

1809799

by Thomas Grennan

Submission date: 20-Jan-2023 04:14PM (UTC+0000)

Submission ID: 195772072

File name: 11301_Thomas_Grennan_1809799_180855_236638919.pdf (2.05M)

Word count: 688

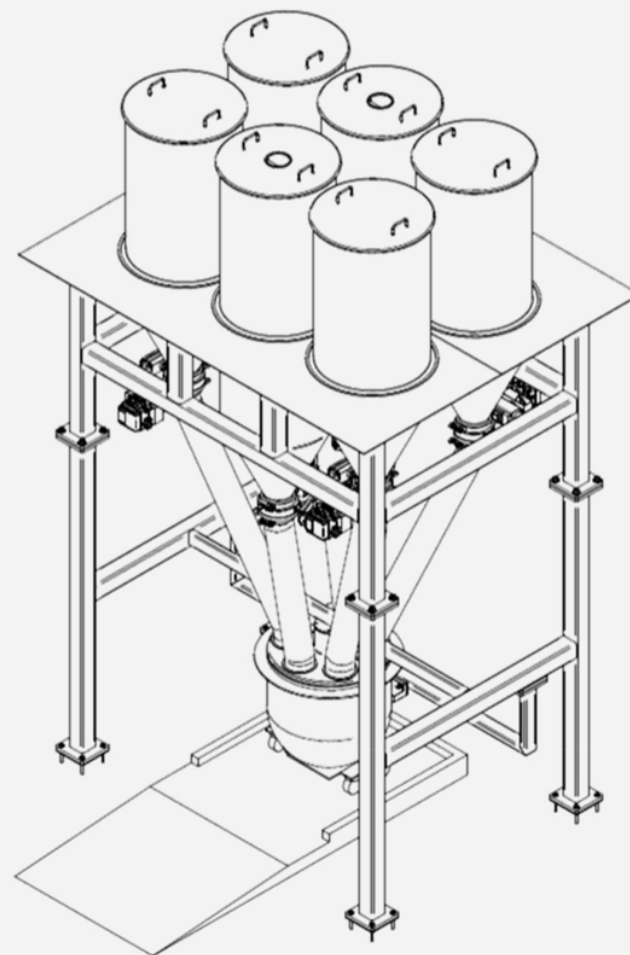
Character count: 3650



Prifysgol Cymru
Y Drindod Dewi Sant
University of Wales
Trinity Saint David

Ingredient Dosing System

Thomas Grennan



Project Background

- Based within a special purpose machinery company
- System is for a bakery who produces tray bake cakes
- Project is a part of “Ffatri 4.0”
- Aim of proving that productivity and sustainability targets in manufacturing can be achieved through digital manufacturing technologies



Problem Definition

- Concerns of variance of consistency and quality
- Vital that each product tastes and looks the same
- Production increase due to new contracts
- Labour-intensive and time-consuming
- Reliant on operator accuracy
- Susceptible to human errors resulting in losses of up to £3300 per mix

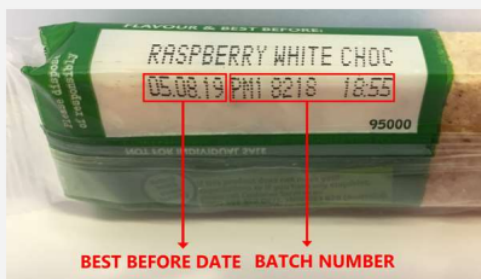


Constraints

Explosive Atmosphere



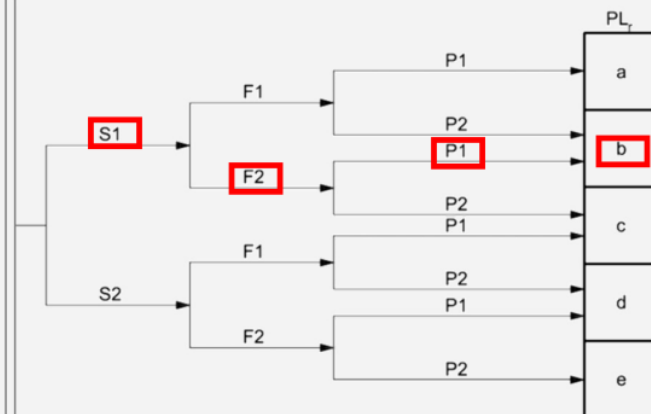
Food Hygiene



BEST BEFORE DATE BATCH NUMBER

Machine Safety

BS EN 13849-1 Performance Level



Risks

- Labour issues
- Supply Chain issues
- Long-lead time electrical components, Particularly HMI and IO Cards



