University of Southern Queensland

Faculty of Engineering and Surveying

Managing
Product Development Process
For
Time to Market

A dissertation submitted by

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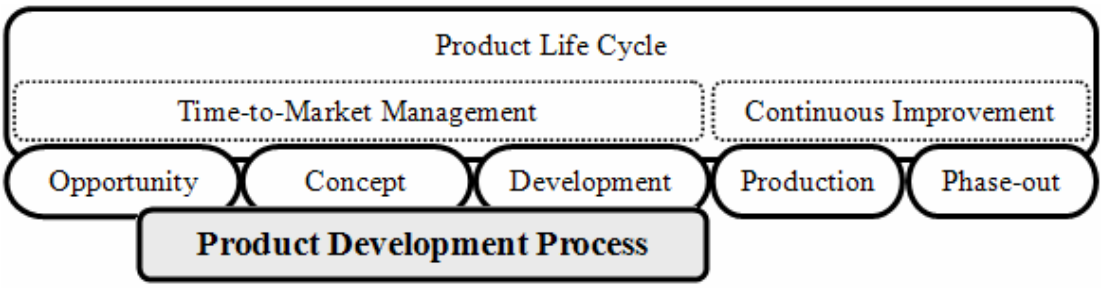
Abstract

In a business environment with intense competition, technology businesses launch new products to market rapidly. Marketing strategies and technological factors, which are driven by business environments, continue to shorten product development from years to months. Product development must be executed with speed, thus managing for Time-to-Market is therefore very important for the competitive success of such companies in the marketplace.

This research aims to establish an effective and efficient product development process based on a 'Gateway Review' framework to ensure best practices and compliance of each phase of a new product development, providing the Project Manager and team members with a systematic way to execute their product development projects for rapid Time-to-Market focus.

Adopting top-down concept, a Product Development framework is created from the higher level Product Life Cycle framework as shown in the diagram below. Gate checkpoints and functional process checkpoints are established throughout the duration of the development.



Checklists are used as the validation tool to assure compliance of all processes required at each checkpoint. The checkpoints will thus conclude with a decision point on whether to continue with the project or not.

While formal project management processes may be in place for larger product development projects, many companies do not adequately use these tools and suffer the consequences. Significant opportunities exist to reduce time-to-market by a better focus on product planning, project planning and resource management. A strategic step is to realistically plan projects based on the tailored product development process.

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Acronyms and Abbreviations

The following table provides definition of acronyms and terminologies commonly used in the area of this research.

Table 1 : Acronyms and Abbreviations

Abbreviation	Definitions
AVL	Approved Vendor List
BDM	Business Development Manager
BOM	Bill of Materials
BR	Business Responsible
CA	Corrective Action
CAD	Computer Aided Design
CAE	Computer Aided Engineering
CAM	Computer Aided Manufacturing
CAP	Corrective Action Plan
CAR	Corrective Action Report
CDM	Contract Design Manufacturing
CDS	Contract Design Services
CEM	Contract Electronic Manufacturer
CP	Checkpoint
DFE	Design for Environment
DFM	Design for Manufacturing
D-FMEA	Design Failure Mode Effect Analysis
DFR	Design for Reliability
DFT	Design for Test
DFx	Design for "x" (x=Mfg, Test, Assembly, Environment, Reliability etc); Design for Excellence
DQA	Design Quality Assurance
DV	Design Validation
DVT	Design Validation Test
ECN	Engineering Change Notice
ECO	Engineering Change Order
EP	Engineering Prototypes
FAI	First Article Inspection
FEA	Finite Element Analysis
FMEA	Failure Mode Effect Analysis
FMECA	Failure Mode Effects Criticality Analysis
FTA	Fault Tree Analysis
GAM	Global Account Manager
GCM	Global Commodity Manager
GCP	Gate Checkpoint
GM	General Manager
HVM	High Volume Manufacturing
HW	Hardware Development
ICT	In-Circuit Test
ID	Industrial Design
IPO	International Procurement Operations
ISO	International Organization for Standardization
IT	Information Technology
JIT	Just In Time
KOI	Key Operating Indicators

Abbreviation	Definitions
KPI	Key Performance Indicators
LOA	Letter of Authorization
LOI	Letter of Intent
PJM	Lead Project Manager
LV	Line Validation
LVM	Limited or Low Volume Manufacturing
MFG	Manufacturing
MPI	Manufacturing Process Instruction
MSA	Manufacturing Services Agreement
MSD	Material Supply Development
MTBF	Mean Time Between Failure
NDA	Non Disclosure Agreement
NPI	New Product Introduction
NRE	Non- Recurring Engineering
ODM	Original Design Manufacturer
OEM	Original Equipment Manufacturer
OPS	Operations
PA	Product Approval
PBR	Program Business Responsible
PCB	Printed Circuit Board
PCBA	Printed Circuit Board Assembly
PCO	Process Change Order
PDD	Product Definition Document
PDP	Product Development Process
PDS	Product Design Specification
PDV	Process Development
PES	Product Environmental Specification
PJM	Project Manager
PJS	Project Specification
PLS	Product Logistics Specification
PM	Program Manager
PO	Purchase Order
POS	Project Objective Statement
PQS	Project Quality Specification
PR	Product Release
PTS	Production Test Specification
PV	Process Validation
R&D	Research and Development
R&R	Repeatability and Reproducibility
RFA	Request for Action
RFP	Request for Proposal
RFQ	Request for Quotation
RoHS	Restriction of use of certain Hazardous Substances in Electrical and Electronic Equipment
ROI	Return on Investment
SA	Supply Approval
SOR	Start of Ramp
SOW	Statement of Work
SSCM	Strategic Supply Chain Manger
TQC	Total Quality Control
TR	Tooling Release
WBS	Work Breakdown Structure
WEEE	Waste Electrical and Electronic Equipment
WIP	Work in Process

Glossary of Terms

The meanings of some relevant terms used in this study take reference from the Web page: DRM Associates, NEW PRODUCT DEVELOPMENT GLOSSARY http://www.npd-solutions.com/glossary.html, viewed 30 July 2006

Table 2 : Glossary of Terms

Terminology	Meaning
Best Practice	Best Practice is a superior method or innovative practice that contributes to the improved performance of an organization, usually recognized as "best" by other peer organizations.
Bill of Material (BOM)	A Bill of Material (BOM) is a hierarchical list of subassemblies, components and/or raw materials that make up a higher-level component, assembly, product or system. An engineering BOM represents the assembly structure implied by the parts lists on drawings and drawing tree structure. A manufacturing BOM represents the assembly build-up the way a product is manufactured.
Business Case	Business Case refers to the results of market, technical and financial analyses used to justify the feasibility of a new product. Ideally defined just prior to the "go to development" decision (gate), the case defines the product and project, including the project justification and the action or business plan.
Capability	Capability is a measure of the ability of a system to perform within its specification limits. It uses a series of indices: Cp, Cpk, Cr, and Cpm.
Concurrent Engineering	A systematic approach to the integrated, concurrent design of products and their related processes, including manufacture and support. This approach is intended to cause the developers, from the outset, to consider all elements of the product life cycle from conception through disposal, including quality, cost, schedule and user requirements.
CPM	Critical Path Method - A method for determining the minimum project duration by identifying the critical path based on task interrelationships and duration. It assumes there is no wasted time for the activities that are on the critical path.
Critical Path	The series of interdependent activities of a project, which determines the shortest total length of the project. The critical path of a project may change from time to time as activities are completed ahead of or behind schedules.
Critical Path Method (CPM)	A scheduling technique using precedence diagrams for graphics display of the work plan. The method used to determine the length of a project and to identify the activities that are critical to the completion of the project.
Cross-Functional Team	Cross-Functional Team is a team consisting of representatives from marketing, engineering, manufacturing, finance. purchasing, test, quality, finance and any other required disciplines with responsibility for developing a product or product subsystem. This team is empowered to represent the functional disciplines and develop a product by addressing its life cycle requirements.
Design Failure Modes and Effects Analysis	Design Failure Modes and Effects Analysis (DFMEA) - a form of FMEA associated with the product design (see Failure Modes and Effects Analysis).
Design for Assembly	Design for Assembly (DFA) refers to the principles of designing assemblies so that they are more manufacturable. DFA principles address general part size and geometry for handling and orientation, features to facilitate insertion, assembly orientation for part insertion and fastening, fastening principles, etc. The objective of DFA is to reduce manufacturing effort and cost related to assembly processes.
Design for Disassembly	Design for Disassembly (DFD) is a set of principles used to guide designers in designing products that are easy to disassemble for recycling, remanufacturing, or servicing.

Terminology	Meaning
Design for Environment	Design for Environment is a process for the systematic consideration during design of issues associated with environmental safety and health over the entire product life cycle. DFE can be thought of as the migration of traditional pollution prevention concepts upstream into the development phase of products before production and use.
Design for Manufacturability	Design for Manufacturability (broad definition) is a methodology for designing products in a way that facilitates the fabrication of the product's components and their assembly into the overall product. In this respect it is synonymous with Design for Manufacturability / Assembly.
Design For Reliability	Design For Reliability (DFR) is methodology and set of principles to enhance product reliability and reduce overall low life-cycle costs. It is based on early involvement of reliability engineering working with design engineering to enhance reliability by performing steps such as the following: reliability program planning, reliability predictions, thermal analysis, failure modes and effects analysis (FMEA), fault tree analysis (FTA), availability and system modeling, HALT/HASS, design verification testing, product return rate analysis, FRACAS, and root cause failure analysis.
Design for Serviceability	Design for Serviceability (DFS) is a set of principles and a methodology for analyzing product concepts or designs for characteristics and design features which reduce service requirements and frequency, facilitate diagnosis, and minimize the time and effort to disassemble, repair/replace, and reassemble the product as part of the service
Design Review	Design reviews are formal technical reviews conducted during the development of a product to assure that the requirements, concept, product or process satisfies the requirements of that stage of development, the design is sound, the issues are understood, the risks are being managed, any problems are identified, and needed solutions proposed. Typical design reviews include: requirements review, concept/preliminary design review, final design review, and a production readiness/launch review.
Design Validation	Testing to assure that the product conforms to defined user needs and requirements. This normally occurs toward the end of the Design Phase following successful design verification and prior to pilot production, beta/market testing, and product launch. Design validation is normally performed on the final product under defined, operating conditions. Multiple validations may be performed if there are different intended uses. See Validation.
Design Verification	Design verification is the process of ensuring the design conforms to specification (design outputs meet design input requirements). Design verification may include: alternate calculations, design reviews, comparison to similar designs, inspection, and system or product testing.
Detailed Design	The conversion of product specifications into designs and their associated process and/or code-to documentation. Detailed design includes design capture, modeling, analysis, developmental testing, documentation, process design, producibility analysis, test plan development, coding, and design verification and validation.
DFX	Design for Excellence - designing to consider all relevant life cycle factors such as manufacturability, reliability, maintainability, testability, affordability, etc.
Engineering Change Notice / Engineering Change Order	Engineering Change Notice (ECN) / Engineering Change Order (ECO) are formal documents notifying selected persons of proposed, pending, or accomplished changes. In a PDM/PIM-managed environment, ECNs may be distributed by electronic mail.
Failure Modes and Effects Analysis	Failure Modes and Effects Analysis (FMEA) is a procedure in which each potential failure mode in every sub-item of an item is analyzed to determine its effect on other sub-items and on the required function of the item. It is used to identify potential failure modes and their associated causes/mechanisms, consider risks of these failure modes, and identify mitigating actions to reduce the probability or impact of the failure.

Terminology	Meaning
Failure Modes, Effects and Criticality Analysis	Failure Modes, Effects and Criticality Analysis is a procedure that is performed after a failure mode and effects analysis to classify each potential failure effect according to its severity and probability of occurrence.
Gantt Chart	A graphic representation of work activities shown by a time-scaled bar line.
Industrial Design	Industrial Design is the design that is done in companies and consultancies by people trained in industrial design, or in art and design schools in general. Industrial design focuses on the physical form and interactive properties as opposed to the functioning of the product or system.
Industrialization	Industrialization is a collection of activities to realize design in manufacturing and eventually into the marketplace. The activities includes supply chain management, quality assurance, and manufacturing readiness
KPI	Key Performance Indicators, also known as KPI or Key Success Indicators (KSI), help an organization define and measure progress toward organizational goals
Manufacturability	The characteristic of a product's design that facilitates the fabrication of the product's components and their assembly into the overall product.
Matrix Organization	A two dimensional organizational structure in which the horizontal and vertical intersections represent different staffing positions with responsibility divided between the horizontal and vertical authorities.
New Product Development	New Product Development is the business process for developing new hardware, software and service products for the enterprise. It includes all activities from development of the idea or concept for the product, the development of the product and its processes, and the launch of the product into production and into the market place.
New Product Introduction	1. New Product Introduction refers to the set of activities that occur once a product has been developed and is ready to be introduced into the marketplace. See Product Launch. 2. New Product Introduction is used by some organizations synonymously with new product development.
ORT	On-going Reliability Testing
Pilot Production	The initial limited-quantity production of the production-ready version of the product design used to confirm readiness for large quantity production.
Process Capability	1. (Statistical definition) Process Capability is the repeatability and consistency of a manufacturing process relative to the customer requirements in terms of specification limits of a product parameter. Specifically, it is the 6 sigma range of common cause variation for statistically stable processes only. Process capability is measured with the indices Cp and Cpk. 2. (Manufacturing process definition) Process capability is a measure of the manufacturability of the product considering availability of desired manufacturing processes, support or workpiece size, equipment characteristics (e.g., speeds, feeds, tonnage, etc.), and statistical capability as defined above. 3. (Business process definition) The extent to which a process is explicitly documented, managed, measured, controlled, and continually improved.
Process Development	Defining and developing a manufacturing process to accommodate the specific requirements of a given product while meeting process quality and cost objectives.
Product	The term "Product" refers to anything "produced". This can be anything composed, created or brought about by intellectual or physical efforts. Thus this term refers to any service that a business provides.
Product Architecture	The scheme by which the functional elements of a product are arranged into physical building blocks (e.g., subsystems or subassemblies) and interact with each other to perform the overall function of the product. Product architectures can be modular (see Modular Architecture) or integral (see Integral Architecture).

Terminology	Meaning
Product Life Cycle	1. The Product Life Cycle from a Marketing perspective is typically defined by its sales volume profile and broken down into the following phases: introduction, growth, maturity and decay. 2. The Product Life Cycle from the broader enterprise and user perspective is defined by phases of its overall life: concept, development, production, operation, support, and disposal.
Qualification Testing	Testing performed to demonstrate that a product or system meets its specified requirements.
Requirements Analysis	The determination of product-specific performance and functional characteristics based on analyses of: customer needs, expectations, , and constraints; operational concept; projected utilization environments for people, products, and processes; and measures of effectiveness.
Responsibility matrix	A matrix which relates responsibility (ownership) to the work breakdown structure; assures that each task is assigned to a responsible individual.
RFP/RFQ	Request for Proposal / Request for Quotation
Risk Assessment	Review, examination and judgment of project risks.
Risk Management	A management process consisting of identification, assessment, mitigation, and management of all projects technical and market risks using formal tools and methods.
Risk Management Plan	A plan that identifies key risks and their probability of occurrence. The plan identifies preventive actions and contingencies.
Supply Chain Management	The procurement, stocking and distribution of components, subassemblies and products throughout the design, manufacturing, and distribution stages, ensuring that the correct components, subassemblies and products are delivered to their appropriate destination at the proper time, the lowest overall cost, and acceptable quality levels.
SWOT Analysis	Strengths, Weaknesses, Opportunities and Threats Analysis - a process where by a group of people determine: a) what strengths do we have? (how can we take advantage of them?); b) what weaknesses do we have? (how can we minimize them?); c) what opportunities are there? (how can we capitalize on them?); d) what threats might prevent us from getting there? (consider technical obstacles, competitive responses, values of people within the organization, etc.). For every obstacle identified, what can we do to overcome or get around it? (This helps to develop contingency plans.)
Time-to-Market	1. Time-to-Market is the cycle time of product development from conception of a new product to initial sale of the new product. 2. Time-to-Market is the dimension of strategy focused on getting products to market quickly as the basis of competition.
Top-Down Design	Top-Down Design is a design methodology whereby an entire design is decomposed into its major components, and then these components are further decomposed into their major components, etc. The constraints are established early in the design flow, and then are passed on and adhered to by the back-end processes.
Work Breakdown Structure (WBS)	A task-orient "family tree" of activities which organizes, defines and graphically displays the total work to be accomplished in order to achieve the final objectives of a project. Each descending level represents an increasingly detailed definition of the project work. It is a system for subdividing a project into manageable components to provide a framework for scope/cost/schedule communications, allocation of responsibility, monitoring and management.
Worst Case Tolerance Analysis	Worst Case Tolerance Analysis - The assembly tolerance is determined by summing the component tolerances linearly. Each component dimension is assumed to be at its maximum or minimum limit, resulting in the worst possible assembly limits. It is a very conservative approach to tolerance analysis and is not the best approach to tolerancing since that it caters to combinations that are extremely unlikely, rather than focusing on a more probabilistic approach.

Chapter 1

Introduction

1.1 Background

World-Businesses in today's globalize market are facing strong competition. The competitive forces for businesses are more intense in this recessionary time.

Product, brand, service, markets and consumers formed the key components of a marketing strategy. Most companies continue to invest for R&D-Based models of economic growth, in good times as well as in bad times so as to own distinctive competencies or strive for differentiation from competitors.

In a business environment with intense competition, companies begin to realize the benefit of outsourcing not only improve the profit margin through cost savings, but also benefit from the efficiency and functionality. They are able to invest more time and resources into developing new products and services, and can operate more economically, which help compete more effectively than companies that do everything themselves.

As part of the competition, technology businesses launch new products to market rapidly, with state of the art technology, or add value to present products in order to stay ahead of their rivals and new entrants into the market. This is essential to the survival and is by far the best way to get through the recessionary yet restless economic times, and also to set-the-stage for renewed growth in better times. Marketing strategies and technological factors, which are driven by business environments, continue to shorten product development from years to months. Product development must be executed with speed, thus managing for Time-to-Market is therefore very important for the competitive success of such companies in the marketplace.

Project Management is a crucial element in the success of developing a product. The fundamental elements of project management are generally the same regardless of where a project is implemented. Some key factors to successful project accomplishment are clear and concise requirement analyses, structured project management framework and systematic product development process.

This research aims to establish a new product development process framework. It is designed to supplement and support other management processes already in place at most companies, and is built upon the Project Management fundamentals, providing the Project Manager and team members with a systematic way to execute their product development projects for rapid Time-to-Market focus.

1.2 Objectives

This project aims to establish an effective and efficient Product Development Process framework to supplement and support other management processes already in place at most companies. It is built upon the Project Management fundamentals, providing Project Manager and team members with a systematic way to execute their new product development projects for rapid Time-to-Market.

- Review modern business and industry that form parts of the external environment of project management. Investigate modern marketing strategy and outsourcing in business operating concept.
- To undertake a literature review of project management fundamentals that forms the basis for managing new product development. Discuss intellectual property and environment sustainability, being the critical factors of new product introduction.
- Review the historical performance and the underlying problems of project management and new product development process.
- Establish an effective and efficient product development process based on a 'Gateway Review' framework with lists of exit criterion for each check-point to ensure best practices and compliance of each phase of a new product development.
- Generate project management tools/templates for all phases of a product development cycle. Formulate functional checklists to ensure products are made to specification and are conform to quality standards.
- Discuss and conclude the research with a formal dissertation report.

1.3 Overview (Organization of Study)

In addition to this introductory chapter, this dissertation consists of seven chapters and a section containing reference and appendices.

Figure 1 : Structure of the dissertation

Chapter 2 reviews the relevant literatures, addresses the disciplines under investigation, and provides an overview of competitive advantage. The chapter then provides a detailed review of the current literatures and practices of project management. With that as the background, chapter 2 continues into identifying gaps in the literature and provides the rationale for selecting the research topic and issues.

The philosophy of project management is discussed in Chapter 3. This chapter provides the fundamental knowledge of this discipline, which lays the foundation for managing product development project.

Chapter 4 begins introducing the main subject of the research topic. This chapter provides an overview of the proposed product development framework.

How Product Development Process is organized under the Product Life Cycle framework is presented in Chapter 5. This chapter entails the product development process with flow charts and checklists and provides recommended processes aims to manage product development projects effectively and efficiently in line with the research objectives. The chapter concludes with a summary of the product development framework.

Chapter 6 reviews the performance of the proposed product development process and its underlying problem through case studies.

Chapter 7 provides a summary of the findings and conclusions of the research objective and issues, discusses the contribution of the research findings to the literature and theory, reviews the implications of the findings, discusses the limitations of the research, and concludes with suggested direction for future research.

Some selected project management tools and templates are attached at the end of this dissertation.

1.4 Scope and Limitations

- This research strives to delve into broader industry segment to devise a generic product development process applicable to most industry sectors. However, most works of this research are drawing from the context of EMS (Electronics Manufacturing Services), and are mainly focusing on product development that form part of a Product Life Cycle.
- Product development projects may vary in terms of for example risk and reward, level of resource, technical difficulty. Therefore, the frameworks or processes need to be flexible or 'scaled' in conjunction with the project management approach to suit the type of product development project.
- Each project environment is unique. As such, the process is intended to be flexible and it should be continuously evaluated, improved and enhance.
- Because project management process is flexible and constantly evolving as it is applied, this research is neither totally comprehensive nor all-inclusive of every aspect, technique, process or procedure related to project management. Instead, it is intended to be a foundation upon which to build, refine, and continuously improve the process.
- The elements of successful project management of product development include the processes, tools and interpersonal behaviors. This research focuses on the processes involve in managing new product development.
- If time permits, this dissertation shall include templates for each functional group of a product development team.

1.5 Research Methodology

The research begins with investigation of recent business environment and how businesses operate in competitive marketplace. Literature review is to be carried out in the context of EMS (Electronics Manufacturing Service) to first obtain brief knowledge of the type of outsourced services and the governing topics such as Intellectual Property and Environmental Sustainability in this industry sector.

A broad understanding of how a product is created from ideas to realization is imperative prior establishing a product development process to meet the research objectives. Knowing the fundamentals of project management will assist in making the research more comprehensive.

Process flowcharts will be used frequently during the course of study, adopting top-down concept, from the highest level of product life cycle framework, down to each stages of a product development process. Figure 2 shows a generic flow chart that lay the foundation of this research.

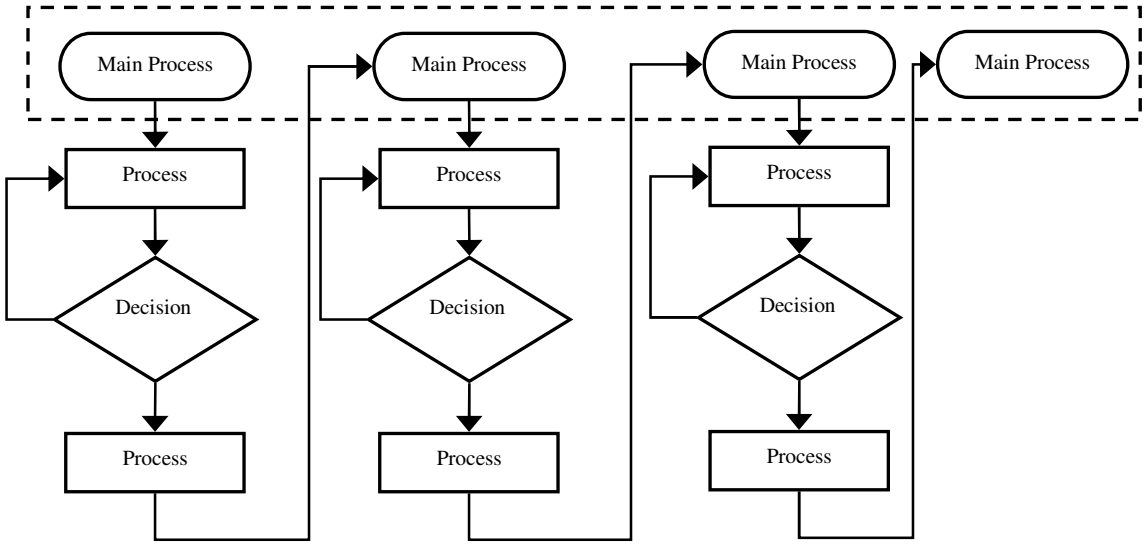


Figure 2 : Top-down Process Flow

Each stage ends with a decision point on whether to continue with the project or not; this is a stage boundary, a control point in the project when progress and deliverables are reviewed by senior management before approval to proceed to the next stage. Where applicable, these decision points are preceded by Gateway reviews. Similarly, sub-checkpoints are also required at processes carried out by functional disciplines. Checklists are used as the validation tool to assure compliance of all processes required at each checkpoint.

Figure 3 illustrate the checkpoint concept,

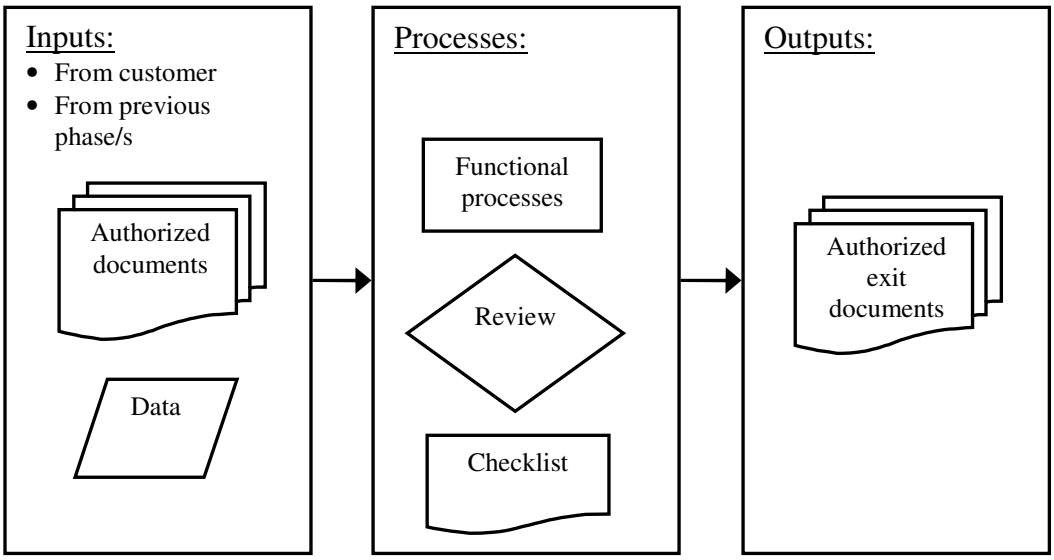


Figure 3 : Checkpoint Concept

Checkpoint requires inputs to be processed to deliver necessary outputs before proceeding to next stage of a product development.

Inputs are those authorized document from previous checkpoints, documents that are endorsed by customer, and data that are used to support the approval process. These inputs are then processed by the questionnaires in the checklist.

If the answers to the checklist questions are unsatisfactory, projects should not be allowed to proceed until the appropriate assurances are obtained. The outputs are signed documents that approve or deny exiting the checkpoint.

Task owners are required for every task to be carried out. In order to identify the key personnel for the checkpoints, the research will understand the project team structure in an organization.

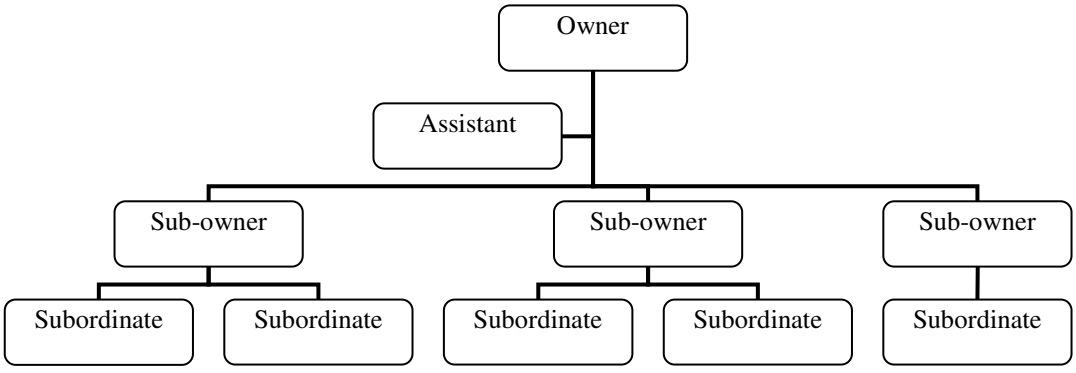


Figure 4 : Project Team Structure

1.6 Consequential Effects of the Research

This research recognizes potential consequences as a result of implementation of the product development process. These effects can be grouped under safety issues, environmental sustainability, ethical issues, and problems associated with the implementation of the proposed product development process.

In Section 1.7, risk assessment is carried out with control measures put in place for project execution.

1.6.1 Safety Issues

This research considers workplace health and safety to be part of the product development process.

The product development checklists shall include workplace health and safety questionnaires. This is not a safety audit to replace the regular audit perform by workplace health and safety committee in the company. The key purpose is to inspire the safety awareness by all persons in the project team. This is an effort on top of existing safety programs to ensure compliance with legislation requirement is not neglected.

1.6.2 Environmental Protection

Environmental protection plays a major part in the product development process. The term DfE will be introduced in the Literature Review Chapter. Since the research is focusing on product design and development, Design for Environment (DfE) must be considered upfront aims to reduce environmental impacts throughout the whole product life cycle by better product and process design.

1.6.3 Ethical Issues

This research is carried out in the context of EMS in outsourcing industry. The dangers of not protecting customer's intellectual property (IP) are multiplied when working with outsourcing. The negligence or ignorance of this ethical responsibility may result in costly litigation, and sudden burden of providing monetary compensation. The losses can be unbearable to both the outsourcing company and outsourcing vendor.

1.6.4 Implementation issues

The potential consequences under this group are associated with the implementation of the proposed product development process. These can be described by the potential behavioral models as follow.

- Non Compliance or participation by the employees
- Cessation of the new process owing to slow or no progress in implementation
- Disruption to current process causing late or no delivery

There are two major areas of concern for consideration in risk management

- Resistance from employees in adopting changes to their existing processes
- Employees face problems in adapting to the new processes, resulting in slow progress in implementation or even cessation of the new process.

Like all other start-up of new project, a project sponsor must be identified to buy-in the new process framework. A strong management support is required to help injecting to the organization the awareness of the need to standardize the product development process.

An implementation team, usually from the documentation control department in the company, is to be formed to,

- Refine Product Development Process to best suit the company operating nature
- Formulate checklists and templates, align or merge with other existing processes.
- Design and create training materials and systematic training schedule
- Conduct training to project sponsors, project managers, functional leaders, engineers, and supporting function personnel
- Assist project team in setting up new project, guiding the project through to the development processes.
- Conduct regular audit to address incorrect practices and non compliance
- Continually refine and improve the new processes

1.7 Risk Assessment

The following risk assessment is a tabulated summary of the consequential effects as discussed in Section 1.6. In addition, risks associated with the execution of this research project are also tabulated.

Risk Assessment Table

ID	Potential Risk	Effect	* Occurrence Severity (S)	Root Cause	* Occurrence Probability (P)	Risk Value (S x P)
A. Product Development Process						
A1	Safety being compromised resulting in injuries, work caused illnesses and other accidents	Costly compensation, loss of lives	5	Safety rules and regulations neglected during the course of developing products	3	15
A2	Product not designed for safe use resulting in users' illnesses	Costly litigation and compensation; consumer backlash	5	Human factor design not considered for Product	3	15
A3	Product is not environmental friendly and rejected for marketing by the local government	Product redesign resulting in late market launch and extra cost	5	Designers not familiar with the restricted substances for use in the product	3	15
A4	IP related breech of agreement	New product aborted; costly litigation	5	Contractual agreement not thoroughly examined or make known to all employees	3	15
A5	Project aborted for implementation	No change over of new process from current process	3	Resistance from employee to adopt new process; Poor understanding of the objective	3	9
A6	Implementation cause disruption to current process	Late or no delivery of current projects	5	Training schedule not coordinated with current works	3	15

* Refer to Appendix C1 for table of values

Risk Assessment Table

ID	Potential Risk	Effect	* Occurrence Severity (S)	Root Cause	* Occurrence Probability (P)	Risk Value (S x P)
B. Risk associated with the execution of this research project						
	Scope Risk					
B1	Proposed scope not meeting USQ requirement	Need to re-submit/Enrolment rejected	3	Poor understanding of USQ study requirement	3	9
B2	Project not feasible leading to drop/change of topic	Fail research project	5	Scope versus schedule and resource	3	15
B3	Not able to complete project on time, out of scope	Fail research project	5	Poor understanding of scope, no project planning	2	10
	Schedule Risk					
B4	Fail to meet project milestones	Fail research project	4	No or inadequate project planning	3	12
B5	Project work affected by travel	Project works on critical path	3	Study schedule affected by work commitments	1	3
	Resource Risk					
B6	Information required from external groups/individual not obtained	Incomplete research	3	Tasks reliant on external groups/individual	4	12
B7	Unavailability of tools and/or software	Affect dissertation writing	2	No or inadequate resource planning	1	2

* Refer to Appendix C1 for table of values

Risk Control Table

ID	Control Measure	Owner	Implementation (wk)	Effectiveness	Occurrence Severity (S)	Occurrence Probability (P)	Risk Value (S x P)
A1	Safety to be included in the Gate Checklist	SL Lam	ENG4112	To be determined during implementation which is beyond the scope of research	5	3	15
A2	Create template of Design Failure Mode, Effect and Analysis (DFMEA) for use in all product design; Gate checklist item	SL Lam	ENG4112, if time permits	Templates included in appendix section	5	1	5
A3	Environmental sustainability to be included in the Gate Checklist	SL Lam	ENG4112	Added as checklist items	5	1	5
A4	Create templates of NDA; Gate Checklist items	SL Lam	ENG4112, if time permits	To be determined if time permits	5	3	15
A5	Setup Implementation committee to conduct training	SL Lam	Start of implementation	To be determined if time permits	3	3	9
A6	Coordinate training programs and schedules	SL Lam	Start of implementation	To be determined if time permits	3	3	15
B1	Go through project reference book, past dissertation. Topic negotiation	SL Lam	6-Mar-06	Project Proposal accepted	3	1	3
B2	Project planning, clear project specification	SL Lam	15-Mar-06	Project specification accepted. Project schedule shows progress under control	5	1	5
B3	Project Planning and tracking	SL Lam	22-Apr-06	Under control, to be tracked regularly	5	2	10
B4	Project Planning and tracking	SL Lam	22-Apr-06	Under control, to be tracked regularly	4	2	8
B5	Obtain notebook computer	SL Lam	6-Mar-06	Under control	3	1	3
B6	Identify functional group/individuals and set timeline	SL Lam	22-Apr-06	Obtained external support with permission	3	1	3
B7	Tools and software identified, obtain approval for use of company resources	SL Lam	1-Apr-06	Under control	2	1	2

1.8 Resource Analysis

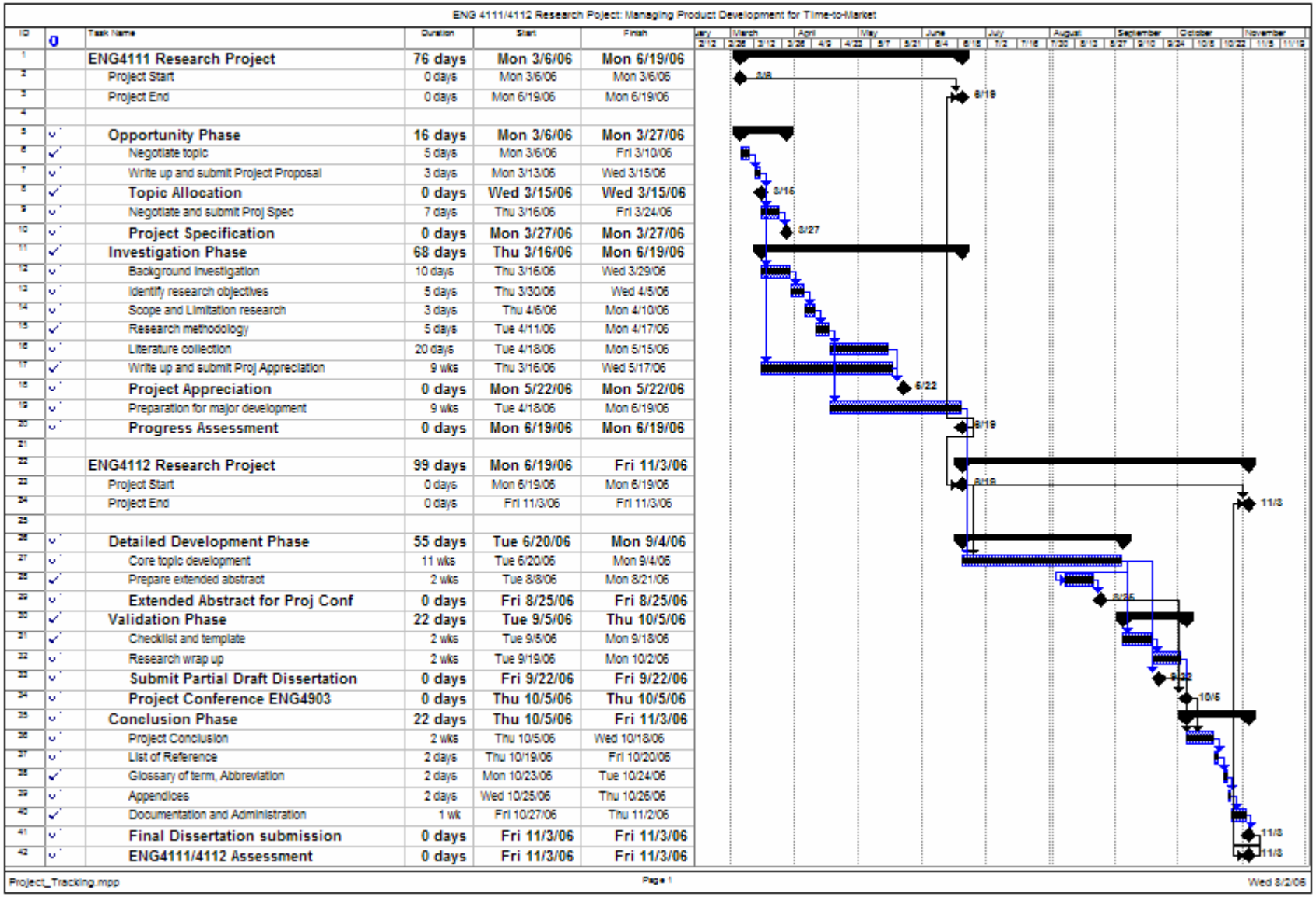
This research project requires extensive reference materials not only those associated with project management and product development, but also those literature by disciplines and information related to works carry out by functional groups from within the project organization. Frequent visits to the Worldwide Wide Web and use of library resources are expected.

