



MADE Six Sigma Green Belt (ACMA5005)

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Project Charter 1/2



Upper Level Project	MLB Auxiliary Radiator scrap improvement	Name of the Leader (BU-Function)	Alan Norris
Project Title	MLB Auxiliary Radiator scrap reduction	Method	Six Sigma

Value/Purpose of this or upper level PJ

- To reduce the scrap cost of MLB production failure
- To reduce the non-scrap/hidden costs of MLB production failure

Current Issues

- High level of reject parts made during the manufacturing process

Presumed Factors or Define Factors

- Scrap cost per part is lower than other products thus not reaching the scrap values to warrant inspection

Activities to be tackled

Scope:

- All MLB Aux radiator variants

Out of scope:

- Other Aux radiators

State should be after this activity

- Scrap rate per volume to be below 2% plant target
- Reduction of reject analysis at wet test
- Reduction of additional manufacture hours to replace failure fallout

Project Charter 2/2



Target (KPI to measure the operation status after adopting solutions)

Definitions	Current	Target	Gap
Scrap rate reduction from current to plant target Eliminate additional labour and material cost Reduce extra build hours	10% £24,633 30hrs	2% £493 0hrs	8% £24,140 30hrs

Requisites to close the activity

Due date for the target achievement

- Target scrap percentage reached
- A stable control method in place (2 week stable data)

April '21

Prerequisite•Constraint condition (Budget, 2nd KPI, etc)

- Cross functional support needed for data and subsequent improvement and control

Basis for project benefit calculation•A Formula (applied only if outcome is quantitative and Monetary evaluable)

