Design and Development

RCCAC-ENG-P-000

Rev. 2.0

Rockwell Collins CETC Avionics Co., Ltd.

Approval

	Name	Title	Approval	Date
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Revision History

Revision	Originator	Description	Date
1.0	Kevin Chen	New Release	06/26/2015
1.1	James Zhang	Added the Signature column in the Approval page	10/12/2015
2.0	James Zhang	1. Updated the design & development inputs and outputs; 2. Added the reference document of RCCAC-ENG-T-003 TMA & TDA Tailoring List	08/24/2017

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1 Introduction

1.1 Purpose

This is the controlling document to define the requirements to be followed for any Design and Development that utilizes engineering time and money, regardless of funding source. This includes, but is not limited to products, research, test equipment or engineering tools. This Design and Development Procedure is to be followed to ensure that customer, internal, and regulatory requirements are addressed.

The deliverables of this procedure are:
1.   Completed RCCAC-ENG-T-000, Complexity Scorecard for Design & Development;
2.   Project specific tailored Technical Consistent Process (TCP);
3.   Project specific Design and Development Plan(s);
4.   The project's cost estimate/budget.

1.2 Applicability

Location: Rockwell Collins CETC Avionics Co. Ltd. (hereafter referred to as "RCCAC"), Chengdu, Sichuan, China
NOTE: In the case of a conflict between this document and other engineering procedures, this document will take precedence.

1.3 Requirements Implementation

This procedure meets the requirements for Design and Development as defined in AS9100: 2016 and ISO 9001: 2015.

1.4 Industrial Standards

Table 1-1 Referenced Industrial Standards

Standard	Description
AS9100: 2016	Quality Management System – Requirements for Aviation, Space and Defense Organizations
ISO9001: 2015	Quality Management Systems – Requirements

1.5 Company Documentation

Table 1-2 Referenced Company Documentation

Document #	Description
RCCAC-QMS-P-000	Quality Manual
RCCAC-ADM-POL-001	Documented Information Management Policy
RCCAC-QMS-P-901	Quality Documented Information
RCCAC-BCP-P-001	Integrated Performance Management
RCCAC-BCP-P-002	Management Authorization Process
RCCAC-ENG-P-020	Design Assurance Center
RCCAC-ENG-M-000	Developmental Process Deviation Management

RCCAC-ADM-MAN-001	RCCAC Documentation Management Manual
RCCAC-ENG-G-600	Developmental Change Control
RCCAC-ENG-T-000	Complexity Scorecard for Design & Development
RCCAC-ENG-T-003	TMA & TDA Tailoring List

1.6 Definitions and Acronyms & Terms

1.6.1 Acronyms

Table 1-3 Acronyms

Acronym	Definition
RCCAC	Rockwell Collins CETC Avionics Co. Ltd.
CDR	Critical Design Review
DAR	Design Approach Review
LCVS	Life Cycle Value Stream
MAP	Management Authorization Process
NAR	Non-Advocacy Review
NRE	Non-Recurring Engineering
PDR	Preliminary Design Review
SysNAR	System Non-Advocacy Review
TCP	Technical Consistent Process
TDA	Technical Development Activities
TMA	Technical Management Activities

1.6.2 Definitions

- Artifact - A tangible result of the Design and Development of a product, including the product itself (system, subsystem, component) and any supporting product item (business documentation, requirements document, design description, analyses, drawings, source code, log file, results summary document, etc.); an item produced by a process that provides value to the organization.
- Complex Project - A project with a significant level of risk as scored by RCCAC-ENG-T-000, Complexity Scorecard for Design & Development. A "Complex" project may be characterized by any of the following:
  - The proposed solution is novel as a new domain with limited or no expertise by RCCAC,
  - The majority of the system capabilities and originating requirements are new to RCCAC and requirements may fluctuate after project start,
  - The project will have organizational challenges of multiple RCCAC engineering directorate organizations across multiple locations in-country and/or international,
  - The execution team is comprised of less than half of inexperienced staff member(s) or an experienced staff that hasn't worked together before,
  - There are challenging information assurance requirements above Department of Defense or National Security Agency minimums,
  - The DO-178 or DO-254 certification of major new and novel functionality of multiple certification authorities

Note that the other categories within the Complexity Scorecard may not characterize the project as "Complex", however the cognizant Engineering Director may identify that the project will follow the complex system project processes for non-advocate reviews.

