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Achieving on-Time IT Project Delivery in an Indonesian Car Manufacturer

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Abstract

To stay ahead of competition in the Indonesian market, one of the car manufacturers in Indonesia commits to digitalization by improving project management in IT projects. This improvement is needed due to the increasing number of IT projects with IT project delays between 2021 and 2024, which is hindering the Corporate Information Technology (CIT) division from achieving its KPI of 80% on-time project delivery. To address this issue, CIT needs to understand their current project management maturity level by conducting a CMMI level 2 assessment using the SCAMPI method. The output of this assessment is the score of each process area in CMMI level 2. After understanding which process area that still not yet passed the settled passing rate, CIT can further analyze which process area in CMMI level 2 to prioritize for improvement by using Pareto analysis. Finally, after getting Pareto of each process area in CMMI level 2, authors will give recommendations on each process area based on the previous study and analysis. This research will help the corresponding company and related fields on how to improve IT project management using CMMI level 2, SCAMPI and Pareto analysis.

Keywords: *Project Management, CMMI Level 2, SCAMPI, Pareto Analysis.*

Introduction

In response to commitment to digitalization, one of the car manufacturers in Indonesia from 2021 until 2024 has been increasing the number of IT projects that are being received and managed by the Business Relations department shown in Figure 1.

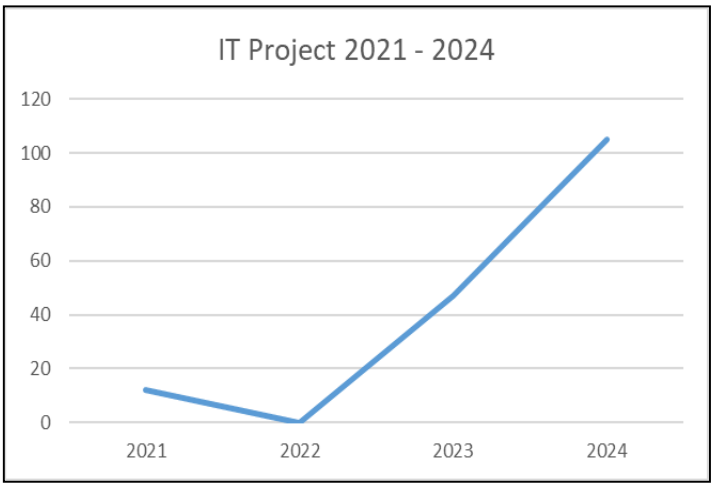

Figure 1: IT Project Receiving

Despite this constant growth of digitalization in IT projects, there is are increasing number of project delays that have happened in the CIT division. Therefore CIT division cannot achieve its KPI of 80% on

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time project delivery shown in Figure 2. This delay may lead to further issues such as compliance, competitive disadvantages, and inefficiency in resource utilization.

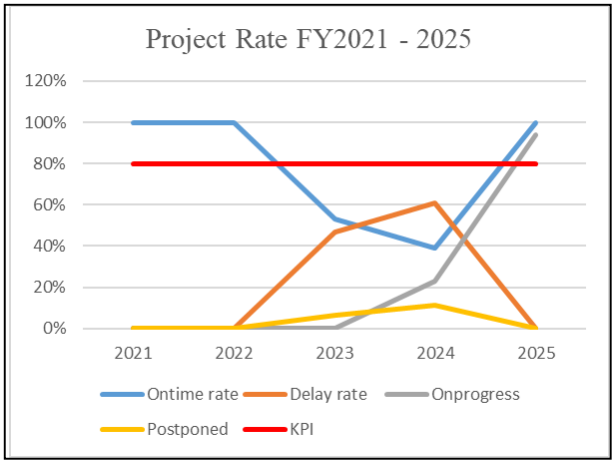

Figure 2 IT Project Delay Rate

Therefore, in order for CIT division can meet its KPI needs to understand the current position of the CIT division for project management handling and managing projects. One of the tools that can help understand and appraise the current position of CIT's project management process maturity using Capability Maturity Model Integration (CMMI) [1]. To appraise CMMI, one of the tools that can be used is SCAMPI. [2]. After understanding of current CIT's project management CMMI level 2, the usage of Pareto Analysis can help further understand which factors to improve in CMMI maturity level 2. After using Pareto [3], will be able to give recommendations on fixing the core problem.

RQ1: How does CMMI level 2 able to identify root causes of IT project delay?

RQ2: Which CMMI level 2 process area have the most significant impact on IT project delay?