Relevant people from various disciplines are to be consulted to assist in designing the checklists so as to make the proposed system process more diversify and practical. The related disciplines are,

- Program and Project Planning
- Mechanical Design
- Industrial Design
- Electrical and Electronics Engineering
- Software and Firmware Design
- Supply Chain
- Logistic
- Industrialization

Majority of this project works are theoretical, investigative, consultation and survey. The process and results of this research are to be compiled in the form of dissertation. Good word processing tools and techniques are essential towards completion of this project. It is also important that information be managed in an organized manner with appropriate citation.

1.9 Project Timelines



ID	Task Name	Duration	Start	Finish
1	ENG4111 Research Project	76 days	Mon 3/6/06	Mon 6/19/06
2	Project Start	0 days	Mon 3/6/06	Mon 3/6/06
3	Project End	0 days	Mon 6/19/06	Mon 6/19/06
4				
5	Opportunity Phase	16 days	Mon 3/6/06	Mon 3/27/06
6	Negotiate topic	5 days	Mon 3/6/06	Fri 3/10/06
7	Write up and submit Project Proposal	3 days	Mon 3/13/06	Wed 3/15/06
8	Topic Allocation	0 days	Wed 3/15/06	Wed 3/15/06
9	Negotiate and submit Proj Spec	7 days	Thu 3/16/06	Fri 3/24/06
10	Project Specification	0 days	Mon 3/27/06	Mon 3/27/06
11	Investigation Phase	68 days	Thu 3/16/06	Mon 6/19/06
12	Background investigation	10 days	Thu 3/16/06	Wed 3/29/06
13	Identify research objectives	5 days	Thu 3/30/06	Wed 4/5/06
14	Scope and Limitation research	3 days	Thu 4/6/06	Mon 4/10/06
15	Research methodology	5 days	Tue 4/11/06	Mon 4/17/06
16	Literature collection	20 days	Tue 4/18/06	Mon 5/15/06
17	Write up and submit Proj Appreciation	9 wks	Thu 3/16/06	Wed 5/17/06
18	Project Appreciation	0 days	Mon 5/22/06	Mon 5/22/06
19	Preparation for major development	9 wks	Tue 4/18/06	Mon 6/19/06
20	Progress Assessment	0 days	Mon 6/19/06	Mon 6/19/06
21				
22	ENG4112 Research Project	99 days	Mon 6/19/06	Fri 11/3/06
23	Project Start	0 days	Mon 6/19/06	Mon 6/19/06
24	Project End	0 days	Fri 11/3/06	Fri 11/3/06
25				
26	Detailed Development Phase	55 days	Tue 6/20/06	Mon 9/4/06
27	Core topic development	11 wks	Tue 6/20/06	Mon 9/4/06
28	Prepare extended abstract	2 wks	Tue 8/8/06	Mon 8/21/06
29	Extended Abstract for Proj Conf	0 days	Fri 8/25/06	Fri 8/25/06
30	Validation Phase	22 days	Tue 9/5/06	Thu 10/5/06
31	Checklist and template	2 wks	Tue 9/5/06	Mon 9/18/06
32	Research wrap up	2 wks	Tue 9/19/06	Mon 10/2/06
33	Submit Partial Draft Dissertation	0 days	Fri 9/22/06	Fri 9/22/06
34	Project Conference ENG4903	0 days	Thu 10/5/06	Thu 10/5/06
35	Conclusion Phase	22 days	Thu 10/5/06	Fri 11/3/06
36	Project Conclusion	2 wks	Thu 10/5/06	Wed 10/18/06
37	List of Reference	2 days	Thu 10/19/06	Fri 10/20/06
38	Glossary of term, Abbreviation	2 days	Mon 10/23/06	Tue 10/24/06
39	Appendices	2 days	Wed 10/25/06	Thu 10/26/06
40	Documentation and Administration	1 wk	Fri 10/27/06	Thu 11/2/06
41	Final Dissertation submission	0 days	Fri 11/3/06	Fri 11/3/06
42	ENG4111/4112 Assessment	0 days	Fri 11/3/06	Fri 11/3/06

1.10 Conclusion

This chapter presents an overview of the dissertation and its relation to the research. It begins with reviewing the background, listing of objectives and limitation of the research topic. The dissertation is an establishment of a structured product development process basing on a 'Gateway Review' framework to ensure best practices and compliance of a product development, aims to assist Project Manager to manage product development for Time-to-Market.

Figure 1 presents an outline of the dissertation to illustrate the stages of the research as well as the continuity of the connecting chapters. This chapter includes a brief explanation of the research methodology. Project timelines and resource requirement are being examined here. Risk assessment and its control measures are also tabulated and attached to this dissertation to demonstrate the planning and execution of the research project.

With all the components of the research introduced in this chapter, the material in this introductory chapter will be treated in more detail in subsequent chapters.

Chapter 2

Key Concept of Product Development

This chapter provides a detailed review of the current literatures and practices of product development and project management that are highly associated with the research topic.

2.1 Modern Marketing Strategy

This section attempts to learn about marketing strategy, which is one of the drivers of many engineering activities.

Modern marketing strategies include the following,

- Set effective organization's vision, objectives and goals
- Perform SWOT analysis to analyze the organization's strength, weakness, opportunities and threats
- Analyze the industry that the organization forms part of, with respect to competition, customer profiles, alternatives and suppliers
- Analyze factors that could influence the market, for example political/regulatory, technological, economic, social/cultural, demographics and natural
- Monitor market trends

The basic strategy for accomplishing any defined goals has two underlying themes:

- High-value of products and services to meet the global market demands and definite needs of the customers
- Distinctive products and services, to differentiate the company from its competitor

The strategy requires outstanding performance for customer whose focus is quality service and time-based competition. It is critical that businesses understand the importance of the changing global environment.

Most industry leaders see product development as a proactive process where resources are allocated to identify market changes and seize upon new product opportunities before they occur (in contrast to a *reactive strategy* in which nothing is done until problems occur). Many industry leaders see product development as an ongoing process (referred to as continuous development) in which a product development team is always looking for opportunities.

What do successful businesses have in common?

1. Ask the highest price for products or services within their market.
2. Earn high margin return for their markets.
3. Make the most money within their markets.
4. Pay the highest money with their markets.
5. Recognize customer's desire for quality.
6. Possess the five dimensions of competitive edge; namely price, quality, service, marketing, and the ability to deliver over competition.
7. Recognize the priorities of success – the right products/ services at the right location, right price and right time.

Conversely, what drives a company out of business? What are the characteristics of companies that fail?

1. Gross margin continues to decrease
2. Percentage of paid wages increases faster than the sales volumes.
3. Margins on decrease until it fall below the industry standard.
4. Lower pricing results in increased sales but higher costs, lower margins, and decreased service levels.

If success in today's global market can be summed up in one fundamental principle, it is: ***Uncover the customer's explicit needs and offer benefits to meet those needs.***

Modern marketing strategy includes accelerating Time-to-Market. The cost of being late is so unaffordable and therefore reducing time to market is the main challenge of most businesses. Because getting to market on time, in time improves profits.

Rapid time-to-market is important for the competitive success of many companies for the following reasons.

- Competitive advantage of getting to market sooner
- Premium prices early in life cycle
- Faster breakeven on development investment and lower financial risk
- Longer market life cycle; and
- Greater overall profits and higher return on investment

The key process requirements for rapid time-to-market are:

- Clear understanding of customer needs at the start of the project and stability in product requirements or specifications
- A characterized, optimized product development process
- A realistic project plan based on this process
- Availability of needed resources to support the project and use of full-time, dedicated personnel
- Early involvement and rapid staffing build-up to support the parallel design of product and process
- Virtual product development including digital assembly modeling and early analysis and simulation to minimize time consuming physical mock-ups and testing; and
- Design re-use and standardization to minimize the design content of a project

2.2 Project Management Review

A design and manufacturing firm in Singapore provides CDM services to clients under design and manufacturing contract. It runs multiple projects all require to meet the requirement of scope, cost, resources and schedule. Project teams are created by the matrix form of organization. Project managers coordinate teams of employees drawn from different functional departments. There were failures to meet time-to-market requirement defined by the customers resulting in monetary penalties. The underlying issue is thus the multiple-command structure because employees in the matrix are simultaneously members of functional departments and of a project team.

History shows some projects failed either in the aspect of scope, cost, resource or schedule. The causes of failures can be grouped in the following

1. Some project managers are either lack of experience in running full scale projects or not equipped with necessary knowledge and skill of project management. Causes of failures from this group are unclear scopes, inadequate project planning, poor budget projection and resource management.
2. Team members are simultaneously assigned to a functional manager and to several project managers. They are uncertain about reporting relationships and priority.
3. Because of the matrix form of organization, more time are spent for coordinating task-related activities resulting in schedule overrun.
4. Critical skills are missing from the project delivery team members. Design failures incurred additional remedial expenses. Very limited design tools and guideline, and templates are available to aid the product development works
5. Little attention from the project sponsors towards the proper running of projects

A structured management of product development ensures no missing tasks. It is essential for the company to setup a structured way of managing product development to prevent the end effects from reaching their customers.

The four cornerstones of successful Project Management are scope, cost, schedule and resource. Experience has shown that projects are inherently at risk – through overrunning on time and cost and/or failing to deliver a successful outcome. Such failures are almost invariably caused by:

1. Lack of clear links between the project and the organization's key strategic priorities, including agreed measures of success
2. Poor project definition by the project's owner, perhaps because of insufficient consultation with stakeholders or their failure to be specific about requirements and desired outcomes
3. Lack of ownership and personal accountability by senior management, or ineffective engagement with stakeholders
4. Lack of skills and proven approach to project management and risk management
5. Too little attention to breaking development and implementation into manageable steps
6. Inadequate reporting arrangements and decision-making
7. Inconsistent understanding of required project activities, roles and responsibilities
8. Evaluation of proposals driven by initial price rather than long-term value for money (especially securing delivery of business benefits)
9. Lack of understanding of, and contact with the supply industry at senior levels in the organization
10. Lack of effective project team integration between clients, the supplier team and the supply chain

Project management helps to reduce and manage risk. It puts in place an organization where lines of accountability are short and the responsibilities of individuals are clearly defined. Its processes are clearly documented and repeatable, so that those involved in the project can learn from the experiences of others.

The principles of project management are equally valuable for smaller and/or less complex projects. The nature of the project will determine the project management approach needed, which should be adapted as required.

In summary, successful projects have in common,

1. A well-defined scope and agreed understanding of intended outcome
2. Active management of risks, issues and timely decision-making supported by clear and short lines of reporting
3. Ongoing commitment and support from senior management
4. A senior individual with personal accountability and overall responsibility for the successful outcome of the project
5. An appropriately trained and experienced project team and in particular a project manager whose capabilities match the complexity of the project
6. Defined and visibly managed processes that are appropriate or the scale and complexity of the project
7. For cross-cutting projects, there may be nominated senior owners from each organization involved in the project and its delivery. Where this is the case, there must be a single owner who is responsible for the whole project

2.3 Outsourcing

In mid 1980s, some companies who designed and made their own products began to outsource the manufacturing works to contract manufacturers. By outsourcing some function, management is free to focus its energies on the core aspects of the business-those that provide revenue-generating products and services-and leave the other areas to vendors who specialize in performing those functions.

2.3.1 Benefits of Outsourcing

1. Cost savings but not compromising overall benefit goals, thereby freeing capital to invest in profit-making aspects of the business. This is achieved through reduction of employee headcount and related costs, such as recruitment, supervision, salary and benefits, and also the costs of equipment obsolescence and depreciation.
2. Technology - Have more time to focus on core business activities and state-of-the-art technology. Gain access to sophisticated technologies through outsourcers.
3. The key to successful outsourcing is careful selection of both the functions you outsource and the vendors you choose to supply them the contract. Because tailored vendor offers client specific needs, outsourcing customer will receive good quality of service compare to the quality provided by in-house staffs.
4. Price Stability - obtain stable pricing by signing a contract with outsourcing vendors, eliminating the future needs to shop around, allowing the company to budget operating expenses and capital purchases more accurately

2.3.2 Potential Drawbacks

1. Outsourcing creates too much loss of control, less flexibility, questionable savings and the risk of over dependence on too few vendors.
2. Initiating an outsourcing arrangement takes considerable management time.
3. Layoffs could very possibly affect employee morale and may cause talented staff in other core areas to leave for fear of job security.

2.3.3 Types of Outsourcing Services

In the computer and electronics fields, thousands of products are manufactured by contract manufacturers. Some contract manufacturers not only make products, but offer value added services such as design and supply chain services. These companies generally prefer to call themselves "electronics manufacturing services" (EMS) or "contract electronics manufacturing services" (CEMS).

Global leaders in the Electronic Manufacturing Services (EMS) industry offer innovative manufacturing and supply chain solutions to world leading electronics and technology companies across a broad range of industries that include aerospace, automotive, computing, consumer, defense, industrial, instrumentation, medical, networking, peripherals, storage, and telecommunications industries.

Some of the most popular products in the market are made by contract manufacturers. For example, Microsoft's Xbox game machine is made by Flextronics International, Ltd. (www.flextronics.com), a huge company with factories around the world and over $15 billion in sales revenue in 2005. Other major contract manufacturers are Solectron Corporation (www.solectron.com), Sanmina-SCI Corporation (www.sanmina-sci.com), Celestica (www.celestica.com) and Jabil Circuit, Inc. (www.jabil.com)

Established EMS companies are capable of providing customers with turnkey solution, partnering with customers at all phases of product development cycle from concept to production launch.

- Offer manufacturing with design services, including user interface, human factor studies and industrial design, mechanical engineering and tooling design, electronic system design, PCB design and semiconductor design etc.
- Prototypes, product qualification testing, compliance and regulatory testing
- Component selection, sourcing, and procurement. Offer effective system cost through global strategic supply chain
- After-market services, repair and warranty services
- Logistics services, including freight forwarding, warehousing and inventory management
- Project management, documentation, engineering change management and industrialization for high volume manufacturing

There are unique terms emerge from the context of outsourcing to describe the business model, or the type of contract manufacturer. Depending on the type of manufacturing service or contract, EMS companies can be further distinguished as follows,

The OEM

Original Equipment Manufacturer (OEM) is an organization that sells products that are made by contract manufacturers. The term is confusing because the OEM is really not the manufacturer, but the vendor of the equipment to the end user.

The OEM often owns the IP of the products but outsource its manufacturing to low cost manufacturing country such as Malaysia, India and China. The OEM's logo is either placed on the devices by the contract manufacturer that makes the equipment or by the OEM itself.

However, there are numerous companies that specialize in OEM manufacturing and never sell anything under their own brand. Many companies do retail and OEM manufacturing. Company such as Hewlett Packard Company, has a independent OEM division for printers that create facelift, partial or full customization of function according to the needs of its OEM customers.

The ODM

An Original Design Manufacturer (ODM) is similar to a contract manufacturer but uses its own designs and intellectual property (IP) to make products under contract for other companies. The regular contract manufacturer uses its customer's designs and IP and can make hundreds or even thousands of different products, but ODMs often specialize in only a handful of categories.

If a regular contract manufacturer possesses the capability to design and build product with its own design concept, it can either offer to or bid from its customer. Upon agreement, the contract manufacturer is said to have been awarded with an ODM project.

Dell Computers engages ODM in Taiwan to design and build computer products. These products are ordered by and branded Dell’s identity, which sells them to its customers.

The CDM

A company may prefer to arrange for a foreign company to design and manufacture its products under a licensing agreement. Licensing is an arrangement whereby one company allows another to use its brand name, trademark technology, patent copyright or other assets. A Contract Design Manufacturer (CDM) offers manufacturing and contract design service leveraging customer's design architectures and intellectual property.

2.4 Product Life Cycle (PLC)

A product is defined as 'anything' that is capable of satisfying customer needs. This definition includes both physical products (e.g. cars, washing machines, DVD players) as well as services (e.g. insurance, banking, private health care).

The Product Life Cycle (PLC) is based upon the biological life cycle. For example, a seed is planted (introduction); it begins to sprout (growth); it shoots out leaves and puts down roots as it becomes an adult (maturity); after a long period as an adult the plant begins to shrink and die out (decline).

In theory it's the same for a product. After a period of development it is introduced or launched into the market; it gains more and more customers as it grows; eventually the market stabilizes and the product becomes mature; then after a period of time the product is overtaken by development and the introduction of superior competitors, it goes into decline and is eventually withdrawn. However, most products fail in the introduction phase. Others have very cyclical maturity phases where declines see the product promoted to regain customers.

Businesses should manage their products carefully over time to ensure that they deliver products that continue to meet customer wants. The stages through which individual products develop over time are commonly known as the 'Product Life Cycle'.

The classic product life cycle has four stages: introduction; growth; maturity and decline as illustrated in the Figure 2 below,

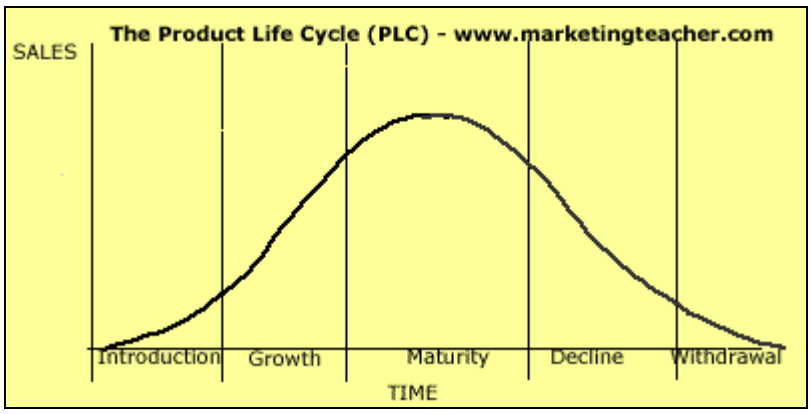


Figure 5 : Product Life Cycle
<http://www.marketingteacher.com/Lessons/lesson_plc.htm>

Introduction Stage

At the Introduction (or development) Stage, market size and growth is slight. It is possible that substantial research and development costs have been incurred in getting the product to this stage. In addition, marketing costs may be high in order to test the market, undergo launch promotion and set up distribution channels. It is highly unlikely that companies will make profits on products at the Introduction Stage. Products at this stage have to be carefully monitored to ensure that they start to grow. Otherwise, the best option may be to withdraw or end the product.

The need for immediate profit is not a pressure. The product is promoted to create awareness. If the product has no or few competitors, a skimming price strategy is employed. Limited numbers of product are available in few channels of distribution.

Growth Stage

The Growth Stage is characterized by rapid growth in sales and profits. Profits arise due to an increase in output (economies of scale) and possibly better prices. At this stage, it is cheaper for businesses to invest in increasing their market share as well as enjoying the overall growth of the market. Accordingly, significant promotional resources are traditionally invested in products that are firmly in the Growth Stage.

Maturity Stage

The Maturity Stage is, perhaps, the most common stage for all markets. It is in this stage that competition is most intense as companies fight to maintain their market share. Here, both marketing and finance become key activities. Marketing spend has to be monitored carefully, since any significant moves are likely to be copied by competitors. The Maturity Stage is the time when most profit is earned by the market as a whole. Any expenditure on research and development is likely to be restricted to product modification and improvement and perhaps to improve production efficiency and quality.

Decline Stage

In the Decline Stage, the market is shrinking, reducing the overall amount of profit that can be shared amongst the remaining competitors. At this stage, great care has to be taken to manage the product carefully. It may be possible to take out some production cost, to transfer production to a cheaper facility, sell the product into other, cheaper markets. Care should be taken to control the amount of stocks of the product. Ultimately, depending on whether the product remains profitable, a company may decide to end the product.

Set out below are some suggested examples of products that are currently at different stages of the product life-cycle:

INTRODUCTION	GROWTH	MATURITY	DECLINE
Third generation mobile phones	Portable DVD Players	Personal Computers	Typewriters
E-conferencing	Email	Faxes	Handwritten letters
All-in-one racing skin-suits	Breathable synthetic fabrics	Cotton t-shirts	Shell Suits
iris-based personal identity cards	Smart cards	Credit cards	Cheque books

Table 3 : Example of products at different stages of Product Life Cycle

2.5 Product Development

In business and engineering, product development is the complete process of bringing a new product to market. There are two parallel aspects to this process: one involves product engineering; the other marketing analysis. Marketers see product development as the first stage in product life cycle management, engineers as part of Product Lifecycle Management.

There are several stages in the product development process:

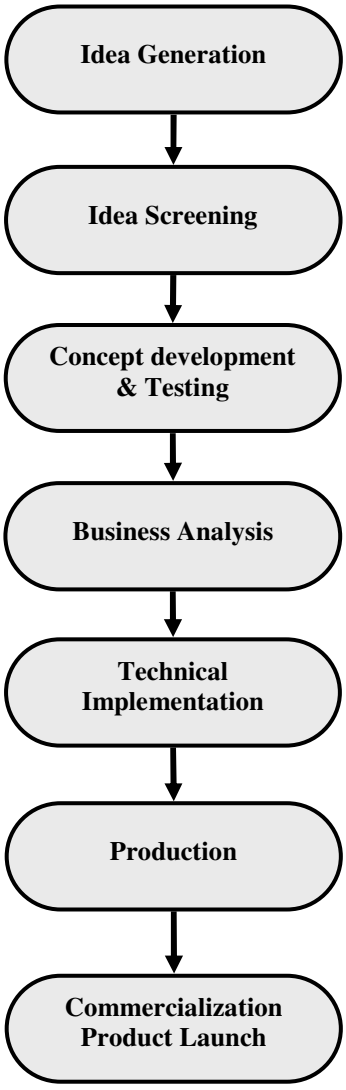


Figure 6 : Product Development Process

These steps may be iterated as needed. Some steps may be eliminated. To reduce the time the process takes, many companies are completing several steps at the same time (referred to as **concurrent engineering** or **time to market**).

2.6 Intellectual Property

The dangers of not protecting intellectual property (IP) are multiplied when working with outsourcing. Proper legal protections including enforceable written agreements and NDAs (Non-Disclosure-Agreement) are to be used. A clearly stated contract helps avoid disagreements later and keeps businesses from the expense of litigation.

Many companies engage in OEM manufacturing/outsourcing take very cautious steps necessary to protect themselves. They carefully identify and protect the trade secrets, proprietary information and know how by properly register the intellectual property rights in the relevant countries. A comprehensive written agreement such as NDA can be used with service provider to protect know how and trade secrets. Such agreements may address issues such as non-competition and confidentiality. The ideal agreement will address all of the issues discussed above while also addressing other basic legal issues such as jurisdiction and dispute resolution.

The U.S. Department of State defines it as:

"Creative ideas and expressions of the human mind that possess commercial value and receive the legal protection of a property right. The major legal mechanisms for protecting intellectual property rights are copyrights, patents, and trademarks. Intellectual property rights enable owners to select who may access and use their property, and to protect it from unauthorized use."

This definition gives emphasis on the word Protect. Indeed, it is designed to extend protection to the creator of a certain creative work or a product. Legal provisions are installed to give the owner the exclusive right to control access and use of his property. The law provides for specific procedures when a violation of these rights is committed.

Copyrights and industrial property are two categories that make up intellectual property. Copyright laws provide for the owner an exclusive right to control access of his creative work. Industrial property includes such things as patents and trademarks. A patent is defined as a legal grant issued by a government permitting an inventor to exclude others from making, using, or selling a claimed invention during the patent's term. A trademark on the other hand is a name or symbol secured by legal registration that identifies a manufacturer's or trader's product or service and distinguishes it from other products and services.

Legal Terms

Types of intellectual property include patents, trademarks and trade dress, copyrights, and trade secrets. Richard A. Chapo listed some of the legal terms in his article 'Legal Terms - A Quick Guide'

Contract

An agreement between two or more parties in which each party agrees to provide something in exchange for the other party doing the same. Typically, one party provides money while the other provides a service or product. Contracts can be oral or written, but oral contracts are difficult to enforce.

Copyright

The legal right attached to literary, musical, dramatic or artistic works. Copyright automatically attaches to the piece in favor of the creator of it. To sue for copyright infringement, the creator must file for an official copyright from the Library of Congress.

Intellectual Property

A product or idea that has tangible commercial value. Examples of intellectual property include copyrighted works such as books, patented items such as a product design and a trademarked item for a brand. The word "Amazon" is not considered intellectual property. When applied to the Internet, however, the word is intellectual property as it refers to a brand for an online bookstore.

Non-Compete Agreement

An agreement whereby one party, typically an employee, agrees not to use information learned during employment in subsequent business efforts for a set period of time. In some states, non-compete agreements are extremely difficult to enforce. An example of a non-compete agreement dispute is the current litigation between Microsoft and Google over Kai-Fu Lee.

Non-Disclosure Agreement

A contract binding one party to a duty of confidentiality in regard to certain information provided by another. An NDA typically is executed where one party wished to discuss a business venture with another and the discussion necessarily requires the disclosure of sensitive information.

Trademark

A name, label or symbol identifying a product or web site. Trademarks are filed with the Patent and Trademark Office and restricted to a class of products or services. "Amazon" is a trademarked term for Internet services, but not for general references such as ecological discussions.

Patent

A patent is granted by the government allowing a (usually) 20 year monopoly on an invention previously "not generally known." Patents are intended to encourage investment in research and development. If a new useful process is created for doing something, a machine, manufacture, or even an improvement on something already in existence, the invention can be patented and prohibit others from "making, using, offering for sale, or selling…or importing" the invention. Design patents protect innovations in the appearance (although not the structure or function) of an item. Utility patents are for wholly new inventions including machines, industrial processes, compositions of matter, and articles of manufacture. Plant patents cover innovations in plant-life, such as new species of plant created from the reproduction of cuttings and grafts of existing plants.

Trade Secrets

It is important to protect business' trade secrets so they will not be misappropriated. Whereas patents have a limited time of coverage and after 20 years are released, trade secrets are always protected. To qualify as a trade secret, it must have independent economic value to the company. For example, the recipe for Coca-Cola is a trade secret, not a patent, and therefore will never be released because without maintaining the secrecy of the recipe, the business would not be able to compete by offering an individual product.

Registered Design

Designs are for the shape or appearance of manufactured goods.

Designs refer to the features of shape, configuration, pattern or ornamentation, which can be judged by the eye in, finished articles. A new or original design may be registered for up to sixteen years. Registration gives the owner the exclusive rights to make, use and sell after incorporating the registered design.

2.7 Environmental Sustainability

Environment means the physical surroundings and conditions that directly or indirectly affect people's lives, including:

- Land, water and air
- All organic and inorganic matters
- All living organisms
- Social, political, economic and cultural conditions that influence the lives of people and communities
- Any structure or thing made by people

Environmental impacts are effects of human activities on the living conditions and productivity of the ecosystem.

- Overuse of natural resources
- Natural resources extraction by humans causing interruption; and
- Pollution by waste discharge

Environment degradation is said to occur when environmental conditions are out of the optimum range, and is caused by human activities.

Carry out environmental impact assessment leads to the following benefits,

- More efficient and productive use of natural resources
- Lower project cost in long term (fewer costly changes at later stage, lower probability of environmental disaster, court cases and clean-ups)
- Avoidance or remedial measures planned and implemented in time to minimize adverse impacts on the biophysical and social environments
- Improved future planning of economic development projects
- Better protection for the environment and minimized adverse social impacts via the consultative process; preserved or enhanced quality of life
- Opportunity for the public to learn about environmental effects, express concerns, and provide input into the assessment process, thus leading to better decisions
- Opportunity for the public to influence the decision making process
- Enhance public confidence in public and private institution
- Good public relation fostered, decision makers more likely to be viewed as good corporate citizens

Conversely, the risk of not performing environmental impact assessment leads to,

- Costly litigation, expensive clean-ups and sudden burden of providing monetary compensation
- Very expensive surprises later down the line which can be resulted in unbearable losses to developers and project proponents
- Loss of public trust in public and private institutions or in individuals in positions of power
- Worsening environmental conditions leading to deterioration of the natural resource base of the economy
- Consumer backlash against industry and businesses responsible for environmental disasters.

2.7.1 What is DfE and its benefits?

Design for Environment (DfE) is a product-focused environmental approach aims to reduce environmental impacts throughout the whole product life cycle by better product and process design. Also known as EcoDesign, it is the systematic integration of environmental considerations into product and process design. Manufacturers using DfE strategies take into account the environmental aspects of a product's use and end of life, and apply this information during its design, production and distribution.

The basis of DfE in product design is LCA (Life Cycle Assessment) and ecological profile.

2.7.1.1 Potential benefits on DfE

Carrying out DfE during product design has the potential benefits as follow,

- Meeting or surpassing customer/user requirements by exceeding current expectations for price, performance and quality.
- Improve customer loyalty
- Increase market competitiveness, 'Green sells better'
- Cost savings: reduce cost of product by optimizing the use of the materials, energy, more efficient processes, and reduced waste disposal
- Employee motivation
  - Stimulation of innovation and creativity
  - Enhancement of organization image
- Product quality
  - Reduction in liability through reduced environmental impacts
  - Reduction of risks
- Meet legislative regulations and thus improved relations with regulators
- Through eco-labeling programs, attract financing and investments, particularly from environmentally conscious investors

2.7.1.2 Main Parameters of DfE

The main parameters of DfE in product design are as follow,

- Product weight and volume
- Amount of recycled material
- Energy consumption during life cycle
- Usage of health or environmental hazard substances
- Environmental management system e.g. EMAS[1]
- Product usage and service
- Extension of life time
- Reuse and recyclability
- Emissions to air, water and soil
- Waste and hazardous waste

Note [1]:

The Eco-Management and Audit Scheme (EMAS) is the EU voluntary instrument which acknowledges organizations that improve their environmental performance on a continuous basis. EMAS registered organizations are legally compliant, run an environment management system and report on their environmental performance through the publication of an independently verified environmental statement. They are recognized by the EMAS logo, which guarantees the reliability of the information provided.

The scheme has been available for participation by companies since 1995 (Council Regulation (EEC) No 1836/93 of 29 June 1993) and was originally restricted to companies in industrial sectors.

Since 2001 EMAS has been open to all economic sectors including public and private services (Regulation (EC) No 761/2001 of the European Parliament and of the Council of 19 March 2001). In addition, EMAS was strengthened by the integration of EN/ISO 14001 as the environmental management system required by EMAS; by adopting an attractive EMAS logo to signal EMAS registration to the outside world; and by considering more strongly indirect effects such as those related to financial services or administrative and planning decisions.

2.7.1.3 EcoDesign 'Rules of Thumb'

1. Material Management

Good material management process for EcoDesign is achieved through conscious selection of materials to reduce hazardous content in the product.

- Avoid Hazardous Substances
- Avoid raw materials with high environmental impact in their manufacture
- Develop environmentally preferable materials e.g. smart polymers, biodegradable polymer for disassembly

2. Waste Management

Proper waste management aims to reduce environmental impacts to our eco-system. The keys to managing wastes are

- Design for disassembly and recycling. Simple product connection makes disassembly of components in product easy for recyclability.
- Select recyclable materials
- Select compatible composites, i.e. eliminate or minimize contamination of one material with another
- Reduce the number / types of materials used

2.7.1.4 6 RE Philosophy

The following describe what 6 RE is,

- Re-think the product and its functions e.g. the product may be used more efficiently
- Re-duce energy and material consumption throughout the life cycle of a product
- Re-place harmful substances with more environmental friendly alternatives
- Re-cycle: select materials that can be recycled, and build the product such that it is easily disassembled for recycling
- Re-use: design the product so parts can be reused
- Re-pair: make the product easy to repair so that the product does not need to be replaced.