- Customer - An internal or external stakeholder who receives a work product produced by RCCAC.
- Design Approach Review - A formal review of the architecture and design artifacts of a project by subject matter experts who are independent (non-advocates) of the project under review to assess the architectural maturity and level of detail.
- Design Assurance Center (DAC) - The Design Assurance Center for Quality has responsibility and authority to make quality judgments on all aspects of engineering product design, verification/validation, and qualification including the authority to stop delivery of non-conforming products and documentation.
- Design and Development Plan(s) - Also referred to as the "Design Plan" in RCCAC-BCP-P-001, Integrated Performance Management. The Design and Development Plan(s) is the collection of artifact(s) that describe how the tasks are to be performed during the project engineering development.
- Major Change - As defined in RCCAC-BCP-P-001, Integrated Performance Management, a change of sufficient magnitude, as determined by the LCVS Team or its leadership, to a project that impacts project strategy (e.g., reversal of make/buy decision, selection of a new or different major supplier, or variation of customer/market strategy); project scope; schedule or budget.
- Non-Advocacy Review - A formal review of a project conducted by subject matter experts who are independent of the project under review. Types of NARs are Design Approach Reviews or System Non-Advocacy Reviews.
- Project - Any design and development effort that consumes engineering resources and produces engineering artifacts. For the purpose of this document the term "project" also refers to Program and Product Line Developments.
- Project Hierarchy - The project hierarchy refers to the association of deliverable product levels established in a parent-child relationship structure.
- Systems Engineering Leading Indicators – Predictive measurements and metrics for systems engineering processes and required measures in assessing Complex Projects.
- System Non-Advocacy Review - A formal review of the Design and Development Plans and execution of a project conducted by subject matter experts who are independent of the project under review.
- Technical Consistent Process - A tailorable process used as guidance in the planning and execution of the Design and Development activities for a project. The TCP consists of two separate yet complementary process models: Technical Management Activities and Technical Development Activities.
- Turbo TCP - The tool that enables a project team to tailor the Technical Management Activities and Technical Development Activities. This tool is owned by Rockwell Collins.

2 Design and Development Overview

2.1

Design and Development, one of the RCCAC Core Processes, is used to turn ideas into desirable, reliable, and profitable customer solutions. Figure 1 shows the relationship of the Design and

Development process to the Management Authorization Process' Decision Points (e.g., DP-C, DP-D). RCCAC-ENG-P-000, Design and Development, specifies the processes that SHALL be used for performing design and development activities in a consistent manner with the other Core Processes.
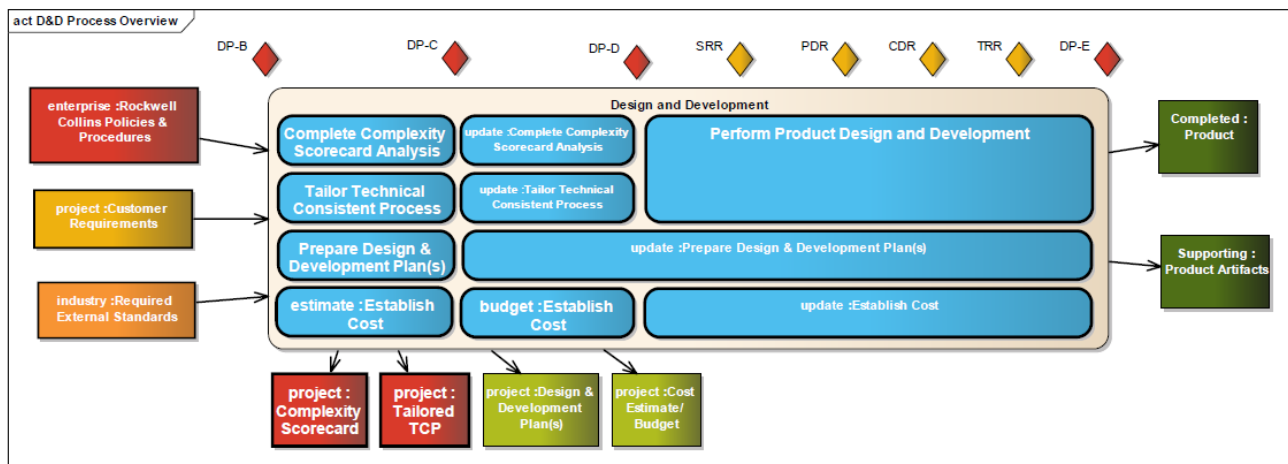