RQ3: How to fix CMMI level 2 process area that has the most significant impact on IT project delay?

Methods

This research will conduct an assessment of IT project management steps that are needed to achieve efficient and effective available resource usage [4]. One of the tools that of project management that is used to ensure continuous workflow, which has a multidirectional flow in an organization, is CMMI, to help deliver tangible benefits in project management [5]. Also, CMMI is being used by organizations to guide in improving their process, measuring maturity level of each area, and enhancing business processes. [6]. According to Hashim (2024) [7] An IT company in the UAE uses CMMI as a framework to assess, evaluate, and improve the organization's processes to meet customer demands. CMMI assessment will be conducted in project management. CMMI measures five levels of maturity, such as:

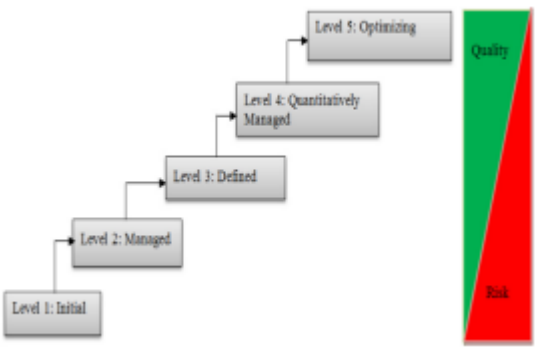

Figure 3 CMMI Maturity Level [8]

Each process area in CMMI has to be fulfilled before moving to the next CMMI maturity level. Some of the areas can be marked as out of scope or not included if the actual process does not have or is not relevant in that process area of CMMI. Below each process area of CMMI is based on maturity level:

5	OID	CAR		
4	QPM	OPP		
3	VER	VAL	TS	RSKM
	RP	PI	OT	OPF
	OPD	IPM	DAR	
2	SAM	REQM	PP	PMC
	PPQA	MA	CM	
1				

Figure 4 CMMI Areas [9]

Standard CMMI appraisal method for process [2]. To asses the strengths and weaknesses of the current software based on the CMMI model called SCAMPI. In the CIT division case, SCAMPI method can be used to asses CMMI level 2. Overall, in this research, the SCAMPI method in the CIT division consists of these steps:

1. Analyze Requirement

In this step, we will define which CMMI area level 2 will be included in assessment based on whether relevant on root causes of IT project delay or not. Next, choose which strategy that will be used in data collection such as discovery, managed discovery and verification. Finally choose scoring result on CMMI level 2 for each process area.

2. Develop Appraisal Plan

Tailor method which item that will be used for assessment, identify needed resource for assessment, such as team support, organization, and facilities, develop a data collection plan for each area CMMI that wants to asses, document and manage risk that will cause delay on SCAMPI, and how to mitigate those.

3. Obtain and Inventory Initial Objective Evidence

This step consists of obtaining initial objective evidence that will be used for SCAMPI assessment. These documents will be divided into artifact and affirmation.

4. Preparation to Conduct Appraisal

This step involves preparing participants that will conduct SCAMPI, examining objective evidence that already inventoried in initial inventory of objective evidence, document objective evidence, verify objective evidence consist of both artifacts and affirmations, validate preliminary findings and generate appraisal results in form of CMMI level. Scoring will be based on table below:

Table 1 SCAMPI Scoring on CMMI Process Areas

Abbreviation	Criteria	Scoring
NY	Not Yet	0
NI	Not Implemented	0
PI	Partially Implemented	1
LI	Largely Implemented	2
FI	Fully Implemented	3

Also in this activity will check each objective evidence that already obtained and prepare questionnaire that will be distributed to CIT department regarding implementation of each process area in CMMI level 2.

5. Preparing Participants

Questionnaire will be distributed to project manager in CIT division to further understand of practice score of each CMMI level 2 process area based on their project implementation and practice. In this questionnaire distributed to some position such as supervisors, foreman, and member.

6. Checking Objective Evidence

Checking each objective evidence that already stored as initial objective evidence, check each document validity and group each document into objective evidence artifact and affirmation.

7. Documenting Objective Evidence

Documenting each process using attendance data for questionnaire, interview and each step of CMMI level 2 assessment using SCAMPI.

8. Verify Objective Evidence

Verify each objective evidence and process area of CMMI level 2 whether already fulfilled or not. For further additional need of objective evidence in each process area of CMMI level 2 can be add later on.

