Project TTC Toronto

Passenger Information System

Software Project Management Plan (SPMP)

CDRL:	Spec Refs:	
Q301E / 164	TS S24.8 #164	

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	Managing Director	Signature		yyyy-mm-dd

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Revision History

Revision	Date (yyyy-mm-dd)	Initials	Description of Changes
00	2010-04-26	PaWi	First issue
01	2010-07-20	PaWi	Typo and spelling correction Several Updates: • Table "Functional Elements" updated to be consistent with SCIST • Table Staffing Plan added (Section 5.1.2) • Reference to the project's Requirements Management Plan added (Section 5.3.1) • Added summary of process model to Section 6.1 • Added caption "Tools" to table in Section 6.2 Methods, Tools, and Techniques • Added explanation regarding SRS and SDD documents to Section 6.2 • Added reference to Software Test Plan in Section 6.3 Infrastructure Plan • Section 1.1.4: Added dates to Table List of Milestones • Section 1.1.3: Added remark Table Software Work Products
02	2010-09-03	PaWi	Several Updates regarding review protocol from TTC: • Added TTC CDRL number on cover page • Documentation releases was not in line with the TTC TS (Table 2) • Added an escalation path in the organization chart (Figure 3) • Added explanation in section 7.7 (quality of the subcontractor)
03	2010-11-05	PaWi	• Table 2: List of Software Work Products: Added an explanation regarding Software Test Procedures; added System Test Procedure as a work product • Amended Table 4: List of References ([SRS_CCU], [SRS_PSC], [ASRTM]) • Amended Table 5: List of Acronyms and Definitions: GPS • Corrected formatting in Section 6.2.2 Software Architecture Design • Added an explanation regarding the use of [I1558] to 6.2.3 Software Detailed Design • Revised due dates in Table 3: List of Project Milestones • Revised Section 6.4 Product Acceptance Plan

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Revision	Date (yyyy-mm-dd)	Initials	Description of Changes
04	2011-03-03	PaWi	As a result of the SW audit held by Bombardier on 2010-12-03 in Gümligen: • In Section 4.2 Internal Structure added an explanation regarding independence of quality roles from the project • Several other changes. See letter 248-AAG-BO-0199_CDRL_submittal Section 1.1: Removed the statement that content related to BTE/PTE is preliminary Section 1.1.1.1: Table "Functional Elements" corrected to reflect changes in new Software Configuration Items Summary Table [ASCIST]. Included BTNA review comments (dated 2011-01-11)
05	2011-03-10	PaWi	Included BTNA review comments (dated 2011-03-10); restructured Section 1.1

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1 Overview

1.1   Project Summary

1.1.1   Purpose, Scope, and Objectives

This Software Project Management Plan (SPMP) is applicable to the Passenger Information System (PIS) software development for the TTC Toronto project. The ANNAX TTC Toronto project implements the functionality of the onboard audible and visual PIS, with the following major components:

- PIS Controller (PSC)
- Internal and External Signs
- Public Address (PA) manual and automatic audio announcement system
- GPS positioning system
- Intercom system
- Ethernet-IP Backbone

This project implements the following major requirements stated in the Toronto Transit Commission (TTC) Technical Specification (TS) - Design and Supply of Low Floor Light Rail Vehicles, Structured Multi-Phase Bid Process Edition, Rev. 2.0 [TS]:

1. Section 9.17: Destination signs
2. Section 9.18: Run number sign
3. Section 10.17: Stop request
4. Section 20.6: Global Positioning System (GPS)
5. Section 20.7: Public Address System
6. Section 20.7.4: Intercom System
7. Section 20.8: Passenger Emergency Intercom
8. Section 20.10.2: Station and Stop Announcement

Please consult the System Functional Description – Communication and Signs [ASFD] if you are interested in further details.

The SPMP applies to the development of the following engineering efforts:

- Development of software for the PIS
- Development of software for the Portable Test Equipment (PTE) of the PIS (Comm./PIS PTE)
- Development of software for the Bench Test Equipment (BTE) of the PIS (Comm./PIS BTE)

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This SPMP conforms to IEEE Std 1058-1998 [I1058], Standard for Software Project Management Plans, as modified by IEEE 1558-2004 [I1558].

The intended audience of this plan includes QA Car Builder for review, TTC for approval and ANNAX engineering, project management, QA members and subcontractors who are involved in this project.

This document is being prepared according to the requirements of the Toronto Transit Commission Technical Specification [TS]

This section provides an overview of the purpose, scope, and objectives of the TTC Toronto project, the project assumptions and constraints, a list of project deliverables, a summary of the project schedule and budget, and the plan for evolution of the SPMP.

The context diagram in Figure 1 depicts the overall system and identifies system and elements covered by this plan. It shows the interface between the PIS provided and the external environment with which it interacts.

