

Presentation 1

by Liesel Williams

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PRIFYSGOL CYMRU
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UNIVERSITY OF WALES
Trinity Saint David

PSDE 6019

Major Project

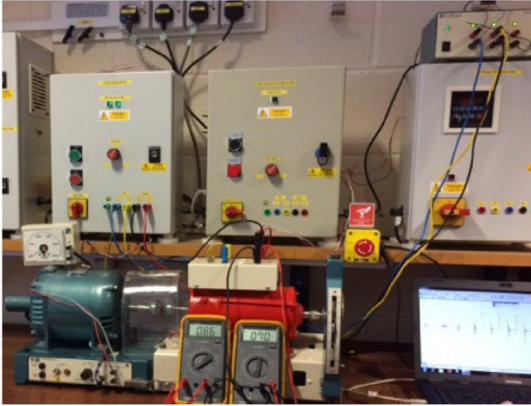
2018-2019

Motor Test Rig

Presentation 1

Liesel Williams

1. Project Background, problem definition and constraints



BACKGROUND

- Outdated Feedback Equipment
- Wiring and Coupling for each m/c
- Rooms/Time
- Safety

DEFINING THE PROBLEM

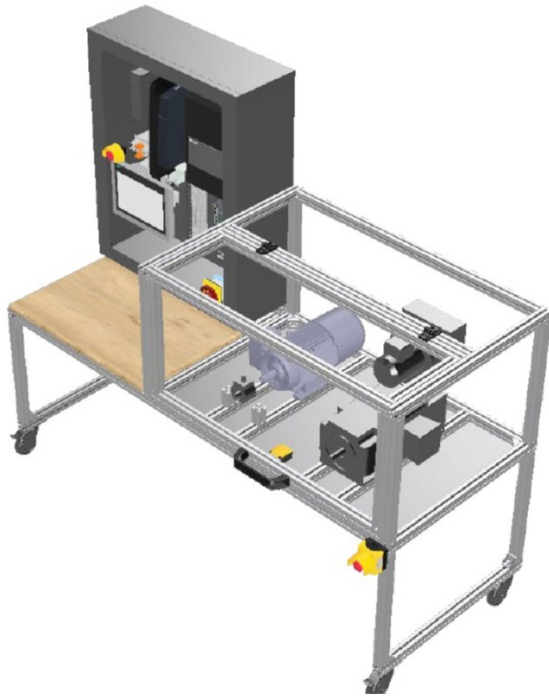
- Safe teaching aid needed, bespoke design meets educational needs of CSG
- No test rig of this nature exists on the current market to solve this need.

CONSTRAINTS

- Supply, physical size, location
- Safety standards IEC61508 and EN ISO 13849

2. Functional Design Specification

- AC induction motor mechanically coupled to a DC motor with dedicated four quadrant drives for each motor, Ethernet links PLC and HMI screen.
- **Demonstration of four quadrant operation**, load simulation and drive parameter selection and system integration.