Functional Design Specification

Functional Design Specification		
Ref.	Requirement	Standard
P.0	4-off 375 Litre capacity stainless steel hopper for Caster Sugar, Light Brown Sugar, Buttery Scone Mix and Rolled Jumbo Oats	Customer Specification
P.1	2-off 500 Litre capacity stainless steel hopper for Plain & Self-Raising Flour	Customer Specification
P.2	System must detect if a hopper is empty	Customer Specification
P.3	System must allow for 'Recipes' to be added	Customer Specification
P.4	System includes function to add external product to mixing bowl	Customer Specification
P.6	Weigh Scale must allow for weights up to 320Kg	Customer Specification
P.7	Weigh Scale must be accurate to 20g (0.02Kg)	Customer Specification
S.0	System Performance Level (PL) must be greater than or equal to the Performance Level Required (PLr)	ISO 13849-1:2015
S.2	All equipment within the ATEX zone must be adequately rated i.e., Equipment in Zone 22 must be rated to minimum Zone 22	Equipment and Protective Systems Intended for use in Potentially Explosive Atmosphere Regulations 2016
F.0	Project must be delivered within budget (£110,000 for Electrical Controls)	Manufacturers Specification

Test Plan – Conformity Tests

Conformity Tests – Testing of FDS criteria that cannot be functionally tested

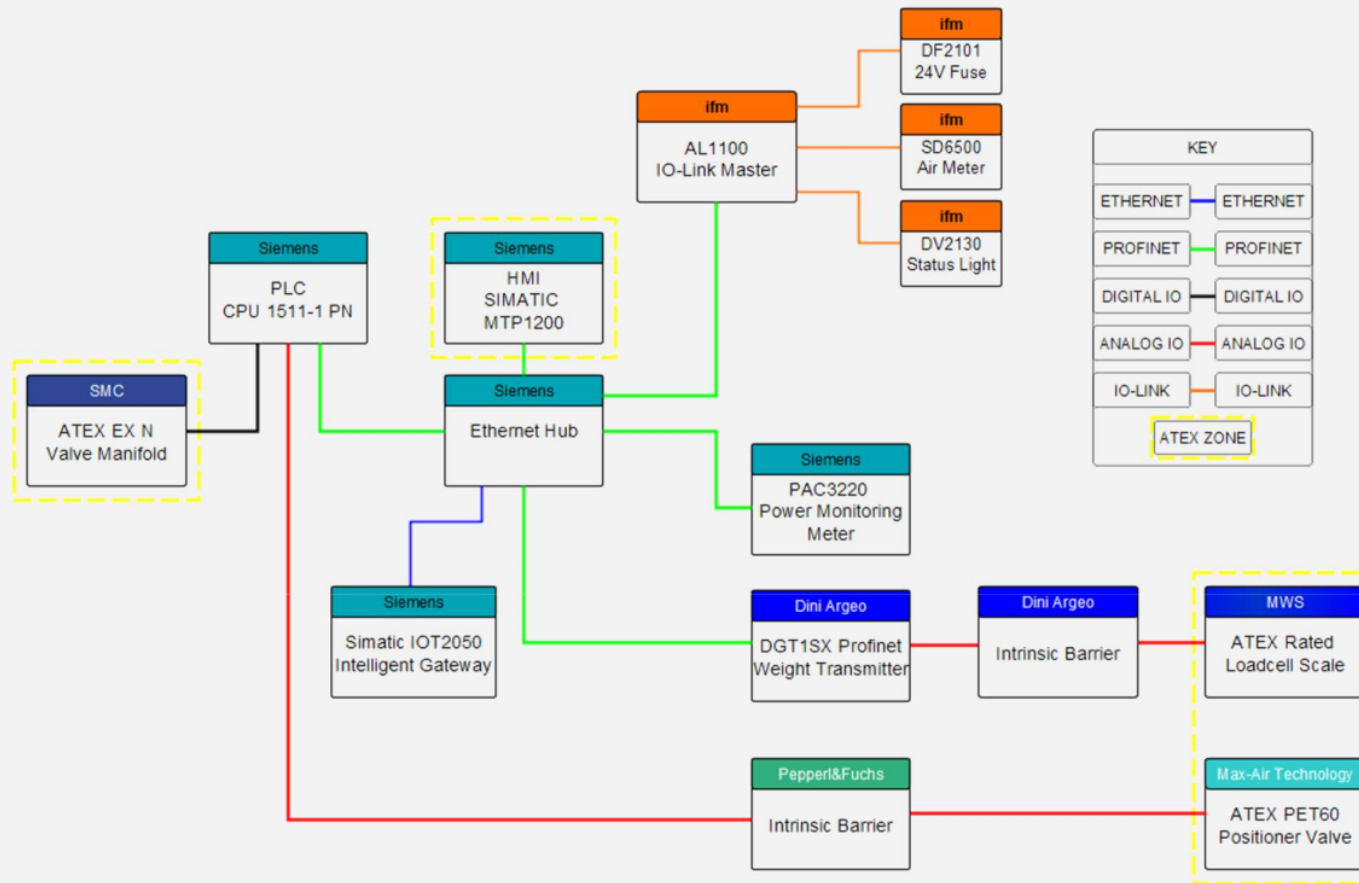
Conformity Tests					
Ref	Test Description	Expected Outcome	Actual Outcome	Pass or Fail?	Evidence
P.0	Check the Hopper Capacity for Caster Sugar, Light Brown Sugar, Buttery Scone Mix and Rolled Jumbo Oats Hoppers	4-off 375 Litre capacity stainless steel hoppers are fitted for Caster Sugar, Light Brown Sugar, Buttery Scone Mix and Rolled Jumbo Oats			
P.1	Check the Hopper Capacity for Plain & Self-Raising Flour	2-off 500 Litre capacity stainless steel hoppers fitted for Plain & Self-Raising Flour			
S.0	Compare the PL rating to the PLr rating	SISTEMA report confirms that the PL is greater than or equal to the PLr			
S.2	Check the ATEX rating of electrical components in the ATEX zone	All equipment within the ATEX zone is rated suitably to the risk assessment.			
F.0	Check that the project budget has not been exceeded	Project budget has not been exceeded			

