1. In dot point form, summarise Thompson's critical software development information needs. What information needs did the IPT identify additional to those already known by Thompson?

Answer:

For Thompson's critical software development information needs

- 1. Lack of information about to assess the feasibility of the current schedule.

- 2. Lack of information to determine why performance against the schedule was lagging.

- 3. The overall product qualities of the development products do not meet the quality needs from project DoD's oversight committee.

- 4. The project has the risk; the existing databases which converted to the shared relational database would not only be accessed by MAPS but by future applications as well.

- 5. The project has the risk; organizational battles would get bogged down the process of data standardization needed to make the shared data concept.

The last two information needs: '4. the existing databases which converted to the shared relational database would not only be accessed by MAPS but by future applications as well' and '5. Organizational battles would get bogged down the process of data standardization needed to make the shared data concept' are identified by the IPT.

2. The combined information needs of Thompson and the IPT should allow you to develop an early indication of some of the measures that might be used to address them. Using the ICM table, construct a table showing the information needs mapped to the appropriate information categories, measureable concepts and prospective measures.

Answer:

	information needs	information categories	measureable concepts	prospective indicators
Project	1	Schedule and Progress	Work unit progress	1.Requirements traced 2.Requirements tested 3.Porblem reports opened 4.Probelm reports closed 5.Reviews completed 6.Change requests opened 7.Change requests resolved 8.Units designed 9.Units coded 10.Uunits integrated 11.Test cases attempted 12.Test cases passed 13.Test cases passed

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				14.Action items opened 15.Action items completed
	2	Process Performance	Process efficiency	1.Productivity 2.Cycle Time
	3	Product Quality	Functional correctness	1.Defects 2.Age of Defects 3.Technical Performance Level
	4	Technology Effectiveness	Technology suitability	Requirement coverage
	5	Schedule and Progress	Milestone completion	Milestone Dates

3. A basic interpretation of Figure B-6 is that more personnel are required. However, there is more that can be interpreted from the information shown. What other significant interpretations can you derive from the Figure? What concern does your interpretation lead to and what sort of impacts do you think are likely?

Answer:

We can drive from this figure

A. Effort plan start close to zero at project begin, while for the actual effort allocation, it start at almost 15.

B. The number of effort allocation increases faster than plan.

C. The majority of duration, the number of effort allocation is stability.

For A, the project start at a high level of workload, leads to the high level of effort allocation, this situation may leads to the project have many staff who are freshman to this project. More freshmen means the team needs more time to perform this project well.

For B, the great increase of workload make the number of effort allocation increase as fast as the diagram shows, this situation may leads to the project entry many freshman at same time and waste of time to let team accept these freshman, this may impact on the affectivity of team.

For C, the stability of workload leads to stability effort allocation, while from the Figure B-5, we can know that the plan level of effort allocation is not as stability as actual, that means the manager does not follow the plan to allocate the staff, he just allocate the work to suit to the number of members in his team. This action may impacts on the perform of project.

4. Cooper and Thompson had enacted a measurement approach to confirm that many problems concerning performance were due to the developers' inexperience with SQL. Thompson decided to bring in additional expertise to address the SQL issue. How could this

issue have been avoided in the first place? In your answer discuss whether PSM could help to address such information needs.

Answer:

For avoid issue which would impact on process of project, project manager should use practical software measurement to address this problem. The project manager should did the plan measurement well **by identify and prioritize information needs**, **select and specify measures** and **integrate into the project processes**. For the issue that lack of staff with experience with SQL, if the project manager could identify this information needs – staff with experience with SQL, and select a measure – **staff level** to indicate the risk of lack of experience staff, after have the plan of staff level, project manager could do **feasibility analysis** with the staff level plan. After all these steps, this issue would be avoiding in the first place.

5. Cooper's strategy for indicating progress with the Personnel Information CI enabled a more detailed and accurate view of progress. What problems did her approaches alleviate?

Answer:

For Cooper's strategy for the Personnel Information CI, She focus on problem of critical CI was lagging, while for the Figure B-8, she cannot identifies the source of problem. She analyse the information needs – lack of information to identify the source of problem, and select new measurements to help her to identify it. By dividing the Personnel Information CI to Screens and reports and Ada code, she constructed the diagrams about them and identify the source of problem came from Ada code. By her approach, the problem of lack of information to identify the source has been alleviating.

6. Which of the indicators presented in the case study provided Thompson and Cooper with leading information and which ones provided them with lagging information? Justify your answer by using the PSM Analysis Model.