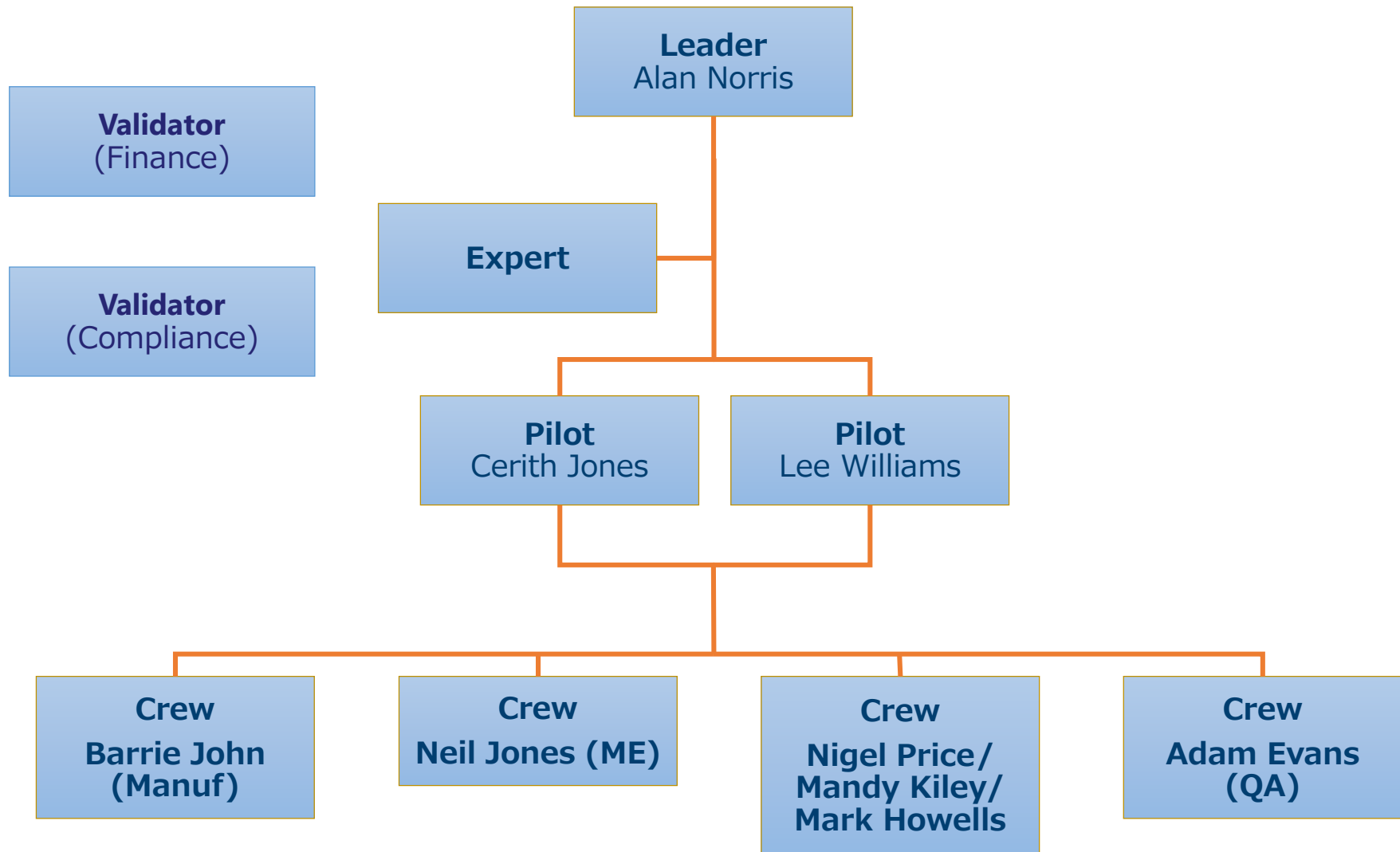
Leader's responsibilities/Commitment

Signed By Pilot

- Reject cores/total cores made

- Identify main contributors of scrap
- Investigate and analyse cause of scrap
- Drive improvement activity
- Report on project status to Champions

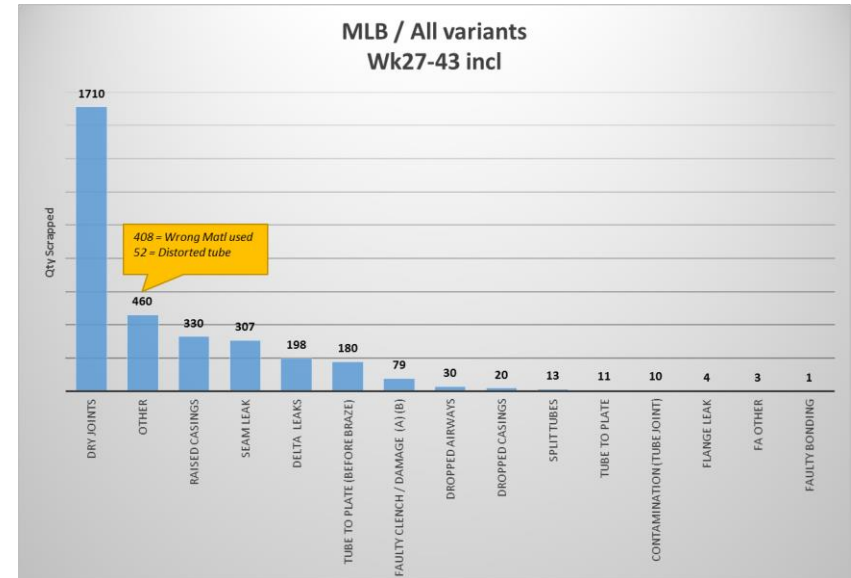
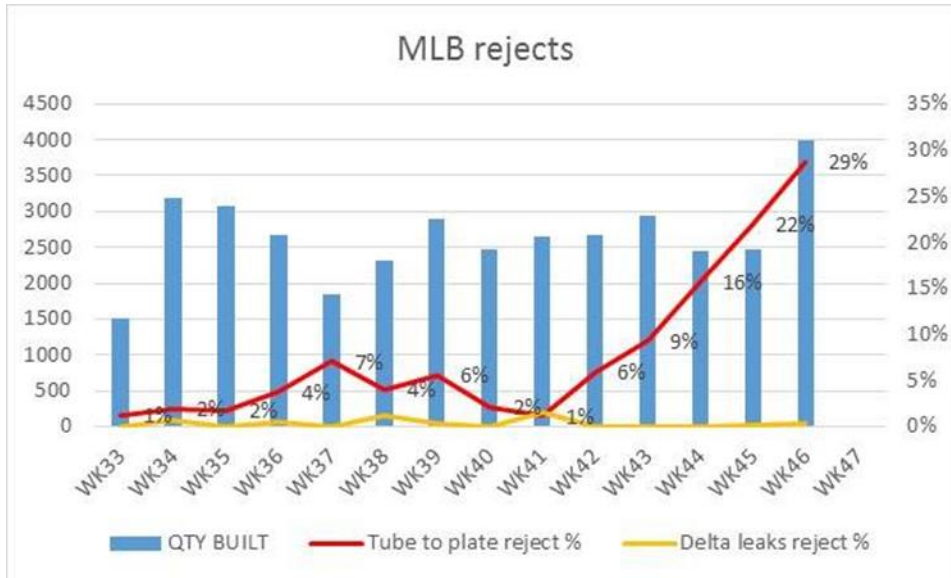
Team Charter



