Thula EV Gameviewer Industrialisation Project

2024

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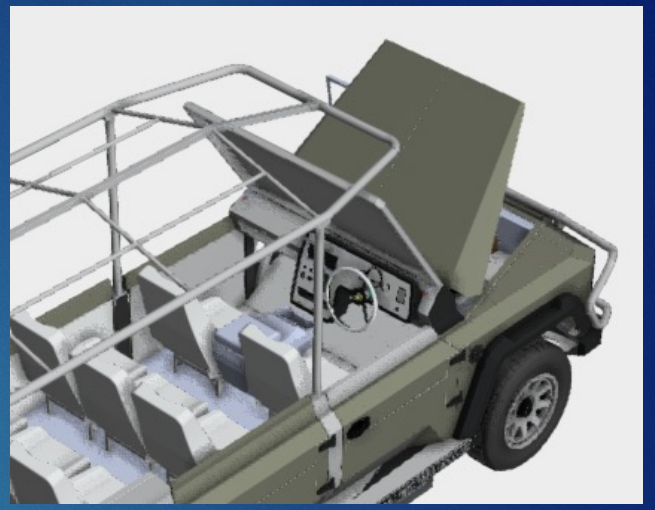
Project Introduction

- AIH were contracted to industrialise the Thula EV gameviewer.
- This required to take the project from concept demonstrator model through to a ready for production state.
- Prototype vehicle to be built and all data requirements would be captured during this build.
- Industrialisation documentation designed and generated
- Jigs and fixtures developed
- Facility, tools and equipment identified
- QC Inspection and testing
- Supplier sourcing support

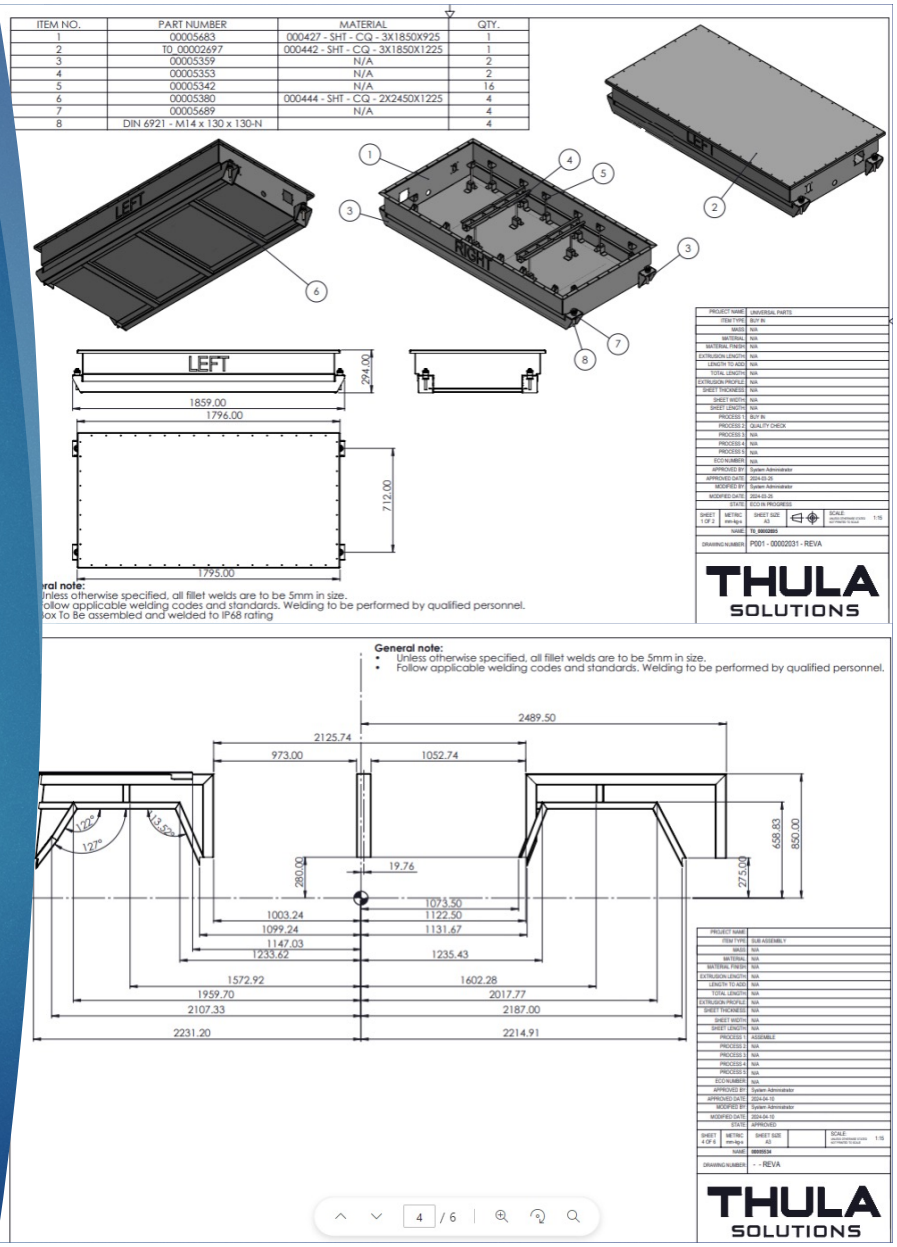
Product status

- Plan (Client responsibilities)
  - Prototype design due for completion February 2024
  - Prototype due for completion March 2024
  - Product baseline to be completed Mid April 2024
- Actual
  - Concept design done in time but detail design and modifications took much longer.
  - Prototype build therefore lagged and slowed down industrialisation work
  - AIH increased project content and added a PM to control the design and prototype build.
  - Prototype completion date is now set for September 17th.