Figure 1 - Design and Development Process Diagram

2.2 Design and Development Entry Criteria

At a minimum, the following entry criteria SHALL be met prior to initiating a Design and Development project:

a) A new, modified or perceived customer need or customer request is identified, or

b) Authorization to proceed in accordance with RCCAC-BCP-P-002, Management Authorization Process

2.3 Design and Development Inputs

Inputs to Design and Development include one or more of the following:

a) Customer documentation (e.g. Statement of Work, Request for Proposal, user need statement, product specification, functional and performance requirements, Statutory and regulatory requirements and concepts of operations, etc.)

b) Innovative ideas

c) New technology information

d) Information derived from previous similar design and development activities

e) Standards or codes of practice that RCCAC has committed to implement

f) Potential consequences of failure due to the nature of the products and services

g) When applicable, the potential consequences of obsolescence (e.g., materials, processes, components, equipment, products)

2.4 Design and Development Processes

The Design and Development processes for a project are:a) Influenced by the Project's complexity

b) Expressed by the tailored Technical Consistent Process to address the project's specific needs and objectives, and

c) Elaborated in the project's Design and Development Plan(s)

2.5 Design and Development Outputs

Outputs from Design and Development include:
a) Meet the input requirements;
b) Are adequate for the subsequent processes for the provision of products and services;
c) Include or reference monitoring and measuring requirements, as appropriate, and acceptance criteria;
d) Specify the characteristics of products and services that are essential for their intended purpose and their safe and proper provision;
e) Are approved by authorized person(s) prior to release.
f) Completed RCCAC-ENG-T-000, Complexity Scorecard for Design & Development
g) Approved (prior to execution) project-specific TCP Tailoring which is used along with the customer requirements and required external standards to produce both:
  1. The project-specific Design and Development Plan(s)
  2. The project's cost estimate/budget
h) Completed product and all supporting artifacts as summarized in the tailored TCP and detailed in the project's Design and Development Plan(s)

2.6 Design and Development Exit Criteria

Exit criteria from Design and Development SHALL include at least one of the following:
a) Completion of all planned development tasks,
b) Customer acceptance of the end product, or
c) Stop work order

2.7 Requirements for Design and Development Process Deviation / Variance

If it is determined during Design and Development that there is a valid business needs to deviate from a company process or procedure, a Process Deviation SHALL be requested in accordance with RCCAC-ENG-M-000, Development Process Deviation Management.

3 Project Complexity Assessment Requirements

3.1 Project Complexity Assessment

Project complexity SHALL be assessed, as shown in Figure 2, using RCCAC-ENG-T-000, Complexity Scorecard for Design & Development, when either of the following conditions is met:
a) Any new Design and Development where engineering resources are used, or
b) Any existing project that is subject to a "Major Change"

The complexity assessment SHALL be performed while considering all levels of the composite project hierarchy.

If the project is following RCCAC-BCP-P-002, Management Authorization Process, the assessment results SHALL be reported at Decision Point C and subsequent Decision Point presentations.
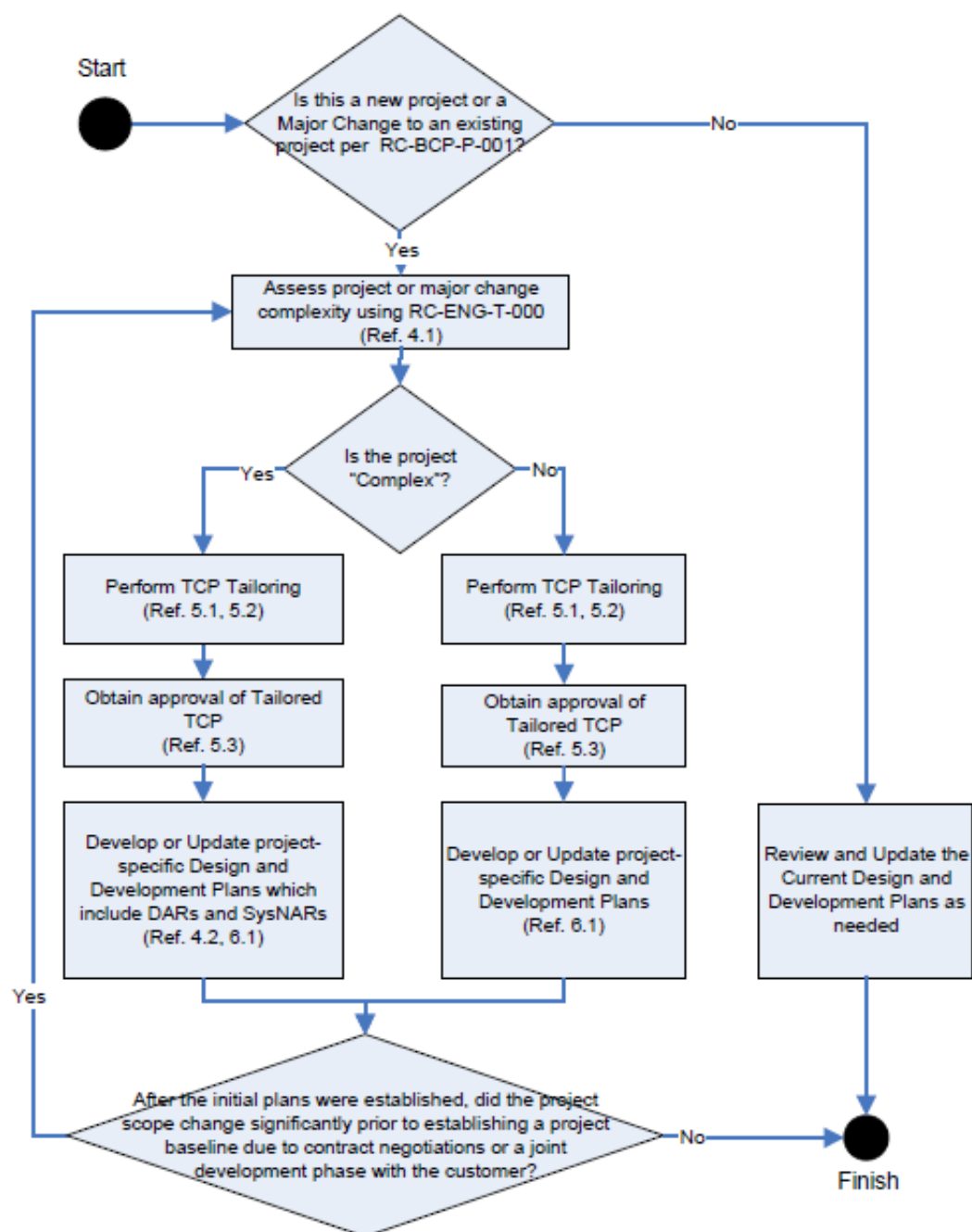
Figure 2 – Flow Chart: Design and Development Planning

3.2 Complex Project Planning

If the results of the RCCAC-ENG-T-000, Complexity Scorecard for Design & Development, indicate that the project meets the definition of a "Complex" Project, the team SHALL:

a) Plan for Non-Advocacy Reviews in the project's Design and Development Plan(s) as detailed below. Approximate timeframe is also shown in Figure 3.