Define



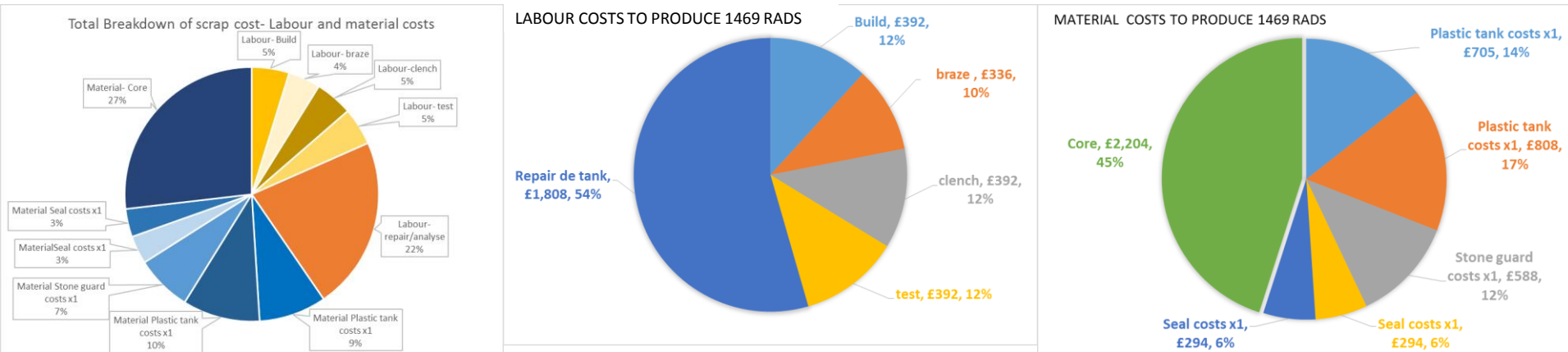
Pareto Analysis of all MLB Scrap



- Scrap rate has dramatically risen from week 42
- Pareto analysis of scrap highlights 50% derives from 'Dry Joint' failure mode

Total hidden costs for 'Dry joint' failure

For the plant, only the material costs are tracked internally, but as is evident in the below charts, 41% of the total 'hidden' costs are labour costs, and this is only for the 'Dry Joint' failure mode. Total internal cost of process failure can be increased by 41%



Material cost	Cost per item	Failures produced	Material cost £
TOTALS	3.33	1469	4891.77

Summary -

The total cost to scrap 1469 parts, including clench and test would be =

OVER 4 MONTHS

£8,211

ANNUALLY

£24.633

Define: What is 'Dry Joint' Failure

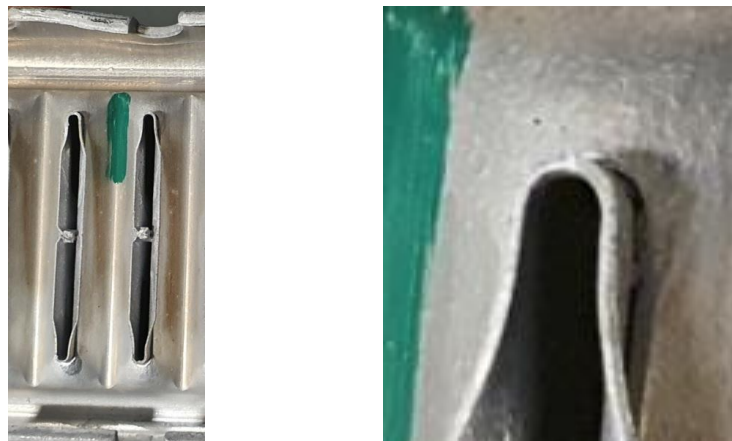
Team definition:

A 'Dry Joint' is described as a Radiator core leaking from the tube to tubeplate joint, either single or multiple joints.

Terminology:

The terminology derives from an unsubstantiated comment of a lack of braze in the joint area.

The cause of this failure mode might not be as a result of lack of flux but to keep the internally used terminology and not to create confusion by using a different name, the term 'Dry Joint' will be used to describe this failure mode. Once the true root cause is identified then a new term can be created.



