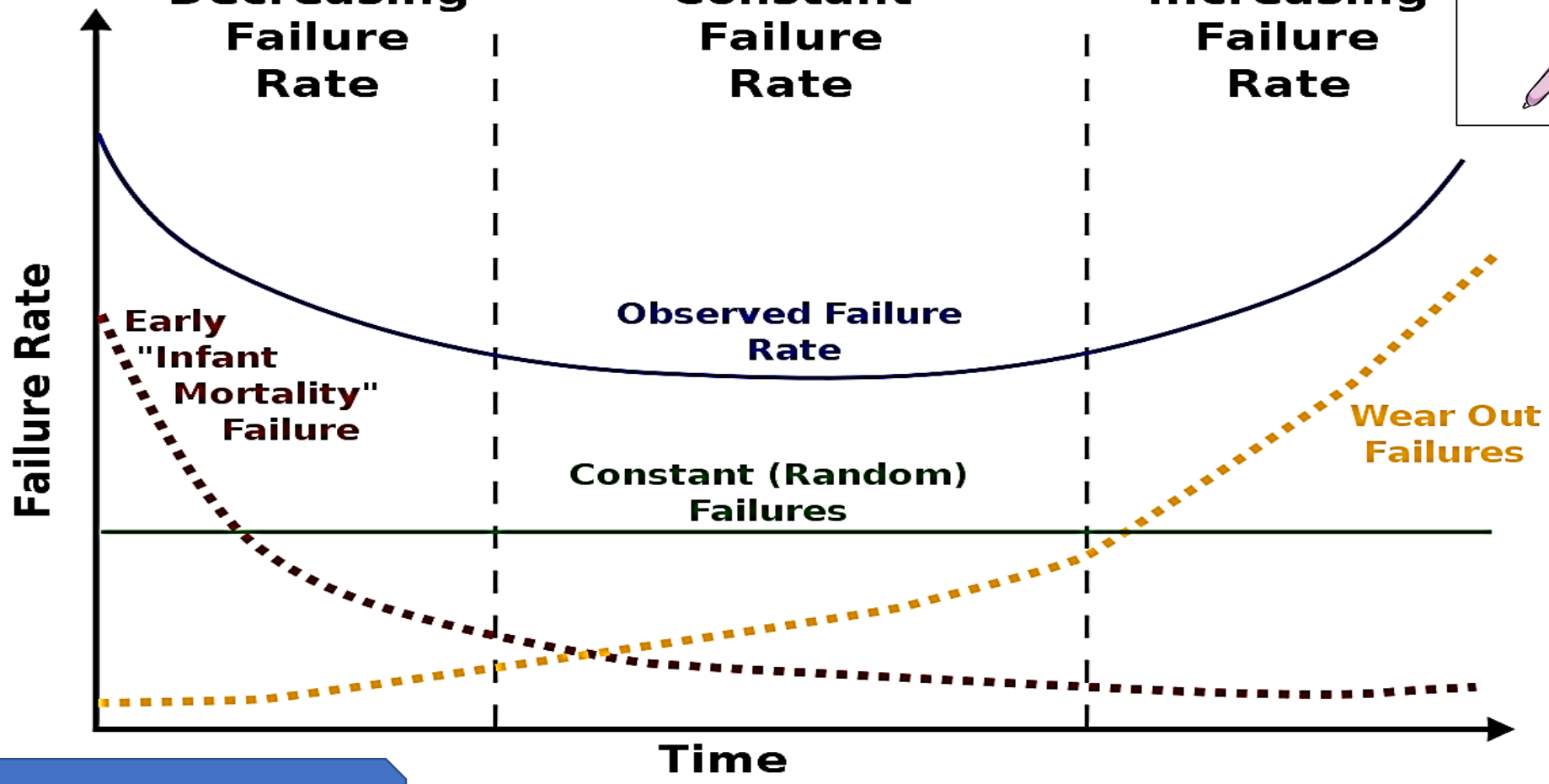


Prof. Kano
Japan



Needs & Expectations of the Customer

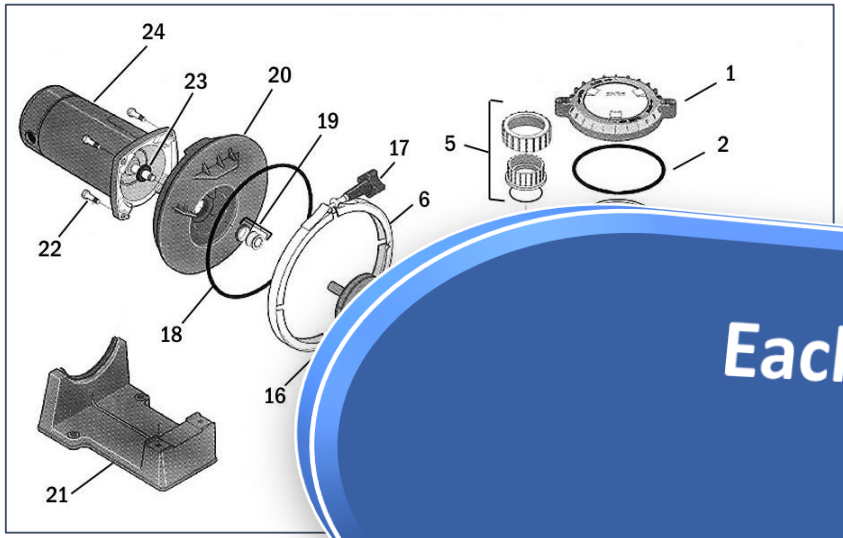


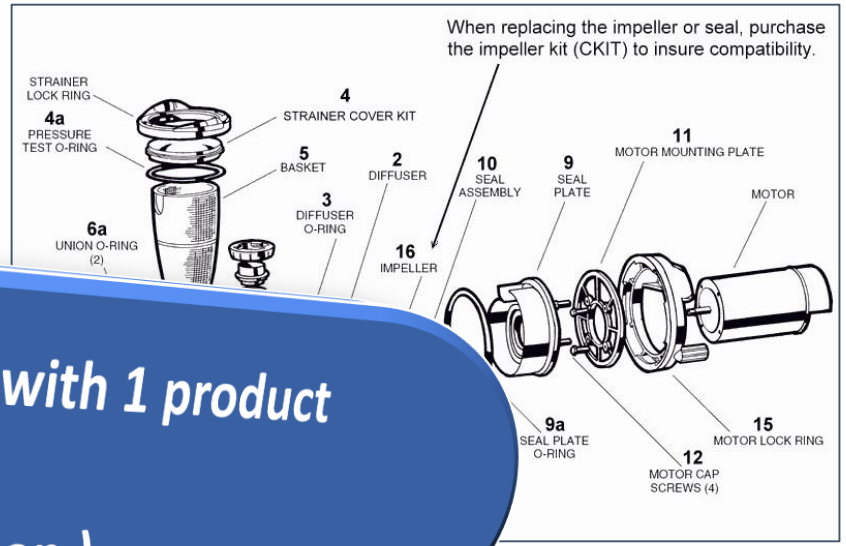


Bath tub curve

1.7 Design goals

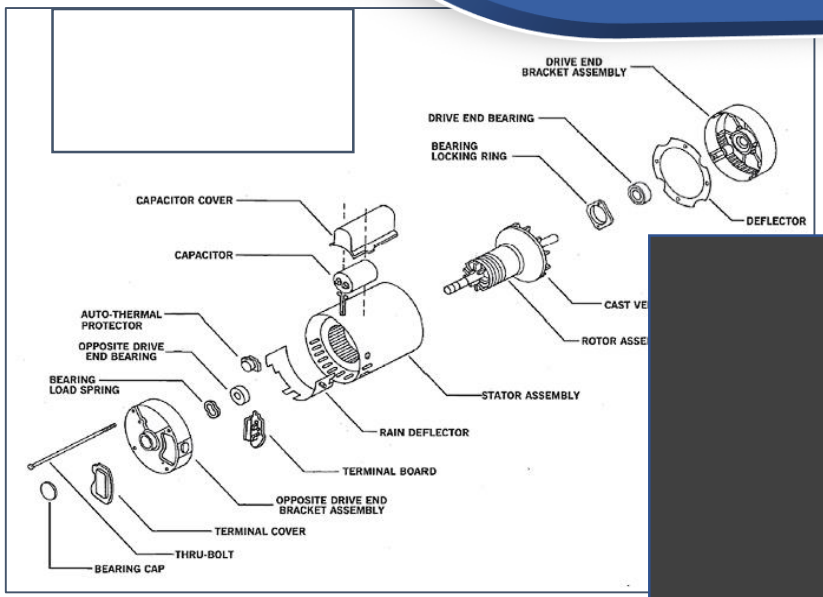
APQP





Each team to deal with 1 product

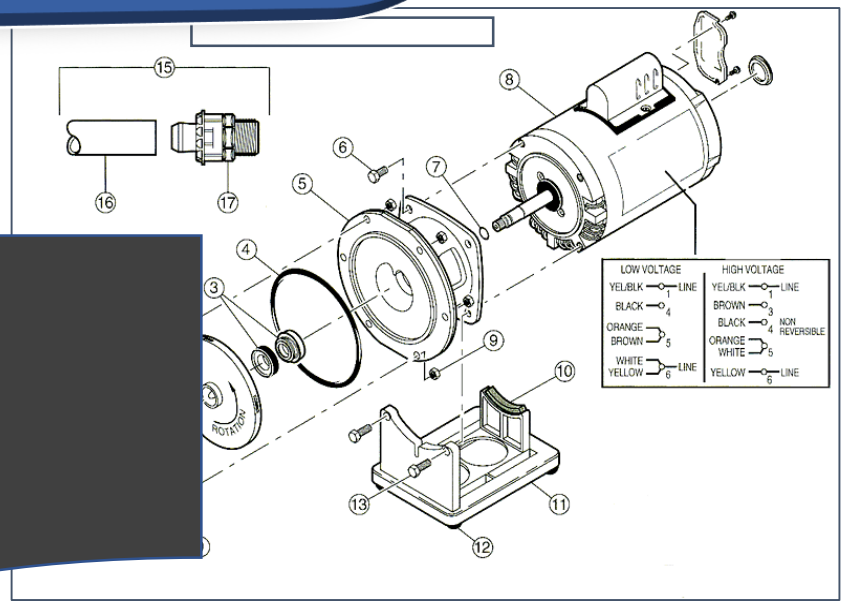
(Simulation)



Refer Page #

18 to 21

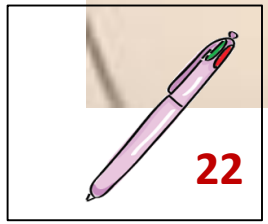
In the workbook



Anticipated manufacturing process !

Source(s) to prepare

- Preliminary B O M
- Product / Process Assumptions



1.10 Preliminary Process Flow Chart (PFC)

Plan & define

GM

TOYOTA

Ford

Needs & Expectations

Product Assurance Plan

Design Requirements

1.12

Product assurance plan

APQP

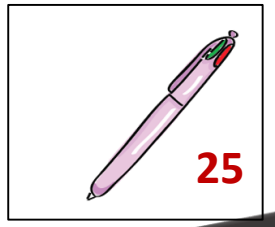
- ✓ Involve your Top Management !
- ✓ Inform the Status !
- ✓ Gain support !