1.1.1.1 Context Diagram
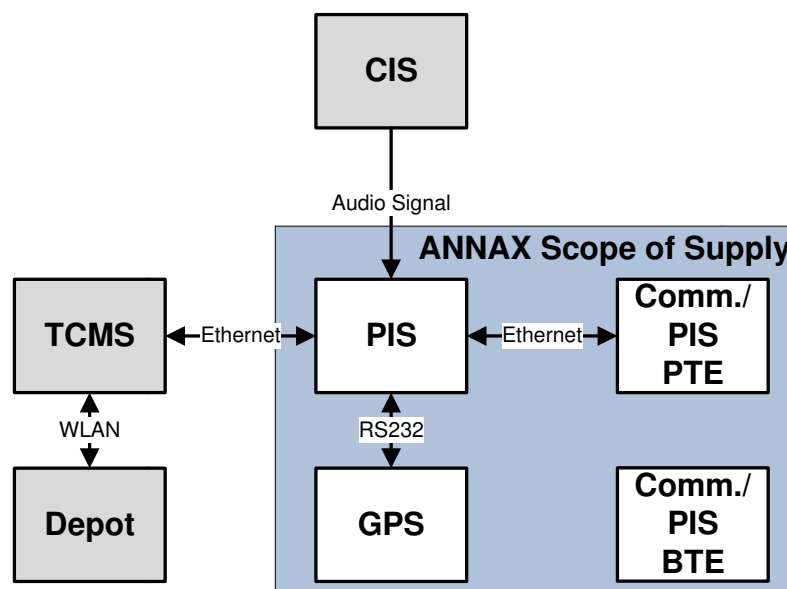
Figure 1: Context Diagram

Further information is contained in the System Functional Description of the PIS [ASFD].

1.1.1.2 Functional Elements

The following table identifies and describes each of the SCIs to be developed. For further information related to SCIs, refer to the Software Configuration Items Summary Table [SCIST]

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Table 1: Functional Elements

Device	SCI #	SCI Name	SCI Description	SW Integrity Level (SIL)
PIS Controller	AXPSC01	PSC OS	PSC Operating System	1
	AXPSC02	PSC APP	PSC Application	1
	AXPSC03	PSC DB	PSC Database	1
	AXPSC04	PSC DSPFW	PSC Digital Signal Processor Firmware	1
PCU-Box	AXPCU01	PCU-Box OS	PCU Box Operating System	1
	AXPCU02	PCU-Box APP	PCU Box Application	1
CCU	AXCCU01	CCU OS	CCU Operating System	1
	AXCCU02	CCU APP	CCU Application	1
Displays	AXDIP01	DISP OS	Display Operating System	1
	AXDIP02	DISP APP	Display Application	1
Comm./ PIS PTE	AXPTE01	PTE OS	PTE Operating System	1
	AXPTE02	PTE APP	PTE Application	1
FMS	AXFMS01	FMS OS	FMS Operating System	1
	AXFMS02	FMS APP	FMS Application	1

Note: Comm./PIS BTE software is the same as for the PIS Car Controller.

1.1.2   Assumptions and Constraints

The project plan assumes that system requirements and interfaces will be timely fixed and that Bombardier/TTC will deliver information required for parameterization of the PSC DB in sufficient detail before the FAI. In particular, definitions of stop windows (position, length, width, etc.) are necessary for the parameterization of the PSC DB.

1.1.3   Project Work Products

The table below is derived from Bombardier's SPMP [BTSPMP], section 1.1.3. It lists the software work products to be delivered to the customer (Bombardier/TTC):

Table 2: List of Software Work Products

#	Work Product	Delivery	Deliverable Media
1.	Software Project Management Plan (SPMP)	PDR	Document
2.	Software Quality Assurance Plan (SQAP)	PDR	Document
3.	Software Configuration Management Plan (SCMP)	PDR	Document
4.	Software Verification and Validation Plan (SVVP)	PDR	Document

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#	Work Product	Delivery	Deliverable Media
5.	Software Verification and Validation Report (SVVR)	FDR	Document
6.	Software Requirements Specification (SRS)	PDR and FDR	Document
7.	Software Requirements Traceability Matrix (SRTM)	FDR	Document
8.	Software Acceptance Test Specification (SWATS), included in the Software Test Procedure (STPr)	FDR	Document
9.	Software Design Description (SDD)	FDR	Document
10.	Software Test Plan (STP)	PDR	Document
11.	Software Test Report (STR)	Qualification and FDR	Document
12.	Software First Article Inspection (SW-FAI)	FAI	Document
13.	Software Version Description (SVD)	Qualifications	Document
14.	Software User Manual (SUM)	FDR and Qualification	Document
15.	Database Design Description (DBDD)	FDR	Document
16.	Software Configuration Items Summary Table (SCIST)	PDR	Document
17.	Software Code (placed under Escrow)	Escrow deposit	Escrow
18.	Software Executables	FAI	CD-ROM
19.	System Functional Description	PDR	Document
20.	System Test Procedure (SysTPr)	FDR	Document
21.	Interface Control Document (*)	PDR	Document
22.	Software Executable Generation Procedure (SEGP)	Escrow deposit	Escrow