2.7.2 Legal requirements for Environmental Sustainability

2.7.2.1 European Union

1. WEEE (Aug. 2005) – Waste Electrical & Electronic Equipment
2. RoHS (July 2006) – Restriction of the use of certain Hazardous Substances
3. ELV (July 2003) – End of Life Vehicle
4. EUP (under discussion) – Energy Using Products

2.7.2.2 The United States

- Federal/State/Local (e.g. CA Prop 65)

2.7.2.3 China MII

- Proposed legislation similar to RoHS and WEEE

2.7.2.4 Japan

- "Home Appliance Recycle Law" (2001), 60% recycle, Government responsible

2.7.2.5 Korea

- Industry agreements to limit certain materials

2.7.2.6 EU Environmental Directive Summary

RoHS (2002/95/EC) = Restriction of the use of certain Hazardous Substances

The RoHS regulation aims to limit the amount of hazardous substances present in products that manufacturers ship into the European Union after July 1, 2006.

The directive sets requirements for collection and recycling of electronic products across Europe, for which producer will be responsible and will cover the costs.

There are 4 key parts covered by this legislation,

1. Substance restrictions

There are six substances to be restricted in products by July 2006. These are Lead, Hexavalent Chromium, Cadmium, Mercury, PBB and PBDE

Items	Banned substance	RoHS limit by weight
1	Lead	0.1% (1000ppm)
2	Mercury	0.1% (1000ppm)
3	Cadmium	0.01% (100ppm)
4	Chromium	0.1% (1000ppm)
5	Polybrominated Biphenyls (PBB)	0.1% (1000ppm)
6	Polybrominated Diphenylethers (PBDE)	0.1% (1000ppm)

Table 4 : RoHS banned substances

Maximum allowed level of banned substances in Components are measured against the homogeneous material of which the component is made off.

Homogeneous material means a unit that can not be mechanically disjointed in single materials. Mechanically disjointed means that the materials can be, at least in principle, separated by mechanical actions such as unscrewing, cutting, crushing, grinding and abrasive processes.

2. Disassembly

The following parts need to be quickly separated at the end of product life,

- Battery
- Printed circuit board >10 cm^2
- Liquid Crystal Display >100 cm^2

3. Recycling

- 50-65% of product weight is recyclable by July 2006.
- Total target is 75-80% over all recovery
- 10-20% allowed for energy recovery

4. Marking

Products must be marked with production date and with symbol indicating separate collection after August 13th 2005.

WEEE (2002/96/EC) = Waste Electrical and Electronic Equipment

- Where appropriate, priority should be given to the reuse of WEEE, and its components, subassemblies, and consumables. In addition, producers should be encouraged to integrate recycled material in new equipment.
- Article 4, Product Design - Member States shall encourage the design and production of electrical and electronic equipment which take into account and facilitate dismantling and recovery, in particular the reuse and recycling of WEEE, their components and materials. In this context, Member States shall take appropriate measures so that producers do not prevent, through specific design features or manufacturing processes, WEEE from being reused, unless such specific design features or manufacturing processes present overriding advantages, for example, with regard to the protection of the environment and /or safety requirements.

2.8 Conclusion

This chapter has reviewed first the modern marketing strategy, which has a lot to do with the fast pace product development environment.

In response to Time-to-Market requirement, common causes of project failure are made known so that each of them will be addressed in the later part of this dissertation.

As the research is carried out in the context of EMS industry segment, this chapter includes the introduction of the outsourcing industry, as well as the awareness of intellectual property rights and environment protection.

This chapter also provides the knowledge about Product Life Cycle (PLC), which lays the foundation and forms the primary elements of product development process.

Chapter 3

The Philosophy of Project Management

The research project is dealing with product development process which is built upon project management fundamental. The dissertation has included this chapter to elaborate the relevant discipline in details, aiming to guide the formulation of product development process.

3.1 What is Project Management?

Business work results in assignments. To address the assignment, we work in 'PROJECTS'.

A project is a unique venture comprised of interrelated activities with a definite beginning and end, specific deliverable, and defined resource. It is conducted by people, possibly from different organizations, to meet established goals within parameters of cost, schedule, resources and quality.

'Project management is the application of knowledge, skills, tools and techniques to a broad range of activities in order to meet the requirements of the particular project. It is a temporary endeavor undertaken to achieve a particular aim. Project management knowledge and practices are best described in terms of their component processes.'

"A Guide to the Project Management Body of Knowledge (PMBOK® Guide), - 3rd Edition"

These processes can be placed into five Process Groups:

- Initiating
- Planning
- Executing
- Controlling, and
- Closing

The processes can also be placed into nine Knowledge Areas. The nine Knowledge Areas centre on management expertise in

- Project Integration Management
- Project Scope Management
- Project Time Management
- Project Cost Management
- Project Quality Management
- Project Human Resources Management
- Project Communications Management
- Project Risk Management, and
- Project Procurement Management

The four cornerstones of successful Project Management

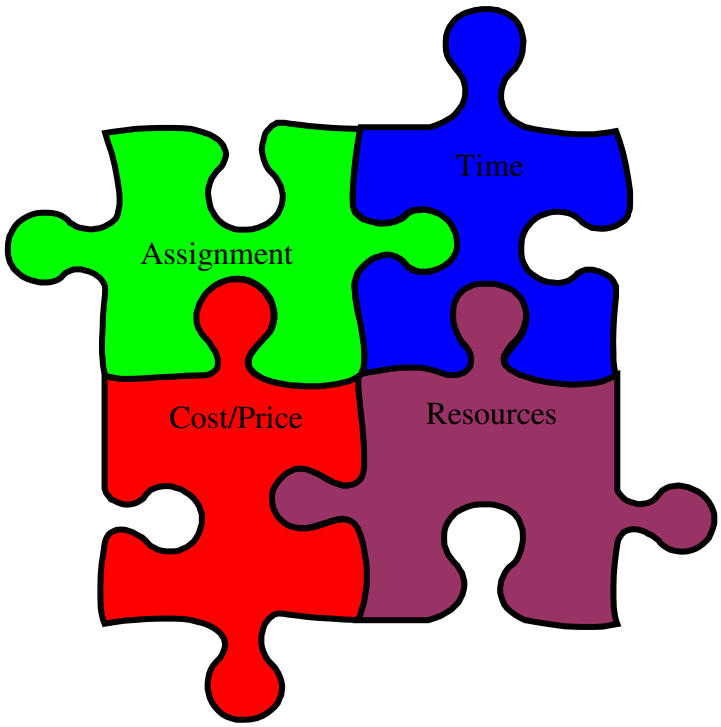


Figure 7 : Project Parameters

In summary, project management has the following key processes,

- To set objectives for the project and have them followed
- To know how long the project will take and how much it will cost
- To decide which features are in and which are out of the project
- To make reasonable changes to requirements throughout the course of the project and to know the costs of making those changes
- To know the project's status clearly and confidently (via your project management report)
- To be appraised regularly of risks that could affect cost, schedule, or quality, and to be provided with options for addressing potential problems.

3.2 Project Management Fundamental

The key components of a full scale project management can be placed into five process groups: Initiating, Planning, Executing, Controlling and Closing.

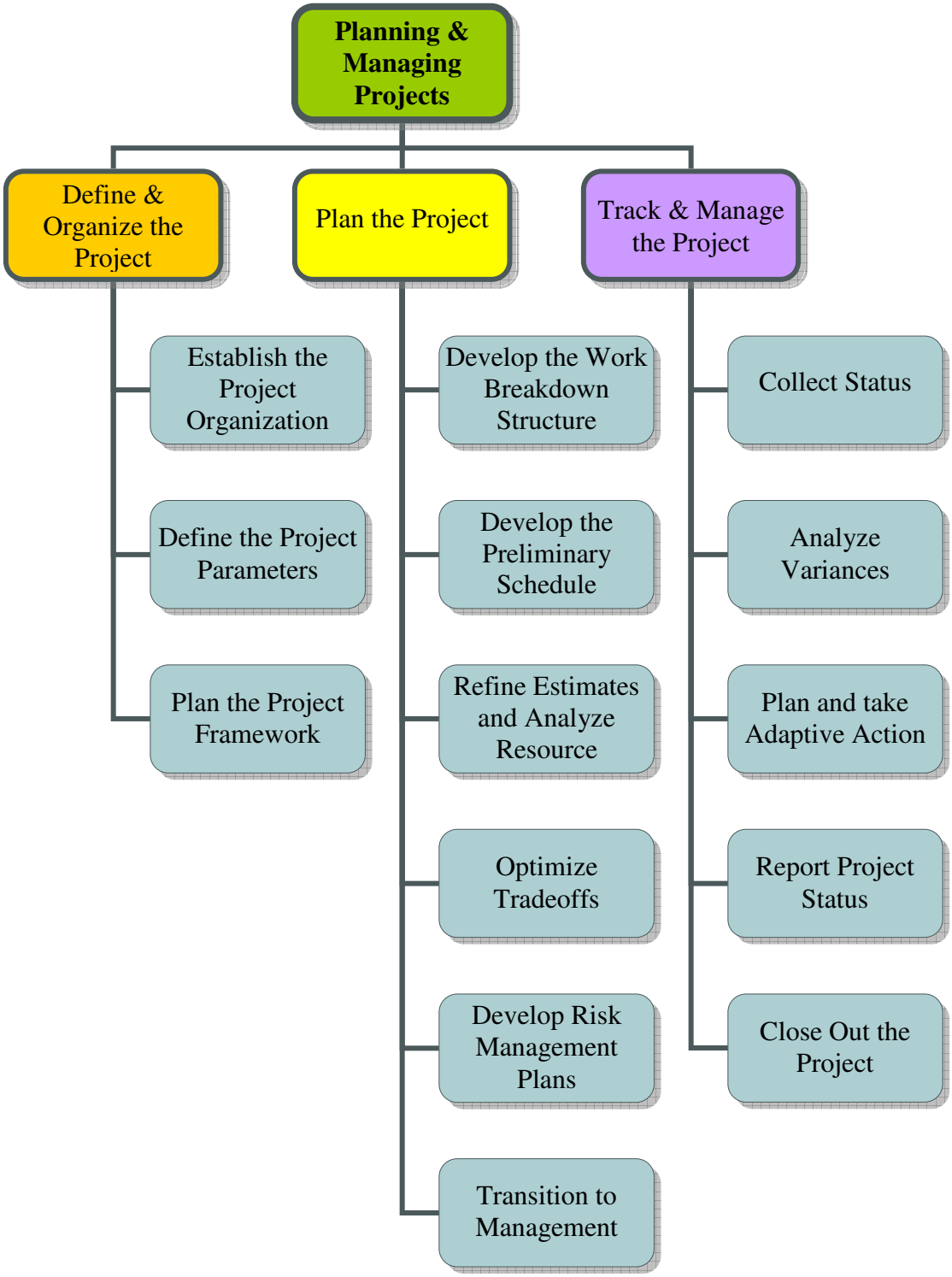


Figure 8 : Project Management Concept, Reproduced from Project Manager's Handbook, ©2004 by IPS

3.2.1 Define and Organize the Project

Projects typically come from a variety of sources including customer requirements, regulatory or legal requirements, market research, new technologies, and infrastructure requirements. Most companies have a process to determine whether or not a project should be approved for funding. The process may be ad hoc or formal. Formal processes typically involve a study to assess cost/benefit, feasibility, strategic fit and relative priority.

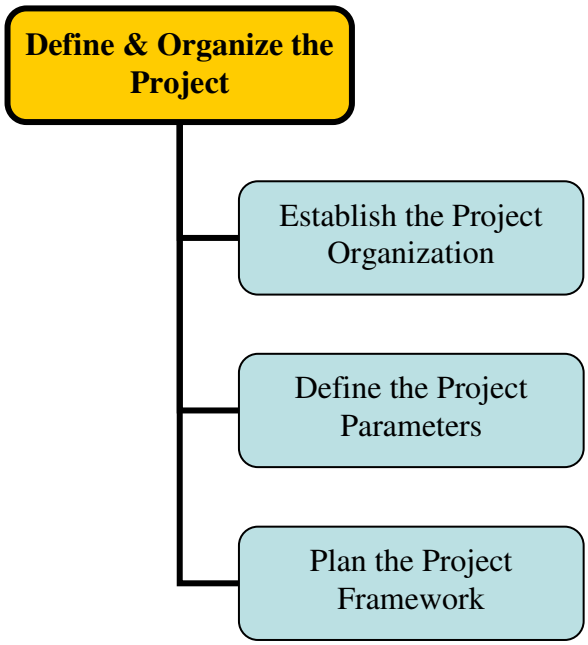


Figure 9 : Define & Organize the Project

At this phase, high-level project goals and target dates are established. The product definition is developed and typically includes

- A comprehensive list of customers
- Customer requirements stated in quantifiable terms
- A list of objectives and constraints
- A priority list of features that distinguish musts from wants
- Competitive analysis
- Globalization issues, if any
- Risk related to the product or product introduction
- Product financials

Once the project is approved for funding, the sponsor is identified, the project manager is assigned and formal project management begins.

3.2.1.1 Establish the Project Organization

The Project Organization in management environment as shown in Figure 10 serves to provide clear lines of reporting and decision taking. The figure shows a structure that illustrates the relationships between the roles.

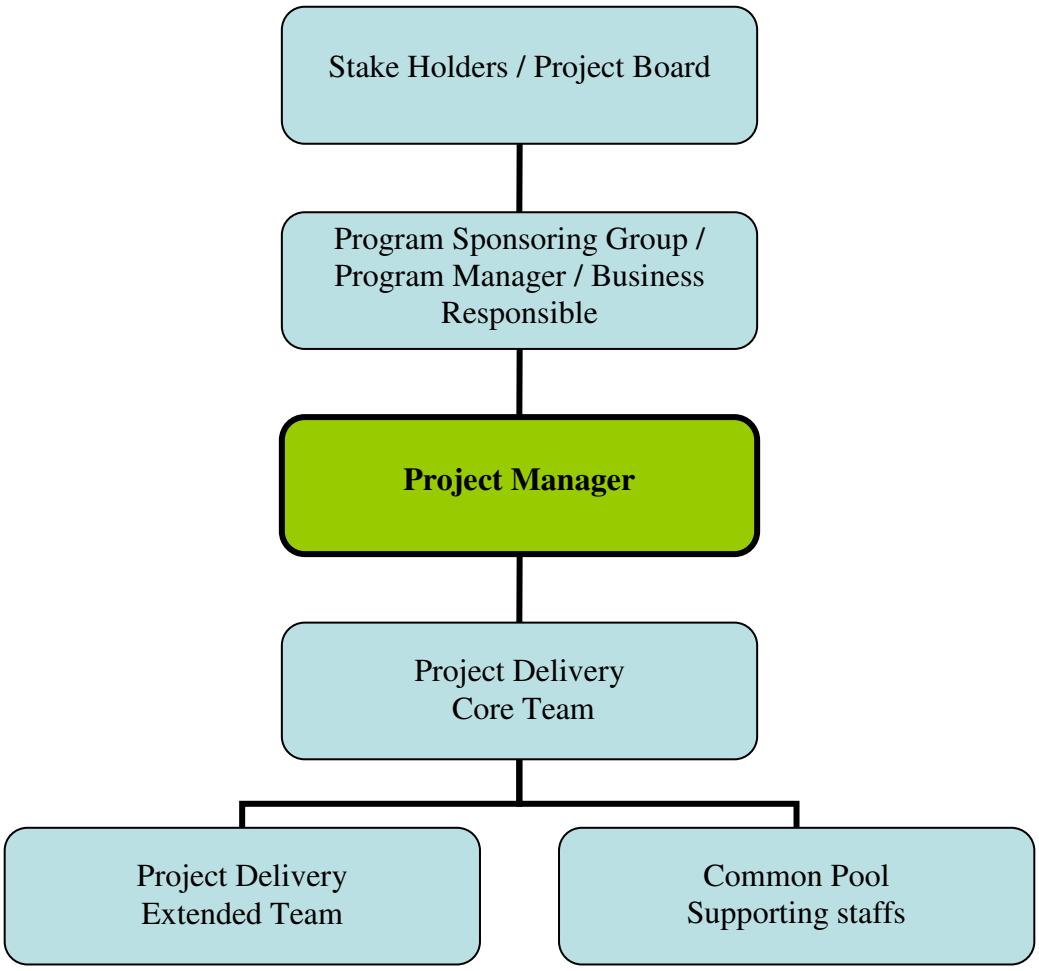


Figure 10 : Project Organization / Line of Reporting

The Stakeholders

Stakeholders are those individuals or groups. They could include senior managers whose business areas are directly or indirectly involved, the end users (including customers outside the organization), suppliers and partners. Effective project organization facilitates management of the stakeholders' interests, including the resolution of conflicting objectives and representation of end-users who may not be directly involved in the project. Stakeholders' interests can be managed through user panels providing input to the requirement specification. For larger projects, there is usually a project board, with a senior individual nominated to represent the stakeholders' interests.

The Project Sponsors

The Project Sponsor provides backing, resources, strategic direction and approval for the project. He/She is the focal point for project decisions beyond the Project Manager's scope of authority.

Typical responsibilities of Project Sponsor include

- Appoint the Project Manager
- Approve scope and objectives, including schedule and budget
- Obtain resources
- Issue directives as appropriate
- Monitor project environment
- Approve project changes, review progress and provide strategic direction
- Set priorities and resolve conflicts

The Project Manager

The Project Manager appointed by the Business Responsible and / or Program Manager has the authority to lead and manage the project on a day-to-day basis within the constraints laid down by the Project Board.

The individual will bring strong planning and process skills to the team and will have management accountability for the definition and execution of the project plans including project initiation, planning, execution, controlling and closing out the project. The project manager will manage project dependencies and team and stake holder relationships as it relates to the project and ensure timely and effective communication with the project team and with the project stakeholders.

This individual will also have strong negotiation and relationship management skills and will work with program / project managers and teams from other areas inside the organization.

As the Project Manager, this position demands skills in resource management, fiscal management of budgets and ability to deliver to committed schedules.

In addition, this individual will be responsible for ensuring that technology solutions are compatible with Company's architecture, policies and standards.

The general roles of Project Manager are listed below,

1. Responsible for organizing and guiding the multidisciplinary project teams to reach the project objectives within scope, schedule and target.
2. Manage projects associated with product development from concept through to successful volume manufacturing.
3. Spearhead cross-functional team development efforts; manage all stages of product development process including interfacing with public/private institutions.
4. Manage project costing and resource planning.
5. Oversees all aspects of projects. Set deadlines, assign responsibilities, monitor and present projects progress reports to the top management through agreed reporting lines.
6. Attend to internal and external customer problems and to organize and guide project team for its solution.

7. Meet and/or exceed customer's specifications, project schedules, financial goals and quality standards.
8. Manage in a timely and cost effective manner based on the contractual schedule and project specification.
9. Ensure good project management standards and practices are implemented at all time.
10. Ensure implementation of timely and accurate cost tracking mechanism of project costs for assigned projects as forecast.
11. Manage project risks, including the development of contingency plans.
12. Change control and any required configuration management.
13. Ensuring all issues are recorded and resolved
14. Negotiate the performance of activities with team members and their managers and establish priorities among project activities
15. Provide periodic status reports and information; coordinate management and technical decisions
16. Arbitrate and resolve conflict and interface problems within the project

Skills and Requirements of a Project Manager

- Good communication, coordination and leadership skills and the ability to establish rapport with people of different backgrounds.
- Exposure to multinational and international cultures
- Possess strong organization and planning skills; capable of operating independently with minimal direction
- Experience in managing multi-discipline projects and teams
- Understands the project management process; Strong awareness and experience in product development processes
- Has an understanding of the technology involved in the project
- Strong people management skills as the position requires managing project teams and activities
- Decisiveness and good judgments required for sound planning
- Well-developed organization / time management skills in order to multitask
- Ability to multitask, prioritize and escalate tasks appropriately

The Project Delivery Team

In identifying the Project Team, review preliminary project description to determine what organizations need to be involved. Consider both internal and external groups. The Project Team should include groups from all phase of the project, and customer(s) if applicable.

The project team consists of core members and extended members. Along with the Project Manager, they are directly responsible for the successful completion of the project and must take ownership of all project activities. Core members make major decisions and recommendations regarding the project. Extended members serve as a resource to the core team, usually providing specific expertise to the team. Critical skills which are missing will cause serious problems at some point in the project. They must be technically competent in the area of their responsibility and their skills must complement others in the group.

3.2.1.2 Define the Project Parameters

Project initiation involves clear definition including the clarification of scope, resources, responsibilities, and plans. This activity is dedicated to establishing a firm foundation and planning the work to be done. A key purpose of this activity is to draw up an agreed way forward based on the initial scope to ensure there is a common understanding of the rationale and aims of the project. This includes planning how quality is achieved and the subsequent work will be conducted. The level of risk for the project needs to be determined at this point.

At this stage, it is necessary to clearly define the project parameters to ensure common understanding of the project and objectives among all team members, and document sufficient information about the project to support planning.

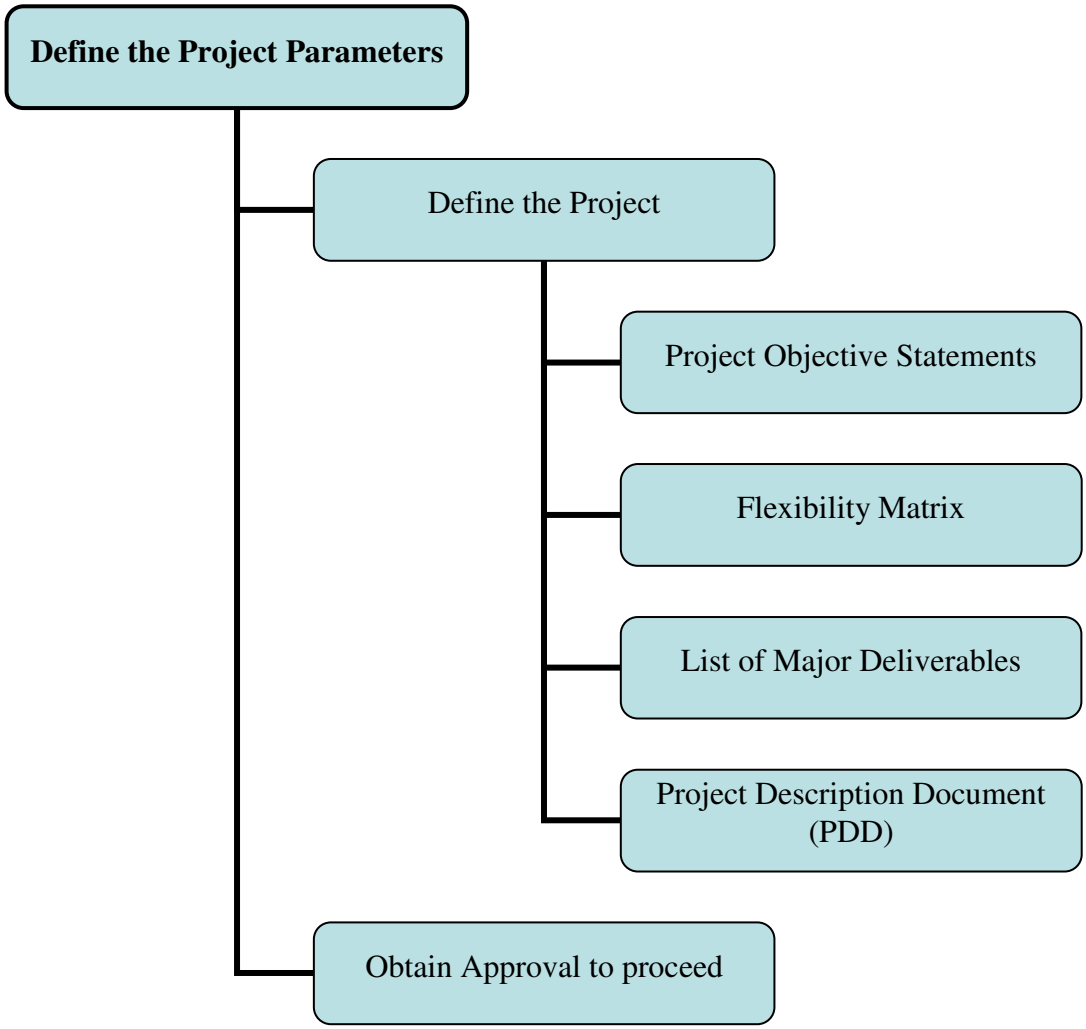


Figure 11 : Define the Project Parameters

Define the Project

1. Project Objective Statement (POS)

Project Objective Statement (POS) states the Scope, Schedule, and Resources/Cost. The statement must provide clarity and focus for the project team. It should be less than 25 words using ordinary English (do not use technical jargon, buzzwords, or expertise specific phrases) without ambiguity in the three project parameters, Schedule, Scope, Resources

2. Flexibility Matrix

Flexibility Matrix is a project legibility matrix that helps the team determine the trade-off among Scope, Schedule and Resources. It explicitly states the basis for decision making and reflects flexibility at this point where no detailed planning has been done yet. When problems are encountered, which objective is the least flexible, which is moderately flexible, and which is most flexible

- least legible means it cannot be exceeded
- moderately flexible means either maximized or minimized within project objectives
- most flexible means that management is willing to exceed the original goal if necessary (this is not a license to go over budget or ignore the scheduled)

The matrix can be used again for clarification when doubts arise during discussion at any period of the project. The matrix may change but changes should always be formally defined and recorded.

	Least Flexible	Moderately Flexible	Most Flexible
Schedule			
Scope			
Resource			

Table 5 : Flexibility Matrix

3. List of Major Deliverables

The major deliverables will define what the project is expected to produce. A common understanding of major deliverables provides scope and boundaries for the project team and serves to reduce rework cycles. The thoroughness of this step will directly impact the success of the project.

In addition to identifying major deliverables from project, the list of major deliverables must describe completely the completion criteria and date constraint, and specify what is/is not included in the deliverables in quantifiable terms.

4. Project Description Document (PDD)

Project Description Document is a high level summary of the project that is used to document the project objective statement, flexibility matrix, major deliverables, Is/Is Not lists and detailed project description.

It should contain the following categories:

- A summary of the description
- What the project will and will not include
- Purpose (why are we undertaking this project)
- Strategic alignment (why are we taking on this project at this time)
- Completion criteria (project end, acceptance criteria)
- Project start
- Target customer(s)
- Dependencies (committed dates, commitments to/from other projects)
- Staffing (in terms of skills and balance of experience)
- Hardware and software required
- Risk of doing project versus. not doing (impact assessment)
- Cost/benefit analysis
- Technology required

A sample PDD can be found in Appendix B5 at the end of this dissertation.

Obtain Approval to Proceed

A clear common understanding of the project description and priorities is essential to the success of the project. All parties involved must participate and approve the project definition through the team validation process.

The completion criteria at this stage is to present project description, objective statement, major deliverables and flexibility matrix to management/sponsor and get approval to proceed. This solidifies understanding of the top down goals and sets expectations.

3.2.1.3 Plan the Project Framework

Framework defines agreements made by the project team as to how the team will operate. It is the rule of the game. It serves to clarify expectations of project participants and ensure that important decisions are made early and documented. Framework categories include Planning, Tracking, Practice and Relationship.

FRAMEWORK CATEGORIES			
PLANNING	TRACKING	PRACTICES	RELATIONSHIP
• Development • Deliverables • Tools	• Tracking • Reporting • Meeting	• Project File • Managing Change • Continuous Improvement • Lifecycle	• Ownership • Communication • Escalation

Table 6 : Framework Categories

The Framework Planning Checklist

Planning Decisions	
Development	Who is responsible for developing the project plan? – Who should be involved if there is more than one person? – What are the specific roles and responsibilities of each participant? What does the plan include? – Does it meet customer's/management's need? – What product or service life cycle will it follow? Will meeting be needed to define the project plan? – When and where should they be held? – Who will attend? Who needs to be informed of decisions made? – How will they be kept informed? – Will a list of terms be distributed for better comprehension? Is there a plan to continuously improve our management of the project? – Is there past experience on similar projects? – How can we use it?
Planning Output	What are the outputs from the planning process? – In what format will they be presented? – How detailed should they be? – Who needs to receive them? – Who is responsible for them? How will we know that each output is completed? – Who will assess the quality of each output? – Who needs to approve and sign off at the completion of each output? – How will we know that it has been signed off?

PM Tools	What project management tool(s) are we going to use? What equipment is required to support the tool(s)? – Will all sub-projects use the same tools? Who will operate the chosen tool? – Who will enter planning and tracking information? – Who will need training to operate the tool? – Who will provide technical support for the users of the tool? What additional software do we need in order to support project management tool? – For financial related issues – For action items, follow-up, etc. – For documentation
Tracking Decisions	
Tracking	How will we assess progress? How will we get data from the project team members and others about the progress of each activity? How often will we get this data? At what level of detail will we track the project? Who will assess the impact of each validation?
Progress Review Meeting	What types of meeting will we hold? – Where will they be held? – How often will they be held? Who will define the strategy and method for managing meetings effectively? – Who will run these meetings? – Who will produce an agenda to be distributed before each meeting? Who should be included in each type of meeting? – In what format should the meeting information be presented? Who will keep minutes of the meetings? – Who will produce them? – To whom should they be distributed?
Reporting	What reports will be generated? – Who will generate, analyze and distributed them? – To whom should they be distributed? What content is appropriate for each audience? – How detailed should status reports be for each audience? – What formats communicate best to each audience? What criteria will we use to define an exception for exception reporting? – Who initiates these reports? – Who will receive and analyze exceptions reports?

Practices Decisions	
The Project File	What should the project file contain? – How will all project information be kept? – Who will create the project file? – Who will update and maintain it? – Has a filing system been set up for all documents? – Where will the file be located? – Who will have assess to the file? For how long will the file be kept after project completion? – Who will keep it after project completion? – How will it be used? – Where will it be stored?
Managing Change	When will the plan baseline be frozen? – Who will make the decision to freeze the plan? – What will the decision to freeze it be based on? What criteria will we use to define change? – Who will define the change management process we will use? – Who will maintain the change log? Who will have change approval authority? – What documents will be presented for change approval? – How will we document approved plan changes? How will we assess the impact of change? – Who will set adaptive actions? – How will we track the effectiveness of these adaptive actions? How will we decide whether to update the baseline plan? – How much deviation from the plan are we willing to accept before doing a total reschedule? – How will we link revision to the change management process?
Project Assessment	Will a project assessment meeting be held? – Who will attend? – What subjects will be addressed? – How often during the project life will an assessment be done? How will we document the project assessment so that others can learn from our experience? – What information should be kept to provide a historical basis for continuous improvement? – Will a project assessment meeting be held?

Project Lifecycle	Which lifecycle will be used? – Is there a standard (common) lifecycle? – Are we going to define one for this project? – Who is responsible for defining it? – By when should it be fully defined? What is the release plan process for this project? – Is the product release part of this project? – Who owns the release plan? – By when should the plan be fully defined? – Who has the authority to approve it?
Relationships Decisions	
Ownership	What departments or organizations will we need to interact with during the life of the project? What re the roles and responsibilities of each organization (reviewer, approver, creator, etc)
Communication	How do we communicate? – Among ourselves (project team) and with others outside the team – How frequently do we need to communicate? How will we keep all involved parties informed of deliverables, schedule dates, expectations, problem areas, etc.? – Are there specific communication milestone dates or intervals? – What information will and will not be exchanged?
Escalation	What is the process we will use to resolve disagreement? – What is the conflict resolution process? – What is the standard decision making process? What is the escalation process we will use for making decisions? – Who has final decision making authority? – Who decides when to escalate a problem?

Table 7 : The Framework Planning Checklist

Because the team will have to live within the framework it creates and build a sense of team accountability for decisions, it is important to reach agreement on each item by the Project Manager and the core team.

Finally, all decisions made during the framework review are to be documented and distributed.

3.2.2 Plan the Project

Planning provides everyone involved in a project with a common baseline of information and ensures that everybody understands the project objectives. Plans will also establish a basis for dealing with risks, issues and changes and help to achieve good quality products.

Plans are developed during project start-up and initiation; they are monitored and updated throughout the life of the project. Depending on the scale and complexity of a project, different levels of plans might be required. The project plan could be broken down into stage plans; typically these are produced in outline and are further developed as the next stage. When it is predicted that a plan will no longer finish within the agreed allowances for cost/time/risk, an exception plan may be produced to supplement that plan.

It is essential that a clear scope is established and agreed before undertaking detailed development activities. Techniques such as stakeholder analysis can be used to clarify requirements.

Good planning is a pre-requisite for applying appropriate controls to achieve the aims of the project. A number of control parameters will need to be managed such as risk, quality, benefits/costs, change and issues.

Benefits of planning lay foundation for

- Improved communication
- Minimized rework
- Improved schedule predictability
- Quality products on time
- Visualize the project

Figure 12 shows the breakdown of project planning.

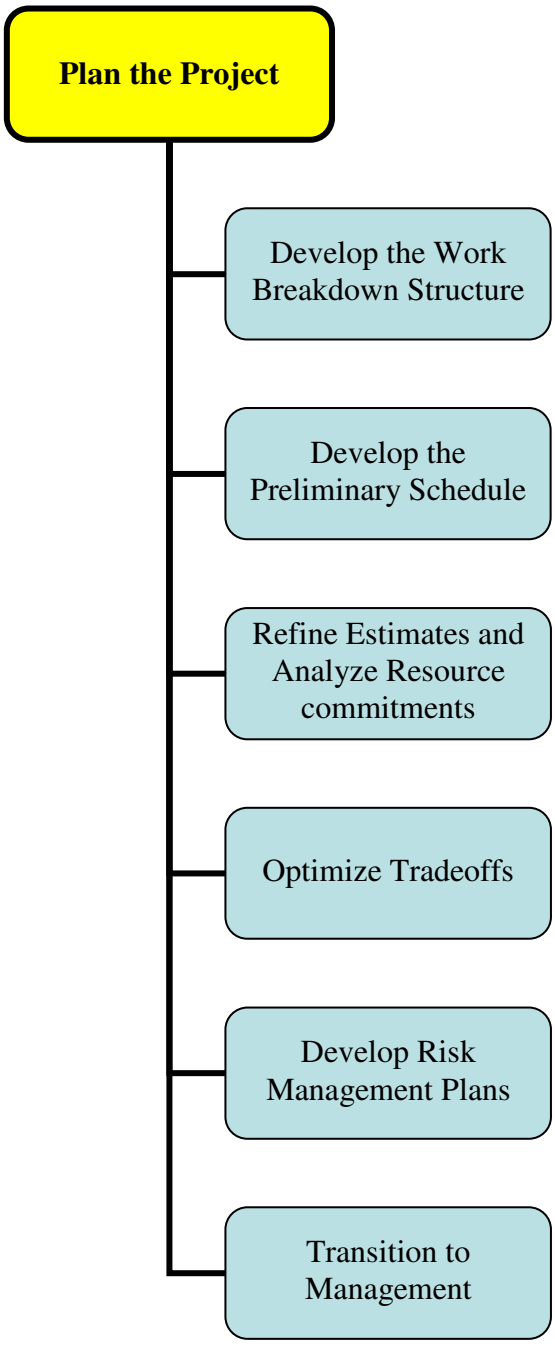


Figure 12 : Plan the Project

3.2.2.1 Develop the Work Breakdown Structure

A work breakdown structure (WBS) is a comprehensive, systematic means of defining project work. It is a tool for identifying project work in a hierarchical and logical structuring manner. WBS ensures all of the work required to meet objectives is identified, defined and assigned with owner. The following lists the characteristics of WBS,

- Specific definition of task output
- Needs to be clear and binary
- Output should be defined in an unambiguous, measurable way
- Provides means by which each output will be judged
- Avoid the use of acronyms and technical jargon

Developing WBS is a team process and it should not be done by the Project Manager alone. Each major component of work is to be broken down to an appropriate level of detail using top down approach until a task has one owner with clear deliverable to the level at which you want to track. With this, quality of work can be monitored through performance criteria associated with each output and the likelihood that a task is omitted is minimized.