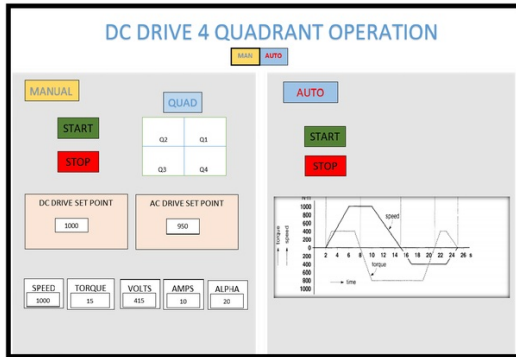


https://oliviadanielle.co/designs_operation_of_electric_brake.php

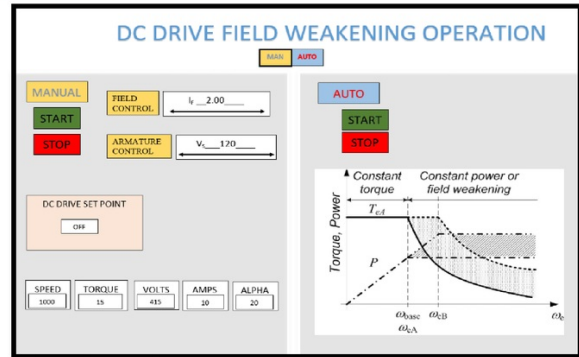


2. Functional Design Specification

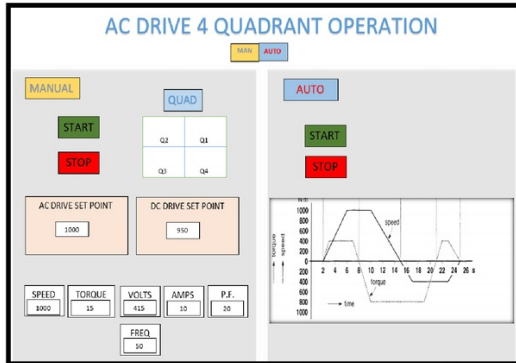
HMI 1



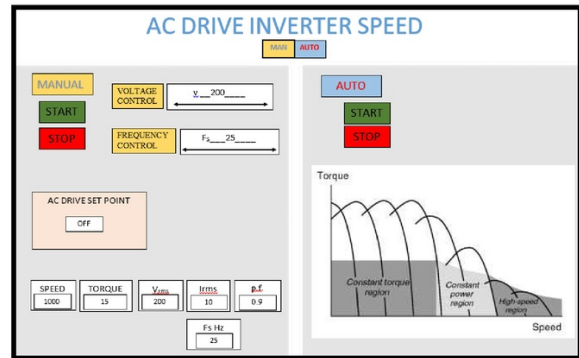
HMI 2



HMI 3



HMI 4



3. Project risks, health and safety

- IEC 61508 (Functional Safety of Electrical/Electronic/Programmable Electronic Safety-Related Systems) defines four SILs; SIL 4 being the most dependable and SIL 1 the least.
- The control panel will be designed and manufactured in accordance with the electrical safety requirements of EN60204-1:1998.

Safety Integrity Level	Safety	Probability of Failure on Demand	Risk Reduction Factor
SIL 4	> 99.99%	0.001% to 0.01%	100,000 to 10,000
SIL 3	99.9% to 99.99%	0.01% to 0.1%	10,000 to 1,000
SIL 2	99% to 99.9%	0.1% to 1%	1,000 to 100
SIL 1	90% to 99%	1% to 10%	100 to 10

<http://www.ryanquiring.com/safety-instrumented-systems-sis/>

4. Test Planning

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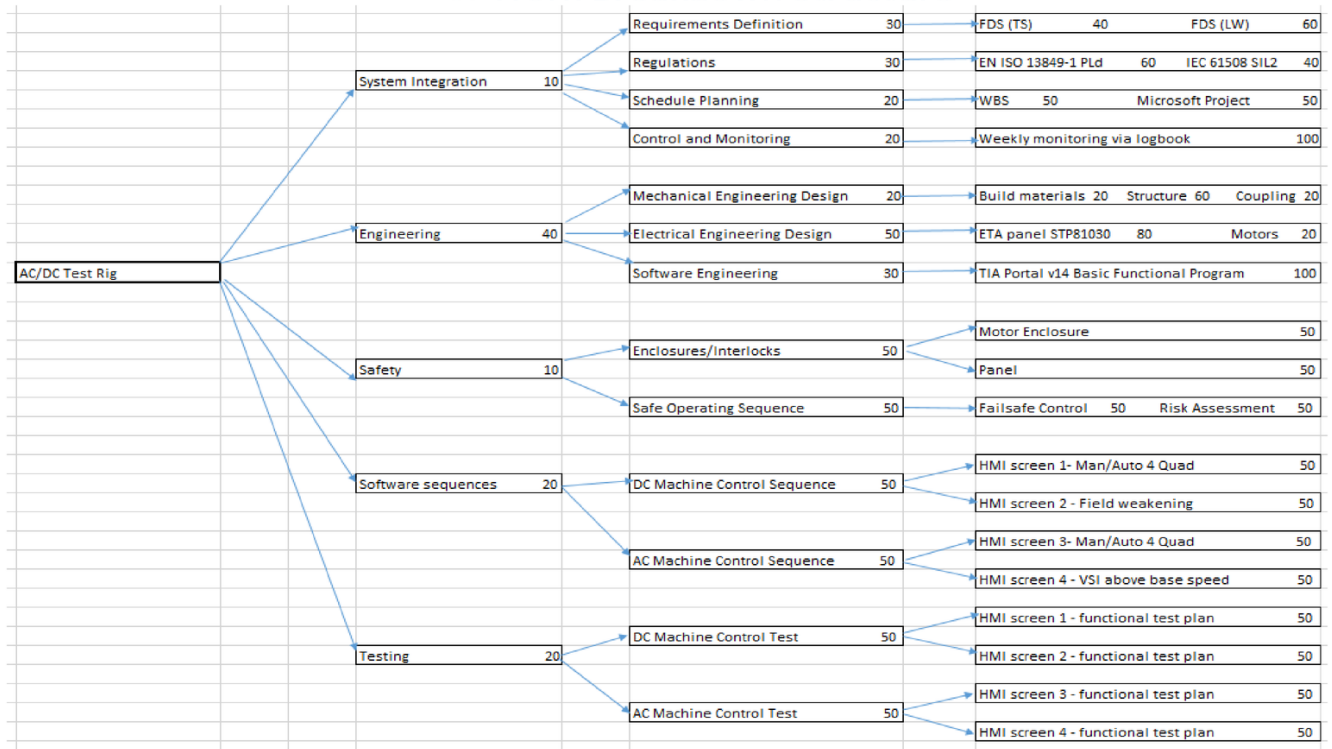
HMI 4 - VFD operation above base speed												
Manual		Auto										
Nom Speed (rpm)	Max Speed (rpm)	Ramp Sequence					Tracer graph (Y/N)	Data Upload				
		Ramp Up	Delay	Ramp Up	Delay	Ramp Down		Vs	Is	N	fs	Tm