Answer:

There are several indicators which are presented in the case study: 1. **The MAPS development schedule**, 2. **Effort allocation**, 3. **Implementation progress**, 4. **Problem status report**, 5. **Problem report discovered**, 6. **Test progress**, 7. **Problem report classification**, 8. **Problem report density**, 9. **Rework effort**, 10, **Installation progress**. We can map them to information categorise. **The MAPS development schedule**, **problem status report**, **problem report discovered**, **problem report classification**, **test progress**, and **problem report density** belong to **schedule and progress**, **The rework effort** belongs to **product quality**. **The effort allocation** belongs to **resource and cost**, the **implementation progress, installation progress** belong to **process performance**. From the PSM analysis model, we can know that the **technology effectiveness**, **process performance** and **product size and stability** are leading information in PSM analysis model, **resource and cost**, **schedule and progress**, **product quality** and **customer satisfaction** are lagging information in the PSM analysis model. In the other words, **implementation progress** and

installation progress are provided with leading information, the others are provide with lagging information.

7. Using the ICM table, indicate which 3 to 5 measures you consider to be the most important for maintaining control of a project similar in nature to the MAPS Project. Justify your answer.

Answer:

From PSM Analysis Model, we can know that these three 'technology effectiveness', 'process performance' and 'product size and stability' information categories are leading information in the PSM Analysis Model, in the other word, these three information categories can leading to the other four information categories - 'resources and cost', 'schedule and progress', 'product quality' and 'customer satisfaction'. If project manager want to use measure to indicate his project, and take action to address the problem in the project, he would pay more attention to the leading information in the PSM Analysis Model, because these information would identify the problem earlier than lagging information. And from the relationship between information categories, we can know that 'resources and cost' would impact on schedule and progress. In summary, I think the measures: '**effort allocation**', '**implementation progress**' and '**installation progress**' are more important for the maintaining control of a project similar in nature to the MAPS project, because implementation progress and installation progress belong to process performance and effort allocation belongs to resource and cost, they are more important than other measurement because of their information categories, they would impact on other measurement. For instance, the '**effort allocation**' would provide the information about how the effort allocation in the project, this information would impact on the project manager to make schedule plan and notice the problem like progress is lagging.

8. Using the Measurement Information Model as a work-aid and the Measurement Specification template, develop the Measurement Specifications of the measures identified in the Figure B-6 and B-14.

Answer:

For the Figure B-6, it offers the information about effort allocation. The following is the measurement information specification.

Information Need Description	
Information Need	Are the level of staffing profile meet the need of project
Information Category	Resources and Cost
Measurable Concept	
Measurable Concept	Development Effort
Entities and Attributes	
Relevant Entities	Effort allocation to the staff

Attributes	The number of effort has been allocated
Base Measure Specification	
Base Measures	1.The number of effort has been plan allocated 2.The number of effort has been actual allocated
Measurement Methods	Add every staff and number of months they worked in the team and add every staff-months number
Type of Method	Objective
Scale	Number
Type of Scale	Ordinal
Unit of Measurement	Staff-month
Derived Measure Specification	
Derived Measure	The gap number of effort allocation between plan number and actual number in the project
Measurement Function	Get the absolute of number of gap of plan number and actual number
Indicator Specification	
Indicator Description and Sample	Collect data by calculate project effort Need sample indicator
Analysis Model	The high level of gap of plan effort allocation and actual effort allocation must be evaluated with a root-cause analysis
Decision Criteria	The gap of plan effort allocation and actual effort allocation is above 15% of plan number, it must be investigated for root cause and to determine if a new effort allocation plan is needed
Indicator Interpretation	Need sample indicator interpretation
Data Collection Procedure	
Frequency of Data Collection	Every two months
Responsible individual	Project manager
Phase or Activity in which Collected	During all over the project
Tools Used in Data Collection	N/A
Verification and Validation	N/A

Repository for Collected Data	PSM Insight database
Data Analysis Procedure	
Frequency of Data Reporting	Every two months
Responsible Individual	Project manager
Phase or Activity in which Analysed	During all over the project
Source of Data for Analysis	PSM Insight database
Tools Used in Analysis	PSM Insight
Review, Report or User	2-monthly report
Additional Information	
Additional Analysis Guidance	Calculate the effort allocation should consider of the holiday of the schedule
Implementation Considerations	Staff reports their effort every week is easier way to calculate the effort by project manager to check the details of staff effort allocation every two months.

For the Figure B-14, it offers the information about test progress. The following is the measurement information specification.