9. Validate Early Findings

Validation of early findings based on questionnaire that distributed to each project manager in CIT. Each project manager will fill scoring on each CMMI level 2 process area with NY, NI, PI, LI and FI. Finally, all CIT project manager's respond will be collected and compiled.

10. Create Scoring Result

Scoring CMMI level 2 will have two categories: practice score and document score. First for document score (DS) will be given for each CMMI level 2 process area objective evidence. If objective evidence in that area still using affirmation will be given 0 score, otherwise affirmation will be given 100 score.

For practice score will be counted based on questionnaire that already shared to each project manager in CIT. First to get maximum CMMI process area score (MCPAS) by multiplying number of participants (NP) with maximum scoring value for CMMI scoring criteria which fully implement in score of 3.

$$NP \times 3 = MCPAS$$

After getting MCPAS, each process area of CMMI level 2 will be counted and scored as CMMI level 2 process area (C2PA). After that practice score (PS) can be counted by dividing C2PA with MCPAS and multiply with 100%.

$$\frac{C2PA}{MCPAS} \times 100\% = PS$$

After getting document score (DS) and practice score (PS) can count final score (FS) by adding DS and PS divided by 2.

$$\frac{DS + PS}{2} = FS$$

Finally set passing standard of each CMMI level 2 process area by 90%. For each process area that not pass passing standard of 90% will be grouped and analyze in the next step using Pareto.

Pareto Analysis

After getting FS, utilize Pareto analysis that involves statistical data such as region, type, data, and many more [3]. Pareto analysis consists of two categories: vital few or 80% which holds the most amount of data but less impact on overall case. And useful many or 20% which holds less amount of data but more impact of overall case. In this research, set passing standard of each CMMI level 2 process area by 90%. For each process area that not pass passing standard of 90% will be grouped and analyze in the next step using Pareto.

$$FS - 90\% = FSG$$

After getting FSG, get total FSG score (TFSG) and get contribution of CMMI GAP (CCG) by dividing FSG with TFSG multiply by 100%. Finally, after getting CCG will be sort and analyze with Pareto analysis.

Give Conclusion and Feedback

Using Pareto analysis will able to pinpoint which CMMI level 2 process area that need to be focus on fix and improving first based on recommendation feedback.

Result and Discussion

Result and discussion based on SCAMPI by checking CMMI level 2 process area and analyze each process area using Pareto. In this result and discussion consist of:

Analyze Requirement

In CIT project receiving and management will use CMMI level 2 process area that will be included in assessment:

Table 2 CMMI Level 2 Process Areas

No	CMMI Area	Scoring
1	Requirements Management	Yes
2	Project Planning	Yes
3	Project Monitoring and Control	Yes
4	Supplier Agreement Management	Yes
5	Measurement and Analysis	No, Out of Scope
6	Process and Product Quality Assurance	Yes
7	Configuration Management	Yes

Develop Appraisal Plan

Using tailor method from SCAMPI to determine which item that will be used in this assessment such as determine appraisal objective, determine data collection strategy, determine appraisal scope, determine appraisal outputs, prepare team, select team members, inventory objective evidence, examine objective evidence form artifacts, examine objective evidence form affirmations, determine process area ratings, determine process area profile, determine maturity level and plan for next step.

Obtain and Inventory Initial Objective Evidence

These are initial objective evidence that will be used for SCAMPI assessment of CMMI level 2 process area below:

Table 3 CMMI Level 2 Objective Evidence Grouping

Process Area	Steps	Data
Requirements Management	Obtain an Understanding of Requirements	Proposal / Change Request Form, High Level Requirement
	Obtain Commitment to Requirements	Approval Proposal / Change Request Form, High Level Requirement
	Manage Requirements Changes	Request / Change Log
Project Planning	Estimate the Scope of the Project	High Level Requirement, Request for Proposal
	Establish Estimates of Work Product and Task Attributes	Vendor Assessment
	Determine Estimates of Effort and Cost	Vendor Assessment
	Establish the Budget and Schedule	Vendor Quotation, WBS
	Reconcile Work and Resource Levels	WBS

Project Monitoring and Control	Monitor Project Planning	ProjectID
	Conduct Progress Review	Project Weekly Meeting, Monthly Man-days Update
	Analyse Issues	Issue list
	Take Corrective Action	Fixing Action
	Manage Corrective Action	Fixing Action, Issue list
Supplier Agreement Management	Select Suppliers	Vendor Assessment, Vendor Selection, Bidding
	Establish Supplier Agreements	Request for Proposal, Quotation
	Execute the Supplier Agreement	Project Development Progress Update
	Accept the Acquired Product	Go-live Document
Process and Product Quality Assurance	Objectively Evaluate Work Products and Services	User Acceptance Test / Testing Document
Configuration Management	Track change request	Change Request Form, Issue List

Preparation to Conduct Appraisal

Preparing passing grade of final score of CMMI level 2 process area of 90%. After setting passing grade for final score, setting document score that already collected if objective evidence in that area artifacts set score 100% otherwise set score 0%. Finally for practice score collected using questionnaire and distributed to each project manager in CIT division.