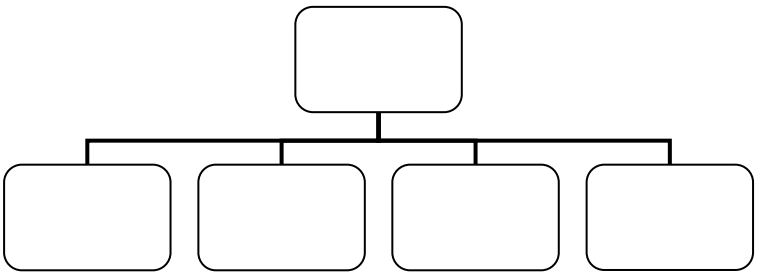


Figure 13 : Work Breakdown Structure

3.2.2.2 Develop the Preliminary Schedule

The purpose of developing preliminary schedule is to clearly understand task dependencies and work flow and determine the overall length of the project. This process focuses exclusively on logical dependencies, not resource dependencies.

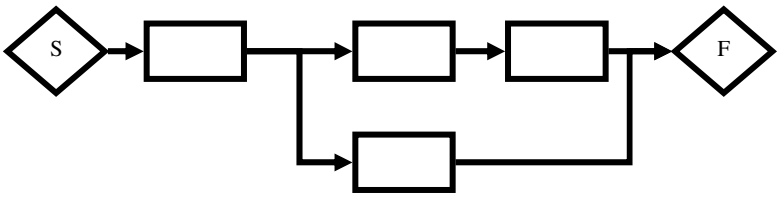


Figure 14 : Dependency Diagram

Figure 14 shows a dependency diagram that follows the flow of work. Most tasks are dependent on the start or completion of other tasks and each task must have a predecessor and a successor.

Project milestones are then defined once the dependency diagram has stabilized. Milestones mark the start or completion of significant tasks and are used for summary monitoring and reporting.

All schedules are based on duration. At this point, duration is determined based on an approximation of effort modified by a reasonable set of assumptions such as documented history and previous experience.

The network that contains task duration and logical dependencies are then analyze using Critical Path Method (CPM) scheduling to determine overall length of the project, when each task can and must start (or finish), and how much each non-critical task can float or slip before it becomes a critical path.

Critical Path (CP) is longest and least flexible sequence. Any slippage on Critical Path slips project. The only way to shorten schedule is to shorten CP.

3.2.2.3 Refine Estimates and Analyze Resource Commitments

The purpose is to develop credible estimates of the time required to complete each task, and understand the resources required to meet the project objectives.

The steps include determine pure effort, calculate duration and determine workload requirements by individual or function.

A good quality estimate of effort is neither 'padded' nor overly aggressive/optimistic. Pure effort considers actual work required to complete a task. Other factors, such as interruptions or number of people working on the task, are not considered at this time.

Team involvement in the estimate is critical. Draw on their expertise and experience and also gain their buy-in to the process and the estimate. Use history base or metric data if available to determine effort.

The effort estimate is the basis for calculating duration. Duration is the elapsed time required to complete a task. A credible estimate of duration takes into account project specific factors, non-project factors, and people factors.

Project specific factors include,

- Inadequate or unstable specification
- Complexity of the technical solution
- Ultra-high reliability requirement
- User and product interfaces require additional time
- The work is not well understood
- Longer projects increase uncertainty
- Geographic diversity of the project team
- Equipment availability
- Work environment

Non-project factors impact team member productivity or availability to work on tasks. These include,

- Vacations
- Holidays
- Meetings
- Interruptions
- Sick leave
- Equipment downtime
- Phone calls
- Electronic mail

People factors are those

- Productivity of individual team member
- People may 'burn-out' if overtime is excessive
- Turnover of personnel
- Teaching or acting as mentor for someone new impacts productivity
- Impact of contention (multi-tasking)
- Team size productivity factor. More people increase time spent communicating and integrating tasks.

3.2.2.4 Optimize Tradeoffs

The goals of optimizing are to meet the objectives established in the POS and make sound business decisions. Meanwhile, the impact of tradeoffs on the team can be considered. Tradeoff is carried out among the three parameters, i.e. schedule, scope and resource, with guidance from flexibility matrix.

The process involves reviewing the POS to determine if the current plan meets the objectives. If the objectives are met, optimize to apply common sense to the plan. If the objectives are not met, optimize to attempt to meet established objectives.

An optimized project plan is agreed to by all team members including management and the customer.

3.2.2.5 Develop Risk Management Plans

A risk is anything that threatens a success of a project. Risks may come from miscommunication, vendor deliverables, loss of key resources, reorganization, changing requirement, long task, interfaces, technical problem, and equipment failures.

Throughout the life of a project there will be risks that need to be managed, to reduce the likelihood and impact of unwanted outcomes such as time and cost overruns as a result of changes in the business environment. There should be a Risk Management Framework that is applied consistently across the organization and a Risk Management Strategy for the project that takes account of the wider business perspective as well as the immediate risks associated with the project. Where suppliers and/or partners are involved in the project, it is essential that there is a shared understanding of risk. There may need to be contingency plans and risk allowances (funding and time) allocated to allow for the possibility of (for example) delays or failure for a service to be taken up. Responsibility and ownership for managing risks must be assigned to individuals with the authority to take appropriate action on risk.

Risk management planning is the process through which the risks associated with any system or process are assessed and managed. Risk is always associated with uncertainty and undesirability of certain states of the system or process of interest.

The process identifies the risk scenarios and estimates the corresponding probabilities. There are three key questions: what can go wrong, what are the consequences, and how likely are such events. An effective plan identifies system vulnerabilities, and ranks them according to their occurrence frequencies and severity of the consequences. In addition, uncertainties associated with the data and models used to quantify the levels of risk are identified and factored into measures of risk.

The purpose of developing risk management plan is to identify areas of risk so that actions can be taken to minimize or eliminate their likelihood of occurrence.

Isolate Areas of High Risk

Type of risks to be isolated can be categorized into scope risks, schedule risks, and resource risks.

1. Scope Risks
    - Uncertainty of new technologies
    - Dynamics of customer requirements
    - Tasks with significant business impact
    - Extremely aggressive performance requirements
    - Unforeseen issues (e.g., department reorganizations)
2. Schedule Risks
    - Tasks with durations longer than 2 weeks
    - Tasks on the critical path
    - Tasks which have several predecessors
    - Tasks that have minimal “float” or “slack”
    - Optimistically estimated tasks
    - Tasks reliant on external groups
    - Start-to-start dependencies
    - Dependencies with lags
    - Major milestones
    - Schedules which don’t list the assumptions
3. Resource Risks
    - Tasks with one key individual assigned
    - Tasks using scarce resources
    - Tasks which are mismatched with the people assigned
    - Tasks which require large amounts of resources
    - Availability of tools and/or techniques

Quantify Risk Factors

In quantifying risk factors, base the assessment on the experience of team members and history of similar problem.

Use risk assessment matrix to compare and prioritize potential risks. Assess potential problems in terms of

- Likelihood of occurrence
- Potential impact in cost, time, or quality
- Likelihood of not being detected in time to take corrective action

Identify areas of highest risk using a simple high, medium or low grading scheme.

Generate Risk Management Plans

Each risk management plan should be clear and well defined. The plan should include preventive actions that will be taken to reduce or remove risk, and contingent actions that can be implemented should a problem occur.

1. Preventive actions
   - Preventive actions reduce the likelihood that the risk will occur
   - Preventive actions are typically better than contingent actions
   - Determine preventive actions by focusing on the cause (vs. effect) of the risk
   - All preventive actions should be added to the project plan
2. Contingent actions
   - Contingent actions minimize the impact of project risks
   - Determine contingent actions by focusing on the effect of the risk
   - Each contingency plan must have a trigger which tells you when to put the contingent action into effect

3.2.2.6 Transition to Management

Project Manager must gain approval of project commitment by management and project team. This must be a formal communication to transit from planning to execution.

The key components of the project plan will be validated during approval process:

- Can you meet POS?
- Major components of WBS
- Schedule (Gantt with critical path) is optimized
- Major resource issues
- Significant risks and their management plans
- Open issues/key assumptions

Baseline plan is established against which all project progress will be measured. It includes

- Priority matrix and POS
- Schedule
- Resources
- Assumptions

The baseline plan can only be changed after major events which cause change have been identified and communicated, and impact of changes has been approved. The process by which the baseline can be changed must be consistent with appropriate change management processes.

At the end of the project planning phase, everyone involved with the project must be told in writing that the planning phase is complete and that management processes are in place.

Change Management

Any changes that are required during the life of the project must be formally planned and controlled to ensure that the impact of change stays within agreed parameters; there should be a documented change control procedure. The cost, time and quality parameters associated with the project should be established before implementation and monitored throughout the life of the project. All proposed changes should be costed and their effect on the overall project established before they can be authorized to go ahead.

The Project Manager is ultimately responsible for the change management process. A well defined process is one of the PM's mechanisms for effectively controlling the project. It must be communicated to all people involved and should reflect the results of the framework discussions. The process should identify the source, describe the change, the impact, the consequences and reasons for approval/rejection.

Figure 15 below shows the change management Process flow,

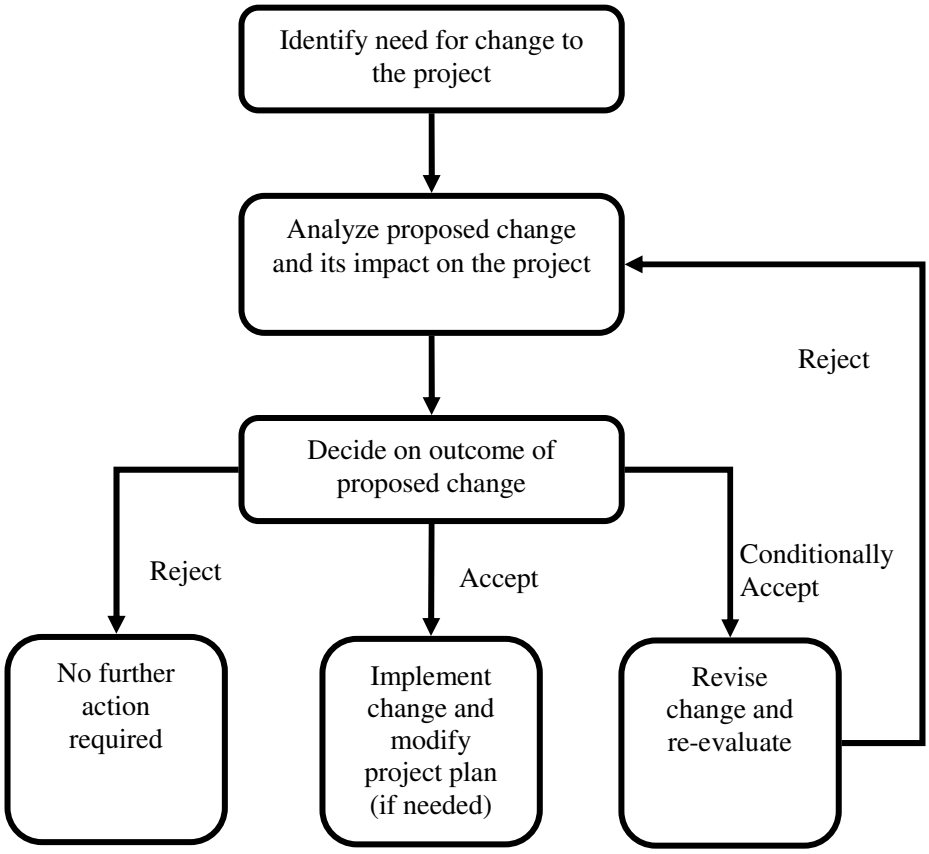


Figure 15 : Change Management Process

3.2.3 Track and Manage the Project

Tracking is critical to the project's success. It provides clear indication of progress and keeps everyone informed of the progress and encourages the addressing of problems early. It also provides credible completion estimates.

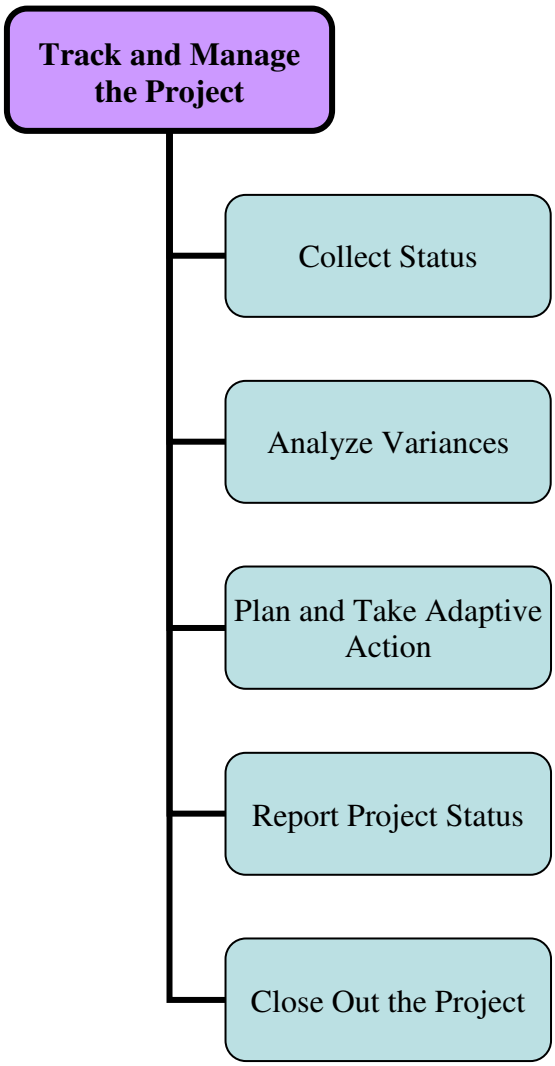


Figure 16 : Track and Manage the Project

3.2.3.1 Collect Status

Status collection effort, like tracking in general, varies in intensity depending on size, cost, importance, public visibility and others.

Higher intensity tracking efforts typically require more frequent status collection, lower detail and more project reviews. Status collection methods include status reports updated by project team members, periodic project meeting and email communication.

Frequency of data collection varies based on,

- Length of project
- Geographic distribution of project team members
- Number of interfaces with external work groups
- Size of project team
- Management requirements and customer requirements

Type of data

1. Quantitative data (Hard Data)
   - Activity data
     - Actual start and finish time
     - Actual duration and remaining duration
     - Tasks complete or not complete
     - Milestones complete or not complete
   - Resource data
     - Actual effort and remaining hours
2. Performance and quality data
     - Current mean time between failures (MTBF)
     - Number of reworks and adherence to quality criteria
     - Number of changes put through change control
     - Actual costs and cycle time
     - Number of component parts completed

3. Qualitative data (Soft data)
   - Problems encountered and anticipated
   - Individual productivity
   - Inhibitors to productivity
   - Persistent problems and proposed actions to correct
   - Things needed to do the job effectively
   - Possibilities for continuous improvement

3.2.3.2 Analyze Variances

It is the Project Manager's responsibility to establish an environment open to problem solving. Confess problems and impacts as early and as often as possible.

Variance is the difference between plan and actual. Variances must be identified and analyzed to assess the effects on project risk.

Types of Variance

1. Schedule variance
   - New activities on the critical path
   - Changes in milestone dates or the end date of the project
   - Reductions or increases in float for upcoming activities
   - Slips in the schedule of particular groups of activities
2. Resource variance
   - Investments of more time than plan
   - Not investing enough time to get the task done on schedule
   - Conflicting requirements for common resources
3. Scope variance
   - Deliverables not meeting or exceeding specs
   - Deliverables not meeting or exceeding quality requirements

3.2.3.3 Plan and take Adaptive Action

Projects are undertaken in very complex environments. The most carefully planned actions do not always have the desired effect. Changes in one aspect of the project (scope, schedule or resource usage) will affect the others. Appropriate adaptive action must be identified for each variance and follow up actively of each adaptive action taken. In addition, monitor any changes very carefully and take additional action as needed.

3.2.3.4 Report Project Status

It is important to provide information about the status of the project. Focus on information that is essential for successful project decision-making and work.

Reviewing the project framework, ensure that the framework decisions are still valid. Communicate project status on a regular basis keeps team focused on the goal and helps with problem solving, save status information.

3.2.3.5 Close Out the Project

A project can end only when one of the following has happened

- All requirements have been satisfied and the customer approves all project deliverables
- Management has decided to terminate the project before the planned completion

The key processes of project closeout are announcement of project end, complete paperwork, debrief key learnings, acknowledge and reward.

It is the Project Manager's responsibility to follow up and ensure that all closing activities have been completed.

Closing activities

- Return or appropriately store confidential information
- Return equipment borrowed from the supplier
- Recover equipment loaned to the supplier
- With the contract manager, negotiate or otherwise settle the contract price of items
- With the contract manager, audit the contract for completion of all requirements
- Assess actual project cost
- Project closeout review meeting held and report written
- Identify the persons responsible for continuation engineering
- Provide reward and recognition to all team members
- Capture lessons learned and formally end the project.
- Complete all closeout activities

3.3 Conclusion

Project management is a discipline, a skill which must be learned before an individual undertakes the management of a project. Technical knowledge and native intelligence are not enough to ensure success. Projects must be planned, staffed and completed with precision and diligence. It is a step by step, iterative, self-correcting and scalable process occurs iteratively throughout the product lifecycle.

Chapter 4

Establishing Product Development Framework

Product development must be executed with speed, managing it for Time-to-Market is therefore important for the competitive success of many companies in the marketplace.

This chapter begins establishing a structured product development process based on a 'Gateway Review' framework with lists of exit criterion for each check-point to ensure best practices and compliance of each phase of a new product development.

The product development process framework is designed to supplement and support other management processes already in place at most companies, and is built upon the Project Management fundamentals, providing Project Manager and team members with a systematic way to execute their product development projects for rapid Time-to-Market.

Objective of Product Development Process

To maintain and continuously improve a common product development process, utilizing standard terminologies, tools, and project management, and clearly defined responsibilities and communication throughout all sites. By achieving this objective, the framework provides the customer:

- The highest yield and quality at the lowest cost and shorter time-to-market
- A seamless transition between design and manufacturing
- Successful product design and development

4.1 Defining Product Life Cycle (PLC)

Product Life Cycle is described comprehensively to include product development life cycle and product marketing life cycle to provide an overview of the combined activities and processes involved during product development and product marketing.

Figure 17 shows the top-level process defining all activities and processes aiming to,

- Optimizes time-to-market
- Manages customer relationships

The Product Life Cycle is comprised of a series of 5 distinct phases that span the entire life cycle of a product. Each phase covers an aspect of the product life cycle, with a defined purpose for each phase.

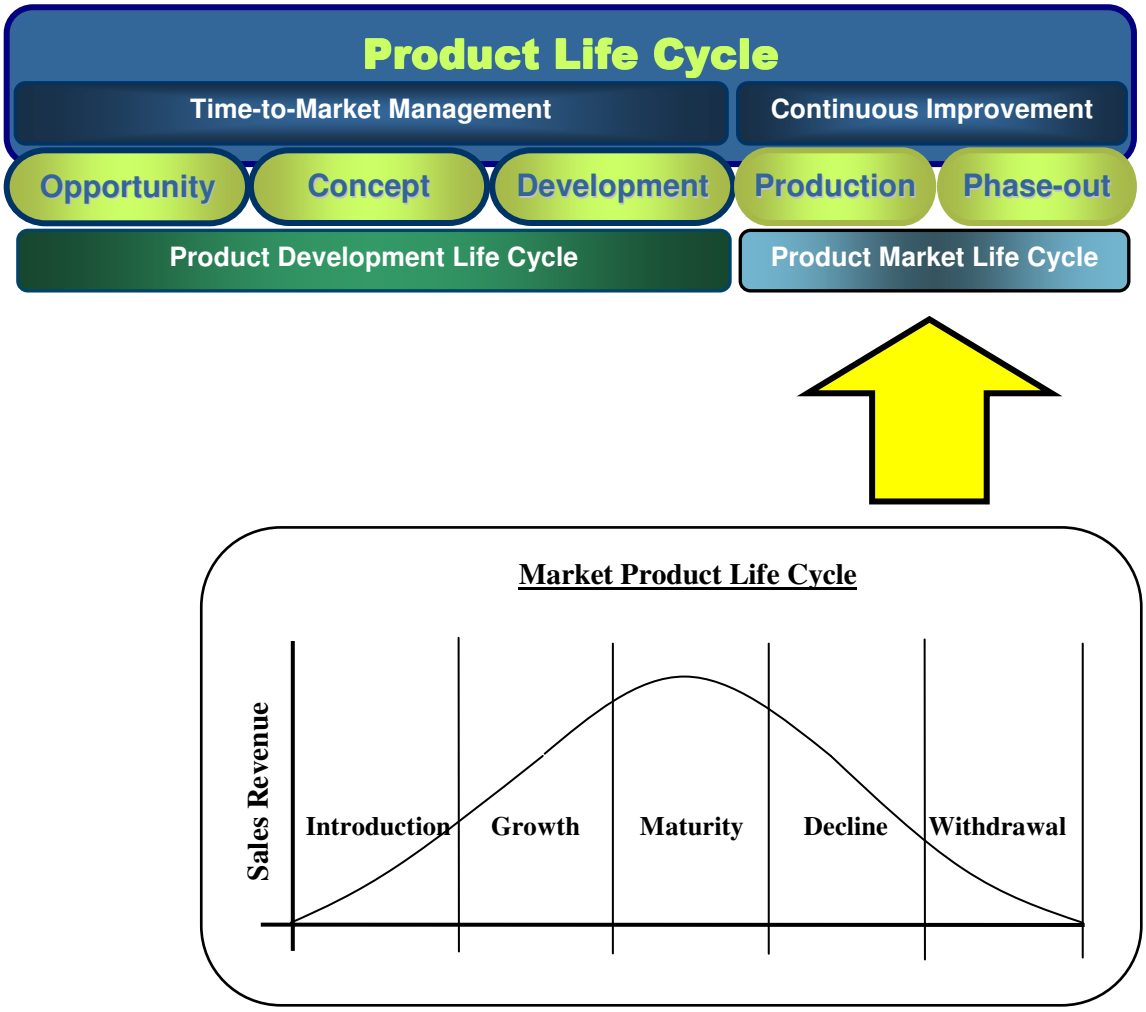


Figure 17 : Overview of Product Life Cycle

4.1.1 Opportunity Phase

The Opportunity Phase identifies marketplace opportunity and relates it to business goals. An initial User Engineering plan is created to outline resources and schedules.

Opportunity analyses include the scanning of and identifying the following,

- Business strategy alignment
- Background technology capabilities and assessment
- Background market conditions and drivers
- User, market and technology trends
- Alternative technology deployment scenarios
- Scenario testing and validation
- Alternative product/service concept generation
- Alternative business model generation
- Adoption cycle modeling
- Financial impact modeling
- Definition of product/services opportunities
- Financial Modeling includes preliminary volume forecast, initial costing forecasts, and a financial model with detailed assumptions
- Competitive Advantage Strategy. This includes a "Competitive Forces Map," and "Key Decisions Map" outlining the initial path to sustainable competitive advantage
- Risk Management
- Recommendation for a business case detailed recommendation to continue investment or terminate with supporting rationale

4.1.2 Concept Phase

In the concept phase, a multitude of ideas are generated, considered and developed into potential product concepts. Investigation and brainstorming are carried out upfront that will eventually lead to conceptual design solutions and minimize future problems. The main objective of the conceptual work is to provide just sufficient detail and rigor in the options analysis and business case documents to enable the decision maker to make an informed decision.

The purpose of this phase is to:

- Develop and document a thorough understanding of the customer's need (problem or opportunity)
- Identify and evaluate the range of possible solutions and select a preferred solution
- Present an unbiased business case that details the costs, benefits and risks of the preferred solution against the organization’s strategic objectives and priorities

This following describes the activities and tasks required during the concept phase of the project lifecycle.

The concept phase is a three-stage project management process for investigating a customer's need and presenting a justification for satisfying that need as part of the organization’s program of work. It can be a very short, simple process completed by a single person in a matter of days or it can be a major project in its own right taking years to complete and requiring a significant commitment of resources. The first stage of this phase is the development and consideration of the proposal, a document that articulates the need and presents a plan for conducting the next two stages. The second stage is the conduct of an options analysis to identify and evaluate all plausible options for satisfying the customer's need. The final stage is the preparation and submission of the project business case, a cost benefit analysis developed around the preferred option. Between each stage is a formal decision point where the project can be terminated, minimizing cost to the organization, if it becomes apparent that the project is not viable.

4.1.3 Development Phase

The purpose of this phase is to establish arrangements for effective implementation of the project.

The development phase commences following the approval of the business case and the allocation of organizational resources. For some projects, the approval of the business case and the allocation of resources occur simultaneously. For many projects however, the allocation of resources occurs as an independent process some time after the approval of the business case. It is not uncommon for there to be a time delay of many months or even years between the concept phase and the development phase.

This phase covers the project organizational structure, detailed project planning and design, contract establishment and detailed design. The major project management outputs are the completed project plan and establishment of any contract arrangements.

4.1.4 Production Phase and Phase-Out

Production Phase begins at the end of product development, where design robustness and production processes have been validated, and the product has been completely developed to begin volume production and proceeds through ramping-up production to full volume or general availability. During the Production Phase, production personnel continue to refine manufacturing process to achieve cost and quality goals.

Phase-Out commences when product goes into decline stage or when there is a substitute product. EOL (End of Life) planning takes place to ensure phasing out of the product is executed in a controlled manner. The plan considers product inventory to fulfill remaining demands, service parts, depletion of material inventory, manufacturing equipments, machineries and other fixed assets.

4.2 Product Development Framework under PLC Context

The product development framework is created to provide a standardized product development life cycle structure for organization to use when developing products.

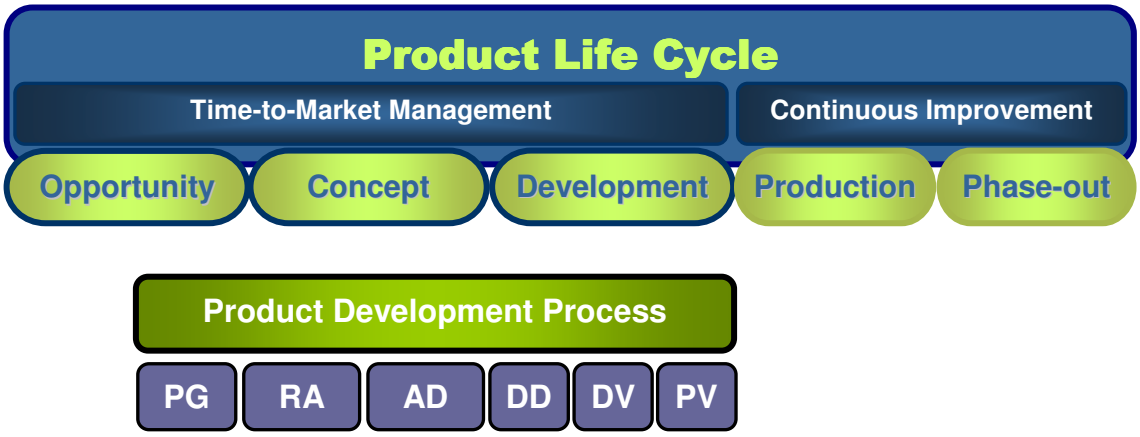


Figure 18 : Product Development Framework

The main processes of product development are

1. Proposal Generation, PG
2. Requirement Analysis, RA
3. Architectural Design, AD
4. Detailed Design, DD
5. Design Validation, DV
6. Process Validation, PV

The Product Development Process is part of the Product Life Cycle and is developed to provide a structure for product development activities and set the foundation for Time-to-Market Management.

- The Product Development Process can be aligned to the customer's process and enable the customer (internal and external) to participate throughout the product development through planned reviews
- The Product Development Process utilizes standard terminologies, project management, tools, and communication throughout all of the design centers. This provides a seamless end-to-end process for customers, regardless of where their product is developed or produced.

Note:

- The term "Product" refers to anything 'produced'. This can be anything composed, created or brought about by intellectual or physical efforts. Thus this term refers to any service that a business provides
- These main processes can be used as standalone and/or as combined, sequential or overlapping process to achieve the deliverables of the phase/phases involved.
- The Product Development Process may be tailored to meet customer requirements for any size of project. Tailoring is a process that defines which main process is applied for each project phase.

4.3 The Scope of Product Development Process

The Product Development Process is designed to support all product development activities within any of the business models.

Regardless of the business model (CDS, CDM or ODM) the entry point of the process begins with the collection of customer requirements.

- CDS – Contract Design Services
- CDM – Contract Design Manufacturing
- ODM – Original Design Manufacturing

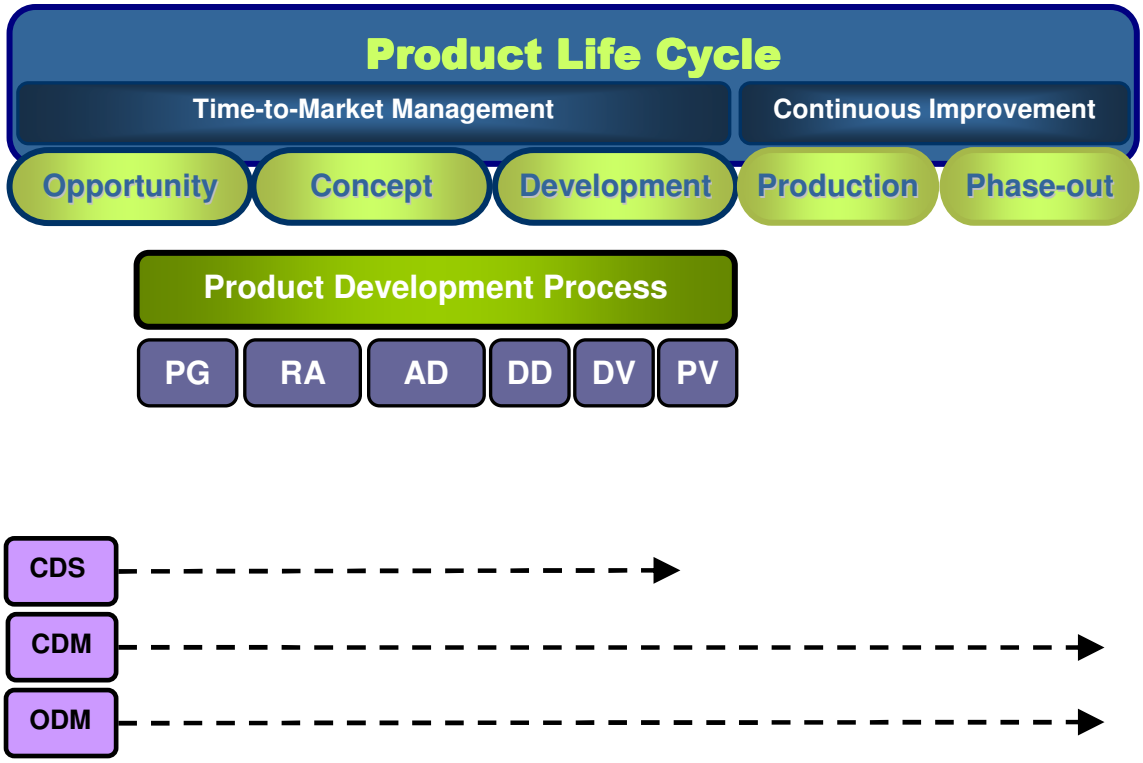
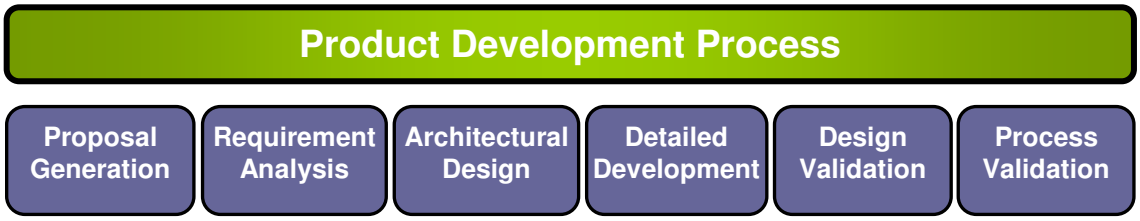


Figure 19 : The Scope of Product Development Process

4.4 The Main Processes of Product Development

The main processes of product development offer additional product development resources and provide direction for development tasks.



Proposal generation

During the Opportunity Phase, define a product concept that customers want. Demonstrate that it aligns with the business strategy, objectives and technical objectives.

Requirement Analysis

Investigate and demonstrate feasibility. Define product features. Develop initial program plans, identify risks & confirm business support.

Architecture Design

Develop design architecture of the product at the Concept Phase

Detailed Development

Develop product details, Achieve full functionality of all subsystems. Gain confidence through early testing and analysis. Make plans for production.

Design Validation

Validate that the product delivers the desired Total Customer Experience. Confirm that manufacturing, distribution and support processes are in place to meet the product launch goals and program goals.

Process Validation

Deliver the product to the marketplace. This includes ramping production to intro-volumes. Fill service, support and sales channels with product, while meeting business goals and ensuring Total Customer Experience.

4.5 Functional Processes and Supporting Processes

4.5.1 Product Development

Product Development is a collection of activities that perform the actual development of a product with the goal of providing the customer the highest yields and quality, the lowest cost and the fastest time-to-market.

These activities include,

- Industrial Design/Mechanical Development
- Electrical Development
- Software Development
- Product Verification and Validation

4.5.2 Industrialization

Industrialization is a collection of activities that enhance the product, and develop reliable processes to provide the customer the highest yield and quality at the lowest cost and fastest time-to-market. Industrialization runs concurrent with product development from Concept Start through Stable Production Release.

These activities include:

- Material Supply Development
- Production Process Development
- Production Test Development
- Product Logistics Development

Product Development and Industrialization are performed by functional groups throughout the life cycle. Resources required to perform these activities are coordinated and managed by a Project Manager with experience in Operations.

Figure 20 shows a project team organized by function.