Test Plan – Functional Tests

Functional Tests – Validates the Software system against the FDS requirements

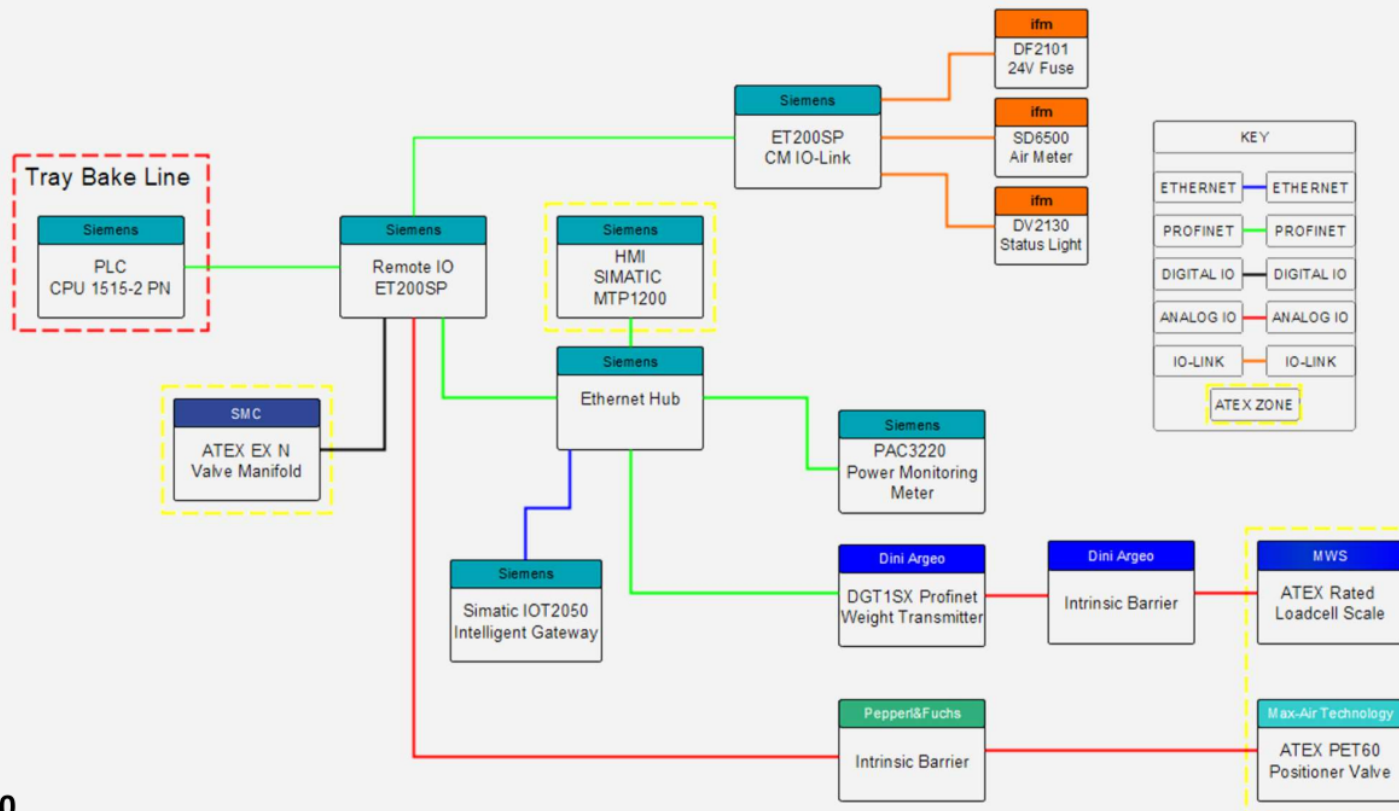
Conformity Tests					
Ref	Test Description	Expected Outcome	Actual Outcome	Pass or Fail?	Evidence
P.2	When the hoppers are empty, start a dosing cycle	After 10 seconds, the system indicates that the hopper is empty			
P.3	On the GUI recipe screen, add a new recipe and press save.	In the controller software, the new recipe is saved			
P.4	During a cycle that requires external product, add a product and enter the product weight	System acknowledges addition of external product, carries on with sequence			
P.6	Load the scale with 320Kg	Scale indicates a weight of 320Kg, Weight displayed on GUI			
P.7	Dose 10 different recipes into the mixing bowl on the scale	Each recipe is manually weighed and is accurate to +/- 20g			

