



Examination Answer Books

12 Pages

Instructions to Candidates

1. Please give the information requested in the boxes below.
2. Enter your name in the space provided to the right, fold over and seal down (using the label provided) to hide your name.
3. The answers must be legibly written. The Examiners can either ignore illegible script or have it typed and the expense of typing charged to the candidate.
4. Write your answers in ink.
5. Begin each answer on a fresh page. Do all rough work in the answer book and cross it through.
6. No part of this book is to be torn out; it must be handed in complete.
7. If more books than one are used, fasten them together using the tags available from the invigilator(s).
8. **Every book must be handed in. In no circumstances may answer books, used or unused, be taken out of the examination venue.**

1	Student Number	1809310
2	Title of Examination Paper	Engineering Management
3	Module Code	SGEE 6004
4	Date and Time of Examination	5 th May 2023
5	Examination Venue	Coleg Sir Gŵr.
6	Seat Number	
7	Number of Answer Books handed in	1

Complete, fold and seal
(see note 2 below)

SURNAME: THOMAS

FORENAME(S): DAVID MATHEW

List the numbers of the questions you have attempted	Office Use
1	16
4	16
3	10
2	19
Total	61 ✓

Mark confirmed as
61 (KC)

- i) In 1986, Bill Smith and Michel Hury, two engineers at Motorola were accredited to having developed six Sigma. In 1995 Jack Welch made it the central business strategy of general electric.

A statistical business approach that seeks to find and eliminate variation and their causes from an organisational processes, focusing on outputs of critical importance to the customer. ✓

Six Sigma is a ruthless and relentless pursuit of reduction in variation. ✓

All work takes place in a system interconnected processes. ✓

Variation exists in all processes. ✓

Understanding and eliminating variation are key to success. ✓

Sigma levels are used to define process variation to defects per million (DPM). ✓

Six Sigma Summary

A unified approach with ~~not~~ cultural changes.

Identifies ~~problems~~ problems in a process > Improvement project > Improve reliability. ✓

Can be ~~so~~ used in manufacturing and service industries based on hard data. ✓

Has transformed some of the most successful companies in the world.

D.M.A.I.C

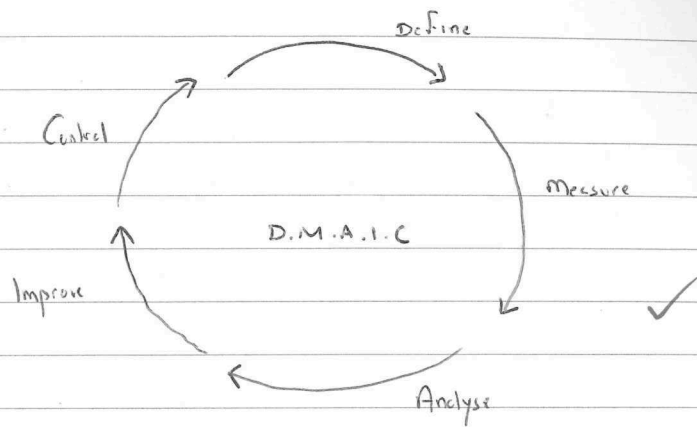
Define - The scope of the improvement project relating to customer requirements. ✓

Measure - Current process ~~performance~~ performance vs process capability. ✓

Analyse - The difference between current process performance vs process capability. Identify root cause and prioritise problems. ✓

Improve - Find improvement solutions to prevent problems ~~recurring~~, recurring. ✓

Control - Implement improvement process such as standards of operation $\checkmark$ ISO 9000 or techniques such as Statistical process control (SPC)



Advantages of six Sigma.

Management by Fact.

Clear implementation steps

Logical Approach

Key performance indicators based on data. $\checkmark$

Project selection based on highest value. $\checkmark$

Training in statistical techniques improves the individual $\checkmark$

Team work approach $\checkmark$

(16)

Disadvantages of six Sigma

High investment for training needed. $\checkmark$

Employees sought after by competing organisations $\checkmark$

Focus on data can ~~also~~ obscure the bigger picture, such as the need for lean manufacturing or 5's implementation. - Not focusing on the bigger picture.

4) Six Big losses.

- Breakdown losses
- Setup and adjustment losses
- Idling and minor stoppage losses
- Reduced yield losses ✓
- Reduced speed losses.
- Quality losses.

Many industries have implemented Total productive maintenance (TPM) such as the automotive industries. These companies have ~~experienced~~ experienced quality improvements with;

- Breakdown time ✓
- Accident rates ✓
- Term Working ✓
- Morale ✓
- ~~Reduced~~ Mean time between failure (MTBF) ✓
- Machinery that does not breakdown can aid ~~and~~ manufacturing efficiency and productive capacity. ✓
- Lower repair and overhaul costs, fewer minor stoppages, fewer delays and better use of time and materials.
- TPM is a holistic approach to machine maintenance ✓
- The goal is to eliminate waste generated from incorrectly maintained machinery
- TPM defines productivity as machine reliability ✓
- TPM Practices that include mean time between failure (MTBF) single minute exchange of die (SMED) statistical process control (SPC) improvements, require the evolution of maintenance management. ✓
- Develop autonomous ~~tools~~ for machinery maintenance.

Reactive & Preventive

Reactive.

- Setting standards of production without considering machinery condition
- Repair when machinery breaks down ✓
- No planning for knock on effects.

Preventive

- Design maintainability into machinery and processes ✓
- monitor process performance ✓
- Identify sources of wear ✓

16

Four step method to TPM

- Stabilise machine between failure. ✓
- Systematically extend machine between failure. ✓
- Continuously Monitor machine between failure and develop a more scientific approach to maintenance. ✓
- Develop planned maintenance schedule. ✓

TPM Phased Approach

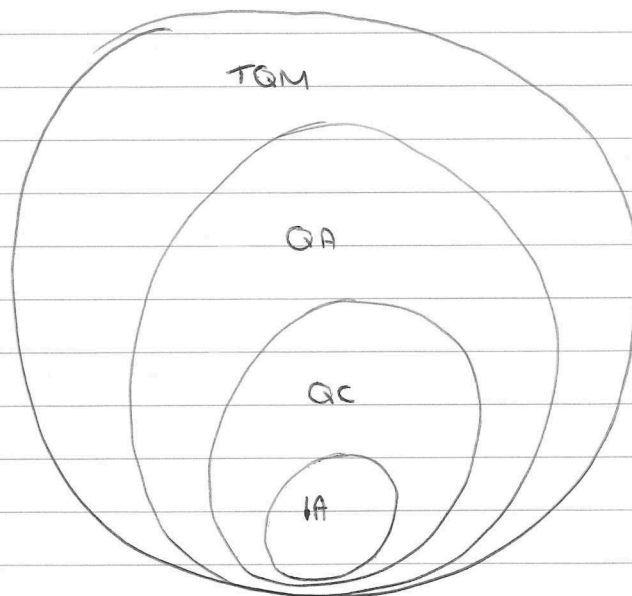
- Develop autonomous teams. ✓
- Institute a companywide cleaning regime. ✓
- Design machinery for maintainability ✓
- Reinstate serviceability of machinery ✓
- Apply advanced engineering solutions to prevent failure. ✓

3) a.

- b) Total Quality Management ~~is~~ is the ~~best~~ hierarchy of quality, overseeing Quality assurance (QA), Quality Control (QC) and Inspection Approach (IA)

Unl. Unlike past initiatives is not a one-shot wonder. ✓

TQM is a journey not a destination.



Total Quality management.

- 100% efficiency
- ~~TQM~~ Involves everybody giving 100%
- Everyone impacts on meeting company requirements
- Company wide approach with cultural changes. ✓

Quality Assurance.

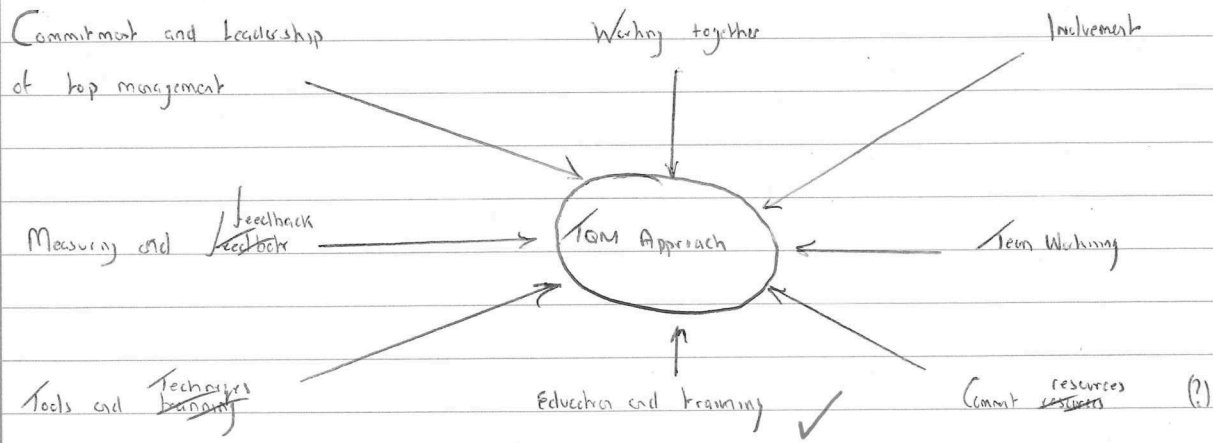
- Prevention of quality problems ✓
- Planned and systematic activities ✓
- Various methods used to assure process, system, product quality. ✓
- Involves procedures, defined inspection/sampling levels/rates, customer satisfaction. ✓

Quality Control

- Controlling and monitoring the process to produce products and services. ✓
- Defining types of inspections, measuring quality against targets. ✓

Inspection Approach

- Undertaking measurements to feed into the quality system. ✓
- Typical types of inspections such as variables and attributes. ✓



Develop beyond a product focus.

- Identify customers needs.
- Design organisation structure to implement
- Train employees in necessary tools and techniques ✓
- Give and get feedback
- Develop recognition / reward system

5 step method for Team

- Preparation - Use of external consultants.
 - Management ~~eng~~ engagement.
 - Commit Resources.
 - Training ✓
- Planning
 - Detailed implementation plan ✓
 - Establish infrastructure. ✓
 -
- Assessment

Self Assessment using individual and company assessments.
- Implementation.
 - Choose and train personnel
 - Raise awareness of Team ✓
 - Team managers and work free.
- Diversification.
 - Managers to use success

10

2a) Regression is the association between dependent and more independent variables. ✓
 Association is ~~given~~ usually given as an equation in terms of dependent variables, where independent variables can be predicted.

Correlation indicates the nature and strength of the relationship between two variables. ✓

Correlation is positive when variables increase or decrease together.

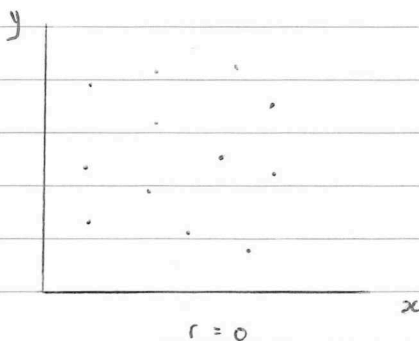
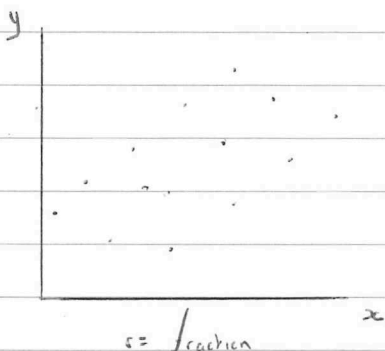
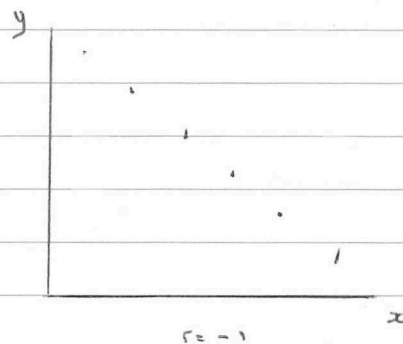
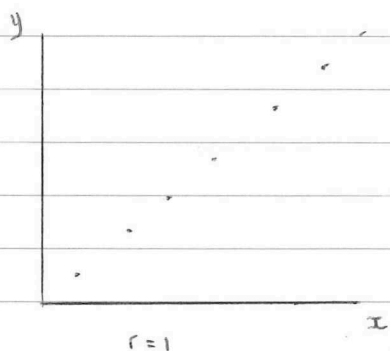
Correlation is negative when one variable increases, while the other decreases.

~~Data points that show a close relationship~~

Data points that show a close relationship are strongly correlated. ✓

Direct correlation is when variables move in the same sense. Such as, an increasing amount of waste in a production that subsequently increases the cost of production. ✓
 Known as positive correlation.

Inverse direct correlation, when variables move in the opposite sense. Such as increasing order quantities that subsequently lower the unit cost of a product. ✓
 Known as perfect negative correlation.



3

The correlation coefficient 'r' cannot exceed +1 or be less than -1

When +1, there is a perfect functional relationship between x and y , where on increasing x is associated with an increasing y .

When -1, there is a perfect functional relationship between x and y , where on increasing x is associated with a decreasing y .

The line of best fit needs to be established when contemplating scatter diagrams.

Plotting this line introduces an element of inaccuracy. ~~To reduce errors and loss of~~

Regression uses the law of straight line graph $y = mx + c$ To reduce errors and loss of averages of means of individual scatter points through the line of best fit.

~~Some~~ The formula can be used to predict future performance based on existing data.

2b)

	x	y	xy	x^2	y^2
	3	6.1	18.3	9	37.21
	4	7	28	16	49
	5	7.9	39.5	25	62.41
	6	8.8	52.8	36	77.44
	7	9.4	65.8	49	88.36
	8	9.9	79.2	64	98.01
	9	11	99	81	121
	10	11.4	114	100	129.96
	11	12.2	134.2	121	148.84
	12	13.1	157.2	144	171.61
Σ	75	96.8	788	645	983.84

$$N = 10$$

$$m = \frac{\bar{E}_{xy} - \frac{(\bar{E}_x)(\bar{E}_y)}{N}}{\bar{E}_{x^2} - \frac{(\bar{E}_x)^2}{N}}$$

$$m = \frac{788 - \frac{(75)(96.8)}{10}}{645 - \frac{(75)^2}{10}}$$

$$m = \frac{788 - 726}{645 - 562.5}$$

$$m = 0.752 \quad \checkmark$$

$$c = \frac{(\bar{E}_x)(\bar{E}_{xy}) - (\bar{E}_y)(\bar{E}_{x^2})}{(\bar{E}_x)^2 - N(\bar{E}_{x^2})}$$

$$c = \frac{(75)(788) - (96.8)(645)}{(75)^2 - 10(645)}$$

$$c = \frac{59100 - 62436}{5625 - 6450}$$

$$c = 4.0436 \quad \checkmark$$

$$\therefore y = 0.752(x) + 4.0436.$$

$$r = \frac{\sum xy - \frac{(\sum x)(\sum y)}{n}}{\sqrt{\left(\sum x^2 - \frac{(\sum x)^2}{n}\right)\left(\sum y^2 - \frac{(\sum y)^2}{n}\right)}}$$

$$r = \frac{788 - \frac{(75)(96.8)}{10}}{\sqrt{\left(645 - \frac{(75)^2}{10}\right)\left(983.84 - \frac{(96.8)^2}{10}\right)}}$$

$$r = \frac{788 - 726}{\sqrt{(82.5)(46.816)}}$$

$$r = 0.998 \quad \checkmark$$

$$r^2 = r \times r = 0.998 \times 0.998 = 0.996$$

When nozzle angle of 15° $y = mx + c$;

$$y = 0.752(15) + 4.0436 = 15.324 \text{ mm} \quad \checkmark$$

15

+

1

16