Preparing Participants

Each project manager from different position such as supervisors, foreman, and member in CIT give scoring to each CMMI level 2 process area that included in assessment. To further understand of practice score of each CMMI level 2 process will be scored with CMMI process area scoring NY, NI, PI, LI and FI based on their practice during handling project management in CIT division.

Checking Objective Evidence

Grouping objective evidence that collected based on type artifact and affirmation.

Table 4 CMMI Level 2 Objective Evidence

No	Document	Type
1	Proposal	Artifact
2	Change Request Form	Artifact
3	High Level Requirement	Artifact
4	Request / Change Log	Affirmation
5	Request for Proposal	Artifact
6	Vendor Assessment	Artifact
7	Vendor Quotation	Artifact
8	WBS	Artifact, Affirmation
9	ProjectID	Artifact
10	Project Weekly Meeting, Monthly Man-days Update	Artifact, Affirmation
11	Issue list	Artifact
12	Fixing Action	Artifact
13	Vendor Selection, Bidding	Artifact
14	Project Development Progress Update	Affirmation
15	Go-live Document	Artifact
16	User Acceptance Test / Testing Document	Artifact

Documenting Objective Evidence

Attendance data of questionnaire that shared in CIT division project manager below:

Table 5 Attendance Questionnaire CMMI Level 2 Process Area Assessment in CIT Division

Title	Year of Experience			Qty
	1 - 5	6 - 10	> 10	
Supervisor	5	2	3	10
Foreman	4	2	0	6
Member	0	0	1	1
Total	9	4	4	17

Verify Objective Evidence

Verify each objective evidence in each process area of CMMI level 2, if objective evidence in that process area consist of artifact will be scored 100%. If objective evidence in that process area only consist of affirmation will be scored with 0%.

Validate Early Findings

Questionnaire on practice scoring that distributed to each project manager in CIT. To fill CMMI level 2 process area score with NY, NI, PI, LI and FI result below:

Table 6 Questionnaire Result of CIT Project Manager on CMMI Level 2 Process Area

No	Process Area	Count				
		NY	NI	PI	LI	FI
1	Obtain an Understanding of Requirements	0	0	2	7	8
2	Obtain Commitment to Requirements	0	0	2	9	6
3	Manage Requirements Changes	0	1	6	3	7
4	Estimate the Scope of the Project	0	1	3	6	7
5	Establish Estimates of Work Product and Task Attributes	0	1	3	6	7
6	Determine Estimates of Effort and Cost	0	2	1	2	12
7	Establish the Budget and Schedule	0	1	3	5	8
8	Reconcile Work and Resource Levels	0	2	3	6	6
9	Monitor Project Planning	0	1	1	6	9
10	Conduct Progress Review	0	0	4	6	7
11	Analyse Issues	0	0	4	3	10
12	Take Corrective Action	0	1	5	4	7
13	Manage Corrective Action	0	0	2	8	7
14	Select Suppliers	0	1	5	2	9
15	Establish Supplier Agreements	0	0	5	3	9
16	Execute the Supplier Agreement	0	0	2	9	6
17	Accept the Acquired Product	0	0	0	3	14
18	Objectively Evaluate Work Products and Services	0	0	0	3	14
19	Track change request	0	0	4	3	10

Create Scoring Result

Scoring will have 2 factor, document score (DS) and practice score (PS). First, DS found on each CMMI level 2 process area based on objective evidence:

Table 7 Document Score on CMMI Level 2 Process Area

No	Process Area	Type	Doc. Score
1	Obtain an Understanding of Requirements	Artifact	100%
2	Obtain Commitment to Requirements	Artifact	100%
3	Manage Requirements Changes	Affirmation	0%
4	Estimate the Scope of the Project	Artifact	100%
5	Establish Estimates of Work Product and Task Attributes	Artifact	100%
6	Determine Estimates of Effort and Cost	Artifact	100%
7	Establish the Budget and Schedule	Artifact, Affirmation	100%
8	Reconcile Work and Resource Levels	Artifact, Affirmation	100%
9	Monitor Project Planning	Artifact, Affirmation	100%
10	Conduct Progress Review	Artifact, Affirmation	100%
11	Analyse Issues	Artifact	100%
12	Take Corrective Action	Artifact	100%
13	Manage Corrective Action	Artifact, Affirmation	100%
14	Select Suppliers	Artifact	100%
15	Establish Supplier Agreements	Artifact	100%
16	Execute the Supplier Agreement	Affirmation	0%
17	Accept the Acquired Product	Artifact	100%
18	Objectively Evaluate Work Products and Services	Artifact	100%
19	Track change request	Artifact, Affirmation	100%

Next, finding maximum CMMI process area score (MCPAS) by multiplying number of participants (NP = 17) with maximum scoring value for CMMI scoring criteria which fully implement in score of 3.

$$17 \times 3 = 51$$

MCPAS = 51

After getting MCPAS equals to 51, each process area of CMMI level 2 will be counted and scored as CMMI level 2 process area (C2PA). After that practice score (PS) can be counted by dividing C2PA with MCPAS and multiply with 100%.

$$\frac{\text{C2PA}}{\text{MCPAS}} \times 100\% = \text{PS}$$

With the result of each practice area of CMMI level 2 below:

Table 8 Final Score on CMMI Level 2 Process Area

No	Process Area	PS	DS	FS
1	Obtain an Understanding of Requirements	78,43%	100,00%	89,22%

2	Obtain Commitment to Requirements	74,51%	100,00%	87,25%
3	Manage Requirements Changes	64,71%	0,00%	32,35%
4	Estimate the Scope of the Project	70,59%	100,00%	85,29%
5	Establish Estimates of Work Product and Task Attributes	70,59%	100,00%	85,29%
6	Determine Estimates of Effort and Cost	80,39%	100,00%	90,20%
7	Establish the Budget and Schedule	72,55%	100,00%	86,27%
8	Reconcile Work and Resource Levels	64,71%	100,00%	82,35%
9	Monitor Project Planning	78,43%	100,00%	89,22%
10	Conduct Progress Review	72,55%	100,00%	86,27%
11	Analyse Issues	78,43%	100,00%	89,22%
12	Take Corrective Action	66,67%	100,00%	83,33%
13	Manage Corrective Action	76,47%	100,00%	88,24%
14	Select Suppliers	70,59%	100,00%	85,29%
15	Establish Supplier Agreements	74,51%	100,00%	87,25%
16	Execute the Supplier Agreement	74,51%	0,00%	37,25%
17	Accept the Acquired Product	94,12%	100,00%	97,06%
18	Objectively Evaluate Work Products and Services	94,12%	100,00%	97,06%
19	Track change request	78,43%	100,00%	89,22%

After getting final score on each CMMI level 2 process area will compare with passing standard of 90% and will be grouped and analyze in the next step using Pareto.

Pareto Analysis

Pareto analysis starts by determine final score gap (FSG) between FS and passing rate of 90% of each process area.

$$FS - 90\% = FSG$$

After getting FSG, get total FSG score (TFSG) and get contribution of CMMI GAP (CCG).

$$\frac{FSG}{TFSG} \times 100\% = CCG$$

With the result of CCG in each practice area item number of CMMI level 2 below:

Table 9 Pareto on CMMI Area Level 2

No.	FS	FSG	CCG	Cumm	Pareto
3	32,35	57,65	36,79%	36,79%	yes
16	37,25	52,75	33,67%	70,46%	yes
8	82,35	7,65	4,88%	75,34%	yes
12	83,33	6,67	4,26%	79,60%	yes
4	85,29	4,71	3,01%	82,60%	yes
5	85,29	4,71	3,01%	85,61%	
14	85,29	4,71	3,01%	88,61%	
7	86,27	3,73	2,38%	90,99%	
10	86,27	3,73	2,38%	93,38%	
2	87,25	2,75	1,76%	95,13%	
15	87,25	2,75	1,76%	96,89%	
13	88,24	1,76	1,12%	98,01%	
1	89,22	0,78	0,50%	98,51%	
9	89,22	0,78	0,50%	99,00%	
11	89,22	0,78	0,50%	99,50%	
19	89,22	0,78	0,50%	100,00%	

Finally, after getting CCG will be sort and analyze with Pareto analysis.

