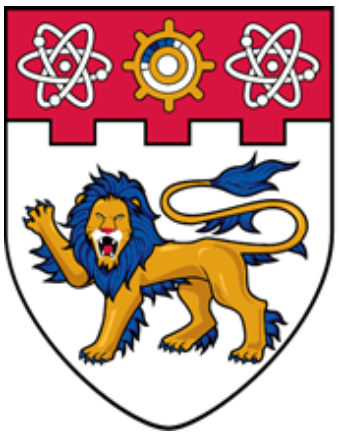

NANYANG TECHNOLOGICAL UNIVERSITY
SINGAPORE

CZ3002 Advanced Software Engineering Project:

CMMI Level 2 Definition - CashTrack

Version 1.3

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VERSION HISTORY

Version #	Implemented By	Revision Date	Approved By	Approval Date	Reason
1.0	Alex Leong, Ravishankar Amrita, Anusha, Daniel Loe, Elliott Ong, S Sri Kalki, Kumar Mehul	24th March 2021	Nicklaus	25th March 2021	Initial CMMI Level 2 definition draft
1.1	S Sri Kalki	27th March 2021	Nicklaus	28th March 2021	Revision to Appendixes C, D, E
1.2	Alex Leong	31st March 2021	Nicklaus	1st April 2021	Revision in Responsibilities
1.3	Alex Leong, Ravishankar Amrita, Anusha, Daniel Loe, Elliott Ong, S Sri Kalki, Kumar Mehul	3rd April 2021	Nicklaus	3rd April 2021	Final changes & revision for all sections

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1. Executive summary

1.1 Purpose

This document describes the CMMI (Capability Maturity Model Integration) model(s) that CashTrack used, in particular the CMMI Level 2. It also provides the framework for developing and improving processes such that the intended goals of this project can be met.

The KPAs (Key Process Areas) this document will focus on in respect to the CMMI Level 2 requirements are:

- Requirements Management
- Project Planning
- Software Quality Assurance
- Configuration Management

1.2 Summary of definition

The below table shows a summary of characteristics the processes in our project will demonstrate (CMMI Level 2):

Level	Characteristic	Key Process Area	Results
2 Repeatable	(Intuitive) Process dependent on individuals	Requirements Management Project Planning Software Quality Assurance Configuration Management	As CMMI Maturity Level increases, 1) Productivity and quality ↑ 2) Risk ↓
1 Initial	(Ad hoc/chaotic)	Survival	

The ‘Repeatable’ description of the adopted Level 2 model implies that some processes are repeatable and produce consistent results. Although process discipline at this level is not scrutinized, the project team will enforce consistency where possible to ensure that processes are maintained for reusability and optimization.

2. Description

This section states the description of additional desired features about the work product, the work product status, the stakeholders of the work products, their commitments, and how it relates to the processes for projects at CMMI1.3 level 2.

<table>
<tr><th>Additional Desired Features</th><th>Work Product Status</th><th>Stakeholders</th><th>Commitments</th></tr>
<tr><td>Adding acknowledgement for each individual in a group for a shared expense record</td><td>Pending Approval</td><td rowspan="2">Lead Developer

Quality Assurance Manager

Project Manager

Change Manager</td><td rowspan="2">Lead Developer is in charge of providing the feasibility/impact analysis of the desired features from a technical point of view

Quality Assurance Manager is in charge of providing the feasibility/impact analysis of the desired features from a quality assurance point of view as well as the testing of the features once implemented

Project Manager will be in charge of accepting or rejecting the features

Once accepted, the Change Manager will process and log the change request</td></tr>
<tr><td>Verification that user must not have any outstanding payments for a shared expense record before leaving a group</td><td>Pending Approval</td></tr>
</table>

Using the above table as an example, we can see that the steps for executing any change follows a consistent flow of how they will be accepted and implemented.This relates to the repeatable definition of the CMMI Level 2 model where we aim to achieve consistency in results from repeatable execution of processes.

3.Level 2 KPAs

3.1 Requirements Management

3.1.1 Process Goal

System Requirement Specification (SRS) is a document that details the analysis and priorities of, and the agreement on the customer's requirement for the software. This agreement with the customer is the basis for planning and managing the software project.