Solution 1 – Siemens S7-1511 PLC



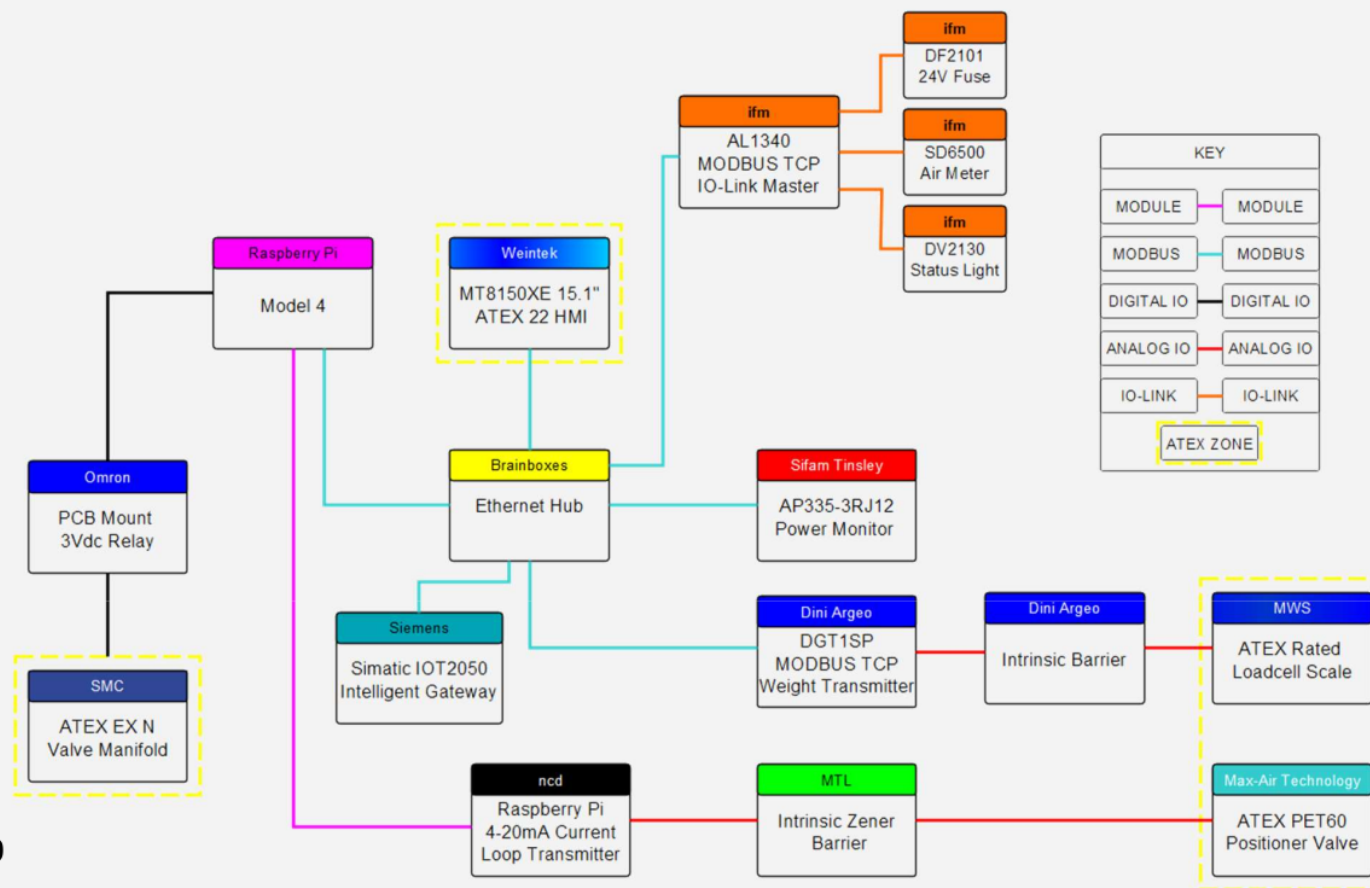
£97,422.59

Solution 2 – Siemens ET200SP Remote IO



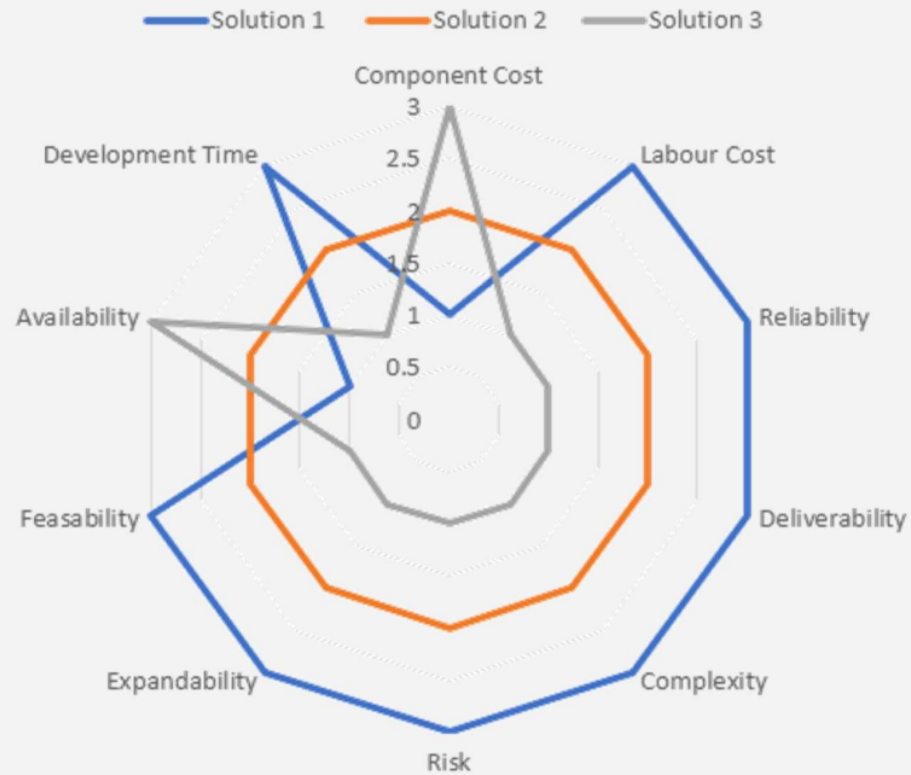
£98,446.00

Solution 3 – Raspberry Pi Microcontroller

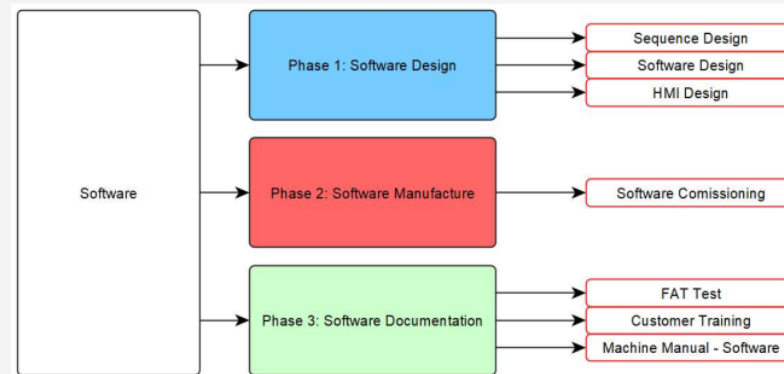
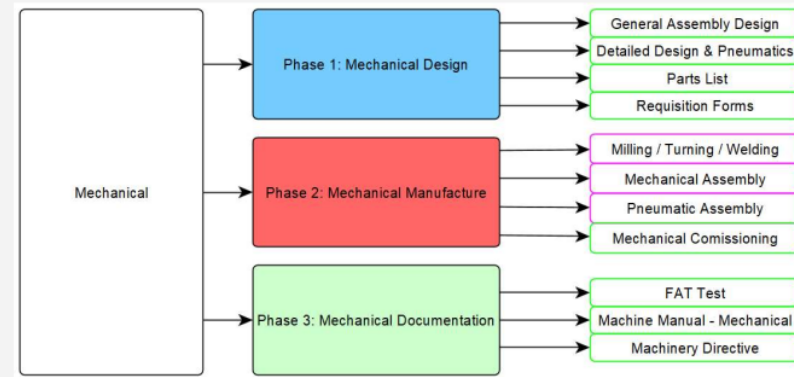
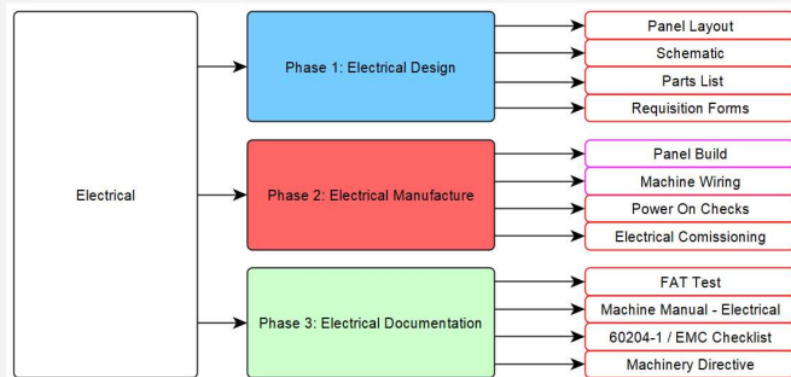


Chosen Solution

Comparison of Three Solutions

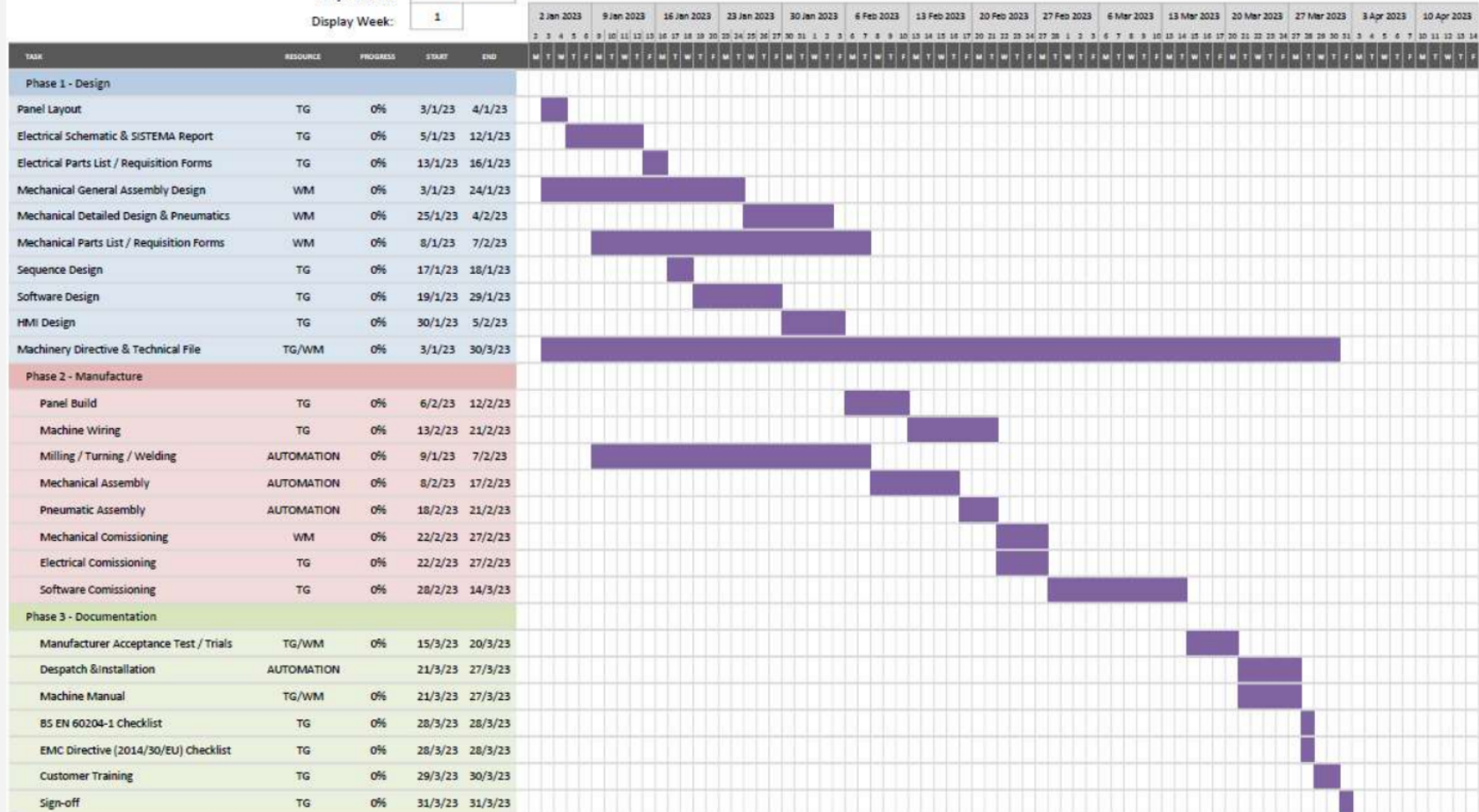


Project Planning – Work Breakdown Structure (WBS)