Industrialisation requirements

- Product baseline assessment
  - Drawings of all components
    - Product specific items
    - Buy out items
    - Commercial off the shelf items
  - Drawings of welded assemblies
  - Details of current suppliers for each component
  - Product bill of material
- Prototype build
  - Prototype materials procurement – Thula
  - Prototype production plan - AIH/Thula
  - Design changes from Current vehicle - AIH/Thula
  - Prototype Build – Thula
  - Prototype build data collection - AIH

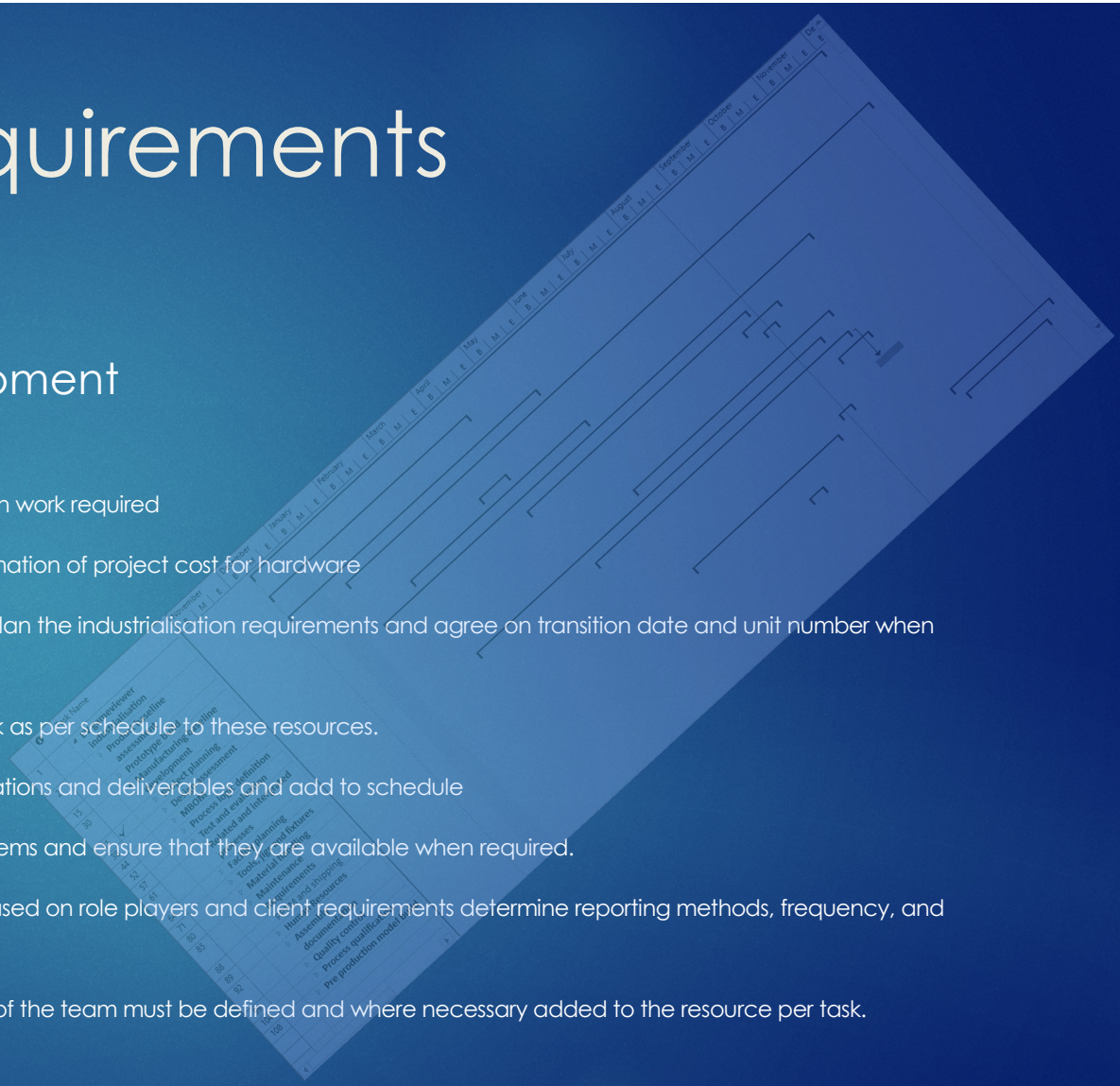


Industrialisation requirements

- Manufacturing baseline development
  - Project planning
  - Design assessment
  - Manufacturing Bill of Materials
  - Process logic definition
  - Test and evaluation
  - Related and integrated processes
  - Facility planning
  - Tools, jigs and fixtures
  - Material handling
  - Maintenance requirements
  - PPPM and shipping
  - Human resources
  - Assembly documentation
  - Quality control
  - Process qualification