3.1.2 Commitment to Perform

Establish and maintain an organization policy for planning and performing the requirement Management process

- All requirements are documented in SRS such as use case model and use case descriptions
- All requirement will be reviewed by Lead Developer and approved by Project Manager
- All the requirement will be discussed with both QA Manager & Engineer and development team to ensure the feasibility of the plan

3.1.3 Ability to Perform

Establish and maintain the plan performing SRM

- All functional and non-functional requirements will be discussed by both QA Manager & Engineer and development team to assess the feasibility
- Every requirement will be analyzed and allocated with hardware, software and other system components
- The stakeholders for the requirements will be determined by the Project Manager
- The constraints and preconditions for the requirements will be documented in the SRS

3.1.4 Activities Performed

Identify and involve the relevant stakeholders of the SRM as planned

- All functional requirements are documented in the use descriptions SRS
- Non-functional requirements are identified and discussed by the development team and documented in the SRS

Monitor and control the SRM against the plan for performing the process and take appropriate corrective action

- Completed tasks are reviewed and tested to determine whether they are consistent with the requirements
- Changes to the allocated requirements are reviewed and documented in the change log

3.1.5 Measurement and Analysis

Measurement are made and used to determine the status for managing the software allocated requirements

- Changes to the requirements
- Status of each of the requirements

3.1.6 Verifying Implementation

Review the activities, status and results of the SRS with management and resolve issues

- All the changes made for the requirements are required to the reviewed by Lead Developer and approved by the Project Manager
- All the changes are documented in the change log
- The requirement review is led by QA Manager & Engineer
- QA Manager & Engineer reviews and audits the work products for the software requirements

3.2 Project Planning

3.2.1 Process Goal
The Project Plan is a document that establishes practicable plans for performing software engineering and managing the software project. The reasonable plans should be developed based on realistic estimates for the development work and necessary commitments to perform the work. It starts with the Statement Of Work (SOW), project constraints and goals that define and bind the development of the project.

3.2.2 Commitment To Perform
Establishing and maintaining company policy for planning and performing necessary project planning activities:

- The project manager will be in charge for the planning phase of the project
- Changes that are to be made has to be approved by the Change Control Board (CCB), the project manager will then communicate the changes to the development team and stakeholders
- The Project Plan ensures that the requirements for the software project can be completed by the specified dateline

3.2.3 Ability To Perform
Establishing and maintaining a plan for the formulation of the project planning process:

- The Project Plan document must include the scope of work, identify the stakeholders involved in the project, assigning responsibilities for members of the development team, estimated cost for the project, schedules for the different phases of the project, contains of the project and goals of the project

Providing ample resources to carry out planned processes, develop a work product and provide services for these processes:

- Software tools to carry out project planning are available for Team Runtime Terror (JIRA, Microsoft Projects, Google Docs, Google Sheets)

Assigning responsibility and authority for performing these processes, developing a working product and providing services to the project planning process:

- The project manager will be responsible for assigning the software work product planning

3.2.4 Activities To Perform
Placing nominated work products from the project planning process under an appropriate level of configuration management:

- Software project planning will be carried out during the initial stages of the Software Development Life Cycle (SDLC)
- The costs and effort that will be needed for the completion of the project has to be determined for each phase of the SDLC
- The version numbers of the Software Configuration items can be used to determine the progress of the work products

Identifying relevant stakeholders and get them involved in the project planning:

- Distinct tasks will be allocated with different amounts of resources, budget and time duration
- The project manager will communicate with stakeholders and evaluate the practicality of the Project Plan
- The project manager will be responsible for identifying the project task dependencies based on the available resources

Monitoring and controlling the project planning process according to the predefined plan for performing the planning process and taking appropriate corrective actions:

- Stakeholders will be required to list down all possible constraints to the project manager
- The project manager has to be updated on all delays and changes to a task
- The development team must evaluate the Project Plan document with the project manager regularly to ensure that the project is keeping to its schedule by using a product checklist, best practice checklist, design checklist and system test checklist that is provided in the Project Plan document

3.2.5 Measurement and Analysis

Measurements will be created and used to determine the status of managing the subcontracts of the software:

- Milestones for the software project planning activities can be used by the project manager as a valid measurement
- Cost and time spent to complete milestone
- Effort spent to complete milestone
- The project manager will be responsible to estimate the Adjusted Function Points and estimated Lines Of Codes for the project

3.2.6 Verifying Implementations

Reviewing activities, status and outcome from the project planning process with stakeholders and fix any issues that may have arised:

- The Project Plan document will be evaluated by the Project Manager, QA Manager, QA Engineer and Lead Developer to determine its feasibility
- Regular reviews will be done between the Project Manager and the CashTrack development team to achieve a mutual understanding of the status and progress of the work product

3.3 Software Quality Assurance

3.3.1 Process Goal

The Quality Plan document will help to provide stakeholders with the necessary clarity of the development processes that will be used during the software project and also insights of the product that will be built. This can be achieved by having proper software reviews and audits for the software product activities which helps to verify if the software is complying with the required standards and meets the project requirement specifications.

3.3.2 Commitment To perform

Establishing and maintaining company policy for planning and performing necessary project quality assurance activities:

- The QA Manager and QA Engineer will act as internal auditors to evaluate the work product and also the development processes of the project
- The Project Manager and the Development Team will have to provide the required documentations and work product to the auditors for evaluations
- The Project Manager will have to conduct regular reviews on the QA activities and the results found after these QA activities

3.3.3 Ability To Perform

Establishing and maintaining the formulation of the project product quality assurance process:

- Establishing and maintaining proper records for QA activities
- QA Manager and QA Engineers will be responsible for organizing and carrying out QA testing processes for CashTrack software application

Providing ample resources to carry out planned processes, develop a work product and provide services for these processes on top of quality assurance processes:

- Software tools to carry out quality assurance activities are available for Team Runtime Terror (Computer Workstation for QA Manager and QA Engineers, CashTrack database tools, Auditing tools and a working prototype of the CashTrack application)
- Software Requirement Specification (SRS) document containing the functional, non-function and user interface requirements must be available to the QA Manager and QA Engineers

Assigning responsibility and authority for performing these processes, developing a working product and providing services to the project quality assurance process:

- Components with which do no meet quality requirements have to be properly communicated to the development team for them to rectify the problem
- Establishing and maintaining proper documentations of QA activities based on Review Form document

Training program for team members whom will be assisting or carrying out the quality assurance processes on CashTrack software application:

- The training program will include topics on Quality Assurance Procedures, Quality Assurance Standards, Tools for QA testing and also best practices for software engineering

3.3.4 Activities To Perform

Placing nominated work products and product quality assurance processes under an appropriate level of configuration management:

- The Quality Plan document will be created during the initial stage of the Software Design Life Cycle (SDLC)
- The Quality Plan document must be evaluated by the Project Manager and stakeholders

Identifying relevant stakeholders and get them involved in the Quality Assurance Process:

- The QA Manager and QA Engineers will carry out QA testing activities based on the Quality Plan document requirements

Monitoring and controlling the quality assurance process according to the predefined plan for performing the quality assurance process and taking appropriate corrective actions:

- Any variation that does not follow the required requirements for Software Activities or Work Product will be documented and rectified according to a procedure that has be set in place

3.3.5 Measurement and Analysis

Measurements will be created and used to determine the status and cost for QA activities:

- Milestones for QA activities will follow those stated in the Quality Plan document
- Amount of audits and reviews done for the product stipulated by the Quality Plan document
- Status of implementation base on the Quality Plan Document
- Effort spent to complete a milestone

3.3.6 Verify Implementation

Reviewing activities, status and outcome from the quality assurance process with stakeholders and fix any issues that may have arised:

- QA Manager and QA Engineer must have a regular review with the Project Manager to ensure that the QA testing processes are carried out as planned.

3.4 Configuration Management

3.4.1 Process Goal

The Change Management Plan document will help in establishing and maintaining the integrity of CashTrack application throughout its Software Design Life Cycle (SDLC). The document will help identify the different possible configurations of the software application at different points in time during the development phases of the application, maintain the integrity of the application and allow for effective and efficient traceability of the different configurations made during the SDLC of the application.

3.4.2 Commitment To Perform

Establishing and maintaining company policy for planning and performing necessary project configuration activities:

- The Project Manager will be the person approving all major releases of the CashTrack application and any changes to the Software Configuration Items (SCIs)
- The Lead Developer will be in charge of updating the Software Requirement Specification (SRS) document in the event that a change made to the software governs a change to the SRS requirements
- The QA Manager and QA Engineers will be responsible for proper documentation of QA processes and activities
- The Lead Developer will also be incharge for managing the source codes, libraries and software documentations for CashTrack application

3.4.3 Ability To Perform

Establishing and maintaining the formulation of the project configuration management process:

Activities	**Person Responsible**
Reviewing Project Plan document and designing suitable QA management and testings processes	QA Manager & QA Engineer
Reviewing Project Plan document and designing suitable Software Configuration Management processes	QA Manager & QA Engineer
Reviewing Software Requirement Specification document and updating design changes that have been made during the SDLC of CashTrack	Lead Developer
Reviewing and updating Software Design Document based on the design changes that have been made during the SDLC of CashTrack	Lead Developer
Reviewing source codes for various releases and	Release

versions of CashTrack to ensure that any changes made are updated in the configuration management tool	Engineer
Reviewing source codes for release versions of CashTrack to ensure that QA testing is done for the correct version that will be released	QA Manager & QA Engineer
Reviewing QA testing results for each release version of CashTrack and ensure that all changes made have be documented in the system	QA Manager & QA Engineer
Reviewing Integration testing results against Software Specification Document and ensure that all changes that are made are the latest versions	QA Manager & QA Engineer
Reviewing User Acceptance Testing Result against Software Requirement Specification document and ensure that all changes made are the latest version	QA Manager & QA Engineer

Providing ample resources to carry out planned processes, develop a work product and provide services for these processes on top of configuration management processes:

- Various systems have been set up to ensure that planned processes can be carried out smoothly:
    - JIRA
    - Github version control repositories
    - Microsoft One Drive
    - Tortoise SVN
    - CashTrack Team Wiki
- Training program for team members whom will be assisting in the configuration management processes

3.4.4 Activities To Perform

Activities when setting up the project	**Person responsible**
Identification of Software Configuration Items (SCI's)	Quality Assurance Manager & Engineer
Install the bug repository tool and set up the database	Quality Assurance Manager & Engineer
Install the software configuration repository tool and set up the database	Project Manager
Setup of documentation archives and repository	Release Engineer
Define the configuration processes	Project Manager & Release Engineer

Activities during the project lifecycle	Person responsible
Export components for modification, test or delivery	Quality Assurance Manager & Engineer
Create version, write version delivery document	Release Engineer
Approve reference configurations	Project manager
Verify version to be delivered and authorise deliveries	Project manager
Creating Backup Spaces	Release Engineer
Do configuration audits	Quality Assurance Manager
Inspect configuration records	Quality Assurance Manager
Monitor configuration records	Quality Assurance Manager & Engineer

Management activities	Person responsible
Manage versions and archives for software	Release Engineer
Manage configuration records	Release Engineer
Manage archives for documents	Release Engineer
Manage spaces backup and archive media	Release Engineer
Manage quality reports	Quality Assurance Manager & Engineer

Identifying relevant stakeholders and get them involved in the Configuration Management Process:

End of an activity of a project Activities	Person Responsible
Perform a configuration freeze	Release Engineer
Present a configuration state of the components impacted by the activity	Release Engineer
Present a documentation state of the components impacted by the activity	Release Engineer

During configuration management process audit Activities	Person Responsible
Perform the configuration management process audit	Project Manager
Present the records of the configuration management process	Release Engineer
Present the quality records of the configuration management process	Quality Assurance Manager & Engineer
Present the records of the documentation management process	Release Engineer

Monitoring and controlling the configuration management process according to the predefined plan for performing the configuration management and taking appropriate corrective actions:

- Control the changes by have a separate branch for different versions of CashTrack and the release version
- Changes can be tracked using functions provided by Github, Tortoise SVN and CashTrack Team Wiki
- Changes must be made whenever an additional requirement is successfully completed, there is a change in initial application requirements or there are bugs or defects found in previous versions of CashTrack

3.4.5 Measurement and Analysis

Measurements can be made and used to determine the progress of system configuration management activities:

- Progress of each allocated requirements has to be recorded and used as part of the measurement
- The identification format for all of CashTracks source codes and documents will be [File Name]_[Version Number].[File Format]
- Change activity documentations can also be used to determine the progress of the project

3.4.6 Verifying Implementation

Reviewing activities, status and outcome from the quality assurance process with stakeholders and fix any issues that may have arised:

- All changes that are to be made must be documented in the Software Change Request form which is provided in the Configuration Management Plan document by the development team.
- The Software Change Request form will then be submitted to the Change Control Board (CCB) for approval.
- Once approval is given by the CCB, any changes to the system requirements has to be approved by the Project Manager before it can be released
- Changes made must be documented under the appropriate Software Configuration Item and also update the change log
- QA Manager and QA Engineer must conduct regular review on these activities and work process documentations to ensure that the requirements for the applications are met

4. Approvals

The undersigned acknowledge they have reviewed the CashTrack **CMMI Level 2 Definition** and agree with the approach it presents. Changes to this **CMMI Level 2 Definition** will be coordinated with and approved by the undersigned or their designated representatives.

Signature:		Date:	02/04/2021
Print Name:	Nicklaus Tan		
Title:	Project Manager		
Role:	Oversees and ensures compliance with the CMMI Level 2 Definition and its defined KPAs		

Signature:		Date:	02/04/2021
Print Name:	Kumar Mehul		
Title:	Lead Developer		
Role:	In charge of ensuring compliance with the Configuration Management KPA		

Signature:		Date:	02/04/2021
Print Name:	S Sri Kalki		
Title:	QA Manager		
Role:	Ensures compliance with the Software Quality Assurance KPA		

Signature:		Date:	02/04/2021
Print Name:	Alex Leong		
Title:	Release Engineer / Acting Change Manager		
Role:	Assist in ensuring compliance with the Configuration Management KPA		

5. CMMI audit checklist

Key Process Area - Practice (Specific)		Implementation Levels			
Indicate the level of compliance of processes by marking each row of the Implementation Levels with exactly one 'X'		**Not**	**Partially**	**Largely**	**Fully**
Requirements Management					X
1	Eliminate ambiguity in requirements				X
2	Ensured that requirements gathered are accurately translated to functional requirements				X
3	Communicate changes of requirements to stakeholders			X	
Project Planning					X
4	Establishes the scope of work and goal of the project				X
5	Identify the stakeholders involved			X	
6	Assigned responsibilities			X	
7	Estimate cost, effort and constraints for the project				X
8	Estimate schedules for the different phases of the project				X
Software Quality Assurance					X
9	Establish and monitor records of quality assurance activities				X
10	Compliance of work product with established policies, standards, and procedures			X	
Configuration Management					X
11	Ensured the traceability of requirements from work product				X
12	Consistency of documents in accordance with the Configuration Management Plan				X

6.CMMI interview affirmation questions

Question # 1:
What is CMMI?
Answer:
Capability Maturity Model Integration. CMMI is an approach/a model that helps organizations streamline process improvements, it encourages building and benchmarking key capabilities, practices and processes

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Question # 2:
Why is CMMI useful?
Answer:
CMMI defines a standard process framework that not only ensures that the best practices, processes and standards are being used but also tracks and maintains these good practices, allowing gradual improvements to be made to them over the long term

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Question # 3:
What is the CMMI Level 2 definition?
Answer:
Level 2 (Repeatable): All specific and generic goals of the level 2 key process areas have been achieved, that is, the project has ensured that requirements are managed and that processes are planned, performed, measured, and controlled.

Question # 4:
What are the Key Process Areas of a CMMI Level 2 model?
Answer:
- Requirements Management
- Project Planning
- Software Quality Assurance
- Software Configuration Management
- Project Monitoring and Control
- Measurement and Analysis

Question # 5:
What is the benefit of moving up a CMMI Level, e.g. CMMI Level 1 -> CMMI Level 2
Answer:
As the CMMI Level increases, the overall productivity and quality of the work product produced also increases, additionally, the chances of risks occurring decreases.