Information Need Description	
Information Need	Is the increment 1 ready to begin operational test?
Information Category	Schedule and progress
Measurable Concept	
Measurable Concept	Work Unit Progress
Entities and Attributes	
Relevant Entities	Cases which are been test
Attributes	The number of test cases
Base Measure Specification	
Base Measures	1. The number of test cases which are planed 2. The number of test cases which are attempted 3. The number of test cases which are passed
Measurement Methods	Count the number of test cases which are planned, attempted and passed.

Type of Method	Objective
Scale	Number
Type of Scale	Ordinal
Unit of Measurement	Number of test cases
Derived Measure Specification	
Derived Measure	1. The ratio between passed number and attempted number 2. The ratio between passed number and planned number
Measurement Function	1. Get the absolute of number of gap of attempted number and passed number, and use gap to divide to attempted number 2. Get the absolute of number of gap of planned number and passed number, and use gap to divide to planned
Indicator Specification	
Indicator Description and Sample	Collect data by calculate number of test cases Need sample indicator
Analysis Model	1.The low level of ratio of passed test cases and attempted one must be evaluated with a root-cause analysis 2. The low level of ratio of passed test cases and planned one must be evaluated with a root-cause analysis
Decision Criteria	The ratio is lower than 85%, it must be investigated for root cause
Indicator Interpretation	Need sample indicator interpretation
Data Collection Procedure	
Frequency of Data Collection	Every two weeks
Responsible individual	Quality manager
Phase or Activity in which Collected	Evaluating readiness for test
Tools Used in Data Collection	N/A
Verification and Validation	N/A
Repository for Collected Data	PSM Insight database
Data Analysis Procedure	

Frequency of Data Reporting	Every two weeks
Responsible Individual	Quality manager
Phase or Activity in which Analysed	Evaluating readiness for test
Source of Data for Analysis	PSM Insight database
Tools Used in Analysis	PSM Insight
Review, Report or User	Readiness for test report
Additional Information	
Additional Analysis Guidance	Calculate the number of test cases should consider of the repeat one
Implementation Considerations	Test case writers could submits the report of test case statues to help manager to calculate this measurement

9. If you were the project manager of a project similar to the MAPS Project, how would you establish an effective measurement program?

Answer:

10. Provide a brief analysis of the types and sizes of organisations (including a percentage breakdown of the main organisation types and sizes) that are embarking on CMMI based improvement programs.

Answer:

From the Maturity Profile Report in September 2013, we can derive the types and sizes of organisation in the report; there are six types of process maturity profile, they are: **not given**, **initial**, **managed**, **defined**, **quantitatively managed** and **optimizing**, there are three types of organization, they are **commercial/In-house**, **contractor for military/government 1110** and **military/government agency 242**, and there are ten types of size, they are: **25 or fewer, 26 to 50, 51 to 75, 76 to 100, 101 to 200, 201 to 300, 301 to 500, 501 to 1000, 1001 to 2000, 2000+**. The following is the percentage breakdowns of the main organisation types which are embarking on CMMI based improvement programs.

Maturity type	Commercial/In-house	Contractor for military/Government	Military/Government agency
Not Given	2.2417%	0.4114%	0.6683%

Initial	0.6957%	0.1122%	0.2419%
Managed	17.2379%	5.5165%	1.8819%
Defined	50.5542%	11.3135%	0.9717%
Quantitatively	1.4687%	0.1496%	0.1558%
Optimizing	5.1018%	1.1781%	0.1804%

The following is the percentage breakdowns of the main organisation sizes which are embarking on CMMI based improvement programs.

Maturity type	25 or fewer	26 to 50	51 to 75	76 to 100	101 to 200
Not Given	1.2332%	0.2782%	0.2367%	0.2367%	0.2481%
Initial	0.3083%	0.1391%	0.0789%	0.0789%	0.0827%
Managed	13.8735%	3.1993%	1.8936%	1.7358%	1.4886%
Defined	15.4150%	10.0152%	5.3652%	5.1285%	5.6236%
Quantitatively	0.0000%	0.1391%	0.1578%	0.1578%	0.1654%
Optimizing	0.3083%	0.1391%	0.2367%	0.5523%	0.5789%
Maturity type	201 to 300	301 to 500	501 to 1000	1001 to 2000	2000+
Not Given	0.3156%	0.3385%	0.3385%	0.3312%	0.0564%
Initial	0.0789%	0.0677%	0.0677%	0.0000%	0.0564%
Managed	1.5780%	0.2708%	0.7447%	0.2070%	0.3384%
Defined	4.8918%	4.4005%	3.9943%	2.3598%	2.9328%
Quantitatively	0.3156%	0.1354%	0.1354%	0.0000%	0.0564%
Optimizing	0.8679%	0.9478%	1.5571%	1.2420%	2.3688%

11. Briefly identify and quantify the main benefits that have been reported by organisations in implementing CMMI based improvement programs.