    1. SysNAR 1 SHALL be held at the concept/proposal phase (or prior to Decision Point-C when following RCCAC-MAP).

    2. DAR 1 SHALL be held at the concept/proposal phase (or prior to Decision Point-C when following RCCA-MAP).

3. SysNAR 2 SHALL be held after the concept phase and before a preliminary design has been finalized, (or prior to PDR if applicable to the project).
4. DAR 2 SHALL be held after the concept phase and before a preliminary design has been finalized, (or prior to PDR if applicable to the project).
5. DAR 3 SHALL be held prior to finalization of design (or CDR if applicable to the project).
6. The SysNARs SHALL utilize Form 074-8433-489, SysNAR Checklist.
7. The DARs SHALL utilize Form 074-8443-490, DAR Checklist.

b) Include the measurement and reporting of System Engineering Leading Indicators in the project's Design and Development Plan(s). Refer to System Engineering Leading Indicators for more detail.
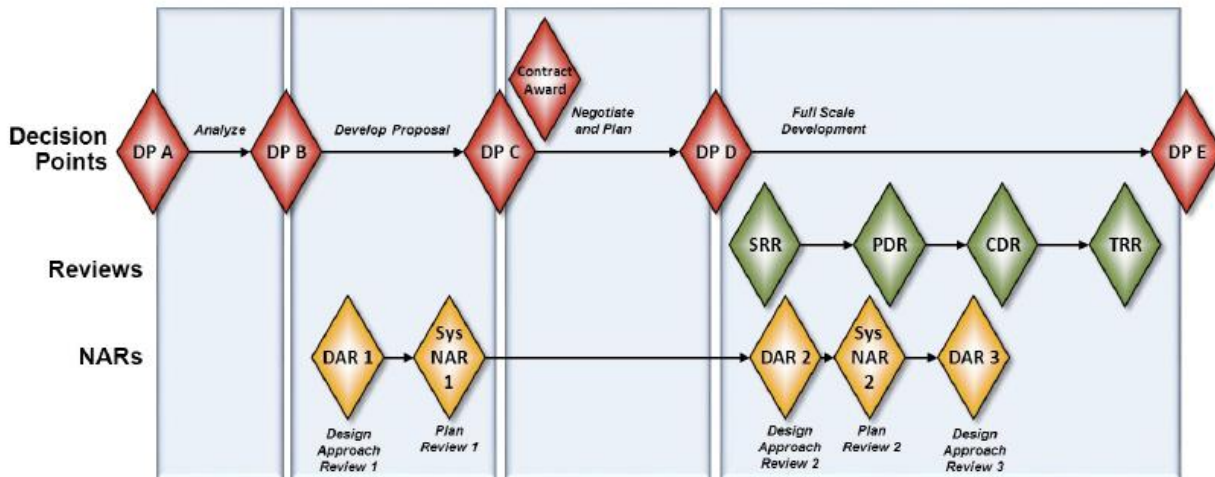

Figure 3 - Timing of Non-Advocacy Reviews (NARs) when RC-MAP is applicable

4 Project Technical Consistent Process Tailoring Requirements

4.1 Process Tailoring using the Tailoring Tools

The TMA and the TDA tasks SHALL be tailored for the specific needs of the project being executed. This is accomplished using the Rockwell Collins Turbo TCP tailoring tool or TMA & TDA Tailoring List (RCCAC-ENG-T-003) across all levels of the project hierarchy. By answering a series of questions about the project at each level of the hierarchy (i.e., software domains, hardware domains, subsystem domains, etc.), the Turbo TCP tailoring tool or TMA & TDA Tailoring List will determine which tasks need to be considered for each level of the hierarchy.

A project may need to update the approved TCP tailoring(s) when (1) as shown in Figure 2, an existing project is subject to a "Major Change", or (2) an existing project needs to update the Design and Development Plan(s) due to a new TCP Version that has been released since the last TCP tailoring approval (see paragraph 5.2).

4.2 Manual Process Tailoring

Once the tailored output of the Turbo TCP tool or TMA & TDA Tailoring List has been created, performing manual tailoring, if necessary, SHALL be managed as follows:

a) Tailoring-out a REQUIRED task will result in the "Below Minimums" indicator being displayed on the TMA or TDA display page where the manual tailoring occurred. Tailoring out a REQUIRED task requires an assessment of the risk, which includes assigning the associated probability of occurrence and determining the impact to cost, schedule, quality, performance, etc. The risk SHALL be managed in accordance with the project's Risk Management Plan.

b) Tailoring-out a RECOMMENDED task should be carefully considered to determine if risk may be incurred from its exclusion. If it is determined that exclusion of a RECOMMENDED task incurs risk, the task SHALL be managed in accordance with the project's Risk Management Plan. Note that the "Below Minimums" indicator is not turned on when RECOMMENDED tasks are manually tailored out.

4.3 Tailoring Approval

The tailored TCP SHALL be approved using Turbo TCP or TMA & TDA Tailoring List by the project: Life Cycle Value Stream Leader (Program Manager, Product Line Manager, etc.), Engineering Technical Leadership, and the DAC representative.

5 Design and Development Plan Requirements

5.1 Design and Development Plan(s)

The Design and Development Plan(s) is the collection of artifact(s) that SHALL describe how the tasks are to be performed during the project engineering development. The tailored TMA and TDA SHALL identify the tasks. The detailed description of the tasks is based on the customer (internal or external) requirements and any applicable RCCAC process and applicable external standards (reference Figure 4). The project's Design and Development Plan(s) fully describes who, what, when, where and how each task is to be completed. Design and Development Plan(s) may be needed for different elements of the project hierarchy with their unique Turbo TCP project tailorings.
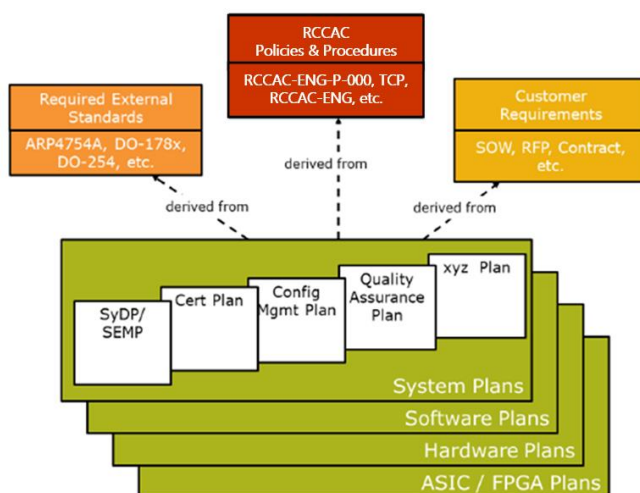

Figure 4 - Design and Development Plan(s) – Derivation and Scope Definition

5.2 Design and Development Plan Maintenance

In accordance with RCCAC-ADM-MAN-001 RCCAC Documentation Management Manual, when there is a change to any applicable prescriptive business documentation/process assets such as:

a) Engineering (ENG)
b) Quality Management System (QMS)
c) Product Integrity (PI)
d) Operations (OPS)
e) Configuration Management System (CMS)

Or a new version of the TCP is released, the project's tailored TCP and their Design and Developments Plan(s) SHALL be assessed for impact and updated if necessary. Refer to Figure 5 for an illustration of the assessment process. Refer to How to Tailor your Project for guidance on performing the impact assessment when a new TCP version is released.