5. Three solutions and justification of final solution

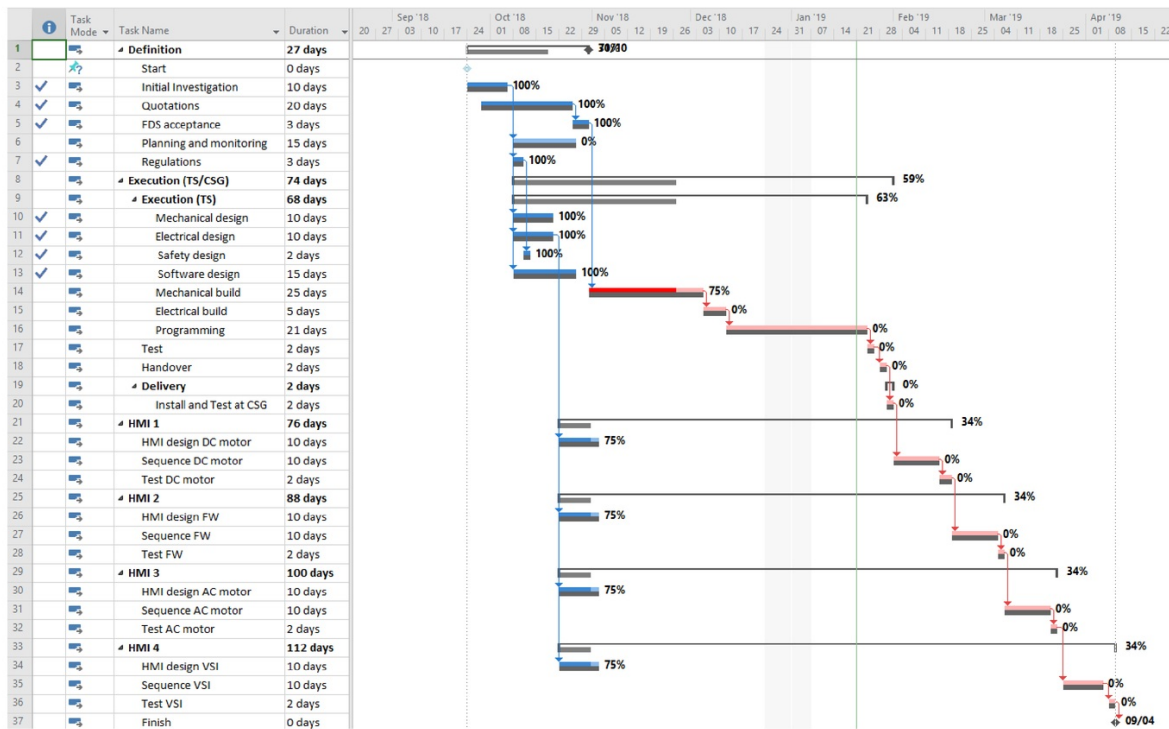
Decision Matrix	Siemens		Rockwell		Parkers	
Overall Cost	Total cost of main parts = £11,496.84 Supplier quotation received for the design, build, test and commissioning = £27,510.00	3	Total cost of main parts = £19,086.03. Including design, build, test and install costs makes overall = £35,099.19	1	Total cost of main parts = £13,265.18. Including design, build, test and install costs makes overall = £29,279.14	2
Connectivity	PROFINET industry standard for data communication over Industrial Ethernet.	3	Provides connection to open networks, including EtherNet/IP™, ControlNet™, and DeviceNet™	2	Discrete and analogue signals between drives and PLC via A I/O and D I/O	1
User Control	Via TIA portal, allowing complete configuration and control of all the devices on the network.	3	Provides ability to develop custom C programs to integrate via external routines	1	TIA portal for programming of Siemens PLC	2
Health and Safety	The Power Module has Safe Torque Off (STO) Failsafe Digital I/O F-DI and F-DO are also available. Options include a safe brake relay. (Siemens, AG 2018)	3	The Logix platform provides a single integrated control architecture for discrete, drives, motion, process, and safety control	3	Parker Drives have STO as a standard feature in accordance with EN 13849-1 (PLe) and EN62061 (SIL3)	2
Software	One software package TIA portal controls all accessories	3	Runs on Windows® 7 and Windows Server 2008 operating systems. Uses the same Studio 5000® environment and Logix control engine as other Logix platforms	1	Siemens PLC software TIA portal	2
Score		15		8		9

