

1451789

by Joshua Williams

Submission date: 17-May-2024 10:20AM (UTC+0100)

Submission ID: 234085616

File name: 17594_Joshua_Williams_1451789_183295_140822803.pptx (10.4M)

Word count: 280

Character count: 1655

Presentation 2

Load Test Rig for Siemens S120 Servo Drives

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Introduction – Aims & Objectives of the Project

- ▶ To produce a dynamic braking system with a DC machine.
- ▶ To function in conjunction with the Sinamics Test rig.
- ▶ To design and implement this machine in the project timeframe.
- ▶ Track on costings while ensuring the budget is not compromised.
- ▶ Test the new system with the FDS requirements.

FDS – Function of the Machine & Safety Features (Changes)

Item	Objective
A1.1	The loading device must load a motor up to a required load.
A1.2	At different speeds the loading device must adapt withstand the change of speed specification.
A1.3	The load testing system must work in conjunction with the Siemens Sinamics Test rig.
B1.1	The system must have the correct enclosed guarding for moving parts in accordance with the Machine Directive EN60204.
B1.2	Machine must have the correct interlocking device(s) in accordance with ISO 14119.
B1.3	The machine must have safe isolation of the test rig and loading system.
B1.4	Any fault condition will be displayed on the local control panel (beacon or pilot light flashing 0.5Hz).
B1.5	Prevention in place to stop overheating and overload of the loading system.

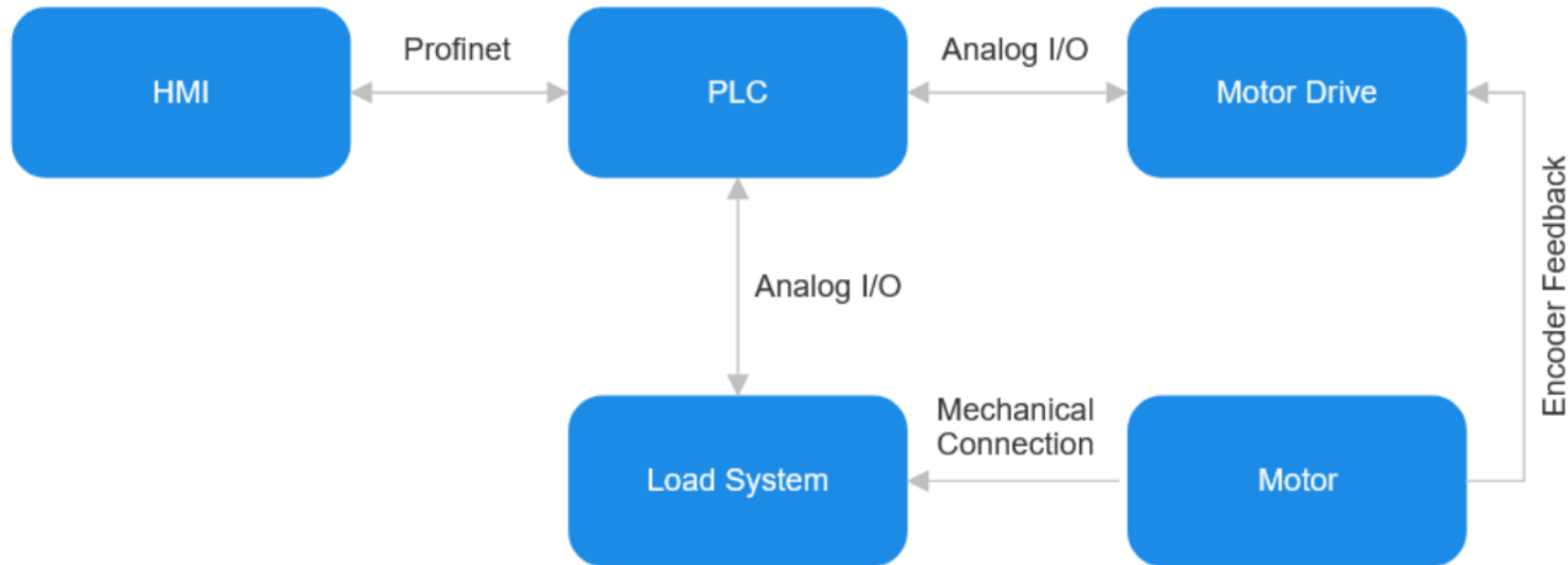
FDS – Display Data Operation (Changes)

C1.1	Performance data displayed of the drive under the load test must be monitored. Parameters required: Speed, Current and Torque.
C1.2	Display data Push button(s) to engage drive control.
C1.3	Different motor speeds must be selected (Now operable from the Sinamics Test rig).
C1.4	Machine must only be operable from the location of the HMI and Control panel.