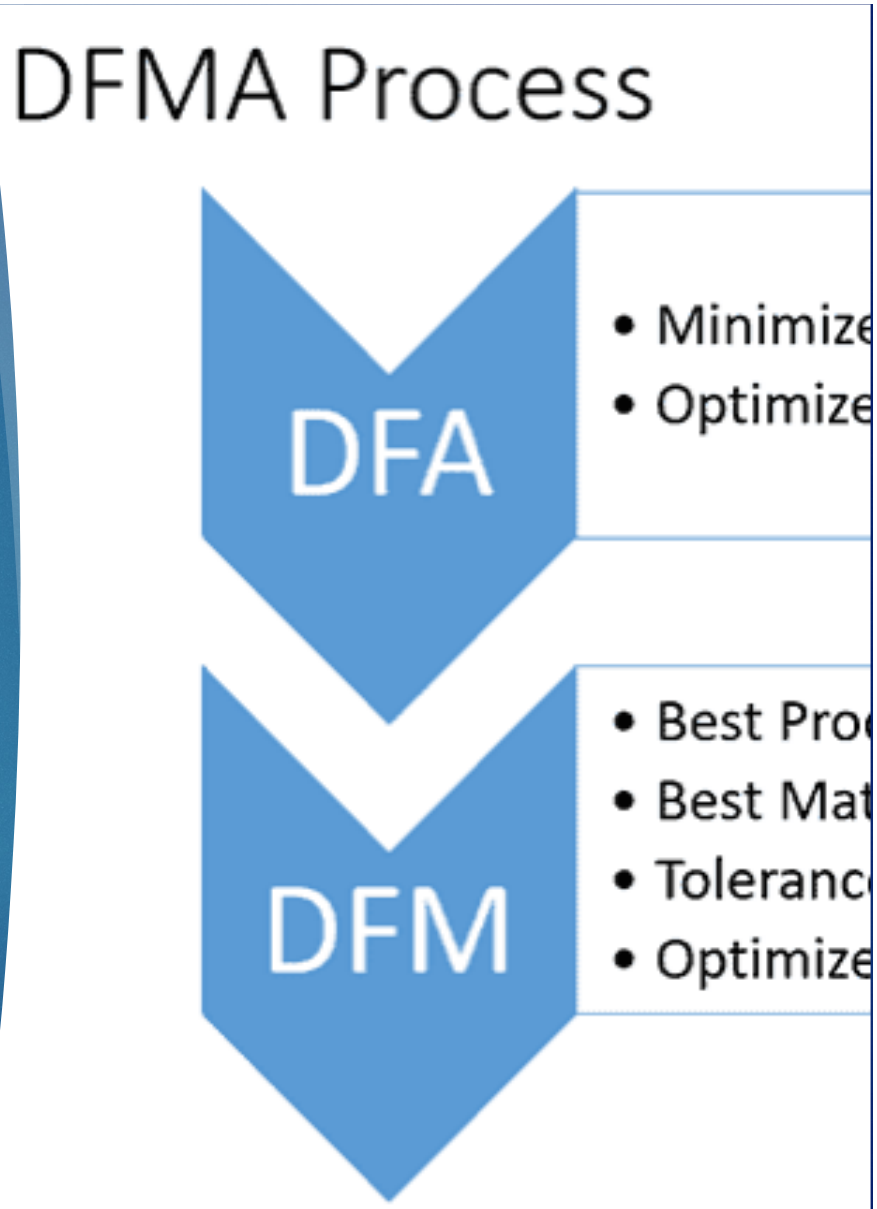
Industrialisation requirements

- Manufacturing baseline development
  - Project planning
    - Schedule - to be drawn up and monitored based on work required
    - Cost/Budget - Cost budget to be drawn up for estimation of project cost for hardware
    - Transition Planning (Industrialisation - Production) - plan the industrialisation requirements and agree on transition date and unit number when production can begin.
    - Team ID - identify the role players and allocate work as per schedule to these resources.
    - Contractual Obligations - discuss contractual obligations and deliverables and add to schedule
    - CFE (Jigs, tools, and equipment) - identify the CFE items and ensure that they are available when required.
    - Define Reporting methods and communication - Based on role players and client requirements determine reporting methods, frequency, and communication channels.
    - Roles and Responsibilities - roles and responsibilities of the team must be defined and where necessary added to the resource per task.



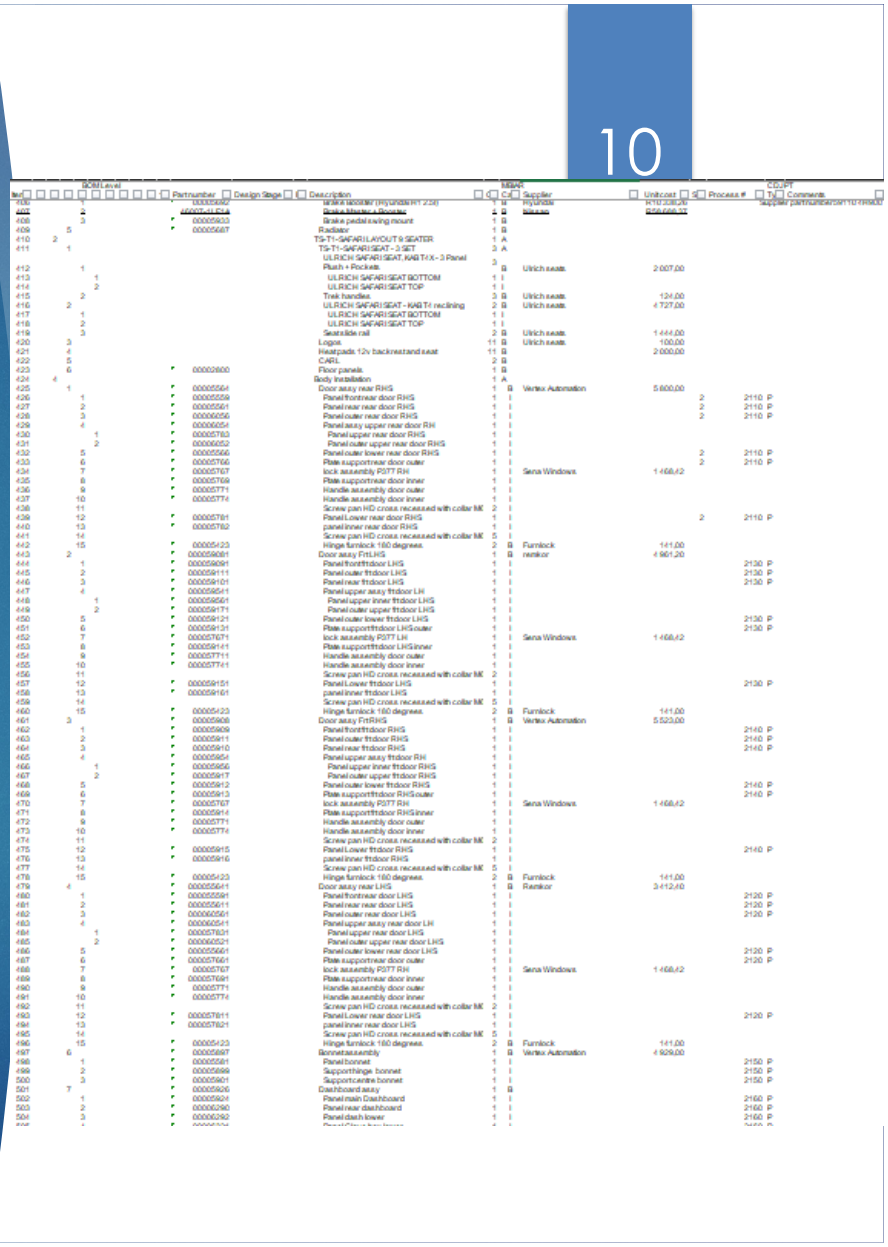
Industrialisation requirements

- Manufacturing baseline development
  - Design assessment
    - Design for manufacture exercise needs to be carried out on all parts and sub-assemblies. Note this is not to re-design the product but rather address issues that will assist manufacturing. The concept of the design will remain intact.
    - Design for Assembly needs to be carried out on all assemblies and installations.
    - Check for commonality of components
    - Check for standard off the shelf components in place of designed items
    - Carry out light weighting and cost saving design exercise.



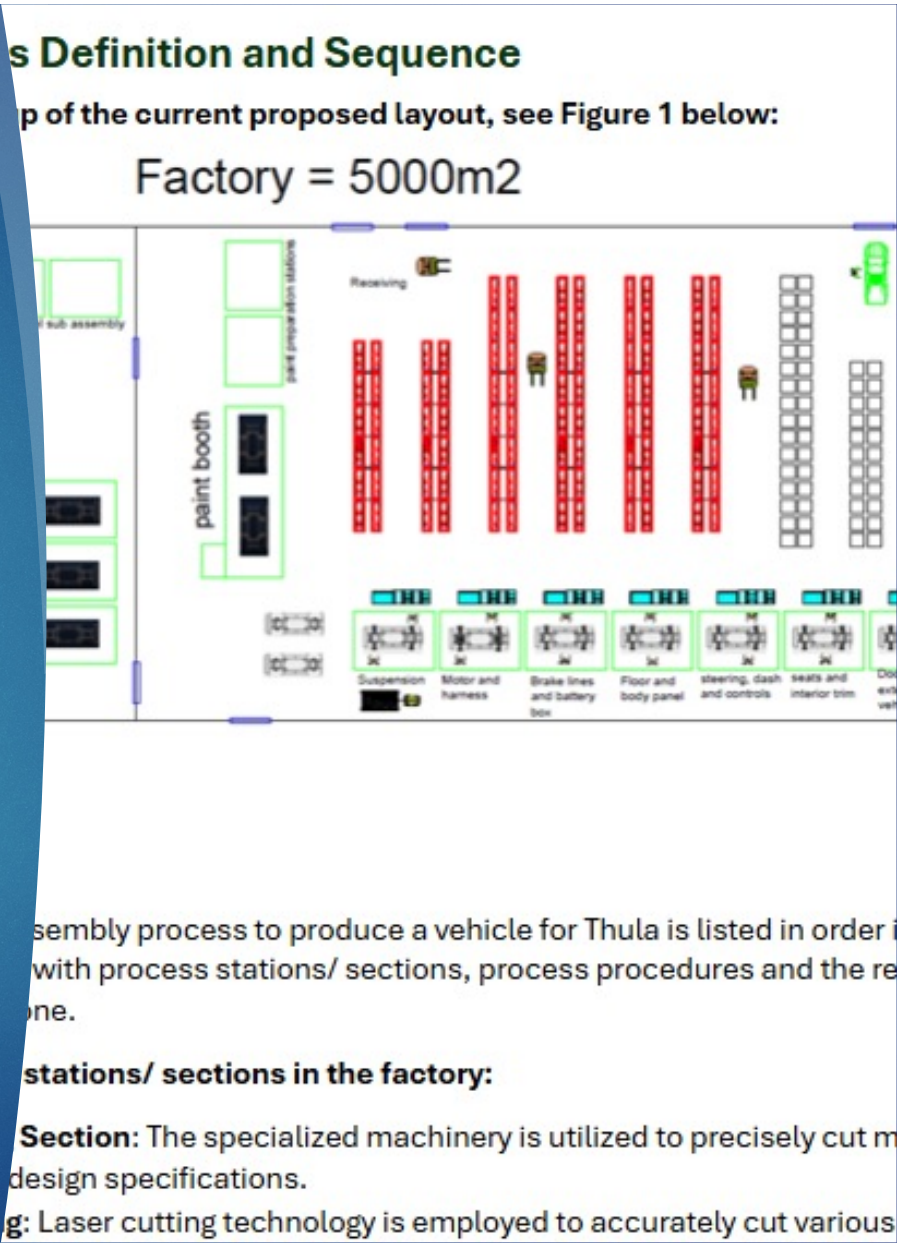
Industrialisation requirements

- Manufacturing baseline development
  - Manufacturing BOM
    - Procurement Levels - The procurement levels must be set upon completion of industrialisation. These could be changed during development and industrialisation phase but should be finalised prior to production start
    - Routings/Deliver to Operations - All routings must be added to the BOM so that correct works orders are loaded to ensure all the process steps are completed.
    - CFE - ensure that all CFE items are identified as such on the BOM
    - Consumables - a list of consumables must be identified on the BOM separate from the product BOM
    - Jigs& Fixtures - The Jigs and fixtures required must be identified up front as best as possible. More can be added as the industrialisation continues. The list must be added to the manufacturing BOM.
    - Tools & equipment - As tools and equipment are identified they must be added to the Manufacturing BOM.
    - Transport stands and stillages – the list of stands and stillages must be added to the manufacturing BOM
    - PPPM – The preparation, packaging, preservation and marking of all products must be added to the manufacturing BOM.



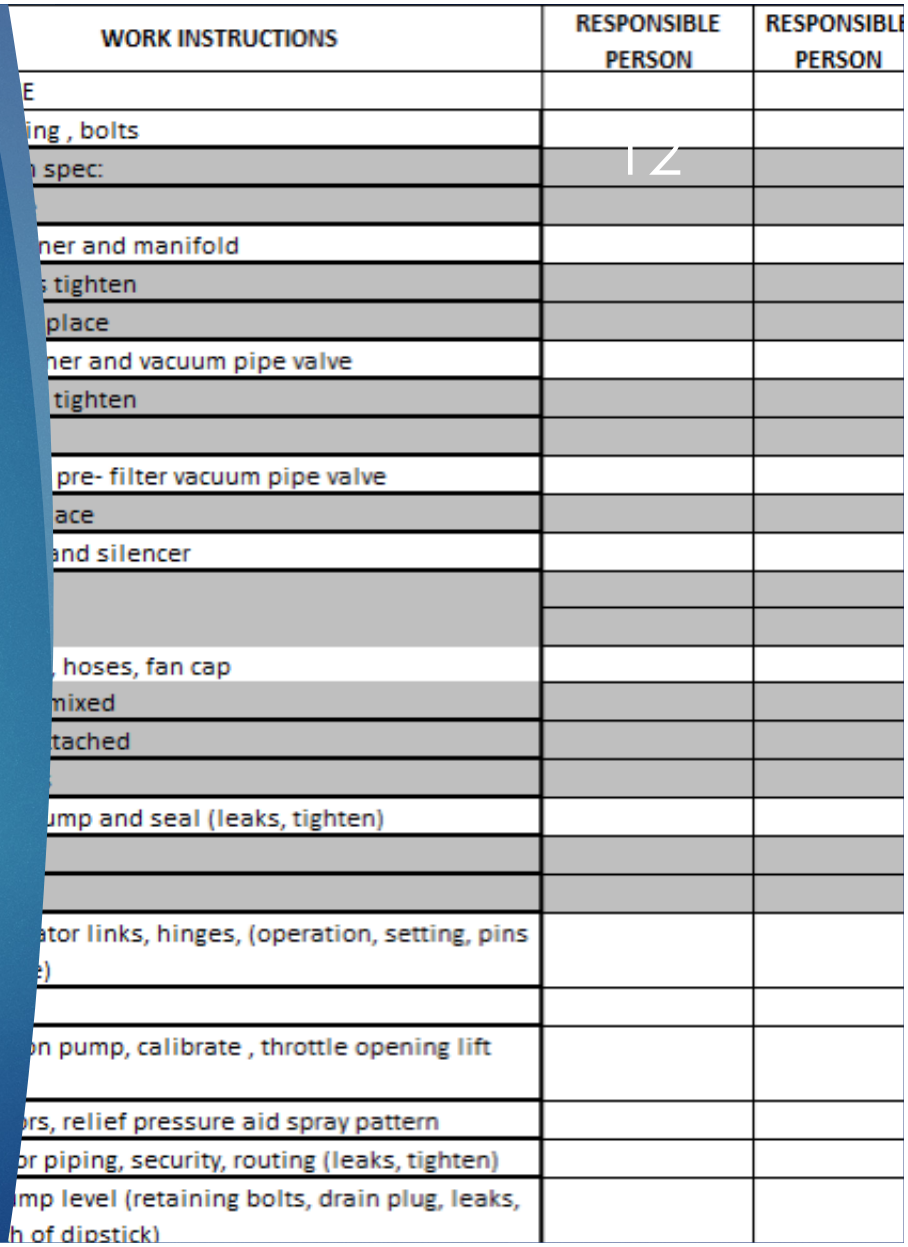
Industrialisation requirements

- Manufacturing baseline development
  - Process logic definition
    - Product Definition - Use the product definition to ensure what is required.
    - Process Boundaries - determine all the boundaries such as space, equipment, personnel skills.
    - Process definition and sequence - determine the process to be followed for fabrication and assembly for each manufactured component, sub assembly and on-line assembly. Set the sequence required so that process flow can be optimised.
    - Process Durations - Times per process must be determined and added to the routings in the BOM.



Industrialisation requirements

- Manufacturing baseline development
  - Test and Evaluation
    - ATP's - All acceptance test procedures need to be finalised in conjunction with engineering. Any specific test equipment required must be identified and added to the tools and equipment list in the BOM.
    - In Process Inspections - The QC gates must be identified for component manufacturing as well as sub-assemblies and final assy.
    - Check lists - In process checklists must be generated in line with build process so that accurate records are maintained of the build.



WORK INSTRUCTIONS	RESPONSIBLE PERSON	RESPONSIBLE PERSON
E		
ing , bolts		
spec:		
ner and manifold		
tighten		
place		
ner and vacuum pipe valve		
tighten		
pre- filter vacuum pipe valve		
ace		
and silencer		
hoses, fan cap		
mixed		
tached		
ump and seal (leaks, tighten)		
ator links, hinges, (operation, setting, pins e)		
n pump, calibrate , throttle opening lift		
rs, relief pressure aid spray pattern		
r piping, security, routing (leaks, tighten)		
mp level (retaining bolts, drain plug, leaks, h of dipstick)		

Industrialisation requirements

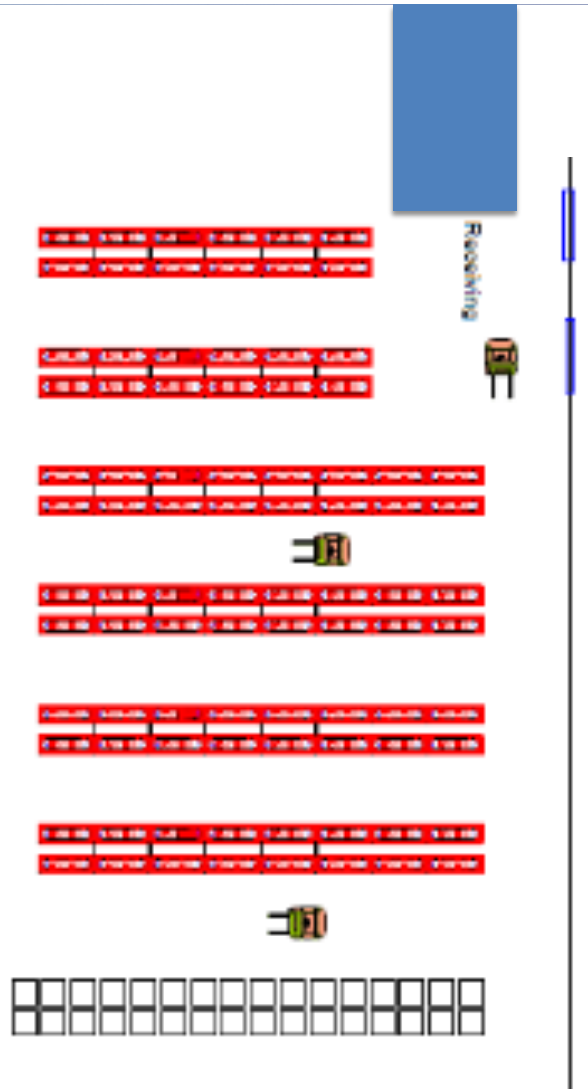
- Manufacturing baseline development
  - Related and integrated processes
    - Identify interacting processes that have impact on the product. Eg paint shop, stores
    - Determine amount of integration the interacting processes have and evaluate for changes required to suit product requirements
  - Facility Planning
    - Existing Facility Evaluation (Contract assembler) - if existing facilities are in place these must be evaluated to determine capability and capacity taking other business into account.
    - Facility Layout for Process - The layout required for the best process flow is to be determined based on space, functions, and equipment
    - Facility Systems (Reticulation, Personnel Facilities etc. - To determine the facility changes all details such as personnel, reticulation, material flow etc. are to be investigated.
    - SHE - all safety and health issues with regards to facilities and equipment are to be considered to ensure that the Act is adhered to. Any training required in this regard must also be done.
    - Storage - Storage type and space must be decided upon throughout the process including stores, paintshop, manufacturing, assembly, inspection, and customer sign off.
    - QCA Area - An area for non-conforming parts must be allocated at each process area.

Industrialisation requirements

- Manufacturing baseline development
  - Tools, Jigs and Fixtures
    - Special Tools - all special tools required for the manufacture and assembly must be designed, manufactured/purchased, and then listed on the MBOM.
    - Standard Tools - All standard COTS tools required must be identified and supplied to the relevant manufacturing and assembly process areas. These must be added to the MBOM
    - Jigs and/or fixtures - All jigs and fixtures required for the manufacture and assembly must be designed, manufactured/purchased and then listed on the MBOM.
    - Human - Machine interface (Ergonomics) - The ergonomics and health and safety on the jigs and equipment that must be designed must be taken into account and signed off as suitable.
    - Automation /Power tool - Based on quantities to be made, automation requirements or power tool usage must be investigated.
    - Test & Evaluation Equipment - All equipment either COTS or special purpose design that are required for testing and sign off of the product must be identified, manufactured/purchased and added to the MBOM.
    - Measuring Equipment - Any specific measuring equipment required to enable sign off must be identified and purchased
    - Manufacturing Equipment - Any specific manufacturing equipment required such as templates, machine tools etc. are to be identified and purchased.

Industrialisation requirements

- Manufacturing baseline development
  - Material Handling
    - Type of materials being moved (parts and product) - All materials that require handling that is not just by hand must be identified. Eg heavy parts, parts requiring special storage etc.
    - Distance being moved - The amount of movement each part must do must be minimised as well as the distance kept as short as possible. This becomes more critical when assy quantities are larger. On low quantities or short production runs the material controls will play a bigger part. The material controls must always be addressed when determining location.
    - Movement external/after process - once the unit has been assembled the type of movement required will determine the requirement for transport fixtures. This must address both the components/sub-assemblies from the suppliers as well as the completed product to the client.
    - Material handling equipment - based on decisions above the type of material handling equipment required will be determined.



Industrialisation requirements

- Manufacturing baseline development
  - Maintenance Requirements
    - Identify Maintenance requirements on equipment - For all new and existing equipment that is required to manufacture or assembly the product, maintenance requirements must be identified, and preventative maintenance schedules must be put in place. Spares must be identified, and repair instructions were required must be drawn up.
    - Calibration - any specific measuring equipment or control jig required for this product must be calibrated and listed on the calibration register to ensure that it remains accurate.
  - PPPM and Shipping
    - Define all PPPM requirements – This is required to determine the state of shipping of each component and completed product and what needs to be done at PDI. Are there any preservatives or corrosion resistant materials added that need to be removed.

Industrialisation requirements

- Manufacturing baseline development
  - Human Resources
    - Define Resources/Skill set - based on all the tasks required to manufacture, assemble, and test the product. The specific skill requirement and type of personnel must be identified and compared to any existing available resource.
    - QTY needed - The qty of personnel required per operation must be calculated from the process durations and routings and the qty to be built per month.
    - Training - Any lack of skill in the personnel identified for this job should be addressed by training. Training must also be supplied on all the processes from manufacturing, assembly and testing. The process instructions and ATP's should be used for this purpose.