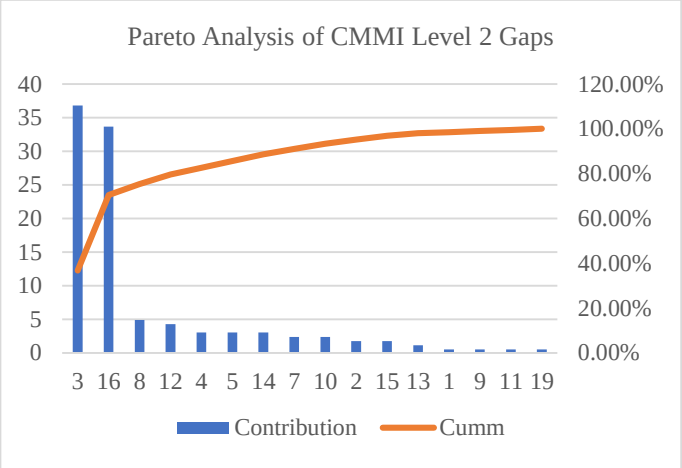

Figure 5 Pareto Graphic on CMMI Area Level 2

Give Conclusion and Feedback

Based on Pareto, there are 5 process area of CMMI level 2 need to be focused on fixing such as:

Table 10 Pareto Result on CMMI Area Level 2

No	Steps	Contribution	Cumm
3	Manage Requirements Changes	36,79%	36,79%
16	Execute the Supplier Agreement	33,67%	70,46%
	Reconcile Work and Resource Levels	4,88%	75,34%
12	Take Corrective Action	4,26%	79,60%
4	Estimate the Scope of the Project	3,01%	82,60%

Hereby recommendations for each CMMI level 2 steps that are included in Pareto such as:

a. Manage requirements changes: further enhancement of manage requirements changes can be done by implementing 5 items below.

Table 11 Implementation on CMMI Level 2 Area Manage Requirement

No	Items	Artifact / Affirmation	Status
1	Adding clear starting and project completion	Change request form, ticket number and proposal	Implemented
2	Adding segregation of duty	ProjectID	Implemented
3	Adding more formal verification in IT project verification	Change request form, ticket number and proposal	Implemented
4	Implement automatic integration tools	Implement integrated tool in change request	Not Implemented
5	Implement traceability matrix	Record history change status in system	Not Implemented
6	Implement audit and suggestion for next improvement	Issue list and fixing	Implemented

Focus on item number 4 and 5 on implementing automatic integration tools and implement traceability matrix on system changes.

b. Execute the supplier agreement: using JIRA ticketing to monitor IT project execution [4] such as document centralization and transparency in IT project status update

c. Reconcile work and resource levels: can be done by having historical data on assessment [10] of previous IT project, validate with stake holder, integrate risk with artifact and implement continuous project monitoring such as WBS.

d. Take corrective action: implementing fixing steps such as initiation, evaluation, implementation, verification, and closure [11]. Based on implemented artifacts such as issue list and fixing action can be directly monitor more organized in each step.

e. Estimate the scope of the project: in creating estimation project scope by implementing 4 elements such as plan, create, review meeting, and rework or update [12]. Based on implemented artifacts such as request for proposal and high-level requirement. First create scope estimation of IT project, then create meeting review to validate scope of IT project. After that validate if there is scope and out of scope of IT project. Finally rework or update if needed.

Conclusions

In conclusion, based on CMMI level 2 assessment conducted there are 3 main item such as:

1. RQ1: How does CMMI level 2 able to identify root causes of IT project delay?
2. By identify each CMMI level 2 process area using practice score using assessment that shared with IT project manager in CIT division and document score combined to create final score of each process area of CMMI level 2. Each process area will be compared with passing standard of 90% and further analyse using Pareto.
3. RQ2: Which CMMI level 2 process area have the most significant impact on IT project delay? By using Pareto, there are 5 main process area that have the most significant impact on IT project delay such as manage requirement changes, execute supplier agreement, reconcile work and resource level, take corrective action, and estimate the scope of the project.
4. RQ3: How to fix CMMI level 2 process area that have the most significant impact on IT project delay?

Based on 5 main process area of CMMI level 2 found using Pareto, to fix each main process area of CMMI level 2 Pareto by enhance requirement changes using digital system management and automated tools, use JIRA to help monitor IT project status by supplier, use historical data of previous project to reconcile IT resource level, implement steps to take corrective action, and create estimation based on 4 elements such as plan, create, review and rework or update.

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