1.13 Management support

APQP

Phase 0
Phase 1
Phase 2
Phase 3
Phase 4
Phase 5

- CFT
- Customer inputs
- Lessons learnt
- Data & information

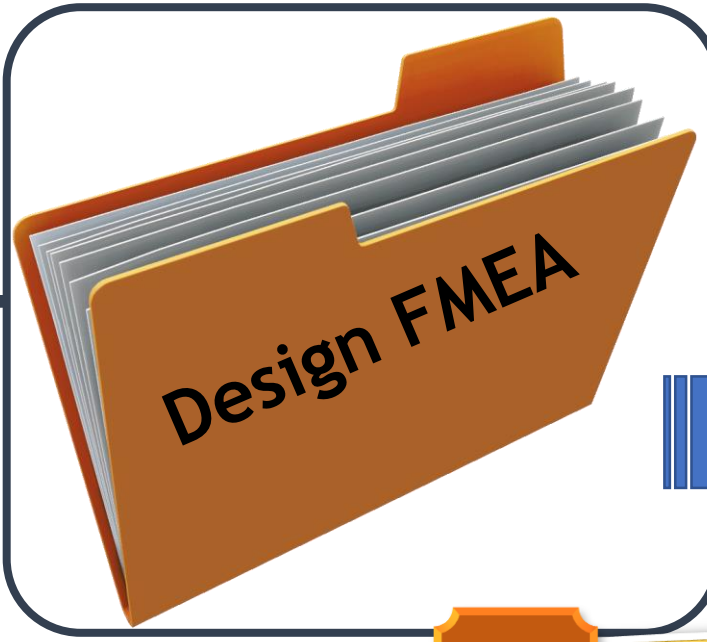


Key outputs

- Potential Failure modes (PFMs)
- Design Causes
- Effects of the PFMs
- Action priorities

List of Recommended actions

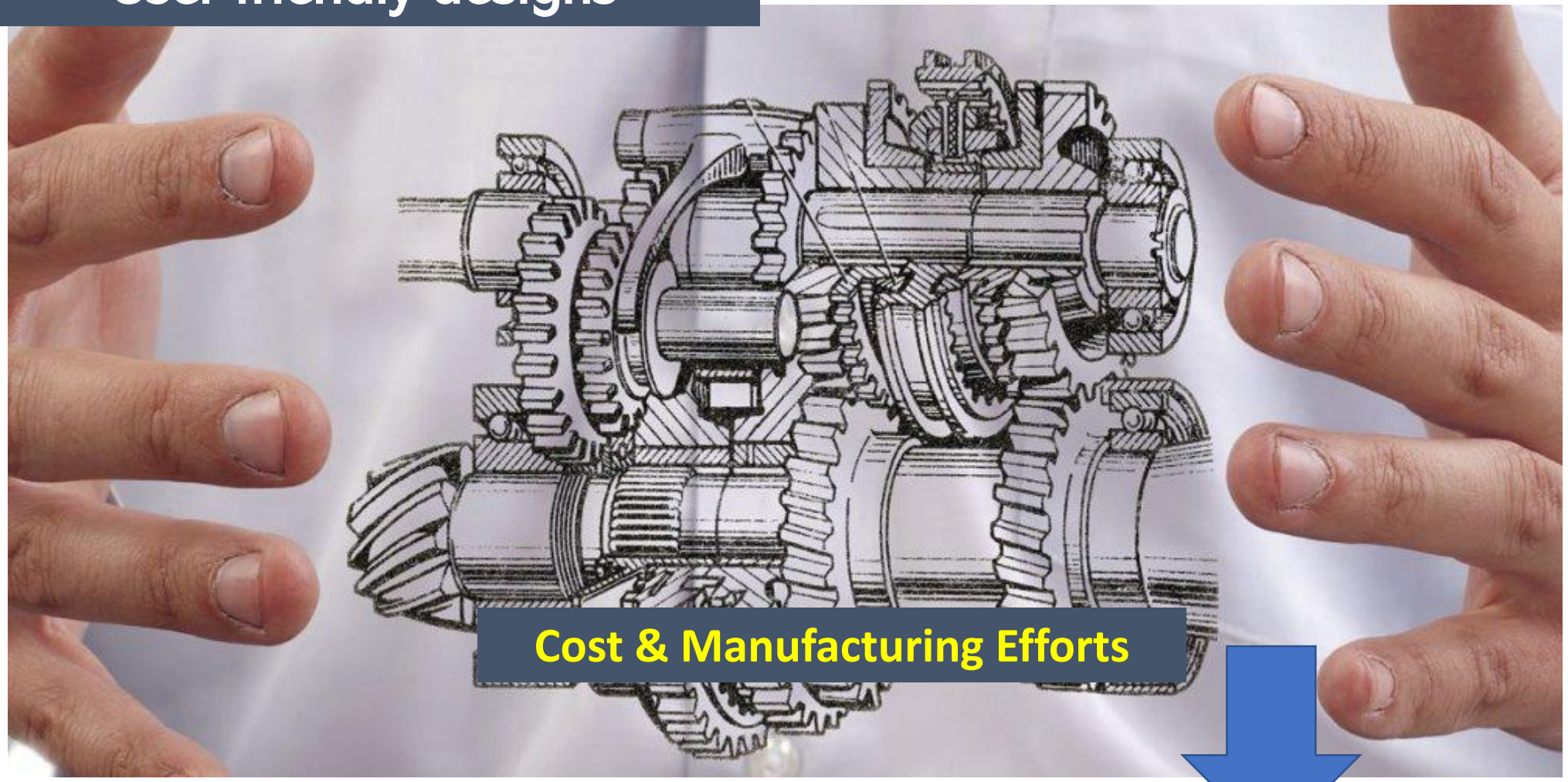
- Boundary diagram
- Parameter diagram
- Interface matrix

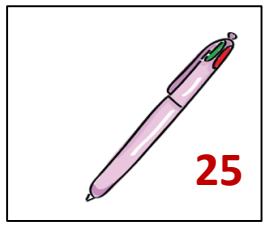


APQP

2.1 Design FMEA

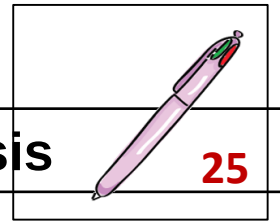
"User friendly designs"





APQP

2.2 Design for Manufacturability & Assembly (DFA & DFM)



#	Focus during DFMA analysis	What will be ideal ?	
1	No.of parts	Less	More
2	Common parts	Less	More
3	ments	Less	More
4		Less	More
5		Less	More
6		Less	More
7		Less	More
8	ndard p	Less	More
9	Handling of parts	Less	More
10	Re-orientation while assembly	L	e