Example of a 'Dry Joint' Failure

Customer requirements- critical to quality

Define



Customer critical requirement for MLB products:

1. 100% non-leaking product
 - 100% leak test of product after final assembly
2. Part internal cleanliness spec must be achieved
 - Flux covers added to prevent internal contamination

Internal customer

1. No leaking cores at final assembly/leak test

Company objectives:

1. 2% scrap rate

MLB Dry Joint Is-Is Not



A simple Is-Is Not analysis was made to narrow down and to help lead the investigation into possible routes of investigation. The information that fuelled this analysis came from information gathering techniques, such as a 'measles chart'.

Is	Is Not
• Is MLB • Observed off both Core Build • Is observed with flux covers • Is clamp side up tubeplate corners • Is majority on one tubeplate (LH side) • Is happening on RH side of furnace(?)	• Is Not JLR • Not a single core build machine • Is not observed without flux covers • Is not on the bottom of the tubeplate • Is Not equally observed on both tubeplate • Is Not observed on all sides of furnace (?)

Measles chart

The rework/analysis operator inspects every failed parts and identifies any 'Dry joint' failure with a mark on a 'measles' chart.

From the data gathered here, we can immediately identify any common themes with the scrap parts.

It was identified that this measles chart did not provide a full image of the core thus an improved chart was made, showing both sides of the core, for greater focus on where specifically the failure mode was occurring (whether it was only on one face, one side etc.)

AUDI MLB ZWK 1 and 2 / VWHA AUX RAD MEASLES

Date: WK44 Product: MLB VW- HA 28.10.4 29.10.4 Dry Joints

Reason for failure

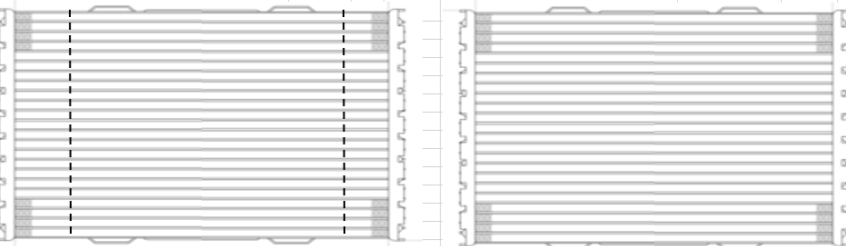
Tube to header	
Split tube	
T/H contamination	
Delta	
Delta damage	
Crushed airway	
Lack of bonding	
Contamination	
Block assembly damage	
Damaged tube	
Handling damage	



Example of 'old' measles chart

AUDI MLB / VWHA AUX RAD MEASLES

Product: _____

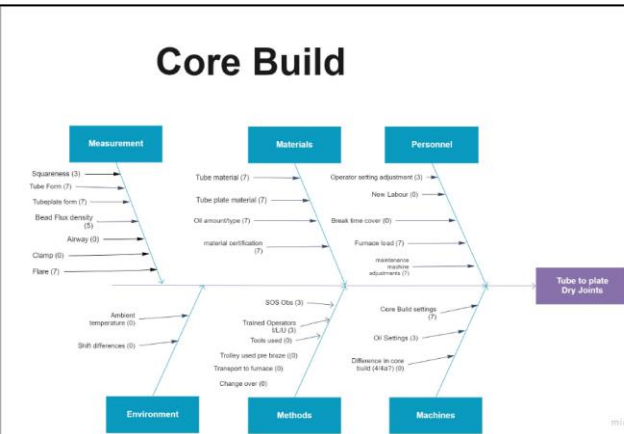


Date	Shift	Concern	Qty

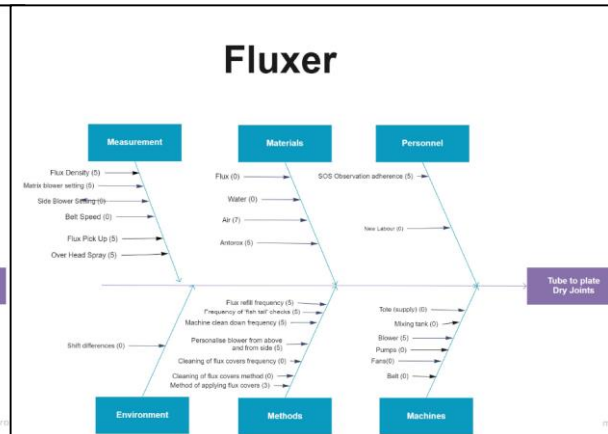
Date	Shift	Concern	Qty

Example of 'new' measles chart

Ishikawa diagram



Example of Core build process Fishbone Diagram



Example of Fluxer process Fishbone Diagram

MLB Dry Joint DMAIC				
THROW SCORE	Item No.	Actions	Resp	Comp Y/N
Define	1	QMS SHEETS	AE	Y wk46
	2	MP2 Tool PM - Relations to punches	NJ	Y wk46
Define	3	Test failure dates ? Monitor braze dates.	BJ	Y wk46
	4	Put 20 Pla down with a cover on	MK/MH	Y wk46
Define	5	M-chart to include the clamp position	MK/MH	Y wk46
	6	Flare removed - 60 qty	MK/MH/NJ/B/I	Y wk47
	7	larger trial of fluxed tube plates - qty 180	MK/MH	Y wk47
	8	One side of furnace trial qty 1-60 - mark the cores	MK/MH	Y wk47
	9	Capability of tube flare / Tube length capability	AE	N
	10	Compare form MLB + DB Cores - Tubplate	AE	N
	11	Tube cladding measure current level / previous history.	AE	Y wk48
	12	Carry out furnace inspection via hatch	Maint	Y wk49
	13	Trial of 12% clad material required, for tube, without paint fluxing the tube plates.	BJ	Y wk49

Example of Action plan list

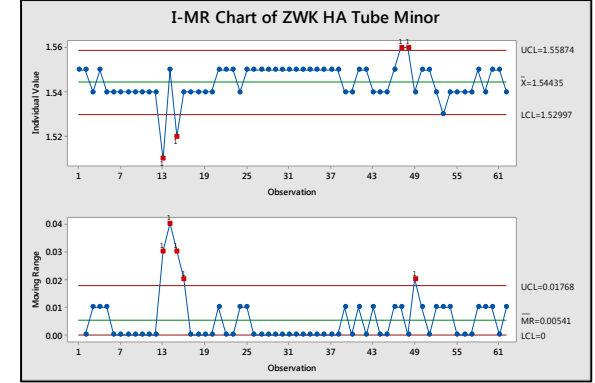
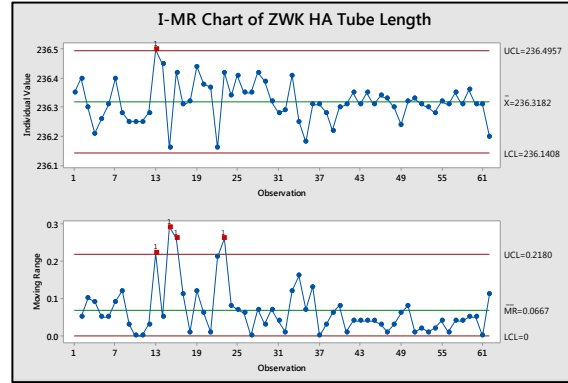
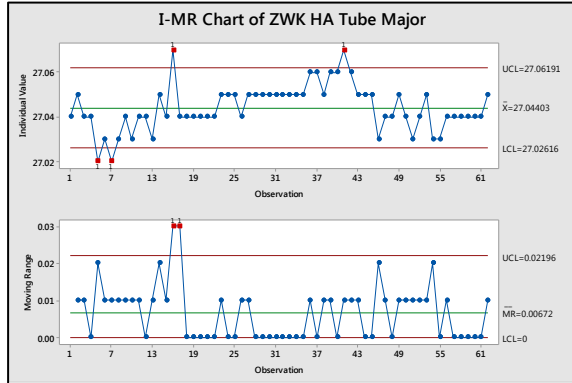
From studying the Pareto diagram, the cross functional team identified the various sub processes within the radiator assembly process to identify areas that could cause the problem statement ('Dry Joints').

Four sub-processes were identified and an Ishikawa diagram was created for each process. From this, an action plan was created for the team to investigate the causes, from most likely to least possible causes. Items were ranked in order for this to be carried out.

Measure



Core build Tube SPC



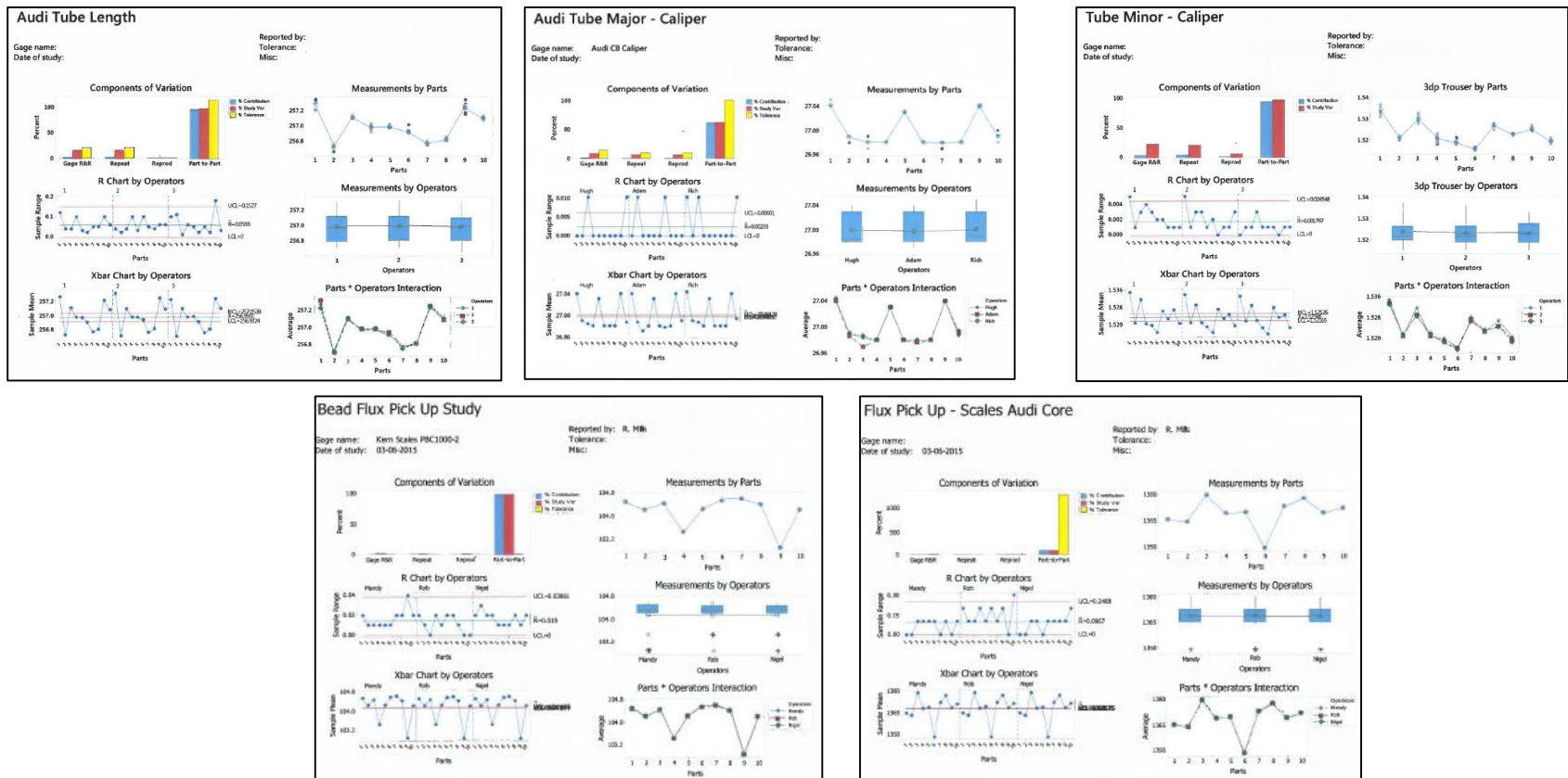
As identified on the core build Fishbone diagram, tube dimensions can have a significant impact on the 'dry joint' failure mode.

SPC Analysis from data collated by operator regular (per shift) dimensional checks provide an image of the tube performance over the past 4 months.

This data will be analysed at the next stage of the project.

MSA study on measurement equipment

Gauge R&R studies have been conducted on measurement equipment to ensure that the measurement of components are accurate, as inaccurate measurement data is useless for controlling processes. These gauges are also calibrated on a yearly basis, or as recommended.



Other measurements identified



From the Ishikawa diagram, other measurements identified were:

Core Build

- Tube plate plunge
- Bead Flux density
- Flare

Fluxing process

- Flux density
- Blower settings
- Flux pick-up
- Over Head spray

Braze process

- Temperature
- Time
- Belt Speed
- Braze pattern



Image of Braze pattern 'measles'

For the most part, these data are collected frequently and are readily available on QMS documentation. Despite this, the documentation is only paper-based and an improvement activity could be made to digitise this data.