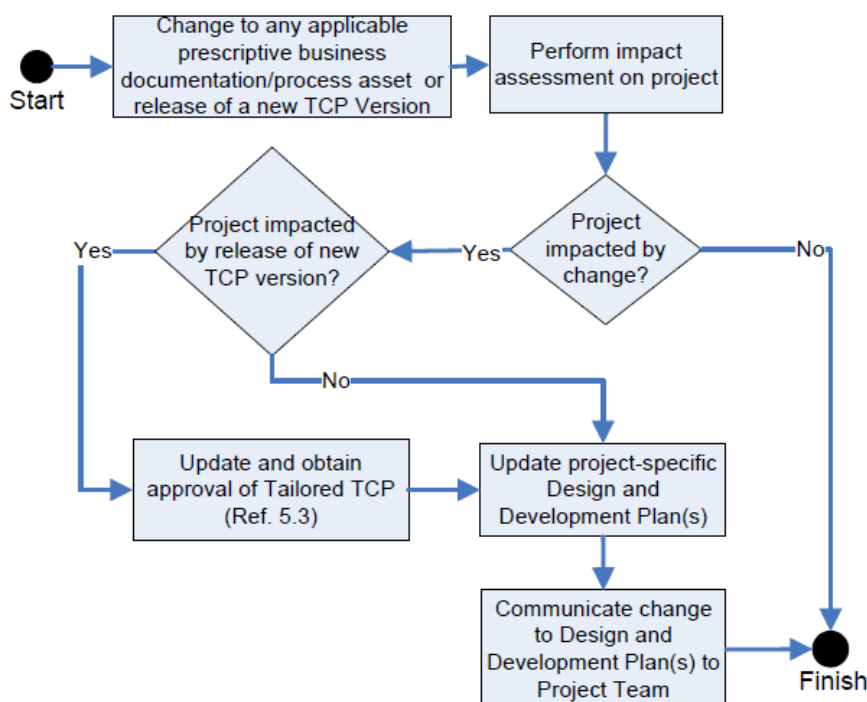Any changes SHALL be approved per paragraph 4.3.

Figure 5 - Flow Chart: Change Impact Assessment

6 Design and Development Procedure Roles and Responsibilities

6.1

Engineering Management/Technical Leadership SHALL:
a) Ensure all engineering developments use the Turbo TCP tailoring tool or TMA & TDA Tailoring List to determine their tailored set of TCP tasks
b) Review and approve the TCP tailoring
c) Develop and approve Design and Development Plan(s) based on the tailored TCP, customer requirements, Statement of Work (SOW), and RCCAC-ENG-T-000, Complexity Scorecard for Design & Development.

d) Ensure the Design and Development Plan(s) are maintained as necessary such that the Turbo TCP or TMA & TDA Tailoring List tailored tasks are addressed
e) Ensure the project is executed according to the Design and Development Plan(s)
f) Ensure deviations / variances to the approved project Design and Development Plan(s) follow RCCAC-ENG-M-000, Development Process Deviation Management
g) Communicate project Design and Development Plan(s) to personnel assigned to the project, including personnel that join the project throughout its lifecycle
h) Ensure that project team members have received necessary training to allow them to productively support their specific role(s) on the project

6.2

All personnel within the Engineering organizations at RCCAC SHALL be knowledgeable of this Design and Development procedure, review relevant Design and Development Plan(s), and execute to the plans for those tasks and deliverables for which they are responsible.

6.3

The Design Assurance Center shall assess engineering compliance to RCCAC-ENG-P-000, Design and Development, assign corrective actions for non-compliances, and escalate overdue corrective actions to senior engineering leadership in accordance with RCCAC-ENG-P-020 Design Assurance Center.

7 Process Governance

Changes to the Design and Development process SHALL in accordance with RCCAC-ENG-G-600 Developmental Change Control.

8 Documented Information Retention

All Design and Development related documented information shall be maintained in accordance with RCCAC-QMS-P-901 Quality Documented Information and RCCAC-ADM-POL-001 Documented Information Management Policy.