**Question 1**

**a.**

**3 SMART Objectives:**

1. To implement the SAP at ABC company within budget.
2. To implement the SAP at ABC company within the time frame which is 2 years for the entire project.
3. To implement the SAP at ABC company in which the system requirements need to be maintained to the quality, functionality and scope.
4. To implement the SAP at ABC company without any disruption to the business operations. The scope and the quality of the functions of the system can be maintained, with the fewest possible software errors that might lead to operational failures.

**Effectiveness measurement:** (Measurement + 1 example)

1. ***Earned value analysis (EVM)***: Monitoring the project budget and schedule whether it was completed within the budget and schedule by using earned value (EV), actual cost (AV), planned value (PV) to calculate cost variance (CV) and schedule variance (SV)
2. ***Project Completion time***: Put milestone task and evaluate whether the project complete within time frame for each milestone
3. ***Inspection testing***: Evaluate whether the system requirements can be fulfilled or not? Detecting the number of errors / bugs occurred during testing? Can those errors be fixed in a short period of time? This is because the error/bugs will cause system failure which does not meet the project objective.

Sample answer for effectiveness measurement given by sir:

1. **Budget / Costs**: Evaluate whether the actual costs incurred compare with the budgeted costs for the project. Are the actual costs exceeding/ within the proposed budgeted costs? AC vs PC
2. **Project Completion Time**: Evaluate if the new SAP systems is implemented as per agreed time frame, i.e. within two years or more than 2 years or less than 2 years?
3. **Number of disruption happens or Functional Correctness**: Evaluate if the new SAP systems are able to perform smoothly without any errors/ bugs occurring. If there were errors / bugs occurred during the implementation, how many errors/ bugs occurred? How serious are those errors / bugs? Can those bugs/ errors can be fixed in a short time before causing disruption to other business operations? Because these errors or bugs can cause the failure of the systems to perform the required functions.

**b.** Identify stakeholders (internal or external) & describe it

* **Warehouse staff** who need to track the product and raw materials quantities / know all the products/ raw materials inventory flows
* The **supplier** who is involved in raw material procurement process and to supply the raw material for the ABC company
* **Manufacturing staff** who need to manufacturing schedule
* **Top management**, the CEO of the ABC company, who needs to read and view some summary/analysis reports.
* **Software and hardware vendors** (if there are any equipment conversion/ software upgrade)

**c.**

* This is because some of the deliverables for certain allocation are not based on the project manager’s expectation. For example, some of the tasks might require more time to complete and this will cause overallocation for some of the staff as they need to follow the instructions given by the project manager, hence, the project manager will need to reallocate tasks to other staff to avoid overallocation.
* Certain task has priority (i.e If didn't finish on time, will affect project plan, hence, need to rearrange task deliverables)

Sample answer:

* Initial estimates of project plan are tentative, subject to change according to the situations, software project life is full of uncertainty and the project manager will always have to modify the original plan as he or she discovered for issues that require a fine tune on the original plan.
* As more information becomes available, the project manager revising his original assumptions is delayed, he or she may have to renegotiate the project constraints and deliverables with the customer or clients or management. The outcome of re-negotiation might be the reallocation of the tasks to new staff, changing in tasks’ priorities, etc. which will have an impact on the project plan.
* Hence, the project manager needs to revise the project plan regularly to ensure the revised project plan is able to reflect the latest software development environment and conditions.

**Question 2**

**a.** Possible issues occured if adding more staff:

* **Increase of learning time** as the new staff who join the project might need to first understand the flow of the project as well as the task they handle. Hence, they need to spend some time picking up to handle the task assigned.
* **Cost increases** because the project manager needs to hire new staff to join the project. It might cause an over budget.
* **Poor communication might occur** as the new staff never collaborate with the existing staff. This might cause misunderstanding and conflict emerging during work which will affect staff’s productivity and might cause a project delay.
* **Task allocation** - time.