Answer:

There are six benefits that have been reported by organisations in implementing CMMI based improvement programs, they are **Decreased Costs**, **Improved On-Time Delivery**, **Improved Productivity**, **Improved Quality**, **Improved Customer Satisfaction** and **Impressive Return on Investment.** By implementing CMMI based improvement programs, many companies get benefits from it. For **the decreased cost**, Siemens Information Systems Ltd. reduced its cost of quality from over 45 % to under 30% over a three-year period, General Dynamics Advanced Information Systems reduced maintenance staff costs by 64% while doubling the size of the organization. For **improved On-time delivery**, General Motors improved the precent of milestones met from 50% to 85%, Raytheon North Texas Software Engineering improved schedule performance by 8% with a 50% decrease in variation. For **improved productivity**, Raytheon North Texas Software Engineering improved schedule performance by 8% with a 50% decrease in variation. For **improved quality**, Siemens Information Systems Ltd. reduced defect density an average of 71% in three technical areas. For improved customer satisfaction, Lockheed Martin Management and

Data Systems increased their award fees by 55%. For impressive return on investment, Lockheed Martin Management and Data Systems increased their award fees by 55%, Siemens Information Systems Ltd. experienced 2 to 1 ROI over 3 years.

12. Identify and describe the generally accepted representations of the CMMI. In your answer, list the categorisations / groupings of the 22 process areas under each representation and explain why they are categorised / grouped in that way.

Answer:

The 22 process areas have been categorised in **four** groups, they are **Process Management** (Organization Process Definition, Organizational Process Focus, Organizational Performance Management, Organizational Process Performance and Organizational Training), **Project Management** (Integrated Project Management, Project Monitoring and Control, Project Planning, Quantitative Project Management, Requirements Management, Risk Management and Supplier Agreement Management), **Engineering** (Product Integration, Requirements Development, Technical Solution, Validation and Verification) and **Support** (Causal Analysis and Resolution, Configuration Management, Decision Analysis and Resolution, Measurement and Analysis and Process and Product and Quality Assurance). The **Process Management** contain the processes or activities that related to defining, planning, deploying, implementing, monitoring, controlling, appraising, measuring and improving process, it focus on the process of project. **Project Management** covers the project management activities related to planning, monitoring, and controlling the project, it pay more attention to the total project. **Engineering** covers the development and maintenance activities that are shared across engineering disciplines, these general engineering terminologies have been involved in the product development, it pay more attention to the quality of the product. **Support** covers the activities that support development and maintenance in the product, it focus on the support on process to apply in more general organization.

13. Explain the similarities and difference between the terms ‘capability’ and ‘maturity, Describe the components of the CMMI that are required, expected and informative.

Answer:

These two terms have the same concept, they characterise the **improvement path**, and to reach a capability or maturity level, the organisation must satisfy all the goals of the process areas in question up to and including the level in question. They provide a way to improve the processes of an organization and **measure** how well organizations can and do improve their process. These two terms both defined how the process **performance** in the project. However, the associated approach to process improvement is different, the two terms represent ‘continuous’ and ‘staged’ respectively. In other words, capability level relative to the **individual** process area capability and maturity level focus on the overall **organisation** maturity level. Capability level can be achieved by using the continuous representation, and maturity level can be achieved by using the staged representation. The capability levels has four levels, they are ‘level 0 Incomplete’, ‘level 1 Performed’, ‘level 2 Managed’ and ‘level 3 Defined’. The maturity levels has five levels, they are ‘level 1 Initial’, ‘level 2 Managed’, ‘level 3 Defined’, ‘level 4 Quantitatively Managed’ and ‘level 5 Optimizing’.

14. Why is SP3.2 in the Project Planning process area important when estimating and planning a project?

Answer:

The SP3.2 in the Project Planning process area is ‘reconcile work and resource level’. It is important in adjust the project plan to reconcile available and estimated resources because it can make the plan **realistic**. The project should be feasible, so obtain commitment from relevant stakeholders and reconcile differences between estimates and available resources are important. When facing some fixed factors in the project background, it is important for project managers to adjust the project plan and make it feasible. For instance, reconcile the scope, time and cost factor in the project, and make them balance in the plan. After this action, the project plan can be estimate a really and reliable project. Without this action, the project plan is unrealistic and useless.