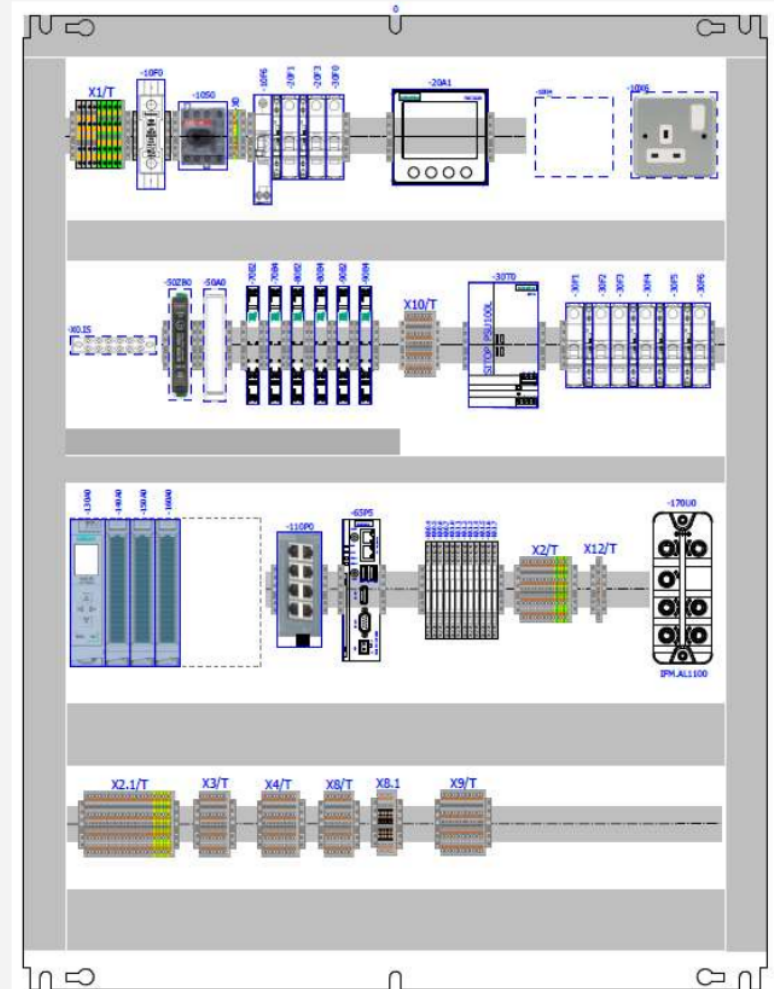
Project Start: Tue, 03/01/2023

Display Week: 1



Progress to date

- Progress has been made on the design stage of the system in line with the Gantt chart plan
- Electrical Design is complete
- Electrical requisition forms are complete
- Control panel equipment ordered
- The sequence has been designed and the software design is currently underway



Thank you,
Any questions?

FINAL GRADE

GENERAL COMMENTS

Instructor

77 /100

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GRADING FORM: NEW CSG-RUBRIC

THOMAS GRENNAN

77

1. ENGAGEMENT WITH LITERATURE

2. KNOWLEDGE AND UNDERSTANDING



Project background and problem definition (7/10) Project constraints, risks, health and safety (8/10) Response to questions (9/10) Total = 24/30

24

3. COGNITIVE AND INTELLECTUAL



Functional Design Specification (8/10) Test planning (8/10) Project
Planning and management methods (8/10) Total = 24/30

24

4. PRACTICAL APPLICATION



Review of Solutions (8/10) Justification of final solution (7/10) Total = 15/20

15

5. TRANSFERABLE SKILLS



Quality of the presentation slides (8/10) Quality of the delivery style (6/10)
Total = 14/20

14