Team based exercise : 07

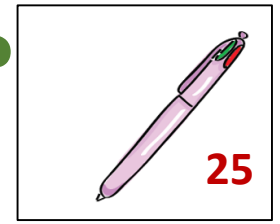
Answers

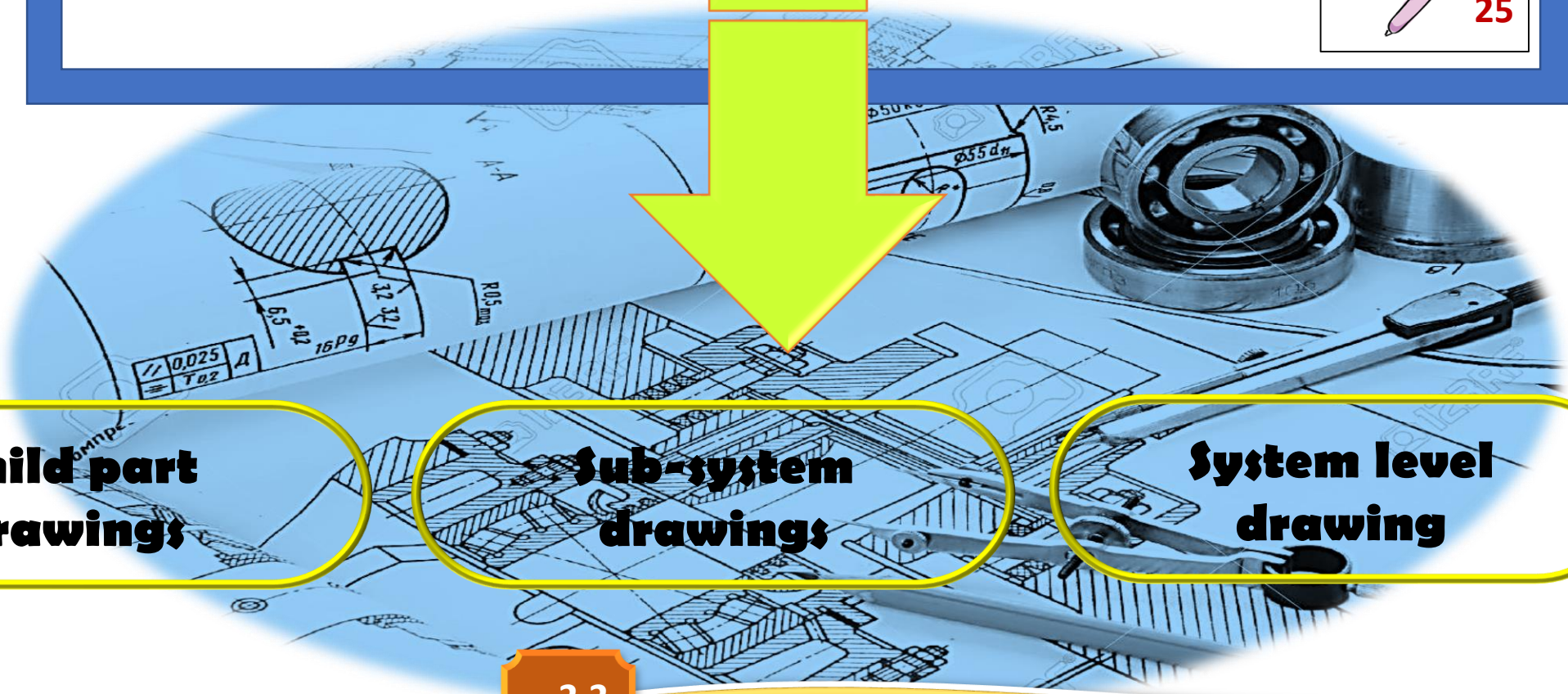
Template

2.2 Design for Manufacturability & Assembly (DFA & DFM)

APQP

D F A & D F M immediate outputs ?





Child part drawings

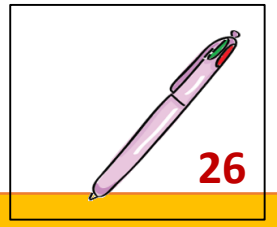
Sub-system drawings

System level drawing

2.2

Design for Manufacturability & Assembly (DFA & DFM)

Phase 0
Phase 1
Phase 2
Phase 3
Phase 4
Phase 5



Customer Requirements

Design Inputs

5 phased APQP approach

Design Outputs

1. Design Review
2. Documents Review
3. Tests

APQP

2.3 Design verification

Phase 0
Phase 1
Phase 2
Phase 3
Phase 4
Phase 5

#	Statement	True	False	Evln
1	Proto samples are not produced, when the customer is not particular about them			
2	Pre-launch samples are produced to prove the new product's concept			
3	Proto samples shall be produced, even when sufficient real-time facilities are not present			
4	Proto-ty…rocess' related informati…also			
5	At time…			
6	The firs…			
7	It is ma…ustomer			
8	Prototy…			
9	The inp…rototype contr…MEA			
10	Generally, Proto samples are verified 100 %…			
11	Prototype control plans must cover performance test related information, as applicable			
12	Outputs derived immediately after Proto build are Packaging requirements & Process parameters			

Team based exercise : 08

APQP

2.5

Prototype Control Plan

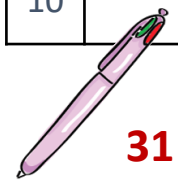
Phase 0
Phase 1
Phase 2
Phase 3
Phase 4
Phase 5

APQP

#	Description	Specifications	Documents / Lists	Activities	Hard wares
1	Proto-type samples				
2	Engineering specification				
3					
4					
5					
6					
7	Material specificatio				
8	Design review				
9	Engineering drawings				
10	DVP & R				