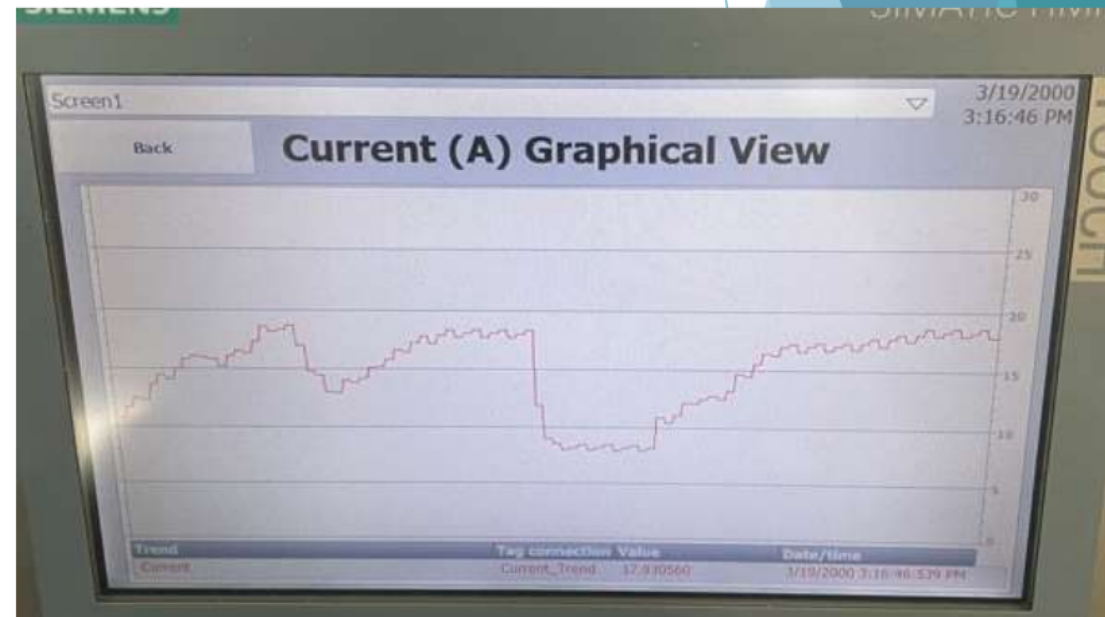
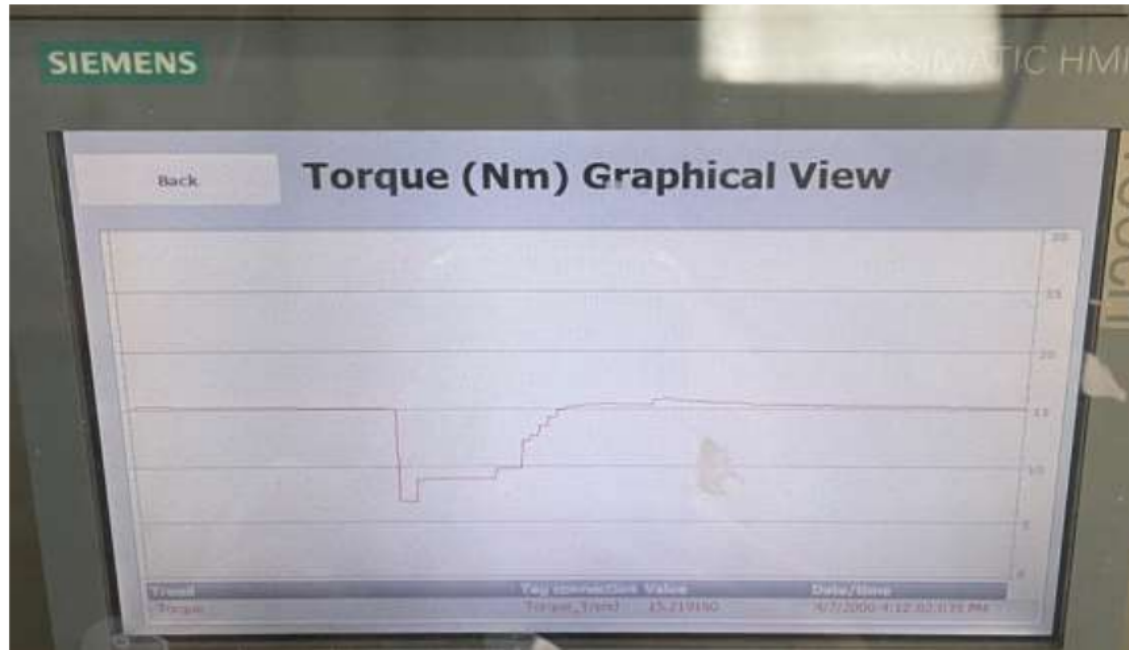
FDS – Performance Requirements (Changes)

D1.1	A display message showing that all safety device contacts are closed.
D1.2	Upon selection of any engagement of moving components, a second display will appear with a message to make sure the intended operation is correct.
D1.3	A display to inform operator of any faults with any part of the communication system. (This is no longer applicable).
E1.1	System should be capable of applying load conditions in a timescale that is accurate amount for testing.
E1.2	The loading system should have required amount of torque that is suitable for the motor that is connected to the drive. The testing range should be: 5.0Nm – 15.5Nm
E1.3	The loading system should be able to achieve the speed testing range of 500rpm – 3000rpm.
E1.4	The loading system should be required to test the following current range: 4.0A – 18A (motor rating values).
E1.5	The loading system will be capable of testing the power range of 2.1kW to 8.2kW.

Solution Design to meet the requirements of the FDS



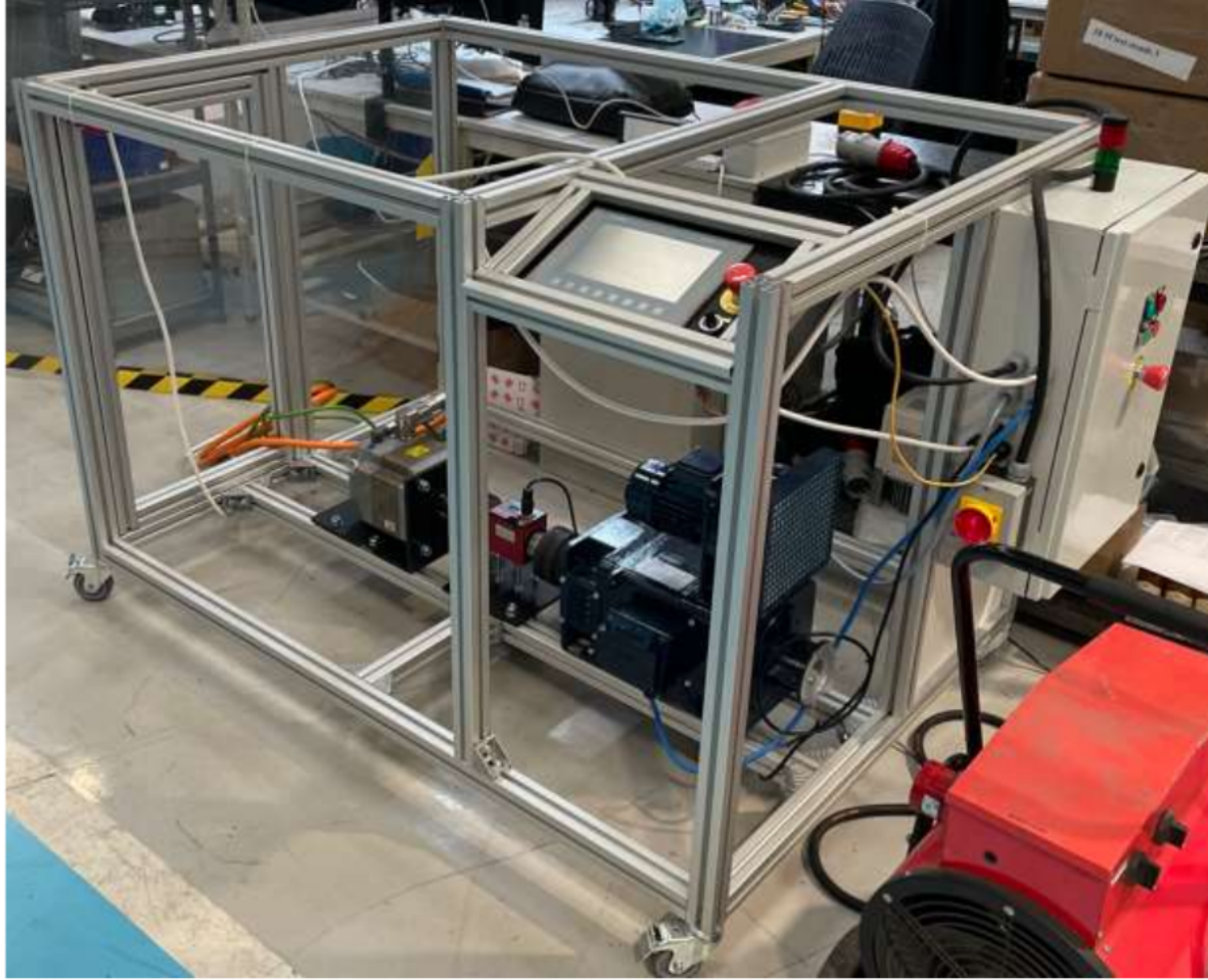
Solution Design to meet the requirements of the FDS



Solution Design to meet the requirements of the FDS



Construction Phase of Solution



Test of Solution and Analysis

Section	Test Number	Reference	Test Description	Expected Result	Actual Outcome	Pass/Fail	Evidence (Appendix 9.8)
A. Function of the machine.							
	1	A1.1	Verify the loading device can load a motor up to the required load.	Meets the required load specification. The range of 5.0Nm – 15.5Nm.	Tested to the load ranges of 5.0Nm – 15.5Nm.	Pass	Figure 54 and Figure 55.
	2	A1.2	Ensure the loading system adapts to different speeds during the test.	The loading system adapts to the speed changes.	Many cycles of the loading system at different speed intervals.	Pass	No 2 test.

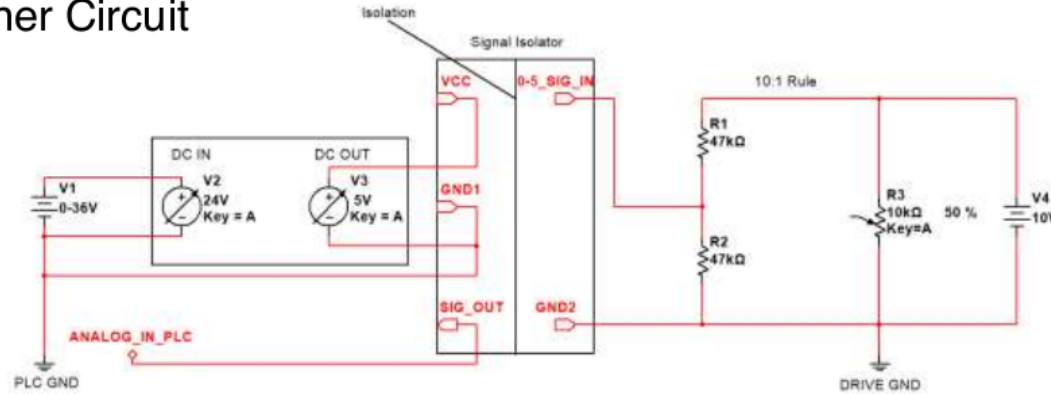
C. Display Data Operation							
	9	C1.1	Performance data displayed of the drive under the load test: - Current (A). - Torque (Nm). - Speed (RPM).	Performance parameters are displayed.	This is displayed on the DC drive control screen.	Pass	Figure 57.
	10	C1.2	Engage drive control.	Push button engages drive control.	Push button on HMI and the starter software control panel start each drive.	Pass	Figure 58.
	11	C1.3	Confirm the selection of different motor speeds.	Different motor speeds can be selected.	Motor speeds can be selected on the Siemens Starter Software.	Pass	Figure 60 and Figure 61.

B. Safety Features.							
	4	B1.1	Verify enclosed guarding for moving parts.	Guarding effectively protects moving parts.	The safety interlock for door is in place but no surround to guard the moving parts/	Fail	N/A
	5	B1.2	Ensure the system has the correct interlocking device(s) per ISO 14119.	Interlocking devices work correctly and conform with the regulation.	Could not meet this specification.	Fail	N/A
	6	B1.3	Safe isolation of the test rig and loading system.	Safe isolation is confirmed.	This could not be achieved due to the change in design.	Fail	N/A

E. Performance Requirements							
	16	E1.1	Confirm the system's ability to apply load conditions within an accurate timescale.	Load conditions are applied accurately in the specified timescale.	The time is displayed on the right-hand side of the trend graphs.	Pass	Figure 64.
	17	E1.2	Loading system should have the required amount of torque that is suitable for the motor that is connected to the drive.	Torque is suitable for the motor.	The motor was calculated to the motor ratings. It achieves the specified torque amount.	Pass	No. 17 Test.
	18	E1.3	The loading system should be able to achieve the speed testing range of 500rpm – 3000rpm.	The loading system confirms the required range of RPM.	Each of the speeds can be selected on the siemens starter software.	Pass	Figure 65 and Figure 66.
	19	E1.4	The current range of 5.0A – 18A (motor rating values) can be achieved.	The system can safely load to the following current range.	It was tested on an 18A module and handled the current range.	Pass	Figure 67 and Figure 68.
	20	E1.5	The power range of 2.1kW to 8.2kW can be tested.	The loading system can handle the power range.	It was tested on an 8.2kW motor and achieved outcomes.	Pass	No. 20 Test.

Test of Solution and Analysis

Signal Conditioner Circuit



Ideal Field Voltage for the required torque

Speed (RPM)	Field Voltage (V)	Armature Current (A)	Armature Voltage (V)	Torque (Nm)
250	124V	0.8	13.3	1.26
500	124V	1.9	26.5	2
750	124V	4.3	51.6	4
1000	124V	5.8	69.1	5.2
1250	124V	7.4	86.5	6.3
1500	124V	8.9	104.1	7.5
1750	124V	9.4	121.4	8.9
2000	124V	11.1	137.2	10.1
2250	124V	12.6	153.6	11.5
2500	124V	13.9	170.8	12.8
2750	124V	14.8	188.9	14.2
3000	124V	16.4	203.9	15.5

Evaluation of the Project Outcomes

- ▶ TB30 option module was chosen instead of the Profibus communication.
- ▶ Machine should only be operable from HMI and control panel (C1.4).
- ▶ The use of Field Control instead of conventional DC Drive Operation.
- ▶ Enclosed guarding for moving parts in accordance with the Machine Directive EN60204 (B1.1).
- ▶ **Constraints** - Ethical Engineering, Legal/Commercial, Environmental & Sustainability

Project Name: Load Rig for Servo Drives

RUNNING WEIGHTED AVERAGE TOTAL:

£9,808.33

TOTAL COST:

£3,882.29

DETAILS		THREE-POINT COST ESTIMATE SCENARIOS			WEIGHTED AVERAGE	Actual Cost	ADDITIONAL INFORMATION / NOTES
DATE	ITEM / TASK DESCRIPTION	BEST-CASE	MOST LIKELY / REALISTIC	WORST-CASE			
19/01/2024	Siemens 1BA S120 Drive Motor	£1,200.00	£1,750.00	£2,500.00	£1,783.33	£377.02	Sourced from used suppliers
19/01/2024	Siemens 5A S120 Drive Motor	£1,000.00	£1,200.00	£2,000.00	£1,300.00	£0.00	Sourced from used suppliers
19/01/2024	Siemens S7-1200 PLC (CPU1214)	£400.00	£600.00	£800.00	£600.00	£213.29	Sourced from used suppliers.
19/01/2024	Siemens HMI	£300.00	£500.00	£700.00	£500.00	£300.00	Sourced from used suppliers.
19/01/2024	Siemens 6SL3055-0AA0-2TA0 Expansion Card	£250.00	£400.00	£550.00	£400.00	£145.00	Sourced from used suppliers
19/01/2024	Panel with accessories	£800.00	£1,000.00	£1,500.00	£1,050.00	£302.67	Sourced New
19/01/2024	Rexroth Aluminium Profile (KJN992425)	£500.00	£700.00	£900.00	£700.00	£834.82	Sourced New
19/01/2024	Foamex and Clear Acrylic panels	£200.00	£300.00	£400.00	£300.00	£423.29	Sourced New
19/01/2024	DC Motor	£1,200.00	£1,500.00	£2,200.00	£1,566.67	£715.00	Sourced from used suppliers
19/01/2024	DC Drive	£400.00	£550.00	£750.00	£558.33	£90.00	Sourced from used suppliers
19/01/2024	Torque Sensor	£500.00	£750.00	£1,000.00	£750.00	£401.20	Sourced New
19/01/2024	Resistors for Armature						
19/01/2024	Siemens SM1231 Analog Input Module	£200.00	£325.00	£450.00	£300.00	£80.00	Sourced from used suppliers

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Overall Conclusions & Recommendations

Conclusions

- ▶ The presented project successfully achieved the performance requirements.
- ▶ Alternative method for communication with the Sinamics Test Rig and PLC was successfully implemented.
- ▶ The project did not achieve the UKCA marking and safety requirements.

Recommendations

- ▶ To complete actions on the Risk assessment to achieve the relevant safety standards.
- ▶ Develop a design for clear printout of the HMI drive performance parameters for customer.
- ▶ Adapt the Loading system to create a system for various drives and motor models.

FINAL GRADE

GENERAL COMMENTS

75/100

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GRADING FORM: NEW CSG-RUBRIC

JOSHUA WILLIAMS

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1. ENGAGEMENT WITH LITERATURE

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2. KNOWLEDGE AND UNDERSTANDING

 Project design
Slides were very informative and gave good evidence of the design procedure. Good level of technical detail with reference to requirements from FDS.

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All discrepancies from FDS were explained in detail and in good logical order.
Changes to the original design were explained in detail with excellent knowledge of the system requirements.
Excellent Evidence presented. (8/10)

Project implementation

A very structured implementation with good evidence on the slides. Explanation was detailed and significant points highlighted. Discrepancies and problems were explained in detail. An excellent significant point made about the requirement of a signal conditioning cct.
Excellent explanation given. (8/10)

Response to questions

Excellent response to questions with a good level of tech detail included.
Very good (7/10)

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3. COGNITIVE AND INTELLECTUAL

-  Testing and analysis of results
Test results and the level of success compared to FDS requirements have been highlighted. Clear evidence was included showing the torque levels and speed.

Good list and analysis. (7/10)

Critical evaluation of the project outcomes relating to FDS and constraints

Outcomes were compared with original FDS requirements with significant points highlighted.

Good explanation given (7/10)

Conclusions and recommendations

Good conclusion drawing on the relevance to deployment in the industry and versatility of the test rig.

Good explanation given (7/10)

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4. PRACTICAL APPLICATION



Deployment method, use of material, tools, equipment and techniques in the construction of the project.

Project was built methodically from sourcing equipment and materials with relevance to budget constraints. Technical details were explained with reference to the diagrams on the slides.

Excellent explanation given of methods employed. (8/10)

Quality of the final product or system

Final product consisted of the actual panel built to a good standard that included all the components sourced with relevance to the coupling component.

Good quality of product but no safety implemented (6/10)

Management of the design process including use of plans, costing spreadsheet

A detailed Gantt chart identified the management plan and the comparison timeline. A good

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explanation highlighted the issues encountered.
Very good explanation given (8/10)

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5. TRANSFERABLE SKILLS



Quality of the presentation slides
Excellent slides (5/5)
Quality of the delivery style
Very good (4/5)

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9/10