Tutorial 1 Project Management Concept
Question 1
Differentiate between a software project and a construction project by completing the Table 1 below. Include an example in each of your answers.

Table 1: Comparison of software project and construction project

	Software Project (example developing the Exam Timetable System)	Construction Project (example building a bridge)
Invisibility	• Progress is not immediately visible (no physical form) • e.g. The code architecture, database relationships or algorithm logic are not visible by human, human can only see the visual representation via the screen.	• Progress is immediately visible (have physical form) • e.g. When building the bridge, human can physically see the foundations being laid, pillars rising and deck taking shape.
Flexibility	• Easier to change • e.g. If there are new features needed to be added on the current system such as "conflict resolution among student schedules", the feature can be easily implemented via code modification by developers.	• Difficult to change once it is completed • e.g. There would be a huge costs and time delays if a sudden change needed during the halfway of building the bridge.

Question 2
T-Shirts2U is a small company which supplies and manufactures customized t-shirts. However, its current system which is partially automated is unable to keep track of the orders and stocks efficiently. Besides that, it is unable to provide accurate information to the management on which items are more profitable and there have been mistakes in some of the order fulfillments. In order to solve these problems, the senior management of T-Shirts2U has requested you to develop a new online ordering system to increase the company annual sales by RM50,000. The new system to be developed has the following modules: Customer, Order carts, Online payment and Order fulfillment. This project must be completed within 3 months with an allocated budget of RM180,000. The project team consists of six software developers.

a) Identify and explain TWO (2) constraints of T-shirt2U project implementation. Explain your answer.

> • Time
>   o The new online ordering system must be completed within 3 months.
> • Budget
>   o The allocated budget for the project is RM 180,000.

b)   The outcome of a project can be classified as truly successful, partially successful or a total failure. Identify and explain TWO (2) criteria that can be used to judge the above project whether it is a total failure.

> • Satisfaction of stakeholders' requirements in the project
>   o The project is considered as a total failure when it completely fails to meet the needs and expectation of its stakeholders such as users, customers and sponsors.
>   o The project will lose its value if it does not deliver the intended purposes to the stakeholders and they refuse to accept it.
> • The project objectives are met or not.
>   o A project is total failure when its fundamental objectives and success criteria are not achieved, it indicates that the project's core purpose is not fulfilled.
>   o The project objectives define what success looks like in terms of time, budget and quality. If

> the primary goals are not met, the project will be considered as failed regardless of secondary achievements.

Question 3

ABC Tech Company provides software consultancy services to business clients, it focuses on selling accounting software. The company consists of 4 different departments: sales and marketing, customer services, information technology (IT) and finance. Each staff member will be assigned to a department according to his or her area of specialization and expertise. The sales and marketing department consists of 3 staff, 2 staff work in the customer service department, while 3 staff work in the finance department and 3 experienced staff work in the IT department. Each department is supervised by a functional manager and each functional manager in turn reports to the Chief Executive Officer (CEO).

a) Determine an appropriate organizational structure and create a corresponding diagram for this company.