Sample answer:

* **Learning Curve Time** because the new added staff need to take extra time and effort to understand the ongoing projects progress (as they were recruited into the project in the half way). They need to spend extra time and effort to learn and pick up the missing pieces as they are not involved in earlier stages of the project. Additionally, they need to be trained with some new skill / knowledge if they were not equipped with the required skill for the current project. During the learning period, the staff may tend to be slower in carrying out the assigned tasks to them which causes lower productivity because they are still learning, it takes time to build their competency(能力) to perform the assigned task.
* It may cause a **further delay of the project’s time frame/ deadlines** because the staff are newly added into the project, they may need to spend extra time and efforts to understand what is going on in the project. Furthermore, some of the staff may not be equipped with the required skill for the project thus they have to be sent for training. All these may delay the project’s time frame even though the original purpose of adding in the additional staff to the project is to serve as the corrective action for the project delay. During the learning period, the staff may tend to be slower in carrying out the assigned tasks to them which causes lower productivity because they are still learning, it takes time to build their competency to perform the assigned task. They could make mistakes also which require rework and this may cause a delay in the completion of the assigned work.
* **Higher cost of the project** because some additional costs may be incurred here because we need to send the new staff for training on the new skill/ knowledge. Furthermore, due to the above-mentioned issue, i.e. further delay of project’s time frame, some costs may need to be incurred for the delay, cost = time, more time means more cost . This could be affected by inflation, change in additional equipment, or changes in the executed project and design revisions (due to change of market and customer expectation) such that the initial budget may need to be supplemented for the project to be completed. The result could be cost overrun and long chains of negotiation which will lead to delay because the project manager needs to negotiate for more funds to support the training for new added staff, as well as to compensate for the delay in the project.

**b.**

* User requirements are uncertain
* Long duration - Might need to carry out risk analysis activity
* High budget

Waterfall model is not suitable as the user requirements are still not finalized. Spiral model is more suitable for this project because:

* This is a long duration project (within two years) that involves many project phases in which the risk analysis activity might need to be carried out to identify and resolve the risk.
* Spiral model includes risk management which is suitable for these situations in which the user requirements are not certain yet.
* In the spiral model, each iteration will produce the prototype such as prototype 1, prototype 2 for them to review before the systems become operational after the third iteration.

Sample answer:

* Spiral model is much more appropriate than the waterfall model because the spiral model involves risk assessment activities which will try to identify and resolve all the possible risks in the project development. Waterfall model does not have risk assessment activities included. By the time we nearly complete the project we will only know the outcomes and it might be too late to do anything already.
* In this scenario, the user requirements are still uncertain. It is still uncertain how long time will be taken to carry out user requirement engineering activity which may possibly lead to slippage or delay. Thus, risk analysis activity may be able to help all possible/available alternatives, which can cope and help in developing a cost-effective project.
* Prototyping is used in a spiral model to proceed with the available data and find out possible solutions in order to deal with the potential changes in the user requirements.
* Alternatively, at stakeholders’ opinion, the entire project can be aborted if the risk is deemed too great/ too serious.
* Spiral model developed the software in a few iterations that allows the project team to build the software part by part for each iteration compared with the waterfall model that only starts the building process after the design process is completed , building one shot of all the features.
* Risk factors in this scenario can be development cost overruns or any other factor that could be in stakeholders’ judgement which may result in a less-than-satisfactory final product, the stakeholders don’t want to use the final products.

**Question 3**

a.

(i) Security is the ability of a system to protect itself from deliberate or accidental cyber attacks (accidental or intentionally hacked). It also refers to authentication and authorization issues which prevent unauthorized personnel from entering or accessing the system data. Some other included issues are such as confidentiality, integrity and availability.

(ii) Security metrics ：

* **Attack and threat frequency**
  + How many attacks are detected for a certain time period, e.g. daily, weekly etc.? How many attempts of unauthorized access? Do servers/ databases are identified?
  + People attempts to hack into the servers or database servers
  + A vulnerability scanner software that includes all the assets will indicate what needs to be done to improve the SAP system security.
  + The higher frequency means the company system security is vulnerable and more work needs to be done to improve it.
* **Mean Time to Identify (MTTI)**
  + Average length of time taken for a security team to **discover/identify** the threats/attacks in the SAP system.
  + The lower the time taken will be better as they will be able to quickly limit any damage done by the cyber-attack incident. They can take precautionary measures before the attacks begin.
* **Mean Time to Remediate (MTTR)**
  + Amount of time taken by the security team to **resolve** the attacks/ threats within the SAP system and restore its service back to normal.
  + The shorter time taken will be better. Normally, threat remediation is the process organizations use to identify and resolve threats to their company network environment. Recovers from the attacks, backup systems to restore back, fault tolerant hardware (DOS attacks)

b.

(i) The progress of the software is intangible (cannot touch physically) in which it is a service and its progress cannot be seen by simply looking at the artifact constructed compared to an engineering project such as building a bridge. A bridge building engineering project can preview and monitor its progress physically. Hence, a well-written documentation will be created for the software project to show its progress to increase its visibility.

Sample answer:

* Because software is an intangible item compared with other engineering projects that build houses, buildings, roads, bridges.
* Software cannot be seen or touched. Software project managers cannot see progress easily. They rely on others to produce the documentation or report needed to review progress. If these report is not make available it will be hard for the project manager to keep track the progress of the project
* For example, the manager of a shipbuilding project or of a civil engineering project can see the product being developed physically because those products are tangible items.
* However, for a software project, for instance for the requirement elicitation survey task, the system analyst may report that 30% of the task has been completed. It is quite hard for the PM to imagine how much the 30% of completion is because the outcome is intangible, it cannot be seen or touched, it only appears in the paper format with characters or diagrams.

(ii) Process metrics :

* **Public metric** - Inspection to detect any errors/bugs during development so that the developer can fix the errors/bugs.
* **Private metric** - Related data to uncover indicators such as the result from module testing, logical and syntax error. The developer has to solve it before integrating into one system and presenting it to the client to improve organizational process performance.

Sample answer:

**Private Metric**

* **Defect rates (by individual)**
  + e.g. Total number of errors/defects detected in a task which is performed by the individual staff.
* **Defect rates (by module)**
  + e.g. Total number of errors/defects performed in a particular system module which is developed by a staff during the code inspection activity/ testing or debugging
* **Errors found during development**
  + e.g. Total number errors performed by the particular staff during the system development process.

**Public Metric**

* **Project level defect rates**
  + e.g. Total errors/defects identified in a delivered system
* **Effort**
  + e.g. Total effort (person-days) required to complete the entire project
* **Calendar times**
  + e.g. Total time spent to complete the project? Is the project schedule delayed? Delayed for how long?

(iii) Process attributes (T6Q4)

* To help her to keep track the progress of the software development project she can implement SPI in the following areas :
* **Visibility** – milestone report, EV report, progress % work done in Ms Project, to measure the effectiveness (have we completed all the task)
  + Do the process activities culminate in clear results, so that the progress of the process is externally visible?
  + Is the project having a clear definition of how it will be performed, with all clear tasks list (with deadlines), including resources allocation and potential risks.
  + Additionally, has everyone involved in the project fully understand their assigned task and their role in helping to meet the project goal?
  + Is the project manager having a real time overview of work status, blocked work items or tasks ready for review to help to improve project’s flow efficiency?
* **Measurability** – time and resources needed to complete the task for us measure the efficiency
  + Does the process include data collection or other activities that allow process or product characteristics to be measured such as time needed to finalized user requirement, process user change request, number of communication channels used, FP?
  + Is there any metrics to be defined for all the assigned tasks to check to trace the project progress visibility from time to time? Such as time needed to finalized user requirement, process user change request, number of communication channels used, overallocated resources reports in MS Project

**Question 4**

a.

(i)

* **Manpower allocation** - One senior staff leads junior staff because the senior staff can provide guidance to junior staff so that they can learn the knowledge and technical skills from seniors staff. By doing this, the junior staff will be able to work on a project smoothly without any guidance in the future as they already have experience on it.
* **Cost constraints** - This is because senior staff need to be hired at higher cost compared to the junior staff.

Sample answer:

* **No budget to hired and maintain so many experienced staff**
  + The project budget may not cover the use of highly paid staff. Less experienced, less well-paid staff may have to be used as some of the company is facing budget constraints for their software development project.
  + Additionally, some staff with the appropriate experience may not be available as they are assigned to some other higher priority projects.
  + It is impossible to recruit new staff with good skill and knowledge just to work on the projects and leave all the least experienced staff/ junior staff without being assigned on any projects.
  + Thus, even though some employees are having least experienced or zero experience, they will still be assigned to some projects to gain the experience as the organization wishes to develop their skills.
  + We need to have a mixture of senior and junior staffs, junior staffs can learn and developed their skills and competency as the worked out, we need to provide an opportunity for the junior staff to work and learn on the project developments
  + The senior staff may expect a better pay from the company and leave the company for better pay.

(ii) They did not have relevant technical experience in alignment with the task stated, hence, they require more time to learn to handle the task. Moreover, they will need close guidance from senior staff which will involve more time for senior staff to teach and guide them. Some organizations even need to send them to attend training programs and this will incur more cost which might lead to an over budget to a project.

Sample answer:

* Because the junior staff may have very ***little experience or zero experience*** which are required by the software project. Before the project is started, they have to be sent for training to equip them with the necessary skill and knowledge for the project.
* The reality is, even if they have gone through the training, the skill and experience are still not as good as those senior staff and they still need more guidance while the project is going on.
* Furthermore, due to their still “new trained” skill, they may tend to be slower in completing the assigned task which in the worst case will cause some delay in task delivery. They also tend to make mistakes and require rework that may cause a delay in the project schedule also.
* This will jeopardize the project schedule if this situation happens frequently.

(iii)

**Risk reduction** - Assigning the junior staff with non critical tasks can help to reduce the possibility of slippage/ project delays- i.e. project schedule to be delayed to happen.

1. Look for those task or activities which slack value more than 0, Most of the non-critical tasks are having buffer time to be completed (slack is not = 0 in PERT chart), at least if due to junior staffs’ still “new” and have limited knowledge and skill, they still have some extra time to complete the tasks without need to delay the overall project duration.
2. There may be a rare situation whereby the junior staffs complete the non critical tasks exceeding the buffer time deadline. At least the senior staff can take over if necessary. If the risk really happens, the project manager adopts a risk mitigation strategy to minimize the impact of the occurred risk by allowing the senior staff to take over the roles.

Sample answer:

* Risk Reduction Strategy adopted by Ms Sharon
* Miss Sharon takes some precaution measurement by assigning the junior staffs to non critical task which helps to reduce the possibility of slippage i.e project schedule to be delayed happened. Most of the non-critical tasks are having buffer time to be completed, at least if due to junior staffs’ still “new” in knowledge and skill circumstances, they still have some extra time to complete the tasks without need to delay the overall project duration.
* There may be a rare situation whereby the junior staffs complete the non critical tasks exceeding the buffer time deadline. If the risk really happens, then Miss Sharon has to adopt a risk mitigation strategy to minimize the impact of the occurred risk.
* Buffer time = activity slack is not 0 (PERT chart or CPM)

b.

* **Safety** - Safety is important as if this system failure happens when the surgery is undergoing, it will cause injury to the patient’s eyes. / It is important that the system failure MUST not occur for microkeratomes as the system failure will cause eye injuries or worse case is eyes blindness.
* **Reliability** - During surgery, the accuracy must be 100%, else, it might cause injury and affect the vision of the patient in the future. / It is important that the system performs reliably without any errors while the eye laser process is being carried out.

c.

* The pros and cons of making the change have to be evaluated.
* Additionally, the costs resulting from the change have to be evaluated too.
* If the change request is major, the project budget and schedule may be impacted. The project manager needs to evaluate the feasibility of the change and communicate with the end users on the possible consequences that they may face due the change such project delay, cost overruns
* If the end users note the impact and agree to delay the project delivery and at the same time agree to fund more budget for the change, the change can be implemented.
* However, if the end users only want the change to be implemented without adjustment to schedule and project cost, the change may not be implemented.
* If the change request from the end users is minor and does not affect any project cost and schedule, the change will be implemented most of the time.
* Spiral model is suitable because the developers have no experience building this type of system before, this is the first time they built it. The spiral model allows the developer to build the systems part by part for each iteration.
* Spiral model includes risk management which is suitable for these situations in which the developers are not familiar with the technology and user requirements are not certain yet.
* In the spiral model, each iteration will produce the prototype such as prototype 1, prototype 2 for them to review before the systems become operational after the third iteration.
* Spiral model is much more appropriate than the waterfall model because the spiral model involves risk assessment activities which will try to identify and resolve all the possible risks in the project development. Waterfall model does not have risk assessment activities included. By the time we nearly complete the project we will only know the outcomes and it might be too late to do anything already.
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* Risk factors in this scenario can be development cost overruns or any other factor that could be in stakeholders’ judgement which may result in a less-than-satisfactory final product, the stakeholders don’t want to use the final products.