15. Which specific practice under which process area identifies the need to maintain bi-directional traceability between requirements and project work products? What would bi-directional traceability allow a project to do?

Answer:

The **specific practice 1.4** (maintain bidirectional traceability of requirements) in **Requirements Management** identifies the need to maintain bi-directional traceability between requirements and project work products. It helps the project to covers relationships to other entities, and it particularly assess the impact of requirements changes on project activities and work products. It also can helps to determine whether all source requirements have been completely addressed and whether all lower level requirements can be traced to a valid source.

16. Which specific practice under which process area describe what should be done when mitigating risks? Describe the typical mitigation actions that are available for most projects. Which project risks would typically be mitigated?

Answer:

The **specific practice 3.1** (develop risk mitigation plans) in **Risk Management** describe what should be done when mitigating risks. There are **five** ways to handle the risk; they are ‘accepted risk’ (acknowledging and no action), ‘reduce probability of the risk and keep consequence of the risk’, ‘keep probability of the risk and reduce consequence of the risk’, ‘reduce both’ and ‘transfer / share the risk’. The risk which are related to objective factors would be typically mitigated, because for the objective risks, it is easy to reduce the probability or reduce the consequence, no matter change the scope or change the requirement, they are easy to monitor and control. However, the subjective factors like staff level, they are hard to identify, monitor or control.

17. Explain the significance of SP3.1 in the Requirements Development process area. In your answer, don’t just focus on the establishment of operational concepts and scenarios but

also explain how these are used throughout the engineering lifecycle. (every changed should be test by two items)

Answer:

The SP3.1 in the Requirements Development process area is 'Establish Operational Concepts and Scenarios'. It describes establish and maintain operational concepts and associated scenarios. This practice is signification is not only the importance of scenario and operational concepts, but also the importance of it going through the whole engineering lifecycle. Testing the requirement would impact on the quality of the product. And this practice is **validating** the feasibility of the requirement. However, project manager have **no time to test everything** in the requirement across the lifecycle. Then we use the operational concepts and associated scenarios which have been established in this practice to make explicit some of the functional or quality attribute needs of the stakeholders. Then we could use these items to improve the processes of projects and product.

18. Explain the difference between verification and validation. In your answer provide examples of verification and validation activities. (add work product)

Answer:

For the verification, it focuses on the ensuring the selected work products meet their requirements, and validation focuses on demonstrating that a product or product component fulfils its intended use when placed in its intended environment. In other words, verification consider of the product is been built in the way which based on the input information (requirement), and validation consider of the product whether meet the intended used environment. In short, validation test the product is useful, and verification tests the product meet the requirement. The **verification** involves the following activities: evaluation work products against specification, conducting product quality evaluations compared with quality assurance evaluations. The validation involves the following activities: evaluating work products against operational concepts and use scenarios, determining the 'fitness for use' of work products.

19. Describe the significance of conducting peer reviews when identifying and removing defects. In your response, discuss the importance of each specific practice under Specific Goal 2 of the Verification process area. (combine sg1 and sg3)

Answer:

From the Specific Goal 2 of the Verification process area, peer reviewing is significance way on identify and remove defects on the selected work products. For the identifying and removing defects, it should be performed in a right and effective way. The specific practice 1 'prepare for peer reviews' is identifying the staff to be invited to participate in the peer review of work product and preparing and updating materials to be used during peer review. This practice would help to make appropriate staff to review this product and right criteria have been reviewed. This action would make the right people to identify the defects in

product based on the right materials; it can make the defects identified in a right way. The specific practice 2 ‘conduct peer reviews’ is conduct peer reviews products and identify issues resulting from these review, this action would identify the defects and issues in the work product and record the results of the peer review. This practice would help project manager getting the peer review results, issue and data, and get the defects in the product. The specific practice 3 ‘analyze peer review data’ is analyse how long it would take to review, who will do this job and this review is effective or not. This action would make the peer review performs in an effective way, and make project manager to know the cost of defects removing. This practice could make the defects removed in an effective and appropriate way.

20. **Answer**:

Practice	Characterisation (FI, LI, PI, NI or NY	Strength(s)/Weakness(es)	Objective Evidence - Artifacts, - Affirmation
RM SP 1.4	PI	(S) The Telelogic DOORS helps the system manager to manage the requirements and their relationships. (W) The Telelogic DOORS has not yet make requirement trace flow down to the lower level requirements.	(Artifact) Telelogic DOORS (Affirmation) Interview session with software engineer