Tick

Team based exercise : 09

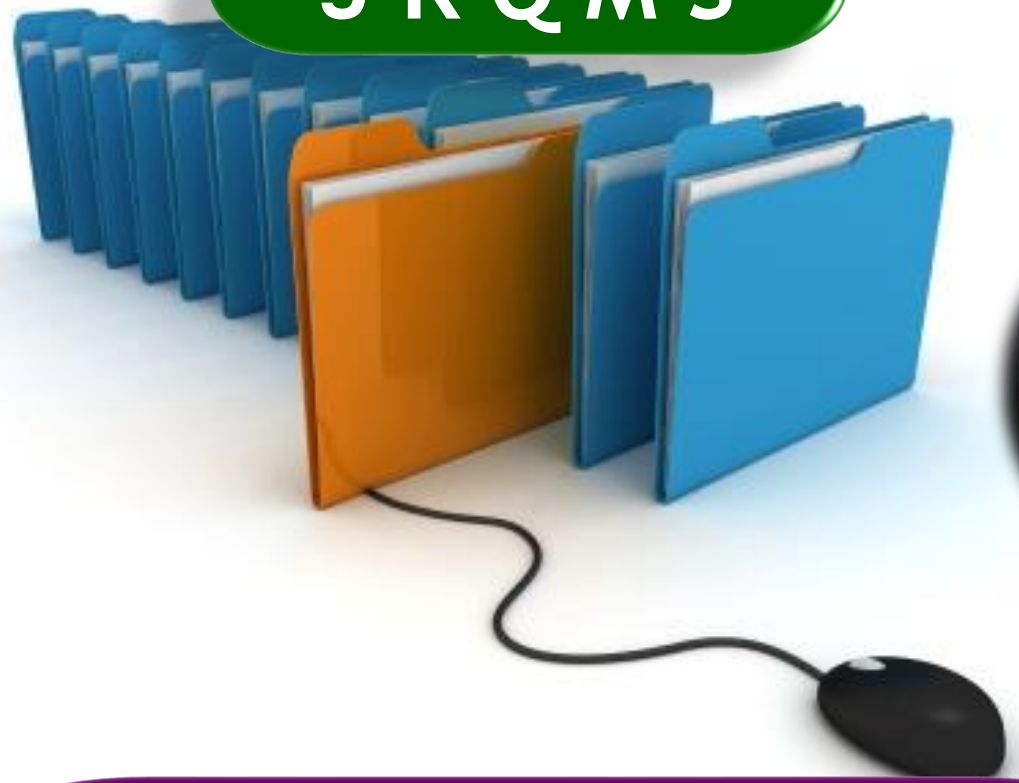


31

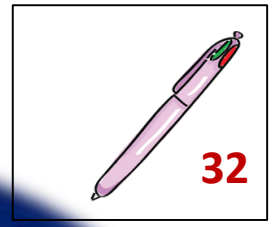
#	Description	Specifications	Documents / Lists	Activities	Hard wares
11			■		
12				■	
13			■		
14			■		
15				■	
16		■			
17		■			
18				■	
19			■		
20			■		

List out

2.0 Key activities & the outputs



J R Q M S

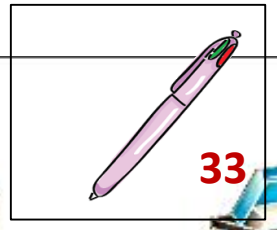


Joint Review on QMS

APQP

3.2

Product / process Quality system review



Purpose ?

Powder

To decide what comes Where in the Shop Floor !

Stacking

Focus ?

Tumbling

Sintering

Cutting

Lamination

Material Travel

Material Handling

Space utilization

Optimization

Health & Safety

Testing/Inspection

Taping

IATF 16949 Clause #

8.3.5.2 (e)

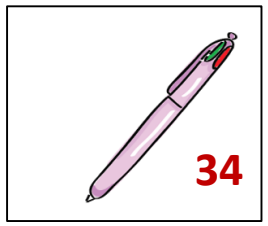
3.4

Floor plan layouts

APQP

Dim #	Description	Tolerance	Operation #			
			10	20	30	40
1	ID 22.5	20 microns	X	C		X
2	Facing	5 microns		X	C	C
3	Boring 67 dia	25 microns		X		L
4	Chamfering	0.5 x 45			X	
5	OD turning 45	18 microns	X			

X : Characteristics created / changed by this operation. To match PFD
C Characteristics at an operation is used for Clamping
L : Characteristics at an operation used for Location



Inputs

Process FMEA !!!

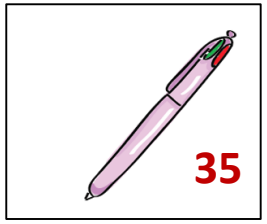
3.5

Characteristics matrix

APQP

Phase 0
Phase 1
Phase 2
Phase 3
Phase 4
Phase 5

- CFT
- Customer inputs
- Lessons learnt
- Data & information



- Design FMEA
- PFD
- Characteristics matrix

Key outputs

- Potential Failure modes (PFMs)
- Process Causes
- Effects of the PFMs
- Action priorities

List of Recommended actions

Better to focus on Product design solutions !!!

3.6

Process FMEA

IATF 16949 : 2016

37

- Clause # 10.2.4 – Error proofing (EP)
- Shall have a documented process to identify
- Method to identify EP shall be documented in P FMEA
- Test frequency shall be in the control plan
- Challenge parts for EP
- EP failures shall have a reaction plan
- EP failures testing records

3.7

Pre-launch Control plan

APQP

Phase 0
Phase 1
Phase 2
Phase 3
Phase 4
Phase 5

Standard Operating Procedures [S O Ps]

#	Description	Input	Output	No link
1	PFD & Floor plan layouts			
2	Design FMEA			
3	Process FMEA			
4	Set-up Instr…			
5	D…			
6				
10				
11	De…			
12	Packaging			
13	Current controls (P & D) identified in the FMEAs			
14	Customer's inputs relevant to the manufacturing stages			

Team based exercise : 12

38

3.8

Process instructions

APQP

Phase 0

Phase 1

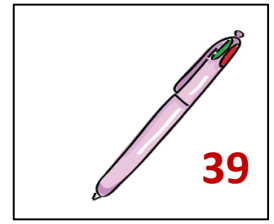
Phase 2

Phase 3

Phase 4

Phase 5

MSA & Capability Studies : Reference documents ?



Pre-Launch Control Plan

Timing Plan (for period)

J R Q M S

3.9 & 3.10

MSA Plan & Preliminary process capability plan

A P Q P

4.1

Significant Production Run

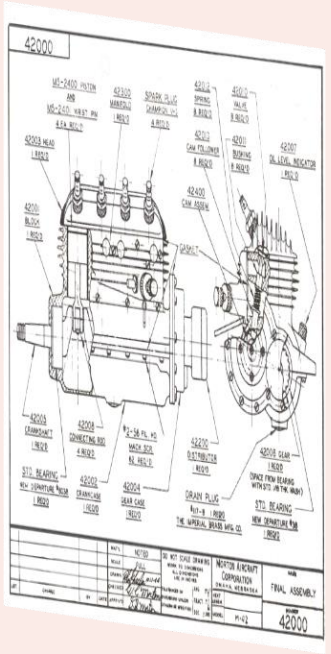
Product & process validation

Phase 0
Phase 1
Phase 2
Phase 3
Phase 4
Phase 5

APQP

Customer Engineering Design record

Final drawing



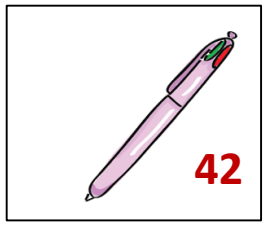
Specification requirements

Technical & others

Engineering Specs

Engr. Spec. #	Importance	Specification (description)	Unit of Measure	Marginal Value	Ideal Value
1	1	Radius of Detection	Feet	1 foot	2 feet
2	1	Battery life	Hours	1 Hr	3 Hrs
3	2	Battery type	Voltage	2-9 Volt	1-9 Volt
4	2	Operating Temperature	Degrees	50-100 F	32-100 F
5	2	Weight	Pounds	3 lbs	2 lbs
6	3	Dimensions	Inches	12"x4"x6"	10"x4"x2"
7	1	Waterproof up to	Feet	6 Feet	10 Feet
8	1	Hole size detection range	Inches	>.25 in	>.1in
9	2	Buoyancy	Newtons	0 N	- 5 N
10	2	LED Brightness	mcd	100 mcd	120 mcd
Hydrophone Specs					
11	2	Directional Characteristics	direction	Omnidirectional	Unidirectional
12	1	Frequency Range	Hz	90-1300 Hz	No
13	1	Sensitivity	dB	-90 dB	No

Understood by the organization



Organization to demonstrate through PPAP….

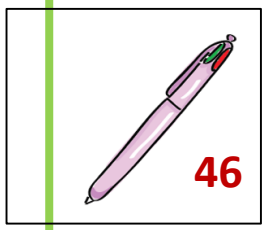
- ✓ Its potentiality *of the manufacturing processes*
- ✓ Its consistency *in meeting the requirements*

Actual production run

Quoted production rate

4.1

Significant Production Run



#	Statement	True	False	Evln
1	PPAP ru… …lan			
2	…valuate the packaging			
3				
4				
5				
6				
7				
8				
9	…control plan (PCP) must in…			
10	IATF 16949:2016 – Clause 8.1.5.5 is dealing with the PCP			
11	PCPs & the Reaction plans are the same			
12	Both D & P FMEAs will provide inputs to the PCPs			
13	Bulk materials means components such as Fasteners			
14	Customer Engineering design record must cover all the Technical requirements in it			

Team based exercise : 14

APQP

Run at rate

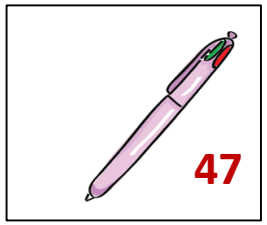
How to perform ?

- After PPAP
- 1000 parts general
- Run at full speed
- Focus on FPY%
- Use audit checklis
- Identify all bottler
- Focus on Process c
- Ensure MSA resul
- Use PFMEA and PCP for audits

Checklists

Click for hyperlink

Snap allowed !



APQP

4.1 Significant Production Run

- ✓ Involve your Top Management !
- ✓ Inform the Status !
- ✓ Gain support !

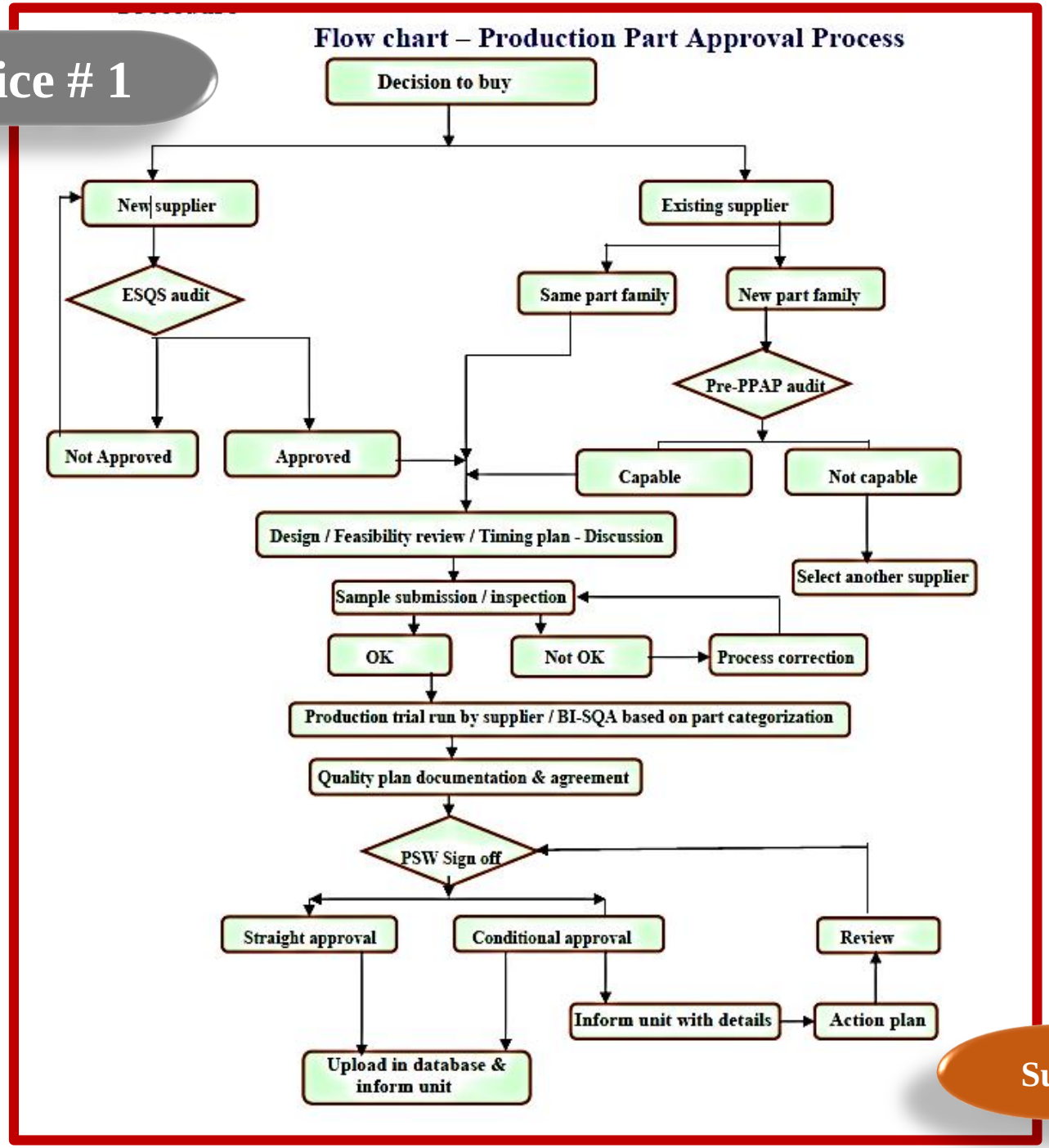
4.8

Management support

APQP

Snaps allowed !

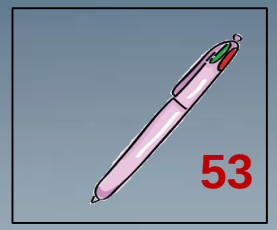
Best practice # 1



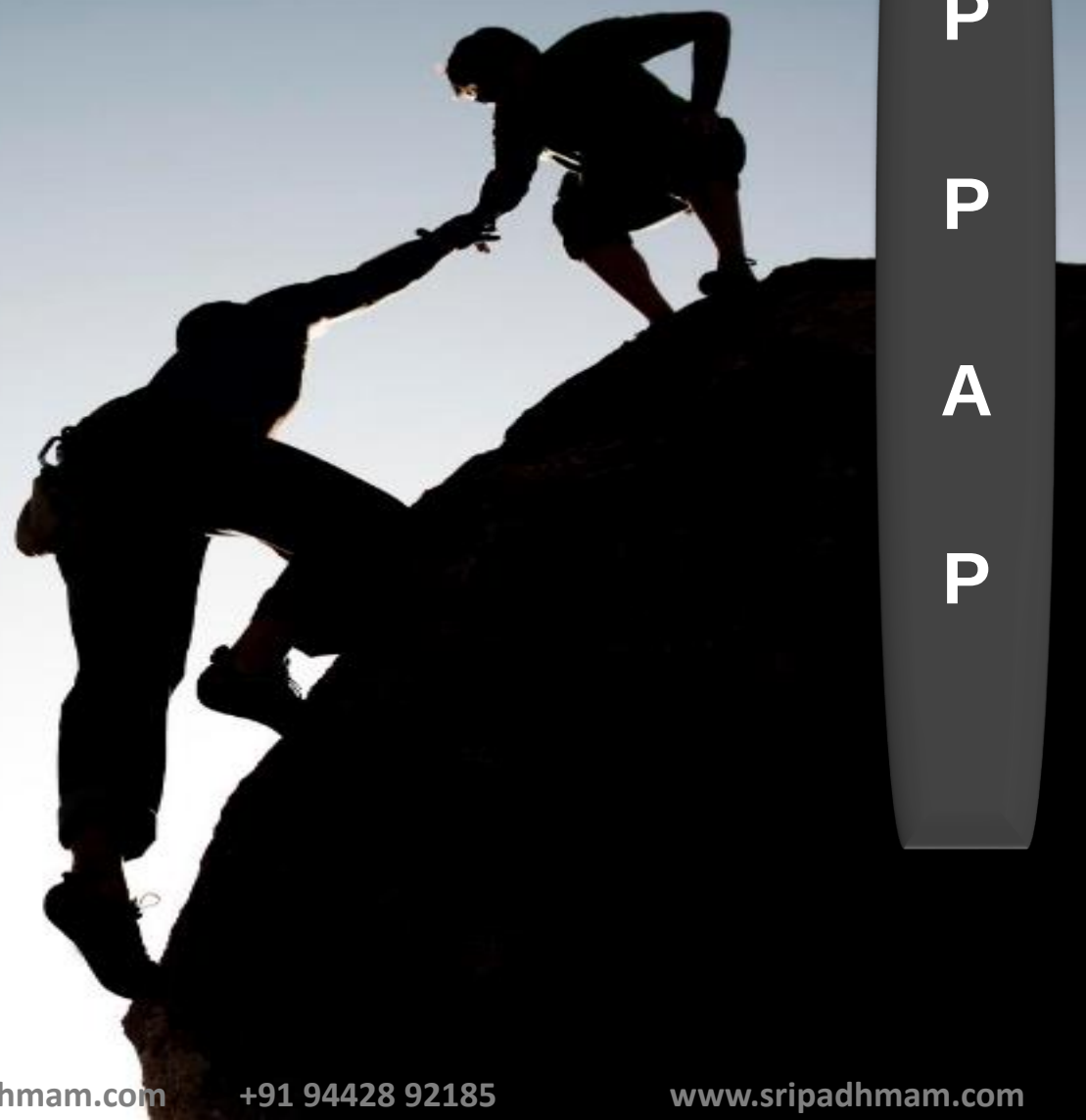
Snaps allowed !