3 = High 2 = Med 1 = Low

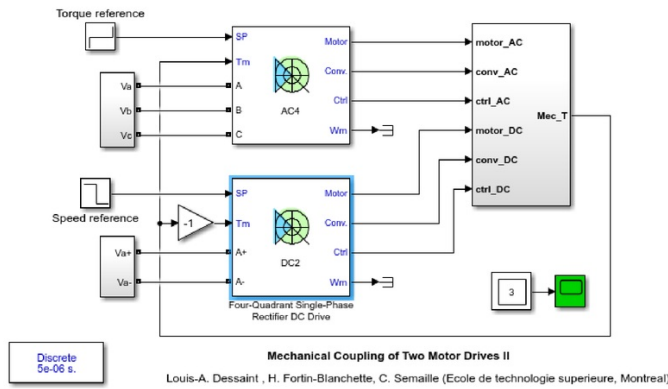
6. Work Breakdown Structure



6. Project Planning



7. Progress made to date



Background research

- Matlab model of two drives mechanically coupled together.
- Graphing results of speed and torque regulation.
- Insight into the types of results possible.

Implementation

- FDS sign off 10/12/18 (phone conversation 30/11/18) bench and panel build underway.
- Delay on DC motor.
- Await status and delivery information.
- Contingency implementation wc 28/01/19 pending assurance from TS of the rig delivery.
- Design of four HMI screens transfer to TIA portal software for simulation.
- Familiarisation with the programming of the PLC is on-going.

Presentation 1

GRADEMARK REPORT

FINAL GRADE

GENERAL COMMENTS

Instructor

77/100

PAGE 1

PAGE 2

PAGE 3

PAGE 4

PAGE 5

PAGE 6

PAGE 7

PAGE 8

PAGE 9

PAGE 10

GRADING FORM: NEW CSG-RUBRIC

LIESEL WILLIAMS

77

1. ENGAGEMENT WITH LITERATURE

-  Project background was determined by an educational need at Coleg Sir Gar. (3/5) Limited research was evident from the presentation in terms of quotations, however research was evident from the content. (3/5) **6**

2. KNOWLEDGE AND UNDERSTANDING

-  Project background: Good explanation given as to the need for such a system for use in education. There exists a requirement for a bespoke training aid to facilitate the teaching of motors, the project is intended to provide that solution. (4/5) Most aspects of H&S were covered including the use of a Plexiglas cabinet to house the moving parts and power supply interlocks. PUWER, risk and electrical safety assessments would be carried out. SIL rating given but no evidence that a SIL assessment has been carried out. Risks explained in relation to the safe torque off, e-stops and guarding. (4.5/5) Clear answers given for each question. However, an opportunity exists that the finished product could have commercial value. It would be a risk not to engage with IP and protect the design. (7.5/10) **16**

3. COGNITIVE AND INTELLECTUAL

-  Clear explanations given of the problem and the reason for the project. Constraints given including safety. It wasn't clear how much of the final product was to be sub-contracted and how this would be **26.5**

controlled. (6.5/10) Detailed FDS with screens that showed the end product. However, a graphic of the final product was a little non-descript. It wasn't clear if this would run several different motors in order for a comparison in performance to be made or if it was for a single motor type. (7.5/10) Very detailed testing table with manual and automatic sections for each screen/mode of operation including a detailed test plan of how the 4 quadrants would perform. (8/10) Very good answers given showing that these issues have been considered. Environmental impact was explained through the use of a programmed hibernation mode and the use of a power reduction technique within PROFINET called PROFIenergy. (4.5/5)

4. PRACTICAL APPLICATION

-  Choice of solution: Well justified for a range of reasons given. Two good alternatives given and a ranking system use to grade the criteria; the highest score being the most suitable option. (8/10) WBS was excellent, detailed Gantt chart showed timing though milestones were not identified. Contingencies not on the presentation slides but explained verbally. (8/10) Clear answers given to questions. Detailed Gantt chart and WBS explained. (4/5)
- 20

5. TRANSFERABLE SKILLS

-  Excellent quality of presentation slides (except one small issue with 1 photo) (4/5) Confident, coherent and concise within the allotted time. Delivery style was clear and precise. All questions answered with confidence. (4.5/5)
- 8.5