* Remarks:

1. The only existing interface to subsystems requiring an ICD is covered by [ICDIPPIS], which is a document provided by Bombardier with input from ANNAX.
2. Interfaces to CIS and GPS do because of their simplicity not require separate ICD documents and will be specified in SRS documents (CIS interface: SRS for CCU [SRS_CCU], GPS interface: SRS for PSC [SRS_PSC])

1.1.4 Schedule and Budget Summary

The project budget is presented in the Project Realisation Plan [APRP]. As a summary, the software project budget comprises 5`370 hours for the following major software related activities.

- Engineering/Development
- Adaption of new GPS module

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- Project management
- Tests
- Software development
- Quality assurance
- Technical publications
- Training

Major milestones of the project are listed in Table 3. For a detailed time schedule, refer to the ANNAX internal MS Project document Developer Resource Plan [ADRP].

Table 3: List of Project Milestones

Milestone	Description	Due Date
PDR	Preliminary Design Review	June 2010
FDR	Final Design Review	End of 2011-01
pre-FAI	pre-First Article Inspection supplier / Bombardier	in negotiation with Bombardier procurement
pre-FAI	pre-First Article Inspection Bombardier / customer	in negotiation with Bombardier procurement
FAI	First Article Inspection	in negotiation with Bombardier procurement
Comm./PIS PTE delivery	Delivery of PTE to Bombardier	TBD
Comm./PIS BTE delivery	Delivery of BTE to Bombardier	TBD
Release 1.0.0	Release of SW for Level 3 Test	Bombardier requested to provide due date
Release 1.1.0	Release of SW for Static Vehicle Test	Bombardier requested to provide due date
Release 1.2.0	Release of SW for Dynamic Vehicle Test	Bombardier requested to provide due date
Release 1.3.0	Release of SW for Site Acceptance Test	Bombardier requested to provide due date
Release 1.4.0	Release of final vehicle software	Bombardier requested to provide due date

Note: Missing dates will be filled in a subsequent version of the SPMP.

1.2   Evolution of the SPMP

After internal review and approval, this SPMP will be submitted to Bombardier/TTC for official approval. After Bombardier's/TTC's approval, the SPMP will be placed under configuration

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management. Subsequent changes to the SPMP will follow the stipulations of the ANNAX Software Configuration Management Plan for the TTC Toronto project [ASCMP].

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2 References

The following documents are referenced within this SPMP:

Table 4: List of References

Doc ID	Document Description
[ACDGL]	Annax Coding Guideline (ANNAX internal document number 29900300)
[ASPSW]	201003XX, MS Project file: Schedule Planning Software (ANNAX internal document; German title: Terminplanung Software)
[ADRP]	201004XX, MS Project file: Developer Resource Plan (ANNAX internal document; German title: Ressourcenplan)
[APIDEV]	ANNAX process instruction VA07 "Development" (German title: Verfahrensanweisung "Entwicklung")
[APIPM]	ANNAX process instruction VA05 "Project Management" (German title: Verfahrensanweisung "Projektmanagement")
[APRP]	Project Realisation Plan for the TTC Toronto project (ANNAX internal document)
[ARMP]	2991019XX, ANNAX Requirements Management Plan for the TTC Toronto Project
[ASCIST]	299017XX, ANNAX Software Configuration Item Summary Table for the TTC Toronto project
[ASFD]	215269XX, ANNAX System Functional Description (SFD)
[ASCMP]	299016XX, ANNAX Software Configuration Management Plan for the TTC Toronto project
[ASRTM]	299010XX, ANNAX Software Requirements Traceability Matrix (SRTM)
[ASTP]	299026XX, ANNAX Software Test Plan for the TTC Toronto project
[ASQAP]	299009XX, ANNAX Software Quality Assurance Plan for the TTC Toronto project
[ASVVP]	299015XX, ANNAX Software Verification and Validation Plan for the TTC Toronto project
[BTSPMP]	248-PLA-0013, Bombardier Transportation TTC LFLRV Software Project Management Plan, date of preparation: 2010-01-20
[I1016]	IEEE Std 1016-1998 - IEEE Recommended Practice for Software Design Descriptions
[I1058]	IEEE Std 1058-1998 - IEEE Standard for Software Project Management Plans
[I1558]	IEEE Std 1558-2004 - IEEE Standard for Software Documentation for Rail Equipment and Systems
[ICDIPPIS]	590017128, Bombardier IP Interface Control Document TCMS - PIS Controller
[SRS_CCU]	215259XX, Software Requirements Specification (SRS) for PSC
[SRS_PSC]	215260XX, Software Requirements Specification (SRS) for CCU

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Doc ID	Document Description
[TS]	Toronto Transit Commission Technical Specification - Design and Supply of Low Floor Light Rail Vehicles, Structured Multi-Phase Bid Process Edition, Rev. 2.0, January 2009

Note: The most recent version of the documents is applicable.

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3 Acronyms and Definitions

The following acronyms and definitions are used within this SPMP:

Table 5: List of Acronyms and Definitions

Term/Acronym	Definition
ADR	Advance Design Review
API	Application Programming Interface
APP	Application
Arch	Architect
BT	Bombardier Transportation
BTE	Bench Test Equipment
CCU	Cab Control Unit
CDR	Conceptual Design Review
CDRL	Contract Deliverable Requirement List
CIS	Communications and Information System
DBDD	Database Design Description
DDD	Dedicated Diagnostics Display
Eng	Engineer
FAI	First Article Inspection
FDR	Final Design Review
FMS	Fleet Management System
GPS	Global Positioning System
ICD	Interface Control Document
LFLRV	Low Floor Light Rail Vehicle
LRV	Light Rail Vehicle
Mgr	Manager
OS	Operating System
PCU-Box	Passenger Communication Unit Box
PDR	Preliminary Design Review
PIS	Passenger Information System
PSC	PIS Controller
PRP	Project Realisation Plan
PTE	Portable Test Equipment
RAMS	Reliability Availability Maintainability Safety

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Term/Acronym	Definition
R&D	Research & Development
SCIST	Software Configuration Items Summary Table
SCMP	Software Configuration Management Plan
SDD	Software Design Description
SFD	System Functional Description
SPMP	Software Project Management Plan
SRS	Software Requirements Specification
STP	Software Test Plan
STPr	Software Test Procedure
SVVP	Software Verification and Validation Plan
SVVR	Software Verification and Validation Report
SW	Software
SWATS	Software Acceptance Test Specification
TBD	To Be Defined
TCMS	Train Control and Management System
TS	Technical Specification [TS]
TTC	Toronto Transit Commission

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4 Project Organization

4.1 External Interfaces
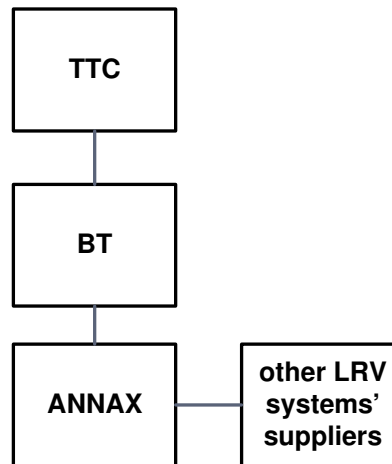
Figure 2: External Interfaces

ANNAX is one of the LRV car system suppliers. Bombardier acts as an integrator of the multiple vehicle systems. TTC is the acquirer of the LFLRV vehicles.

Mr. Patric Wittwer as the ANNAX Project Manager for the TTC Toronto project is the main contact for Bombardier and for the other systems' suppliers.

4.2 Internal Structure

Figure 2 shows the ANNAX internal structure of the TTC Toronto project.

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Steering Committee
W. Elbert, W. Malcherek, M. Jaeggi

Project Management
P. Wittwer
Proj Mgr
F.X. Eckl
Dpty Proj Mgr

PIS
Q Mgr
M. Eichinger

Product Development

System Respons
Sys Integr Mgr
P. Wittwer

PIS branch:
- Q Gates / Q Gate Ctrl / P. Wittwer
- Documentation / Doc Mgr / P. Wittwer
- IEEE / IEEE Support / Tilo Fuchs
- SW / Q Mgr / Tilo Fuchs
- Safety / RAMS Eng / R. Pongratz

Speaking units Component Mgr J. Allmacher:
- SW
  - Appl SW / SW Eng / G. Kollmann
  - Driver SW / SW Eng / G. Kollmann
- Hardware / HW Eng / J. Allmacher
- Construction / Mech Eng / R. Walter
- Integration / HW Eng / G. Allmacher

Central SW Component Mgr S. Andres:
- FMS / SW Eng / U. Meinke
- Service SW / SW Eng / S. Andres
  - PasisCE / SW Eng / J. Boichat
  - Layout Editor Matrix / SW Eng / R. Mikulecky

PIS Master Component Mgr A. Reimann:
- Hardware / HW Eng / P. Wittwer
- Database / SW Eng / R. Mäder
- Parametering / SW Eng / M. Binz
- Network / SW Eng / M. Walthert
- Application / SW Eng / M. Binz

Displays Component Mgr F.X. Eckl:
- LED
  - Hardware / HW Eng / H. Fischer
  - Software / SW Eng / M. Riewe
- Construction / Mech Eng / R. Walter

CCU Component Mgr A. Reimann:
- Hardware / HW Eng / D. Neukomm
- Construction / Mech Eng / R. Walter
- Type Test / Test Eng / N. Frick
- External SW Develop / SW Eng / A. Reimann (VIC)

System Respons branch:
- SW Architecture / SW Arch / Ch. Kündig
- HW Architecture / HW Arch / D. Neukomm
- SW Testing / SW Test Mgr / D. Briksi
- System integration / SW Eng / M. Binz
- System test / Test Eng / M. Weber
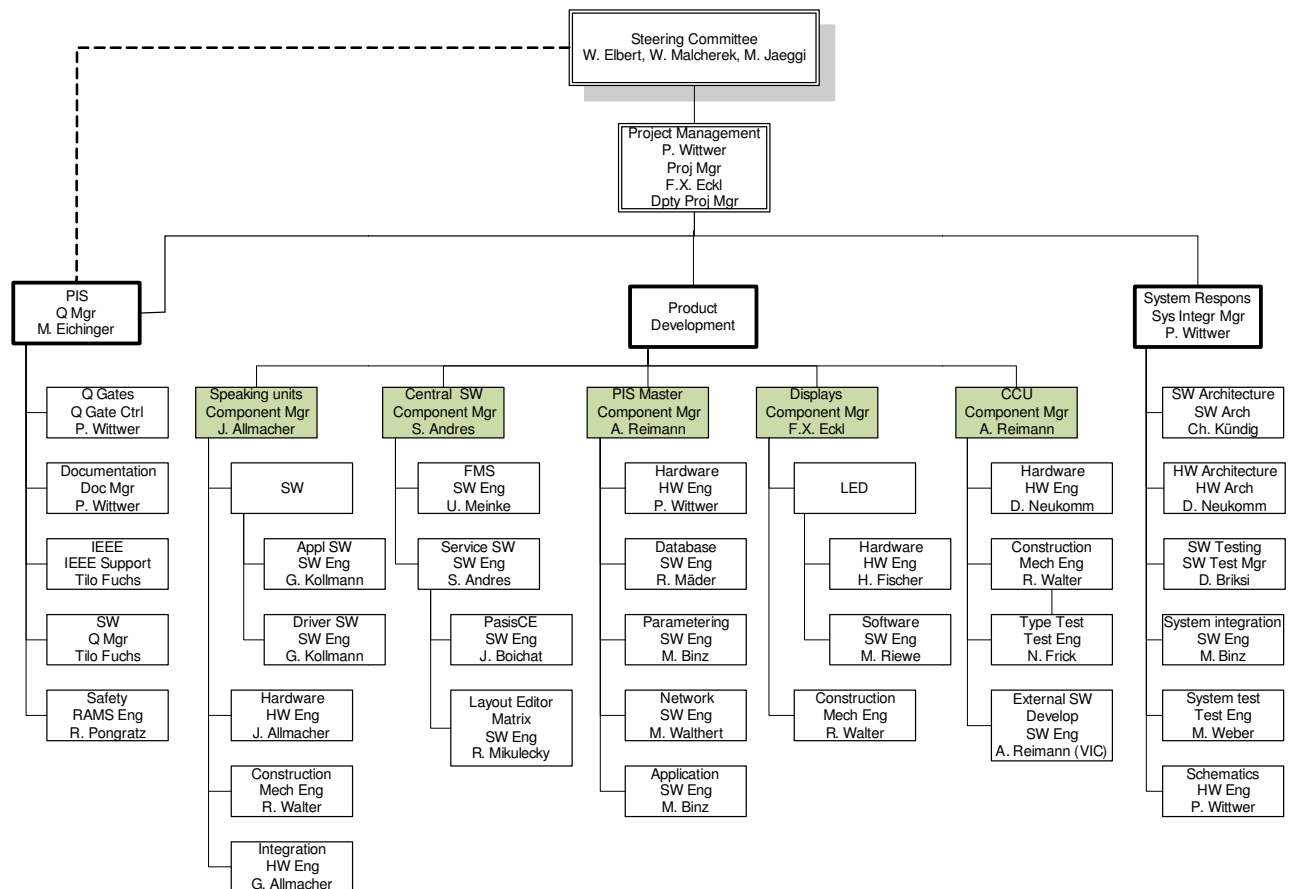- Schematics / HW Eng / P. Wittwer

Figure 3: Internal Structure

The PIS Quality Manager and the roles shown in Figure 3 below the PIS Quality Manager are independent from the Project Manager; the PIS Quality Manager reports directly to the Steering Committee.

4.3 Roles and Responsibilities

Table 6: Roles and Responsibilities

Role	Responsibility
Steering Committee	• Approval of the project plan • Approval of major changes (in content, schedule, etc.) requested by the project • Monitor project progress through Project Reviews

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Role	Responsibility
Project Manager	• Project planning, monitoring and control • Prepare and maintain the SPMP • Schedule control • Risk planning and risk management • Supplier control • Coordination of all project related work activities • Main customer contact • Prepare and participate in Project Reviews • Participate in customer design reviews
Software Architect	• Refine software requirements • Develop the software design • Preparation or review of SRS, SDD, STPr
Software Engineer	• Review or preparation of SRS, SDD, STPr • Software coding • Module test
System Integration Manager	• Coordination and management of all engineering activities for the project • Identify/Analyze system requirements • Overall system design • Requirements management, SRTM setup and maintenance • Manage/coordinate interfaces of all design activities • Preparation of SFD and ICDs • Assign requirements implementation to individual project team members • Participate in internal and customer design reviews to ensure compliance with interface requirements, specifications, and applicable standards
Document Manager	• Control all document submittals to the customer • Maintain overview of document submittal status
Q Gate Controller	• Planning, preparation, moderation of Quality Gates • Tracking of corrective action defined in Quality Gates
PIS Quality Manager	• Overall project quality responsibility • Coordinate internal and external audits
Software Quality Manager	• Plan and monitor SQA and SVV tasks • Prepare and maintain SQAP and SVVP • Prepare the SVVR • Participate in software documentation reviews and software related audits • Track corrective actions related to software
Component Manager	• Identify and analyze component requirements • Coordinate component development work tasks

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Role	Responsibility
Software Test Manager	• Plan and monitor software tests • Prepare and maintain the STP
Test Engineer	• Hardware/software integration testing
Software System Integrator	• Configuration management • Change management • Release management • Prepare and maintain SCMP
RAMS Engineer	• Prepare and maintain RAMS related plans and analysis • Assign Software Integrity Level (SIL) to SCIs
IEEE Support	• Provide guidance to project team for IEEE Software Engineering standards

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5 Managerial Process Plans

5.1 Project Startup Plan

5.1.1 Estimation Plan

The project's effort and cost was estimated according to Process Instruction „Project Management" [APIPM]. The estimates were documented in the Project Realisation Plan (PRP) [APRP] and the Developer Resource Plan [ADRP]. Cost estimates include costs of technical tasks as well as supporting activities, e.g. quality assurance, configuration management, and requirements management.

5.1.2 Staffing Plan

The staff required for the software project is documented in the [APRP]. A summary is given in the table below.

Table 7: Staffing Plan Summary

Phase Role	(Overall/ Continuously) Number of staff required	Analysis Number of staff required	Design Number of staff required	Imple- mentation Number of staff required	Integration & Test Number of staff required
Project Manager	1				
Software Quality Manager	0.5				
Requirements Manager	0.5				
System Architect	0.2				
Project Core Team (SW Engineer, SW Architect)		1	2	3	1
Software Test Manager					1

5.1.3 Resource Acquisition Plan

All staff/human resources required for the project are available and assigned to the project by the business management.

Non-human resources needed for the project consists of standard office equipment like desktop, chairs, PCs, and additional equipment needed for integration and test.

Standard office equipment is available for all project members and does not require any particular planning. The test environment is already available for the Flexity product platform.

Acquisition of additional equipment needed as listed below is the Project Manager`s responsibility:

- CIS for the Site Acceptance Test
- TCMS Simulator for SW testing

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- HW for suppliers developing software for the project.

5.1.4 Project Staff Training Plan

Staff training requirements were identified and documented in the Project Realisation Plan [APRP].

An IEEE 1558 documentation training for the TTC Toronto project team members as well as software suppliers was held on February 19, 2010.

The Project Manager and the Software Architect participated in an Enterprise Architect training that was held on March 09/10, 2010.

5.2 Work Plan

5.2.1 Work Activities

The project´s MS Project schedule [AMSPS] contains summarized work activities, while detailed work activities are shown in the Developer Resource Plan [ADRP].

5.2.2 Schedule Allocation

Software activities and their relationships are shown in the Developer Resource Plan [ADRP].

5.2.3 Resource Allocation

Resources allocated to the software activities are shown in the Developer Resource Plan [ADRP].

5.2.4 Budget Allocation

The budget allocated to major software activities is listed in the Project Realisation Plan [APRP]. The Project Realisation Plan is a MS Excel worksheet; the budget items are listed in the sheet "Steckbrief".

5.3 Control Plan

5.3.1 Requirements Control Plan

Based on the system requirements analysis performed during the bid phase, system requirements will be refined in the System Functional Description [ASFD]. The software requirements will then be derived from the defined system requirements and will be documented in Software Requirements Specifications. Additionally, all software requirements will be listed in a Software Requirements Traceability Matrix [ASRTM]. The SRTM will be the tool for tracing requirements backwards to their source (e.g. [TS], [ASFD]) and forwards to design and test documents like Software Design Descriptions (SDDs), Software Test Procedures (STPrs), and Software Test Reports (STRs).

Requirements changes will be handled according to the ANNAX Software Configuration Management Plan [ASCMP].

For the overall requirements management process, please refer to the ANNAX Requirements Management Plan [ARMP].

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5.3.2 Schedule Control Plan

Measurement and control of the project schedule progress will be based on the MS Developer Resource Plan Software [ADRP]. While the Project Manager is responsible of frequent tracking of the project schedule, milestone achievement will be assessed in periodic project review meetings attended by the Project Manager and the ANNAX Managing Director.

5.3.3 Budget Control Plan

Budget will be controlled by the Project Manager. Effort spent for the project will be reported into a centralized MS Excel time reporting worksheet. The Project Manager together with the ANNAX Managing Director will compare spent cost to planned cost and completed work. Such comparison and definition of corresponding corrective action will take place during periodic project review meetings.

5.3.4 Quality Control Plan

Software quality control is performed according to the ANNAX Software Quality Assurance Plan for this project [ASQAP]

5.3.5 Reporting Plan

The Project Manager will report the progress of the project to the ANNAX Managing Director. Furthermore, the Project Manager will discuss the progress of the project with the project engineering team during periodic meetings. Reporting will be based on metrics specified in Section 5.3.6.

5.3.6 Metrics Collection Plan

Metrics collected for the project comprise:

- Number and status of software requirements
- Milestone achievement
- CDRL items open/completed
- Cost

5.4 Risk Management Plan

Risk management techniques will be used to identify issues that could potentially have negative impact on the scope and to eliminate or mitigate such issues.

Risks will be identified during the project planning phase and will be documented in the Project Realisation Plan [APRP]. Mitigation measures for major project risks will be planned and controlled like regular project tasks. This included for example planning in the project time schedule.

Control of risk is the Project Manager's responsibility.

5.5 Project Closeout Plan

To ensure orderly closeout of the project, the following tasks will be performed:

- Archiving of project documentation
- Updating of the project cost calculation

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- Official application for project closeout (written form)
- Official transition of the project to Customer Support
- Lessons learnt review

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6 Technical Process Plans

6.1 Process Model

The process model for this project is mainly, as for all other projects, described in the major ANNAX process instructions for project management [APIPM] and for development [APIDEV].

The process model can be summarized as follows:

- During bid stage, analyze system requirements, check feasibility, roughly design and document the system, roughly estimate the project's effort and cost.
- After contract award:
  - o Initialize project; handover project to Project Manager
  - o Plan project
  - o Refine system requirements analysis and system design
  - o Derive software requirements
  - o Design software
  - o Integrate software
  - o Integrate software with hardware
  - o Test software
  - o Test system
- All phases are subject to quality and verification and validation tasks.

The process model is tailored for this project as follows:

- There are specific customer milestones: Conceptual Design Review, Preliminary Design Review, Final Design Review

- The entire customer documentation will be written in English

- Names, content and structure of the majority of the documents must be adapted to conform with [I1558].

6.2 Methods, Tools, and Techniques

The project uses a number of tools for different aspects. General tools for the project are as follows:

Table 8: Tools

Tool	Description
Subversion	Configuration management of source code
Infra	ERP
Mantis	Change Request Management, Problem reporting
Dokumentenverwaltungs-system	Naming, storing, retrieving documents
MS Word	Writing text documents
MS Excel	PSC database generation

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Tool	Description
MS Visio	Documentation of the system overview
MS Project	Project time schedule, resource planning
MS Sharepoint	File sharing (permanent)
ftp server	File sharing (temporary)
Pasis CE	PSC database generation
El Matador	PSC database generation
Enterprise Architect	Generation of UML diagrams
Cygwin	API Wrapper
Eclipse	Integrated Development Environment
gcc	GNU C Compiler
TikiWiki	Knowledge Base for software development
ZOC	Terminal emulation
Mozilla Firefox	Internet browser
Internet Explorer	Internet browser
FileZilla	ftp transfer

Specific tools to be used for the respective SCI are listed in the ANNAX Software Configuration Item Summary Table [ASCIST].

Methods and techniques to be used for the respective SCI are described in the SRS and SDD documents. Refer to Sections 6.2.2.

6.2.1 Software Requirements Analysis

Please refer to Section 5.3.1 Requirements Control Plan.

6.2.2 Software Architecture Design

During the software architecture design phase, Software Documentation Descriptions (SDDs) shall be written to transform the software requirements as defined in the SRS into an architecture that describes its top-level structure and identify all the software modules. The SDDs will conform with IEEE Std. 1016 - Recommended Practice for Software Design Descriptions [I1016], as modified by IEEE 1558, Table A.7.

For the software architecture design, the common Tool "Enterprise Architect" and the rules of UML shall be used. Unified Modeling Language (UML) is a standardized general-purpose modeling language in the field of software engineering. UML includes a set of graphical notation techniques to create visual models of software-intensive systems.

The SDDs shall contain UML use cases, design diagrams, state diagrams, and class diagrams.

The SDDs will split the customer requirements into use cases, define the classes which need to be built or modified and contain the class diagram. The SDD will also define the dynamic model based on state diagrams with related events and actions.

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6.2.3   Software Detailed Design

During software detailed design, the SDD prepared during the software architecture design phase will be refined. Section 6, Detailed Design, of the SDD will be filled during this phase.

6.2.4   Software Code and Test

For software testing, please refer to the ANNAX Software Verification and Validation Plan [ASVVP], Section 4.6.s.

6.2.4.1   Software Coding Standard

The ANNAX Coding Guidelines [ACDGL] are applicable for this project

6.2.5   Software Integration

During software integration, the software will be implemented: Software code will be written and/or configuration files will be created.

6.2.6   Software Qualification

Please refer to the ANNAX Software Quality Assurance Plan [ASQAP], Sections 6.2.5 and 6.2.6.

6.2.7   Software Release

Please refer to the ANNAX Software Configuration Management Plan [ASCMP], Section 3.2.4.2

6.2.8   Traceability

Please refer to Section 5.3.1 Requirements Control Plan.

6.3   Infrastructure Plan

The requirements for the infrastructure needed for this project do not exceed the standard project environment requirements. Infrastructure needed for test is described in the ANNAX Software Test Plan [ASTP], Section 11.

6.4   Product Acceptance Plan

The project acceptance will be achieved by formal testing witnessed by Bombardier. See Table 3: List of Project Milestones. TTC will be invited to attend. The tests will be performed at the ANNAX site in Gümligen and will be carried out as defined in [TS], Section 24.19.6, based on a System Test Procedure [SysTPr] previously submitted to Bombardier/TTC.

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7 Supporting Process Plans

7.1 Configuration Management Plan

Refer to the ANNAX Software Configuration Management Plan for this project [ASCMP].

7.2 Verification and Validation Plan

Refer to the ANNAX Software Verification and Validation Plan for this project [ASVVP].

7.3 Documentation Plan

Refer to Section 4 Documentation of the ANNAX Software Quality Assurance Plan for this project [ASQAP].

7.4 Quality Assurance Plan

Refer to the ANNAX Software Quality Assurance Plan for this project [ASQAP].

7.5 Reviews and Audit Plan

Refer to Section 6 Reviews and Audits of the ANNAX Software Quality Assurance Plan for this project [ASQAP].

7.6 Problem Reporting and Corrective Action Plan

Refer to Section 8 Problem Reporting and Corrective Action of the ANNAX Software Quality Assurance Plan for this project [ASQAP].

7.7 Subcontractor Management Plans

For the TTC Toronto project, SCI # AXCCU02, CCU Application, and SCI # AXPCU02, PCU-Box APP will be subcontracted.

The selection of subcontractors was based on:

- The commercial offer of potential subcontractors
- The past experience with the respective potential subcontractor (evaluation list of development partners)

The selection was performed by the Managing Director.

The subcontractor will deliver code for the SCI as well as the following documents

- SRS
- STPr
- SDD
- STR
- SUM
- SVD

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In general, the contract for a subcontractor partner will be based on fixed-prices and the deliveries will be split at least in to a design and in implementation and test stage. Therefore the stages and deliveries for subcontractors are almost equal to the internal development stages and deliveries.

The size or simplicity of the subcontract does not relax the management, quality or documentation of the subcontractor.

Subcontractors must also follow IEEE software documentation and are held to the same standards as ANNAX is by Bombardier. This is stated within [TS].

7.8   Process Improvement Plan

Assessment of process improvement opportunities for the project will be performed during quarterly project review meetings attended by the Project Manager and the Managing Director. It is then the responsibility of the Managing Director to define process improvement actions and assign responsibility of implementation to appropriate personnel.

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8 Additional Plans

There are no additional plans to this SPMP.

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