Industrialisation requirements

- Manufacturing baseline development
  - Documents
    - Operational:
      - Assembly/Manufacturing Instructions - all instructions required to manufacture or assemble the product must be documented with the following details. Sequence, parts required, tools required, consumables required, special instructions, photos or drawings of the specific operation. These should be generated as separate instructions per operation and not an assembly book. This makes it easier to update and issue as well as switch to different assembly bays to assist with process time levelling.
      - Test Instructions - Acceptance Test procedures are to be written for all test requirements highlighting the test equipment required, test sequence, test parameters and value limits as well as what must be recorded during the test to generate the Acceptance test report.
      - Manufacturing BOM – The manufacturing BOM should include, Product BOM, Process sheets, tools and equipment, jigs and fixtures, consumables, quality documentation
    - Programme/Information Management:
      - QCP – a Quality control plan needs to be generated that covers the quality requirements as well as all business quality processes that impact production.
      - Industrialisation Plan - This plan is generated from this SOW and must identify what will be done and how.
      - Risk Management Plan - From all of the above the main risks to success should be identified and then special focus should be put on these items in the schedule and plan identifying resources to tackle this risk and a more controlled action plan for them.

THULA SOLUTIONS

ASSEMBLY PROCESS SHEET

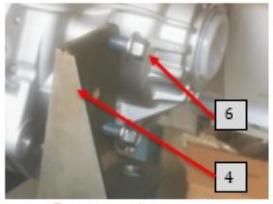
Assy Seq. No.	4040
Part Number	00002917
Revision No.	

Product: Electric game viewer

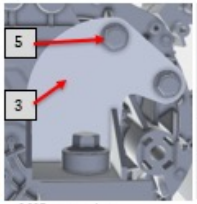
Assembly Description: Motor installation

Description of process:

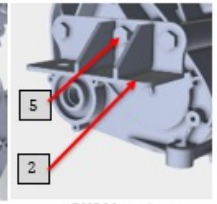
Attach the motor sling to item 1, the motor.
Without the mounting brackets (Item 2,3 and 4) attached to the motor, lower the motor into the designated area with the hoist. Lowering of the motor should be done slowly and with caution. Once the motor has been lowered below the top crossmembers on the chassis, fix the 3 mounting brackets to the motor with item 5 and 6 before finally lowering the motor into position.



Front mounting



LHS mounting



RHS Mounting

Torque the bolts to 130Nm

Tools and equipment required:

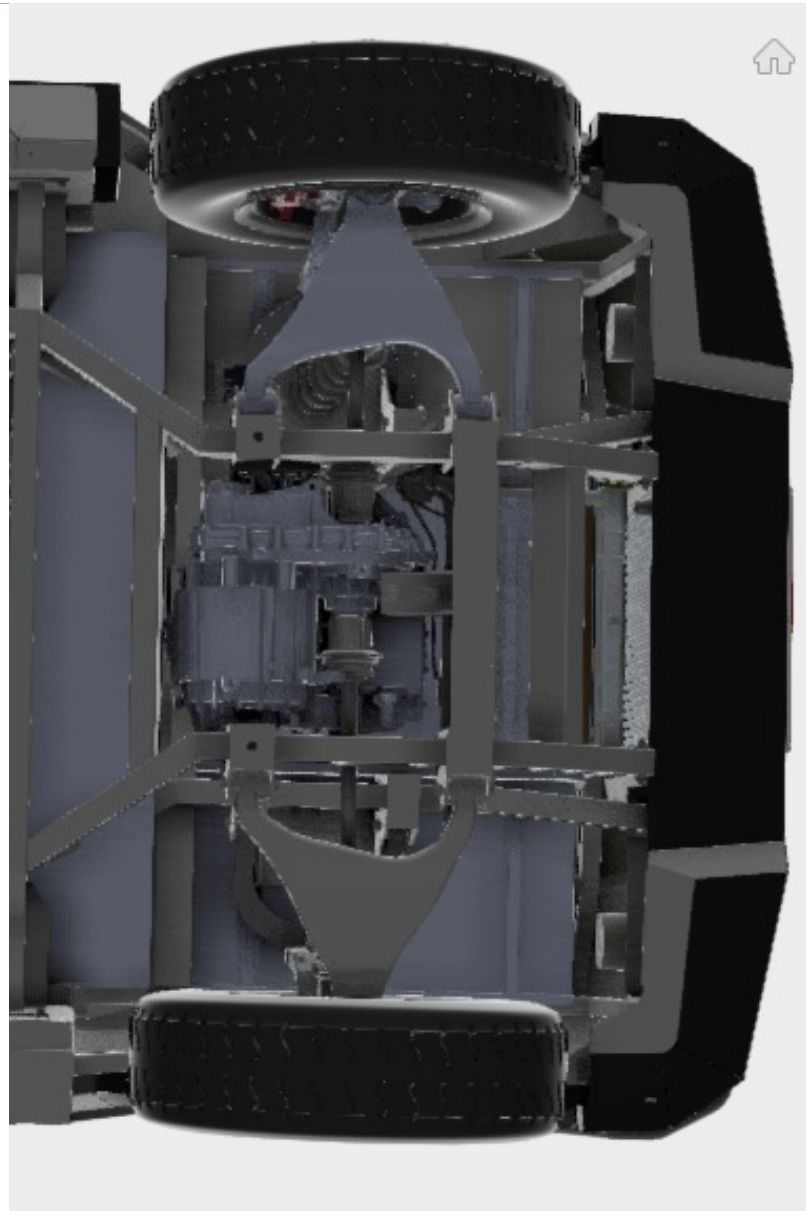
250kg hoist	|	24mm spanner
Motor sling	|	Torque Wrench 30 - 280Nm
18mm socket	|	Torque Wrench 40 - 420Nm
24mm socket	|	

Industrialisation requirements

- Manufacturing baseline development
  - Quality Control
    - ATR's – Acceptance test reports are the outcome of the ATP and need to be generated and saved per vehicle.
    - Build History Dossier – This is the vehicle travel card that identifies the build of each vehicle and records all component serial numbers, QC inspections and checks, ATR's, material certificates and final sign off.
    - Traceability – Any special materials used require that the material certificate and batch control need to be addressed and the system for the traceability of what batch was used for what vehicles must be developed.
    - Control of non-conforming product (Concessions, Deviations)

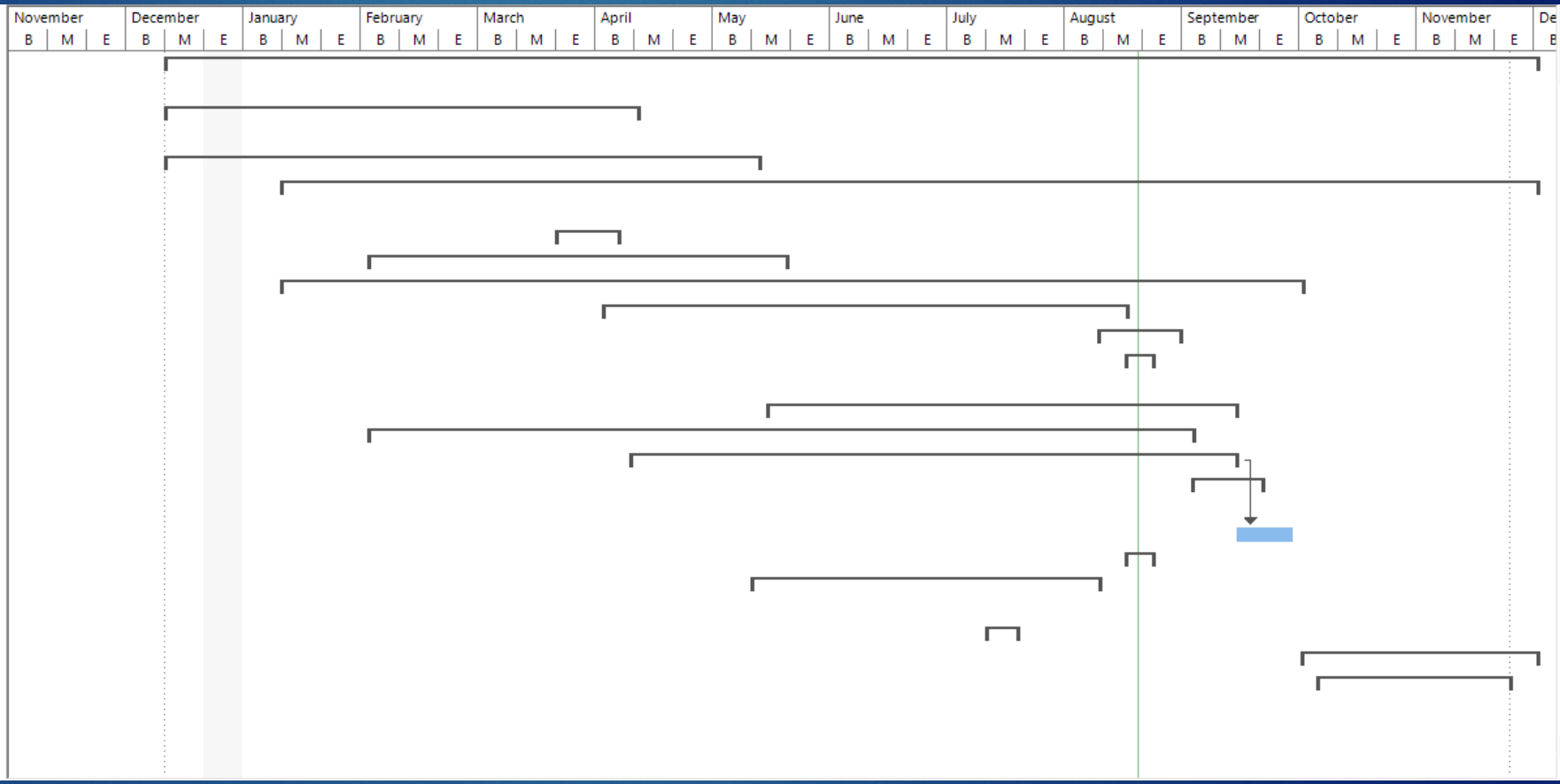
Industrialisation requirements

- Manufacturing baseline development
  - Process Qualification
    - Pre PRR - The pre PRR is used as a theoretical exercise to establish if all is in place prior to building the PPM's and carrying out the PRR.
    - PRR - The production Readiness review must be carried out during the PPM phase to establish if the industrialisation was successful or to highlight where additional effort needs to be put in place to address the shortcomings.
    - PPM's - These are to be built under control circumstances utilising all the equipment, jigs, processes and documentation identified to check and qualify each of them.
    - Rate PRR - This is carried out during production to ascertain if the equipment, resources, process flow, storage etc. is suitable for the production rate required.



Industrialisation Schedule

		Task Name
1		EV gameviewer industrialisation
2		Product baseline assessment
15		Prototype build
30		Manufacturing baseline development
31	✓	Project planning
38		Design assessment
44		MBOM
52		Process logic definition
57		Test and evaluation
61		Related and intergrated processes
64		Facility planning
71		Tools, jigs and fixtures
80		Material handling
85		Maintenance Requirements
88		PPPM and shipping
89		Human Resources
92		Assembly documentation
99		Quality control
104		Process qualification
108		Pre production model build



Future options for AIH Group

CONTRACT ASSEMBLY

SUB ASSEMBLY MANUFACTURING