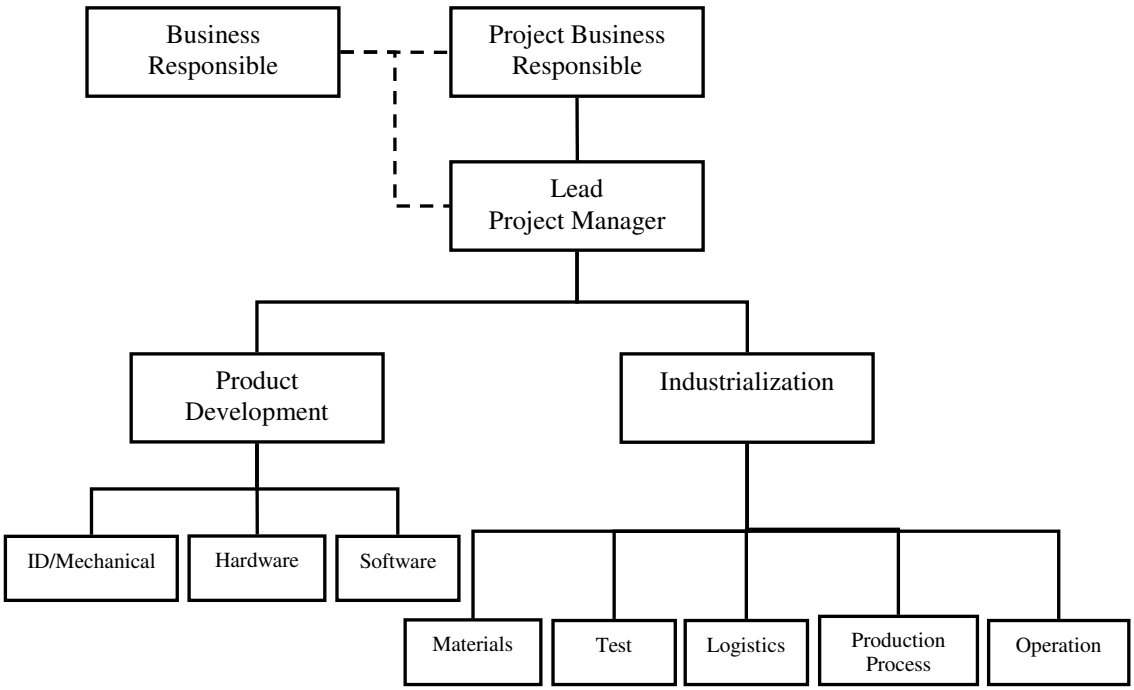


Figure 20 : Project Team Structure by Function

PROJM	Project Management
HW	Hardware Development
MECH	Mechanical / Industrial Design Development
SW	Software Development
DQA	Design Quality Assurance Development
PPD	Production Process Development
PTD	Production Test Development
MSD	Material Supply Development
PLD	Product Logistics Development

Table 8 : Functional Processes

4.5.3 Supporting Processes

Supporting processes are also an integral part of the framework. In general, these are the processes that have been created for use in other applications or environments.

Table below is a sample list of supporting processes and is not intended to be inclusive of all supporting processes.

	PG	RA	AD	DD	DV	PV
IP Search		*	*	*	*	
BOM (Bill of Materials)		*	*	*	*	*
Risk Management		*	*	*	*	*
Supplier Management		*	*	*	*	*
Corrective Action	*	*	*	*	*	*
Engineering Change Order (ECO)		*	*	*	*	*
Request for Actions (RFA)		*	*	*	*	*
Document Control	*	*	*	*	*	*

Table 9 : Supporting Processes

4.6 Project Team Structure

Because this process typically requires both engineering and marketing expertise, cross-functional teams are a common way of organizing a development project. The team is responsible for all aspects of the project, from initial idea generation to final commercialization, and they usually report to senior management (often to a vice president). In those industries where products are technically complex, development research is expensive, and product life cycles are short, strategic alliances among several organizations helps to spread the costs, provide access to a wider skills set, and speeds the process.

Depending on the scale and/or complexity of the project, some of these roles could be combined and reporting lines shortened. For smaller/straightforward projects, the roles of Project Sponsor/Director and Project Manager may be combined subject to the provision that the person taking on the combined responsibilities possesses the requisite competencies, expertise, experience and has the available time and resources. Where roles are combined, it is essential that delegations and responsibilities are clearly understood and do not overlap with other roles. This role description assumes that the roles of Project Sponsor/Project Director and Project Manager are separate.

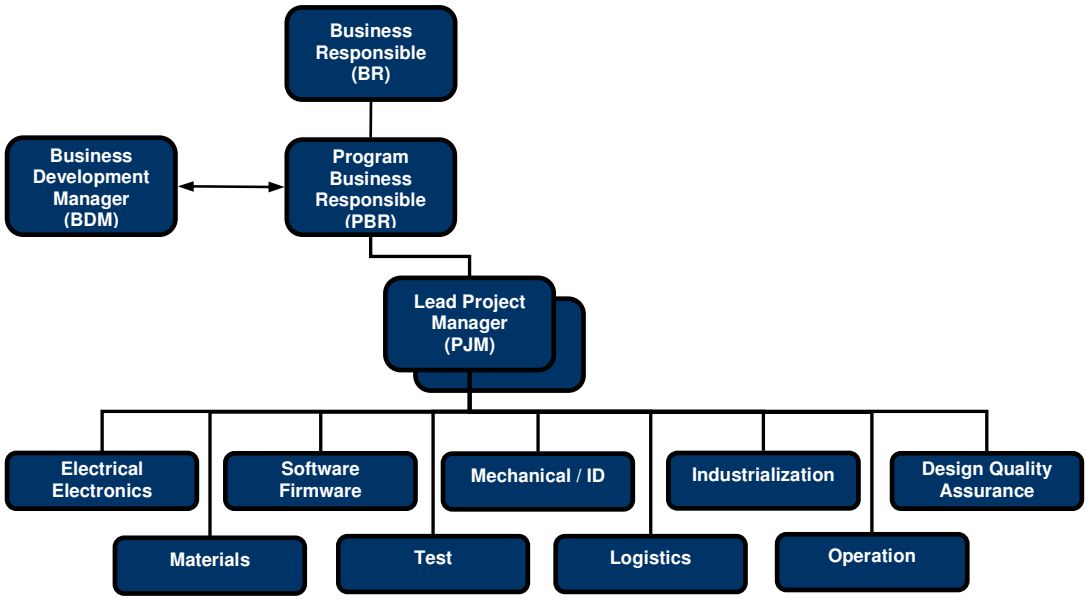


Figure 21 : Project Team Structure

The project is managed by a Lead Project Manager. This Project Manager will assign project team members to fulfill the roles and responsibilities required to meet the Product Development and Industrialization needs of the project.

Product development project management is the primary responsibility of the Project Manager and includes tasks such as:

- Overall project management
- Securing project resources and assigning roles and responsibilities
- Creation and maintenance of project specification (project plan) (PJS)
- Management of project budget and schedule

Abbreviation of Appointment

BDM	Business Development Manager
PBR	Program Business Responsible
PJM	Project Manager
GAM	Global Account Manager
DCM	Design Centre Manager
IND	Industrialization Lead
DSPM	Design Service Procurement Manager

Table 10 : Abbreviation of Appointment

4.7 Roles and Responsibilities

All main processes will be managed and controlled as outlined in the Roles and Responsibility matrix. The responsibilities will be noted as:

D (Decision):

Function responsible for the decision processes and the documentation/dissemination of the decision outcome

R (Responsible):

Function(s) responsible for the execution of the activity with an obligation to inform on status, progress, risk and any obstacles that hinder the process

C (Contribute):

Function(s) assist in the completion of a decision or task.

I (Information Only):

Function(s) that do not have a responsibility in the decision or task, but will be affected by its outcome

Process / Function	Proposal Generation	Requirements Analysis	Architectural Design	Detailed Development	Design Validation	Process Validation	Conclusion
Business Responsible	R C	R	R		I	C D I	C
Project Business Responsible	C D I	R C I	C D I	C I	C I	C I	C
Project Manager	R C	R D	R C D I	R C D	R C D	R C D I	R
Product Development	C I	C I	R C I	R C I	C I	C I	C I
Industrialization	C I	C I	C I	R C I	R C I	R C I	C I
Customer	C	C I	C I	C I	C I	C I	C
Operations				R	C I	R C D I	C I

Table 11 : Roles and Responsibility Matrix

4.8 Product development Specifications

Customer requirements are received and translated into an internal Assignment Specification which defines the "Scope" of the project. This is used along with the Product Requirements documentation to explain the "**what**" (what will be created) of the project. The "**how**" (how the requirements will be met) of the project is outlined in the 8P specifications as follow.

1. PJS – Project Specification (Project Plan)
2. PDS – Product Design Specification
3. PPS – Production Process Specification
4. PTS – Production Test Specification
5. PLS – Product Logistics Specification
6. PSS – Procurement Supply Specification
7. PQS – Project Quality Specification
8. PES – Product Environmental Specification

4.9 Product builds: some semantics

During the course of product development, several prototype builds are necessary to validate product concept, architectural design and final design. The builds are also used to validate industrialization processes such as material and manufacturing readiness. Multiple builds may be required within a phase. For example, LP1, LP2 and so forth until the product design is ready to exit to next phase of the development.

Name of Build	Build Functions
I-Mec (Invention Mechanism)	Mechanism for fundamental inventions of one or a subset of technologies required for product feasibility studies
Test-bed	Integration of main technologies on a mechanism to prove product feasibility. Not a product concept
BB (Bread Board)	First product concept for system integration & technology feasibility. Not representative of final product on footprint, performance, industrial design, tools & industrial processes
LP (Laboratory Prototype)	Product concept with final tooling ,industrial design, functionality and performance Product validation to check design margin
PP (Pre-Production or Pilot Production)	Final product validation before volume production

Table 12 : Product Builds

4.10 Conclusion

Beginning with defining higher level Product Life Cycle, this chapter illustrates how Product Development Framework is established using top-down concept.

It begins with introducing the Product Life Cycle, which is an overall framework of product development and product marketing. There are five distinct phases with each covers a specific aspect of the product life cycle. These phases are namely Opportunity, Concept, Development, Production and Phase-Out.

The product development process under the Product Life Cycle structure with combined activities and processes occur during a product development. It is broken down into phases each with its own distinctive objectives and activities. The main processes of product development are Proposal Generation, Requirement Analysis, Architectural Design, Detailed Design, Design Validation, and Process Validation.

With a project team structure formed by functional groups, functional and supporting processes run concurrently through the main processes towards the common project objectives.

With the basic structure of the Product Development Process introduced in this chapter, Chapter 5 will begin organizing the Product Life Cycle structure and Product Development Process into Gateway Review framework.

Chapter 5

Organizing Product Development Process

Under the Product Life Cycle framework, i.e. at a level above the product development process, there are checkpoints that govern the product development as presented in figure 22. These higher level checkpoints are major milestones of product life cycle and are called Gate Checkpoints. This section details the criteria and deliverables for each Gate Checkpoints.

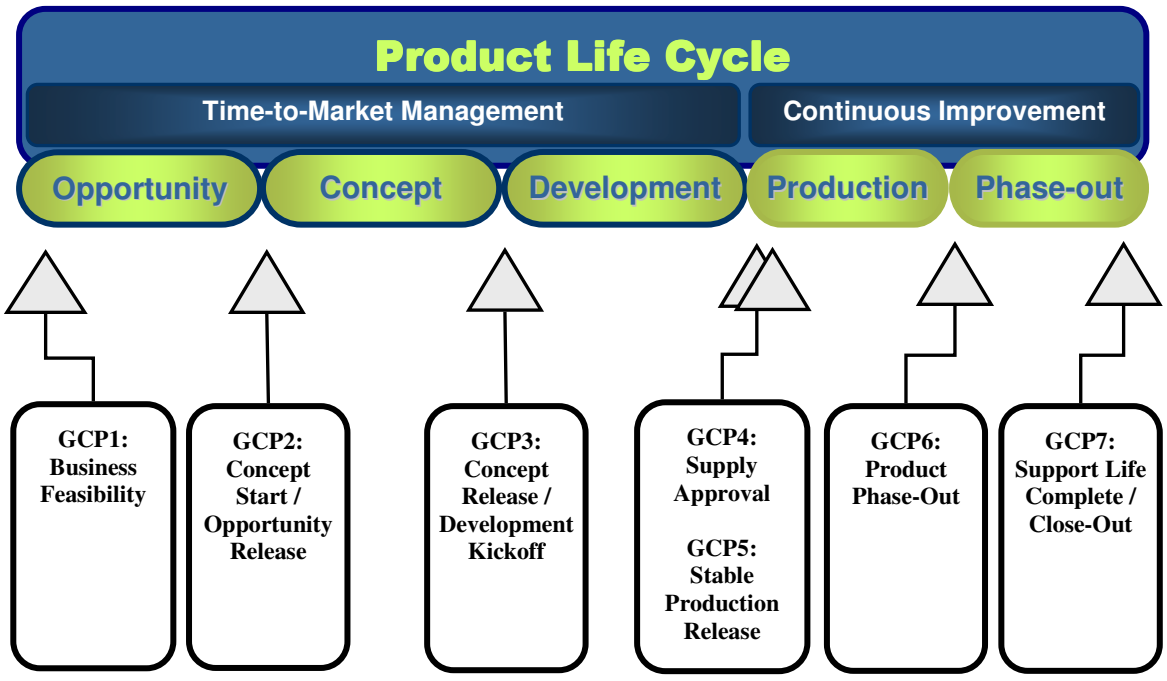


Figure 22 : Gate Checkpoints

5.1 Product Life Cycle Gate Checkpoints

Gate Checkpoints are decision points, where the status of the project is reviewed and senior management decides whether to continue with a project.

The product development process phases start with a Business Feasibility Gate Checkpoint and end at Stable Production Release Gate Checkpoint.

A project is created as a result of assignment and may begin in any of the phases. However, all of the Gate Checkpoints must be completed. For example, if a project were to start with the Development phase, GCP1-3 must be completed by the project team. This ensures that no data inputs have been over looked.

At the end of each stage, it is necessary to assess whether the project is still on course and still aligns with the business case, the risks are under control, the business case itself is still viable and this information informs the decision as to whether the next stage should be undertaken or the project should be terminated.

Gate Checkpoint Decision

Gate Checkpoint Decisions are made between the PBR and the PJM. It could also include a Gate Checkpoint review meeting with more people involved, depending on what is agreed between the PBR and PJM.

Gate Checkpoint Outcome

The result of a Gate Checkpoint is a decision to Go, Cancel, Hold, or Restart the project, along with an action list of any open issues.

Checklist templates have to be developed for use at each Gate Checkpoint review. A checklist may be customized by adding additional review items.

5.2 GCP Deliverables and Exit Criteria by Phases

The checkpoint in each phase requires inputs to be in place to be processed and reviewed. The outputs are Yes/No decision, and/or a set of documents to be passed on to the next phase of PLC.

The Gate Checklist, together with other supporting documents, is the important output to be authorized by the BDM prior commencing next phase of the program.

Each Gate Checklist covers the following categories:

- Contract/Business
- Specification
- Price/Cost
- Logistic
- Environment
- Compliance (Safety and Regulatory)
- Quality
- Project Management

Each Checkpoint questionnaire has an accountable. For example, a bid/no bid decision has to be make known by the BDM after reviewing with the senior management the risks associated with the business, SWOT analysis, business scope etc. For the convenience of reader, the abbreviation of appointment holders is re-produced here.

BDM	Business Development Manager
PBR	Program Business Responsible
PJM	Project Manager
GAM	Global Account Manager
DCM	Design Centre Manager
IND	Industrialization Lead
DSPM	Design Service Procurement Manager
PM	Program Manager (Operation)

For simplicity, the Gate checklists primarily outline the checkpoint description. A complete checklist template can be found in Appendix B.

Acronyms and abbreviation are used extensively in the checklists. Refer to Acronym and Abbreviation page for a list of their meaning and description.

5.2.1 Opportunity Phase Deliverables

GCP1: Business Feasibility Gate

Purpose

- Identify new and recurring business, analyze the opportunity
- Ensure that the information and documentation available is sufficient to perform the Opportunity phase
- Get approval on the time, resources and budget for the Opportunity phase
- To create a project proposal based on customer requirements and expectations

Inputs

- General Customer profile and Customer Financial Status
- RFQ Specific Capability and Strategic Fit
- Business Case Estimate (Cost)

Processes

- Pre-Qualification and Account Qualification
- Strategic Business Decision (Bid/No Bid)

Outputs

Gate Requirements		Responsible
1	Market Research & Analysis (volume, market shares, key technologies)	BDM
2	Business Defined/Customer Background	BDM
3	Customer Financial Background	BDM
4	Key Customer Requirement List / Documents	BDM
5	Technology Assessment & Capabilities	BDM
6	Lead Design Centre Identified	BDM
7	Production Site Identified	BDM
8	Qualified Account	BDM/GAM
9	Bid/ No Bid Decision	BDM/GAM

GCP2: Opportunity Release / Concept Start

Purpose

- Identify new and recurring business, analyze the opportunity, and generate the quote
- Insure that the information and documentation provided is sufficient to perform a complete Concept Phase
- Obtain internal approval on the assignment, time, resources and budget for the proposal

Input

- Marketing Research
- Business Defined/Customer Background
- Customer RFQ documents, Business Plan or Statement of Work
- Customer Requirements Document (includes key product specifications, market requirements, required volume, special contractual requirements, etc.)

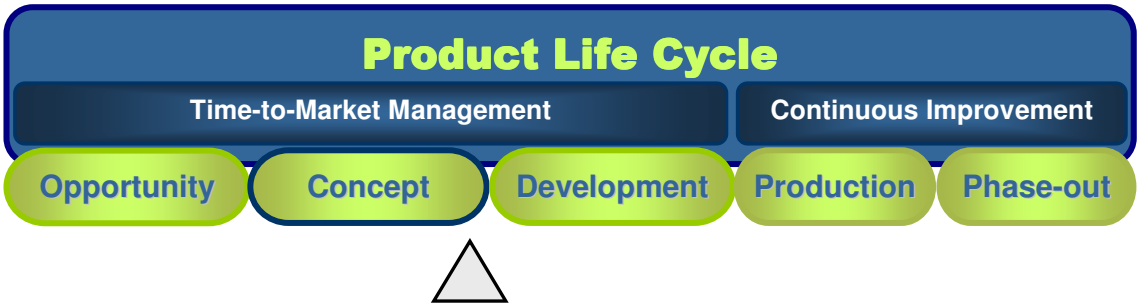
Processes

- Account Approval
- Quote Process
- Business Strategy – Bid/No Bid
- Proposal Generation

Output

Gate Requirements		Responsible
1	Account Qualification	BDM
2	Business Case Draft Approval by Senior Management and Finance	BDM/GAM
3	Assignment Specification	BDM/PJM
4	Proposal (Design Quote, Schedule, Scope of Work, Contractual Agreement, Estimate of BOM Cost, Block Diagram of Conceptual Design)	PJM
4	• Initial Risk Management Plan • Budget and Schedule • Technology/Capability Assessment • Forecast and Volume Projections • Initial Project Specification • Initial Product Design Specification • Initial Industrialization Plan	PJM PJM DCM PJM PJM Design Lead IND. Lead
5	Overall Project quote that has both Design, Mfg and financial requirements	BDM/GAM
6	Customer PO / Agreement	BDM/GAM
7	Approved Concept Start/Opportunity Release Gate Checklist	GAM/PJM

5.2.2 Concept Phase Deliverables



GCP3: Concept Release / Development Kick-off

Purpose

- Develop the Product Architecture, Implementation Plans, Specifications and Preliminary design.
- Agree internally and externally on how to perform the Development phase in the project.
- Insure that the information and documentation provided is sufficient to perform a Development phase in the project.
- Obtain agreement on the assignment, resources, time and cost/price for the Development phase

Input

- Customer P.O./Contract/ Authorization to Bill
- Quote / Proposal (May include strategy, technology requirements, critical suppliers, etc.)
- Results from Opportunity Phase / Approval to proceed to Concept Phase
- Assignment Specification
- Initial Product Design Specification
- Initial Project Risk Assessment
- Initial Project Specification
- Budget & Schedule
- Technology Overview
- Forecast and Volume Projections
- Initial Industrialization Plan
- Approved Business Case

- Product Requirement Documents
- Approved Concept Start/ Opportunity Release Gate Checklist

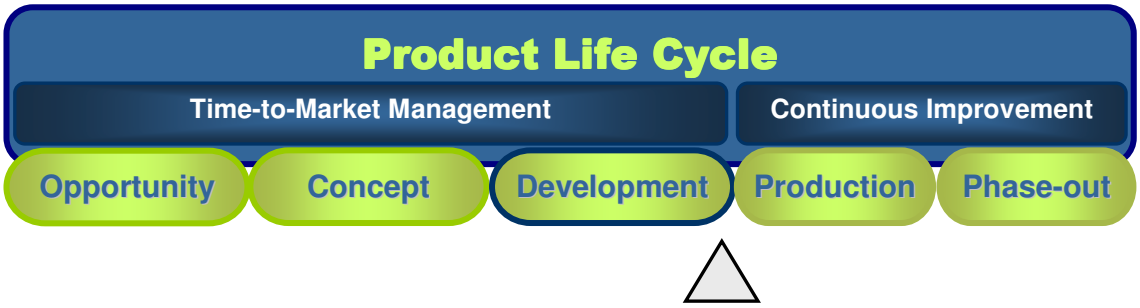
Processes

- Requirements Analysis
- Architectural Design
- Industrialization
- Supplier & Component Selection
- Specification Creation

Output

Gate Requirements		Responsible
1	Quote to Customer (if last quote is only for Conceptual and/or Architectural Design work)	BDM/GAM
2	Development Contract and PO	GAM
3	Business Case with Forecast Projections : • Target Cost & Projected Sales Price • Cost Reduction Road Map	DCM
4	Project Specification : • Project Organization and Communication Matrix • Risk Management Plan	PJM
5	Product Design Specification • Technology/Intellectual Property Overview • Preliminary BOM • Initial DFX Report (DFMEA,DFA,DFM)	Design Lead
6	Architectural Prototype	Design Lead
7	Product Concept Feasibility Demonstration	Design Lead
8	Production Process Specification Capacity Requirement	IND. Lead
9	Production Test Specification Test/ Cycle Time Assumption	IND. Lead IND. Lead
10	Product Logistics Specification	IND. Lead
11	Project Quality Specification	Design QA Lead
12	Product Environmental Specification	Design QA Lead
13	Procurement Supply Chain Specification • Supplier Development Plan/ Supplier Base (NDAs/ Commercial Agreements/ AML) • List Of Long Lead Time & Unique Components • Components Qualification Plan	DSPM
14	Concept Release / Development Kick-Off Gate Checklist	GAM/PJM

5.2.3 Development Phase Deliverables



GCP4: Supply Approval

Purpose

- Develop the Product, Services, Tooling and Processes
- Supply Chain, Production/Process, Production Test and Product Logistics should be validated at this point and Supply Approval (SA) approved.
- All Line Validation (LV) specifications and plans should be final according to the PQS.
- Insure that all technical product documentation is finalized for Volume Manufacturing and is applicable to internal manufacturing standards
- Insure that there is a Manufacturing and/or supply contract/agreement and a product price available and approved by the customer (internal/external)

Input

- Customer P.O./Contract/ Authorization to Bill
- Qualified Suppliers
- Qualified Components
- DFX
- Specifications
- Quotation
- Product Requirements Documents
- Risk Management Plan
- List of Long Lead Time, Key & Unique Components
- Preliminary BOM
- Technology Overview
- Forecast and Volume Projections
- Estimated Capacity Requirements
- Test/Cycle-Time Assumptions
- Target Costs and Project Sales Prices
- Architectural Prototypes

Processes

- Detailed Development and Design Validation
- Process Validation
- Industrialization
- ECO Process (Change Management)

Output

Gate Requirements		Responsible
1	BOM Readiness For Prototype Build	Design Lead
2	Prototype Tooling Readiness & Approval (SLA/Rubber Mold Part/Soft Tooling)	Design Lead
3	Prototype Line Readiness	PJM
4	Prototype Build	PJM
5	Design Verification/ Module & Component Qualification	Design Lead
6	Regulatory Approval	Design QA Lead
7	Supplier Approval/ROHS Evaluation & Readiness	IND/Procurement
8	Manufacturing Process Plan	IND. Lead
9	Manufacturing Quality Plan	IND. Lead
10	Assurance Of Supply	IND/Procurement
11	BOM Update	PJM/Design Lead
12	DFX (DFM,DFA,DFR,DFMEA)	Design Lead
13	Critical Design Review	All
14	a. Hard Tooling Readiness b. Hard Tooling Part Approval	Procurement Design Lead
15	Production Line Readiness	PJM
16	Pilot Production Build	PJM
17	Design Vaildation	Design Lead
18	Final BOM Readiness For Production	IND. Lead
19	Process/Line Validation	PJM
20	Update 8'Ps • Project Specification • Product Design Specification • Project Quality Specification • Project Environment Specification • Production Test Specification • Production Process Specification • Procurement / Supply Chain Specification • Product Logistics Specification	PJM PJM Design Lead DQA Lead DQA Lead IND. Lead IND. Lead IND. Lead IND. Lead
21	Update Risk Management Plan	PJM
22	Ongoing Reliability Test (ORT) Plan	DQA Lead
23	Business Rationalization (Does Design & Cost Hit Objective)	DCM
24	Transition Plan To Stable Production	PJM
25	Approved Supply Approval Gate Checklist	GAM, PJM, Internal & External Customer

5.2.4 Production Phase Deliverables

GCP5: Stable Production Release

Purpose

- Develop the product, services, tooling and processes
- Secure and control the ramp-up of the product according to customer and operation requirements
- Insure High Volume Manufacturing (HVM) is performed and approved according to process
- Close all open actions and issues on the product, process or commercially

Input

- Acceptance of Supply Chain, Manufacturing Process and Quality Plans
- Transition Plan to Stable Production Release (include Key metrics such as optimum cycle time, yield, quality criteria, etc)
- Updated Risk Management Plan
- Updated Specifications
- Approved Supply Approval Gate Checklist

Processes

- Stable Production
- Product Introduction
- Industrialization
- ECO Process

Output

Gate Requirements		Responsible
1	Business Rationalization (Does design and cost meet objectives?)	GAM
2	Manufacturing Readiness (4M)	PM
3	Acceptance for High Volume Production	PM
4	Periodical Field/Operation Feedback Report Template (design, test, logistics issues)	PM/PJM
5	Post Engineering Plan	PJM
6	End Of Life Plan	PM/PJM
7	Approved Stable Production Release Gate Checklist	GAM, PJM, PM, Internal & External Customer

5.2.5 Summary of Gate Checkpoint Requirements

For the convenience of the readers, Table 13 summarizes the exit criteria of the five Gate Checkpoints.

GCP1	GCP2	GCP3
• Business Feasibility Process • Account qualification • Bid/no bid decision	• Proposal generation • Project feasibility • Risk Assessment • Quote • Project Award • SOW • Team Structure • Communication Matrix	• Project Requirement • Concept prototype • Concept Evaluation • 8 P's • Supplier Selection • Concept release

GCP4	GCP5
• Sub-System Qualification • Engineering prototype • Engineering verification • DFMEA/DFX • BOM/Tool release • Tool & part validation • LP build • Design Validation • Regulatory Approval • Supplier Approval • Mfg plan & Line Setup • PP build • Process/Line Validation • Update 8P's • ECO process	• Mfg buyoff of design • Mfg readiness • Acceptance of high volume production • Post Engineering plan • EOL plan

Table 13 : Summary of Gate Checkpoint Requirements

5.3 Product Development Process Flow and Checkpoints

This section presents the flow of product development and its processes. An overview of the flow is provided in Table 15.

Checkpoints are the points in the process at which the process owner (Sales, Project Manager, Lead Engineer, etc) reviews the status or results of a task or sub-phase.

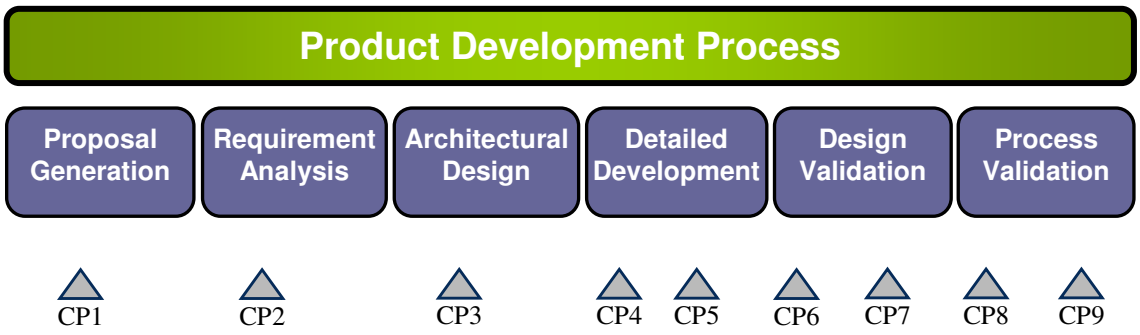


Figure 23 : Product Development Process Checkpoints

The process checkpoints are distributed throughout the whole product development process as shown in Figure 23. It is the responsibility of the Project Manager to ensure all processes are taking place and approve the process checkpoints as described in Table 14 below.

Process Checkpoints

CP1	Proposal Review
CP2	Design Requirements Review
CP3	Specification Review
CP4	Critical Design Review
CP5	Qualification Readiness Review
CP6	Design Validation Build Review
CP7	Final Design Review
CP8	Supply Approval
CP9	Line Validation

Table 14 : Process Checkpoints

Checkpoint Decision

Checkpoint decisions are made within the project with the PJM and functional team responsible. Prior to the checkpoint review meeting, an evaluation of the checkpoint is made within the functional teams.

Checkpoint Outcome

The outcome of checkpoint review meeting is typically a list of issues with corrective actions.

Process Checklist

Process Checklist is undertaken by functional leaders from each discipline. For simplicity, the process checklists outline the checkpoint description. A complete checklist can be found in Appendix C.

Although there is no simple procedure for managing product development that can be applied to all situations, there is a typical process flow chart that engineers can find useful in their course of development. To become familiar with the basic process of product development, an overview of product development flow is presented in Table 15 in the following page.

Note:

Acronyms and abbreviation are used extensively in the checklists. Refer to Acronym and Abbreviation page for a list of their meaning and description.

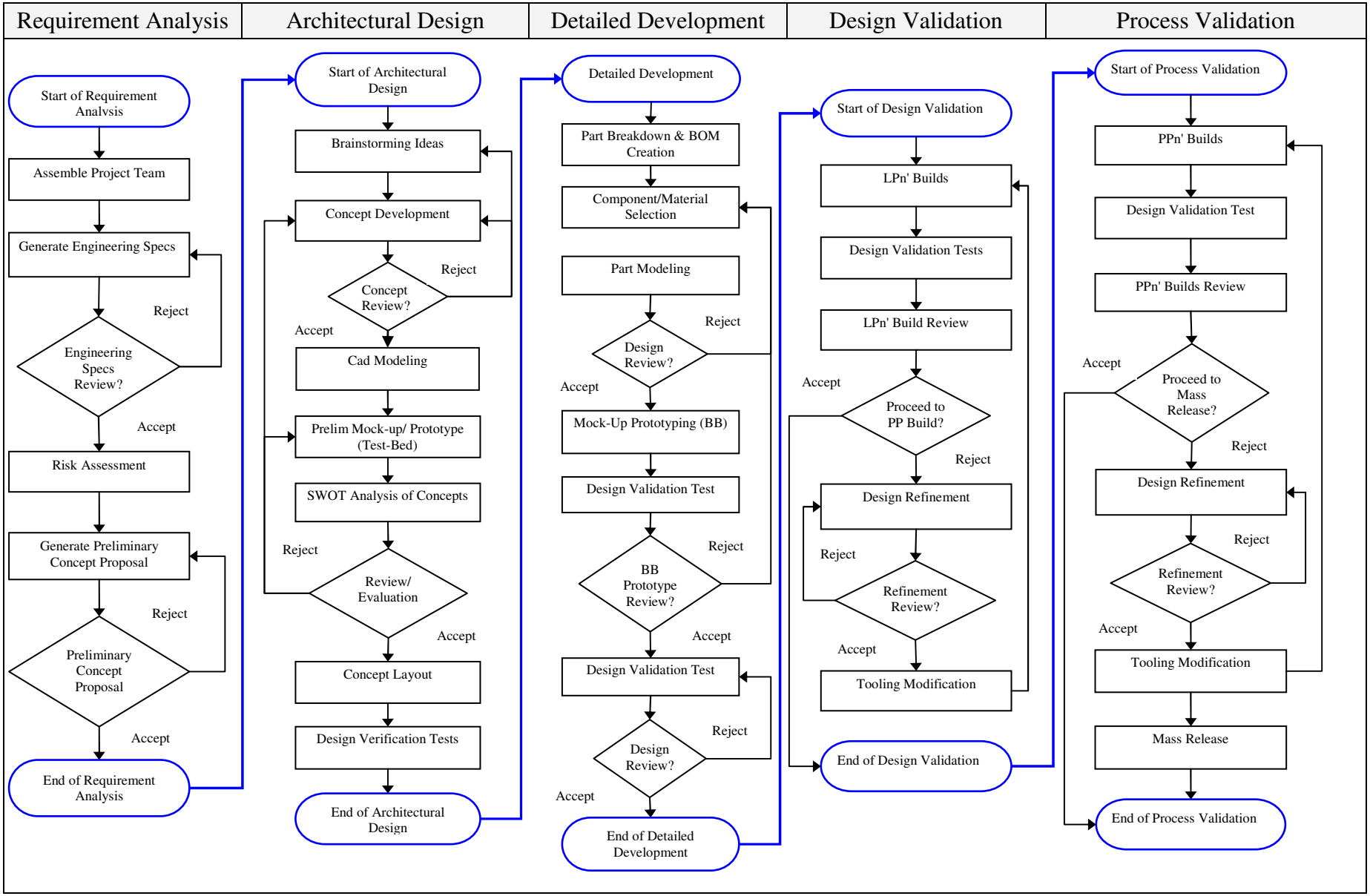
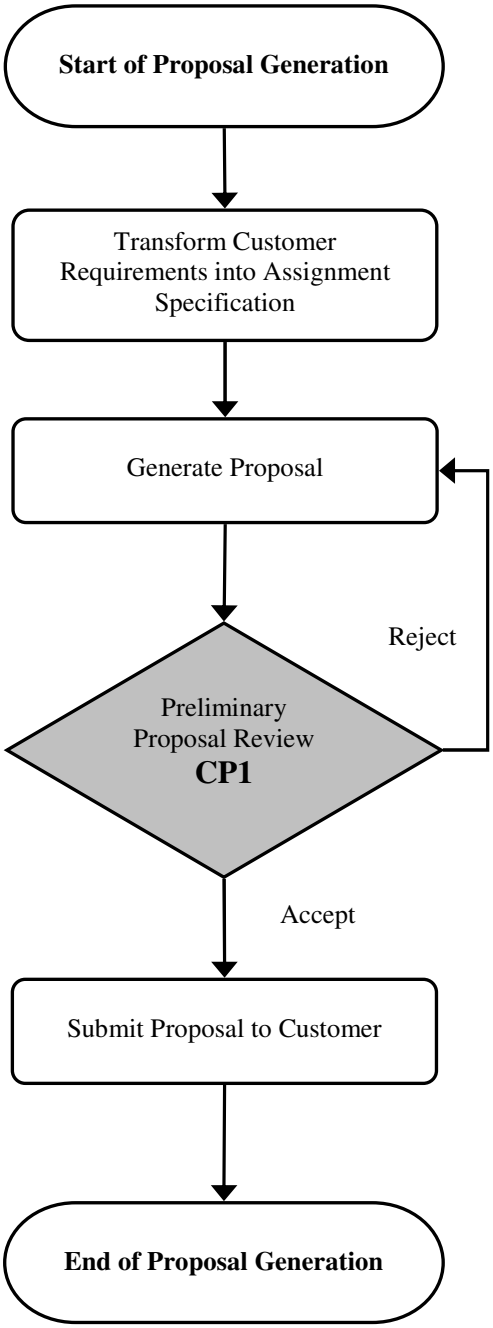
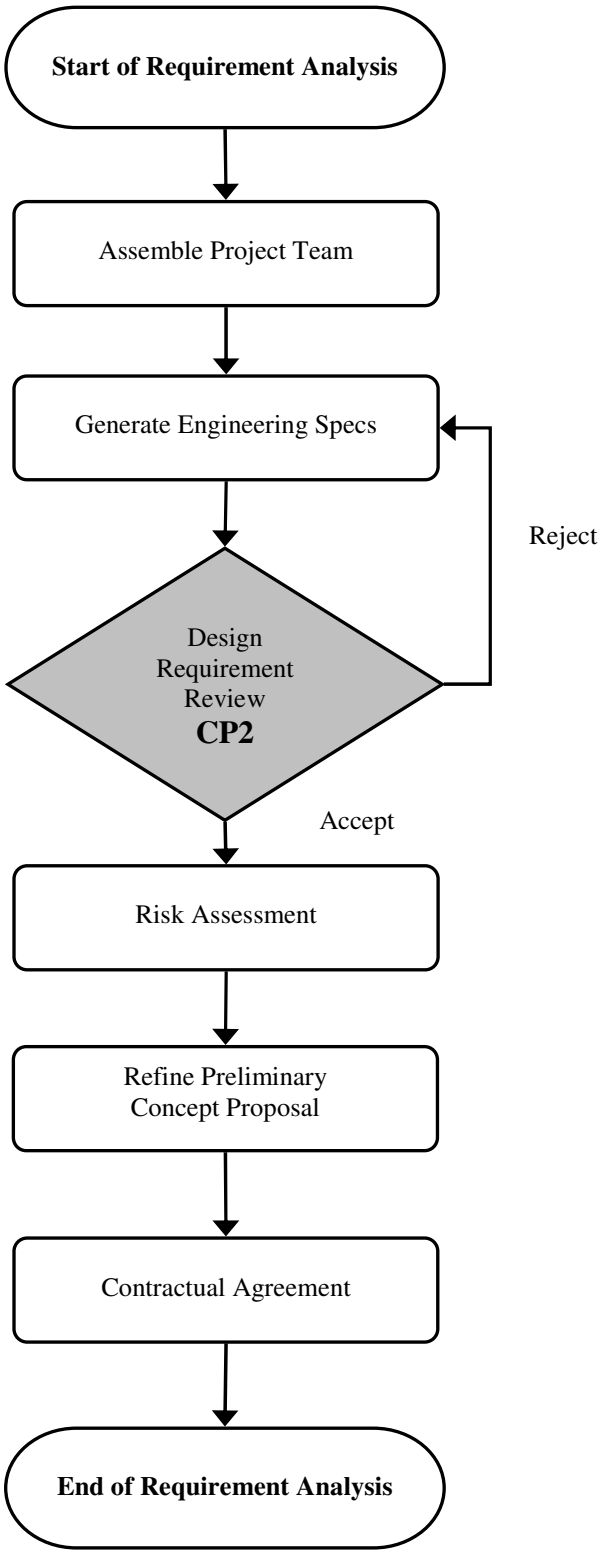