- Functional organizational structure
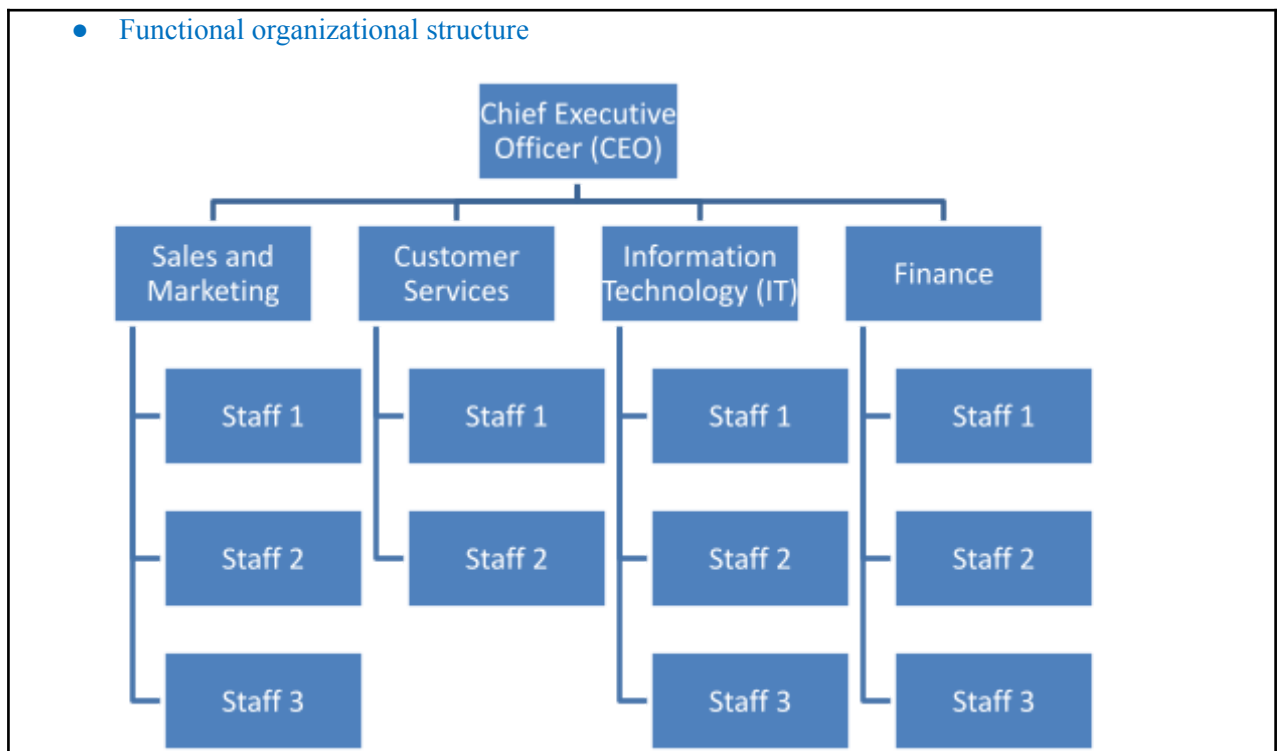
b) Based on part a), explain TWO (2) advantages of the selected organizational structure.

- Cost savings
  - It can eliminate the resource duplication when dealing with different projects. For example, one accounting department can serve all projects instead of each project having its own accountant.
  - Less training costs will be required since all the specialists stay in their field.
- Clear career progression and specialization
  - All employees will have clear advancement paths within their expertise areas such as sales and marketing, customer services, information technology and finance departments.
  - It also provides specialized skill development and professional growth opportunities within disciplines.

Question 4

You are a project manager of an online education management system (EMS) developed for a private college. After communicating with the staff for collecting requirements, the following scope is defined: the system will be used to manage communication between lecturer and students, uploading and downloading learning materials (such as tutorial questions, lecture notes, assignments specifications), making announcements, and assessing students' assignments. The modules of EMS can be modularized

with a well-defined scope and high staff involvement. The project team focuses on the core features of the user interface design, assessment, communication, announcement and submission. A budget of RM150,000 has been approved for the project with a duration of 8 weeks.

Construct a *Work Breakdown Structure* (WBS) for the online education management system using an outline numbering format. Assume that you have chosen the *Waterfall software process model*.

1.0 Project Management
        1.1 Project Planning
                1.1.1   Project charter development
                1.1.2   Schedule and resource planning
                1.1.3   Risk management planning
        1.2 Project Monitoring and Control
                1.2.1   Progress tracking
                1.2.2   Budget monitoring
                1.2.3   Quality control
        1.3 Project Closure
                1.3.1   Final documentation
                1.3.2   Project evaluation
2.0 Requirements Analysis
        2.1 Requirements Gathering
                2.1.1   Staff interviews
                2.1.2   Functional requirements collection
                2.1.3   Non-functional requirements collection
        2.2 Requirements Documentation
                2.2.1   Requirements specification
                2.2.2   Use case development
                2.2.3   Requirements approval
3.0 System Design
        3.1 Architecture Design
                3.1.1   System architecture
                3.1.2   Security design
                3.1.3   Integration design
        3.2 User Interface Design
                3.2.1   UI wireframes
                3.2.2   User experience design
                3.2.3   Interface specifications
        3.3 Database Design
                3.3.1   Database schema
                3.3.2   Data relationships
                3.3.3   Database optimization
4.0 System Development
        4.1 User Interface Module
                4.1.1   Login system
                4.1.2   Dashboard development
                4.1.3   Navigation system
        4.2 Communication Module
                4.2.1   Messaging system
                4.2.2   Discussion forums
                4.2.3   Notification system
        4.3 Learning Materials Module
                4.3.1   File upload functionality
                4.3.2   File download system
                4.3.3   Document management
        4.4 Announcement Module
                4.4.1   Announcement creation
                4.4.2   Announcement display
                4.4.3   Announcement management

Question 5

Return on Investment (ROI), Net Present Value (NPV) and many other financial techniques can be used to evaluate and compare the risks and rewards of different projects. They help project managers to decide whether a project is worthwhile to pursue or not. Table 1 illustrates the cash flow of Project ABC. The cash flow takes place at the end of each year.

Table 1: Cash flow of Project ABC

Year	Project X
0	-50,000
1	20,000
2	20,000
3	20,000
4	30,000

Using a 12% discount rate, calculate the Net Present Value (NVP) and Return on Investment (ROI) for this Project. Based on your calculations, analyse whether the project is attractive, or should be rejected. Explain your answer.

Note:
- Show your workings in calculation.
- Negative values represent costs.
- Discount factors round up to 4 decimal points. All other figures round up to the nearest integer.
- ROI in percentage, rounds up to 2 decimal points.

Question 5

Net profit = - 50 000 + 20 000 + 20 000 + 20 000 + 30 000

        = 20 000

Average annual profit

$= \dfrac{20\,000}{4}$

$= 5000$

ROI

$= \dfrac{5000}{50\,000} \times 100$

$= 10\%$

$= 0.10$

Year	Cash Flow	Discount Flow	Discounted Cash Flow
0	-50 000	$\frac{1}{(1+0.12)^0} = 1.0000$	-50 000 X 1.0000 = -50 000
1	20 000	$\frac{1}{(1+0.12)^1} = 0.8929$	20000 x 0.8929 = 17858
2	20 000	$\frac{1}{(1+0.12)^2} = 0.7972$	20000 X 0.7972 = 15944
3	20 000	$\frac{1}{(1+0.12)^3} = 0.7118$	20000X 0.7118 = 14236
4	30 000	$\frac{1}{(1+0.12)^4} = 0.6355$	30000 X0.6355 = 19065
			NPV : 17 103

Question 6

Using a <u>10%</u> discount rate, calculate the Net Present Value (NPV) and Return on investment (ROI) for Project X and Project Y. Based on your calculations, suggest the most profitable project. Explain your answer.

Show your calculation to justify your answer. Discount factors round up to 4 decimal points.

Discount Rate: **10%** for both projects

Project X	Year 0	Year 1	Year 2	Year 3	Total
Costs	100,000	50,000	40,000	30,000	-
Discount Factor	1	0.9091	0.8264	0.7513	
Discounted Costs	100,000	45455	33056	22539	201050
Benefits	0	100,000	120,000	100,000	-
Discount Factor	1	0.9091	0.8264	0.7513	
Discounted Benefits	0	90910	99168	75130	265208
NPV	64158				
ROI: Use discounted value	31.91%				

Project Y	Year 0	Year 1	Year 2	Year 3	Total
Costs	100,000	70,000	60,000	20,000	-
Discount Factor	1	0.9091	0.8264	0.7513	
Discounted Costs	100,000	63637	49584	15026	228247
Benefits	0	100,000	150,000	90,000	-
Discount Factor	1	0.9091	0.8264	0.7513	
Discounted Benefits	0	90910	123960	67617	282487
NPV	54240				
ROI:	23.76%				

Comment:

Question 6

Project X

Year 1

Discount Factor = $\frac{1}{(1+0.10)^1}$ = 0.9091

Discounted Costs = 50000 X 0.9091 = 45455

Discounted Benefits = 100 000 X 0.9091 = 90910

Year 2

Discount Factor = $\frac{1}{(1+0.10)^2}$ = 0.8264

Discounted Costs = 40000 X 0.8264 = 33056

Discounted Benefits = 120 000 X 0.8264 = 99168

Total Discounted Costs
= 100000 + 45455 + 33056 + 22539
= 201050

Total Discounted Benefits
= 90910 + 99168 + 75130
= 265208

NPV
= -201050 + 265208
= 64158

ROI
= $\frac{64158}{201050}$ X 100
= 31.91%

Year 3

Discount Factor = $\frac{1}{(1+0.10)^3}$ = 0.7513

Discounted Costs = 30000 X 0.7513 = 22539

Discounted Benefits = 100000 X 0.7513 = 75130

Project Y

Year 1

Discount Factor = $\frac{1}{(1+0.10)^1}$ = 0.9091

Discounted Costs = 70000 X 0.9091 = 63637

Discounted Benefits = 100000 X 0.9091 = 90910

Year 2

Discount Factor = $\frac{1}{(1+0.10)^2}$ = 0.8264

Discounted Costs = 60000 X 0.8264 = 49584

Discounted Benefits = 150000 X 0.8264 = 123960

Total Discounted Costs
= 100000 + 63637 + 49584 + 15026
= 228247

Total Discounted Benefits
= 90910 + 123760 + 67617
= 282487

NPV
= -228247 + 282487
= 54240

ROI
= $\frac{54240}{228247}$ X 100
= 23.76%

Year 3

Discount Factor = $\frac{1}{(1+0.10)^3}$ = 0.7513

Discounted Costs = 20000 X 0.7513 = 15026

Discounted Benefits = 90000 X 0.7513 = 67617

∴ Project X is the most profitable project because it has higher Net Present Value (NPV) and Return of Investment (ROI) compared to Project Y.

Tutorial 2: Project Planning, Control and Process Models Question 1

Case Study: Beamscope Canada, Inc.

Beamscope Canada, Inc. is an electronics distributor located in Scarborough, Ontario. In their manual order processing system, when a customer called to place an order, the clerk would scribble it down, run down the hall to the credit check guys and flip through files and folders to see if their credit was okay. The clerk would then run to see whether Beamscope actually had the item in stock and then go back to the telephone to confirm the order. There were two PCs at the company and they were doing $93 million worth of business. The phone orders were manually routed to the warehouse, where they would sit for at least a week. Plus, it was hard to know what was actually in the warehouse and where it was. It took Beamscope five to seven days to ship an order and very often, there were mistakes made with the orders. In addition, products were collecting dust at Beamscope's physical warehouses. It also took a long time to compile reports for senior management and by the time the reports were printed, the information was already outdated. Senior management at Beamscope envisioned a new system that not only takes on order entry but also features a radio frequency bar-code system for inventory control, electronic data interchange and a data warehouse for decision support. In the new system, customers can place orders themselves, check the status of previous orders and download product literature. If an item is temporarily out of stock, the system will suggest a substitute or put the customer on a list for back orders. The system will also allow users to browse 120,000 square feet of shelves holding 10,500 different products in the company's 2 warehouses. In addition, the new system is directly tied into United Parcel Service, Inc.'s electronic shipping system.

a)   Well-defined objectives should be specific, measureable, achievable, relevant, and time-constrained (SMART). Consider an objective: **design an user friendly system** for Beamscope's project to develop a new system that automates their order processing, inventory and warehousing.
Does this project objective fulfill the SMART criteria? Explain your answer.

b) Identify and describe TWO (2) stakeholders of the Beamscope's project.

Question 2

Your project team has been assigned to handle the Beamscope's project, duration is 24-months with a high-budget project. The user requirements for the system are still uncertain but the company has committed to a few departmental managers to be highly involved and provide consultation for this project. In addition, the scale of the project is large and it entails the use of a new technology and programming language that your team is unfamiliar with.

Consider which software process model would you propose for the above project: *Rapid Application Development* or *Spiral model*? Explain your answer.

Question 3

Given the following information in table 1 below:

Table 1: Status of Project A   (Refer to Appendix 2.2)

Activity	Estimated Duration (month)	Estimated Cost (RM)	Status	Earned Value (EV)
A	1	20,000	50%	
B	3	20,000	80%	
C	2	30,000	80%	
D	4	40,000	70%	
E	4	45,000	60%	
F	4	25,000	0%	
G	2	20,000	0%	
Total	20	200,000	-	

Assume that project A is now in its **10th** month. As of today, you have paid out RM 103,000 to the contractors. Contractors are those who performed the tasks shown in Table 1. The budget at completion for project A is RM200,000. Show the workings in your calculation. Formula: SV= EV-PV,CV = EV-AC.

a) Calculate the following values based on information provided in Table 1:
   - *Planned Value (PV)*   - *Earned Value (EV)*
   - *Schedule Variance (SV)*   - *Cost Variance (CV)*

   Based on the calculated results, provide comments with an analysis on performance of this project.

b) Based on the results calculated in part a), explain ONE (1) corrective action to ensure the project's success.

Question 4
A network diagram can be used to illustrate the interdependencies between tasks in a project.
Table 1 shows Project tasks, duration and its predecessor.

Task ID	Task Name	Duration (in week)	Predecessor
A	Collect requirements	1	None
B	Design online module	1	A
C	Code online module	2	B
D	Design offline module	1	A
E	Code offline module	1	D
F	Testing online and offline module	2	C, E

a) Create a network diagram based on information provided in Table 1.
b) Based on the answer given in part a), identify the critical path based on the task ID and specify the total duration needed to complete the project.

Question 5
Gantt charts are used to illustrate the sequence of activities in a project. Figure 1 is an example of a Gantt chart. Redraw the Gantt chart in Figure 1 using the predecessor information provided in Table 1 to illustrate the interdependencies between project activities. Assuming the project starts in June 2024.
Figure 1: Example of a Gantt chart

Task ID	Task Name	Jun '24	Jul '24	Aug '24	Sep '24	Oct '24
1	Analyse Requirements	▇				
2	Design online module	▇				
3	Code online module	▇▇				
4	Design offline module	▇				
5	Code offline module	▇				
6	Test online and offline module	▇▇				

Table 1: Project activity and its predecessor

Task ID	Task Name	Duration (in month)	Predecessor
1	Analyze requirements	1	None
2	Design online module	1	1
3	Code online module	1.5	2
4	Design offline module	1	1
5	Code offline module	1	4
6	Testing online and offline module	1.5	3, 5

Identify the month for the **task ID 6** will be completed.

Tutorial 3: Quality Management & Assurance
Question 1
Refer to the case study in Tutorial 2 Question 1 (Beamscope company),
Suggest **ONE (1)** *software quality attribute* for Beamscope's project implementation. Explain your answer. (Refer to Appendix 3.1)

Question 2
Quality Assurance (QA) and Quality Control (QC) activities are important in software quality management. Identify and explain **THREE (3)** differences between Quality Assurance (QA) and Quality Control (QC) in software development.

Question 3
Errors and defects found in a software will reduce the software quality. However, there are many techniques to avoid errors and defects in software projects. Below are the two of them:
- Inspections   - Lessons learnt

report Describe each of the two above techniques.

Question 4
The president of ABC College has recently assigned you to manage a new project that is to develop an Access Card Control System for enhancing the security in the campus. For implementing this system, the quality of the software is as important as the quality of hardware such as RFID devices. In order to produce good quality software, it is necessary to perform quality management activities. However, performing quality management activities will incur costs.

Describe 3 categories of quality costs as given below:
- Prevention costs   - Appraisal costs   - Failure costs

Explain which category is likely to be *most costly* to the ABC College. Justify your answer.

Tutorial 4: Software Metrics
Question 1
Table 1 shows the size oriented metrics of Project team A & B.
Table 1: size oriented metric of Project Team A and Team B

	Non normalised		Normalised with KLOC	
	Team A	Team B	Team A	Team B
Programming languages used	Java	Php	Java	Php
Total Lines of Code (LOC)	306,000	256,000		
Errors	288	233		
Defects	30	20		
Pages of Documentation	205	180		

Normalised the metrics of project team A and project team B with KLOC (thousand lines of code). Using the normalised metrics, compare the *quality* of both projects. Provide comments with an analysis of both projects.
Note:
-Provide your answers for the last 2 columns of Table 1.
- Show your workings, round up your answer to 4 decimal points.

Question 2
For **a) and b)**, show the workings in your calculation. Round up your answer to two decimal places.

a)   Referring to Table 1, calculate the *function points (FP)* for the both projects. FP formula: Count Total x $[0.65 + 0.01\sum Fi]$

Table 1: Information domain values of Project A and B

Measurement parameters	Weighting factor	Project A's Count	Project B's Count
Number of inputs	Complex (5)	4	4
Number of outputs	Simple (2)	6	5
Number of inquiries	Average (4)	8	8
Number of files	Average (3)	4	2
Number of external interfaces	Simple (2)	2	1
The adjustment values $\sum$**Fi** for both projects		50	40

Table 2: Defects found and documentation of Project A and B

|	Project A's Count	Project B's Count
Defects	90	70
Pages of documentation	120	130

b)   Referring to Table 2, calculate the normalised defects and pages of documentation based on the calculated answer in part a) function point. Compare which project has *higher maintainability* based on the calculated result. Provide comments with an analysis of both projects.

Question 3

McCall's Software Quality Factor model is used to evaluate the quality of software products.
a) Describe the following categories
  - Product Operation, Product Revision and Product Transition.
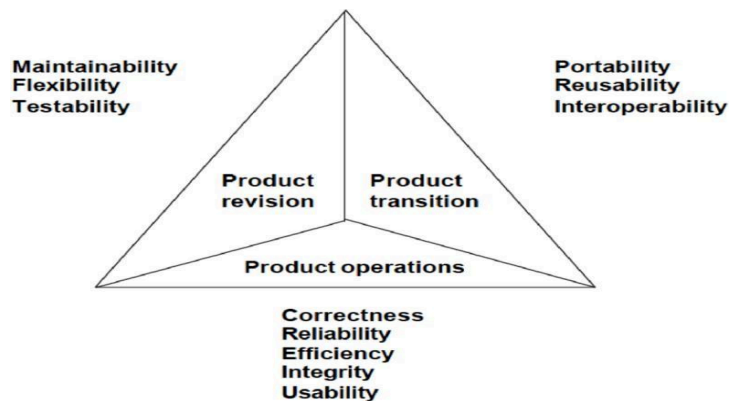
Refer to Appendix 4.1, software quality attributes in each categories

b) Refer to the case study in Tutorial 1 Question 2 (T-shirt2U company).
Explain ONE (1) quality attribute applicable to the T-shirt2U's new ordering system and provide ONE(1) metric for measuring it.

Question 4

Identify and explain TWO (2) characteristics of good metrics to measure the quality attributes of the system.

Tutorial 5: Risk Management

The risk categories are product size (PS), business impact(BU), process definition(PR), customer characteristics(CU), development environment(DE), technology to be built(TE), staff size and experience(ST).
Risk mitigation, monitoring and management (RMMM) actions
Risk management strategy considered as risk acceptance, risk avoidance, risk reduction, risk mitigation, or risk transfer.

Question 1

The risk projection shows the following information:
60 reusable software components were planned. 42 components can be reused, 18 new components would have to be developed from scratch and new requirements.
Risk identified: 18 components have to be custom developed based on new requirements. The average component is 100 lines of code (LOC) and the cost for each LOC is RM14.00.

Risk probability: 50%

Calculate the following values using a Halstead's risk exposure metric (probability X cost):
● Cost to develop the 18 software components.
● Risk exposure

Question 2

Project risks can be dealt with by using reactive risk strategy or proactive risk strategy. Explain *reactive risk strategy* then give an example to highlight why it is a bad strategy.

Question 3

Consider the following potential risks in table 1
Table 1: Project risk, category, probability and impact

No.	Risks	Category	Probability of Occurrence (0-1)	*Impact* on the project (1-4)	Risk Score
1	Unstable database	TE	0.5	3	
2	Inadequate software architecture	PR	0.3	2	
3	Staff turnover in project team	ST	0.6	4	
4	Resistance to use system	CU	0.1	2	

*Impact values: 1 – negligible 2 – marginal   3 – critical   4 – catastrophic

a) Calculate the risk score for each risk listed in table 1, *rank the risks* according to their priority *using risk no* (i.e., from highest to lowest risk score). Show the workings in your calculation.

b) Identify ONE (1) risk with the **highest** risk score in part a). Propose a suitable *risk mitigation* and *monitoring actions* for the identified risk. Explain your answer.

Tutorial 6: Software Process Improvement
Question 1
Figure 1 illustrates a 3-stage generic framework for improving Software Development Process. Identify THREE (3) types of process metric that you would consider gathering at the beginning of the 3-stage model shown in Figure 1. Provide an example for each of your answers.
Figure 1: Software Process Improvement Cycle
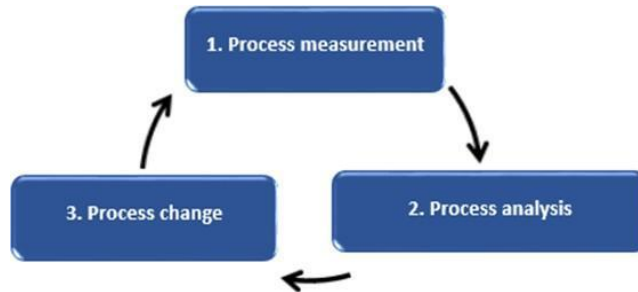
Question 2
You are measuring a software process to solve an issue which is to *reduce development time* from a programmer perspective. It was found that software development time always takes longer than planned. 2 main areas that might contribute to the issue are: time required to collect system requirements with customers and requirement changes. You have identified the metrics in measuring these 2 areas which are time taken for communication with customer, number of communication with customer and pages of requirement documentation. On the other hand, the top management does not agree with your findings and thus will not support your software improvement process (SPI) efforts financially. Seeing that the top management is not supportive, your colleagues appeared less cooperative in giving their feedback when you tried to collect the data for process analysis.

a) Prepare a Goal-Question-Metric proposal for the given goal by filling the blank in figure 2.
● Analyse TWO (2) questions to assess the given goal.
● Identify TWO (2) relevant software metrics for each question you have listed. *Explain* each of the software metrics that can be applied to the suggested questions.

Figure 2: GQM proposal
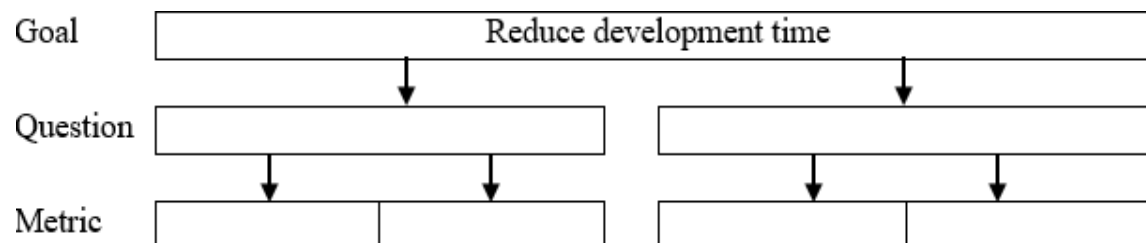
b) Given below are two difficulties that may arise during process change stage:
   - Resistance to change   - Change Persistence

Select ONE (1) of these difficulties that may arise in the above case scenario. Explain TWO (2) reasons to justify your selections.

Question 3

Refer to the Figure 1 (Software Process Improvement Cycle) in Question 1, explain TWO (2) techniques used during the process analysis stage.

Tutorial 7: Software Configuration Management

Question 1
In the context of version management, identify and explain TWO (2) features of Distributed Version Control and Centralized Version Control Systems in software development.

Question 2
System release is a crucial phase in the software development lifecycle where the developed software is made available to users. Describe TWO (2) factors that influence system release planning.

Question 3
One of the change management activities is to approve the change requests from stakeholders. Discuss ONE(1) factor in change analysis that influences whether the change request should be approved or not.

Tutorial 8: System Dependability and Critical System

Question 1
Describe TWO (2) examples of critical systems, which include a *mission-critical* system and a *business-critical* system. For each system that you have given, assess which dimension of system dependability is the most important. Provide justifications in your answer.

Question 2
Consider the following scenario:
The Food and Drug Administration (FDA) has approved the first automated insulin delivery system. An automated insulin delivery (AID) system has three main components: an insulin pump, a continuous glucose monitor and an algorithm that determines the best insulin dose to keep patients in range.
This represents a step toward a so-called artificial pancreas that could automatically regulate blood sugar levels for people who have diabetes. The device made by the manufacturer Medtronic has been approved to treat people with Type 1 diabetes who ages 14 and older.
                    (Source: https://www.livescience.com/56305-automated-insulin-delivery-device-approved.html)

a)   Identify ONE (1) important dependability dimension that can be applied to the automated insulin-delivery system. Explain your answer.

b) Insulin delivery system is considered to be which type of *safety critical system*? Explain your answer.

Question 3
Propose a fault management approach used to manage the faults that might occur in the automated insulin delivery system. Explain your answer with an example.