



12 Pages

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.**

Complete, fold and seal
(see note 2 below)

SURNAME: MORGAN

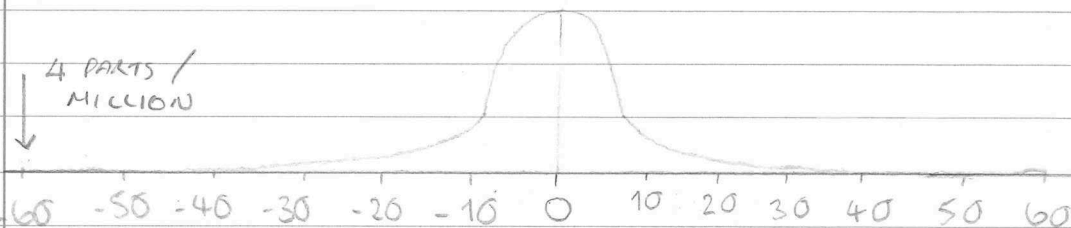
FORENAME(S): MASON RICHARD

1	Student Number	1809802
2	Title of Examination Paper	ENG MANAGT (ELEC)
3	Module Code	SGEE6004
4	Date and Time of Examination	05/05/23
5	Examination Venue	~~CARE-EG02~~
6	Seat Number	
7	Number of Answer Books handed in	1

List the numbers of the questions you have attempted	Office Use
1	8
2	20
4	11
5	12
Total	51

Mark confirmed as
51 (KC)

- Q1
- SIX - SIGMA WAS DEVELOPED BY MOTOROLA
 - SIX - SIGMA IS USED TO REDUCE THE AMOUNT OF DEFECTS IN THE MANUFACTURING PROCESS. ✓
 - IN STATISTICS SIX - SIGMA IS DENOTED AS OR REFERRED TO AS STANDARD DEVIATION.
 - THE STANDARD DEVIATION IS MEASURED AS SIX - SIGMA AND IS GIVEN THE SYMBOL σ .
 - TYPICALLY WHEN IMPLEMENTING SIX - SIGMA IF THE MEAN VALUE GOES PAST σ THEN THE NUMBER IS VERY SMALL.
 - THE NUMBER OF DEFECTS IS APPROX. 4 DEFECTS PER MILLION. ✓



TO SUMMARISE, TO REDUCE THE AMOUNT OF DEFECTS:

- FOCUS ON INCREASING THE QUALITY
- FOCUS ON INCREASING & LISTENING TO CUSTOMER FEEDBACK ✓
- REDUCE AMOUNT OF DEFECTS & WASTE

~~(USING THE DATA)~~

THE 4 LEVELS OF σ

YELLOW BELT

REQUIRES 3 WEEKS OF σ TRAINING

GREEN BELT

REQUIRES 5 WEEKS OF σ TRAINING & CAN MANAGE A σ TEAM.

BLACK BELT

REQUIRES 9 WEEKS OF TRAINING, LEADS σ TEAMS, HAS COMPLETED MORE THAN 2 σ PROJECTS & HAS UNDER GONE A TEST

Q1 MASTER BLACK BELT

(H) IS AN EXPERIENCED BLACK BELT. MANAGES, TRAINS & COACHES BLACK BELT PEOPLE.

~~(DATE IS A)~~

WHAT IS DMAIC?

- DMAIC IS A BUSINESS IMPROVEMENT TOOL.
- IN STATISTICS DMAIC IS USED TO CREATE THE LIFE CYCLE OF A GO PROJECT & IS ALSO USED FOR PROBLEM SOLVING. ✓
- D-M-A-I-C STANDS FOR THE PROCESS USED FOR PROBLEM SOLVING & THE LIFE CYCLE OF A GO PROJECT.
- DMAIC BROKEN DOWN STANDS FOR DEFINE, MEASURE, ANALYSE, IMPROVE & CONTROL.
- DEFINE: WHAT IS THE PROBLEM IN THE PROCESS. ✓
- MEASURE: GATHERING INFORMATION BASED ON THAT PROBLEM.
- ANALYSE: READING ALL INFORMATION AND DATA GATHERED.
- IMPROVE: HOW TO FIX THE PROBLEM MOVING FORWARD.
- CONTROL: MONITOR THE FIXES/MODIFICATIONS MADE.
- THE FISHBONE DIAGRAM IS A TOOL TO USE WHEN TRYING UNDERSTAND WHERE PRODUCT IS GOING WRONG. ✓

ADVANTAGES OF DMAIC

- IT IS USEFUL WHEN TRYING TO UNDERSTAND COMPLEX PROBLEMS
- IT HELPS AVOID FIXING THE WRONG PROBLEM

DISADVANTAGES OF DMAIC

- IT IS NOT USEFUL FOR COMPANY'S WHICH RELY ON CREATIVITY
- IT ISN'T USEFUL FOR SINGLE ISSUES. AS AN EXAMPLE A PUMP WHICH IS LEAKING. ✓

Q2 - CORRELATION REFERS TO A STATISTICAL MEASURE WHICH DETERMINES THE RELATIONSHIP BETWEEN A PAIR OF VARIABLES. ✓

- CORRELATION COEFFICIENT USES THE MEASURE TO DETERMINE HOW STRONGLY A PAIR OF VARIABLES ARE CORRELATED.

- 'r' IS USED TO DETERMINE THE RELATIONSHIP OF THE TREND. ✓

- 'r' CAN BE MEASURED BETWEEN +1 & -1, SOME OF THESE PATTERNS ARE EXPLAINED BELOW.

POSITIVE CORRELATION ($r = +1$) DIRECT CORRELATION

NEGATIVE CORRELATION ($r = -1$) INVERSE DIRECT CORRELATION ✓

NO CORRELATION ($r = 0$)

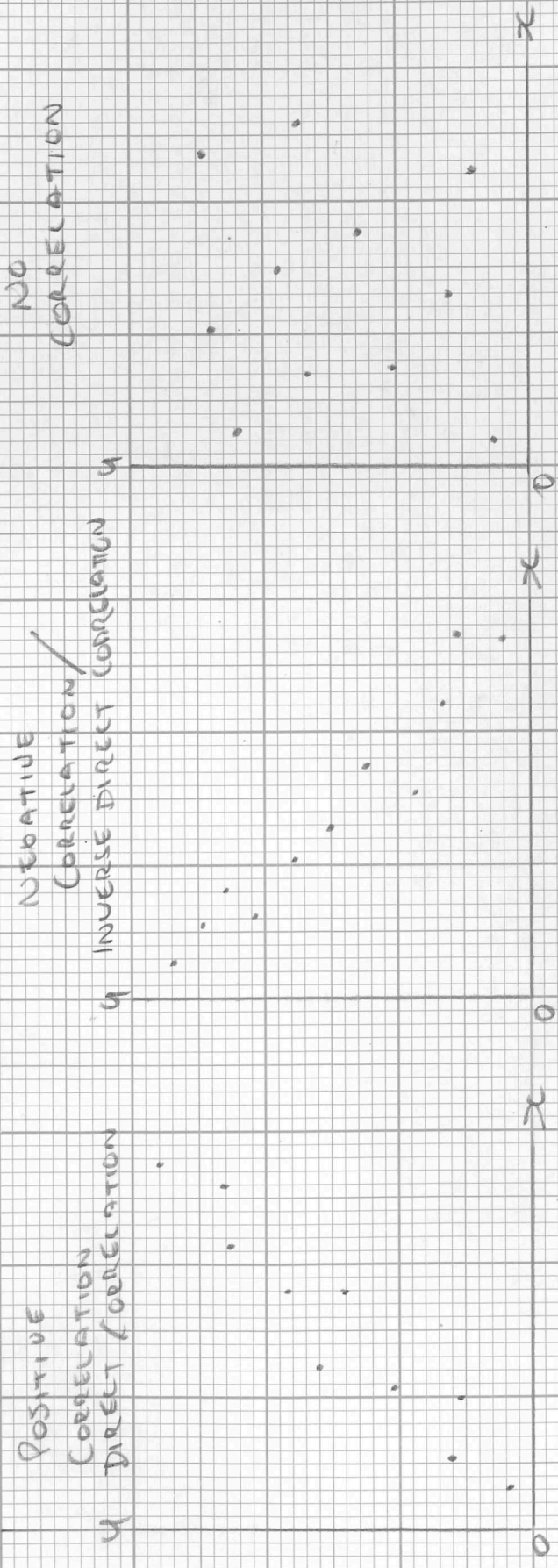
- ~~THE~~ REGRESSION IMPLIES A STATISTICAL TOOL THAT IDENTIFY'S THE NATURE OF THE RELATIONSHIP BETWEEN A DEPENDENT VARIABLE & A PAIR OF INDEPENDENT VARIABLE.

- THE REGRESSION LINE OR LINE OF BEST FIT IS PLOTTED USING DATA GATHERED. ✓

- THE REGRESSION IS ABLE TO DETERMINE THE DEPENDENT VARIABLE & MORE THAN ONE INDEPENDENT VARIABLE.

NOZZLE ANGLE x	STRAND 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
TOTALS	75	96.8	788	645

Q2 CORRELATION & REGRESSION. (POSITIVE / NEGATIVE / NO CORRELATION GRAPHS)



Q2

(CONTINUED)

x	y	xy	x^2	y^2
75	96.8	788	645	983.84

$$C = \frac{(\sum x)(\sum xy) - (\sum y)(\sum x^2)}{(\sum x)^2 - N(\sum x^2)}$$

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

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

$$= \frac{-3336}{-825}$$

$$C = 4.0436$$

$$M = \frac{\sum xy - \frac{\sum x \sum y}{N}}{\sum x^2 - \frac{(\sum x)^2}{N}}$$

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

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

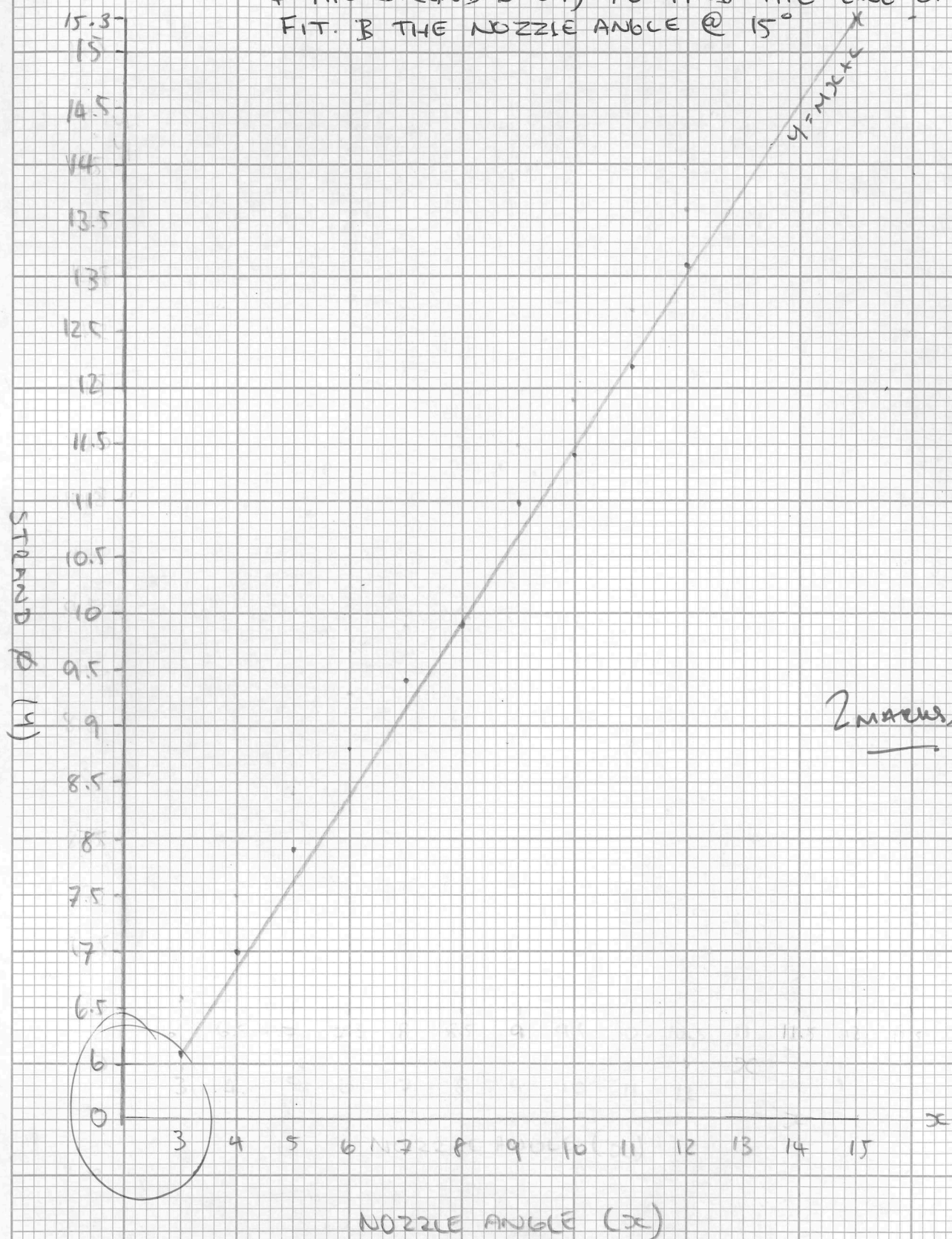
$$= \frac{62}{82.5}$$

$$M = 0.751$$

~~F~~ = * TURN OVER *

Q2

A GRAPH MEASURING BETWEEN THE NOZZLE ANGLE (x)
 & THE STRAND Ø (y) TO FIND THE LINE OF BEST
 FIT. & THE NOZZLE ANGLE @ 15°



4 — THIS IS POSITIVELY CORRELATED ✓
 ?

Q2

(CONTINUED)

$$\begin{aligned}
 r &= \frac{\sum xy - \frac{(\sum x)(\sum y)}{n}}{\sqrt{\left[\sum x^2 - \frac{(\sum x)^2}{n}\right] \left[\sum y^2 - \frac{(\sum y)^2}{n}\right]}} \\
 &= \frac{788 - \frac{(75)(96.8)}{10}}{\sqrt{\left[645 - \frac{(75)^2}{10}\right] \left[983.84 - \frac{(96.8)^2}{10}\right]}} \\
 &= \frac{788 - 726}{\sqrt{[645 - 562.5][983.84 - 937.024]}} \\
 &= \frac{788 - 726}{\sqrt{(82.5)(46.816)}} \\
 &= \frac{62}{62.14756632}
 \end{aligned}$$

$$r = 0.9976255495 \quad \checkmark$$

TO 2 d.p

$$r = 0.99$$

THE REGRESSION LINE OR LINE OF BEST FIT

$$y = mx + c$$

$$y = 0.751(15) + 4.0436 \quad \checkmark$$

$$y = 11.265 + 4.0436$$

$$y = 15.3086$$

TO 1 d.p

$$y = 15.3 \quad \checkmark$$

15
+
2 graph

17

Q4

EDUCATION & TRAINING

CONTINUED

- TRAINING & EDUCATING STAFF TO BE MORE KNOWLEDGEABLE & EFFICIENT WHICH REDUCES DOWNTIME & INCREASES PRODUCT QUALITY

EARLY EQUIPMENT MANAGEMENT

- ENSURING EQUIPMENT IS READY FOR EFFICIENT OUTPUT OF PRODUCT.

OFFICE TPM

- ENSURING THAT STOCK IS UP TO DATE & ALL MAINTENANCE JOBS ARE PLANNED. ✓

HEALTH, SAFETY & ENVIRONMENT

- MAKING SURE ALL STAFF ARE WORKING UNDER ALL REGULATIONS & MANAGEMENT ARE ENSURING LOTO IS TAKING PLACE & EVERYONE IS WORKING SAFELY. ✓

THE BENEFITS OF TPMIMPROVED RELIABILITY

- MACHINES ARE IN A BETTER & MORE EFFICIENT RUNNING STATE ✓

IMPROVED EQUIPMENT CAPACITY

- MACHINES ARE CAPABLE OF BEING MORE EFFICIENT

IMPROVED QUALITY

- THE PRODUCT GOING TO THE CUSTOMER IS TO A BETTER STANDARD AND RESULTS IN LESS COMPLAINTS

DEVELOPED PEOPLE

- THE STAFF UNDERSTAND & ARE MORE AWARE OF ACTING IN A SAFE MANNER & MAKES MACHINES RUN MORE EFFICIENTLY

(11)

Q4 TPM

- THE AIM OF TPM IS PERFECT PRODUCTION
- USING MACHINES, EQUIPMENT, EMPLOYEES & SUITABLE PROCESSES IT HELPS EXISTING PRODUCTION & QUALITY SYSTEMS

THE AIMS OF TPM

- TPM AIMS TO DETECT, ELIMINATE & EXCLUDE ANY MINOR FLAWS IN EQUIPMENT.
- TO IMPROVE & MAINTAIN EQUIPMENT TO STANDARDS
- TO IDENTIFY & SET OPTIMAL OPERATING CONDITIONS
- TO ELIMINATE ALL DEFICIENCIES, EVEN SMALL ONES.

THE 5 S METHODOLOGY

STABILITY

SUSTAIN

ORDERLINESS

ORGANISE

CLEANLINESS ✓

THE 8 PILLARS OF TPMFOCUSED IMPROVEMENT

- MAKING IMPROVEMENT ON PARTS OF EQUIPMENT WHICH LEADS TO MORE DOWNTIME

AUTONOMOUS MAINTENANCE

- EXAMPLES LIKE SELF LUBRICATING MACHINES WHICH DO NOT REQUIRE PEOPLE

PLANNED MAINTENANCE

- SCHEDULED MAINTENANCE ON MACHINERY TO AVOID THE CHANCES OF FUTURE PROBLEMS.

QUALITY MAINTENANCE

- ENSURING THE CORRECT LEVEL OF INSPECTION IS TAKING PLACE ON PRODUCTS TO ENSURE THE CUSTOMER IS ALWAYS HAPPY.

TUCKMAN & THE 4 DEVELOPMENT STAGES

- Q5 - THE US NAVY TASKED TUCKMAN WITH ANALYSING THE DYNAMICS OF BRINGING TOGETHER A TEAM IN HOPE AT A FUTURE DATE THEY WOULD BE A HIGHLY FUNCTIONING TEAM.
- THERE 4 DEVELOPMENT STAGES REFERRED TO THIS, THESE BEING: FORMING, STORMING, NORMING & PERFORMING

FORMING

- BRINGING TOGETHER OF COMPLETE STRANGERS W/ HOPE OF ENDING UP W/ A HIGHLY FUNCTIONING TEAM. THE LEADER WILL INTRODUCE THE TASK IN HOPE THEY GET FAMILIAR.

NORMING

- THE TEAM ARE GETTING USED TO THE TEAM & ARE STARTING TO LOOK AT THE TASK

STORMING

- THE TEAM ARE MORE COMFORTABLE W/ THEIR ROLES & THE TASK & ARE MORE COMFORTABLE WITH THEIR TEAMMATES

PERFORMING

- THE TEAM ARE COMFORTABLE W/ THEIR ROLE & UNDERSTAND THE TASK IN HAND W/ UNDERSTANDING THEY NEED TO ACHIEVE RESULTS.

BELBIN'S 5 ROLES & CONTRIBUTIONSHAPER

- MOTIVATES THE TEAMMATES & BRINGS ENERGY TO THE GROUP

IMPLEMENTER

(Worker?)

- BRINGS GOOD DELIVERING SKILLS, STRONG PRACTICALITY & AN ORGANISED APPROACH
- ENSURES THAT THE TEAM ARE FOCUSED ON ACTION & ENSURES THAT RESULTS ARE TOP PRIORITY.

Q5

COMPLETER FINISHER

- CONTINUED
- BRINGS RESOLUTION & DELIVERS RESULTS ✓
 - IS VERY MITICULOUS W/ ATTENTION ✓ TO DETAIL WITH A PERCHANT OF ACCURACY.

PLANT

- BRINGS ALOT OF CREATIVITY ✓ TO THE GROUP. ✓
- COMES UP WITH LOTS OF IDEA'S AND SOLUTIONS ✓

MONITOR EVALUATOR

- MONITORS THE PROGRESS OF THE GROUP ✓ & ENSURES EVERYTHING IS IN PLACE FOR A SUCCESSFUL OUTCOME