Table 15 : Overview of Product Development Flow

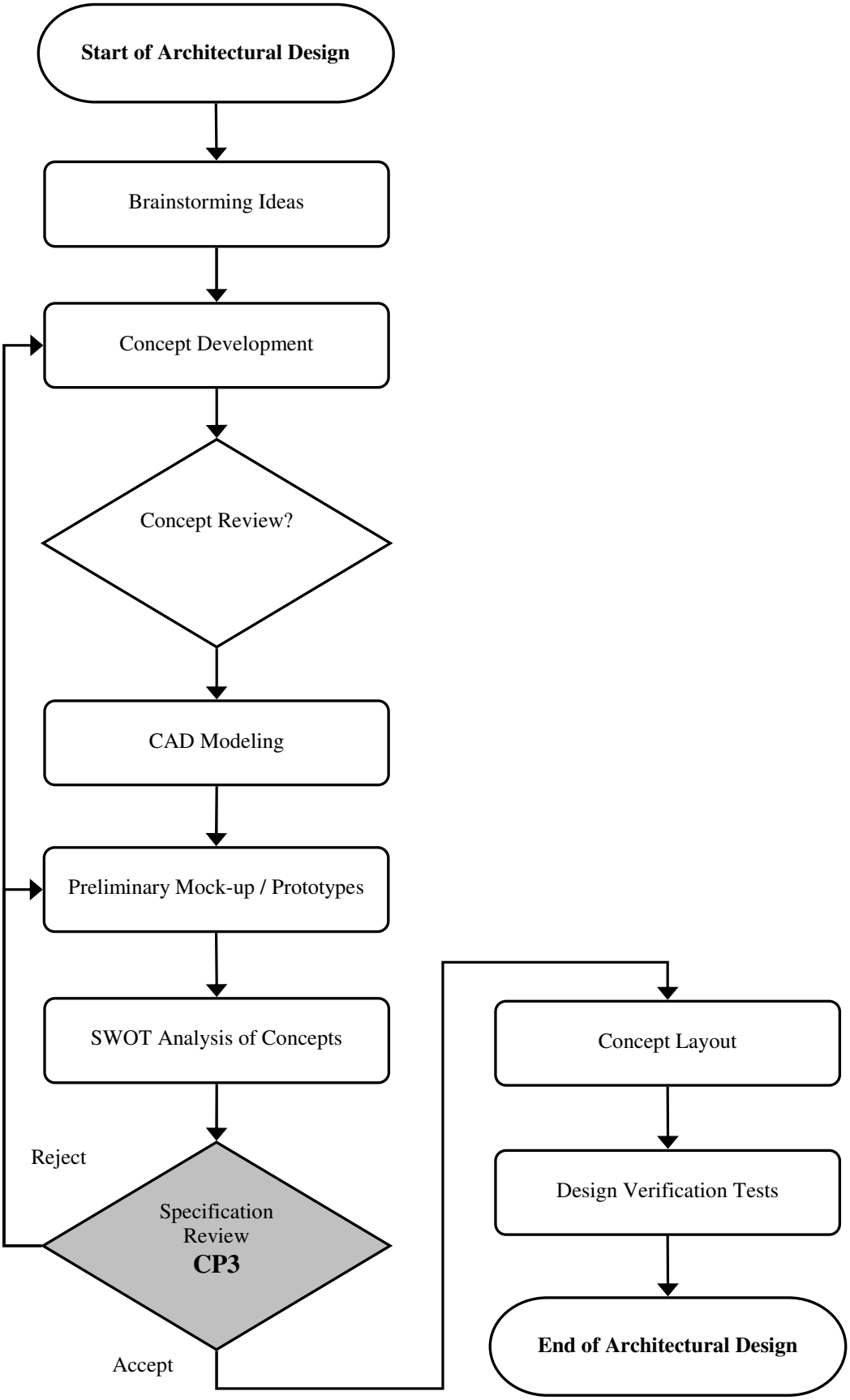
5.3.1 Proposal Generation Process Flow



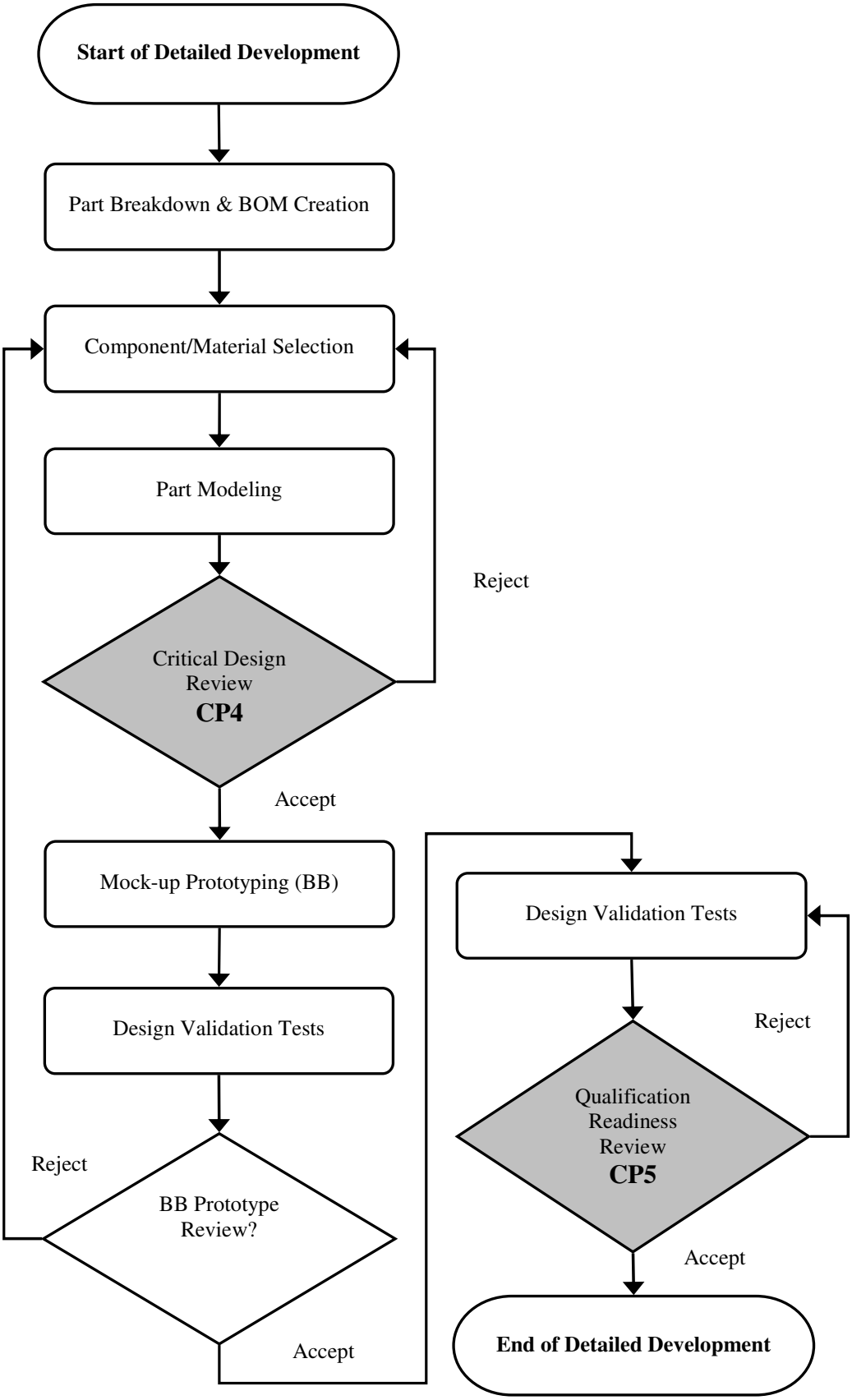
5.3.2 Requirement Analysis Process Flow



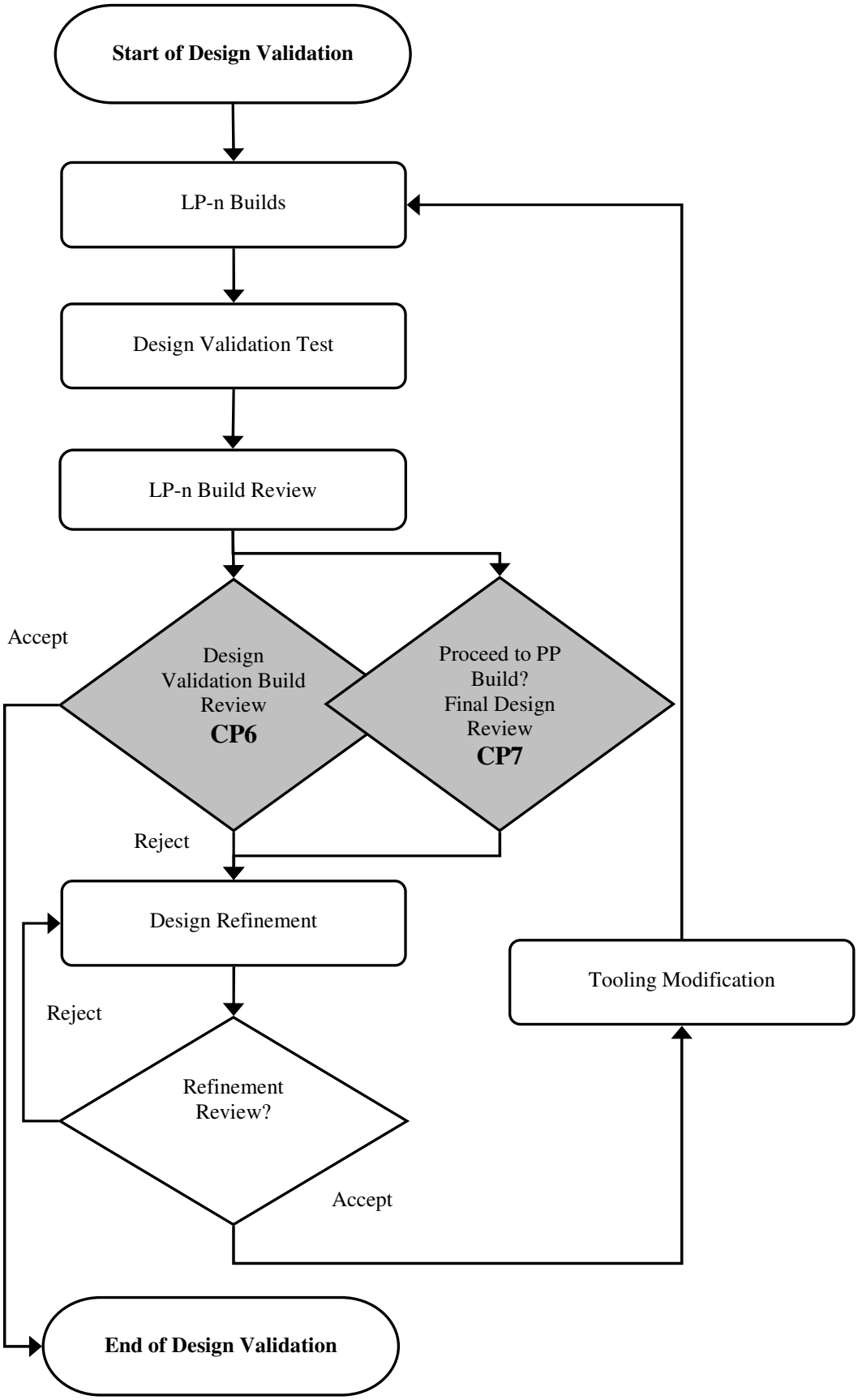
5.3.3 Architectural Design Process Flow



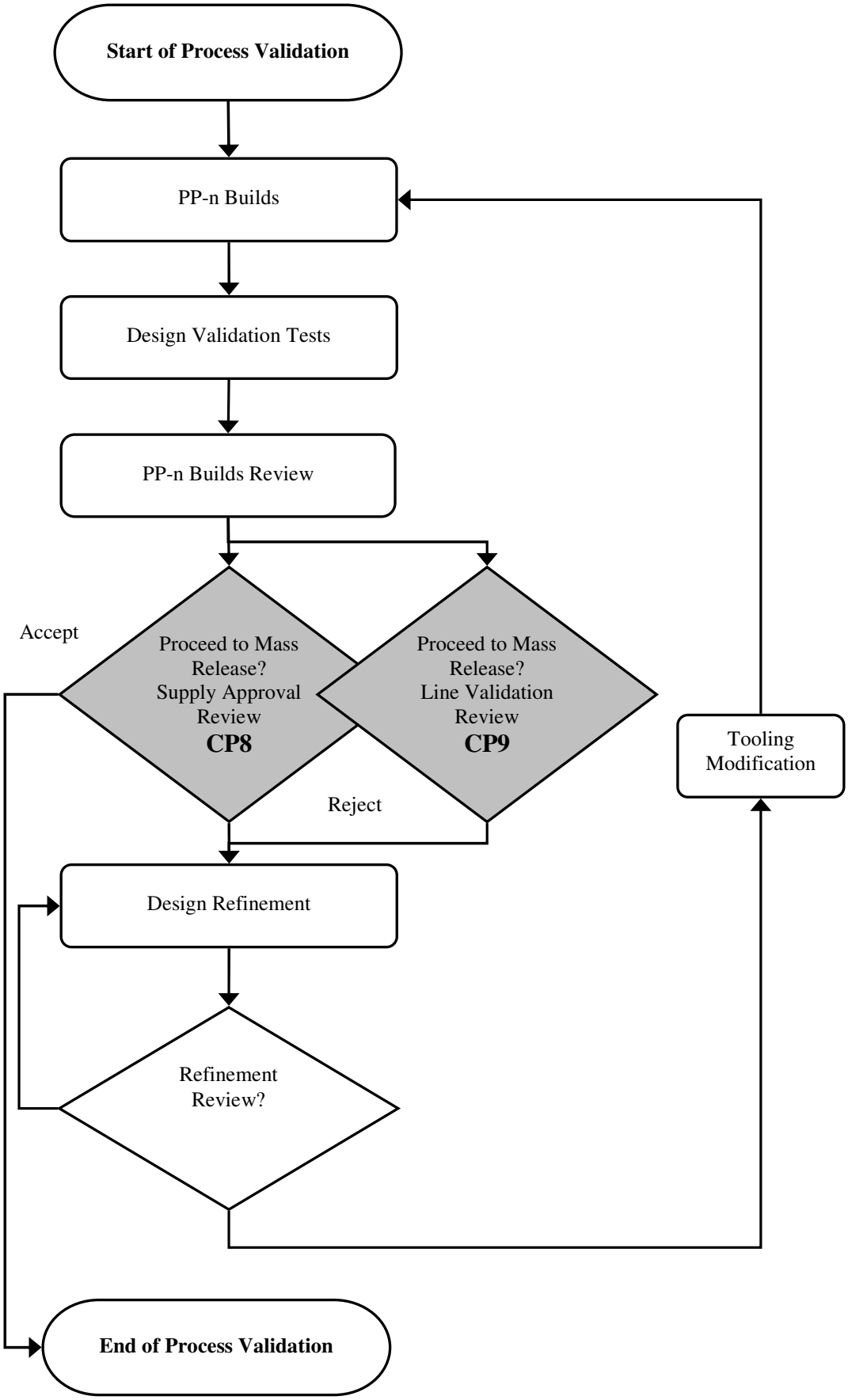
5.3.4 Detailed Development Process Flow



5.3.5 Design Validation Process Flow



5.3.6 Process Validation Flow



5.3.7 Product Development Process Documents

Each project environment is unique. As such, the product development process is intended to be flexible and it should be continuously evaluated, improved and enhance. In addition, project management process is flexible and constantly evolving as it is applied, the checklists and suggested templates and reports are neither totally comprehensive nor all-inclusive of every aspect, technique, process or procedure related to project management. Instead, it is intended to be a foundation upon which to build, refine, and continuously improve the process.

Some samples of template and report are included in the dissertation report under Appendix D.

In the following pages, an overview of Gate and Process checklists is tabulated. The table also proposes templates and reports and other auxiliary documents. It also suggests responsible person for each tasks.

The roles and responsibility matrix is reproduced from section 4.7.

D (Decision):

Function responsible for the decision processes and the documentation/dissemination of the decision outcome

R (Responsible):

Function(s) responsible for the execution of the activity with an obligation to inform on status, progress, risk and any obstacles that hinder the process

C (Contribute):

Function(s) assist in the completion of a decision or task.

I (Information Only):

Function(s) that do not have a responsibility in the decision or task, but will be affected by its outcome

Table 16 : Overview of Gate and Process Checklist

Phase	Checkpoints	Mechanical	Hardware	Software	Design QA	Tooling	PBR	PJM	Design Leads	Designers	Design QA	Material Engg	Industrialization	Customer
Proposal Generation	**GCP1**	**Business Feasibility Gate Checklist**					R	C	C					
		Customer Requirement Checklist					R	C	C					C
		Template for Project Scoping Report					I	R	C	C	C	C	C	C
		Template for Feasibility Study Report						C	R	C	C	C		C
		Proposal Template					D	R	C	C	C	C	C	
	CP1	**Checklist for Proposal Review**	**Checklist for Proposal Review**	**Checklist for Proposal Review**	**Checklist for Proposal Review**		C	C	R	C	C		C	
Requirement Analysis		Template for Project Member List					D	R	C	C	C	C	C	I
		Checklist for Engineering Specs	Checklist for Design Requirement	Checklist for Firmware Requirement	Template for Quality Plan		I	D	R	C	R	I	I	
	CP2	**Checklist for Design Requirements Review ME**	**Checklist for Design Requirements Review HW**	**Checklist for Design Requirements Review SW**	**Checklist for Design Requirement Review DQA**		I	D	R	C	R	I	I	
		Template for Risk Assessment					D	R	C	C	C	C	C	
	GCP2	**Opportunity Release / Concept Start Gate Checklist**					D	R	C	C	C	C	C	

Phase	Checkpoints	Mechanical	Hardware	Software	Design QA	Tooling	PBR	PJM	Design Leads	Designers	Design QA	Material Engg	Industrialization	Customer
Architectural Design		Template for Brainstorming	Template for Concept HW	Template for Concept SW	Template for FMEA		I	D	R	C	R	C	I	
		Checklist for Risk Assessment						D	R	C	C	I	I	
		Checklist for CAD Release						I	D	C				
		Template for ME Verification Test Report	Template for HW Verification Test Report						R	C	I			
	CP3	**Checklist for Specifications Review**	**Checklist for Specifications Review**	**Checklist for Specifications Review**	**Checklist for Specification Review**		I	D	R	C	C	C	C	I
		SWOT analysis Template					R	C	C					
	GCP3	**Concept Release / Development Kickoff Gate Checklist**					D	R	C	C	C	C	C	I

Phase	Checkpoints	Mechanical	Hardware	Software	Design QA	Tooling	PBR	PJM	Design Leads	Designers	Design QA	Material Engg	Industrialization	Customer
Detailed Development		Template for Bill of Materials				Template for Tool Specs			C	C		C	R	
		Template for Tolerance Analysis	Template for Part Specs	Template for Detailed Design		Checklist for Material Characteristics			R	C				
	CP4	**Checklist for Critical Design Review ME**	**Checklist for Critical Design Review HW**	**Checklist for Critical Design Review SW**	**Checklist4 Critical Design Review DQA**	**Checklist for Critical Design Review Tooling**		D	R	C	R	C	C	
		Checklist for Prototyping Review	Template for Schematic		Template for Test Procedures	Checklist for Mold Design			R	C	R			
						Template for Tool Progress Tracking		I	R					
	CP5	**Checklist for Qualification Readiness Review ME**	**Checklist for Qualification Readiness Review HW**	**Checklist for Qualification Readiness Review SW**	**Checklist for Qualification Readiness Review DQA**	**Checklist for Qualification Readiness Review Tooling**		I	R	C	R	I	I	
			Checklist for ME Specs	Template for FW Release Notes					R	C			C	
			Form for PCB Release	Form for Release Codes					R	C		C	C	
		Checklist for Release to Production							R	C		C	C	
			Checklist for ICT/FCT						R	C		C	C	
			Template for MTBF Report						C	C	R			

Phase	Checkpoints	Mechanical	Hardware	Software	Design QA	Tooling	PBR	PJM	Design Leads	Designers	Design QA	Material Engg	Industrialization	Customer
Design Validation			Form for PCBA Open/Short Tests	Template for Test Cases		Template for FAI Report		I					R	
		Template for PP Checklist			Template for DQA Test Report	Template for Capability Study Report		D					R	
	CP6	**Checklist for Design Validation Build Review ME**	**Checklist for Design Validation Build Review HW**	**Checklist for Design Validation Build Review SW**	**Checklist for Design Validation Build Review DQA**	**Checklist for Design Validation Build Review Tooling**	I	D	R	C	R		C	
	CP7	**Checklist for Final Design Review ME**	**Checklist for Final Design Review HW**	**Checklist for Final Design Review SW**	**Checklist for Final Design Review DQA**	**Checklist for Final Design Review Tooling**	I	D	R	C	R			

Phase	Checkpoints	Mechanical	Hardware	Software	Design QA	Tooling	PBR	PJM	Design Leads	Designers	Design QA	Material Engg	Industrialization	Customer
Process Validation	**CP8**	**Checklist for Supply Approval Review ME**	**Checklist for Supply Approval Review HW**	**Checklist for Supply Approval Review SW**	**Checklist for Supply Approval Review DQA**	**Checklist for Supply Approval Review Tooling**	I	D				R	C	
	CP9	**Checklist for Line Validation Review ME**	**Checklist for Line Validation Review HW**	**Checklist for Line Validation Review SW**	**Checklist for Line Validation Review DQA**	**Checklist for Line Validation Review Tooling**	I	D	C			C	R	
		Checklist for Builds Readiness				Template for FAI Report	I	D	C	C			R	
						Template for Capability Study Report		I	R	C	C	C		
						Checklist for Tool Buy Off		I	R					
		Procedure for Engineering Change Order							C	C	C		R	
		Form for ECO						D	C	R	I	I	I	
		Template for Wrap-Up Report					D	R	C	C	C	C	C	I
	GCP4	**Supply Approval Release Gate Checklist**					I	R	C	C	C	C	C	
	GCP5	**Stable Production Release Gate Checklist**					I	R	C	C	C	C	C	I

5.4 Conclusion

This chapter has presented in detail the main works of the research topic.

The established framework structure is basing on a ‘Gateway Review’ framework to ensure best practices and compliance of a product development, aims to assist Project Manager to manage product development for rapid Time-to-Market.

The framework has considered all aspects of managing product development involved in delivering a new product.

- Contract/Business
- Specification
- Price/Cost
- Logistic
- Environment
- Compliance (Safety and Regulatory)
- Quality
- Project Management

Gate Checklists and Functional Process Checklists are proposed in this chapter. It should be noted that the processes, as well as the checklists, can be tailored according to the type of business and operating practice. In addition, product development projects may vary in terms of for example risk and reward, level of resource, technical difficulty. Therefore, the frameworks or processes need to be flexible or 'scaled' in conjunction with the project management approach to suit the type of product development project.

In the next chapter, the performance and underlying problem of the established framework and processes will be reviewed and validated by case studies.

Chapter 6

Review Performance and Underlying Problem

This chapter can be considered an extension of Chapter 4 and 5. The concept of the proposed product development process framework is to be examined in this chapter through case studies because the implementation is the same for all problems.

6.1 Case Study 1

The historical failure records of a CDM service provider (Section 2.2) is re-visited and used as a reference for case study here. This case study analyzes the inefficiency as a result of multiple-command matrix organization.

Because employees in the matrix are simultaneously members of functional departments and of several project teams, reporting relationships and priority are unclear. In addition, more time are spent for communication and coordinating task-related activities. With a product development team's need for resources from different functional department, it is likely that resources from one or more departments will be constrained and unable to respond to the project's requirements in a timely way.

When the development projects planned or underway create a significant overload on development resources, all projects are stretched out, affecting time to market. Further, individual development personnel make decisions on project priorities which are not necessarily in line with enterprise priorities. Finally, this overload causes development personnel to take shortcuts, undermining the desired process. When this overload situation is indicated, the organization must take one of two actions: add resources, whether permanent hires, contract labor, or subcontracting; or change the resource requirements by deferring project starts.

The timely development of a new product requires that all required personnel resources to support the development effort are available when needed. This requires planning resource requirements by developing a realistic development plan which includes a time-phased schedule of manpower requirements (by discipline and position/skill level). The earlier this resource planning occurs prior to the start of a development project, the greater the flexibility to respond to resource constraints. There are a number of actions that can mitigate these resource conflicts in an integrated product development environment. One action to alleviate these likely resource constraints is to maximize the flexibility of development personnel so that they can perform tasks that are not normally their responsibility. As people become broader generalists through exposure to other disciplines on teams, through training, and through team member collaboration, a balancing of work loads will occur naturally.

For example, by allowing engineers and designers to operate equipment in a lab, this avoids having to wait for a lab technician who is backlogged with work. When flexible, easy-to-use design and analytic tools (e.g., FEA) are provided, this may mitigate the need for an analyst or specialist who may not be available. It is important to emphasize training and personnel development to create this type of broadly skilled workforce.

At the Opportunity Phase, GCP 1 suggested BDM or PJM to ensure the presence of a Product Definition Document or an Assignment Specification supplied by customer, which are pre-requisites to commence the Requirement Analysis as part of the Product Development Process.

Both GCP1 and GCP2 Gate Checkpoint draw the attention of BDM and PJM to the availability of resource and competency for the entire project. Project is defined and organized during these stages and it must be noted that a well defined project organization structure, detailing who is going to be involved and what their responsibilities are (team management structure and job descriptions) provides clear lines of reporting and decision taking. While lining up the required resources for the project team, GCP also suggest PJM to review the requirement of critical skills from the project delivery team members.

As an extension of GCP1 and GCP2, the following checklist questions can be considered.

- Is the project organization structure complete, with names and titles?
- Have all the roles been considered?
- Does it clearly show a control, reporting and direction regime that is applicable, and appropriate to the scale, business risk and business importance of the project?
- Is the project organization structure backed up by agreed and signed job definitions?
- Are the relationships and lines of authority clear?

To facilitate rapid time to market, some key staffing strategies are suggested in this case study. These include:

- Plan based on early involvement of functional disciplines to support the parallel design of the product and the process
- Use full-time, dedicated personnel where possible. Part-time personnel and task-switching affect productivity and slow down development activities
- Support rapid staffing build-up to insure the project gets off to a good start
- Consider delaying the start of the project if needed personnel and resources are not available
- Maintain the core integrated product team into production to resolve transition problems until stable production is achieved. This provides resources to quickly solve problems and it provides direct feedback to development personnel on lessons learned

The proposed Product Development Process Framework suggests regular review meetings prior to the checkpoints so that each product development team member clearly understands his or her responsibilities. Since project conditions change and performance doesn't always go according to plan, the plan needs to be periodically maintained and revisions reviewed with team members.

Carry out risk analysis at high level at initial stage helps address risks and recognize the potential need for additional resources, enable control plan to be put in place before commencing detail works of the product development.

The case study presented thus far has uncovered an underlying issue of the proposed Product Development Process. That is, the framework checklist is both neither comprehensive nor suggesting solution and corrective action for the list of issues found.

In all cases, the research has suggested that the Product Development Process framework is established to supplement and support other management processes already in place at most companies, such as business operating procedures, risk management, and decision-making process. Moreover, good project management relies on skills of individual that are rational, logical, objective and systematic, with intuition and personal insight to solve unusual and non-routine problems.

6.2 Case Study 2

This case study discusses some prior volume production design readiness issues. The common issues of this category are produced here for analysis.

- Late design releases owing to time spent on design iteration and resolving test failures, resulting in eventual material readiness issues at build
- DFX issues that occur during volume production, resulting in low output and high yield loss causing delay in shipment
- Critical skills are missing from the project delivery team members. As a result, design is not meeting product requirement or specification that leads to customer dissatisfaction, consumer backlash and additional remedial expenses

Numerous design reviews and design validation builds are put in place within the Product Development Process framework to ensure no missing tasks. Although they provide the Go/No Go mechanism, a potential problem lies on whether development personnel value these as a means to reduce project risks and increase success.

Because the review must be successfully conducted before the project proceeds, additional time is required to prepare for gate reviews beyond their normal development activities. However, when a well-disciplined development process is in place and development personnel are used to gate reviews, the organization can execute the process flexibly allowing the project to proceed in parallel with conducting the review, thereby reducing time-to-market.

Design reviews are conducted with a design review team composed of experienced, senior-level personnel who understand the technology involved in the product or system and its associated technical risks. The team is multi-functional to address all the subject matter and issues covered during the review. Design reviews, while technically focused, are not limited to just the design of the product. They must address all the life cycle requirements of the product as well as the project requirements such as cost, schedule and risk.

Chapter 7

Recommendation and Further Works

An organization does not necessarily want to copy approaches taken by other organizations, because they may not be appropriate for its business environment, products, market, or culture.

Many organizations take totally different directions in the evolution of their product development process. While some of these differences are the result of legitimate differences in their business strategy, business environment, organization, and the nature of their products, a frequent problem is the lack of a common framework of the best practices of product development.

As the size and complexity of companies increased, industry lost many of the best practices in developing products. In the competitive world, companies must aggressively improve the way that they develop products.

7.1 Achievement of Objectives

In conclusion, all of the objectives set out for this research project have been fulfilled in the previous chapters.

The background of the research topic and all previous assessment methods that have led up to it have been researched and understood (Chapter 1). In addition to this, the project management fundamental that lay the foundation for product development framework has been applied successfully to the management processes of product development (Chapter 2 and 3).

Chapter 4 has introduced the basic structure of the Product Development Process established using top-down concept from the higher level of product life cycle that forms the overall framework of product development and product marketing.

Chapter 5 organizes the Product Life Cycle structure and Product Development Process into Gateway Review framework where gate checkpoints and functional checkpoints are installed at each phases of the product development.

The performance of the proposed process has been reviewed and underlying problem identified through case studies.

7.2 Proposal for future works

The following are proposed for future works

- Refine the framework and processes through trial run and customization
- Create new and refine current management tools and templates
- Implementation Plan
- Training Plan

The implementation of these practices and the process of changing a company's culture are challenging. Success can be achieved with a well-planned and managed effort. Management must understand not only the concepts of Product Development Process, but the process of managing change within the organization. The responsibility for making these major changes in culture, organization, business process and technology can not be delegated. Proactive management involvement, leadership, and attention to detail will pay off.

Unsuccessful or disappointing efforts to implementation can be traced to one or more of the following pitfalls:

- Limited perspective - management believes they have achieved it
- Not a high priority; treated as a fad
- Lack of understanding of how to manage change, involve employees, or change the culture
- Teams formed, but no guidance given on roles, responsibilities, reporting relationships, etc.
- No management leadership or follow-up - imperative lost
- Lack of time or investment in training, process improvement, systems, or guidelines
- No plan, accepted responsibilities, or coordination
- Policies & reward systems not re-aligned to support the process

The implementation effort should be planned and lead from the top down, but implemented from the bottom up to develop ownership. Employee involvement must be based on communicating the proper goals and providing necessary training in the concepts and skills. When executive management makes continuous improvement a high priority, initiatives such as the Product Development Process can be achieved.

The focus of this research is theory building and analytical generalization. Thus, the proposed model was developed in a generic, non scenario specific procedure. It is recommended that further research should test this theory by trial runs and use a more quantitative research method for the purpose of statistical generalization.

Future research can also extend research into evaluation and exploration of improved techniques, into different geographical areas, and try to understand if there are different behavior and characteristics of companies, such as traditional and progressive manufacturing companies. If the difference can be confirmed, it can lead to recommended strategies on how companies can improve performance.

There is also scope for research to be done on comparing between the various industries to understand if critical success factors are similar or different across industries and countries. Such learning can help various industries develop processes that lead to competitive advantage and business success.

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Appendices

Appendix A: Project Specification

Faculty of Engineering and Surveying

Courses ENG4111/4112 RESEARCH PROJECT Part 1 & 2

Project Specification 2006

Version 1 (6 march 2006)

Student: Lam Suet Leong

Student No.: 0050015125

Supervisor: R Fulcher

Originator:

Sponsor:

Aim: This project aims to establish an effective and efficient Product Development Process framework to supplement and support other management processes already in place at most companies. It is built upon the Project Management fundamentals, providing Project Manager and team members with a systematic way to execute their new product development projects for rapid Time-to-Market.

Objectives:

1. Review modern business and industry that form parts of the external environment of project management. Investigate modern marketing strategy and outsourcing in business operating concept.
2. To undertake a literature review of project management fundamentals that forms the basis for managing new product development. Discuss intellectual property and environment sustainability, being the critical factors of new product introduction.
3. Review the historical performance and the underlying problems of project management and new product development process.
4. Establish an effective and efficient product development process based on a 'Gateway Review' framework with lists of exit criterion for each check-point to ensure best practices and compliance of each phase of a new product development.
5. Generate project management tools/templates for all phases of a product development cycle. Formulate functional checklists to ensure products are made to specification and are conform to quality standards.
6. Discuss and conclude the research with a formal dissertation report.