Supplier PPAP approval – a TVS model

Tricky Part of PPAP ?

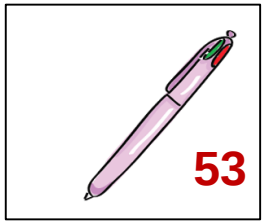


- Pass Through Characteristics
- Black Box Items
- ROHS & MD systems
- Part Weight Criteria
- Checked & Marked Prints

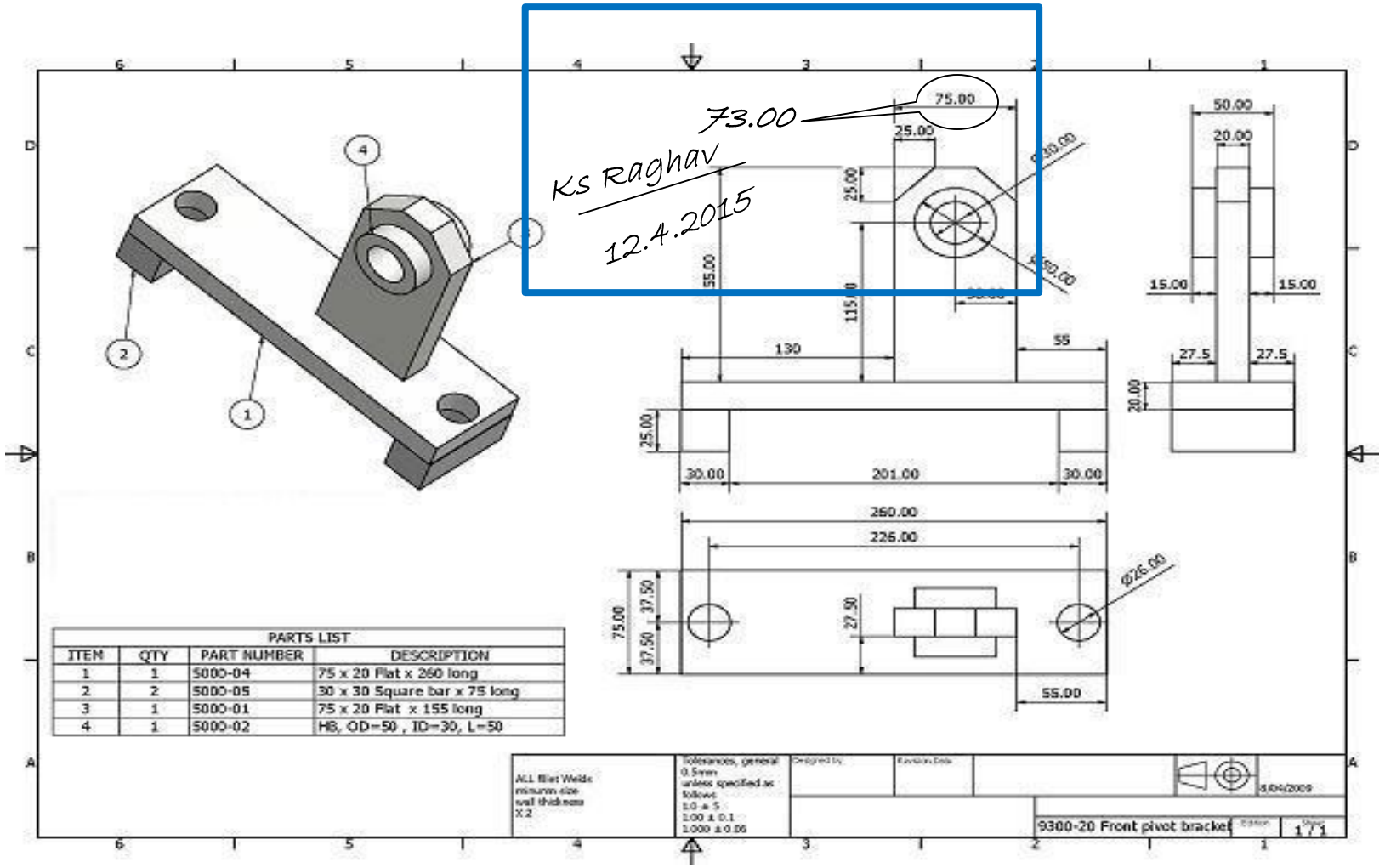


P
P
A
P

Marked Prints

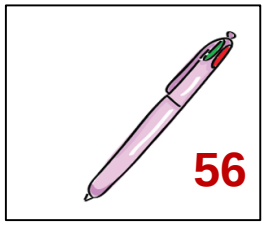


An engineering drawing – modified, signed and dated by the customer engineer



P P A P

Accelerated Learning Process — Matching Exercise



P P A P

PPAP : Accelerated Learning		Match the following in a MOST Logical way !		
Ref.	Criteria	Ref.	Criteria	
A		1	Stability First & then Performance target	
			NABL certification	
			ist	
	PPAP target date is advanced by the Customers			
H	New Vernier and an Air gauge introduced now	8	actions	
I	Part weight in PSW	9	Amend the Timing Plan and speed-up related actions	
J	Tool has not been used for 16 months, after the PPAP approval	10	Quality Goal and include in the JRQMS (QMS Contract)	

Team based exercise : 18

Situation Analysis

Team based exercise : 20

P P A P

- Please study the situations carefully and decide your action(s).
- You may have certain (logically acceptable !) assumptions and conclude.
- Must justify your conclusions
- Let us have a healthy discussion to enhance our PPAP understanding

Issue the A 3 sheet

- PPAP submission level is 2
- The Quality system review & agreement (JRQMS) must be kept in mind