Student:  **Date:** 6 March 2006

Supervisor:  **Date:** 12 April 2006

Appendix B: Gate Checklists

GCP1 Gate Checklist

GCP1: BUSINESS FEASIBILITY GATE CHECKLIST		Sheet 1
No.	**Checklist**	**Owner**
I. Contract / Business:		
1	Has a Bid/No Bid been supplied and approved?	BDM
2	Has a customer account qualification been performed?	BDM
3	Has the business scope for the project and program been established?	BDM
4	Are assessments made on whether the business is economically profitable and/or whether the business provides other positive effects?	BDM
5	Are a competitor's analysis available and/or market analysis available?	BDM
6	Is there an external customer matrix created? (Should include decision makers, orderer, etc)	BDM
7	Have all IPR (Intellectual Property Rights) issues been defined and agreed to?	BDM
8	Is there an agreed upon Assignment Specification from customer?	BDM/PJM
9	Is there an RFQ from customer?	BDM
10	Are new processes and technologies required and are they available?	BDM
II. Specification:		
1	Are there enough information/requirements from the customer in order to complete the opportunity phase?	PJM
III. Price/Cost:		
1	Is the budget for the Opportunity phase approved?	BDM
IV. Logistics: N.A.		
V. Environment: N.A.		
VI. Compliance: N.A.		
VII. Quality: N.A.		
VIII. Project:		
1	Is a steering group (External and/or Internal) assigned and roles and information flow agreed upon?	BDM
2	Is a project manager for the opportunity phase or the entire project assigned?	BDM
3	Has experience from past projects been considered?	PJM
4	Are there resources and competence for this phase and the entire project?	PJM
5	Is the time schedule for the opportunity phase defined and agreed upon?	PJM
6	Are resources assigned and secured for the opportunity phase?	PJM
7	Have project accounts been established?	PJM

GCP1: BUSINESS FEASIBILITY GATE CHECKLIST		Sheet 2
No.	**Checklist**	**Owner**
8	Have project databases been established?	PJM
9	Has the opportunity phase been tailored according to the Product Development Process?	PJM
10	Is Lead Design site been identified?	BDM
11	Is Production site been identified	BDM
IX. WH&S:		
1	Has the project been logged with the Workplace Health and Safety Committee?	PJM

GCP2 Gate Checklist

GCP2: OPPORTUNITY RELEASE/CONCEPT START GATE CHECKLIST		Sheet 1
No.	**Checklist**	**Owner**
I. Contract / Business:		
1	Has the external/customer matrix including decision makers and orderer been updated?	BDM/PJM
2	Is there an approved revised assignment specification?	BDM/PJM
3	Is the business scope for the project and program approved?	BDM
4	Are assessments made on whether the business still is economically profitable and/or whether the business provides other positive effects?	BDM/PJM
5	Is a contract/agreement in place (Internal/External)?	BDM
6	Have all license agreement(s) with the customer, sub-contractor or supplier been defined?	BDM/PJM
7	Is the level of confidentiality defined and all required NDA's (Non Disclosure Agreement) in place with customer and/or suppliers?	BDM
8	Is there a Purchase Order or authorization-to-bill available to cover the concept phase?	BDM
9	Is Market Research & Analysis (volume, market shares, margins, key technologies) available?	BDM
10	Is the Customer Account Qualification report available?	BDM
11	Is there an RFQ from customer?	BDM
12	Has the Proposal been approved by customer?	BDM
13	Is there a overall Project Quote(Design, Mfg and other financial requirements)	BDM
II. Specification:		
1	Are the Customer / product requirements clearly defined and sufficient?	PJM
2	Can we create technical product specification(s) based on the customer/product requirements?	PJM /Lead Engineer
3	Are all required standards defined and known?	PJM /Lead Engineer
4	Are new processes and technologies required and are they available?	PJM
5	Are there enough information/requirements in order to complete the concept phase?	PJM
III. Price/Cost:		
1	Is a target or target range for the product price defined by the customer?	BDM
2	Is there a cost estimate for the entire project?	PJM
3	Is the budget for the Concept phase approved?	PJM
4	Has a cost reduction roadmap been considered?	BDM
5	Does the costed BOM, based on experience and estimates from former projects, and the predicted product price meet the target price?	BDM

GCP2: OPPORTUNITY RELEASE/CONCEPT START GATE CHECKLIST		Sheet 2
No.	**Checklist**	**Owner**
IV. Logistics:		
1	Is a project schedule available and accepted for the concept phase?	PJM
2	Is the production quantity target and production life cycle defined?	BDM
3	Do we have target markets and logistic flow information available?	BDM
4	Is there an agreed change request handling process available?	PJM
V. Environment:		
1	Are customer's environmental requirements taken into account in quotation? ▪ Lead free ▪ Halogen free ▪ Recyclability percent and disassembly time ▪ Material declaration report requirements ▪ Environment declaration report requirements ▪ Life cycle assessment requirements ▪ End of life (recycling) requirements	PJM
2	Are environmental cost impact calculated and approved?	PJM
VI. Compliance: N.A.		
VII. Quality:		
1	Are any particular Quality Certificates required (ISO, QS, TS, Etc...)?	PJM
2	Are all quality targets defined and agreed upon with the customer?	BDM
3	Has a Project Quality responsible been assigned?	PJM
VIII. Project:		
1	Are all necessary resources (including equipment) for the concept phase secure?	PJM
2	Has the Proposal been generated?	PJM
3	Are customer deliverables and follow up routines (interface, report structure, meeting schedule) for the Project phases established with the customer?	PJM
4	Have Functional CP checklist(s) been approved?	PJM / Lead Engr
5	Is the project documentation updated in applicable project database?	PJM
6	Are there resources and competence available for this project?	PJM
7	Is there a need to have sub-contractors to fulfill this project?	PJM
8	Are project KPI(s) (Key Performance Indicators) defined? (Comments: KPI: BOM Cost, Strategic Supplier, Core supplier, Yield, Test Time, MTBF, Product parameter etc...)	PJM
9	Has information/skills from technology and engineering road-maps been taken into consideration?	PJM
10	Have Lessons Learned from Opportunity phase been recorded for the project conclusion?	PJM
IX. WH&S:		
1	Have the WH&S representatives been elected to oversee workplace health and safety throughout the project?	PJM

GCP3 Gate Checklist

GCP3: CONCEPT RELEASE / DEVELOPMENT KICK-OFF GATE CHECKLIST Sheet 1		
No.	**Checklist**	**Owner**
I. Contract / Business:		
1	Is there a business contract/agreement available with the customer (DSA/contract) and are all contract issues closed?	BDM
2	Is there an approved assignment specification revision?	BDM/PJM
3	If there is no business contract available, is there an agreement on how to handle material and equipment material cost?	BDM/PJM
4	Is the Operations/factory site established and approved?	BDM/PJM
5	Do we have authorization to buy material?	BDM
6	Are program KPIs and metrics validated so that they are in-line with customer requirements/expectations and Company's requirements??	BDM/PJM
7	Is there a Purchase Order or authorization-to-bill available to cover the continued concept phase?	BDM/PJM
8	Does the PO or Authorization-to-bill match the Proposal?	PJM
9	Is there a final/revise quote to Customer(if last quote is only for Conceptual and/or Architectural Design work)	BDM/PJM
10	Is there a need to revise & resubmit proposal to customer?	BDM/PJM
II. Specification:		
1	Is there any technical product documentation available?	PJM/Lead Engineer
2	Are the customer requirements finalized?	PJM
3	Is there a Product Design Specification (PDS) available and approved?	PJM/Lead Engineer
4	Is there a Production Process Specification (PPS) available and approved?	PJM/Lead Engineer
5	Is there a Procurement Supply chain Specification (PSS) available and approved?	PJM/Lead Engineer
6	Is there a Product Logistic Specification (PLS) available and approved?	PJM/Lead Engineer
7	Is there a Production Test development Specification (PTS) available and approved?	PJM/Lead Engineer
8	Is there a Project Specification (PJS) available and approved?	PJM
9	Is there a Project Quality Specification (PQS) available and approved?	PJM/Lead Engineer
10	Is there a Product Environment Specification (PES) available and approved?	PJM/Lead Engineer

GCP3: CONCEPT RELEASE / DEVELOPMENT KICK-OFF GATE CHECKLIST Sheet 2		
No.	**Checklist**	**Owner**
III. Price/Cost:		
1	Are the costs for the development phase defined (labor and expenses)? o Industrial design o Hardware engineering o Software engineering o Mechanical engineering o Layout design o Product verification and release o External and internal compliance o External resources o Test development o Production process preparation (NPI) o Supply chain development o Logistic development	PJM
2	Are the costs for tooling, fixtures and test equipment defined (non labor)? o Plastic tools o Metal tools o PCB tools (NRE) o Tools, equipment and initial cost for specific mechanical and electrical components o Production tools and fixtures o Specific design and development equipment (software tools, programming tools, measurement equipment, ...) o Production test equipment	PJM
3	Are the costs for product samples defined (prototypes)?	PJM
4	Is the preliminary costed BOM available?	PJM
5	Is the cost of the project to date in accordance with budgeted cost?	PJM
IV. Logistics:		
1	Is the agreed change request handling process still valid?	PJM
2	Are the key components defined and in agreement with strategic suppliers?	PJM/Lead Engineer
3	Is there a Demand forecast study (forecast & volume projections) available? (Comment: Can we meet the customer forecast from a time and quantity point of view?)	PJM
4	Is the production ramp-up planned according to customer forecast and approved by operations and the customer?	PJM
V. Environment:		
1	Has an environmental cost impact been recalculated and approved?	PJM
2	Has awareness been created within the project and the supplying project about the environmental requirements?	PJM
3	Does the PES include any deviations or risks according to the environmental requirements settled in the product and the project?	PJM
4	Have key targets been agreed for accessories and sales packaging?	PJM
VI. Compliance:		
1	Are all requirements for Product Validation testing (compliance, regulatory, safety, etc…) defined and agreed upon with the customer?	PJM/Lead Engineer

GCP3: CONCEPT RELEASE / DEVELOPMENT KICK-OFF GATE CHECKLIST Sheet 3		
No.	**Checklist**	**Owner**
VII. Quality:		
1	Is the Risk list and Risk Management Plan updated and have the risks been mitigated?	PJM
2	Are all quality targets defined and agreed upon with the customer?	PJM
3	Has the project quality responsible changed?	PJM
4	Are quality assurance activities such as inspections and reviews planned in the PQS?	PJM
5	Has design FMEA, FFR and MTBF been initiated?	PJM
VIII. Project:		
1	Is the project documentation updated in the applicable project database?	PJM
2	Are all necessary resources (including equipment) and skills secured and assigned? Is there an initial Industrialization Plan?	PJM
3	Have information/skills from technology and engineering road-maps been taken into consideration?	PJM
4	Are necessary samples/prototype built?	PJM
5	Has product concept demonstration been conducted?	Lead Engineer
6	Are the Project KPI (Key Performance Indicators) defined? Comment: KPI ; BOM cost, Strategic supplier, core supplier, yield, test time , MTBF, Product parameter performance etc...)	Lead Engineer
7	Are any special security requirements considered and implemented (In PJS)?	PJM
8	Have the Functional CP checklist(s) been approved?	PJM/Lead Engineer
9	Is a project schedule for the development phase available and accepted by the customer (until production ramp up)?	PJM
10	Are all open issues from previous GCP's "Opportunity Release/Concept Start" closed?	PJM
11	Have the lessons learned from Concept phase been recorded for the project conclusion?	PJM
12	Have additional project, product or customer specific items been addressed?	PJM
13	Is there a steering group assigned for the development phase and the entire project (external / internal) and have the roles and information/communication flow agreed upon?	BDM/PJM
14	Are the project costs and hours filed for the correct project order numbers (budget vs. actual)?	PJM
15	Is there a plan for long lead-time components?	PJM
16	Is there a plan for long lead-time tools and equipment?	PJM
17	Have second source activities for critical & unique components been initiated?	PJM
18	Has a sub-contractor assessment in term of competencies and capability been carried out?	PJM
IX. WH&S:		
1	Have any of the WH&S compliance and advisory standards been neglected?	PJM

GCP4 Gate Checklist

GCP4: SUPPLY APPROVAL GATE CHECKLIST		Sheet 1
No.	**Checklist**	**Owner**
I. Contract / Business:		
1	Has the PE (Post Engineering) contract / agreement been updated and approved?	BDM
2	Are all contract/agreement requirements fulfilled to the customer's satisfaction?	BDM
3	Is there a manufacturing and /or supply contract/agreement approved and signed?	BDM
4	Is there a sustaining/product refinement contract/agreement approved and signed?	BDM
5	Is there a Purchase Order or authorization-to-bill available and agreed upon to cover the continued development phase and the rest of the project?	BDM/PJM
6	Does the PO or Authorization-to-bill match the Proposal?	PJM
7	Has the Customer orders for Volume Manufacturing been received?	BDM
8	Are all or a part of the development cost amortized onto the product?	PJM
II. Specification:		
1	Is there sufficient documentation for supply approval available for the customer and has the content been explained to the customer?	PJM
2	Is all necessary documentation for supply approval signed by the project manager, program manager and the customer?	PJM
3	If the process validation/supply approval is not meeting the requirements for the process, is there an action list or deviation list available and approved?	PJM
4	Are all the 8Ps updated? – Project Specification – Product Design Specification – Product Quality Specification – Project Environment Specification – Production Test Specification – Production Process Specification – Procurement / Supply Chain Specification – Product Logistics Specification	 PJM Lead Engineer Lead Engineer Lead Engineer Lead Engineer Lead Engineer Lead Engineer Lead Engineer
III. Price/Cost:		
1	Are the costs for the development phase on track (labor and travels)?	PJM
2	Are the costs for tooling, fixtures and test equipment on track (non labor)?	PJM
3	Are the costs for product samples on track (prototypes)?	PJM
4	Are the final product price(s) and variants calculated and in agreement with the customer?	BDM
5	Are there any non-budgeted additional expenses, and are they accounted for?	PJM

GCP4: SUPPLY APPROVAL GATE CHECKLIST		Sheet 2
No.	**Checklist**	**Owner**
IV. Logistics:		
1	Have the equipment, systems, tools and fixtures been validated and transferred to operations?	PJM
2	Are there any changes to the Demand forecast study (forecast & volume projections)?	PJM
3	Have all material shortages for Volume Manufacturing been identified?	PM
4	Is the production Test/cycle time assumption been verified and within specification?	PM
5	Are all suppliers (component, tooling & equipment) been qualified?	PJM
6	Are all Components use in Product been qualified?	PJM
V. Environment:		
1	Have ALL environmental targets (e.g. RoHS/WEEE) been met?	PJM
2	Are the environmental declaration(s) completed?	PJM
VI. Compliance:		
1	Are all verification/validation tests (including Quality targets) completed according to the specification/plan?	PJM/Lead Engineer
2	Are all regulatory/safety compliance test completed?	PJM/Lead Engineer
3	Are ALL certificates obtained?	PJM/Lead Engineer
VII. Quality:		
1	Are the Risk List and Risk Management Plan updated and have all risks been mitigated?	PJM
2	Has product training for operations been completed?	PJM/Lead Engineer
3	Was the first shipment accepted by the customer?	PM
4	Is there an approved Ongoing reliability test (ORT) plan?	Lead Engineer
VIII. Project:		
1	Is there an list of long lead time, key & unique components available?	PJM
2	Is the preliminary costed BOM been scrubbed?	PJM
3	Is Prototype BOM ready for release to production for Prototype Build (DV, PV runs)?	Lead Engineer
4	Is Prototype Tooling(SLA/CNC/Rubber Mold Part/Soft Tooling) ready for build & approval	Lead Engineer
5	Is Prototype line ready for build?	PJM/PM
6	Is planned Prototype build done?	PJM/PM
7	Are all DFx(DFM,DFA,DFR & DFMEA) report completed & approved?	Lead Engineer
8	Is there an approved manufacturing process plan?	Lead Engineer

GCP4: SUPPLY APPROVAL GATE CHECKLIST		Sheet 3
No.	**Checklist**	**Owner**
9	Is there an approved manufacturing quality plan?	Lead Engineer
10	Is there an "assurance of supply" agreement with supplier?	Lead Engineer
11	Has the Product gone through the critical design review?	PJM//PM/Lead Engineer
12	Is the Product ready for hard tooling release?	Lead Engineer
13	Are all hard tooling parts approved?	Lead Engineer
14	Is Operation ready for Pre-production run?	PJM/PM
15	Is there a pilot build done?	PJM/PM
16	Is the Product BOM updated & release for Production?	Lead Engineer
17	Is there a transition plan to Stable Production?	PJM/PM
18	Are the project costs and hours filed for the correct project order numbers (budget versus actual)?	PJM
19	Is the project documentation updated in applicable project database?	PJM
20	Are the project KPI (Key Performance Indicators) on target?	PJM
21	Is the project schedule for the development phase on track?	PJM
22	Is the level of technical product documentation (Schematics Diagram, Part Drawings, Cad files etc...) available and accepted by operations?	PJM/Lead Engineer
23	Are all operation interfaces defined and completed (Agile, Baan)?	PJM
24	Are project changes captured in the applicable documentation?	PJM
25	Have relevant Functional CP checklist(s) been approved?	PJM / Lead Engineer
26	Are all open issues from previous GCP's closed?	PJM
27	Have Lessons Learned from Development phase been recorded for the project conclusion?	PJM
28	Are all issues of the PSS (Procurement Supply chain Specification) closed?	PJM
29	Are all issues of the PLS (Product Logistic Specification) closed?	PJM
30	Is the production process validated and all issues of the PPS (Production Process Spec) closed?	PJM
31	Is the test equipment validated and all issues of the PTS (Production Test Specification) closed?	PJM
IX. WH&S:		
1	Have any of the WH&S compliance and advisory standards been neglected?	PJM

GCP5 Gate Checklist

GCP5: STABLE PRODUCTION RELEASE GATE CHECKLIST		Sheet 1
No.	**Checklist**	**Owner**
I. Contract / Business:		
1	Are key program KPIs and metrics validated/updated, and in-line with customer expectations/requirements?	BDM
2	Are all contract/agreement requirements fulfilled to the customer's satisfaction?	BDM
3	Have customer order(s) for HVM been received according to contract and forecast?	PM
II. Specification:		
1	Is there sufficient documentation for line validation and Stable production volume release available for the customer and has the content been explained to the customer?	PJM
2	Are all necessary documentation for line validation and Stable production volume release signed by the project manager, program manager and the customer?	PJM
3	If the line validation Stable production volume release is not meeting the requirements for the process, is there an action list or deviation list available and approved?	PJM
III. Price/Cost:		
1	Are there any updates to the product price/cost (Does Design & Cost hit Objectives)?	PJM
IV. Logistics:		
1	Have all material shortages for HVM been identified?	PM
4	Can we still deliver according to HVM (approved ramp-up plan) forecast?	PM

GCP5: STABLE PRODUCTION RELEASE GATE CHECKLIST		Sheet 2
No.	**Checklist**	**Owner**
V. Environment: N.A.		
VI. Compliance: N.A.		
VII. Quality:		
1	Is there an updated Risk List and Risk Management Plan?	PJM
2	Are all the quality targets validated and within requirement during the HVM?	PJM
3	Are all issues from the process FMEA(s) closed?	PJM/Lead Engineer
VIII. Project:		
1	Is there an acceptance of approved Supply Chain, Manufacturing Process and Quality Plans?	PM
2	Is there an approved Transition Plan to Stable Production (include Key metrics such as optimum cycle time, yield, quality criteria, etc)?	PM
3	Is manufacturing/operation site ready (4M - Material, Machine, Man & Method) for Stable Production Release?	PM
4	Is there a periodic Operation/Field feedback report template available?	PM/PJM
5	Is there an agreed & approved Post-Engineering Plan?	PM/PJM
6	Is there a Product End Of Life Plan?	PM/PJM
7	Is the project documentation updated in applicable project database?	PM/PJM
8	Are project changes captured in the applicable documentation?	PJM
9	Have relevant Functional CP checklist(s) been approved?	PJM / Lead Engineer
10	Are all open issues from previous GCP's closed?	PJM
11	Have lessons learned from Stable Production Release phase been recorded for the project conclusion?	PJM
IX. WH&S:		
1	Have any of the WH&S compliance and advisory standards been neglected?	PJM

Appendix C: Functional Process Checklists

CP1 Checklist

CP1 General Checklist is to be undertaken by all functional leaders of product development project team. (Mechanical/ID, Tooling, Hardware, Software/Firmware, Design Quality Assurance and Material)

CP1: PROPOSAL REVIEW CHECKLIST (GENERAL)	**Sheet 1**
No.	**Checklist**
I. Customer Requirements	
1	Does design satisfy all specified requirements for the product?
2	Does design meet functional and operational requirements, performance and dependability objectives?
3	Is the design satisfactory for all anticipated environmental and load conditions?
4	Does the proposal cover the Design and QA requirement requested in the customer RFQ?
5	Is there a communication matrix available?
II. Production Requirements	
1	Are components or service elements standardized and do they provide for interchangeability, maintainability and replacement?
2	Have appropriate materials and / or facilities been selected?
3	Is there adequate compatibility of materials and components and / or service elements?
4	Are plans for implementing the design, for example, purchasing, production, installation, inspection and testing, technically feasible?
5	Can the tolerance requirements consistently be met?
6	Where computer software forms part of the product, or has been used in design computations, has the software been appropriately validated, authorized and verified?
7	Have the inputs to such software and the outputs been appropriately verified and documented?
8	Has the DFM Report been generated, and the report reviewed by the Design Review Team?
9	Is resource planning in place for scope of work?
10	Is there a Preliminary BOM available?
11	Is a budgetary quote for the Project available?
12	Is there a Test & Approval Strategy available?
13	Is there a Manufacturing Strategy/Plan Available?

CP1: PROPOSAL REVIEW CHECKLIST (GENERAL)	Sheet 2
No.	**Checklist**
III. Regulatory Requirements	
1	Does design satisfy all regulatory requirements for the product?
IV. Environment Requirements	
1	Has relevant environmental legislation been identified (restricted substances, regulatory demands for recyclability etc.)?
2	Has customer approved Banned substance list and material data collection process?
V. Risk Assessment	
1	Has a risk analysis been carried out to ensure that safety considerations are covered?
VI. WH&S	
1	Has the project been logged with the Workplace Health and Safety Committee?
2	Have any of the WH&S compliance and advisory standards been neglected?

CP1: PROPOSAL REVIEW CHECKLIST (FUNCTIONAL)	Sheet 1
No.	**Checklist**
I. Mechanical	
1	Is all mechanical functionality specification received clearly understood?
2	Is there a Mechanical Development Timeline available?
3	Does the mechanical team has the Technical Capability?
4	Is the Mechanical Form Factor available?
5	Is the mechanical deliverables & compensation stated in the Proposal & understood by team member?
6	Is there a change control in place stated in the proposal?
7	Is there a Mechanical Design NRE cost incurred for this project?
II. Hardware	
1	Is all hardware functionality specification received clearly understood?
2	Is there a hardware development timeline available?
3	Does the hardware team has the Technical Capability?
4	Is the Mechanical Form Factor available?
5	Is the hardware deliverables & compensation stated in the Proposal & understood by team member?
6	Is there a Hardware Design NRE cost incurred for this project?
7	Are there an Architectural/ Block Diagram available?
8	Has the PCB Fabrication file been used as the form to document the PCB Fabrication details?
III. Material	
1	Awareness of product requirements: ▪ Has feasibility study and PRS reviewed and feedback given? (Product Requirement Specification) ▪ Are RoHS and WEEE Compliances required? ▪ Are main market and volume split by market available?
2	Is there agreement of Engineering, Sales/Business and identification of Materials Responsible person available?
3	Are project schedule, requirements and preliminary parts list communicated with Purchasing Managers for pricing?
4	Is there a new technology required, do we have the needed supplier base and will the technology be available for product launch?
5	Are mechanics parts and manufacturing technologies cross checked with technology/mechanics team
6	Are components specified by customer or project (e.g. chipset) RoHS compliant and capable for lead free process?
7	Is preliminary/budgetary priced parts list (BOM) submitted to Business Responsible?
8	Is Key supplier and component selection (AML) in process?
9	Are SW Licenses, royalties and IP's checked and estimates available?

CP1: PROPOSAL REVIEW CHECKLIST (FUNCTIONAL)	Sheet 2
No.	**Checklist**
10	Are Tooling estimates available?
11	Is Product Information Tracking Template completed?
12	Has the BOM been analyzed to determine if there is sufficient strategic sourcing for each Component?
IV. Production Process	
1	Are the production process requirements defined?
2	Are volumes requirements clear?
3	Is the Process Model(s) defined?
4	Is it feasible to meet the Proposal deadline?
5	Are process deliverables defined?
6	Did we transform all verbal info into written form?
7	Has a Non Disclosure Agreement been agreed?
8	Is the Project schedule feasible?
9	Is a Proposal Team/leader assigned?
10	Does the customer requirement match the production process know-how?
11	Have we considered input and outputs from/ to other disciplines?
12	Have similar project proposals served as a baseline?
13	Have "Best Practice" been considered?
14	Have use of "Used"/excess equipment been considered?
15	Have the potential workload been logged in resource planning estimate?
16	Is there a lessons learned report from this phase?

CP2 Checklist

CP2: DESIGN REQUIREMENT REVIEW CHECKLIST	Sheet 1
No.	**Checklist**
I. Mechanical	
1	Are Industrial Design (ID) Specifications available?
2	Has the Mechanical Product Requirements documents been completed and reviewed?
3	Has the Project Team established?
4	Is the Safety Requirements of material (i.e. Plastic) qualified?
II. Tooling	
1	Has the vendor's competency and technology been assessed?
2	Has the Project Team established?
3	Has a requirements review been conducted to review the product requirements?
4	**Vendor Track Record**
	• Delivery and Quality Performance
	• Pricing
	• Technical /Development Support
	• Existing Technology Competency
	• New Technology Milestones
5	**Internal Resources**
	• Skill and Competence
6	**Technical Feasibility to meet Production Requirement**
	• Repeatability at Mass Production
III. Hardware	
1	Is there a Hardware Roadmap/Technology available?
2	Has the Chipset selection been completed?
3	Has the Features selection been completed?
4	Has the Hardware Product Requirement Spec been defined?
5	Has the CAD Tools selection been done?
6	Has the PCB technology and stack up been defined?
7	Is the product lead free compliant?
8	Is Mechanical ID defined and available?

CP2: DESIGN REQUIREMENT REVIEW CHECKLIST	Sheet 2
No.	**Checklist**
9	Has the Project Team established?
10	Has a requirements review been conducted to review the product requirements?
11	Is the Hardware Project plan (draft) available?
12	Has the Technology selection been completed?
13	Are critical components certified and qualified?
IV. Software / Firmware	
1	Is there a Software Roadmap/ Technology available?
2	Is the software feature List & Software Requirements Spec (SRS) available and reviewed?
3	Is there a draft Software schedule available?
4	Has a feasibility study on specific requirements for new feature done?
5	Is there a draft User Interface Document (UID) available?
6	Has the Project Team established?
7	Are the Commercial Requirements Spec/ Product Requirements Spec reviewed and finalized?
8	Is the suppliers' reference solution baseline/ release roadmap defined?
9	Have Software subcontractors to support this project been selected?
V. Design Quality Assurance	
1	Is a Quality Plan completed to support the Project?
2	Has Quality Specifications been defined?
3	Has Risk Analysis been initiated?
4	Has MTBF prediction been initiated?
5	Has the Quality representatives to support the project been selected and defined in QP?
6	Has Quality requirements been reviewed in accordance to the product specs and updated in QP?
7	Roles and Responsibilities clearly communicated and understood and defined in the QP?
8	New functions and features identified and specified? (product specification document)
9	Aging Accelerated Reliability Test (ART) specified?
10	Measurement parameters and acceptance criteria updated?
11	Mechanical ART specified?

CP2: DESIGN REQUIREMENT REVIEW CHECKLIST	Sheet 3
No.	**Checklist**
12	Drop test parameters satisfy the form of the mechanical designs?
13	Mechanical Endurance ART specified?
14	Sub-tests specific to the forms, functions and features of the mechanical and hardware designs included?
15	Aggravated ART specified?
16	Special ART specified?
17	Climatic ART specified?
18	Packaging ART specified according to prior requirements requested?
19	Validation strategy specified according to the designs.
20	Exact quantities of Engineering samples required for testing defined?
21	Have the regulatory certifications for all relevant compliance test been determined?
22	Have all the validation test tools been determined?
23	Have all the validation requirement been determined?
24	Have the entire verification test requirement from other functional groups been determined?
25	Have the entire accessory requirement from Project management about Accessory Supplier been determined?
26	Project schedules for both Architectural prototype (Lab samples) and Engineering prototype builds.
27	Understood the basic design structure of this product? (Concept proposal)
VI. Material	
1	Has team analyzed materials related issues (Quality, Reliability, and Supply Chain) to minimize risks in supplier/component selections?
2	Has analysis of Field Failure Rate for customer / components / products been completed?
3	Is preliminary/budgetary priced parts list (BOM) submitted to Business Responsible?
4	Has platform components been analyzed for RoHS compliance?
5	Is Key supplier and component selection (AML) completed?
6	Are SW Licenses, royalties and IP's checked and estimates available?
7	Are Tooling estimates available?
8	Is Product Information Tracking Template completed?
9	Does a known target price exist?
10	Does customer have pre-existing supply or technology agreement for chipset(s)
11	Has the Design Group chosen a supplier that is non-strategic?
12	For unknown suppliers, has a supplier qualification / audit been completed?

CP2: DESIGN REQUIREMENT REVIEW CHECKLIST	Sheet 4
No.	**Checklist**
13	Do we have the correct technology from our Strategic Supply base?
14	Identify key component second sources or reasons why not?
15	Does the technology have Licensing, or Royalty issues? If so who and how will they be paid
16	Does the release schedule give ample time to negotiate volume pricing, terms and conditions?
17	Are purchasing contracts available for key components?
18	Do we have the authorization to buy material?
19	Is the BOM updated in the applicable project database?
20	Is the plan for long lead time tools and equipment revised?
21	Will the Strategic suppliers have the required technology available prior to High Volume Manufacturing?
22	Are key component lead times known and tied to program schedule?
23	Has a list of known platform components been generated for RoHS Material Data collection?
24	Have initial responses on RoHS hazardous substances been received on platform components from supply base?
25	Are ID and mechanical information sufficient for budgetary tooling and parts quotations and soft tools?
26	Are prototype tool suppliers identified?
27	Finalize Volume manufacturing location

CP3 Checklist

CP3: SPECIFICATION REVIEW CHECKLIST	Sheet 1
No.	**Checklist**
I. Mechanical	
1	Is the PCB Outline Layout completed?
2	Is the Detail ID Specification available?
3	Is the Mechanical Concept Document available?
4	Is an approved SLA Mock-up available?
5	Are the Key components selected?
6	Has the Design Review been completed?
II. Tooling	
1	Has supplier qualification been completed?
2	Has the technical feasibility in reference to specification been done?
3	Has the capacity planning been completed?
4	Is the budgetary tooling cost available?
5	Has the Design Review been completed?
6	Is the selected supplier a strategic supplier or preferred supplier (AVL)?
7	Is the design specification a proven technology?
8	Has RFQ been sent to supplier?
III. Hardware	
1	Has Hardware-Software Interface Document been made available?
2	Is the PCB Outline Layout available and frozen?
3	Has a Hardware Compliance Test Spec been made available?
4	Is the Industrialization Test Requirements available?
5	Is an evaluation PCB (reference design) available?
6	Is the schematics finalized?
7	Is the BOM finalized?
8	Have the components been selected and reviewed?
9	Is the PCB panelization layout available?
10	Has the Design Review been completed?
11	Is Product Compliance Report available?

CP3: SPECIFICATION REVIEW CHECKLIST	Sheet 2
No.	**Checklist**
12	Is Conducted Test Report available?
13	Is Radiated Test Report, if applicable, available?
14	Is Troubleshoot & Service Manual available?
15	Is Failure Analysis & Correction Report available?
16	Is Measurement Report for Golden Sample available?
17	Is New Components Evaluation Reports available?
18	Is Design Checklist Completed?
19	Is Change Request Form Raised?
20	Is schematic available?
21	Is Fabrication Tape-Out Available?
22	Is Assembly Tape-Out Available?
23	Is ODB++ Database Available?
24	Is Test Database Available?
25	Is Drawing Tape-Out Available?
IV. Software / Firmware	
1	Is the Software High Level Design finalized?
2	Has the UID been formally released?
3	Is the software feature List & SRS formally released?
4	Has the Project Estimations report been completed?
5	Have the Subcontractors' SOW been defined?
6	Is the Software Development Plan (including SCMP and SQAP) released?
7	Is the Acceptance Criteria available?
8	Are all software requirements reflected in the software architecture?
9	Is modularity effectively achieved?
10	Are modules functionally independent?
11	Are all modular interfaces clearly and completely defined?
12	Are data structures consistent with information supplied?
13	Are data structures consistent with requirements?

CP3: SPECIFICATION REVIEW CHECKLIST	Sheet 3
No.	**Checklist**
14	Has maintainability been considered?
15	Have efficiency and performance issues been considered?
16	Is the document layout ok (cover page, header, footer, document date, version, status etc.)?
17	Is the software architecture consistent with the software requirements?
18	Is the software requirement specifications document approved?
V. Design Quality Assurance	
1	Are the actions defined and facilitated for FMEA?
2	Are the pre-verification test results available?
3	Has the Quality team participated in the Design/ Specification Review?
4	Has the MTBF predictions been calculated in accordance to Product Design?
5	Are the quality targets (zero hour, reliability) verified?
6	All test results' non-conformities verified to ensure their validity?
7	Has the failure been identified as Hardware, Software, Mechanical and / or Manufacturing Process issue?
8	Has each failure been recorded in the Defect Tracking form with detail description?
9	Has the Defect Tracking Form identify the person responsible for the analysis of this failure?
10	Has the Defect Tracking Form define a action due date?
11	Are Test case guidelines (Checklist for System Test, Field test and Type Approval) available?
12	Are test plan (Include system test plan, Field test plan, Type Approval test plan) available?
13	Have all team members and responsibilities been determined?
14	Is the formal release of project schedule used for test planning?
15	Have the location of the test site been defined?
16	Have the project tracking and reporting mechanism been defined?
17	Have the relevant training been planned?
18	Have the validation test tool development been defined?
VI. Production Process	
1	Have we considered if any new requirements from the customer or for the product?
2	Are previous experiences from similar projects been considered?
3	Are processes and technologies from customer considered?
4	Has production site requirements been considered?

CP3: SPECIFICATION REVIEW CHECKLIST	Sheet 4
No.	**Checklist**
5	Is test concept available?
6	Is the Make/Buy analysis available?
7	Is the 3D model simulation of a complete product available?
8	Does the customer requirement match production process know-how?
9	Have we considered input and outputs from/ to other disciplines?
10	Have similar project proposals served as a baseline?
11	Have "Best Practice" been considered?
12	Have use of "Used"/excess equipment been considered?
13	Have the potential workload been logged in resource planning estimate?
14	Are product design and processing capabilities compatible?

CP4 Checklist

CP4: CRITICAL DESIGN REVIEW CHECKLIST	Sheet 1
No.	**Checklist**
I. Mechanical	
1	Is a Mechanical Part Approval available?
2	Are all the final Mechanical documents completed?
3	Have the critical dimensions indicated in the drawings
II. Tooling	
1	Have all the tools been completed?
2	Have tools and finishing buy-off done?
3	Have the tools capacity been assessed?
4	Have all Tool costs been finalized?
5	Have all the part costs been finalized?
6	Has the finalized CAD files released to supplier?
7	Are tool and part finishing finalized?
8	Is tooling budgetary cost being approved by Project Manager?
III. Hardware	
1	Electrical component approval available?
2	Electrical evaluation passed?
3	Troubleshooting Description available?
4	Repair Description available?
5	Training Documentation (for Production and Quality) available?
6	Have all new parts been approved?
7	Are the hardware reports available?
8	Are all the hardware specifications completed?
	• Schematics
	• Layout and Gerber
	• New components specifications
	• BOM available?
	• The product is conformed to the product specifications
10	Have measurement of the boards completed?

CP4: CRITICAL DESIGN REVIEW CHECKLIST		Sheet 2
No.	**Checklist**	
IV. Software / Hardware		
1	Have all software features been fully implemented?	
2	Is the Software High Level Design finalized?	
3	Has the Acceptance Test Criteria been defined?	
4	Is the Detail Design reviewed and released?	
5	Is the Integration Test Plan available and report completed?	
6	Have the subcontract design documents been created and reviewed?	
7	Has the Unit Test Plan available and report been completed?	
V. Design Quality Assurance		
1	Has FMEA been closed and all major potential risk failures been addressed?	
2	Have the verification test defect been addressed to the Design Team?	
3	Have the verification test defect action items been verified and closed?	
4	Has a Defect Tracking Report been made available?	
5	Are the quality targets as per PQS verified with the prototypes?	
6	All Potential Failure Modes have their RPN numbers reduced to less than Goal set by PD teams?	
7	Objective evidences provided with each and every closure of the respective Potential Failure Mode?	
8	All team members communicated with the FMEA completion and closure?	
9	Is the System Test Report available?	
10	Is the Field Test Report available for previous models?	
11	Have the Regulatory, Environmental & certification preparation been completed?	
12	Has the System Test plan been reviewed and available?	
13	Has the test tools been finalized & verified?	
14	Have the Test procedure completed?	
15	Have the relevant trainings been carried out?	
16	Have all the items specified in FMEA been covered in the test plan and update accordingly?	

CP4: CRITICAL DESIGN REVIEW CHECKLIST	Sheet 3
No.	**Checklist**
VI. Material	
1	Check BOM for changes since Architectural Definition
2	Will the Strategic suppliers have the required technology available prior to High Volume Manufacturing
3	Is Long Lead Time Report Created?
4	Long lead time material purchases authorized and order long lead time Material to support design validation build schedule
5	Has BOM and all known components or PCB been checked for homogeneous materials per ROHS List?
6	Have all responses on known design components RoHS hazardous substances been received from supply base?
7	Check for IP, software and Royalties in the project
8	Are CQP's (Component Quality Plan (=targets), Flow Charts, Cpk etc.) agreed with the key suppliers?
9	Are suppliers for production tooling identified and selected?
VII. Production Process	
1	Has the customer reviewed and approved the Production Process Proposal?
2	Is the Production floor system defined and requirement specified?
3	Is there a critical component list? (Moister sensitive, peak temp.)
4	Are resources secured for this phase?
5	Have we considered if any new requirements from the customer or for the product?
6	Is available information sufficient to design a fixture/tool?
7	Have fixtures/tools been identified and designed?
8	Do we have solutions for all known issues?
9	Is there an updated verification plan for production process development?
10	Is there a Quality Plan available?
11	Has the build checklist been updated?
12	Is there a lesson learn report from this phase?
13	Is the DFM action list updated?
14	Are packaging requirement specified for each component?
15	Is there a part packing list?
16	Is there an Equipment list?

CP5 Checklist

CP5: QUALIFICATION READINESS REVIEW CHECKLIST	Sheet 1
No.	**Checklist**
I. Mechanical	
1	Is a Mechanical Part Approval available?
2	Are all the final Mechanical documents completed?
II. Tooling	
1	Have all the tools been completed?
2	Have tools and finishing buy-off completed?
3	Have the tools capacity been assessed?
4	Have all tool costs been finalized?
5	Have all the part costs been finalized?
6	Has the finalized CAD files release to supplier?
7	Are tool and part finishing finalized?
8	Is tooling budgetary cost being approved by Project Manager?
III. Hardware	
1	Electrical component approval available?
2	Electrical evaluation passed?
3	PCB Layout for validation frozen?
4	Troubleshooting Description available?
5	Repair Description available?
6	Training Documentation (for Production and Quality) available?
7	All new parts have been approved?
8	Are the hardware reports available?
9	Are all the hardware specifications done? ▪ Schematics, layout and Gerber ▪ New components specifications ▪ BOM available? ▪ The product is conformed to the product specifications
10	Have Measurement of the boards completed?
11	Has the maturity Criteria been met prior to Production handover?

CP5: QUALIFICATION READINESS REVIEW CHECKLIST	Sheet 2
No.	**Checklist**
IV. Software / Firmware	
1	Has all software features been fully implemented?
2	Is the Software High Level Design finalized?
3	Has the Acceptance Test Criteria been defined?
4	Is the Detail Design reviewed and released?
5	Is the Integration Test Plan available and report completed?
6	Have the subcontract design documents been created and reviewed?
7	Has the Unit Test Plan available and report been completed?
8	Is the scope of the testing correctly identified?
9	Are the entities or roles responsible for testing described? (e.g. are independent third party organizations involved?)
10	Are information resources upon which testing will depend outlined? (e.g. requirements specifications, design specifications)
11	If appropriate, are physical resources related to testing described? (e.g. test lab, software utilities, staffing , schedule)
12	Have all the test items been identified clearly?
13	Is the testing environment identified?
14	Is the test team sufficiently trained in executing the test plan?
15	Is the test coverage sufficient to install confidence in the reliability of the product?
16	Is the test tool being used the right one?
17	Are test cases captured in test specification documents?
18	Is automation being done and if so, done in the right manner?
19	Does the test plan address abnormal conditions, which could arise during the execution of the unit/integration test?
20	Are any assumptions which may affect the execution of the plan discussed?
21	Is the Traceability Matrix available?
22	Are defects targets identified?
23	Is test estimation done and captured?
24	Is previous projects data available and used?
25	Is defect logging and tracking method identified? And who does it?
26	Are all test deliverables and responsibilities identified?
27	Are test metrics and collection mechanism identified?
28	Are product quality escalation mechanism identified?

CP5: QUALIFICATION READINESS REVIEW CHECKLIST		Sheet 3
No.	**Checklist**	
V. Design Quality Assurance		
1	Has FMEA been closed and all major potential risk failures been addressed?	
2	Have the verification test defect been addressed to the Design Team?	
3	Have the verification test defect action items been verified and closed?	
4	Has a Defect Tracking Report (e.g.: Maturity Grid) been made available?	
5	Are the quality targets as per PQS verified with the prototypes?	
6	All Potential Failure Modes have their RPN numbers reduced to less than Goal set by PD teams?	
7	Objective evidences provided with each and every closure of the respective Potential Failure Mode?	
8	All team members communicated with the FMEA completion and closure?	
9	Is the System Test Report available?	
10	Is the Field Test Report available for previous models?	
11	Have the Regulatory, Environmental & certification preparation been completed?	
12	Has the System Test plan been reviewed and available?	
13	Has the Test Tools been finalized & verified?	
14	Have the Test procedure completed?	
15	Have the relevant trainings been carried out?	
16	Have all the items specified in FMEA been covered in the test plan and update accordingly?	

CP6 Checklist

CP6: DESIGN VALIDATION BUILD REVIEW CHECKLIST	Sheet 1
No.	**Checklist**
I. Mechanical	
1	Are the Approved mechanical parts available?
2	Are the Finishing processes approved?
3	Have the related documents (e.g. Drawings, Operational Specs, etc) been completed?
II. Tooling	
1	Is the Final Sample for approval (for Production) available?
2	Have all the vendors' production processes been fixed?
3	Is Mass Production possible with Quality Consistency?
4	Are we satisfied with supplier Mass Production Process?
III. Hardware	
1	Is the Product Training for Factory completed?
2	Is the hardware report available? • Schematics and PCB Tape Out • The product is conformed to the product specifications including BOM and CAD • Reference boards available for production (10) gold samples available? • Measurement of these boards completed?
3	Is the Golden sample report available?
4	Is the Troubleshoot and Service Manual available?
IV. Software / Firmware	
1	No S severity and A bug
2	Maturity Grid < 500.
3	Is Release Matrix created?
V. Design Quality Assurance	
1	Has the Product Quality Training (Knowledge Transfer) been completed?
2	Has all the PQS requirements verified & closed?
3	Are the Ongoing Reliability Procedures (subject to Customer Requirement) available?
4	Is the Defect Management outcome fulfilling the project targets?
5	Are all Regulatory & Environmental tests passed & certified?
6	Is the Test report released?

CP6: DESIGN VALIDATION BUILD REVIEW CHECKLIST	Sheet 2
No.	**Checklist**
VI. Material	
1	Is the technical product documentation (drawings, specification) available? ▪ Contains the component specification and all relevant information for safety and environmental requirements ▪ Standards (tolerances, materials)
2	Has the second sourcing for critical & unique components been completed?
3	Have any material changes to the product been checked against the requirements in the Banned Substance List??
4	Have all components been analyzed for RoHS compliance?
5	Has the Risk Management Plan been updated
6	Does the BOM meet the price target
7	Order Material to support process validation build and pilot production

CP7 Checklist

CP7: FINAL DESIGN REVIEW CHECKLIST	Sheet 1
No.	**Checklist**
I. Mechanical	
1	Are the approved mechanical parts available?
2	Are the finishing processes approved?
3	Have the related documents (e.g. Drawings, Operational Specs, etc) been completed?
II. Tooling	
1	Is the final sample for approval (for Production) available?
2	Have all the vendors' production processes been fixed?
3	Is mass production possible with respect to quality consistency?
4	Is the supplier mass production process satisfactory?
III. Hardware	
1	Is the Product Training for Factory completed?
2	Is the hardware report available? ▪ Schematics ▪ PCB Tape Out ▪ The product is conformed to the product specifications including BOM and CAD ▪ Reference boards available for production (10) gold samples available? ▪ Measurement of these boards completed?
IV. Design Quality Assurance	
1	Has the Product Quality Training (Knowledge Transfer) been completed?
2	Has all the PQS requirements verified & closed?
3	Are the Ongoing Reliability Procedures (subject to Customer Requirement) available?
4	Is the defect management outcome fulfilling the project targets?
5	Are all Regulatory & Environmental tests passed & certified?
6	Is the test report released?

CP7: FINAL DESIGN REVIEW CHECKLIST	Sheet 2
No.	**Checklist**
V. Production Process	
1	Will the delivery dates of the fixture match the time schedule?
2	Is there a volume / month demand list from Customer
3	Is the design frozen?
4	Is the component packaging list available?
5	Are issues from Test, Material and/or Logistics taken into consideration?
6	Do the fixtures meet specifications?
7	Does the process meet the specification and requirements according to verification plan?
8	Is there an updated verification plan for fixtures and tools?
9	Is there a NPI checklist?
10	Are there solutions for all known technical & production process issues?
11	Is the Quality plan updated?
12	Is the process FMEA action list updated?
13	Is there a build report?
14	Is there a ramp up plan?
15	Are the DFM action/ tracking list updated?
16	Is each workstation well documented/ equipped?
17	Does each workstation meet all requirements (Layout, tools, instructions, time)?
18	Has the customer reviewed and approved relevant documents?
19	Is there a lesson learn report from this phase?

CP8 Checklist

CP8: SUPPLY APPROVAL REVIEW CHECKLIST	Sheet 1
No.	**Checklist**
I. Mechanical/Hardware	
1	Has RFP/REV A process been completed?
2	Are all parts and components qualified? ▪ Metrology data Parts/assemblies buy-off
3	Have all the ROHS compliance certificates obtained and documented?
II. Tooling	
1	Has Tooling details been documented?
2	Have tool qualification been completed? Metrology data
3	Have all the ROHS compliance certificates obtained and documented?
III. Material	
1	Do we have product requirement, Bill Of Materials and revision history available?
2	Do we have line items and supply base qualification reports available?
3	Have we successfully loaded the BOM in ERP?
4	Do we have ERP shortage reports and Materials Status available for all items in the BOM?
5	Has the Supply Approval sign-off been granted by Operations Program Manager?
IV. Production Process	
1	Are all issues in the part verification of the production process closed?
2	Is the line ready for pilot run?
3	Is the ramp up plan updated?
4	Any update on the test flows?
5	Is the sampling size appropriate for statistic analysis?
6	Is a validation report generated?
7	Has the process documentation been submitted to the customer and the target factory?
8	Is the process FMEA action list updated?
9	Have we updated the Quality plan?
10	Is there a build report?
11	Are actions in the NPI checklist closed?
12	Are all personnel trained to run the production process?

CP8: SUPPLY APPROVAL REVIEW CHECKLIST	Sheet 2
No.	**Checklist**
13	Is there opportunity for production process cost saving?
14	Is there a lesson learn report from this phase?
15	Are all major issues closed in the DFM action list?
16	Is packaging approved for all components?
17	Does the delivery of the fixtures/ tools meet the ramp up plan?

CP9 Checklist

CP9: LINE VALIDATION REVIEW CHECKLIST		Sheet 1
No.	**Checklist**	
I. Mechanical		
1	Are all mechanical issues resolved?	
2	Is an Approved Deviation List available and communicated to Production?	
II. Tooling		
1	Have all CP/CPK values for critical dimensions fixed?	
2	Have customers' feedback on vendors' delivery and quality performance done?	
3	What are the critical & control dimensions?	
4	Is the golden sample given to supplier for approval?	
III. Hardware		
1	Are all hardware issues resolved?	
2	Is a Approved Deviation List available and communicated to Production?	
3	Has a maintenance team been assigned?	
4	Golden Sample available?	
IV. Design Quality Assurance		
1	Have all Quality documents been acknowledged and implemented by Production?	
2	Has production quality results been made available and evaluated to find the root cause?	
3	Are the production quality targets achieved?	
4	Has the final defect management report, if applicable, been updated?	
5	Is the Process Validation Assessment Report prepared and reviewed?	
6	Are all Regulatory & Environmental tests passed & certified?	

CP9: LINE VALIDATION REVIEW CHECKLIST		Sheet 2
No.	**Checklist**	
V. Material		
1	Has the Supply Approval document been signed off?	
2	Does the term and conditions for material exist?	
3	Are cancellation lead times/windows available?	
4	Is material allocation report available, if applicable?	
5	Are the approved and latest BOM, AVL, 2nd/3rd sources and product structures loaded in the MRP?	
6	Are the latest specifications and drawings available at the site for incoming inspection and production instructions?	
7	Is the updated tooling plan with tools approval status/schedule available?	
8	Is the ECO/ECN (engineering change) process in place?	
9	Are (LOA's) letter of authorization from customer available for customer controlled/managed parts?	
10	Does the MRP plan follow customer forecast?	
11	Are the component & supplier quality plans been reviewed and updated?	
12	Is the materials post engineering plan with cost reduction/2nd & 3rd source opportunities been created?	
13	Is the lessons learnt document updated?	
VI. Production Process		
1	Has a Line validation run been performed and evaluated?	
2	Are all issues in the action list closed?	
3	Are all process FMEA actions closed?	
4	Is there any update in the PE (Post Engineering) plan?	
5	Has the customer reviewed and approved relevant documents/reports?	
6	Is the final release of the Quality plan reviewed and approved?	
7	Is there a lesson learn report from this phase?	
8	Are all DFM actions closed?	
9	Is there a Line Validation report?	

Appendix D: Templates

Appendix D1: Risk Assessment and Control Table

Risk Assessment and Control Table

Project : _____ **Customer:** _____

Date of Issue:

Distribution: _____

_____

Version History

Date	Version	Originator	Description of Change

Revision History

Date	Version	Originator	Description of Change

Approved By

Name	Signature	Date

Guidelines for Risk Assessment

1. Identify potential risk, such as risk of
   - not meeting product requirement
   - meeting regulatory requirement
   - meeting project schedule
   - not meeting target cost
   - limitation of resource or skill set
2. Describe the effect when risk becomes real.
3. Assign Occurrence Severity (S) with Table 1 as reference.
4. Identify the root cause that could lead to that potential risk.
5. Assign Occurrence Probability (P) with Table 2 as reference.
6. Tabulate Risk Value which is product of Occurrence Severity and Probability
7. Decide if control measure is necessary with Table 3 as reference. Generally, control measure will be required when Risk Value is equal or higher than 9.

Guidelines for Risk Control

1. Describe control measures to be implemented.
2. Assign owner and note date of implementation.
3. Verify effectiveness of control measures by stating the outcome.
4. Assign new value of Occurrence Severity and Probability.
5. Tabulate Residual Risk Value, if value is equal or lower than 8, risk is under controlled

Table 1

Numeric Value	Classification Level	Severity of Occurrence (S)
1	Very Low	User inconvenience
2	Low	User distraction
3	Moderate	Minor failure product usable
4	High	Major failure product unusable, no harm to user
5	Very High	Catastrophic failure, harm to user

Table 2

Numeric Value	Classification Level	Probability of Occurrence (P)
1	Very Low	Not expected to occur
2	Low	Infrequent occurrence expected
3	Moderate	Moderate occurrence expected
4	High	Likely occurrence expected
5	Very High	Routine occurrence expected

Table 3

Risk Value (SxP)	Potential Severity				
Occurrence	Very Low (1)	Low (2)	Moderate (3)	High (4)	Very High (5)
Very Low (1)	1	2	3	4	5
Low (2)	2	4	6	8	10
Moderate (3)	3	6	9	12	15
High (4)	4	8	12	16	20
Very High (5)	5	10	15	20	25

Risk Assessment Table

ID	Potential Risk	Effect	Occurrence Severity (S)	Root Cause	Occurrence Probability (P)	Risk Value (S x P)

Risk Control Table

ID	Control Measure	Owner	Implementation (wk)	Effectiveness	Occurrence Severity (S)	Occurrence Probability (P)	Risk Value (S x P)

Appendix D2: Gate Checkpoint Checklist

GCP# Gate Checklist	**Project:** <project name> **Customer:** <customer name>	Document No.	
		Rev:	

GCP# Gate Check Point Objectives:

Lead Project Site: _____ Support Project Site(s): _____ Operations Site(s): _____ Review Participants: _____ Review Date: _____ Location: _____ Copy: _____	**Project Contacts:** BDM/GAM: _____ PM(Operation): _____ PJM/PJM: _____ Lead Engineer _____			**The 'REMARKS' space is to create notes, actions, etc. for the question and explain all open or "NO" items**
	OWNER	**Yes / OK No / NOK N/A**	**DOCUMENT # or REFERENCE**	**REMARKS**
I. Contract / Business:				
II. Specification:				
III. Price/Cost:				

IV. Logistics:				
V. Environment:				
VII. Quality:				
VIII. Project:				
Gate Checkpoint Notes: Notes should include any considerations, decisions and actions that are an outcome of the GCP decision.				
NOTE 1				
NOTE 2				
Decision:				
Reviewed by: _____ *Lead Project Manager (Signature & Date)* **Approved by:** _____ *BDM/GAM (Signature & Date)*				

Appendix D3: Functional Process Checklist

TITLE: < Description > Review - < function>			Issued Date: mm/dd/yyyy Rev:	Document No. Page of	
Project:	<project name>		**Location:**		
Customer:	<customer name>		**Contacts:**		
Lead Design Center:			**PBR:**		
Support Design Center(s):			**PM:**		
Operations:			**PJM:**		
Participants:			**Lead Engineer:**		
Copy:					
			OWNER	**YES/NO/N/A**	**REMARKS**
Customer Requirements	1				
	2				
	3				
Production Requirements	1				
	2				
	3				

Regulatory Requirements	1			
Risk Mgt	1			
Mechanical	1 2			
Tooling	1 2			
NOTE 1				
NOTE 2				

Decision

	<Checkpoint name> can be passed. The project can continue as planned with changes according to remarks (as applicable).
	<Checkpoint name> cannot be passed. New <checkpoint name> after modifications.
	The project is to be brought to an end after storing <checkpoint name> gate checkpoint minutes.

Decided by:

Project Manager *Date*

Reviewed by:

Lead Engineer *Date*

Lead Engineer *Date*

* All open points have to be explained in an attachment to this checklist

Appendix D4: Project Team Member List

Team Member List for : <Project Name> **Revision :** _____ **Date of Issue :** _____

Function	<Customer>					Company				
	Name	Area of Responsibility	Phone	Mobile	e-mail	Name	Area of Responsibility	Phone	Mobile	e-mail
MANAGEMENT										
DESIGN										
INDUSTRIALIZATION										

Function	<Customer>					Company				
	Name	Area of Responsibility	Phone	Mobile	e-mail	Name	Area of Responsibility	Phone	Mobile	e-mail
SUPPLY CHAIN										
QUALITY										
LOGISTICS										
PRODUCTION										

Appendix D5: Project Feasibility Study Report

1 PROJECT OBJECTIVE

1.1 PURPOSE

<Describe the purpose of the Feasibility Study>

1.2 SCOPE

<Describe the scope of the Feasibility Study as it relates to the project>

1.3 SYSTEM OVERVIEW

<Provide a brief system overview description as a point of reference for the remainder of the document. In addition, include the following:

- Responsible organization
- System name or title
- System category
- System environment or special conditions>

1.4 PROJECT REFERENCE

<Provide a list of the references that were used in preparation of this document. Examples of references are:

- Competitor Study
- Documentation concerning related projects
- Previously developed documents relating to the project>

1.5 PROJECT CHALLENGES

<Provide a brief description of the challenges for this project and review challenges>

1.6 PROJECT BUDGET

<Define lump sum project budget. Is capital budget available?>

1.7 ACRONYMS AND ABBREVIATIONS

<Provide a list of the acronyms and abbreviations used in this document and the meaning of each>

1.8 POINT OF CONTACT

1.8.1 INFORMATION

<Provide a list of the points of organizational contact (POC) that may be needed by the document user for informational and troubleshooting purposes. Include type of contact, contact name, department, telephone number, and e-mail address (if applicable).>

1.8.2 CO-ORDINATION

<Provide a list of organizations that require coordination between the project team and its specific support function (e.g., installation coordination, security, etc.). Include a schedule for coordination activities>

2 MANAGEMENT SUMMARY

2.1 ENVIRONMENT

2.1.1 ORGANIZATIONS INVOLVED

<Identify the project sponsor, developer, user, and competitor>

2.1.2 INPUT/OUTPUT

<Identify the system input and output requirements>

2.1.3 COMPETITOR STUDY

<Provide a brief description of research performed on competitor products>

2.1.4 FUNCTIONAL OBJECTIVE

<Analyze the anticipated functions of the system, considering such areas as new features sets, increased capacity or performance…etc and target completion date>

2.1.5 PERFORMANCE OBJECTIVE

<Identify major performance objectives, considering such areas as increased productivity, reduced cost, more user friendly…etc and compliance with regulations>

2.1.6 ASSUMPTIONS AND CONSTRAINTS

<Determine the assumptions and constraints, such as operational life of the proposed system; financial constraints; availability of proven technology and operating environment>

3 RISKS

3.1 TECHNOLOGY GAPS

<Provide a list of the technology limitation in the industry that would prevent the successful implementation of the product. Examples of technology gaps are:

- Manufacturing Methods
- Material
- Components>

3.2 SKILL GAPS

<Provide a list of the resource or skills sets limitation that would prevent the successful implementation of the product. Examples of skills gaps are:

- Relevant Experience
- Relevant Knowledge base>

4 DESIGN SOLUTION

4.1 DESCRIPTION OF PROPOSED SOLUTION

<Present the overall system concept and describe how the requirements will be met>

4.2 IMPROVEMENT AND CUSTOMER EXPECTATION

<Describe the improvement of the system in terms of the objectives. Summarize how the design and functionality of the solution meets or exceeds customer expectations>

4.3 TIME AND RESOURCE COSTS

<Outline the time and resource costs, including the time and funding required for all activities of the product development cycle. It is imperative to use realistic estimates. When making the estimates, remember to include such factors as the current workload of the personnel, staff absences due to vacation and illness, lead time for procurement of equipment and software, and staff training >

5 RECOMMENDATIONS

<Conclude the report with recommendations>

Appendix D6: Design Requirement Document

Customer Name:	<Customer Name>	**Our Contact:**	<Contact Name>
Customer Contact:	<Contact Name>	**Contact Number (direct):**	<Contact Direct Phone>
Contact Number(s):	<Customer Direct Phone>		
Main	<Customer Main Phone>		
Fax	<Customer Fax Phone>		

DESIGN REQUIREMENT

PROJECT NAME:

<INSERT PROJECT NAME HERE>

1 REFERENCE DOCUMENT(S)

1.1 DESIGN REQUIREMENT CHECKLIST

<*Document number*>

1.2 PRELIMINARY ELECTRICAL SPECIFICATIONS

<*Document number*>

2 INTRODUCTION

<*Introduction*>

3 DESIGN REQUIREMENT

3.1 DESIGN REQUIREMENT CHECKLIST

- Block diagram

- Power requirement

  <*details*>

- I/O

  <*details*>

- Others

  <*details*>

3.2 ENVIRONMENTAL REQUIREMENT

- Temperature and humidity

  <*details*>

- Shock and vibration

  <*details*>

- Altitude

  <*details*>

3.3 REGULATORY REQUIREMENT

- EMC

  <*details*>

- Safety

  <*details*>

- Other regulatory requirement

  <*details*>

3.4 QUALITY REQUIREMENT

- Lifetime

  <*details*>

- MTBF

  <*details*>

4 STRATEGY

4.1 DESIGN

<*details*>

4.2 TOOLING

<*details*>

4.3 ASSEMBLY

<*details*>

4.4 SOURCING AND QUALIFICATION

<*details*>

4.5 SHIPPING & HANDLING REQUIREMENT

<*details*>

5 RECOMMENDATIONS

<*Recommendations*>

6 CONCLUSION

<*Conclusion*>

7 APPENDIX

<*Attach any appendix*>

Appendix D7: Assignment Specification

Project Definition Document

Introduction

This document presents a definition of the <Project Name> project. It includes the following sections:

- Project Objective Statement
- Assumptions
- Major Deliverables -- Definitions
- Major Deliverables -- Target Dates
- Flexibility Matrix
- Project Core Team Roster
- Major Risks
- Key Operating Principles
- Appendices

When finished, the data in this document represents acknowledgment of the target parameters of the project, and is a commitment to achieving those parameters. Together with the optimized project schedule plan, this Project Definition Document represents the project baseline. All changes will be applied to this baseline through the Change Management process.

Project Objective Statement

The project objective statement for the <Project Name> Project is shown below.

Create, validate, and … by July 1, 2000 for 12 FTE.

Project Definition

1. Success Criteria

In order to be successful, the <Project Name> Project will need to meet a number of key business objectives and success criteria including:

- <key success criteria>
- <key success criteria>

A complete list of project success criteria can be found in Appendix II.

2. Major Deliverables

There are five major deliverables for this project. Each of these deliverables is described below. A complete definition for each deliverable, in the form of an Is/Is Not List, can be found in Appendix III.

D1:

Write a short description of deliverables for this major deliverable.

D2:

Write a short description of deliverables for this major deliverable.

D3:

Write a short description of deliverables for this major deliverable.

D4:

Write a short description of deliverables for this major deliverable.

Major Deliverables – Target Dates

The following are the target dates for major deliverables. They will not be confirmed until the detailed, integrated project plan is completed, optimized and validated by the <Project Name> Project sponsor.

Major Deliverable	Target Date
D1:	
D2:	
D3:	
D4:	

For a detailed schedule of this project and the Microsoft Project Work Breakdown Structure file, see Appendix I.

Flexibility Matrix

	Least Flex	Mod Flex	Most Flex
Scope			✓
Schedule	✓		
Resources		✓	

For the <Project Name> Project:

- *Schedule* is least flexible since …
- *Resources* are moderately flexible because …
- *Scope* is most flexible because …

Project Core and Extended Team Roster

The following three tables summarize the Core Team membership, roles and responsibilities for the <Project Name> Project.

Name	Role	E-mail	Phone	Fax

Assumptions

A preliminary risk analysis identified the following “high” risks to the success of the project:

-
-

A complete list of project risks and associated risk management plans can be found in Appendix IV.

Major Risks

A preliminary risk analysis identified the following “high” risks to the success of the project:

-
-

A complete list of project risks and associated risk management plans can be found in Appendix IV.

Key Operating Principles

This section contains key operating principles for the project. For a complete summary of all operating principles, see Appendix V.

1. **Change Management**

A change to the Project is defined as any proposed work that cannot be associated with a numbered task in the validated project plan or any change to the detailed deliverable definitions (Is / Is Not Lists). The standard change management process will be used.

2. **Issues/Action Item Tracking**

The standard issues/action item tracking process will be used. Issues lists will be provided as part of regular status reporting.

3. **Escalation Process**

The escalation process will be:

-

4. **Tracking and Managing**

A written status report on activity will be provided to the management sponsor biweekly. It will include, at least: reporting against the plan and any new issues that have arisen.

Appendix I – Project Schedule

<Project Schedule>

Appendix II - Success Criteria

Includes	*Doesn't Include*
♦	♦
♦	♦
♦	♦
♦	♦
♦	♦
♦	♦
♦	♦
♦	♦
♦	♦
♦	♦
♦	♦

Appendix III – Detailed Deliverable Description (Is / Is Not Lists)

D1

Is	*Is Not*
♦	♦
♦	♦
♦	♦

D2

Is	*Is Not*
♦	♦
♦	♦
♦	♦

D3

Is	*Is Not*
♦	♦
♦	♦
♦	♦

D4

Is	*Is Not*
♦	♦
♦	♦
♦	♦

Appendix IV – Risk Management Plan

<Risk Management Plan>

Appendix V – Team Values and Operating Principles

1. Team Values

Values that have been defined as important to the team include:

-
-

2. Operating Principles

<The project manager, along with several team members, should review the "Project Framework Checklist" to establish clear operating principles for the project. These framework decisions should be reviewed and agreed to by the entire project team and then documented in this section.>

Appendix D8: Non Disclosure Agreement (ODM version)

NONDISCLOSURE AGREEMENT

[FILL IN BLANKS AND MODIFY PARA 1 AS APPROPRIATE]

_____(name of company)_____ of ____(city)____, ___state)____ and _____(name of company)_____ of ____(city)____, ___state)____, enter into this agreement with the intent to exchange certain information with each other, and in consideration for said exchange agree as follows:

1. Each party (the "receiving party") agrees that it shall use any proprietary information disclosed by the other party (the "disclosing party") under this Agreement only [to evaluate the parties' technology for commercial applications.] OR [to pursue or evaluate a business relationship between the parties.] OR [to negotiate and discuss design consultation] OR ["anything else more specific you want to describe"]

2. The receiving party shall not disclose any proprietary information disclosed to it by the disclosing party to anyone other than employees or authorized representatives of the receiving party who have a need to know the information in connection with the purpose described in paragraph 1 and who have signed confidentiality agreements or are otherwise bound by confidentiality obligations at least as restrictive as those contained herein. The receiving party shall exercise the same degree of care to prevent disclosure of any proprietary information received from the disclosing party hereunder as it takes to preserve and safeguard its own confidential information but, in any event, no less than a reasonable degree of care. In the event of any loss or improper disclosure of the proprietary information, the receiving party shall promptly notify the disclosing party.

3. The existence, terms and conditions of this Agreement are confidential and shall not be disclosed by the Parties to any third-party without the other party's prior written consent. The obligations of the receiving party with respect to the proprietary information contained in this Agreement shall, unless specifically released earlier by the disclosing party in writing, extend for a period of three (3) years from the date on which such proprietary information is disclosed.

4. This Agreement shall terminate one (1) year after the effective date of this Agreement, except for the obligations of the parties hereto with respect to proprietary information received prior to such termination which shall survive such termination.

5. No rights or obligations other than those expressly provided for in this Agreement shall be implied from this Agreement. Nothing herein contained shall in any way affect the present and prospective rights of the parties under the patent laws of any country, or be construed to (i) grant to the receiving party a license under any present or future patent, patent application, trade secret or trademark related to the proprietary information of the disclosing party or (ii) restrict in any way the marketing of any product or merchandise of the receiving party unless such marketing will constitute a breach of this Agreement by the receiving party.

6. This Agreement shall be binding upon and inure to the benefit of the parties hereto and their respective successors, assigns and legal representatives. Neither party shall have the right to assign or otherwise transfer its rights or obligations under this Agreement except with the prior written consent of the other party, not to be unreasonably withheld. Notwithstanding the foregoing, ODM may assign some or all of its rights and obligations under this Agreement to an affiliated ODM entity.

7. This Agreement shall be governed by and interpreted in accordance with the laws of the state of xxxxx; any disputes under this Agreement shall be subject to the exclusive jurisdiction and venue of the xxxxx state courts and the Federal courts located in xxxxx, and the parties hereby consent to the personal and exclusive jurisdiction and venue of these courts.

8. IN THE EVENT OF ANY DISPUTE BETWEEN THE PARTIES, WHETHER IT RESULTS IN PROCEEDINGS IN ANY COURT IN ANY JURISDICTION OR IN ARBITRATION, THE PARTIES HEREBY KNOWINGLY AND VOLUNTARILY, AND HAVING HAD AN OPPORTUNITY TO CONSULT WITH COUNSEL, WAIVE ALL RIGHTS TO TRIAL BY JURY, AND AGREE THAT ANY AND ALL MATTERS SHALL BE DECIDED BY A JUDGE OR ARBITRATOR WITHOUT A JURY TO THE FULLEST EXTENT PERMISSIBLE UNDER APPLICABLE LAW.

9. In this Agreement, the term "proprietary information" means any information disclosed for the evaluation or discussion contemplated hereby, that the disclosing party owns or otherwise controls, except information which:
   a. is already known to, or independently developed by, the receiving party;
   b. is already publicly available or becomes publicly available without a breach of this Agreement by the receiving party;
   c. is lawfully received by the receiving party from a third party;
   d. is not either (i) disclosed in writing and identified thereon as confidential or proprietary, or (ii) if first disclosed orally, identified as confidential or proprietary at the time of oral disclosure and so confirmed in writing within thirty (30) days after such oral disclosure;
   e. becomes known to the receiving party by examining a product or merchandise made publicly available by the disclosing party; or
   f. is required to be disclosed by law or a valid order by a court or other governmental body, provided that the receiving party provides the

disclosing party with prior written notice of such disclosure in order to permit the disclosing party to seek confidential treatment of such information.

10. Upon written request of the disclosing party or termination of this Agreement, the receiving party shall promptly return to the disclosing party all the proprietary information disclosed by the disclosing party.

11. This Agreement contains the final, complete and exclusive agreement of the parties relative to the subject matter hereof, and supersedes all prior and contemporaneous understanding and agreements relating thereto.

The parties hereto, intending to be legally bound hereby, have caused this Agreement to be duly executed as of the later date written below.

____(Company Name)_____	**____(Company Name)_____**
Signed:	Signed:
By:	By:
Title:	Title:
Date:	Date: