Mapping OGC-PRINCE 2 to SEI-CMMI 1.1

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Final Approval

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A dissertation submitted to the
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for the award of the degree of
MS (Software Engineering)

DEDICATED TO

MY DEAREST FATHER

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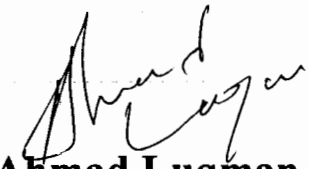

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Project in Brief

Project Title:	Mapping OGC-PRINCE 2 to SEI-CMMI 1.1
Objective:	Develop an assessment of transformation from Planning Process of OGC-PRINCE 2 to Project Planning of SEI-CMMI 1.1.
Undertaken By:	Ahmad Luqman, Fida Hussain
Supervised By:	**Prof. Dr. S. Tauseef-Ur-Rehman** Head (Telecommunication Engineering) Federal Urdu University of Arts, Science & Technology, Islamabad.
Technologies Used:	Microsoft®. Net Framework
System Used:	Dell Latitude D600 Laptop
Operating System Used:	Microsoft® Windows XP Professional Service pack II
Date Started:	26th January, 2005
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8 Dec 05	Architecture Styles	Software Architect
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Abstract

Mapping of Central Computing and Telecommunications Agency (CCTA) / Office of Government Commerce (OGC) - Project IN Controlled Environment (PRINCE) Version 2 a United Kingdom based standard to Software Engineering Institute (SEI)–Capability Maturity Model Integration Version 1.1 a United State of America based standard. Organizations concerned with PRINCE 2 certification often question its overlap with the CMMI 1.1. This analysis report will provide answers to some common questions about the comparisons and mapping of these two USA and UK standards.

Preface

This report describes the mapping between OGC-PRINCE 2 to SEI-CMMI 1.1. It consists of seven chapters along with few appendices. First chapter describes the introduction of this research with literature survey. Second chapter is all about PRINCE 2 and same to previous, chapter three briefly describes the CMMI 1.1. Chapter four discusses the mapping technique in detail. Where as, fifth chapter elaborates selected software architecture. Chapter 6 deals with functionality and user's manual. In last chapter, we discus the conclusion and expected future enhancements.

Appendices include publication, case studies and bibliography.

Abbreviations

CCTA	Central Computing and Telecommunications Agency
OGC	Office of Government Commerce
PRINCE	PRoject IN Controlled Environment
SEI	Software Engineering Institute
SW	Software
CMMI	Capability Maturity Model Integration
PL	Planning
PP	Project Planning
PM	Project Management
KPA	Key Process Area
CM	Configuration Management
CMU	Carnegie Mellon University
FTR	Formal Technical Reviews

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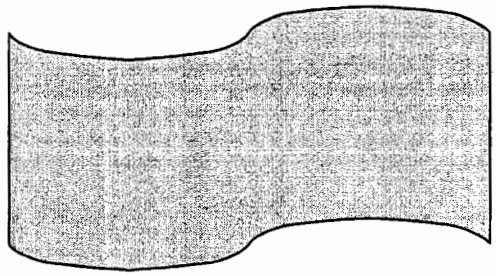
Chapter 1



INTRODUCTION

1. Introduction

More now than ever, companies today want to deliver products better, faster, and cheaper. At the same time, in the high-technology environment of the twenty-first century, nearly all organizations have found themselves building more and more complex products. Today, a single company usually does not develop all the components that compose a product. Organizations must be able to manage and control this complex product development and maintenance.

Many organizations have also found themselves in the software business. Organizations that were not typically software companies-such as financial institutions, car manufactures, airplane manufactures, and insurance companies – find that much of their business relies on software. Software is often what differentiates them from their competitor's .The problems these organizations address today involve both software and systems engineering. More and more, these disciplines are becoming a critical part of their business. In essence, these organizations are product developers that need a way to manage an integrated approach to their software and systems engineering as part of reaching their business objectives.

1.1 Process Management

Product development process means that product is submitted on time, within allocated budget and with the capabilities expected by the customer. Unfortunately this goal is not achieved by most organizations and persons (team). However, a properly managed project in a standard environment can consistently achieve this, and software engineering is no exception. Thus success is the product of only three abstract variables a properly managed project, a competent manager, and a mature standard environment [13].

The concepts of a mature software engineering environment are easily described in comparison with an immature environment. In the area of processes, an immature environment's processes are ad hoc (or chaotic) and the individual projects are independently defining and improving their processes, resulting in unrelated processes and metrics from project to project. This environment lends itself to poor and often optimistic project cost and schedule estimates because these estimates are usually not based on quantifiable historical data. Product quality will be inconsistent across projects and may not be improving over time. Process improvement will be limited at best and usually will not take place across an organization. This lack of coordination and communication of corporate knowledge produces an organization that may have concurrent successful and unsuccessful projects.

An immature software engineering environment offers little support from the organization, which means that project success must solely rely on the skills, talent, & heroic efforts of the personnel on the project. A chaotic environment forces the

manager to be reactive to problems as they occur, because the process feedback is unavailable. This information vacuum severely limits their ability to control and mitigate the risks associated with a project. This absence of information further inhibits an organization from improving by not providing the historical documentation needed. This fire fighting method of management may be useful in the short run to solve immediate problems, but results in a myopic short term perspective which doesn't promote the efficient use of resources. Replacing people requires a long learning curve in training personnel before they are fully able to contribute to the project.

1.1.1 Process Documentation

Process documentation provides a practical approach to managing and preparing the documentation necessary for implementing any system.

Now here question arises that why process documentation is necessary? The answer is that most of the process-oriented methodologies are meant to record programs as they occur and feed the information back to managers, other researchers, and policy makers to help them in understanding the working of the project better. However there are several other purposes, equally important, for which processes are sought.

Process documentation is very necessary because many organizations or IT companies develop excellent processes but fail to document them adequately. After an initially successful implementation of the process, many of these procedures go unused due to lack of documentation, particularly as new staff members who are unfamiliar with the process attempt to use it. Now it is important to mention some of the characteristics of process documentation, these are:

Ownership rates the degree to which the three key ownership roles—process owner, documentation custodian, and technical writer—are clearly identified, understood, and supported.

Readability rates the clarity and simplicity of the written documentation. This characteristic especially looks at how well the level of the material matches the skill and experience level of the audience.

Accuracy rates the technical accuracy of the material.

Format rates the overall organization of the material; how easy it is to follow; how well it keeps a consistent level of technical depth; and to what degree it documents and describes an actual process.

Effectiveness rates the overall usability of the documentation.

Accountability rates to what degree the documentation is being read, understood, and effectively used; all appropriate users are identified and held accountable for proper use of the documentation.

1.2 Project Management

PRINCE defines a project as;

`A management environment that is created for the purpose of delivering one or more business products according to a specified Business Case'

Projects are sub-divisions of programs & composed of tasks, sub-tasks, deliverables, activities and milestones.

Project failures are too common – some make the headlines, but the vast majority quickly forgotten. The reasons for failure are many and varied. Some common causes are [11];

- Insufficient attention to checking that a valid business case exists for the project.
- Insufficient attention to quality at the outset and during development.
- Insufficient definition of the required outcomes, leading to confusion over what the project is expected to achieve.
- Lack of communication with stakeholders and interested parties, leading to products being delivered that are not what the customers wanted.
- Inadequate definition and lack of acceptance of project management roles and responsibilities, leading to lack of direction and poor decision making.
- Poor estimation of duration and costs, leading to projects taking more time and costing more money than expected.
- Inadequate planning and co-ordination of resources, leading to poor scheduling.
- Insufficient measurable and lack of control over progress, so that project's do not reveal their exact status until too late.
- Lack of quality control, resulting in the delivery of product, which is unacceptable or unusable.

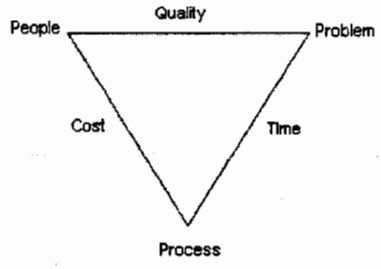
Without a project management method, those who commission a project, those who manage it and those who work on it will have different ideas about how things should be organized and when the different aspects of the project will be completed. Those involved will not be clear about how much responsibility, authority and accountability they have and, as a result, there will often be confusion surrounding the project. Without a good project management method, a project is rarely completed on time and within acceptable cost and this is especially true for large projects.

A good project management method will guide the project through a controlled, well-managed, visible set of activities to achieve the desired results.

1.3 Quality Management

Quality management reflects the idea that before your organization builds or creates a product, service, or process; ensures that it meets the highest quality standards. Process improvement has proven to increase product and service quality as organizations apply it to achieve their business objectives. The traditional quality standard for organizations is ISO9000 and there are a growing number of people aware of the benefits of ISO.

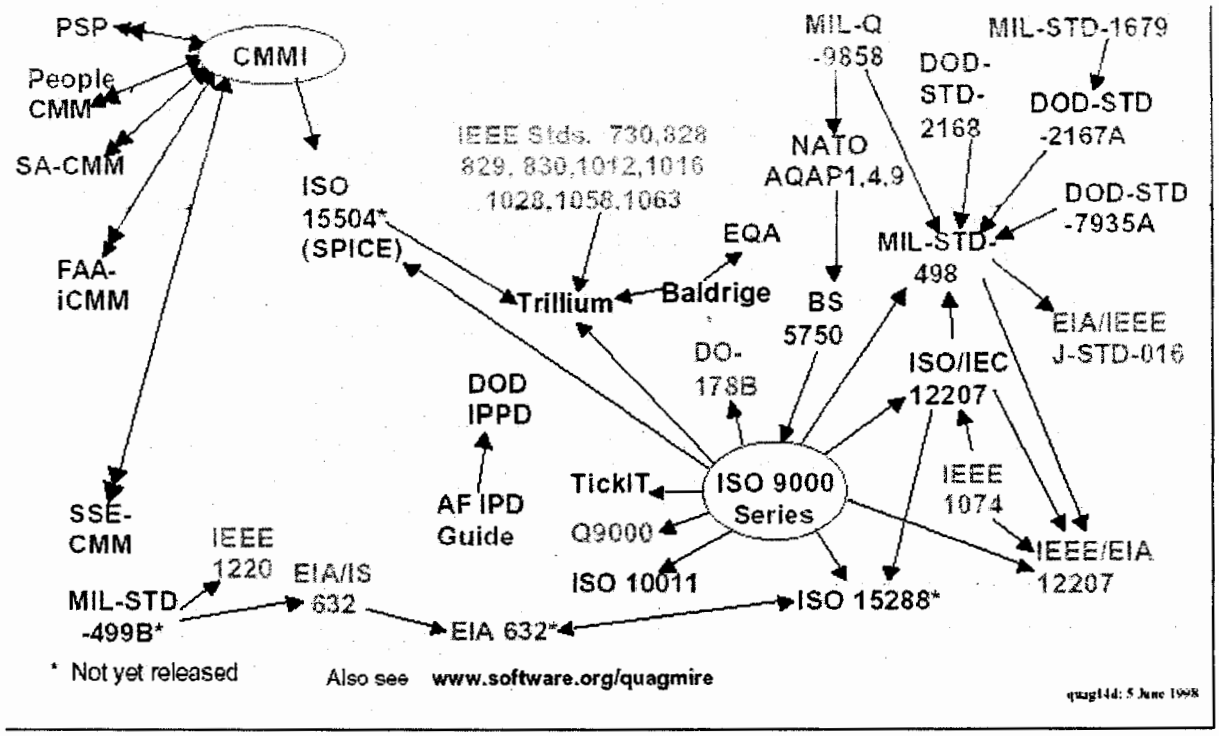
The quality of a product is largely determined by the quality of the process [W4] (Fig. 1.1) that is used to develop and maintain it.



3-P (Fig 1.1)

1.4 Standard

A standard provides a place to start the benefit of a community's prior experiences. It is a common language and a shared vision of a framework (Fig. 1.2) for prioritizing actions [w1].



Leading Standards (Fig. 1.2)

In the current marketplace, there are maturity models, standards, methodologies, and guidelines that can help an organization improve the way it does business. However, most available improvement approaches focus on a specific part of the business and do not take a systemic approach to the problems that most organizations are facing

1.5 Mapping

It is always difficult to determine the appropriate granularity of maps between models. Mapping at a high level may not provide enough insight into similarities and differences. Mapping at a very low level, on the other hand, results in an overwhelming number of connections that also fails to properly illuminate model correspondence [12].

The map thus serves as an indicator of correspondence rather than as an implementation guideline. A good mapping is two way, meaning you could either look at an activity in a process and see what model practices this activity fulfills, or you could look at a practice in a model and see where these are included as activities in the organization's processes.

Mapping between models should be able to highlight practices in one of the model that were not well covered in the second model. Concentrate on these gaps and address them on a case-by-case basis.

1.6 Literature Survey

David Wilson defines the aim of mapping is how to leverage the similarities to benefit and accelerate your improvement efforts [1]. Mapping is intended to be used as a tool for reviewing and analyzing existing process documents to ensure that they are consistent with the CMM or as an aid in designing new process documents that are consistent with the CMM. It is not a "how-to" guide for reaching higher maturity levels. And it does not constitute process definition training, and it does not specify a method for defining a process [2].

Paul Solomon et al have defined a strategy of mapping tables which is, used to develop instruments that will provide evidence to an appraisal team to enable it to quickly verify and validate specific practices based upon effective implementation [3]. However, other effort lacks the implementation part.

An early effort by James McHale et al links mapping (also known as a gap analysis), involved with process improvement and appraisal efforts that can more easily determine how well the organization or a particular project is implementing the TSP (Team Software Process), how well projects using TSP might rate with respect to CMMI, and where and how to fill any gaps in CMMI coverage [4].

An industry work in this regard is that of Boris & Harvey where weight factor has been considered. Each ISO-9001 "shall" statement has been mapped to a CMMI practice, using only the most prominent correspondence. If an ISO "shall" statement strongly maps to a CMMI specific practice, they do not indicate mappings to other specific practices that may show some weaker correspondence. The map thus serves as an indicator of correspondence rather than as an implementation guideline 12]. Sarah et al further develop these effort for adding new practices to the set of standard organizational processes, or even adding a few new processes, is easier than establishing an organization-wide process infrastructure in the first place [6].

Weight is assigned to each scenario in terms of its relative importance to the success of the system. The weighting ties back to the business goals supported by a scenario or other criteria like costs, risks, time to market, and so on. Based on this scenario weighting can be proposed an overall ranking if multiple architecture are compared [7]. The proposed scheme, called "level comparison weighted combining", is simplified in a manner that its weighting factor for each branch is generated from hard-decision results of comparing signal among the branches [8].

The SW-CMM v2.0 draft C has been merged with the SE-Capability Model and with the Integrated Product Development CMM v0.98 to form the CMMI [9]. Federal Aviation Authority released the FAA Integrated Capability Maturity Model (FAA-iCMM) in 1997 to unify its process improvement efforts [10].

PRINCE 2 does not include every aspect of project management. For example, team selection, motivation, and contract management is not part of the method but are

often critical to the success of projects. Effective project management relies on an effective planning and control process [11]. This adds greater complexity towards mapping with a great model like CMMI.

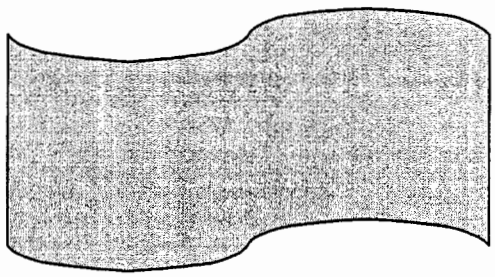
1.7 Objective

The Capability Maturity Model Integration (CMMI) version 1.1, developed by the Software Engineering Institute (SEI), USA and the PRoject IN Controlled Environment (PRINCE) version 2 developed by Central Computing and Telecommunications Agency (CCTA) now Office of Government Commerce (OGC) as UK Government standard for IT Project Management, share a common concern of Project management by proper process management. Both are driven by similar concerns and intuitively correlated. Organizations concerned with PRINCE 2 certification often question its overlap with the other leading standards. We have looked into OGC PRINCE 2 process / components and map it to the different goals / practices in the SEI CMMI 1.1. Analysis provides the comparisons and mapping of these standards in planning area. In order to achieve good mapping there is a need to follow proper case studies. These metrics needs to be implemented on each and every Practice.

One should keep in mind that this is a one-to-one (most relevant) mapping, meaning that one PRINCE 2 sub-process correspond to one CMMI 1.1 specific practice. As with all mappings, it is relative. In Mapping, we are using traditional approach for cross-reference of mentioned standards. A judgment of the strength of the correspondence is shown as; S – Strong match; M – Medium match; W – Weak match [Details are discussed in chapter-4].

Resultant map will serve as an indicator of correspondence between the Planning Process of PRINCE 2 to Project Planning of CMMI 1.1, rather than as an implementation guideline.

Chapter 2



PRINCE

2. PRINCE

PRINCE, PRoject IN Controlled Environment is a structured method for effective project management covering the organization, management & control of projects. PRINCE was developed by the Central Computer and Telecommunications Agency (CCTA) now the Office of Government Commerce (OGC) in 1989 as a United Kingdom government's de facto standard for IT project management.

Since its introduction, PRINCE has become widely used in both the public & private sectors and is now the UK's de facto standard for project management. Although PRINCE was originally developed for the needs of IT projects, the method has also been used on many non-IT projects.

In Australia, a professional accreditation system for PRINCE has been set up in-line with and supported by the England PRINCE accreditation system. It is now spread to Europe and the rest of the world.

2.1 History and Background

The PRINCE Methodology is a development of the **PROMPT** (Project Resource Organization Management Planning Technique) methodology originally formulated in the 1975.
A private sector company, Simpact Systems Limited, evolved the PROMPT methodology to provide a suitable framework within which to manage the strategy, feasibility study, development and support of information technology systems through a structured project management approach [S1].

The PROMPT methodology comprised five major components;
- PROMPT I – Strategic Planning
- PROMPT II – System Development
- PROMPT III – Operations Maintenance
- Q-STAR Quality Assurance
- PROMPT Software Support Tools (The PROMPT Aids).

In the early 1980s, the UK government published a requirement for a project management method to improve the management and control of government IT projects. Many different methods were proposed and evaluated, and the contract to license the use of the method was awarded to Impact Systems Limited. CCTA acting for the UK government commissioned some changes in the basic methodology. Chief amongst these was the incorporation of the quality assurance aspects into the PROMPT II methodology to provide a product that was to become referred to as government PROMPT. Although CCTA licensed all the PROMPT methodology, PROMPT II was the only element fully implemented [S1].

The belief was that government departments were already well supported in the production of strategic plans, and that maintenance and enhancements aspects would be easily handled provided development systems were properly supported by development and quality

assurance documentation. PROMTP II was therefore considered to be the key ingredient for success. Government PROMPT, incorporating PROMPT II principles only was introduced in the major UK Government.

Government PROMPT had a number of deficiencies form the start; for instance, a pre-defined lifecycle provided the backbone for a PROMPT II project, but this caused some problems with its view that IT projects broke down into six standard stages of work addressing Initiation, Speciation, Design, Development, Installation and Operation. Many projects did not conform to these formula and inconsistencies were encountered.

The PROMTP II method made no mention of project managers, instead relying on a series of stage managers, each responsible for a pre-defined stage within the standard six stage lifecycle. The philosophy was that this left the way open to appoint the most appropriate individual to manage each stage of the project. The specification stage managed by a user/customer, the design stage by a designer/analyst, the development stage by a technical programmer and the installation and operation stages by user/customers. The initiation stage was typically managed by someone with sufficient technical expertise to understand and plan the whole of the project.

The government PROMPT methodology also made no mention or use of Critical Path Analysis, which was (and still is), used extensively in major projects. In practice these omissions did not because real problems as training courses and consultancy support filled the gaps. However this methodology was perceived as being not quite complete, or indeed, relevant to many projects.

During 1987, CCTA determined to update the methodology by reflecting the actual usage of PROMPT II and by introducing modern project management ideas. These elements were Product-based planning, formal Project Initiation procedures, a Project Manager role, sharper focus on quality Management, and open life-cycle planning. CCTA were keen to place the enhanced method into the public domain, as an open method, in order to enable suppliers of major IT systems (and their component parts) to adhere to consistent standards when fulfilling UK government contrasts. The overall objective was to provide a high level of consistency throughout government projects and to improve project management generally [S1].

Meanwhile, LBMS (Learmonth & Burchett Management Systems) a major management consultancy company, who had developed SSADM (Structured Systems Analysis and Design Methodology) under a CCTA contract, had acquired the PROMPT products and name form Simpact Systems (which had ceased its commercial operations) and was licensing the methodology successfully to the public and privet sectors. LBMS obviously could not agree to an enhanced version of PROMPT II being placed in the public domain direct competition with their own proprietary method, and negotiations provided that the enhanced method is re-named **PRINCE** to meet this point.

PRINCE was introduced in April 1989 with full documentation and formal entry in to public domain the January 1990. CCTA, with its collaborative partners (the Association for Project

Management-APM group , IBM UK limited , and stationery office-OGC) continues to pursue the acceptance of PRINCE as best practice project management with in the UK, Europe and worldwide.

PRINCE 2 was funded by CCTA for two years. PRINCE 2 is Process-driven (i.e. "what" and "why" but little in the way of "how") addresses a wider base of projects (IT and not-IT), programs of work, smaller projects, customer-supplier issues & introduces changes to the PRINCE version 1 organization component.

PRINCE 2 was formally launched by CCTA in London on 1st October **1996**. CCTA are working in collaborative partnership with number of organizations (IBM, UK, the stationery office & the APM) to promote PRINCE. One of the partners, IBM has developed software support product based on their existing process integrator application, which provides a full PRINCE environment enabling the launch of specific software for planning word-processing and other office applications. The package is particularly useful for managing the myriad of project documentation that has to be created, updated, tracked and managed during the life of a project.

Future plans include companion volumes covering the softer aspects of project management (leadership, delegation, appraisal etc.) and program management, risk management and possibly implementation.

2.2 PRINCE® 2

PRINCE is based on the experiences of scores of projects, project managers and project teams, who have contributed, some from their mistakes of omissions, others from their successes & it was designed to enhance the method towards a completely generic, best practice approach.

PRINCE 2 adopts the principles of good project management to avoid the problems and so helps to achieve successful projects. These principles are;

A project is a finite process with a definite start and end

Projects always need to be managed in order to be successful

For genuine commitment of the project, all parties must be clear about why the project is needed, what it is intended to achieve, how the outcome is to be achieved and what are their responsibilities in that achievement.

PRINCE 2 is a process-based approach to project management providing an easily tailored and scaleable method for the management of all types of projects. Each process is defined with its key inputs and outputs together with the specific objectives to be achieved and activities to be carried out. It describes how a project is divided into manageable stages enabling efficient control of resources and regular progress monitoring. The various roles and responsibilities for managing a project are fully described and are adaptable to suit the project's size and complexity and the skills of the organization.

Driving any PRINCE 2 project is the business case, which describes the organization's justification, commitment and rationale for the deliverables or outcome. The business case is reviewed regularly during the project so as to ensure the business objectives, which often change during the lifecycle of the project, are still being met.

PRINCE defines a project as;

> *'A management environment that is created for the purpose of delivering one or more business products according to a specified* Business Case*'*

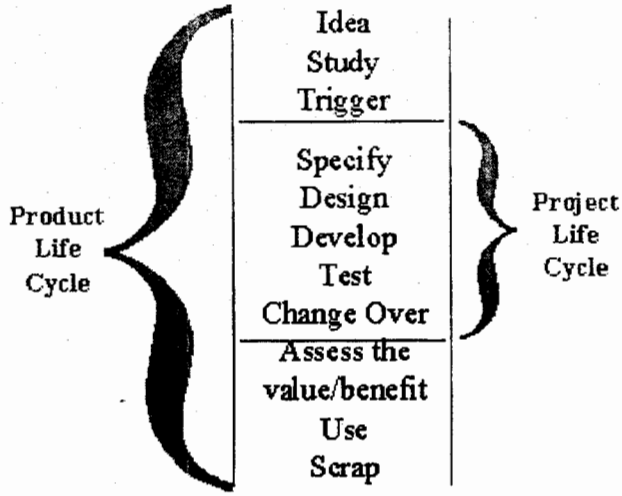
Another definition of a project might be

> *'A temporary organization that is needed to produce a unique and pre-defined* Outcome *or result at a pre-specified time using predetermined resources'*

A PRINCE project, therefore, has the following characteristics;

A finite and defined lifespan
Defined and measurable business products
A corresponding set of activities to achieve the business products
A defined amount of resources
An organization structure that defined responsibilities to manage the project.

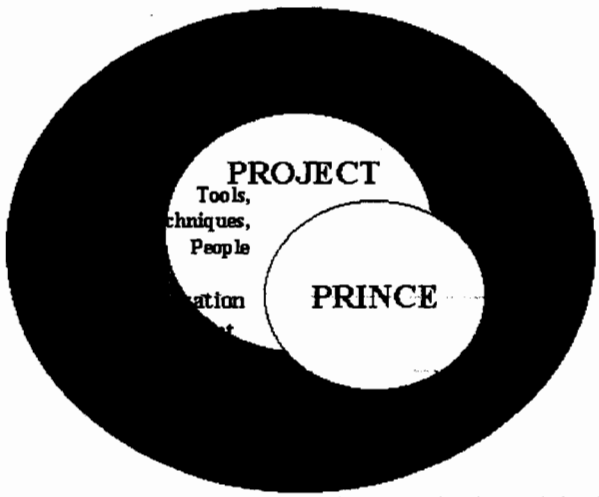
Each project falls within a specific business context. A project may be stand-alone, it may be one in a sequence of related projects, or it may form part of a program or corporate strategy. A project, by its nature, is a temporary structure, created to achieve a specified business benefit or objective. When the work has been completed, the project is disbanded. A project has a life cycle, which is the path and sequence through the various activities to produce the final product. The term 'life cycle' is also used to describe the life of a product. Figure 2.1 shows how a **product life cycle** might start from the initial idea or conception, through to the operation of the product, finishing with the eventual scrapping of the product when it comes to the end of its usefulness. The project life cycle covers the tasks of specifying and designing a product, through to its testing and hand-over into operational use. PRINCE covers the **project life cycle** plus some pre-project preparation.



Product and project life cycles (Fig. 2.1)

Figure 2.2 shows where PRINCE fits into a business and project environment. PRINCE 2 is not intended to cover all subjects relevant to Project Management. The Project Management techniques and tools needed; will vary according to the project type and the corporate environment. There are also certain aspects of Project Management that are well covered by existing and proven methods and are therefore excluded from PRINCE. Examples of these aspects are:

People management techniques such as motivation, delegation and team leadership
Generic planning techniques such as Gantt Charts and Critical Path Analysis
Risk management techniques
The creation and management of corporate Quality management and Quality assurance mechanisms
Business Case management, budgetary control and earned value analysis



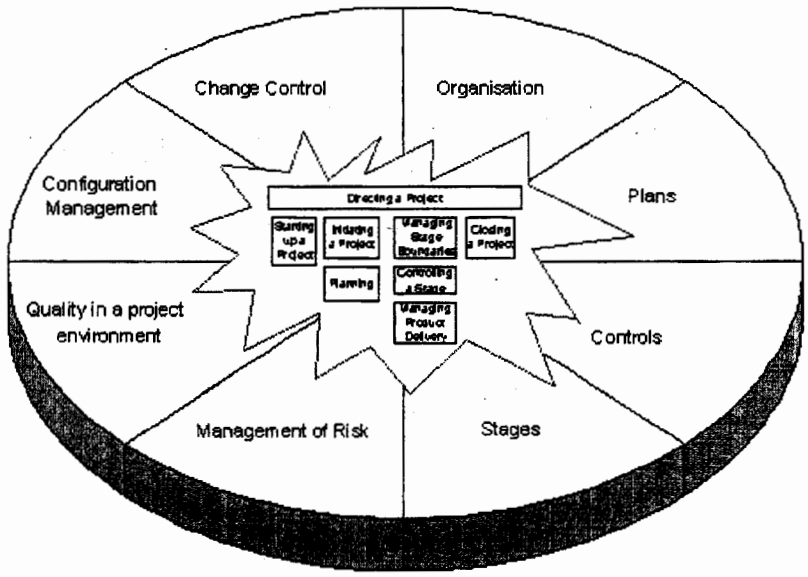
The PRINCE relationship with projects and business (Fig. 2.2)

PRINCE covers the management of the project, and the management of the resources involved in carrying out the activities of the project. It does not cover the specialist

techniques involved in the creation of the products. This is the job of other methods, although PRINCE must interface with them to enable information on such areas as estimating, for example, to be provided for Project Management.

Although PRINCE is centered on the project, it begins before the project does by preparing the ground so that the project starts in an organized and controlled manner.

Another often critical project area is procurement. PRINCE assumes that the project is run within the context of a contract. The contracting process is not included within the method itself. Contracting and procurement are themselves technical activities (like software engineering) and can therefore be managed using the PRINCE method. If procurement or contracting is to be undertaken during the early stages of the project, changes may be needed to the Project Board and other parts of the project management team once these stages have been completed. For example, it may be appropriate to have a senior representative of the contractor organization as a member of the project board (in the role of senior supplier).
Contract and procurement issues will also increase the importance of a complete and accurate Project Initiation Document (PID) which will need to be kept in line with the text of the contract(s). Where PRINCE describes project roles, the conversion of these into formal job definitions for a particular project will also require careful attention, for example project assurance, the approval of product descriptions, and the allocation of risk `ownership'.



PRINCE Processes and components (Fig. 2.3)

PRINCE, a Process-based approach to Project Management, defines the management activities to be carried out during the project. In addition, PRINCE describes a number of components that are applied within the appropriate activities. Figure 2.3 shows the components positioned around the central process model.

All PRINCE 2 projects begin with a business case. This PRINCE 2 business case is regularly reviewed throughout the project's lifecycle, ensuring that business objectives are met. And

documents with templates and clear decision points are characteristics of this methodology. For senior management PRINCE uses the 'management by Exception' concept. Senior managers are kept fully informed of the project status without having to attend regular, time-consuming meetings.

As well as helping the managers and directors of a project, PRINCE 2 also offers benefits to the organization as a whole. These are achieved through the controllable use of resources and the ability to manage business and project risk more effectively.

PRINCE 2 enables projects to have;

- A controlled and organized start, middle and end;
- Appropriate reviews of progress against plan and against the Business Case;
- Flexible decision points;
- Automatic management control of any deviations from the plan;
- The involvement of management and stakeholders at the right time and place during the project;
- The necessary controls and breakpoints to work successfully within any required contractual framework;
- A common language across all the interested parties thereby ensuring effective communication channels between the project team, project management and the rest of the organization.

The single most common reason for failure of a PRINCE 2 project is the absence or wavering of management commitment to the PRINCE 2 approach. Thus, the most important prerequisite to implementing PRINCE 2 is awareness and buy-in at the most senior level of the organization. Once this has been achieved, project staff (from sponsors right through to team members) can be trained to a level of competence appropriate to their individual roles. This training also provides staff with the skills necessary to oversee the PRINCE 2 implementation, though often these are augmented by use of external consultancy.

2.2.1 Components

PRINCE 2 consists of 'Components', which are applied within the appropriate activities (processes) as shown in figure 2.3.

Business Case

The existence of a viable Business Case is the main control condition of a PRINCE 2 project. The Business Case is verified by the Project Board before a project begins and at every major decision point throughout the project. The project should be stopped if the viability of the Business Case disappears for any reason.

Organization

PRINCE 2 provides a structure of a project management team and a definition of the responsibilities and relationships of all roles involved in the project. According to the size and complexity of a project, these roles can b combined or shared.

Plans

PRINCE 2 offers a series of plan levels that can be tailored to size and needs of a project and an approach to planning based on products rather than activities.

Controls

PRINCE 2 provides a set of controls which facilitate the provision of key decision-making information, allowing an organization to pre-empt problems and make decision on problem resolution. For senior management PRINCE 2 controls are based on the concept of management by exception is forecast, i.e. we agree a plan, and then let the manager get on with it unless something is forecast to go wrong.

Management of Risk

Risk is a major factor to be considered during the life of a project. PRINCE 2 defines to the key moments when risks should be reviewed outlines an approach to the analysis and management of risk and tracks these through all the processes.

Quality in a project Environment

PRINCE 2 recognizes the importance of quality and incorporates a quality approach to the management and technical processes. It begins by establishing the customer's quality expectations and follows these up by laying down standards and quality inspection method to be used and by checking that these are being used.

Configuration Management

Tracking the components of a final product and incorporates a quality approach to the management and technical processes.

Change Control

PRINCE 2 emphasizes the need for change control, and this is enforced with a change control technique plus identification of the processes that apply the change control.

2.2.2 Techniques

PRINCE 2 offers very few techniques, preferring to leave the choice of technique to the users of the method, and according to the circumstances of the project. Three common techniques are; Product-based planning, change control and quality review.

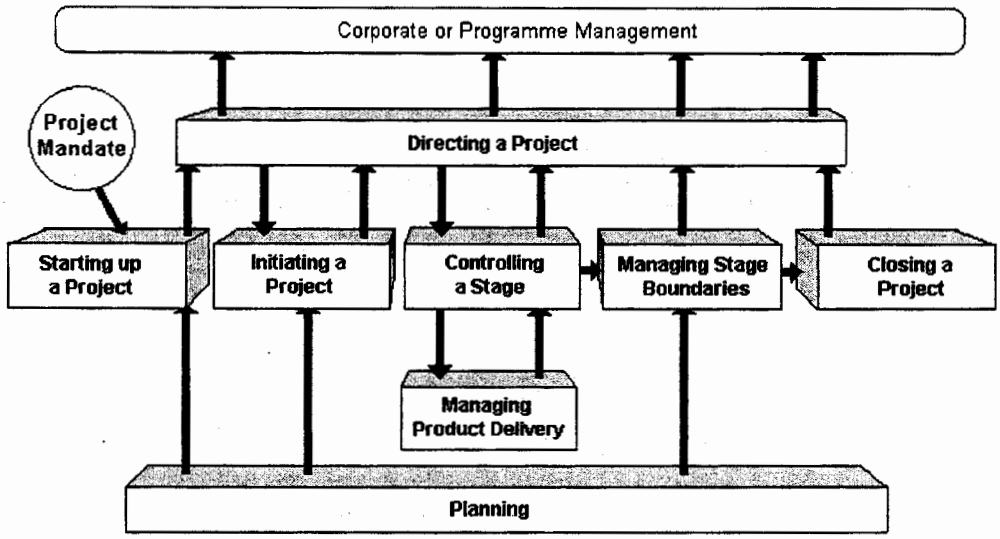
PRINCE 2 provides a product-based start to the planning activity. It also provides a planning framework that can be applied to any type of project. This involves;

- Establishing what product are needed
- Determining the sequence in which each product should be produced
- Defining the form and content of each product.

Part of the product-based planning techniques enables the project to define the standard of quality to which each product must conform. Every project needs a technique for the control of changes. PRINCE 2 also describes a specific technique; quality review, which is particularly suitable for the quality testing of document-based products.

2.2.3 PRINCE 2Processes

PRINCE 2 consists of eight distinctive components (Figure 2.4). Management Processes, covering the activities from setting the project off on the right track, through controlling and managing the project's progress, to the completion of the project. The common planning process is used by many of the other process.



PRINCE 2 Process Model (Fig. 2.4)

The Processes state the minimum content that can be expected to be found in a PRINCE 2 project. Exactly how the Processes are addressed within any given project is the responsibility of the organization's senior management and the Project Manager, but the method requires that each process is reflected within the project one way or another.

Starting up a Project (SU)

This is the first process in PRINCE 2. It is pre-project process, designed to ensure that the prerequisites for initiating the project are in place. The process expects the existence of project mandate that defines in high-level terms the reason for the project and what product is required. The process should be very short.
The work of the process is built around the establishment of six things;

- The design and, as for as possible, appointment of the project management team
- The project brief
- The project approach (in general terms how a solution will be provided)
- The customer's quality expectations
- A risk log
- The initiation stage plan.

Directing a Project (DP)

Directing a project returns from the end of SU until the project's closure. This process is aimed at the project board, a group of managerial decision makers representing business, users and suppliers. The project board manages by exception, monitors via reports, and controls through a number of decision points.

The key processes for the project board break into four main areas;

- Initiation (starting the project off on the right foot)
- Stage boundaries (commitment for more resource after checking results so far)
- Ad hoc direction (monitoring progress, providing advice and guidance, reaction to major threats to plans or benefits)
- Project closure (confirming the project outcome and bringing the project to a controlled close).

Initiating a Project (IP)

The objectives of initiating a project are to;

- Define how the required product quality will be achieved
- Plan and cost the project
- Document and confirm that an acceptable business case exists for the project
- Ensure that the investment of time and effort required by the project is justified, taking account of the risks to the project
- Enable and encourage the project board to take ownership of the project
- Provide the base-line for decision-making processes required during the project's life
- Agree to commitment of resources for the next stage of the project.

The key product of the process is the Project Initiation Document (PID), which defines the what, why, who, when and how of the project.

Three other blank products are created in readiness for use during the project. These are;

- The Quality Log

- The Issue Log
- The Lessons Learned Log.
- Another required product is the next stage plan.

This, however, comes form the process managing Stage Boundaries (SB), which will occur at the end of the initiation stage.

Managing Stage Boundaries (SB)

This process produces the information on which the project board will take key decisions on whether to continue with the project or not.
The objectives of the process are to;

- Assure the project board that all products planned in the current stage plan have been completed as defined
- Provide the information needed for the project board to assess the continuing viability of the project
- Provide the project board with any other information needed to approve the current stage's completion and authorize the start of the next stage, together with its delegated tolerance level
- Record any measurements of lessons that can help later stages of this project and/or other projects.

The products of this process are;

- An end stage report, given by the project manager to the project board, containing information on the stage achievements
- Current stage plan actual, showing performance against the original stage plan
- The next stage plan or exception plan, for which approval is sought
- A revised project plan
- The updated risk log, which, together with the next two products, is used by the project board to review the continuing viability of the project
- A revised business case
- The lesson learned log, updated with any lessons learned form the current stage
- Any changes to the structure of staffing of the project management team.

Controlling a Stage (CS)

This process describes the monitoring and control activities of the project manager involved in allocating work, ensuring that a stage stays on course and reacts to unexpected events. The process forms the core of the project manager's effort on the project, being the process that handles day-to-day management of the project.
Throughout a stage there will be a cycle of;

- Authorizing work to be done
- Gathering progress information about that work
- Watching for changes
- Reviewing the situation
- Reporting

- Taking any necessary corrective action.

This process covers these activities, together with the ongoing work of risk and issue management. Products produced during the stage on a cycle basis are:

- Work packages
- Highlight reports
- Project issues (and updated issue log)
- An updated risk log
- A regularly updated stage plan.

There may also be the need for an exception report.

Managing Product Delivery (MP)

The objective of this process is to ensure that planned products are created and delivered by the project by;

- The team manager negotiating details of work packages with the project manager
- Making certain that work on products allocated to the team is effectively authorized and agreed
- Ensuring that work conforms to the requirements of interfaces identified in the work package
- Ensuring that the work is done
- Assessing work progress and forecasts regularly
- Ensuring that completed products meet quality criteria
- Obtaining approval for the completed products.

Products created or updated during this process are;

- Team plans
- Quality log updates, giving the project manager a view of quality work being done
- Project issues (updating the business case)
- Risk log updates
- Checkpoint reports, regular progress reports from the team manager to the project manager.

Closing a Project (CP)

The purpose of this process is to execute a controlled close to the project. This process covers the project manager's work to wrap up a project either at its end or at premature close. Most of the work is to prepare input to the project board to obtain its confirmation that the project may close.

The objectives of closing a project are;

- Check the extent to which the objectives or aims set out in the PID have been met
- Confirm the customer's acceptance of the products
- Assess to what extent all expected products have been handed over and accepted by the customer

- Confirm that maintenance and operation arrangements are in place (where appropriate) including any relevant training
- Make any recommendations for future work (follow-on-action recommendation)
- Capture lessons resulting from the project and complete the lesson learned report
- Prepare an end project report
- Archive the project files
- Produce a post project review plan
- Notify the host organization of the intention to disband the project organization and release the resources (end project notification).

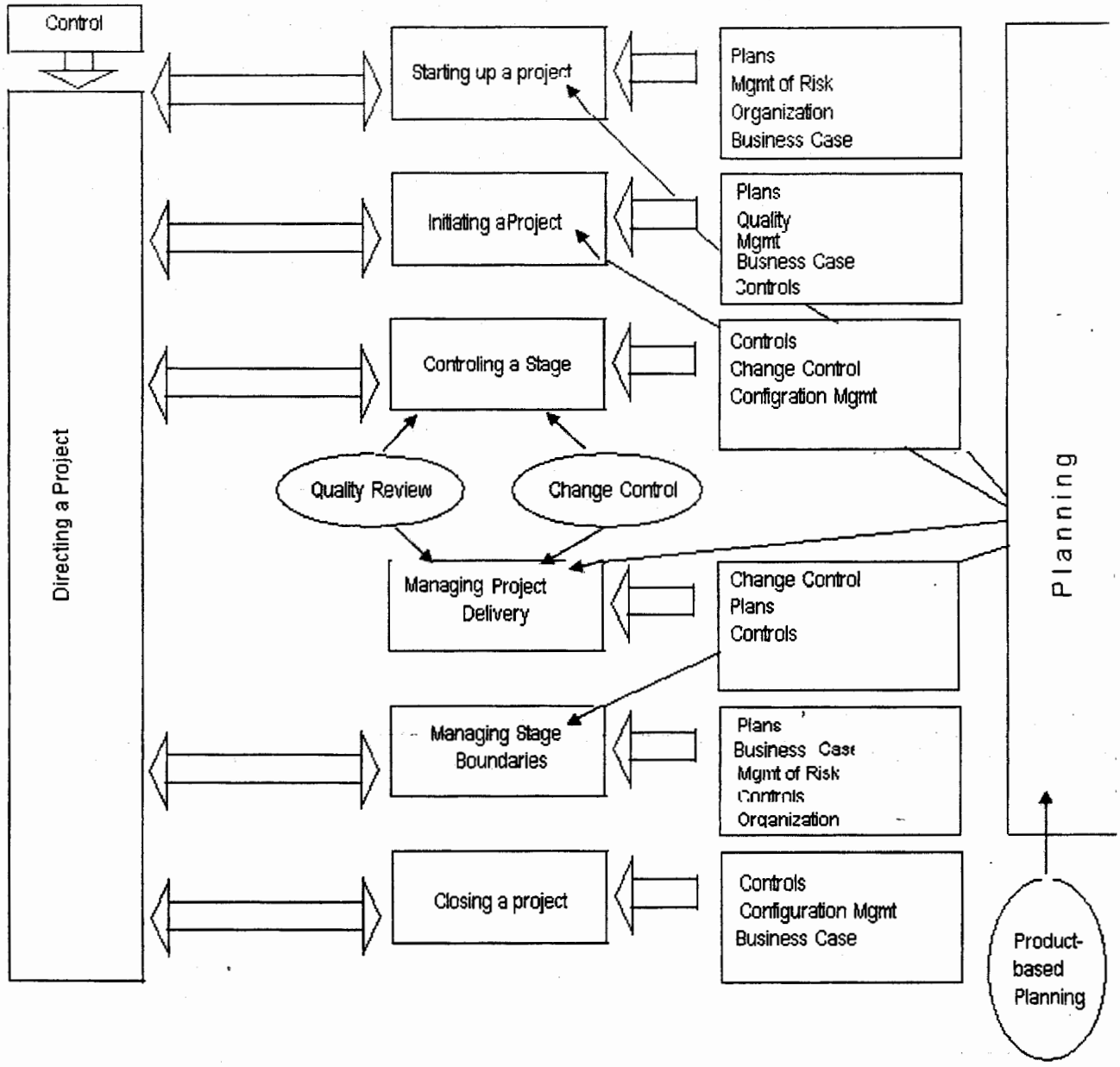
Planning (PL)

Planning is a repeatable process and plays an important role in other processes, the main ones being;

- Planning an Initiation Stage (SU6)
- Planning a Project (IP2)
- Planning a Stage (SB1)
- Updating a Project Plan (SB2)
- Accepting a Work Package (MP1)
- Producing an Exception Plan (SB6)

Apart from a plan, the process produces:

- A product checklist, which is a table of the products to be produced by the work planned, with space for planned and actual dates for delivery of draft, quality-checked and approved products
- The risk log updated with any risk situation changes made as a result of the planning activity.



Use of PPRINCE 2 Components & Techniques in the Processes (Fig. 2.5)

All the Processes link to Techniques (Fig. 2.5). It is anticipated that most organizations will already be using some specific techniques and PRINCE encourages the continued use of these where they provide value to the management decision-making process.

2.2.3.1 Planning Process

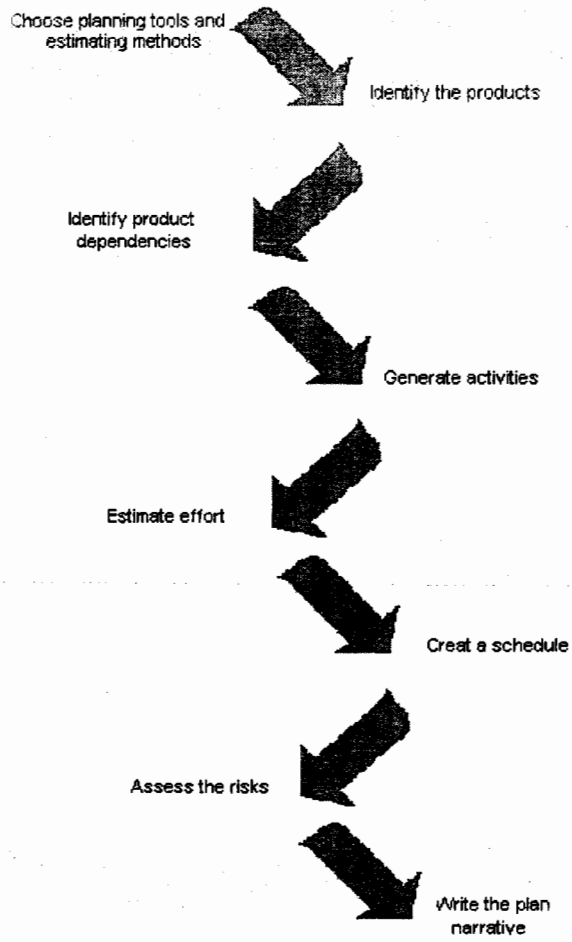
Every project depends on planning, and of course a PRINCE 2 project is not different. Project planning in PRINCE 2 is product-based which means the project plans are focused on

delivering results and are not simply about planning when the various activities on the project will be done. The process of planning is well defined in the PRINCE 2 methodology, using the usual planning suspects of work breakdown, activity networking and scheduling. The method of work breakdown is the product breakdown structure, essentially the same as a deliverable oriented Work Breakdown Structure (WBS), supplemented by the Product Flow Diagram (PFD). PFD allows a high-level structure for the project plan to be agreed at the deliverable level, which could be described as a milestone-led approach. It's useful stuff, and when pragmatically integrated with existing planning approach can deliver great benefits in the (often badly done) scope definition phase of planning. Planning is also closely integrated with the quality systems, with the methodology defining the production of the product description as a product of the process. Together, the product breakdown, product descriptions and product flow create an effective (and necessary) scope definition prior to commitment of resources to the project.

Don't confuse this process with the PRINCE 2 component 'Plans', which are a product of Planning, or 'stages', which define a PRINCE 2 planning principle explored in the 'Controls' component. Risk analysis, and estimation are related areas to PL. PRINCE 2's approach is a single unified methodology starting from developing the initial product breakdown structure through to identifying the corresponding network schedule.

PRINCE 2 planning does not end once the project has started. One of the reasons PRINCE 2 breaks down projects into small manageable stages is that they are much easier to plan. And of eight PRINCE 2 processes all but one DP involves planning. Even the final process-Closing a Project involves the planning of the post project review.

As PRINCE 2 is a product based methodology 'what' is to be produced defines its success, planning is the process to identify the product to be produced. Planning is also a Process, which is iterated (Fig. 2.6) and has impact across the whole of the project throughout its life.



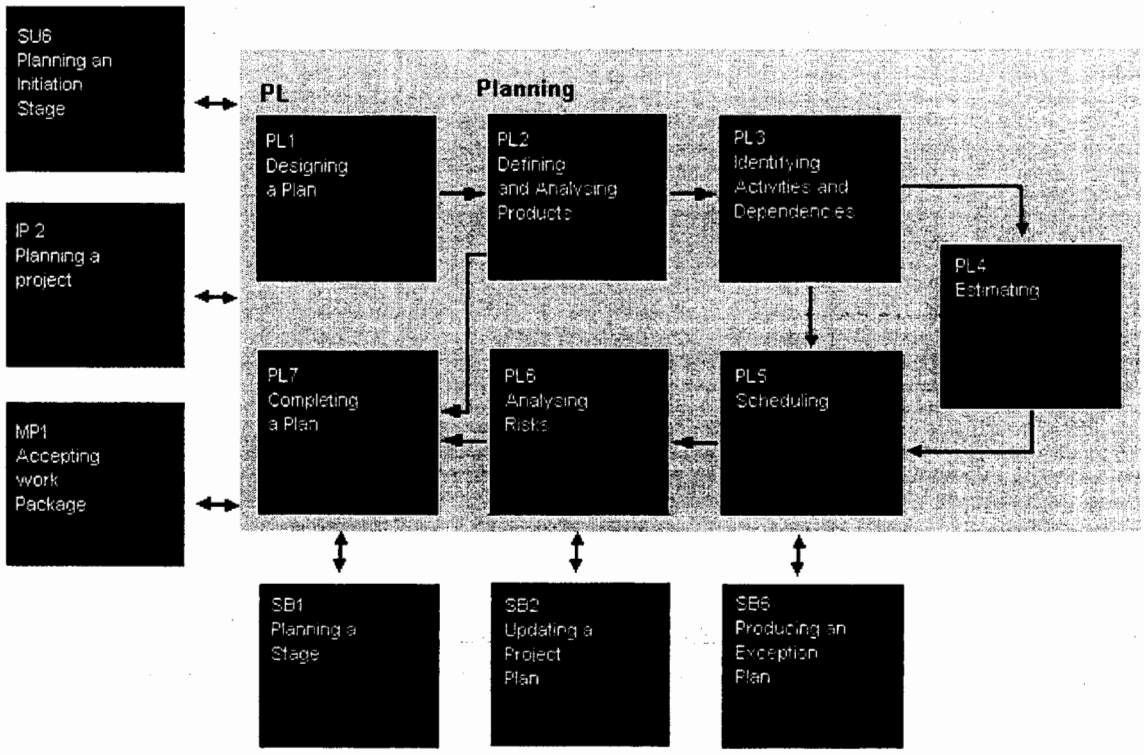
Overview of planning (Fig. 2.6)

PL1 Designing a Plan

Based on the project approach & using planning (Fig. 2.7) tools and estimation a plan design is being produced. Key characteristics are;

- The detail level of the plan is determined by the planning approach
- Identify the maximum length of time and how to measure the quality of the product
- To achieve required estimations the following my be employed;
  - computer tools
  - experienced planners in this area
  - either top-down or bottom-up estimation
  - discussions with others
- Allowances to consider;
  - change budget
  - contingency plans
- Responsibility lies with the project board

- Preceded by;
  - project approach
  - project quality plan
- leads to;
  - PL2 Defining and Analyzing Products
  - Plan Design.



Planning (Fig. 2.7)

PL2 Defining and Analyzing Products

Produce a ordered sequence of all products required by the project to achieve its objective. Key characteristics are;

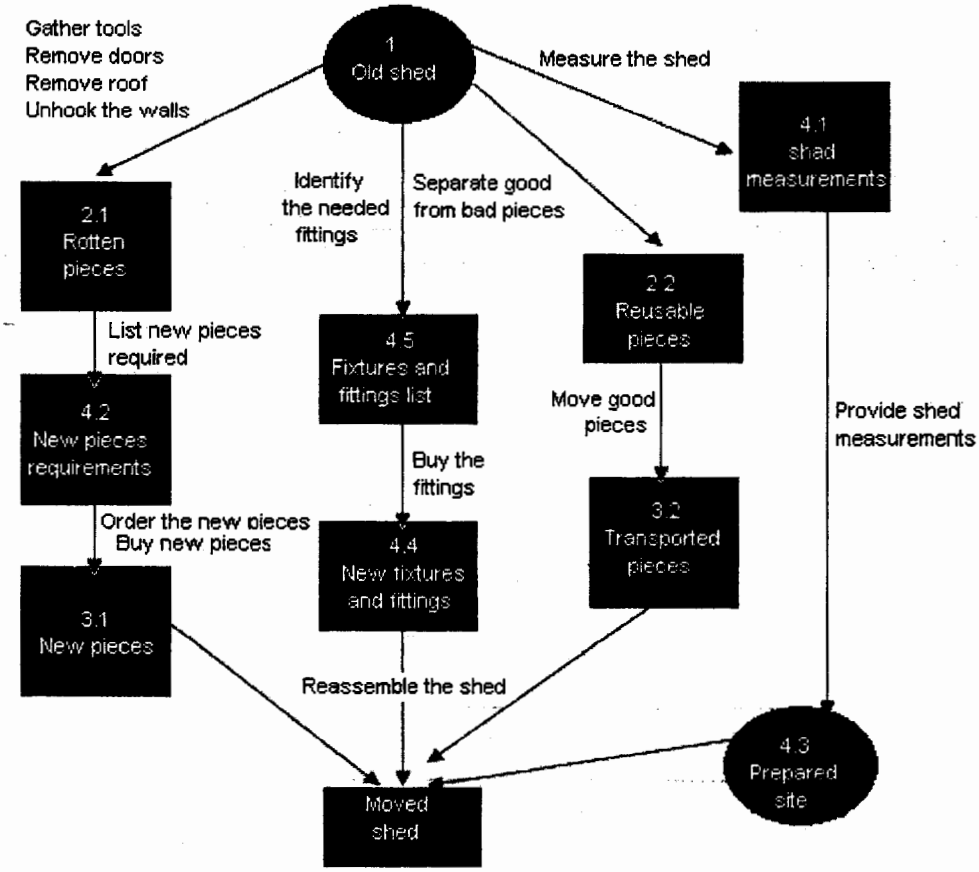
- Uses product based planning
- Outline the management of all (specialist & management) products and their quality requirements
- Ensure all the product specifications are approved
- Sequence these products in order of their creation
- Preceded by;
  - PL1 Designing a Plan
- Leads to;
  - PL3 Identifying Activities and Dependencies
  - PL7 Completing a Plan
  - Product Descriptions

- Product Flow Diagram (PFD).

PL3 Identifying Activities and Dependencies

Ensure interdependencies between activities are sequenced and dealt with appropriately. Key characteristics are;

- Completes the product flow diagram (Fig. 2.8)
- Identify activities required by the project from external contractors
- Estimate interdependencies that may exist between these activities
- Deal with any dependencies by ensuring they are sequenced appropriately
- Resource availability is dealt with in PL5
- Preceded by;
  - PL2 Defining and Analyzing Products
- Leads to;
  - PL4 Estimating
  - PL5 Scheduling.



Product Flow Diagram (Fig. 2.8)

PL4 Estimating

Outline all assumptions and margins of error when estimating the resources and time required for each activity in the project. Key characteristics are;

- The two major steps in estimating are;
  - Identify resources required
  - Estimate effort required for each activity
- Identify resources and time required for each activity. Be sure to include;
  - Specific skills
  - Degree of confidence and margin of error
  - Assumptions made
  - Level of product and activity understanding
- Preceded by;
  - PL3 Identifying Activities and Dependencies
- Leads to;
  - PL5 Scheduling.

PL5 Scheduling

Complete process where by activity resources are allocated, agreed upon and the schedule is updated. Key characteristics are;

- Will be changed and updated to ensure agreement between all parties
- Steps are;
  1. create planning network
  2. assess resource availability
  3. produce draft schedule and assign responsibilities
  4. reassess the level of resource usage after reassigning activities
  5. confirm control points with the Project Board
  6. calculate resources and costs to produce the plan budget
- Preceded by;
  - PL3 Identifying Activities and Dependencies
  - PL4 Estimating
- Leads to;
  - PL6 Analyzing Risks
  - SB6 Producing an Exception Plan.

PL6 Analyzing Risks

Use risk management techniques to evaluate each resource. Key characteristics are;

- Ensure the cost of avoiding the risk does not exceed the cost of risk itself
- If there is something not under the control of the project manager there is a risk
- Evaluate each resource in the project for risk
- Preceded by;

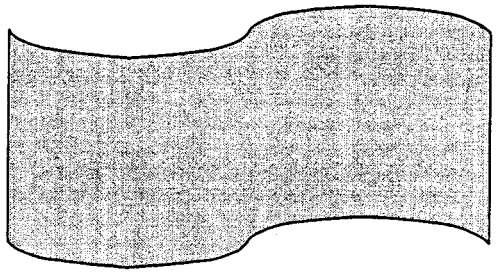
  - SB2 Updating a Project Plan
  - PL5 Scheduling
- leads to;
  - PL7 Completing a Plan
  - SB2 Updating a Project Plan.

PL7 Completing a Plan

List of products, that need to be produced within stage plan. Key characteristics are;

- Project descriptions, risk analysis, the schedule and estimations should be consolidated and presented to the project board
- Product checklist should have start and end dates
- Tolerance margins should be set by the project board
- A GANTT chart or bar diagram of the schedule should be included
- Once approved the project board 'freezes' the plan, thereby setting a baseline
- Project manager is responsible
- Preceded by;
  - PL2 Defining and Analyzing Products
  - PL6 Analyzing Risks
  - SB1 Planning a Stage
- Leads to;
  - SB1 Planning a Stage.

Chapter 3



CMMI

3. CMMI

CMMI, Capability Maturity Model Integration contains the essential elements of effective processes for one or more bodies of knowledge. These elements are based on the concepts developed by Crosby, Deming, Juran, and Humphrey. The model provides guidance to use when developing processes. CMMI model is not processes or process descriptions.

A process is a leverage point for an organization's sustained improvement. The purpose of CMM Integration is to provide guidance for improving the organization's processes and the ability to manage the development, acquisition, and maintenance of products or services. CMM Integration places proven approaches into a structure that helps the organization appraise its organizational maturity or process area capability, establish priorities for improvement, and implement these improvements.

The CMMI Product Suite contains and is produced from a framework that provides the ability to generate multiple models and associated training and appraisal materials. These models may reflect content from bodies of knowledge (e.g., systems engineering, software engineering, Integrated Product and Process Development & Supplier Sourcing) in combinations most useful to organization (e.g., CMMI-SE/SW, CMMI-SE/SW/IPPD/SS). An organization can use a CMMI model to help set process-improvement objectives and priorities, improve processes, and provide guidance for ensuring stable, capable, and mature processes. A selected CMMI model can serve as a guide for improvement of organizational processes.

3.1 History and Background

CMMI project team has been working to provide guidance that encourages process improvement in organizations of any structure. Experts define CMMI as;

- An **integrated framework for maturity models** and associated products that integrate the two key disciplines that are inseparable in a systems development activity: software engineering and systems engineering.
- A **common-sense application** of process management and quality improvement concepts to product development, maintenance and acquisition.
- A set of **best practices**.
- A **model for organizational improvement**.

Since 1991, CMMs have been developed for a myriad of disciplines. Some of the most notable include models for systems engineering, software engineering, software acquisition, workforce management and development, Integrated Product and Process Development. The key developments are listed in Table 3.1.

Development History (Table 3.1)

Date	Milestones
1987	First CMM published
1991	Model refine and published as SW-CMM v1.0
1993	SW-CMM v1.1 published
1995	Software Acquisition (SA-CMM) System Engineering (SE-CMM) Integrated Product Development (IPD-CMM) Organizational Work Force Capability Development (People CMM)
1997	CMMI initiative lunched
July 1998	A-Spec (Requirements) version 1.3
Aug 1998	Released stakeholder review package 1: framework descriptions, process areas, generic practices
Nov 1998	Released stakeholder review package 2: CMMI-SW
Dec 1998	Released stakeholder review package 3: CMMI-SE, SW-CMMI-SW/SE
Aug 1999	Public review CMMI-SW, CMMI-SE, and CMMI-SW/SE
Aug 1999	Stakeholder review: CMMI-SW/SE/IPPD Integrated Product and Process Development
Sept 1999	Pilot training methods Capability model training Assessment training Framework training Tailoring guidance Glossary
Sept 1999	Pilot assessment methods Assessment requirements Assessment methodology (quick-look, first assessment, reassessment) Assessment data collection models and tools Assessment team qualifications
Dec 1999	Public Review: CMMI-SW/SE/IPPD
Oct /Nov 99-May 00	Pilot all models
Dec 12, 2000	Publish models v1.02 (accept change requests on Feb 28, 2001)
Aug 2001	Release of CMMI, version 1.1 accumulated by SW-CMM (v 2.0 Draft C) SE-CM IPD-CMM (v 0.98)
Dec 2003	Sunset of SW-CMM, v.1.1.1 (3 years from release of 1.0)

Although these models have proven useful to many organizations, but the use of multiple models has been problematic. Many organizations would like to focus their improvement efforts across the disciplines within their organizations. However, the differences among these discipline-specific models, including their architecture, content, and approach, have limited these organization's ability to focus their improvements successfully. Further, applying multiple models that are not integrated within and across an organization becomes more costly in terms of training, appraisals, and improvement activities. A set of integrated models that successfully addresses multiple disciplines and has integrated training and appraisal support solves these problems.

The CMM Integration project was formed to sort out the problem of using multiple CMMs. The CMMI Product Team's mission was to combine three source models;

1 Capability Maturity Model for Software (SW-CMM) v2.0 draft C

2 Electronic Industries Alliance Interim Standard (EIA/IS) 731

3 Integrated Product Development Capability Maturity Model (IPD-CMM) v0.98

into a single improvement framework for use by organizations pursuing enterprise-wide process improvement.

Developing a set of integrated models has involved more than simply adding existing model materials together. Using processes that promote consensus, the CMMI product team has built a framework that accommodates multiple disciplines and is flexible enough to support two different representations (staged and continuous).

Using information from popular and well-regarded models as source material, the CMMI product team created a cohesive set of integrated models that can be adopted by those currently using other CMMs, as well as by those new to the CMM concept.

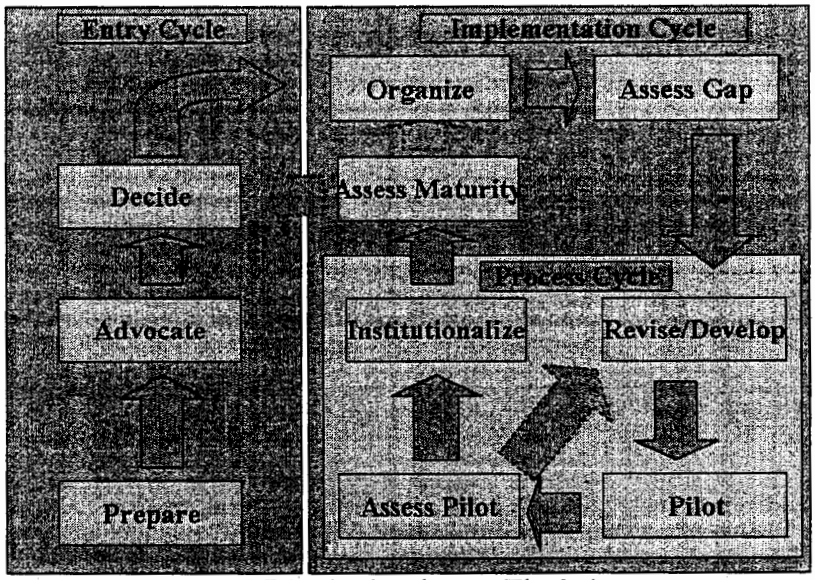
During the development phase of the CMMI project, the team's mission included the development of a common framework for supporting the future integration of other discipline-specific CMMI models. Furthermore, the team's mission included the objective of ensuring that all of the products developed are consistent and compatible with the International Organization for Standardization/International Electrotechnical Commission (ISO/IEC) 15504 technical report for software process assessment.

CMMI version 0.2 was publicly reviewed and used in initial pilot activities. Following release of that version, improvement was guided by change requests from the public review, piloting organizations, and various focus group sessions. The CMMI product team evaluated more than 3,000 change requests to create CMMI version 1.0. Shortly thereafter, version 1.02 was released, which incorporated several minor improvements. As with any release, however, the opportunity for further improvement remained. Version 1.1 accommodates further improvements from early use as well as more than 1,500 change requests.

CMMI is developed, maintained by **SEI** (Software Engineering Institute), Carnegie Mellon University (**CMU**), Pittsburgh Pennsylvania USA. SEI is being financed by **DoD** (Department of Defense) USA. Stephen E. Cross is the Director and CEO of SEI and Mark C. Paulk is the Product Manager for SEI CMMI 1.1.

3.2 CMMI® 1.1

SEI strives to improve the quality of processes in product development for the organization. CMMI product suite is being adopted worldwide, including North America, Europe, India, Australia, Asia Pacific, and the Far East. There are 122 SEI-authorized SCAMPI Lead Appraisers in place to conduct appraisals for the organizations moving toward CMMI adoption (Fig. 3.1).



CMMI adoption abstract (Fig. 3.1)

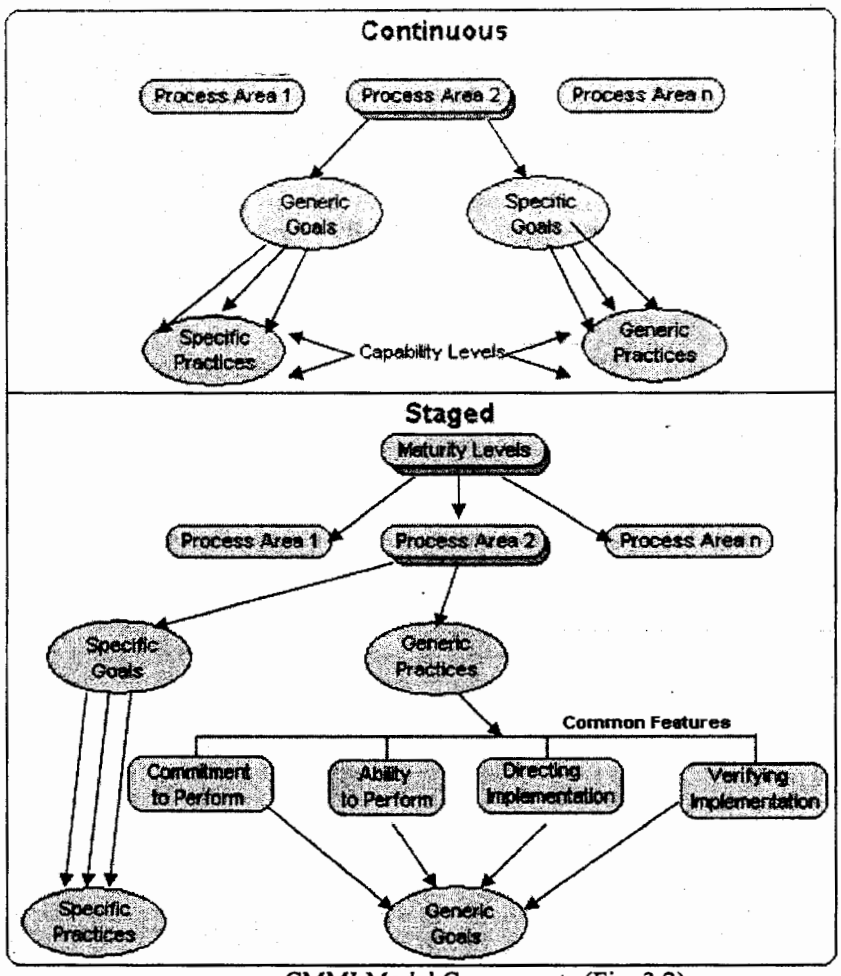
SEI recently opened an office in Germany because of European interest in the CMMI product suite. In 2002, SEI released the Standard CMMI Appraisal Method for Process Improvement (SCAMPI). Before discussing CMMI components (Fig. 3.2) in detail, we need to understand few terminologies.

Process Areas

Process area is a cluster of related practices in an area that, when performed collectively, satisfy a set of goals considered important for making significant improvement in that area. All CMMI process areas are common to both continuous and staged representations (Fig. 3.3). In the continuous representation, process areas are organized by process area categories.

Generic Goals

Each capability level (1-5) has only one generic goal that describes the institutionalization that the organization must achieve at that capability level. Thus, there are five generic goals; each appears in every process area. Achievement of a generic goal in a process area signifies improved control in planning and implementing the processes associated with that process area thus indicating whether these processes are likely to be effective, repeatable, and lasting. Generic goals are required model components and are used in appraisals to determine whether a process area is satisfied.



CMMI Model Components (Fig. 3.2)

Specific Goals

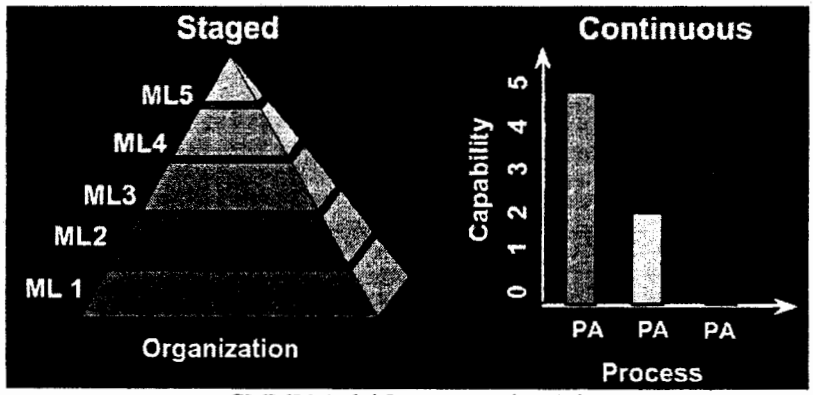
Specific goals apply to a process area and address the unique characteristics that describe what must be implemented to satisfy the process area. Specific goals are required model components and are used in appraisals to help determine whether a process area is satisfied. There can be specific practices at different capability levels mapped to the same goal. However, every goal has at least one capability level-1 practice mapped to it.

Generic Practices

Generic practices provide institutionalization to ensure that the processes associated with the process area will be effective, repeatable, and lasting. Generic practices are categorized by capability level and are expected components in CMMI models. In the continuous representation, each generic practice maps to one generic goal.

Specific Practices

A specific practice is an activity that is considered important in achieving the associated specific goal. The specific practices describe the activities expected to result in achievement of the specific goals of a process area. Every specific practice is associated with a capability level. Specific practices are expected model components.



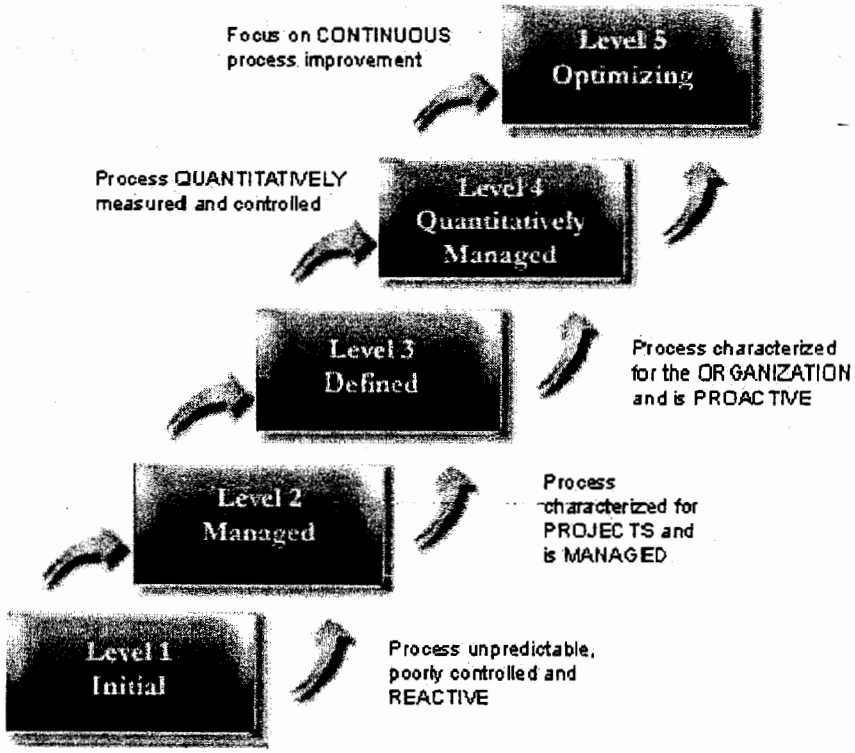
CMMI Model Representation (Fig. 3.3)

Continuous Representation

Continuous representation allows selecting the order of improvement that best meets the organization's business objectives and mitigates the organization's areas of risk & it enable comparisons across and among organizations on a process area by process area basis or by comparing results through the use of equivalent staging.

Staged Representation

Staged representation (Fig. 3.4) provides a proven sequence of improvements, beginning with basic management practices and progressing through a predefined and proven path of successive levels, each serving as a foundation for the next.



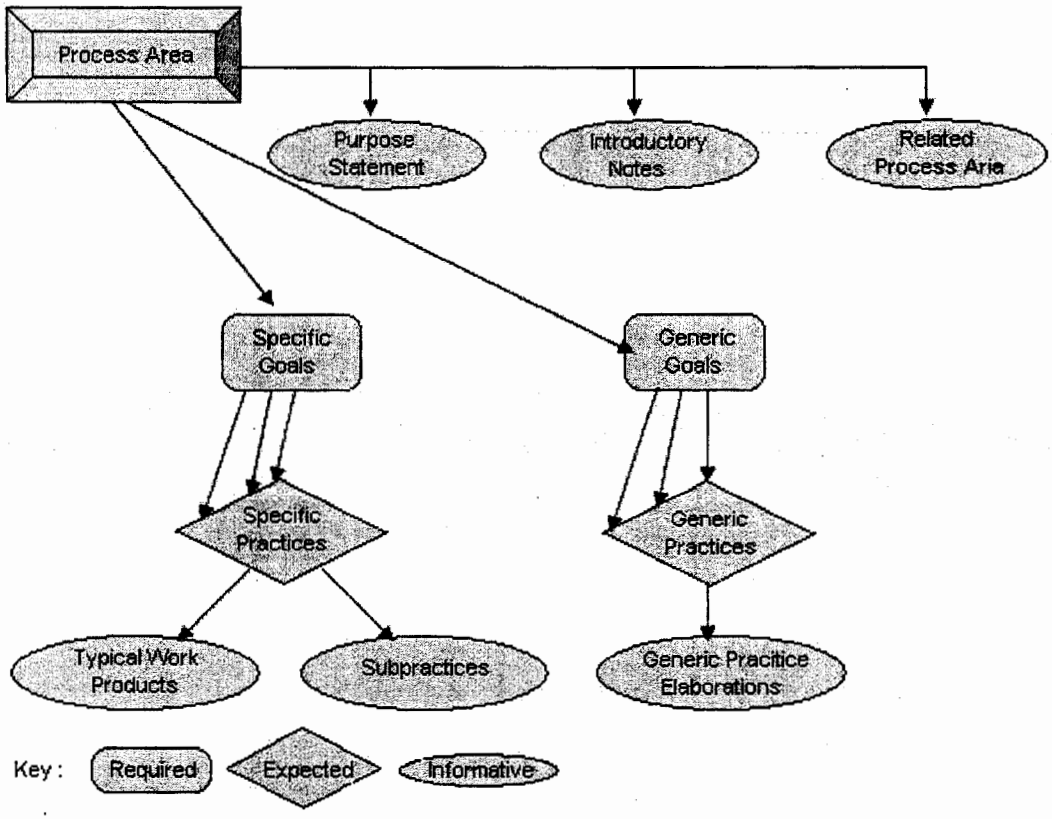
Staged Representation (Fig. 3.4)

3.2.1 Process Areas Categories / Levels

There are Twenty-five (**25**) Process areas (Fig. 3.5) that are grouped into four (4) categories and five (5) maturity levels; (Table 3.2)

Categories & Levels list (Table 3.2)

Categories	**Maturity Levels**
1. Process Management	*1. Initial*
2. Project Management	*2. Managed*
3. Engineering	*3. Defined*
4. Support	*4. Quantitatively Managed*
	5. Optimizing



Process Area Configuration (Fig. 3.5)

Process areas and their associated categories and maturity levels are listed in table 3.3.

Process Areas and their associated Categories & Maturity Levels (Table 3.3)

Process Area	**Category**	**Maturity Level**
Causal Analysis and Resolution	Support	5
Configuration Management	Support	2
Decision Analysis and Resolution	Support	3

Integrated Project Management	Project Management	3
Integrated Supplier Management	Project Management	3
Integrated Teaming	Project Management	3
Measurement and Analysis	Support	2
Organizational Environment for Integration	Support	3
Organizational Innovation and Deployment	Process Management	5
Organizational Process Definition	Process Management	3
Organizational Process Focus	Process Management	3
Organizational Process Performance	Process Management	4
Organizational Training	Process Management	3
Product Integration	Engineering	3
Project Monitoring and Control	Project Management	2
Project Planning	Project Management	2
Process and Product Quality Assurance	Support	2
Quantitative Project Management	Project Management	4
Requirements Development	Engineering	3
Requirements Management	Engineering	2
Risk Management	Project Management	3
Supplier Agreement Management	Project Management	2
Technical Solution	Engineering	3
Validation	Engineering	3
Verification	Engineering	3

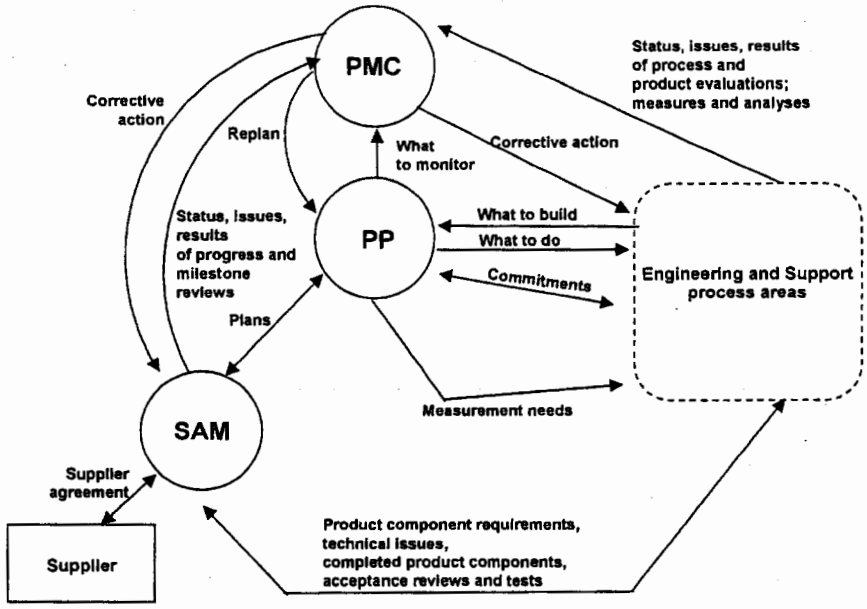
3.2.1.1 Project Management Category

Project Management process areas cover the project management activities related to planning, monitoring, and controlling the project. The Project Management process areas of CMMI are as follows;

- Project Planning
- Project Monitoring and Control
- Supplier Agreement Management
- Integrated Project Management
- Risk Management
- Integrated Teaming
- Integrated Supplier Management
- Quantitative Project Management

To describe the interactions among the Project Management process areas, it is most useful to address them in two process area groups;

The **Fundamental** Project Management process areas (Fig. 3.6) are Project Planning (PP), Project Monitoring and Control, and Supplier Agreement Management. These process areas address the basic activities related to establishing and maintaining the project plan, establishing and maintaining commitments, monitoring progress against the plan, taking corrective action, and managing supplier agreements.

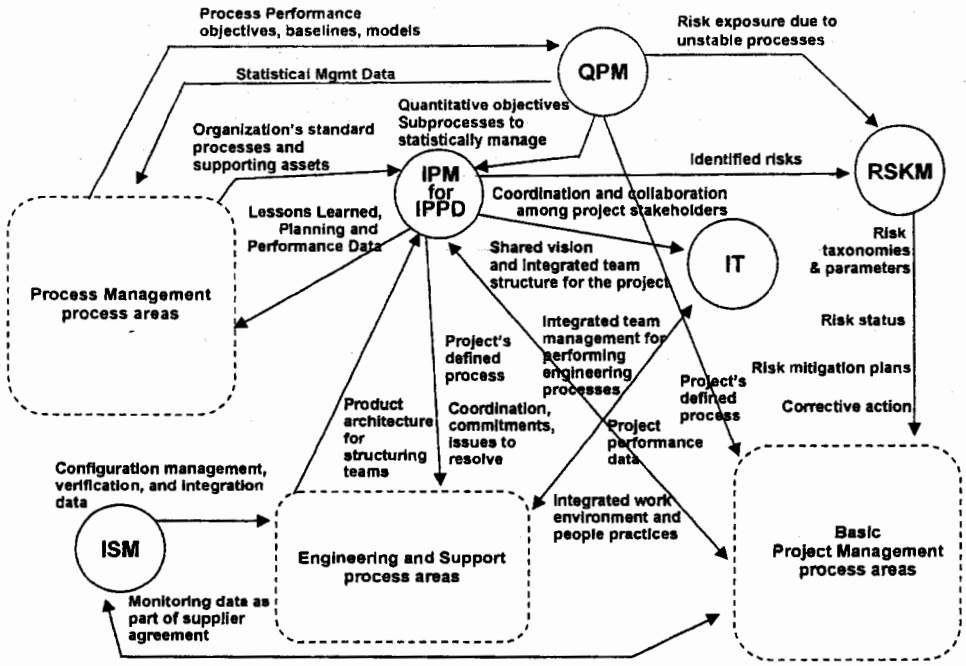


Fundamental Project Management process areas (Fig. 3.6)

The **Progressive** Project Management process areas are Integrated Project Management, Risk Management, Integrated Teaming, Quantitative Project Management, and Integrated Supplier Management. These process areas address activities such as establishing a defined process that is tailored from the organization's set of standard processes, coordinating and collaborating with relevant stakeholders (including suppliers), risk management, forming and sustaining integrated teams for the conduct of projects, and quantitatively managing the project's defined process (Fig. 3.7).

3.2.1.1.1 Project Planning

The purpose of project planning is to establish and maintain plans that define project activities. The project planning process area involves developing the project plan, interacting with stakeholders appropriately, getting commitment to the plan and maintaining the plan. Planning begins with requirements that define the product and project. Planning includes estimating the attributes of the work products and tasks, determining the resources needed, negotiating commitments, producing a schedule, and identifying and analyzing project risks.



Progressive Project Management process areas (Fig. 3.7)

The project plan provides the basis for performing and controlling the project's activities that address the commitments with the project's customer. Project plan will usually need to be revised as the project progresses to address changes in requirements and commitments, inaccurate estimates, corrective actions, and process changes. Specific practices describing both planning and re-planning are contained in this process area. Requirements development & management, risk management, and technical solution are related process areas to PP.

Specific Goals (SG)

SG 1 **Establish Estimates**

Estimates of project planning parameters are established and maintained.

SG 2 **Develop a Project Plan**

A project plan is established and maintained as the basis for managing the project.

SG 3 **Obtain Commitment to the Plan**

Commitments to the project plan are established and maintained.

Generic Goals (GG) (Continuous Representation)

GG 1 Achieve Specific Goals

The process supports and enables achievement of the specific goals of the process area by transforming identifiable input work products to produce identifiable output work products.

GG 2 Institutionalize a Managed Process

The process is institutionalized as a managed process.

GG 3 Institutionalize a Defined Process

The process is institutionalized as a defined process.

GG 4 Institutionalize a Quantitatively Managed Process

The process is institutionalized as a quantitatively managed process.

GG 5 Institutionalize an Optimizing Process

The process is institutionalized as an optimizing process.

Practice-to-Goal Relationship

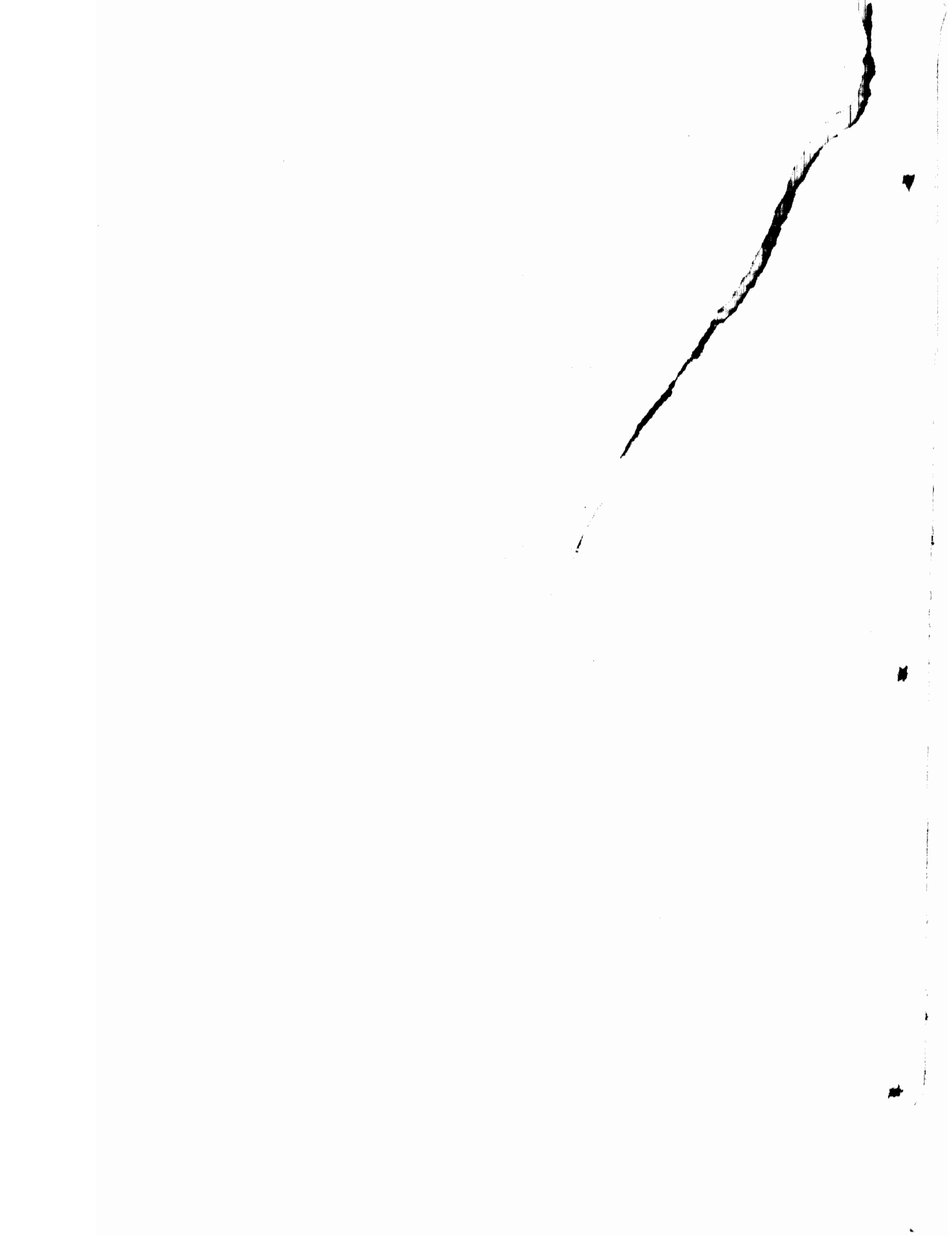
SG 1 Establish Estimates
- SP 1.1-1 Estimate the Scope of the Project
- SP 1.2-1 Establish Estimates of Work Product and Task Attributes
- SP 1.3-1 Define Project Life Cycle
- SP 1.4-1 Determine Estimates of Effort and Cost

SG 2 Develop a Project Plan
- SP 2.1-1 Establish the Budget and Schedule
- SP 2.2-1 Identify Project Risks
- SP 2.3-1 Plan for Data Management
- SP 2.4-1 Plan for Project Resources
- SP 2.5-1 Plan for Needed Knowledge and Skills
- SP 2.6-1 Plan Stakeholder Involvement
- SP 2.7-1 Establish the Project Plan

SG 3 Obtain Commitment to the Plan
- SP 3.1-1 Review Plans that Affect the Project
- SP 3.2-1 Reconcile Work and Resource Levels
- SP 3.3-1 Obtain Plan Commitment

GG 1 Achieve Specific Goals
- GP 1.1 Perform Base Practices

GG 2 Institutionalize a Managed Process
- GP 2.1 Establish an Organizational Policy
- GP 2.2 Plan the Process
- GP 2.3 Provide Resources
- GP 2.4 Assign Responsibility
- GP 2.5 Train People



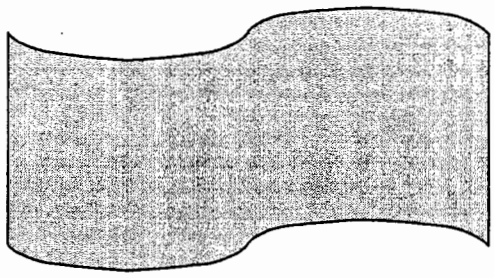
GP 2.6 Manage Configurations
GP 2.7 Identify and Involve Relevant Stakeholders
GP 2.8 Monitor and Control the Process
GP 2.9 Objectively Evaluate Adherence
GP 2.10 Review Status with Higher Level Management

GG 3 Institutionalize a Defined Process
GP 3.1 Establish a Defined Process
GP 3.2 Collect Improvement Information

GG 4 Institutionalize a Quantitatively Managed Process
GP 4.1 Establish Quantitative Objectives for the Process
GP 4.2 Stabilize Subprocess Performance

GG 5 Institutionalize an Optimizing Process
GP 5.1 Ensure Continuous Process Improvement
GP 5.2 Correct Root Causes of Problems

Chapter 4



MAPPING

4. Mapping

When we are first setting up our processes to comply with a model, we need to know exactly where we stand against that model. A good comparison is two-way, meaning we could either look at an activity in a process or see what model practices this activity fulfills or we could look at a practice in a model and see where these are included as activities in the organization's processes.

Once we have such a comparison, we should then continue mapping our processes to other models or standards for transformation / transition. Quagmap®7 ((C) *Software Productivity Consortium, NFP, 2001 originally published in International Council on Systems Engineering Symposium Proceedings 2001*) which is preloaded with paragraph titles of popular models and shows how they map to each other. This allows input and mapping of an organizational set of processes to any of the preloaded models. Once a practice in one of your processes is mapped to a section of one model, the tool will give you an "inferred mapping", of the paragraphs in another model that also may map to this part of the process. A process may combine the practices of two different process areas (such as Planning and Tracking) or several processes may be written to satisfy one process area.

The fundamental elements of the model (OGC-PRINCE 2) must be mapped to the fundamental elements of the reference Model (SEI-CMMI 1.1); the assessor needs to have access to the details of the mapping of the elements of the model to the reference model. Mapping needs to be complete, clear and unambiguous; such mapping helps to substantiate the claims of scope of coverage of the model. Both PRINCE 2 and CMMI 1.1 are already mapped with other leading standards i.e. ISO 9001:2000, PMI PMBoK, etc[12], [14].

We have break down the "Planning" method of both concerned standards to the lowest level of working and had tried to map these constituent on most relevant basis. Analysis covered the mapping from PRINCE 2 to CMMI 1.1 only. This analysis is mainly based upon some leading organization's case studies [C1-8] from different parts across the globe and incorporation of real time gathered through questionnaires.

4.1 Planning Process Breakup

The philosophy behind producing plans in PRINCE 2 is that; [11]

- Plans are constructed by identifying the products required, and then the activities and appropriate resources necessary to deliver them
- Plans should cover management needs as well as the customer's products
- There should be assurance that all activities are thought through in advance and to a level consistent with the control requirements identified in the Project Initiation Document.

The product-based planning technique provides a start to the planning activity and a planning framework. It involves;

- Establishing what products are needed for this plan

- Describing those products and their quality criteria
- Determining the sequence in which each product should be produced and any dependencies.

After these initial steps, the normal steps of planning are;

- Deciding when the activities should be done and by whom
- Estimating how much effort each activity will consume
- Estimation how long the activities will take
- Agreeing what quality control activities and resources are needed
- Producing a time based schedule of activities
- Calculating how much the overall effort will cost
- Producing the budget form the cost of the effort plus any materials and equipment that must be obtained
- Assessing the risks contained in the plan
- Identifying the management control points needed
- Agree tolerance levels for this plan.

These steps are the same for all levels of plan. Several iterations of the Planning process are normally needed through development. The Project Approach is a prerequisite for planning. This should have been defined as part of Starting up a Project (SU). Table 4.1 describes the typical artifacts-Management Information of Planning Sub-processes.

Planning Sub-Processes Information needs (Table 4.1)

Management Information	Usage	Explanation
PL1 (Designing a Plan)		
Project Approach	Input	The approach may impact on the number of stages and plan levels required
Project Quality Plan	Input	The contents of plans, level of detail and monitoring needs will be affected by the Project Quality Plan
Company planning standards	Input	These may identify the planning and estimation tools and methods to be used
Project Brief or PID	Input	Scope of the work to be planned
Plan design	Output	A statement of the planning approach, levels of plan, tool set to be used and major monitoring methods
PL2 (Defining and Analyzing Products)		
Plan Design	Input	This defines the level of plan required, the tools to be used, estimating techniques and the approach to contingency allowances
Project Quality Plan	Input	This will guide the selection and placement of quality control activities. Also contains the Configuration Management Plan. This will identify products which will require Configuration Item Records
Product Breakdown Structure	Output	A hierarchical table of all the products required to be created in the plan
Product Descriptions / Configuration item records	Output	A description of each product plus its quality criteria. This is also the initial creation of the Configuration Item Records for the products
Product Checklist	Output	A draft list of the major products of the plan
Product Flow Diagram	Output	A diagram showing the sequence in which the products should be produced
PL3 (Identifying Activities and Dependencies)		
Product flow Diagram	Input	The products and their dependencies are the basis of defining the required activities and their dependencies
Product Descriptions	Input	The derivation section of the description may contain information helpful in identifying dependencies
Risk Log	Input	The Risk Log may contribute risk monitoring activities that need to be added to the plan
List of activities	Output	All the activities required to produce the products
Activity dependencies	Output	Any dependencies between the activities in the preceding list
PL4 (Estimating)		
All planning information so far	Input	Products and activities that require estimation

Activities estimates	Output	Estimated activities are passed to Scheduling (PL5)
PL5 (Scheduling)		
Activity estimates	Input	When studied with the resource numbers, these give the activity duration
Activities dependencies	Input	These give the required sequence of work in the schedule
Resource availability	Input	The start and end dates of resource availability, are required
Schedule	Output	A list of activities and their allocated resources, plus the dates over which the activities will take place
PL6 (Analyzing Risks)		
All previously planned information	Input	Basis of the risk assessment
Risk Log	Update	Any new risks should be added to this
PL7 (Completing a Plan)		
Assessed plan	Input	Basics of the final planning package
Product Checklist	Update	Start and end dates added to the list
Completed plan for approval	Output	For approval by the Project Board

4.2 Project Planning Breakup

In CMMI Project plan provides the basis for performing and controlling the project's activities that address the commitments with the project's customer. Project plan will usually need to be revised as the project progresses to addresses changes in requirements and commitments, inaccurate estimates, corrective actions, and process changes. Specific practices describing both planning and re-planning are contained in this process area. The term "project plan" is used throughout the generic and specific practices in this process area to refer to the overall plan for controlling the project.

Planning Sub-Practices (Table 4.2)

Goal	Practice	Sub-Practice	Work Products
SG 1	SP 1.1-1	Develop a WBS based on the product architecture.	1. Task descriptions 2. Work package descriptions 3. Work Breakdown Structure (WBS)
		Identify the work packages in sufficient detail to specify estimates of project tasks, responsibilities, and schedule.	
		Identify work products (or components of work products) that will be externally acquired.	
		Identify work products that will be reused.	
	SP 1.2-1	Determine the technical approach for the project.	1. Technical approach 2. Size & complexity of tasks and work products 3. Estimating models 4. Attribute estimates
		Use appropriate methods to determine the attributes of the work products and tasks that will be used to estimate the resource requirements.	
		Estimate the attributes of the work products and tasks.	
		Estimate, as appropriate, the labor, machinery, materials, and methods that will be required by the project.	

	SP 1.3-1	-	1. Project life-cycle phases
	SP 1.4-1	Collect the models or historical data that will be used to transform the attributes of the work products and tasks into estimates of the labor hours and cost.	1. Estimation rationale 2. Project effort estimates 3. Project cost estimates
		Include supporting infrastructure needs when estimating effort and cost.	
		Estimate effort and cost using models and/or historical data.	
SG2	SP 2.1-1	Identify major milestones.	1. Project schedules 2. Schedule dependencies 3. Project budget
		Identify schedule assumptions.	
		Identify constraints.	
		Identify task dependencies.	
		Define the budget and schedule.	
		Establish corrective action criteria.	
	SP2.2-1	Identify risks.	1.Identified risks 2. Risk impacts and probability of occurrence 3. Risk priorities
		Document the risks.	
		Review and obtain agreement with relevant stakeholders on the completeness and correctness of the documented risks.	
		Revise the risks as appropriate.	
	SP2.3-1	Establish requirements and procedures to ensure privacy and security of the data.	1. Data management plan 2. Master list of managed data 3. Data content and format description 4. Data requirements lists for acquirers & for suppliers 5. Privacy requirements 6. Security requirements 7. Security procedures 8. Mechanism for data retrieval, reproduction, & distribution 9. Schedule for collection of project data 10. Listing of project data to be collected
		Establish a mechanism to archive data and to access archived data.	
		Determine the project data to be identified, collected, and distributed.	

	SP 2.4-1	Determine process requirements.	1. WBS work packages 2. WBS task dictionary 3. Staffing requirements based on project size & scope 4. Critical facilities/equipment list 5. Process/workflow definitions & diagrams 6. Program administration requirements list
		Determine staffing requirements.	-do-
		Determine facilities, equipment, and component requirements.	
-do-	SP 2.5-1	Identify the knowledge and skills needed to perform the project.	1. Inventory of skill needs 2. Staffing and new hire plans 3. Databases (e.g., Skills and Training)
		Assess the knowledge and skills available.	
		Select mechanisms for providing needed knowledge and skills.	
		Incorporate selected mechanisms in the project plan.	
	SP 2.6-1	-	1. Stakeholder involvement plan
	SP 2.7-1	-	1. Overall project plan
SG3	SP 3.1-1	-	1. Record of the reviews of plans that affect the project
	SP 3.2-1	-	1. Revised methods & corresponding estimating parameters (e.g., better tools, use of off-the-shelf components) 2. Renegotiated budgets 3. Revised schedules 4. Revised requirements list 5. Renegotiated stakeholder agreements

	SP 3.3-1	Identify needed support and negotiate commitments with relevant stakeholders.	1. Documented requests for commitments 2. Documented commitments
		Document all organizational commitments, both full and provisional, ensuring appropriate level of signatories.	-do-
		Review internal commitments with senior management as appropriate.	
		Review external commitments with senior management as appropriate.	
		Identify commitments on interfaces between elements in the project, and with other projects and organizational units, so they can be monitored.	
GG 1	GP 1.1	-	-
GG2	GP 2.1	Commitment to perform.	-
	GP2.2	Ability to perform.	-
	GP2.3	-	1.Estimates 2.Schedules 3.Applicable areas technical experts
	GP2.4	-	-
	GP2.5	-	-
	GP2.6	Directing Implementation.	1.WBS 2.Project Plan 3.Data Management Plan 4.Stakeholder Involvement Plan
	GP2.7	-	1.Reviews
	GP2.8	-	1.Revisions
	GP2.9	Verifying Implementation.	1.Commitements
	GP2.10	-	-
GG3	GP3.1	Ability to perform.	-
	GP3.2	Directing Implementation.	-
GG4	GP4.1	-	-
	GP4.2	-	-
GG5	GP5.1	-	-
	GP5.2	-	-

Table 4.2 describes the details of Generic/Specific Goals, Generic/Specific Practices, Sub-practices and their specific typical work products.

4.3 Transformation Assessment

As discussed earlier, that Planning process in PRINCE 2 is breakdown to the typical artifact level and project planning in CMMI 1.1 is also breakdown to the level of work product.

PRINCE 2 and PMI/PMBoK A Combined Approach at Getronics (APM Group Case Study)

This case study provides us a way for understanding that PRINCE 2 can provide a better environment for project management even if it is combined with other proven project management standards e.g. PMI-PMBoK, PMMM.

Product-based planning is a key feature of PRINCE 2, providing a focus on the products to be delivered and their quality. It forms an integral part of the planning process and leads into the use of others generic techniques such as network planning and Gantt charts. It provides a product-based framework that can be applied to any project, at any level, to give a logical sequence to the project's work. A product may be a tangible one, such as machine a document or a piece of software or it may be intangible such as a different organizational structure. PRINCE 2 describes three steps to the planning technique.

1. Producing a product break down structure.
2. Writing product description.
3. Producing a product flow diagram

The corollary is that if it is not possible to write the description then more work or other iteration is necessary to ferret out the necessary information. The products are re-ordered into their logical sequence to form a product flow diagram. The original product break down structure can become very detailed because the links between the products in the product flow diagram represents the activities required to create them, and every product must be included to capture every activity. The converse is that no activity necessary unless it contributes to the final outcome. A correctly formed flow diagram, therefore, not only identifies the activities in involved but also leads to a network dependency-based schedule or Gantt chart. PRINCE 2 provides a good explanation of the technique and specifies the associated documentation to go with it.

The resultant typical artifacts of Planning Process are Completed plan for approval, Project Approach, Project Quality Plan, Company Planning Standards, Project Brief, Plan Design, Product Breakdown Structure, Product Descriptions, Product Flow Diagram, Risk Log, List of activities, Activity dependencies, Activities estimates, Resource availability, Schedule, Assessed plan, and Product Checklist.

Enterprise Risk Management Project Registers of Scotland Executive Agency (Case Study).

Heater (interim project manager) has given a high priority to planning process when implementing PRINCE 2 to the registers of Scotland ERM.
It was made clear in the business case that full plan could not be produced until the outcome of known stage. So there was no team plan or exception plan. Specific interactions with the program plan have been identified.
The product description forms the basis of agreement, time planning and quality review.
In the planning process different document were produced including, communication plan, exception plan, project approach in (PID), project quality plan and team plan.

The resultant typical artifacts of Planning Process are Project Approach, Project Quality Plan, Company Planning Standards, Project Brief, Plan Design, Product Breakdown Structure, Product Descriptions, Product Flow Diagram, Risk Log, List of activities, Activity dependencies, Activities estimates, Resource availability, Schedule, and Assessed plan.

CMMI Case Study: United Space Alliance, LLC

The CAU (Cockpit Avionics Upgrade) project was strategically populated with experienced personnel from the previous project to allow rapid transfer of experience in the project planning process area. This permitted the champions who were place into CAU to contribute their intense process culture, experience base, and history to this start-up project.
Projects develop software estimates based on experience with similar functions. Initial estimates are developed from the top down with historical costing factors applied. A bottom up costing activity is then used for tuning. For the CAU project, following the generation of estimates, three independent assessments are used for a sanity check using industry tools. Independent estimates are generated by the customer, consultants, and an independent sub contactor.
The basic inputs to the estimates are source lines of code, projected error rates and level of testing required. A basis of estimates is developed for each estimate. The basis for the estimated includes product size (e.g. lines of code, number of test cases) and the computations using that data to generate an estimate.

Project budgets are based on the estimates. These are developed against an integrated master schedule. This takes into account task size complexity, and dependencies.

Assessment of the growth in the work scope based on requirements creep is conducted on a schedule that has been accepted by the customer. Source line of code estimates are used to determine the impact of requirements creep. This data is used to renegotiate the scope of the work. Requirements growth beyond a negotiated threshold will result in a customer-directed scrub of the requirements.

The staffing plan is developed based on the agreed-on products content schedule and budget. Equipment and system resource to support all project activities are estimated and funding is allocated. Actual plans for obtaining this equipment are documented in the information technology plan. Task charge numbers are opened for each activity decomposed from the work breakdown structure, with funding loaded using the earned value system. Allocation of

facilities for housing the staff and performing testing and integration are included in the plan. Funding is allocated for these facilities and they are now in place.

Three levels of schedule plans are covered by the project integrated management schedule. Plans are also in place for verification and validation integration, facilities, and software via the Software Development Management Plan (SDMP). The SDMP covers planning for the process to be used in developing the software. Subordinate plans are direct fallout of the plans documented in the project management plan and SDMP. Subordinate plans are developed to be consistent with those upper level documents.
Data management plans include the use of the project's intranet webpage- the Integrated Collaborative Environment, which includes such project data as presentations, trade studies, product team agendas and minutes, and requirement documents.

A training plan is developed that identifies the skills required by the project team. For the CAU project, skills are required in the three area: the legacy system that the project interfaces with, the Commercial Off-The-Shelf (COTS) real-time operating system, and the language and tools to be used.

Relevant stakeholders participate in the planning through the various product teams, as defined in the project management plan. Participation of the relevant stakeholders is also defined in the process documents for each phase of the development cycle (e.g. requirements generation and evaluation, development process, and detailed test process). Relevant stakeholders participate through attendance at both formal and informal reviews and inspections.

The resultant work products of Project Planning are Task descriptions, Work package descriptions, Work Breakdown Structure, Technical approach, Estimating models, Attribute estimates, Project life-cycle phases, Estimation rationale, Project effort estimates, Project cost estimates, Project schedules, Schedule dependencies, Identified risks, Risk impacts and probability of occurrence, Risk priorities, Data management plan, Security procedures, Schedule for collection of project data, WBS work packages, WBS task dictionary, Staffing requirements based on project size & scope, Critical facilities/equipment list, Process/workflow definitions & diagrams, Staffing and new hire plans, Stakeholder involvement plan, Overall project plan, Record of the reviews of plans that affect the project, Documented commitments, Estimates Schedules, and Project Plan.

Appropriate work products were elicited for comparison to a typical artifact based upon the referred case studies [C1-8] as shown in table 4.3.

Relevant Work Products (Table 4.3)

Typical Artifact	**Relevant Work Products**
PL-1	
Project Approach	Technical Approach Estimation Rationale Security Procedures Mechanism for Data Retrieval, Reproduction, & Distribution Program Administration Requirements List Revised Methods & Corresponding Estimating Parameters (e.g., better tools, use of off-the-shelf components)

Project Quality Plan	Overall Project Plan
	Documented Commitments
	Stakeholder Involvement Plan
	Record of the Reviews of Plans that Affect the Project
Company Planning Standards	Documented Commitments
	Estimating Models
	Project Life-Cycle Phases
	Staffing and new Hire Plans
	Overall Project Plan
	Record of the Reviews of Plans that Affect the Project
Project Brief (or PID)	Work Package Descriptions
	Project Life-Cycle Phases
	Data Content and Format Description
	Mechanism for Data Retrieval, Reproduction & Distribution
	WBS Work Packages
	Overall Project Plan
Plan Design	Overall Project Plan
	All Project-Cycle Phases
	Master List of Managed Data
	Listing of Project Data to be Collected
	Schedule for Collection of Project Data
	Critical Facilities/Equipment List
	Program Administration Requirements List
	Inventory of Skills Needs
PL- 2	
Plan Design	Overall Project Plan
	All Project-Cycle Phases
	Master List of Managed Data
	Listing of Project Data to be Collected
	Schedule for Collection of Project Data
	Critical Facilities/Equipment List
	Program Administration Requirements List
	Inventory of Skills Needs
Project Quality Plan	Overall Project Plan
	Documented Commitments
	Stakeholder Involvement Plan
	Record of the Reviews of Plans that Affect the Project
Product Breakdown Structure	Work Breakdown Structure
	Work Package Description
	Task Description
	WBS Work Packages
	Process/Work Flow Definitions and Diagrams
Product Descriptions / Configuration Item Records	Work Package Descriptions
	Task Descriptions
	Data Content and Format Descriptions
	WBS Task Dictionary
	Process/Work Flow Definitions & Diagrams
Product Checklist	WBS Work Packages
	Work Package Descriptions
	WBS Task Dictionary
	Documented Commitments
Product Flow Diagram	Process/Work Flow Definitions and Diagrams
	Work Breakdown Structure
	WBS Work Packages
PL- 3	
Product Flow Diagram	Process/Work Flow Definitions and Diagrams

	Work Breakdown Structure
	WBS Work Packages
Product Descriptions /	Work Package Descriptions
Configuration Item	Task Descriptions
Records	Data Content and Format Descriptions
	WBS Task Dictionary
Risk Log	Risk Impacts and Probability of Occurrence
	Identified Risks
	Risk Priorities
	Security Procedures
	Critical Facilities/Equipment List
	Inventory of Skill Needs
List of Activities	Overall Project Plan
	Work Package Descriptions
	Work Breakdown Structure (WBS)
	Master List of Managed Data
	Listing of Data to be Collected
	WBS Task Dictionary
	Critical Facilities/Equipment List
	Program Administration Requirements List
Activity Dependencies	Schedule Dependencies
	Work Breakdown Structure
	WBS Work Packages
PL- 4	
All Planning Information	Overall Project Plan so Far
so far	Project Life-Cycle Phases
	Project Schedules
	Schedule for Collection of Project Data
	Stakeholder Involvement Plan
Activities Estimates	Attribute Estimates
	Estimation Rationale
	Revised Methods & Corresponding Estimating Parameters (e.g., better tools, use of off-the-shelf components)
	Estimating Models
PL -5	
Activity Estimates	Attribute Estimates
	Estimation Rationale
	Revised Methods & Corresponding Estimating Parameters (e.g., better tools, use of off-the-shelf components)
	Estimating Models
Activities Dependencies	Schedule Dependencies
	Work Breakdown Structure
	WBS Work Packages
Resource Availability	Staffing and new Hire Plans
	Staffing Requirements based on Project Size and Scope
	Inventory of Skill Needs
Schedule	Project Schedule
	Schedule Dependencies
	Schedule for Collection of Project Data
	Revised Schedules
PL- 6	
All Previously Planned	Overall Project Plan
Information	Project Life-Cycle Phases
	Project Schedules
	Stakeholder Involvement Plan
	Record of the Reviews of Plans that Affect the Project

Risk Log	Risk Impacts and Probability of Occurrence
	Identified Risks
	Risk Priorities
	Security Procedures
	Critical Facilities/Equipment List
	Inventory of Skill Needs
PL-7	
Assessed Plan	Record of the Reviews of Plans that Affect the Project
	Project Schedules
	Data Management Plans
	Overall Project Plan
	Revised Schedules
Product Checklist	WBS Work Packages
	Work Package Descriptions
	WBS Task Dictionary
	Documented Commitments
Completed Plan for Approval	Overall Project Plan
	Project Life-Cycle Phases
	Project Schedule
	Revised Schedules
	Staffing and new Hire Plans

A thorough questionnaire comprises of nine pages and ninety questions was designed and developed to incorporate the real time data for the assessment of comparison between the typical artifacts of PRINCE 2 to work products of CMMI 1.1. OGC provide us the different document templates used for the different typical artifacts e.g. Work Package, Stage Plan, Risk Log, Quality Log, Project Quality Plan, Project Plan, Project Mandate, Project Issue, Project Initiation Document, Project Brief, Project Approach, Product Description, Product Checklist, Post-Project Review Plan, Lessons Learned Report, Lessons Learned Log, Issue Log, Highlight Report, Follow-on Actions, Exception Report, End Stage Report, End Project Report, Daily Log, customer-acceptance-form, contract, Configuration Management Plan, Configuration Item Record, Communication Plan, Checkpoint Report, Business Case, Acceptance Criteria, Request Change Form, Lessons Learned Report.

In the process of answering the questionnaire, the practitioner (PRINCE 2 certified individual) needs to select the most relevant work product and its relevancy in percentage against a typical artifact. We have devised five different types of weights e.g. very Strong, Strong, Medium and Weak very Weak. If a typical artifact can only be matched with one work product then its seems to be a Strong mapping, if a typical artifact can be matched up to three work products then mapping seems to be Medium and if typical artifact can be matched up to more than three work products then mapping will be weak.

The relevance in percentage ranges form 0 to 99, by the interval of 10, no standard or method can't be 100% matched to CMMI; because CMMI in optimizing level (Level-5) believes on Continuous process improvement. The assigned weights for relevance are defined as:

If practitioner selects the relevance percentage in between the range of "0-19" then it seems to have very weak,

If practitioner selects the relevance percentage in between the range of "20-39" then it seems to have weak,

If practitioner selects the relevance percentage in between the range of "40-59" then it will be consider as medium, and
If practitioner selects the relevance percentage in between the range of "60-79" then it will be consider as strong, and
If practitioner selects the relevance percentage of 80 or more then it means that very strong mapping is founded.

Beside the selection of work products and their relevance in percentage, questionnaire contains these listed questions against a particular sub-planning process related to a particular typical artifact. We have given three different options against each question. These options includes "Yes" or "No" or "Not Applicable".

We had sent questionnaires to total of 17 organizations from different countries including European countries e.g. England, Ireland, Scotland, Australia and USA. These organizations are from the core IT industry. Pre-requisite of selection is the practical knowledge of organizations and individuals with PRINCE 2 and CMMI 1.1. As per the definition of small and medium enterprises of International Labor Organization (ILo), the targeted organizations are of medium to large category.

We have received 8 (eight) complete responses. Here is the data analysis of the information we were able to gathers from the filled questionnaires in table 4.4.

Data Analysis (Table 4.4)

Organization	A	B	C
Country	England	Ireland	Australia
Business Type	System Engineering	IT Consultancy	IT Project Management
Employment	50-65	40-45	55-60
PRINCE 2 Experience	Two PRINCE 2 Practitioner, One PRINCE 2 Foundation	One PRINCE 2 Practitioner, Six PRINCE 2 Foundation	One PRINCE 2 Practitioner
CMMI 1.1 Experience	1 SCAMPI Lead Appraiser 1 SCAMPI Lead Assessor (level 4)	1 SCAMPI Lead Appraiser 1 SCAMPI Lead Assessor (level 2)	1 SCAMPI Lead Appraiser 1 SCAMPI Lead Assessor (level 2)
PL1-1	Y	Y	Y
PL1-2	Y	Y	Y
PL1-3	Y	N	N
PL1-4	N/A	Y	Y
PL1-5	N	Y	Y
PL1-6	Y	N	N/A
PL1-7	Y	Y	N
PL1-8	Y	Y	Y
PL1-9	Y	N/A	Y

PL2-1	N	Y	Y
PL2-2	Y	N	N
PL2-3	Y	Y	Y
PL2-4	Y	Y	N/A
PL2-5	Y	Y	Y
PL2-6	N	N	Y
PL3-1	Y	Y	N
PL3-2	N	Y	Y
PL3-3	N/A	N	Y
PL3-4	Y	Y	Y
PL3-5	Y	Y	Y
PL4-1	N	N/A	N
PL4-2	Y	Y	Y
PL4-3	Y	Y	Y
PL5-1	N	N	Y
PL5-2	Y	Y	N
PL5-3	Y	Y	Y
PL5-4	N	Y	Y
PL5-5	Y	Y	Y
PL5-6	Y	N	Y
PL6-1	Y	N	Y
PL6-2	N/A	Y	N
PL6-3	N	N	Y
PL7-1	Y	Y	Y
PL7-2	Y	Y	N/A
PL7-3	N/A	N	N

PL 1

1) Did any estimating, and risk assessment methods were used? [Related to Company Planning Standards]
2) Did Project Board have enough detail in Project Initiation Document to monitor progress? [Related to PID]
3) Was there any quality checks being shown on the plans? [Related to Project Quality Plan]
4) Was there being a defined process for a change budget? [Related to Company Planning Standards]
5) Was there any mechanism to asses the level of productivity for team members? [Related to Company Planning Standards]
6) Was there any approved contingency plan? [Related to Plan Design]
7) Did the technical approach define a top-level strategy for development of the product? [Related to Project Approach]
8) Does team identify commitments on interfaces between elements in the project, and with other projects and organizational units so that they can be monitored? [Related to Project Approach]

9) Did WBS permit the identification of the tasks for development of needed support plans, i.e. configuration management, quality assurance? [Related to Project Quality Plan]

PL 2

1) Was the plan reached to the agreed level of detail? [Related to Plan Design]
2) Was all management products identified, as well as specialist products? [Related to Product Checklist]
3) Does known risk factors being identified? [Related to Product Description / Configuration Item Records]
4) Does the amount of detail in WBS minimize the need for management reserve? [Related to Product Breakdown Structure]
5) Did WBS permit the identification of the tasks for development of needed support plans, i.e. configuration management, quality assurance? [Related to Project Quality Plan]
6) Did each work package in WBS assign a unique identifier to permit tracking? [Related to Product Flow Diagram]

PL 3

1) Was all parallel activities identified? [Related to List of Activities]
2) Does all constraints being identified? [Related to Activity Dependencies]
3) Does all process & workflows were shown in pictorial form for ease of project team? [Related to Product Flow Diagram]
4) Did revised risks identification includes that when risks become problems & when risks were retired? [Related to Risk Log]
5) Did the assumptions about the duration of certain activities provide insight into the level of confidence for management in the schedule? [Related to Product Description]

PL 4

1) Was the estimation made against known resources for skill and experience? [Related to Activities Estimates]
2) Was estimation assumptions documented in the plan text? [Related to All Planning Information So Far]
3) Did estimates contain the labor, machinery, materials, and methods that will be required by the project? [Related to Activities Estimates]

PL 5

1) Does all types of required resource been considered? [Related to Activities Dependencies]
2) Did the critical path been identified? [Related to Schedule]
3) Did sufficient monitoring been planned for activities on the critical path? [Related to Activities Dependencies]
4) Does resource availability been realistically assessed? [Related to Resource Availability]
5) Did project manager assess the knowledge & skills needed? [Related to Activities Dependencies]

6) Does a schedule involve the identification of predecessor and successor tasks to determine the optimal ordering? [Related to Activity Estimates]

PL 6

1) Does there any documented dependencies on products or other support form external sources that have not been listed as risks? [Related to Risk Log]
2) When does the cost of risk avoidance or reduction approach the cost of the risk if it occurs, who should be contact, need to be defined? [Related to Risk Log]
3) Does the plan define all aspects of milestones, data management, skill requirements, & stakeholder identification and interaction? [Related to All Previously Planned Information]

PL 7

1) Does consideration been given to the business risks and constraints when setting tolerance levels in risk mitigation strategy? [Related to Product Checklist]
2) Does the format of the plan's presentation material been agreed with the Project Board? [Related to Completed Plan for Approval]
3) Were all plans that affect the project reviewed to ensure a common understanding of the scope, objectives, roles, & relationships that are required for the project to be successful? [Related to Assessed Plan]

After the mapping at first stage, If a selected work product of CMMI is not yet started to develop then its status will be represented by "Very Weak", if selected work product of CMMI is not yet completed then its status will be "Weak", if the selected work product of CMMI is not yet base-lined then its status will be represented as "Medium" ,if a selected work product of CMMI is base-lined or under the formal change control process then its status will be treated as "Strong" and if a selected work product of CMMI is successfully gone through the formal change control process then its status will be treated as "Very Strong". Conditions of the assigning different categories are listed below in pseudo code.

"Select Work-product of Typical-artifact.
If Relevance (%) of Work-product1 = 0 or Work-product1 < = 19 and SumofAnswers = 2 and If Work-product1.ListIndex = 1 or Work-product1.ListIndex = 2 Then
Label-Work-product7.Caption = "Very Weak"
End If
If Relevance (%) of Work-product1 = 20 or Work-product1 < = 39 and SumofAnswers = 4 and If Work-product1.ListIndex = 2 or Work-product1.ListIndex< = 4 Then
Label-Work-product7.Caption = "Weak"
End If
If Relevance (%) of Work-product1 = 40 or Work-product1 < =59 and SumofAnswers = 6 and If Work-product1.ListIndex = 4 or Work-product1.ListIndex< = 8 Then
Label-Work-product7.Caption = "Medium"
End If
If Relevance (%) of Work-product1 = 60 or Work-product1 < =79 and SumofAnswers = 7 and If Work-product1.ListIndex = 8 or Work-product1.ListIndex< = 10 Then
Label-Work-product7.Caption = "Strong"

End If
If Relevance (%) of Work-product1 >= 80 and SumofAnswers = 8 and If Work-product1.ListIndex > 10 Then Label-Work-product7.Caption = "Very Strong"
End If." [Yes=1, No= -1, N/A =0]

We have devised eleven different levels to a work product of CMMI 1.1's practices during the work-product development process. These are;

1. Not Applicable (*Lowest level*)
2. Not Initiated
3. Initiated
4. Unfinished
5. Complete
6. Checked
7. Verified
8. Approved
9. Baseline
10. Change Control
11. Change Approved (*Highest level*)

Five different kinds of categories are assigned depending upon the level of the work product against a typical artifact of a sub-task of PRINCE 2. Theses categories are;

1. Very Weak (in Red color)
2. Weak (in Yellow color)
3. Medium (in Blue color)
4. Strong (in Green color)
5. Very Strong (in Dark Green color)

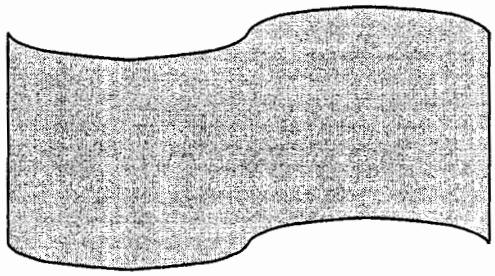
Mapper (Table 4.5)

OGC PRINCE 2		**SEI CMMI 1.1**		**Map**
Typical Artifact	*Usage*	*Practice*	*Work Product*	*Weight*
PL1(Designing a Plan)				
Project Approach	Input	SP1.2-1	Technical Approach	Medium
Project Quality Plan	Input	SP2.7-1	Overall Project Plan	Medium
Company Planning Standards	Input	SP3.3-1	Documented Commitments	Weak
Project Brief (PID)	Input	SP1.1-1	Work Package Descriptions	Medium
Plan Design	Output	SP2.7-1	Overall Project Plan	Medium
PL2 (Defining and Analyzing Products)				
Plan Design	Input	SP2.7-1	Overall Project Plan	Medium
Project Quality Plan	Input	SP2.7-1	Overall Project Plan	Medium
Product Breakdown Structure	Output	SP1.1-1	Work Breakdown Structure	Strong
Product Descriptions / Configuration Item records	Output	SP1.1-1	Work Package Descriptions	Weak
Product Checklist	Output	SP2.4-1	WBS Work Packages	Weak
Product Flow Diagram	Output	SP2.4-1	Process/Work flow definitions and diagrams	Medium
PL3 (Identifying Activities and Dependencies)				
Product Flow Diagram	Input	SP2.4-1	Process/Work flow	Medium

			Definitions and Diagrams	
Product Descriptions	Input	SP1.1-1	Work Packages Descriptions	Weak
Risk Log	Input	SP2.2-1	Risk Impacts and Probability of Occurrence	Medium
List of Activities	Input	SP2.7-1	Overall Project Plan	Medium
Activity Dependencies	Output	SP2.1-1	Schedule Dependencies	Weak
PL4 (Estimating)				
All Planning Information so far	Input	SP2.7-1	Overall Project Plan	Weak
Activities Estimates	Input	SP1.2-1	Attribute Estimates	Medium
PL5 (Scheduling)				
Activity Estimates	Input	SP1.2-1	Attribute Estimates	Medium
Activities Dependencies	Input	SP2.1-1	Schedule Dependencies	Weak
Resource Availability	Input	SP2.5-1	Staffing and new Hire Plans	Medium
Schedule	Output	SP2.1-1	Project Schedules	Strong
PL6 (Analyzing Risks)				
All Previously Planned Information	Input	SP2.7-1	Overall Project Plan	Weak
Risk Log	Update	SP2.2-1	Risk Impacts and Probability of Occurrence	Medium
PL7 (Completing a Plan)				
Assessed Plan	Input	SP3.1-1	Record of Reviews of Plans that Affects the Project	Medium
Product Checklist	Update	SP2.4-1	WBS Work Packages	Weak
Completed Plan for Approval	Output	SP2.7-1	Overall Project Plan	Strong

Table 4.5 shows the end result that is based upon information elicited from case studies and answers to questionnaires; of the mapping of CCTA / OGC-PRINCE 2 (Planning Process) to SEI-CMMI 1.1 (Continuous Representation, Project Management process area – Project Planning).

Chapter 5

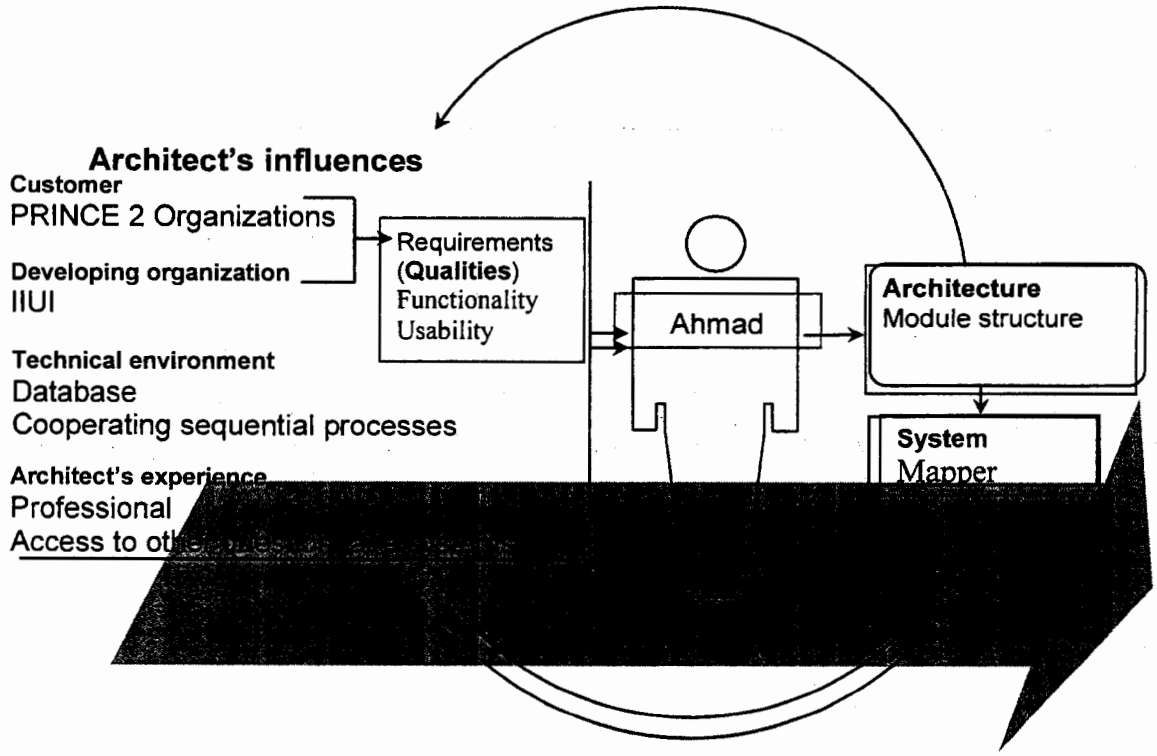


SOFTWARE ARCHITECTURE

5. Software Architecture

Architecture is a description of system structures (data flow, process, etc.) [B1]. Architecture Business Cycle (ABC) is influenced by the functional and quality goals of both the customer and the developing organization. An objective for all architecture is the desire to achieve particular software qualities.

Figure 5.1 describes the architecture business cycle [B1] for our project. System name is "Mapper", Ahmad Luqman is the architect who uses Module structure as architectural structure. Functionality and Usability (Runtime qualities) are the quality requirements. Product is being developed by the University intentionally for the PRINCE 2 certified organizations.



ABC of Mapping OGC-PRINCE 2 to SEI-CMMI 1.1 (Fig. 5.1)

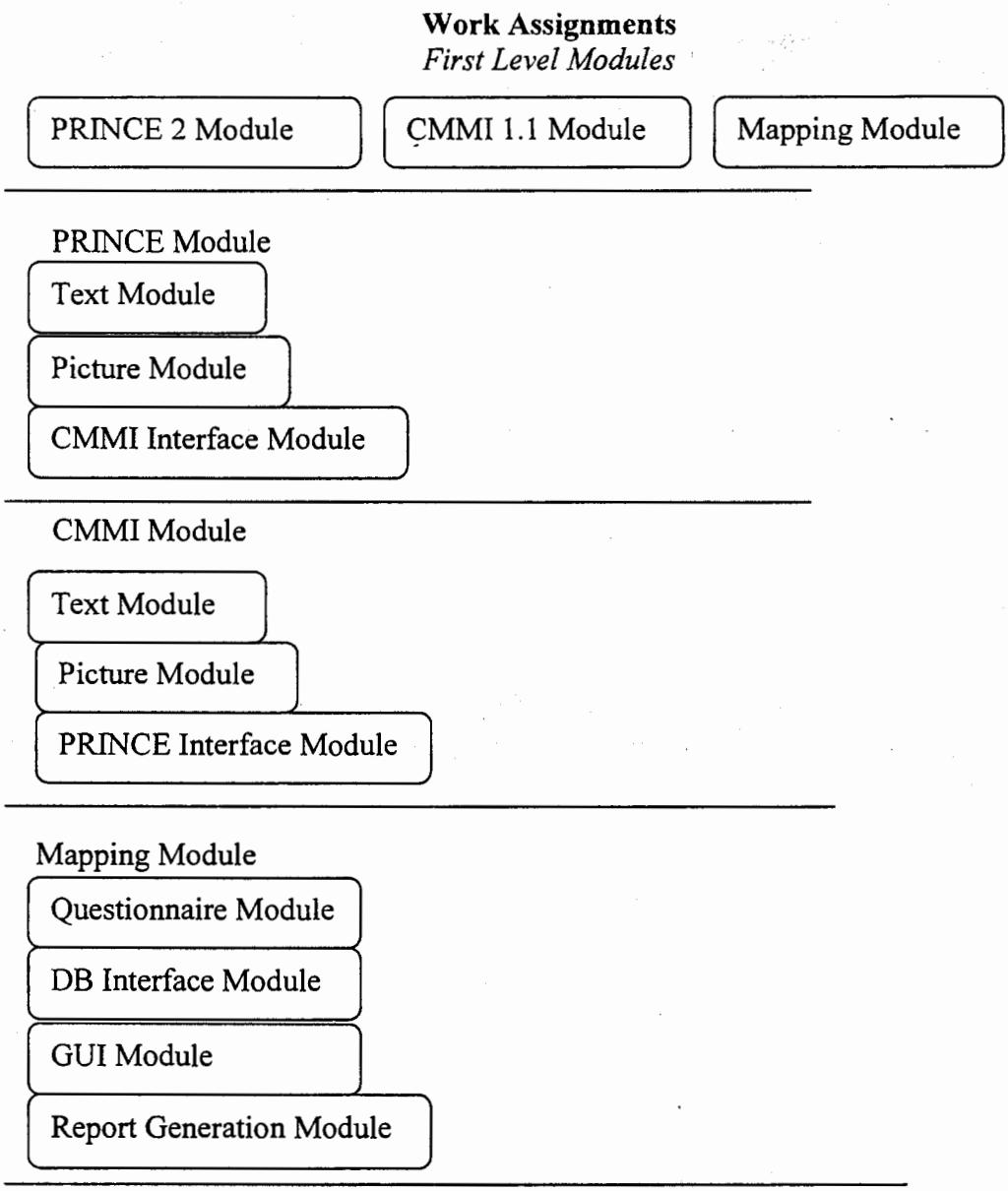
The process of moving form an architecture to an executable system deals with the creation of the work breakdown structure and its relationship to the architecture. **Module** structure uses work assignments (Fig. 5.2) as structure unit and Information retrieval was taken as the design principle. We

Identify areas of likely changes and assign a module to each (PRINCE 2 text, CMMI 1.1 text, Database, Flash tour, Questionnaire and Mapping report).

Encapsulate the changeable aspects in the module's implementation (Mapping and questionnaire forms).

Build the constant aspects into the module's interface (Database Connectivity).

Decree that all uses of the module occur via the facilities on its interface (Inclusion of GUI, Flash tour and pictures of these two standards).
Hide data structures, algorithms, and other changeable aspects (Development of Install program).



Three modules (Second level) (Fig. 5.2)

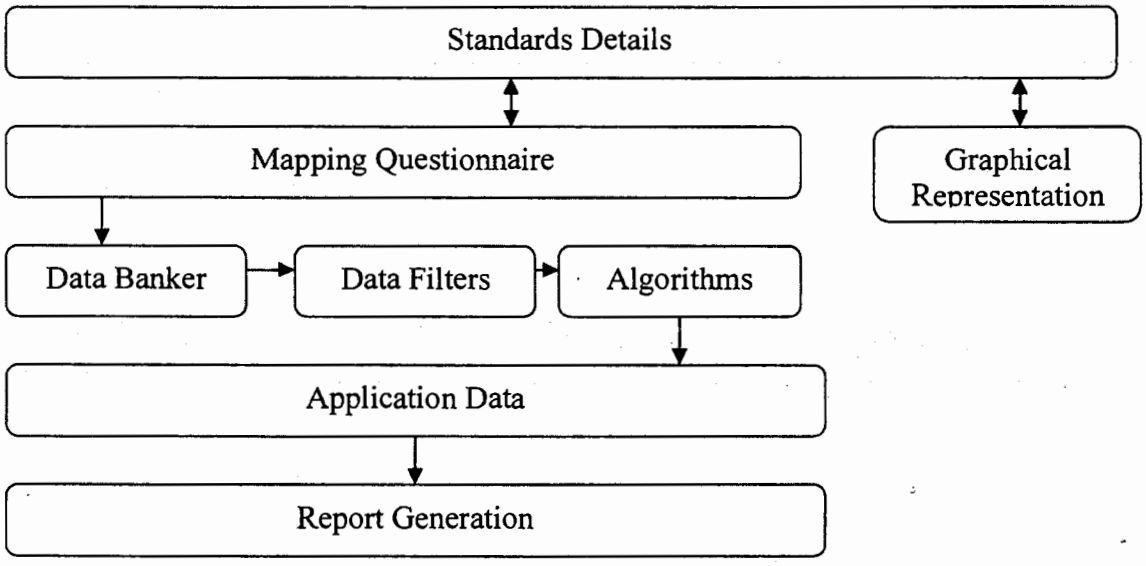
5.1 Architectural Styles

An architectural software style is determined by the following;

- A set of component types (e.g., data repository, a process, a procedure) that perform some function at runtime
- A topological layout of these components indication their runtime interrelationships

- A set of semantic constraints (e.g., a data repository is not allowed to change the values stored in it)
- A set of connectors (e.g., subroutine call, remote procedure call, data steams, sockets) that mediate communication, coordination, or cooperation among components.

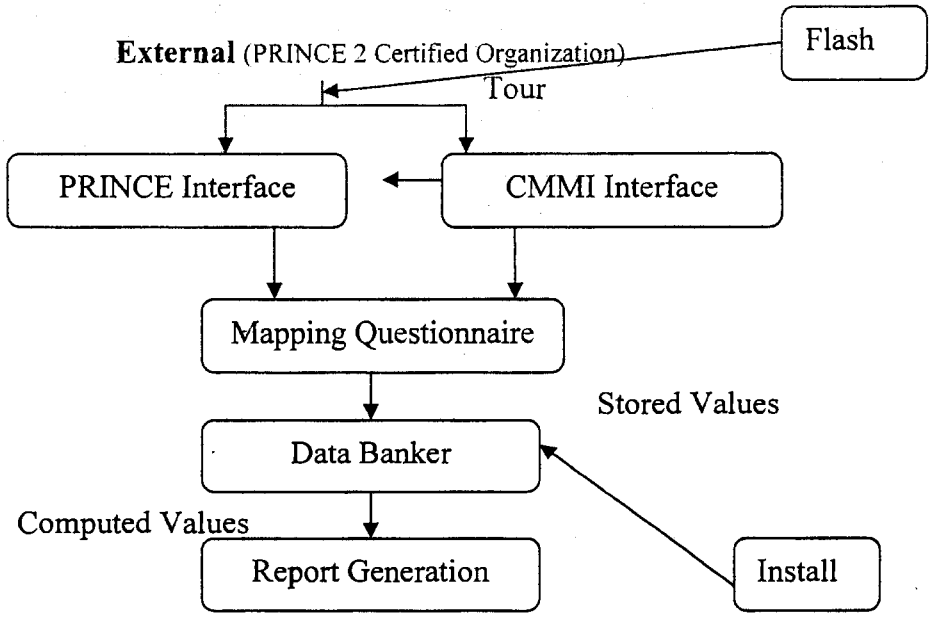
We select the Layered architectural style in the call-and-return architectures category. Call-and-return architecture has the goal of achieving the qualities of modifiability, functionality and scalability. Layered, (Fig. 5.3) are ones in which components are assigned to layers to control inter-component interaction. In the pure version of this sub style, each level communicates only with its immediate neighbors. The lowest layer provides some core functionality, such as hardware, or an operating system kernel. Each successive layer is built on its predecessor, hiding the lower layer and providing some services that the upper layers make use of. The upper layers often provide virtual machines themselves: complete sets of coherent functionality upon which an application, can be built.



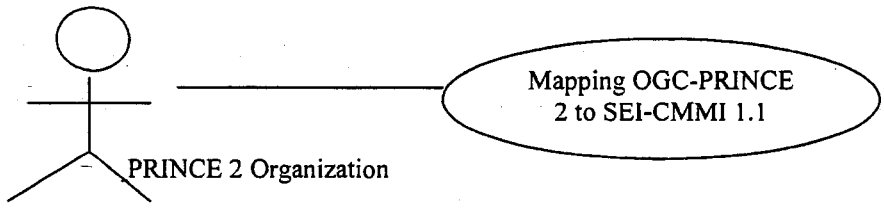
Layered Style of OGC-PRINCE 2 to SEI-CMMI 1.1 (Fig. 5.3)

In practice, layered systems are frequently not "pure": functions in one layer may talk to functions in layers other than its immediate neighbors. This is called **layer bridging**, and this practice is used where runtime deficiency is of concern. For example, a program written in java requires no porting effort to run it on large variety of hardware and software platforms, because java presents a uniform virtual machine abstraction on many platforms.

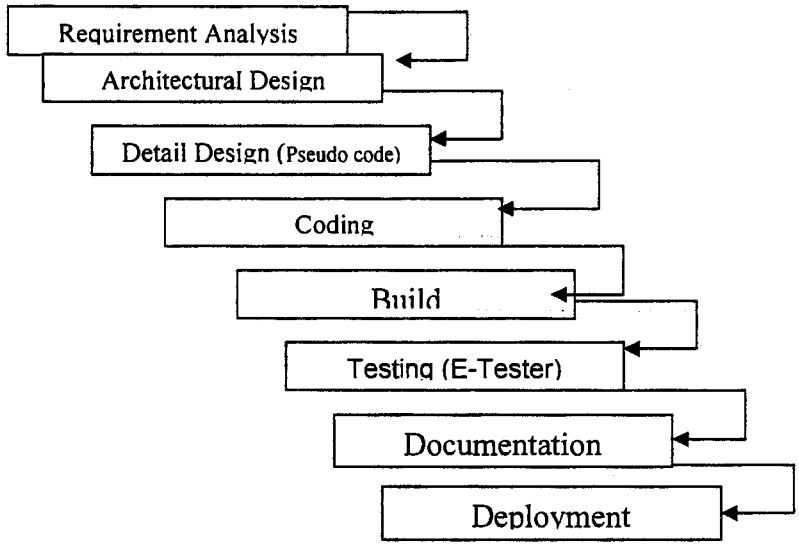
Useful information about architecture is often conveyed not only by the views but also by merging or overlaying views (Fig. 5.4). The Use Case view (Fig. 5.5) presents the functional requirements of the software to be built. Finally, the Process view provides insights into the transformation of the model toward an executable process (Fig. 5.6).



Data Flow View (Fig. 5.4)



Use Case View (Fig. 5.5)



Process view (Fig. 5.6)

5.2 Architecture Evaluation

It is possible to evaluate architecture to see if it allows certain system quality attributes to be achieved. **SEI** had developed three software architecture evaluation methods, that all can be applied to any software-intensive system. Architecture Tradeoff Analysis Method (ATAM) [B2] process takes three days and the involvement of evaluator, and architect. The output of an ATAM is a report that includes the major findings of the evaluation. These are;

- The architectural styles identified
- A "utility tree" - a hierarchic model of the driving architectural requirements
- A set of quality-attribute specific questions that were applied to the architecture and the responses to these questions
- A set of identified risks
- A set of identified non-risks.

After evaluation we select Layered architectural style, main reasons behind the selection was the use of different layers e.g. database, questionnaire, and report generation by the application.

Utility Tree (Table 5.1)

Utility	Performance	Data Latency	(M,L) Maximize connection/seek latency of database to 400 ms
			(H,M) Display flash tour in real time
		Transaction Throughput	
	Modifiability	New Product Categories	
		Change Scope	(L,H) Add ODBC as Connection string in <2 person-week
			(H,L) Change to web user interface in <2 person-month
	Availability	H/W Failure	(M,M) Restart after disk failure in <3 minutes
			(H,M) Sleep mode is detected and recovered in < 2 minutes
		S/W Failure	
	Security	Data Confidentiality	(L,H) Database are secure 99% of time
			(L,H) Database connectivity works 99.999% of time
		Data Integrity	
	Portability	Cross O/S Platforms	(L,H) System must be available in Win 98
			(L,H) System must be available in Win XP
		Cross DB Platforms	(L,H) System must be available in Access 97
			(L,H) System must be available without Access

			2003
	Functionality	Inputs	(H,H) System should have <4 inputs on a screen
			(H,H) System should have tab sequence of controls
		Outputs	(H,H) Report generates in multiple format
			(H,M) Output should have the option of Print
	Usability	Interface	(M,H) Application Should have GUI. (H,M) Application should have navigation property
		Response	(L,M) Error Messages should be application generated (L,M) Install should have uninstall script

Table 5.1 represents the utility tree with quality-attribute specific questions. Identified risks are listed below:

I) Application can't be completed in due time.
II) Team member leaves the team during development of application.
III) Development tool needs to be changed during execution.
IV) Questionnaire shouldn't be answered by non-PRINCE 2 practitioner.
V) Availability of case studies is not sure.

Similar to above the identified non-risks are listed below:

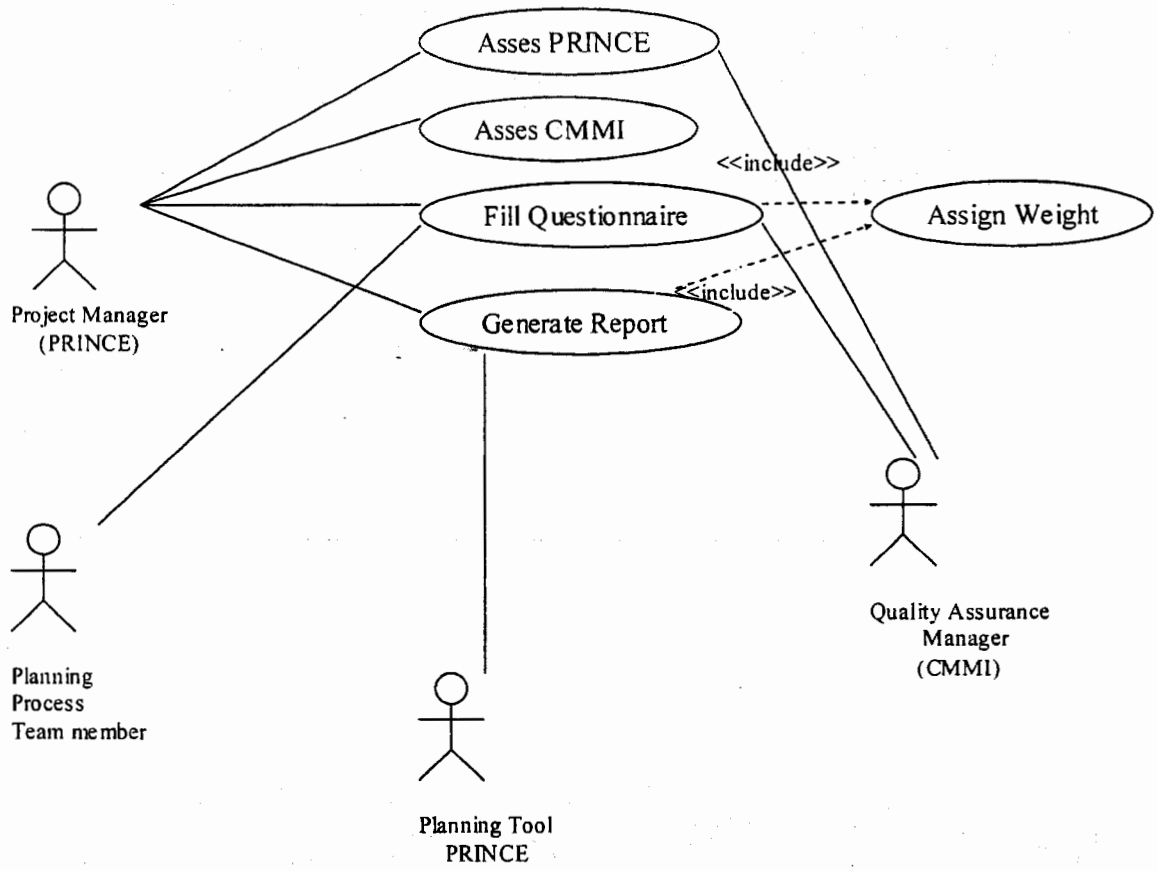
A) Hands-on training of the development tools.
B) Development of questionnaire regarding project planning process.
C) Conceptual understanding of Unified Modeling Language.
D) Assessment of correctness for the execution of the program.
E) Technical writing skills for the documentation of User's Manual.

The main reason of selecting ATAM for evaluation of architecture is that; less modifiability was involved in the software development.

5.3 Software Design

We consulted Rational Rose for application design using Unified Modeling Language 1.3. Listed below are Use case diagram, Class diagram, Sequence diagram, State diagram and Deployment diagram for concerned application.

In figure 5.7, four actors i.e. Project Manager-PRINCE, Planning Process Team member, Quality Assurance Manager-CMMI, and planning tool used in PRINCE certified organization; can interact with the system in different roles (external events). The "include" relationship uses a chunk of behavior (assign weights) that is similar across questionnaire, mapper, and map report uses cases. Whereas questionnaire is the basic use case, that most of the actors needs to utilize.

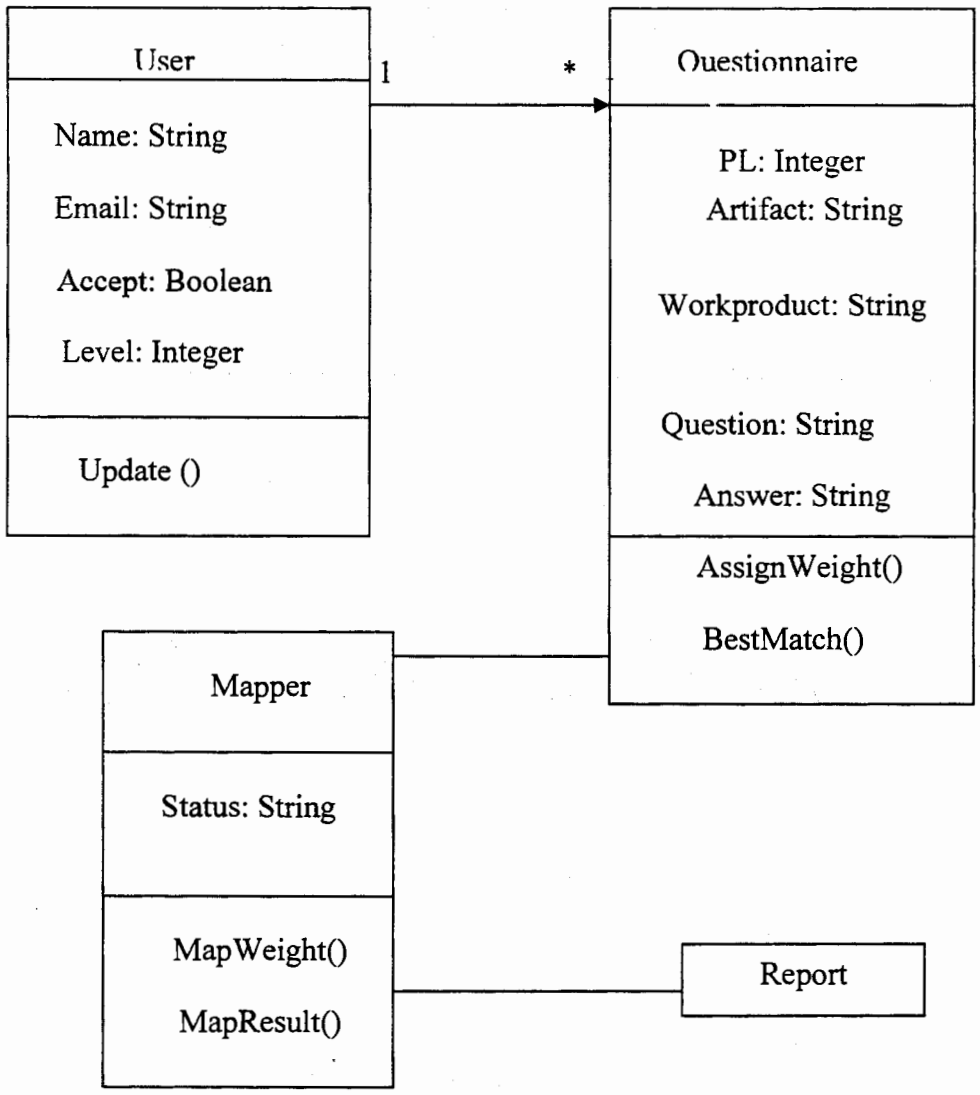


Use Case diagram (Fig. 5.7)

Figure 5.8 shows the class diagram, in which three classes i.e. user, questionnaire and mapper encapsulates specific attributes, operations and methods. Multiplicity association from user class to questionnaire class indicates that one or more method associated with user tell us about the practitioner information in questionnaire class. Another connotation is that one user can answer multiple questionnaires. Arrow line implies the navigation feature from user to questionnaire class.

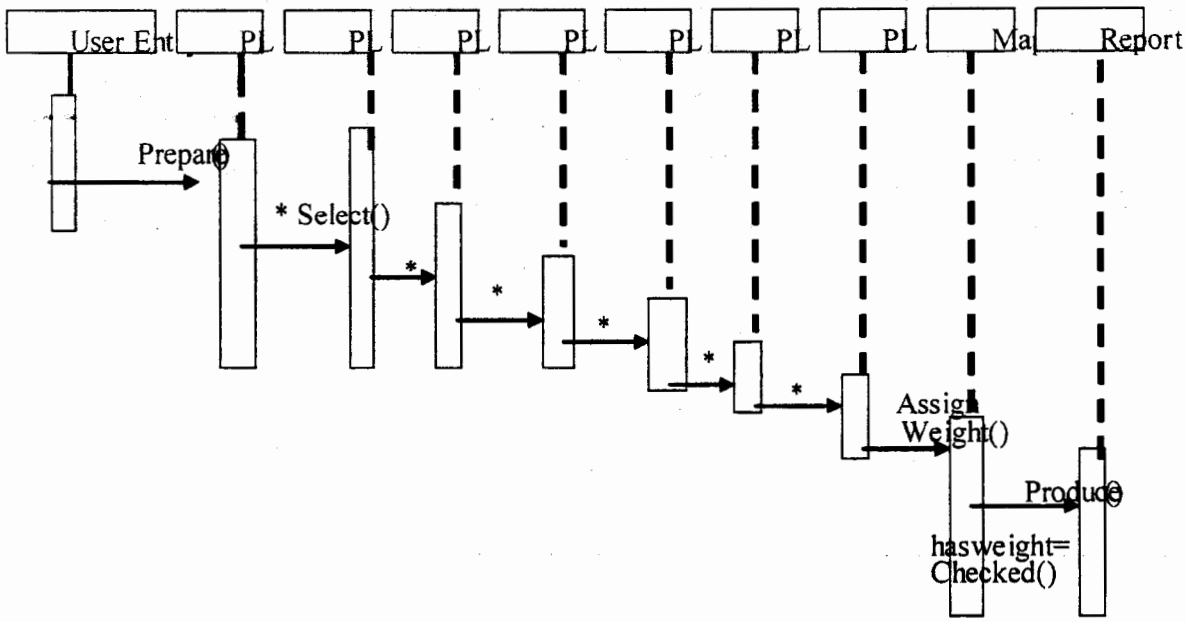
User class has four attributes, i.e. name, email address, disclaimer acceptance and expertise level. Character is the data type for name and email, logical for accept trigger, and integer for level ranging from 1 to 9. There is no default value for any attribute. Update the record set is the only operation with friendly access modifier.
Questionnaire class has six attributes, i.e. planning sub-process level, PRINCE typical artifact, work product of CMMI, relevance of best match in percentage, questions about PRINCE artifact and answer to these questions. Character is the data type for artifact, work-product, question and answer, and integer for PL ranging from 1 to 7, relevance with given range of 0,10,20,30,40,50,60,70,80,99. There is no default value for any attribute. Assign

weight and best match are the operations performs on PL objects with friendly access modifier. Questionnaire class is further associated with mapper class.
Mapper class has one attribute, i.e. status of typical artifact of PRINCE with string data type having no default value. Mapping weight and result are the described operations for report object.



Class diagram (Fig. 5.8)

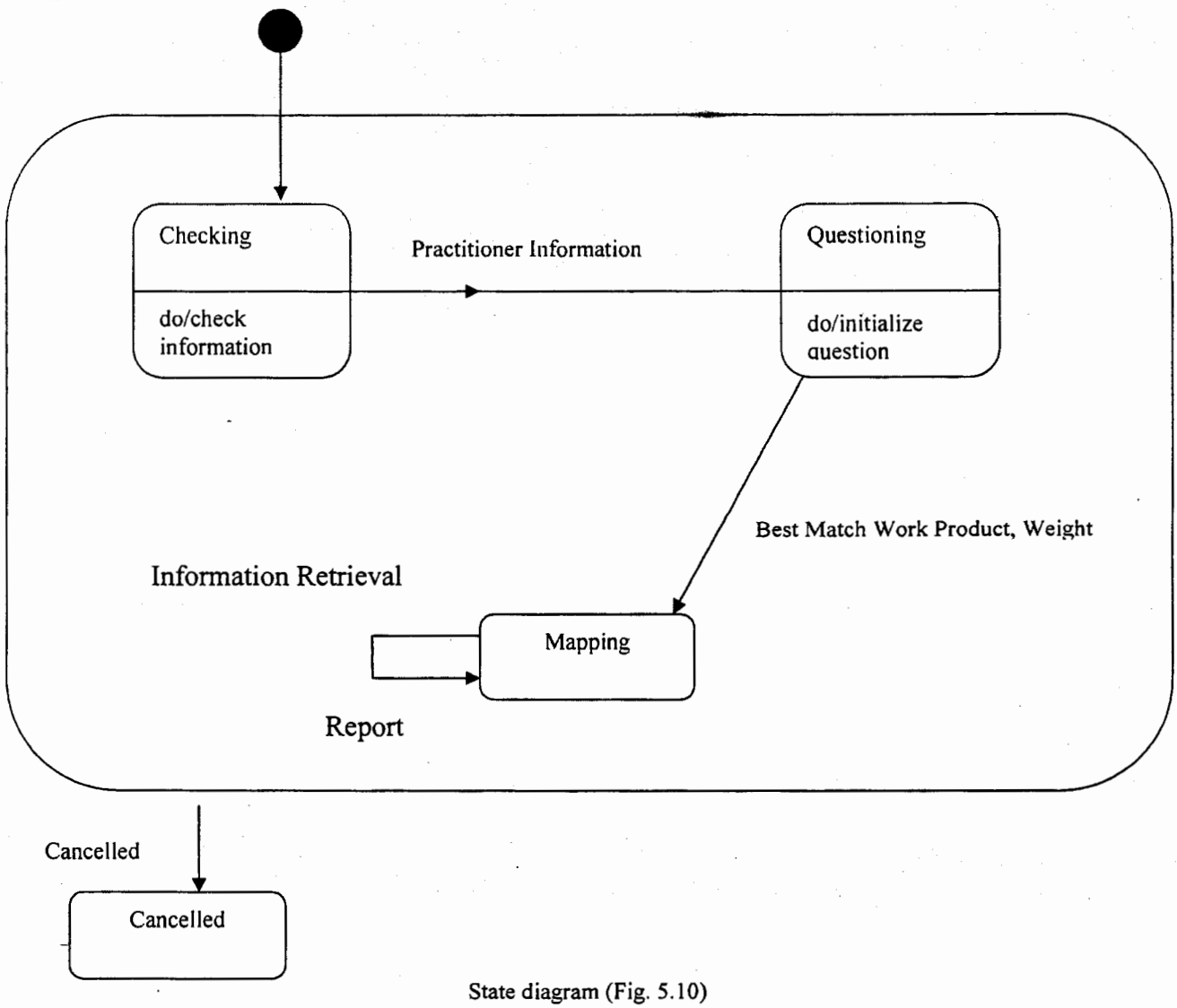
Figure 5.9 shows the sequence diagram, in which messages are passed between ten objects within the use case. Objects are user entry, pl1 to pl7, map and report. Vertical line shows the life line (object's life during interaction) of an object. Prepare, select, assign weight and produce are messages that travel along with arrowed line. Asterisk sign shows the iteration of select message among planning sub-processes. A condition; "hasweight=check()" is performed on selected work products of CMMI before the message to produce report passed to report object from map object.



Sequence diagram (Fig. 5.9)

Figure 5.10 shows the state diagram with superstate to describe the behavior of the system. There are four states, i.e. checking, questioning, mapping, and cancelled. There is no guard (logical) transition. Checking state has the activity to validate the user information. Questioning state has the activity to ask questions. Cancelled state is taken as outside to superstate with cancelled action.

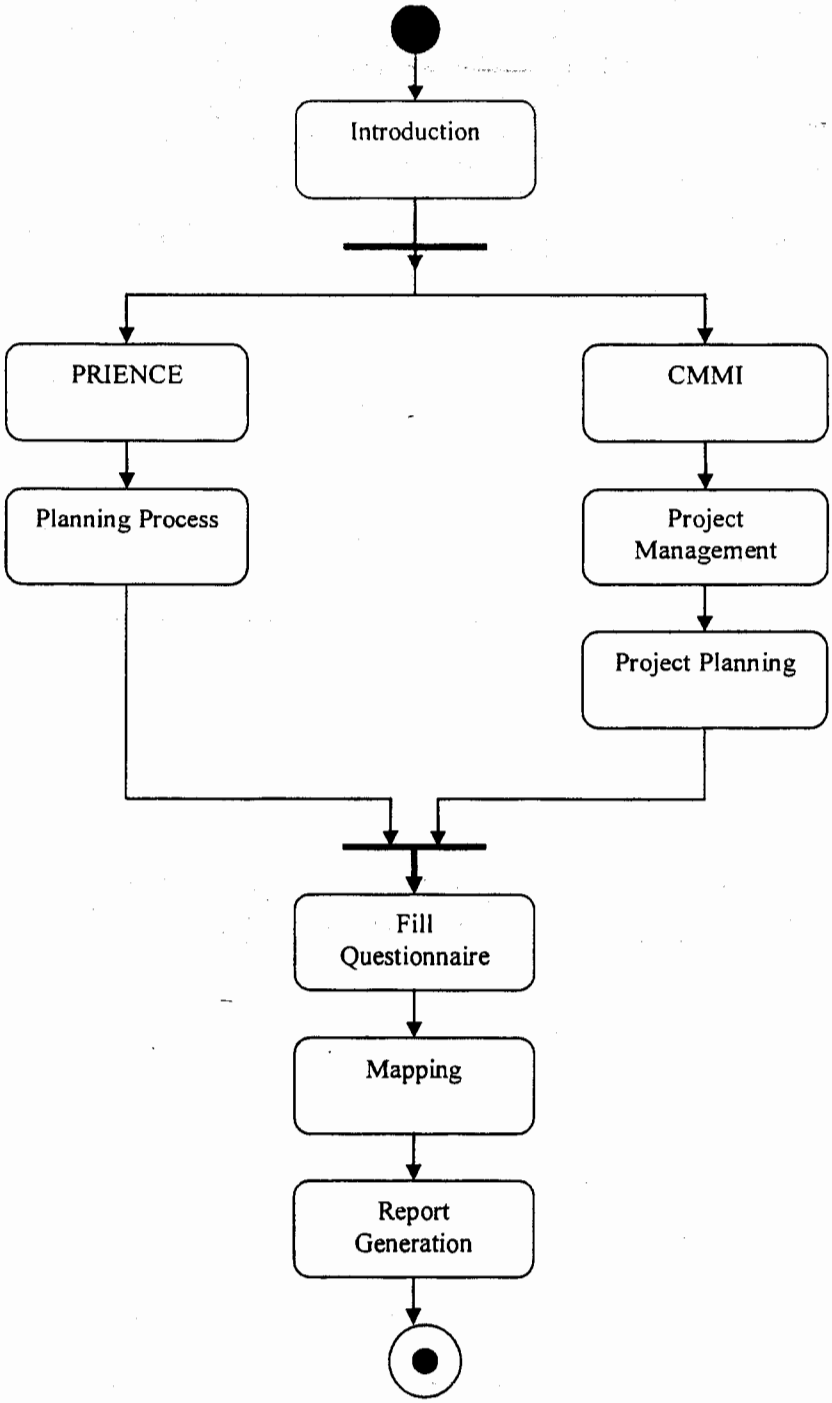
Events are performed with transition from one state to another state. Report generation is an event needs to perform by mapping state based upon the information retrieval transition. After the provision of practitioner information to questioning state, initiate activity will take place. And when best match of work product with specific relevance action is performed only then report generation event will take place.



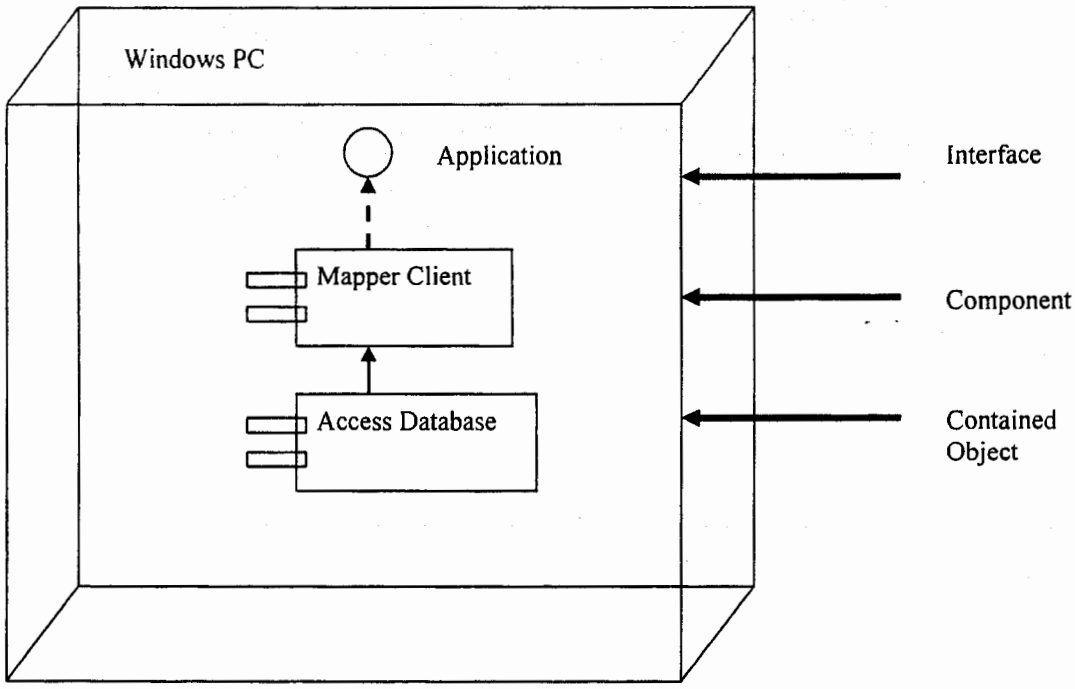
State diagram (Fig. 5.10)

Figure 5.11 shows the activity diagram to understand the workflow. Nine activities are shown; introduction, PRINCE, CMMI, planning process, project management, project planning, fill questionnaire, mapping and report generation. Diagram contains one fork, join and there is no merge. Activities start from introduction and ends upon report generation activity.

Figure 5.12 shows the deployment diagram to understand the physical installation of the components of the system and their dependencies. Database and mapper components runs on a personnel computer with Microsoft window as system software. Database not essentially required the database table platform. Access database object needs to communicate with the client component of the application to provide the updated information to user on the same machine.

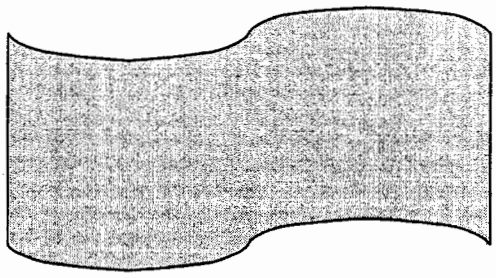


Activity diagram (Fig. 5.11)



Deployment diagram (Fig. 5.12)

Chapter 6



SOFTWARE DEVELOPMENT

6. Software Development

Microsoft Visual Basic® 6.0 enterprise edition and Access 2003 are being used as development technologies. Windows 2000 Server (Service pack 4) is the selected system software environment. Visual Source Safe 6.0 was used as configuration management tool, Project Server as Project Planning and Tracking tool. Structured software development technique was followed with Linear Sequential application development process model. Only Constraints was of the Windows operating environment.

6.1 Functionality

Software application will act as a mapper for the real-world understanding of the Planning phases both in PRINCE 2 & CMMI 1.1. Initially, in the execution of the program, the application will introduce the user with the standards & planning concepts in respective standards. Graphical representation will help the customer to make the better understanding. This relevant knowledge will allow the user to the proper selection of the "work products" against the typical artifacts of the PRINCE 2 planning process. Later on, a mapping report will provide conclusion to the user on transition methodology.

For the ease and comfort usage to the customers, Graphical User Interface (GUI) is being used. Proper labels are embedded on the buttons and combo boxes for the easy selection. Graphical representation plays important role to improve the navigation of the application. Keeping in mind the human difficulties, light colors and readable text fonts/styles are beings applied throughout the application. Simplified English language is use to display the error messages. Install program is developed with minimum dependency of the system files and memory.

Exception handler is written for the avoidance of the unforeseen events. Application is made structured, by having optimum size code modules and files. Logical names are used for the variable declaration and files name. Comments are written in all code modules. Relative path selection is adopted for files integrity.

6.1.1 Database

In Microsoft Access 2003, as backend database tool, we had developed a database to control & integrate of the user-selected values to tables. PRINCE 2 Planning process, task's typical artifacts are hard coded in the table with an auto number as primary key. In total, database contains 152 fields in eight tables. ActiveX Data Object Data Control (ADODC) is used as connection mechanism of the database to the scripting language. Table 6.1 shows the detail design of complete database.

Database design (Table 6.1)

Table	Fields	Data Type	Description
Map	PL1-1	Character	Status of Typical artifact, i.e. Project Approach of designing a plan process
	PL1-2	Character	Project Quality Plan

	PL1-3	Character	Company Planning Standards
	PL1-4	Character	Project Brief (or PID)
	PL1-5	Character	Plan Design
	PL2-1	Character	Plan Design
	PL2-2	Character	Project Quality Plan
	PL2-3	Character	Project Breakdown Structure
	PL2-4	Character	Product Descriptions/CI records
	PL2-5	Character	Product Checklist
	PL2-6	Character	Product Flow Diagram
	PL3-1	Character	Product Flow Diagram
	PL3-2	Character	Product Descriptions
	PL3-3	Character	Risk Log
	PL3-4	Character	List of Activities
	PL3-5	Character	Activity Dependencies
	PL4-1	Character	All Planning Information so far
	PL4-2	Character	Activities Estimates
	PL5-1	Character	Activities Estimates
	PL5-2	Character	Activity Dependencies
	PL5-3	Character	Resource Availability
	PL5-4	Character	Schedule
	PL6-1	Character	All Previously Planned Information
	PL6-2	Character	Risk Log
	PL7-1	Character	Assessed Plan
	PL7-2	Character	Product Checklist
	PL7-3	Character	Completed Plan for Approval
	Auto	Auto Number	Primary Key

Table	Fields	Data Type	Description
PL-2	Required1	Boolean	Typical artifact is required or not?
	Required2	Boolean	Typical artifact is required or not?
	Required3	Boolean	Typical artifact is required or not?
	Required4	Boolean	Typical artifact is required or not?
	Required5	Boolean	Typical artifact is required or not?
	Required6	Boolean	Typical artifact is required or not?
	Selection1	Character	Selection of work product
	Selection2	Character	Selection of work product
	Selection3	Character	Selection of work product
	Selection4	Character	Selection of work product
	Selection5	Character	Selection of work product
	Selection 6	Character	Selection of work product
	Relevance1	Integer	Weight in percentage
	Relevance2	Integer	Weight in percentage
	Relevance3	Integer	Weight in percentage
	Relevance4	Integer	Weight in percentage
	Relevance5	Integer	Weight in percentage
	Relevance6	Integer	Weight in percentage
	QA 1	Boolean	Answer to question
	QA 2	Boolean	Answer to question
	QA 3	Boolean	Answer to question
	QA 4	Boolean	Answer to question
	QA 5	Boolean	Answer to question
	QA 6	Boolean	Answer to question
	QA 7	Boolean	Answer to question

	Auto	Auto Number	Primary Key

Table	Fields	Data Type	Description
PL-3	Required1	Boolean	Typical artifact is required or not?
	Required2	Boolean	Typical artifact is required or not?
	Required3	Boolean	Typical artifact is required or not?
	Required4	Boolean	Typical artifact is required or not?
	Required5	Boolean	Typical artifact is required or not?
	Selection1	Character	Selection of work product
	Selection2	Character	Selection of work product
	Selection3	Character	Selection of work product
	Selection4	Character	Selection of work product
	Selection5	Character	Selection of work product
	Relevance1	Integer	Weight in percentage
	Relevance2	Integer	Weight in percentage
	Relevance3	Integer	Weight in percentage
	Relevance4	Integer	Weight in percentage
	Relevance5	Integer	Weight in percentage
	QA 1	Boolean	Answer to question
	QA 2	Boolean	Answer to question
	QA 3	Boolean	Answer to question
	QA 4	Boolean	Answer to question
	QA 5	Boolean	Answer to question
	Auto	Auto Number	Primary Key

Table	Fields	Data Type	Description
PL-4	Required1	Boolean	Typical artifact is required or not?
	Required2	Boolean	Typical artifact is required or not?
	Selection1	Character	Selection of work product
	Selection2	Character	Selection of work product
	Relevance1	Integer	Weight in percentage
	Relevance2	Integer	Weight in percentage
	QA 1	Boolean	Answer to question
	QA 2	Boolean	Answer to question
	QA 3	Boolean	Answer to question
	Auto	Auto Number	Primary Key

Table	Fields	Data Type	Description
PL-5	Required1	Boolean	Typical artifact is required or not?
	Required2	Boolean	Typical artifact is required or not?
	Required3	Boolean	Typical artifact is required or not?
	Required4	Boolean	Typical artifact is required or not?
	Selection1	Character	Selection of work product
	Selection2	Character	Selection of work product
	Selection3	Character	Selection of work product
	Selection4	Character	Selection of work product
	Relevance1	Integer	Weight in percentage
	Relevance2	Integer	Weight in percentage
	Relevance3	Integer	Weight in percentage
	Relevance4	Integer	Weight in percentage
	QA 1	Boolean	Answer to question

	QA 2	Boolean	Answer to question
	QA 3	Boolean	Answer to question
	QA 4	Boolean	Answer to question
	QA 5	Boolean	Answer to question
	QA 6	Boolean	Answer to question
	QA 7	Boolean	Answer to question
	Auto	Auto Number	Primary Key

Table	Fields	Data Type	Description
PL-6	Required1	Boolean	Typical artifact is required or not?
	Required2	Boolean	Typical artifact is required or not?
	Selection1	Character	Selection of work product
	Selection2	Character	Selection of work product
	Relevance1	Integer	Weight in percentage
	Relevance2	Integer	Weight in percentage
	QA 1	Boolean	Answer to question
	QA 2	Boolean	Answer to question
	QA 3	Boolean	Answer to question
	Auto	Auto Number	Primary Key

Table	Fields	Data Type	Description
PL-7	Required1	Boolean	Typical artifact is required or not?
	Required2	Boolean	Typical artifact is required or not?
	Required3	Boolean	Typical artifact is required or not?
	Selection1	Character	Selection of work product
	Selection2	Character	Selection of work product
	Selection3	Character	Selection of work product
	Relevance1	Integer	Weight in percentage
	Relevance2	Integer	Weight in percentage
	Relevance3	Integer	Weight in percentage
	QA 1	Boolean	Answer to question
	QA 2	Boolean	Answer to question
	QA 3	Boolean	Answer to question
	Auto	Auto Number	Primary Key

6.1.2 Report Generation

After the successful selection of the different statuses of the selected CMMI's Work Products with relevance against PRINCE's Typical Artifacts, system will generate a mapping report. This report can be saved in html or notepad format. User can also print that report for future use. Report incorporates the coloring schemes for better view.

6.2 User's Manual

It is important to know the following information before discussing the user's manual in detail.

System Requirement(s)

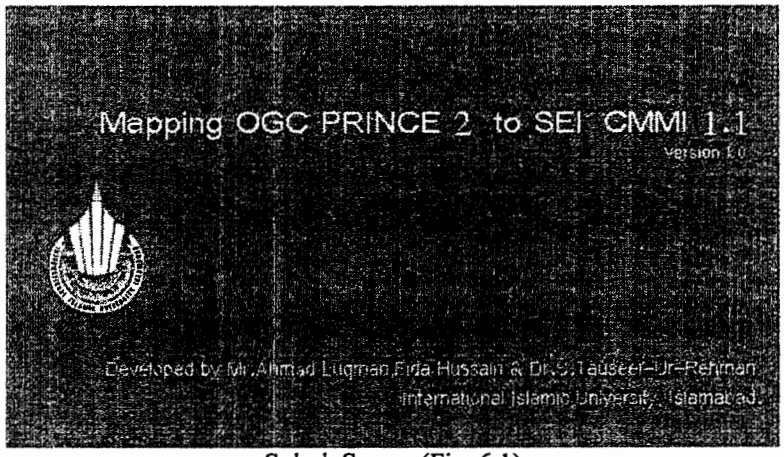
Pentium II or higher
128 MB of RAM

50 MB free space
1024x768, 32 Highest bit colors is recommended resolution
Windows 2000 Professional edition or higher
Internet Explorer 5.0 or higher

Size

61 MB (98 files, 8 folders)

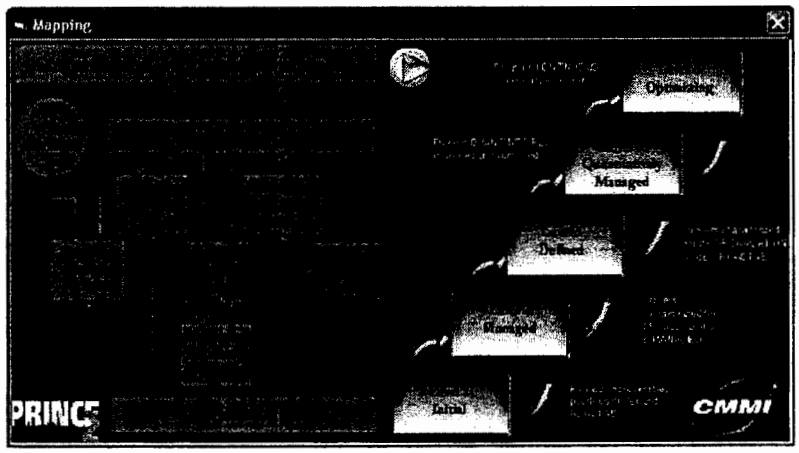
After the successful installation, execute the program.



Splash Screen (Fig. 6.1)

Splash Screen

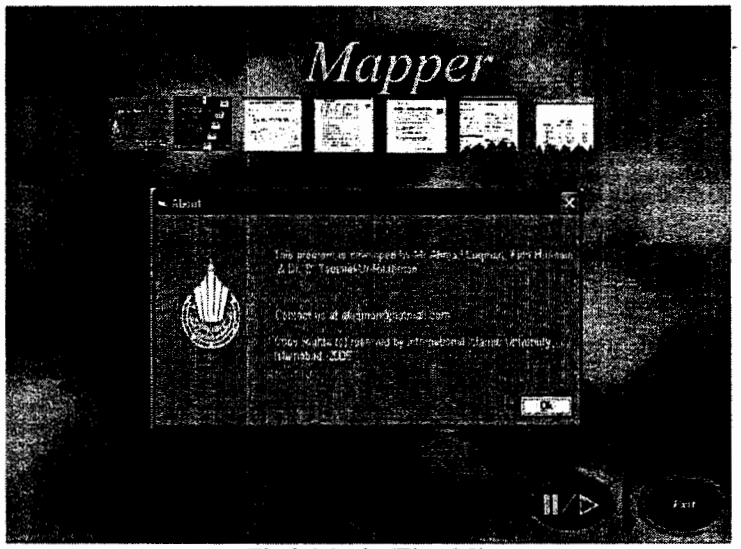
First screen that appears is the splash screen (Fig. 6.1) in light blue color. This screen shows the version number of the software (Mapping OGC-PRINCE 2 to SEI-CMMI 1.1). On the left panel of the screen, university logo is displayed. Screen also shows the development team.



Introduction Screen (Fig. 6.2)

Introduction Screen

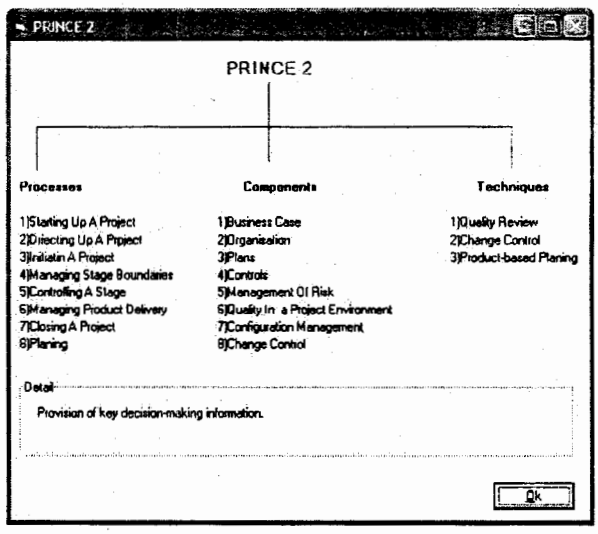
Immediately after the Splash screen the Introduction screen (Fig. 6.2) will appear. This screen displays the abstract information as background images for PRINCE 2 & CMMI 1.1. Background image clearly displays the Staged representation of CMMI and eight Processes of PRINCE. On the left corner of the screen there is link to PRINCE 2 details; link is being developed on PRINCE 2 registered trademark, whereas on the right side of the screen there is link to CMMI details too. That is also developed on CMMI 1.1 registered service mark. When we click on any of these two links we will be further forwarded to respective standards detail. There is another button whose icon is same like as windows media player picture. When we click on this button the flash demo will be started in a new maximized window.



Flash Movie (Fig. 6.3)

Flash Demo

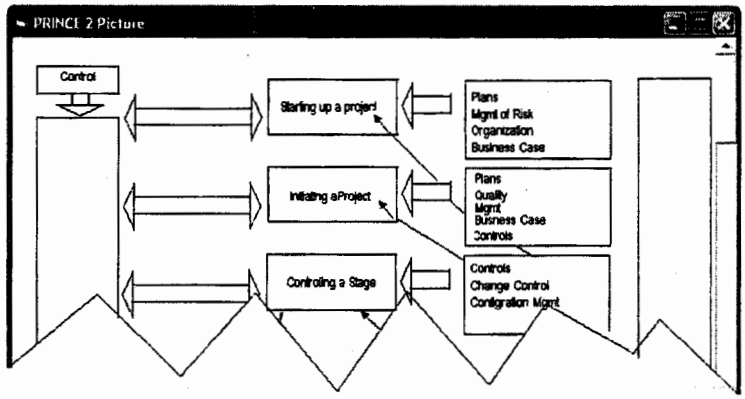
If we click on the 'Window media player icon' in introduction screen, the icon is further linked to the software demo (Fig. 6.3) that is prepared in "Macromedia Flash 6.0 MX". The purpose of demo is to provide the general information about the functioning and flow of the application. Demo is divided into five parts named by "How to install", "PRINCE 2", "CMMI 1.1", "Database", and "Mapper". All the relevant headings are presented in light brownish color. All frames appear by zoom-in style and after this they are adjusted automatically. After "how to install "screen the "CMMI 1.1" screen comes. This screen shows that what is included in this section. The CMMI 1.1 section shows all the screens of the software which come under CMMI in sequence. After CMMI 1.1 the PRICE 2 section is being displayed. Remaining sections shows their part of software in the same way for database and mapper. In this demo we see that there is an exit and play / pause buttons at the right bottom corner of the demo application. Exit button is blinking continuously. Exit button is in blue color. If we want to exit at any time then we need to click on that button. Play button is by-default selected, whereas by the selection of pause button, the movie gets stop and resume by clicking the play button.



PRINCE 2 Screen (Fig. 6.4)

PRINCE 2 Screen

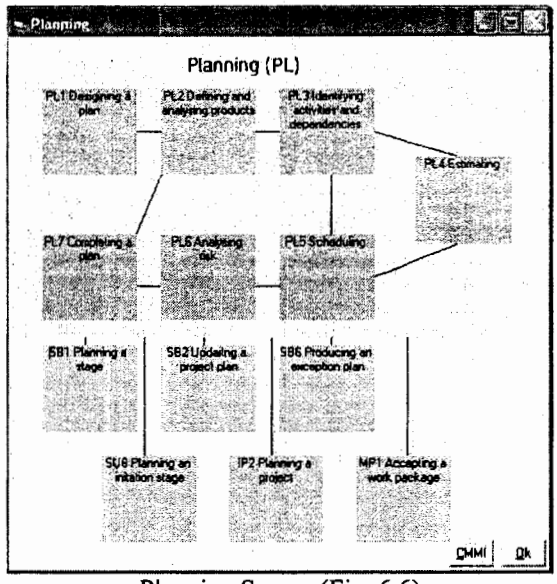
If we click on PRINCE 2 link on introduction screen, we will reach on the PRINCE 2 screen (Fig. 6.4). Here we see the hierarchal structure of PRINCE 2. Main headings are of processes, components and techniques. These headings further include relevant points. When we move the mouse cursor over them we will see the description of the topic in the detail pane. There is an Ok (Alt + O) button to jump to Planning screen. We can also use the other path by click on the Planning topic (that is already in blue color) under processes heading to go to the Planning screen. And if we click on the main heading of the screen (PRINCE 2) we reach to a graphical representation of concerned standard.



PRINCE 2 Picture Screen (Fig. 6.5)

PRINCE 2 Picture Screen

Picture screen elaborates the interconnections of the processes, components and techniques of PRINCE 2. If we click on the picture, the screen will be disappeared & the control comes to previous position. Here PRNCE 2 picture (Fig. 6.5) is cut down for the sake of reducing the user's manual size.

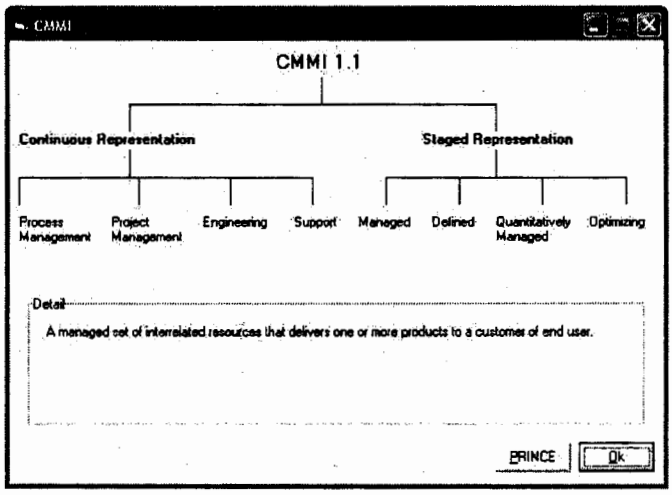


Planning Screen (Fig. 6.6)

Planning Screen

If we select the OK button or 'Planning' link on PRINCE 2 screen, we will be able to reach on Planning screen (Fig. 6.6), there are seven tasks/phases on the screen. This screen shows that panning process is divided into seven parts and how they are connected to each other. Planning sub-processes are in dark yellow squares with gray background. Where as related sub-processes are in blue squares.

Now you have two paths ahead, if we click on the Ok (Alt + O) button then we will be transited to the 'Mapping' screen, and if we click on CMMI (Alt + C) button then we will be guided to the CMMI screen.

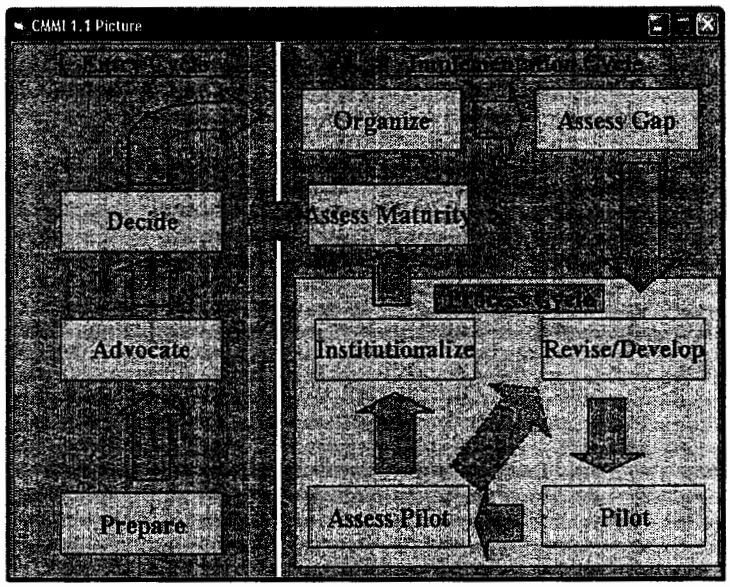


CMMI Screen (Fig. 6.7)

CMMI Screen

Similar to PRINCE 2 screen, on CMMI screen (Fig. 6.7) there is a hierarchal structure of CMMI 1.1 is displayed. On the top CMMI is represented by two categories; Continuous and Staged. Further division is the detail of respective representation. The main heading of this screen is CMMI, which is linked to a picture. Under the continuous representation, Project Management is linked to Project Management screen. When we move the mouse cursor over embedded text, then we can see the description of the topic in the detail pane. There is an Ok (Alt + O) button to jump to Project Management screen. Another button is of PRINCE (Alt + P) that is being linked to PRINCE 2 main screen.

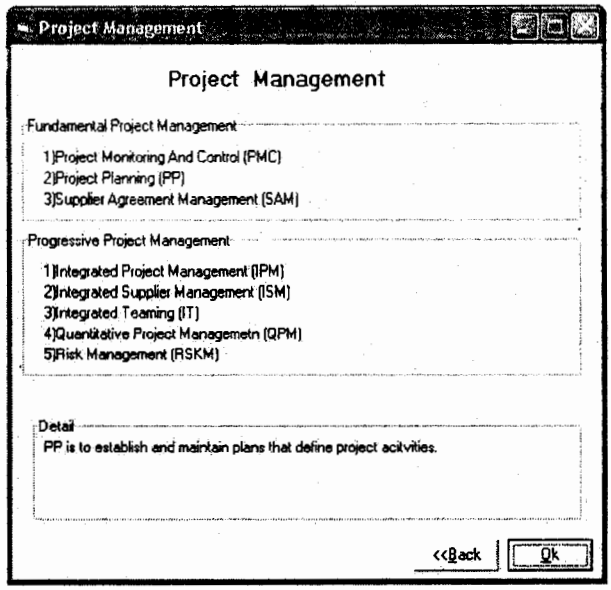
All the application screens are center-aligned to improve the visibility and light brown color is used as background throughout the application. To avoid the text truncation, the screen maximize button is de-activated for all application.



CMMI 1.1Picture Screen (Fig. 6.8)

CMMI 1.1 Picture Screen

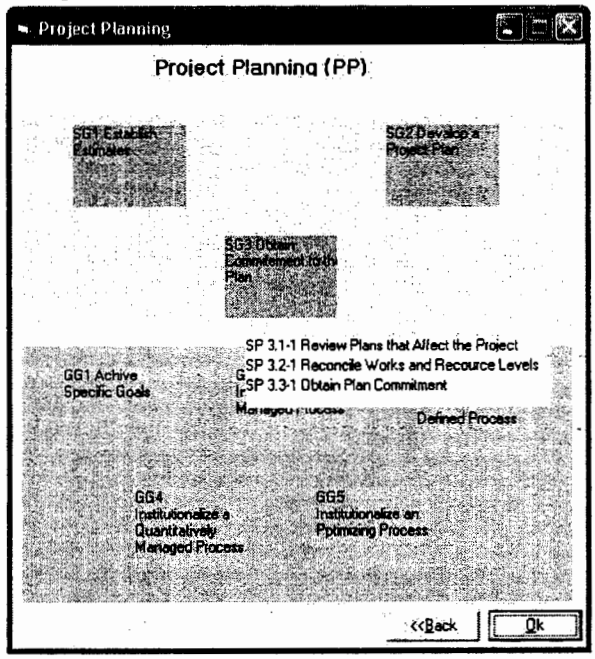
If we click on the CMMI 1.1 text on CMMI main screen, we will be reaches to CMMI 1.1 Picture screen (Fig. 6.8). If we click on the picture, the screen will be disappeared & the control comes to previous screen. This screen got a comprehensive image about the CMMI implementation.



Project Management Screen (Fig. 6.9)

Project Management Screen

Project Management screen (Fig. 6.9) is an important one for CMMI understanding. To make consistency, same style is applied on this screen. Two text areas are having information about the two categories of project management. In fundamental project management category 'Project Planning' is only click able. When we move the mouse cursor over embedded text, then we can see the further description of the topic in the detail pane. There is an Ok (Alt + O) button to jump to Project Planning screen. Another button is of <<Back (Alt + B) that will allow us to go to previous screen of CMMI. '<<' is also an indication for the linkage to previous section.

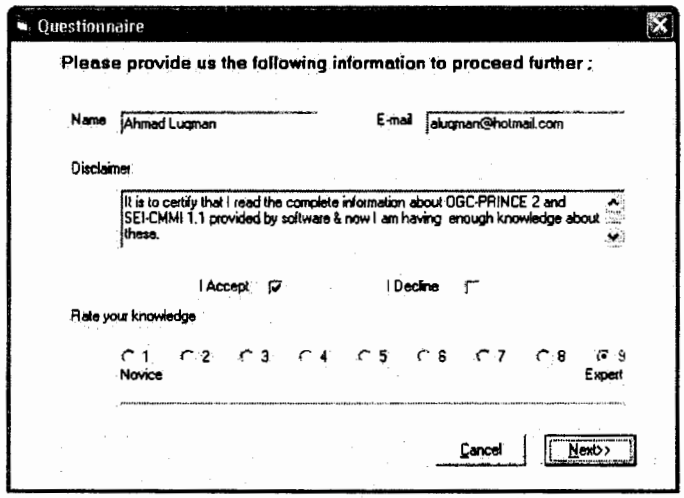


Project Planning Screen (Fig. 6.10)

Project Planning Screen

One of the most informative screens, Project Planning screen (Fig. 6.10) contains the Specific & General goals. There are eight squares, divided into two groups. Three squares in dark yellow color represents the specific goals and remaining five squares in dark gray color mentions the generic goals for project planning process area. There is an Ok (Alt + O) button, which is by-default selected to jump to 'Mapping' screen. Another button is of <<Back (Alt + B) that will allow us to go to previous screen of project management in CMMI.

A unique style is used to display the Specific / Generic practices of selected Specific / Generic goals. By clicking on a square, a popup will be displayed with respective practices of the goal.

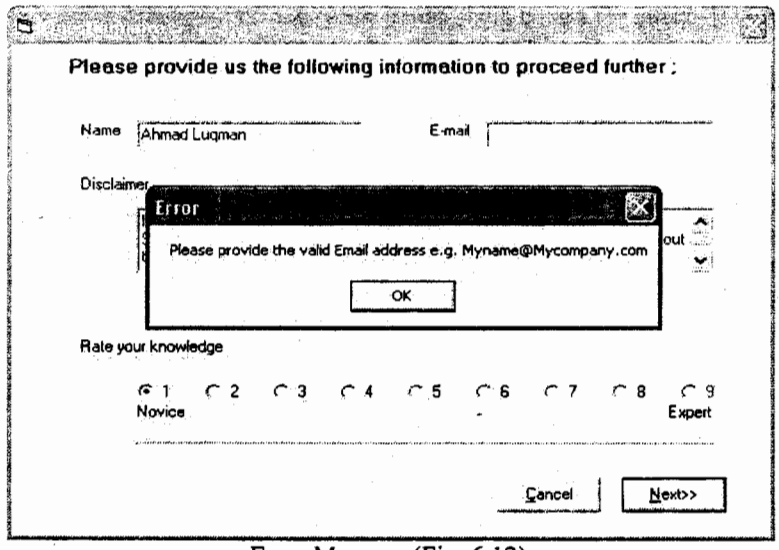


Questionnaire Screen (Fig. 6.11)

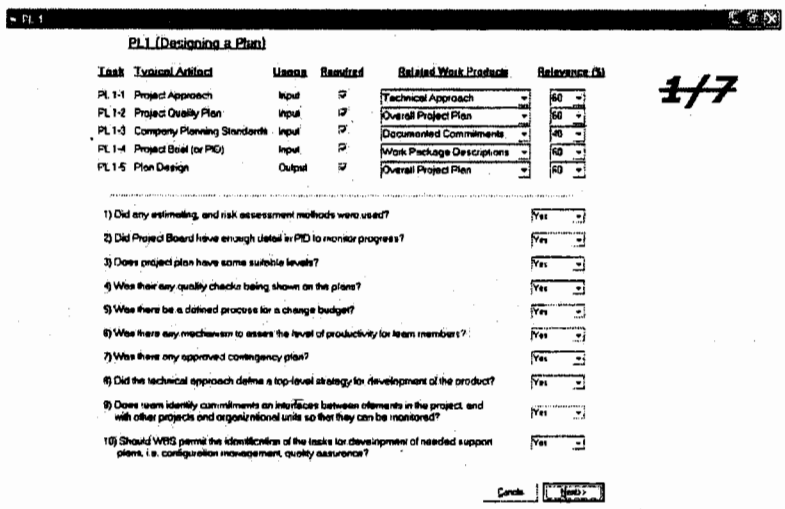
Questionnaire Screen

The purpose of questionnaire (Fig. 6.11) is to get the practitioner information. This screen appears after the PP & PL screens. In this screen the user has to enter his name and valid email address. Then s/he must agree to lay down terms and conditions. If user does not agree the terms and conditions then s/he has to click "I decline" and in case if s/he selects "I decline" then s/he will be directed towards the introduction screen.

When "I accept" is selected against the disclaimer, then different expertise levels turns activated and user can select any one of these levels. Different levels ranging from 1 to 9 shows the expert level; one is lowest and nine is the most expert one. After the selection of levels user can either clicks on the cancel or next button. If cancel button is selected then s/he will be forwarded to introduction screen. By clicking on the next button the user will see the pl-1 screen. Next>> (Alt + N) button is by-default selected. If the user has entered the incorrect email address or if s/he does not provides his name then s/he will be asked for "your must provide the valid information" (Fig. 6.12).



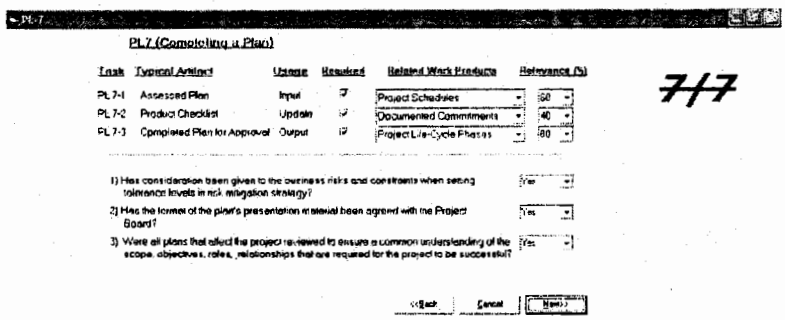
Error Message (Fig. 6.12)



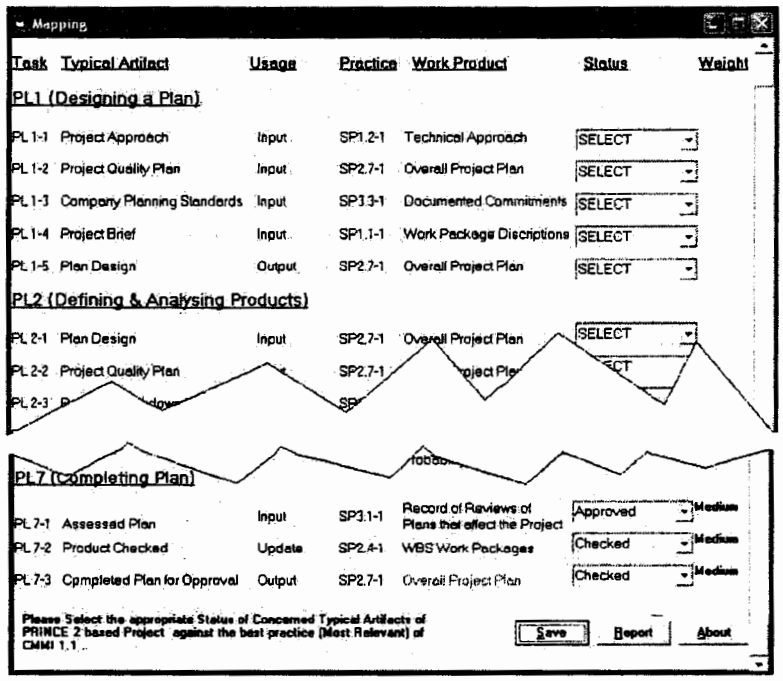
PL-1/7 (Fig. 6.13)

PL 1/7

This is the second screen (Fig. 6.13) of questionnaire. Screen is labeled as by 1/7, written at right top corner. There are 6 columns named by "tasks" ,"typical artifacts", "usage", "required", "relevant work product" and "relevance %". If the user wants to select any work product then he must select the required checkbox to enable the work product and relevance combo boxes. Relevant work product column contains the most relevant work products of CMMI against the specific typical artifact of PRINCE based upon case studies. Relevance (in percentage) helps the user to assign weights, in given range (0, 10,20,30,40,50,60,70,80,99). In the lower part of the screen, user needs to answer several questions. Questions can be answered in three options, i.e. yes, No, or N/A.
The screen layout remains same across other questionnaire screens up till PL-7/7 (Fig. 6.14). When the user finishes filling the questionnaire form then s/he will be guided to mapping screen.



PL-7/7 (Fig. 6.14)



Mapping Screen (Fig. 6.15)

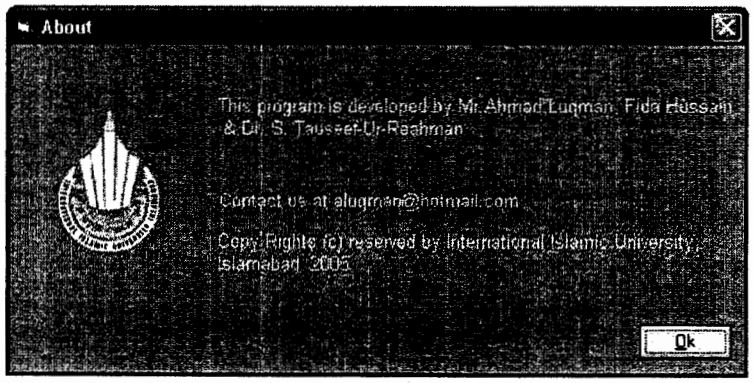
Mapping Screen

Mapping screen (Fig. 6.15) is the most important screen, where several data validation checks and algorithms are being implemented. This large form needs to be filled out by user. Vertical horizontal bar is used to drag the page down & up. In mapping screen questionnaire, we have seven columns;

1. Task (7 Sub processes of OGC PRINCE 2 Planning Process)
2. Typical Artifact (27 management information needs)
3. Usage (use of artifact, either input, output or update)
4. Practice (most related Specific / Generic practices of SEI CMMI 1.1 Project Planning, in three colors i.e. red-irrelevant, blue-relevant & green-most relevant)
5. Work Product (selected output of specific / generic practices)
6. Status (User needs to select the current status of the PRINCE 2's typical artifacts from combo box. Combo box label is by-default written as 'Select'. Predefined values in combo box are; Not Applicable, Not Initiated, Initiated, Incomplete, Complete, Checked, Verified, Approved, Baseline, Change Control, & Change Approved).

7. Weight (Four different kinds of categories are assigned depending upon the status of the work product against a typical artifact of a sub-task of PRINCE 2. Theses categories are; Nil (in Red color), Weak (in Yellow color), Medium (in Blue color) & Strong (in Green color)).

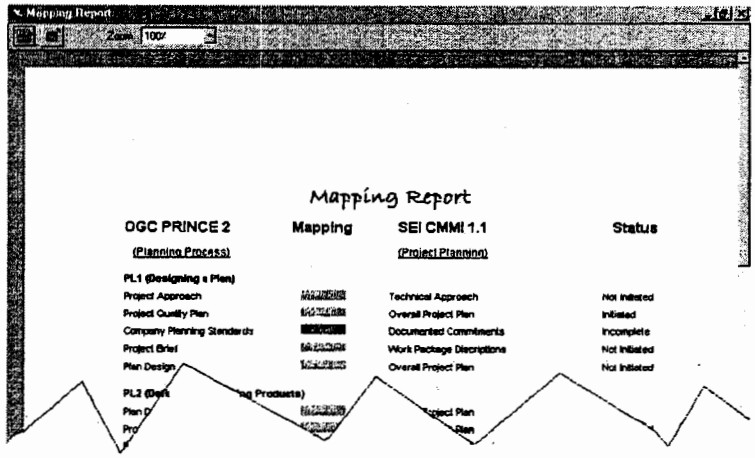
There is a message written in left down corner about the selection of status to user. When user selects the status values against all 27 artifacts, then he/she needs to save the values. For this purpose Save (Alt + S) button is used. Upon the savage, the values will be transmitted to 'mapping' database. When save button is clicked once, the next button (Report) that was de-active earlier gets active. For the generation of mapping report, user needs to click on Report (Alt + R) button. Mapping report will be displayed in new form. Last button is of About (Alt + A), that will proceeds the system towards about dialogue. Here Mapping screen picture is broken into two parts for the sake of reducing the user's manual size.

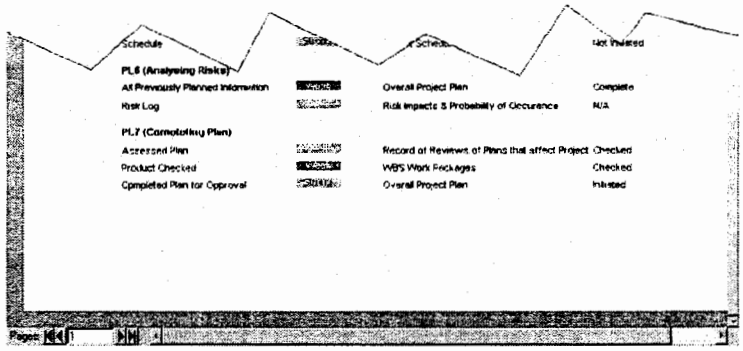


About Screen (Fig. 6.16)

About Screen

If we click on the About button (Alt + A) on the Mapping screen, we will be able to got the idea regarding the copy rights of the application, development team and their contact. About (Fig. 6.16) dialog box, shows the university logo on left hand. This dialog is can't be movable on the monitor screen. There is an Ok (Alt + O) button, which is by-default selected to close the dialog box.





Mapping Report Screen (Fig. 6.17)

Mapping Report Screen

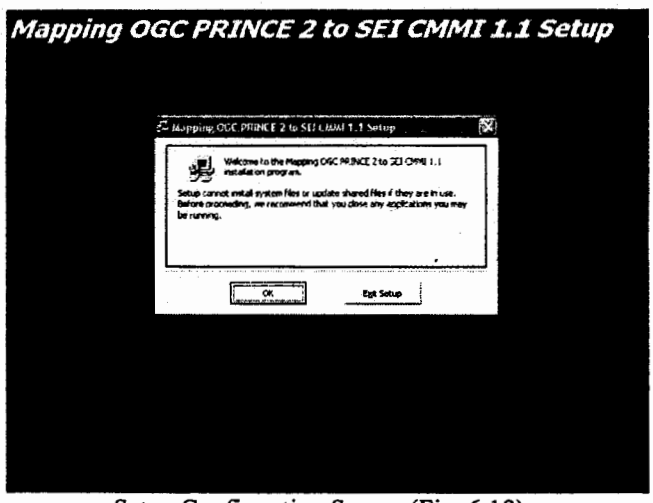
Last screen of the application is of 'Mapping report'. Report (Fig. 6.17) displays all the information about mapping of planning phases of two standards. In report, under the heading of '*Mapping Report*' we have four columns by the names of OGC PRINCE 2 Planning Process, Mapping, SEI CMMI 1.1 Project Planning and Status. First column lists the twenty seven typical artifacts of the specific tasks of PRINCE 2. Mapping column has three kinds of value, i.e. Strong, Medium and Weak. These values are written in white colors with respective background color. Background colors are red for weak, blue for medium and green for strong. Mapped work products of CMMI are in third column against specific typical artifacts. Last column of status fetches the values from the 'Mapping' database that the user had selected before.

To facilitate the further use, a user can print the report or he/she can export it in many formats (i.e. html, notepad, etc.) for further consultation. Instead of text we used computer images as icon to print or save the report. Report is by-default zoomed on 100%, where as user has the facility to view the report by 10%, 25%, 50%, 75%, 150%, 200% and on page fit size by selecting the zoom value from the zoom list. Vertical & horizontal bars will adjust the text movement. On the status bar, a data grid is used to display the current page of the report i.e. 1 and a user can navigate through the report by selecting up, down, end or start button on the data grid. Here Mapping report screen is broken into two parts for the sake of reducing the user's manual size.

6.3 Installation Guide

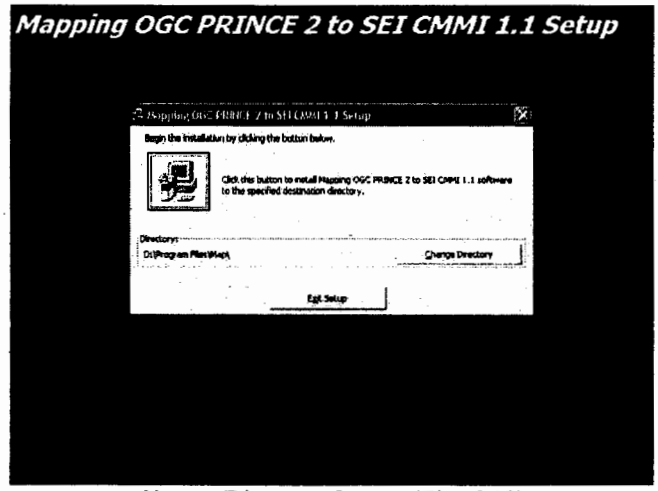
It is highly recommended that before continuing with installation of the application, please carefully read the "*Installation Procedure.txt*" file from Setup folder on CD. Few important instructions are;

1. Copy the "map" folder to c:\
2. Run the Setup.exe.
3. Now installer will guide you towards the smooth execution of the program.



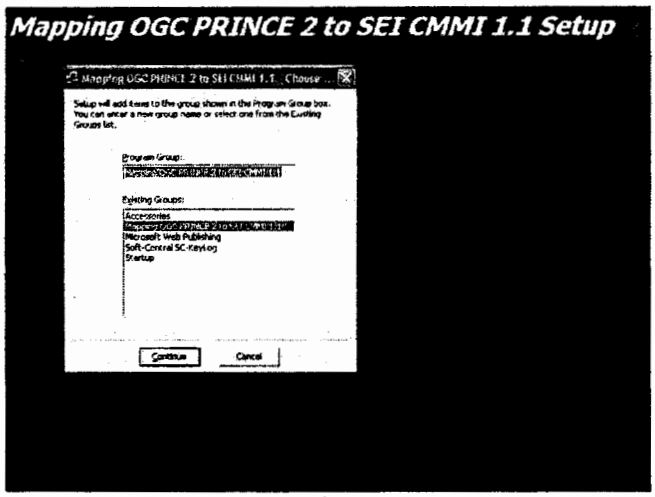
Setup Confirmation Screen (Fig. 6.18)

After double click the setup.exe, the install program will start executing. First screen (Fig. 6.18) will be of installation confirmation. Click Ok button to further proceed with Installer.



Change Directory Screen (Fig. 6.19)

Now installer will ask you to select the installation directory. Change the directory (Fig. 6.19), if you want and then click on setup icon/button in the dialog box.

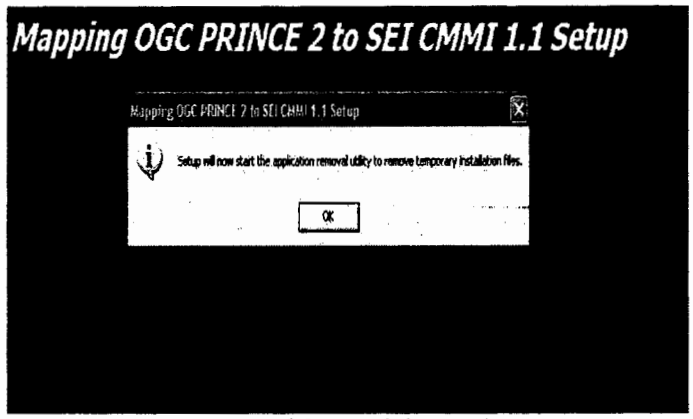


Program Group Screen (Fig. 6.20)

Third step is to select the program group (Fig. 6.20) (place of the shortcut of the program), few option are listed. Theses are startup, accessories etc.

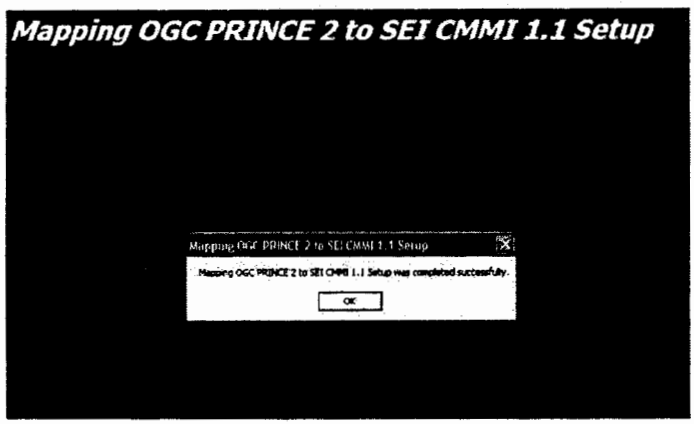
Status Screen (Fig. 6.21)

Fourth screen will indicate the user, that how much percent (Fig. 6.21) of the program is being installed. If user wants to abort, he/she can click on the Cancel button.



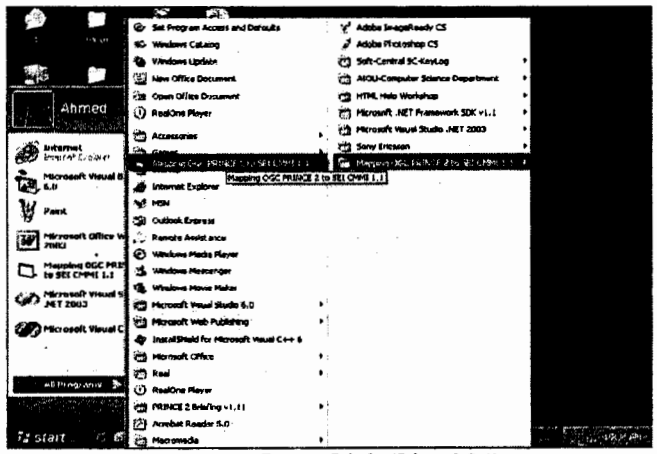
Removal Screen (Fig. 6.22)

If we want to remove or cancel the installation process then we need to click on the cancel button (that is already selected) during installation process. When we cancel the installation process the installer will confirm that application is removed (Fig. 6.22).



Setup Completion Screen (Fig. 6.23)

Last screen in the installation process is the confirmation of the successful (Fig. 6.23) installation.

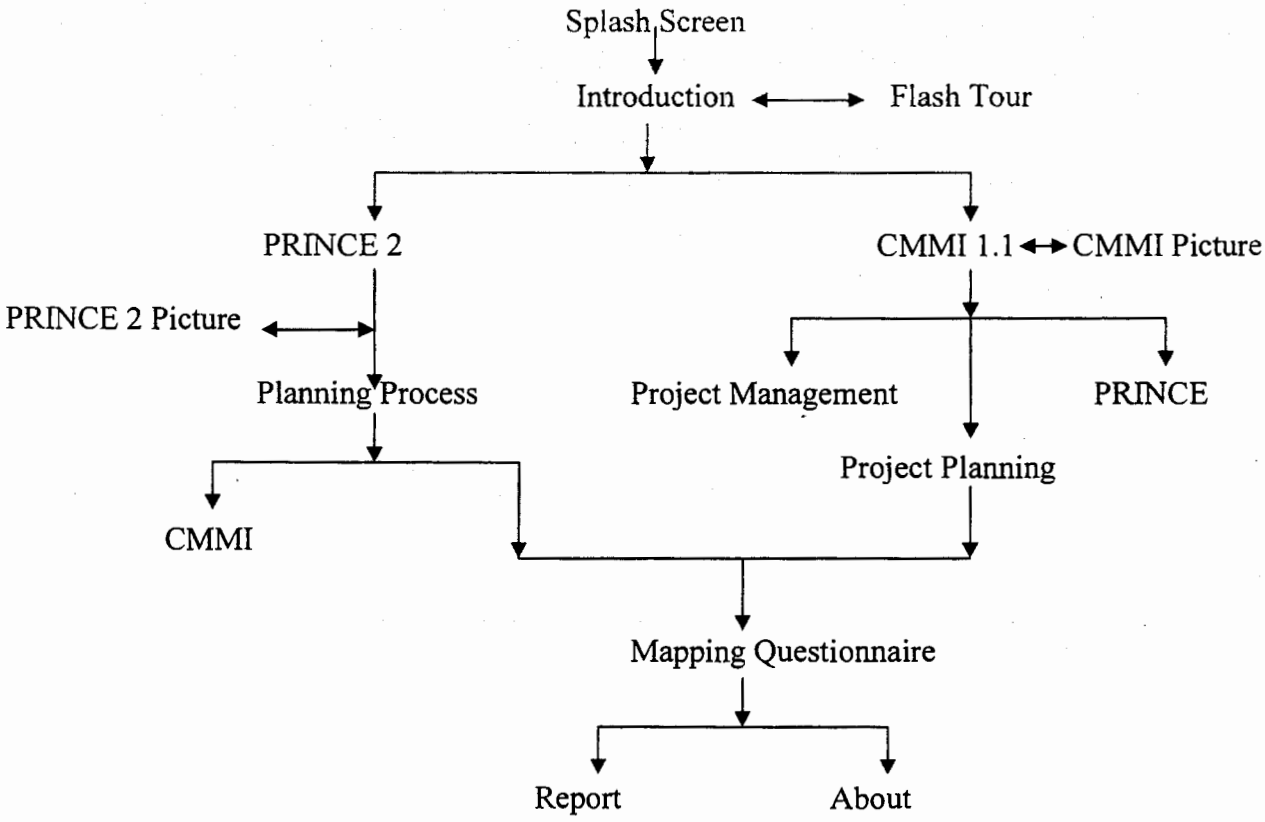


Program Group Link (Fig. 6.24)

When the application installed successfully then the shortcuts of the application will be placed in the programs group (Fig. 6.24). So we can access the application form the program group.

6.4 Application Map

Program flow always helps the novice user to understand the functionality and sequence of an application. Figure 6.25 shows the abstract level application flow. The mapping cycle starts with standards introduction screen and end upon the generation of mapping report. Key decisions are made on mapping questionnaire, especially on the list selection of the statuses of artifacts against work products to assign different categories.



Application Map (Fig. 6.25)

6.5 Testing

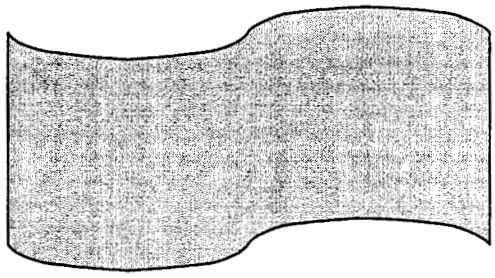
Software testing is one of the most important phases of software development life cycle. Beta testing is performed in automated testing tool using test scripts for RSW E-tester. Functional system testing is thoroughly executed after development of beta version. Code debugging and regression testing is performed on all versions of the application. To improve quality control Formal Technical Reviews (FTR) are being gathered from different professionals. Table 6.2 shows an example of the executed test case developed in quality control phase of application development.

Test Case (Table 6.2)

Test Case #	Mapper/v0.5/questionnaire/2
Execution Date & Time	24 Dec, 2005 18:34
Screen Name	Questionnaire.frm
Test Case Description	Does email address contain "@" and "." in the text field.
Expected Result	Email address must contain @ and dot, otherwise an error message should be displayed.
Actual Result	Email address verify the "@" validity but lacks to dot before the completion of the valid email address.
Error # in Bug Report	Questionnaire/1
How to Reproduce	1. Launch the questionnaire form.

	2. Click in the email text field. 3. Write an email address, e.g. aluqman@hotmail.com and then click on save button.
Attachment(s)	D:\bugs\v0.5\quest\email.jpg
Prepared by	Ahmad Luqman
Executed by	Fida Hussain
Comments	Error generated due to regression test on Windows XP (SP-II).

Chapter 7



CONCLUSION & FUTURE ENHANCEMENTS

7. Conclusion and Future Enhancement

Both OGC-PRINCE 2 and SEI-CMMI 1.1 are leading standards of the IT industry and are being followed worldwide. CMMI covers broader range of processes with emphasizing on quality aspects then PRINCE. Where as, PRINCE 2 have proven its presence in the market in UK industry [W2] since long compares to CMMI. CMMI has a long list of cliental, in few years. Around 125 organizations are on 'Optimizing' level [W1]. Most of them have adopted the staged representation to achieve the highest level of organizational quality standards. Now days CMMI came into competition with splendid achievements to Six-Sigma, Total Quality management (TQM), Software Process Improvement Capability dEtermination (SPICE) & TickIT.

SEI is the owner of the one of the largest information repository (Software Engineering Information Repository), which contains around hundred thousands of case studies, white papers and research paper presentations [W3]. No organization or individual has done any kind of research on the mapping/transformation/transition/comparison of these two standards before [Appendix B]. Segmented market for this research is comprised of the organizations that are PRINCE 2 certified or they have an intention of the adoption towards PRINCE 2. The planning phases in these two standards are most common to each other, because they are accomplishing the same task by different means. We have adopted the continuous representation, because it covers most of the generic goals as compared to staged representation.

7.1 Conclusion

Both PRINCE 2 and CMMI 1.1 continuous representation - project management process area addresses the project (product development) management by improved process management. Particularly the planning phase activities (depending upon the developing environment) in these standards are generally related to each other at higher level. Planning stage / phase dominates these standards on rest of the areas in project management. It is almost impossible that one can have exact one-to-one strong mapping and transition between these standards, because of different approaches that are being followed for accomplishment of the same task. But on the basis of experience and assessment, the gap between these two can be narrowed down to a reasonable extent.

7.2 Proposed Future Enhancements

Possible future research can be comprised upon the mapping of other areas of these two standards. One similar enhancement to this research is of; reverse mapping to this research 'Mapping SEI-CMMI 1.1 to OGC-PRINCE 2'. On the higher side, eight components, three different techniques and seven other processes of PRINCE 2 can be mapped to any individual or to whole categories of support, engineering, process management and other seven process areas of project management categories by using continuous representation or different levels such as defined, quantitatively managed,

optimizing of CMMI 1.1. An example can be of Configuration Management (CM) component of PRINCE 2 mapped to CM of managed stage in CMMI 1.1 or to CM of support process area.

The better understanding of transformation is only possible by discussing more case studies consist of complex scenarios. If any person or organization is interested to know more, please don't hesitate to contact us. The contacts of the official presence of these two noble organizations are as under;

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   United Kingdom.
   Phone: 0845 000 4999
   Email: ServiceDesk@ogc.gsi.gov.uk

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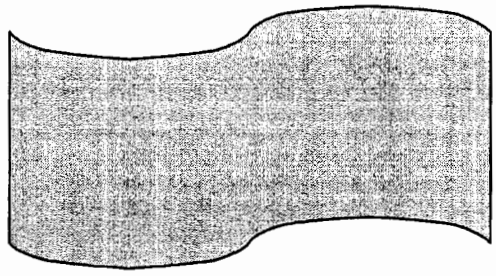
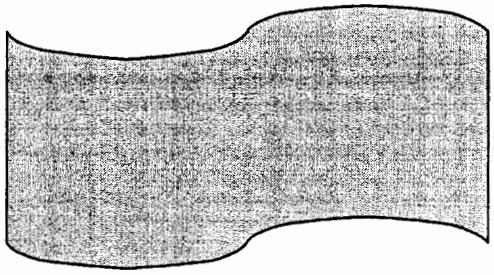
   Phone: 412-268-5800
   FAX: 412-268-5758
   Email: customer-relations@sei.cmu.edu

APPENDCIES



APPENDIX A



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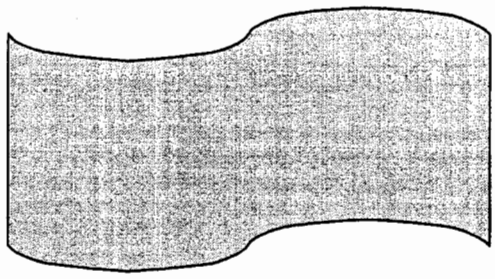
APPENDIX B



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EMT'05 Conference

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Reference # 150

Dear Ahmad Luqman,

We are pleased to inform you that your paper entitled "MAPPING OGC PRINCE2 TO SEI-SW-CMMI 1.1(Project Management (planning))" has been accepted for presentation and publication in the refereed conference proceedings at the *European Management and Technology Conference* in Rome, Italy on June 20 - 21, 2005. All papers are evaluated using a double blind reviewing process.

If you have restrictions on your availability and need special times and dates for your presentation we will try our best to assist you so that you may present your paper on the day that you request. Please e-mail us to make arrangements. About 2 weeks before the conference you will receive an e-mail with your exact date and time of your presentation.

Attached you will find the Conference Style Guidelines and a sample page to assist you in preparing your paper for publication. A registration form for the EMT'05 Conference is also enclosed which should be completed and returned in order for your paper to be included in the conference proceedings or you may also register online on our web site.

Thank you for considering the *European Management and Technology Conference* and congratulations on your successful research efforts.

Yours sincerely,

Dr. Chris Rose
Conference Chair

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Mapping OGC PRINCE 2 to SEI CMMI 1.1

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Abstract-The Capability Maturity Model Integration (CMMI) version 1.1, developed by the Software Engineering Institute (SEI), USA and the PRoject IN Controlled Environment (PRINCE) version 2 developed by Central Computing and Telecommunications Agency (CCTA) now Office of Government Commerce (OGC) as UK Government standard for IT Project Management, share a common concern with Project and Quality management by improved process management. Both are driven by similar concerns and intuitively correlated. Organizations concerned with PRINCE 2 certification often question its overlap with the CMMI. We have looked into OGC PRINCE 2 process/ components and map it to the different goals/ practices in the SEI CMMI 1.1[i]. Analysis provides answers to some common questions about the comparisons and mapping of these standards. The result of the analysis indicates that, although PRINCE 2-compliant organization would not necessarily satisfy all of the Process Areas of CMMI[ii], but it would satisfy most of the goals and practices of continuous representation. PRINCE 2 certified organizations would have generally significant advantages & less difficulty in obtaining CMMI certification.

In order to achieve good transformation there is a need of applying proper software metrics. These metrics needs to be implemented on each and every process / goal /Practice.

I. INTRODUCTION

It is always difficult to determine the appropriate granularity of maps between models. Mapping at a high level may not provide enough insight into similarities and differences. Mapping at a very low level, on the other hand, results in an overwhelming number of connections that also fails to properly illuminate model correspondence [1].

The map thus serves as an indicator of correspondence rather than as an implementation guideline. One should keep in mind that this is a one-to-many mapping, meaning that one Prince 2 sub-process correspond to more than one CMMI specific or generic practice. As with all mappings, it is subjective. Although maps are convenient, they cannot replace an understanding of the frameworks being mapped.

In Mapping, we are using traditional approach [2] for cross-reference of mentioned standards. A judgment of the strength of the correspondence is shown as: S – Strong match; M – Medium match; W – Weak match. Mapping table – 1 does not indicate a mapping between PRINCE 2 components and CMMI 1.1 generic / specific goals. This analysis is mainly based upon some leading organization's case studies [3 – 10] from different parts across the globe.

II. PRINCE

PRINCE® was first developed by the CCTA in 1989. Since its introduction, PRINCE has become widely used in both the public and private sectors and is now the UK's de facto standard for project management. Although PRINCE was originally developed for the needs of IT projects, the method has also been used on many non-IT projects. The latest version of the method, PRINCE 2, is designed to incorporate the requirements of existing users and to enhance the method towards a generic, best practice approach for the management of all types of projects. PRINCE 2 is a process-based approach for project management providing an easily tailored and scaleable method for the management of all types of projects. The method

[i] SW-CMMI

[ii] CMMI is a service mark of Carnegie Mellon University

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describes how a project is divided into manageable stages enabling efficient control of resources and regular progress monitoring throughout the project. The various roles and responsibilities for managing a project are fully described and are adaptable to suit the size and complexity of the project, and the skills of the organization.

A PRINCE 2 project is driven by the project's business case [11], which describes the organization's justification, commitment and rationale for the deliverables or outcome. The business case is regularly reviewed during the project to ensure the business objectives, which often change during the lifecycle of the project, are still being met. PRINCE 2 is designed to provide a common language across all the interested parties involved in a project. The method provides the necessary controls and breakpoints to work successfully within a contractual framework. PRINCE 2 outlines eight components & eight processes [Figure-1]. Two Process, "Planning" and "Directing a project" are continuous processes supporting the other six. Each of these processes has their respective sub-process totaling 45 in all. Finally, PRINCE 2 describes three techniques namely: "Product Based Planning", "Quality Review" and "Change Control".

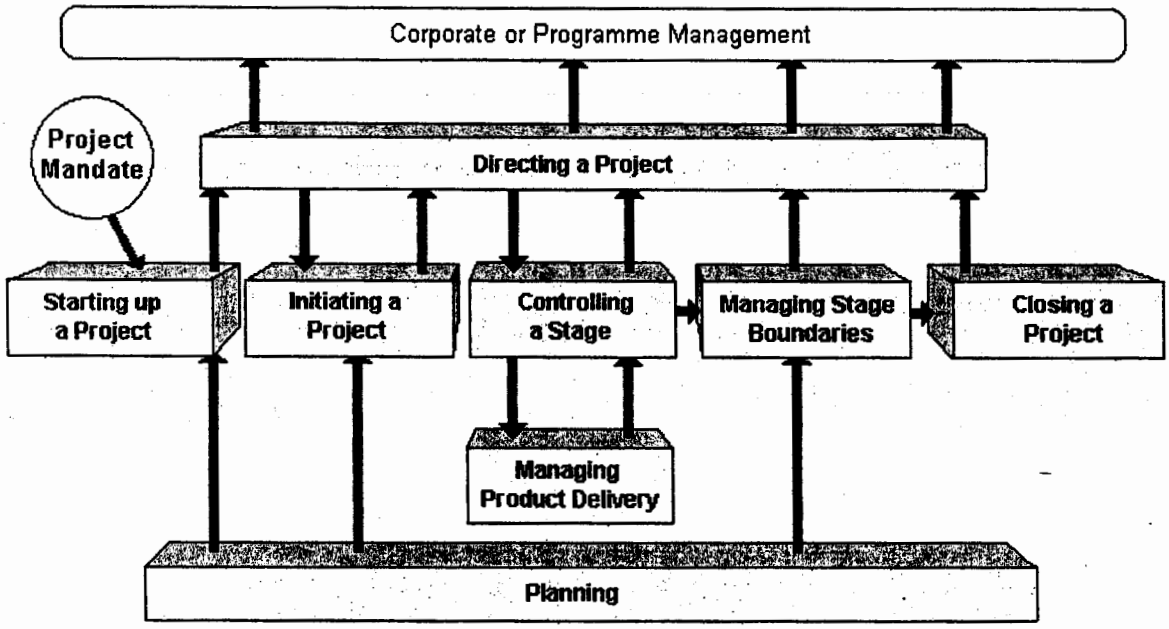

Figure –1 Prince 2 process model

A. Planning (PL) Process

Every project depends on planning, and of course a PRINCE 2 project is no different. Project planning in PRINCE2 is product-based which means the project plans are focused on delivering results and are not simply about planning when the various activities on the project will be done. The process of planning is well defined in the PRINCE 2 methodology, using the usual planning suspects of work breakdown, activity networking and scheduling. The method of work breakdown is the product breakdown structure, essentially the same as a deliverable oriented Work Breakdown Structure, supplemented by the Product Flow Diagram (PFD). PFD [12] allows a high-level structure for the project plan to be agreed at the deliverable level, which could be described as a milestone-led approach. It's useful stuff, and when pragmatically integrated with existing planning approach can deliver great benefits in the (often badly done) scope definition phase of planning. Planning is also closely integrated with the Quality systems, with the methodology defining the

production of the product description as a product of the process. Together, the product breakdown, product descriptions and product flow create an effective (and necessary) scope definition prior to commitment of resources to the project.

Don't confuse this process with the PRINCE 2 component 'Plans', which are a product of Planning, or 'stages' [13], which define a PRINCE 2 planning principle explored in the 'Controls' component. Risk analysis, and estimation are related areas to PL.

PRINCE 2's approach is a single unified methodology starting from developing the initial product breakdown structure through to identifying the corresponding network schedule. PRINCE 2 is not intended to cover all subjects [14] relevant to project management. There are also certain aspects of project management [15] that are well covered by existing and proven methods and are therefore excluded from PRINCE 2. Examples of these aspects are:

- People management techniques such as motivation, delegation and team leadership
- Generic planning techniques such as Gantt charts and critical path analysis
- Risk management techniques
- The creation and management of corporate quality management and quality assurance mechanisms
- Business case management, budgetary control and earned value analysis.

PRINCE 2 does not cover the specialist techniques involved in the creation of the products. This is the job of other methods, although PRINCE interfaces with them to enable information on such areas as estimating, to be provided for project management.

III. CMMI

CMMI® was developed by the SEI in 2001. CMMI is a model for improving and appraising the performance of development organizations [16] and is being adopted worldwide, including Europe, India, Australia, Asia Pacific, and Far East. CMMI 1.1 is organized in two representations, continuous and staged. They provide alternative approaches to process improvement that leverage users' familiarity with either approach [17].

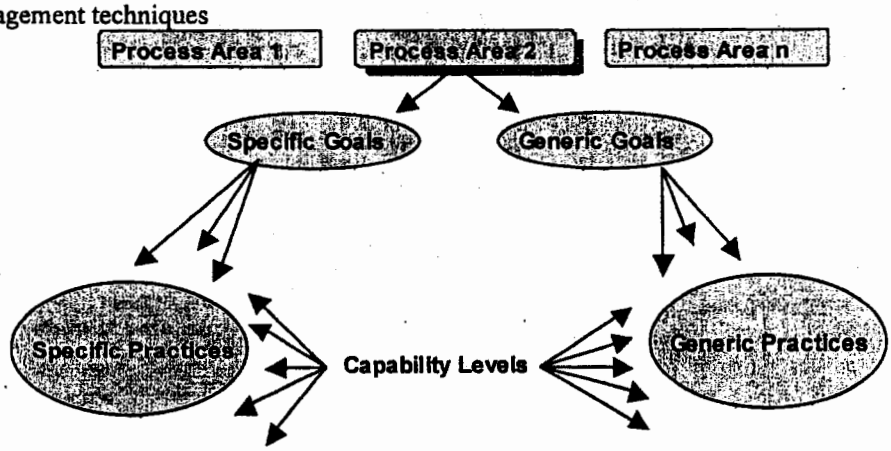

Figure – 2 CMMI Model Components

The continuous representation is based on process capability—the range of expected results that can be achieved by following a process [18]. Continuous representation provides flexibility for organizations to choose which processes to emphasize for improvement. It enables selection of the order of process improvement that best meets the organization's business objectives and that most mitigates risk.

The staged representation is based on organizational maturity—the combined capabilities of a set of related processes [19]. This representation has a recommended order for approaching process improvement, beginning with basic management practices and progressing along a proven path.

A capability level consists of related specific and generic goals / practices for a process area that can improve the organization's processes. Capability levels focus on growing the organization's ability to perform, control, and improve its performance in a process area. There are six (0 –5) capability levels for continuous representation.

A process area [Figure –2] is a cluster of related practices in an area that, when performed collectively, satisfy a set of goals considered important for making significant improvement in that area. Specific goals apply to a process area and address the unique characteristics that describe what must be implemented to satisfy the process area. Specific practice is an activity that is considered important in achieving the associated specific goal. Generic Goal describes the institutionalization that the organization must achieve at that capability level.

In continuous representation project management process areas cover the project management activities related to planning, monitoring, and controlling the project. Project planning is one of the eight project management process areas of CMMI.

A. Project Planning (PP)

The purpose of project planning is to establish and maintain plans that define project activities. The project planning process area involves developing the project plan, interacting with stakeholders appropriately, getting commitment to the plan and maintaining the plan. Planning begins with requirements that define the product and project. Planning includes estimating the attributes of the work products and tasks, determining the resources needed, negotiating commitments, producing a schedule, and identifying and analyzing project risks. The project plan provides the basis for performing and controlling the project's activities that address the commitments with the project's customer. Project plan will usually need to be revised as the project progresses to address changes in requirements and commitments, inaccurate estimates, corrective actions, and process changes. Specific practices describing both planning and re-planning are contained in this process area. Requirements development, & management, risk management, and technical solution are related process areas to PP [20].

IV. MAPPING

Mapping PRINCE 2 (Planning Process) to CMMI 1.1 (Project Planning)

PRINCE Sub-Processes	Typical Artifacts	CMMI Goals / Practices	Strengths	Typical Work Products
PL1	1. Product flow diagram	SP 2.4-1	M	**SP 1.1-1**
	2. Management stage plan (check point reports, time sheets, project issues)	SP 1.3-1	W	1. Task descriptions 2. Work package descriptions
	3. Contingency plan (change budget)	SP 2.2-1 SP 3.2-1	M M	3. Work Breakdown Structure (WBS)
PL2	1. Product break down structure	SP 1.1-1	S	**SP 1.2-1**
	2. Product flow diagram	SP 2.4-1	M	1. Technical approach 2. Size & complexity of tasks and work products
	3. Product checklist	SP 1.1-1 SP 2.4-1	W M	3. Estimating models 4. Attribute estimates
PL3	1. Team plan	SP 2.4-1 SP 2.5-1 SP 2.1-1	W M W	**SP 1.3-1** 1. Project life-cycle phases
	2. Transformation document	SP 2.4-1	M	**SP 1.4-1** 1. Estimation rationale 2. Project effort estimates 3. Project cost estimates
PL4	1. Function point analysis	SP 1.2-1 SP 1.4-1	W W	**SP 2.1-1** 1. Project schedules 2. Schedule dependencies 3. Project budget
	2. Structured Analysis and Design	-	-	**SP 2.2-1** 1. Identified risks 2. Risk impacts and probability of occurrence 3. Risk priorities

	3. Program Evaluation Review Technique (PERT)	SP 3.2-1 SP 1.2-1 SP 2.1-1	W W M	**SP 2.3-1** 1. Data management plan 2. Master list of managed data
PL5	1. GANTT Chart	SP 2.1-1 SP 2.3-1 SP 2.5-1 SP 2.7-1	M W W S	3. Data content and format description 4. Data requirements lists for acquirers & for suppliers 5. Privacy requirements 6. Security requirements
	2. Resource plan	SP 2.3-1 SP 2.5-1 SP 2.6-1	W W M	7. Security procedures 8. Mechanism for data retrieval, reproduction, & distribution 9. Schedule for collection of project data 10. Listing of project data to be collected
	3. PERT	SP 3.2-1 SP 1.2-1 SP 2.1-1	W W M	**SP 2.4-1** 1. WBS work packages 2. WBS task dictionary 3. Staffing requirements based on project size & scope 4. Critical facilities/equipment list 5. Process/workflow definitions & diagrams 6. Program administration requirements list
PL6	1. Contingency plan	SP 2.2-1	M	**SP 2.5-1** 1. Inventory of skill needs 2. Staffing and new hire plans 3. Databases (e.g., Skills and Training)
	2. Project initiation document	SP 1.2-1 SP 1.3-1 SP 2.3-1 SP 3.3-1	W W M W	**SP 2.6-1** 1. Stakeholder involvement plan
	3. Resource plan	SP 2.3-1 SP 2.5-1 SP 2.6-1	W W M	**SP 2.7-1** 1. Overall project plan
	4. Risk identification document	SP 2.2-1	S	**SP 3.1-1** 1. Record of the reviews of plans that affect the project
PL7	1. Plan text (summary)	SP 2.7-1	M	**SP 3.2-1** 1. Revised methods & corresponding estimating parameters (e.g., better tools, use of off-the-shelf components) 2. Renegotiated budgets 3. Revised schedules 4. Revised requirements list 5. Renegotiated stakeholder agreements
	2. Product checklist	SP 1.1-1 SP 2.4-1	W M	**SP 3.3-1** 1. Documented requests for commitments 2. Documented commitments
	3. Project level plan	SP 2.7-1	S	

Table –1 Mapping of PRINCE 2 to CMMI 1.1 (Planning)

V. CONCLUSION

Both PRINCE 2 and Software CMMI 1.1 continuous representation - project management category addresses the project (product development) management by improved software process management. Particularly the planning phase activities (depending upon the developing environment) in these standards are generally related to each other at higher level. Planning stage / phase dominates these standards on rest of the areas in project management. It is almost impossible that one can have one-to-one mapping between these standards, because of different approaches that are being followed for accomplishment of the same task. But on the basis of experience and assessment, the gap between these two can be narrowed to a reasonable extent.

VI. FUTURE STUDIES

Mapping of PRINCE 2 components and support / engineering / process management categories of continuous representation of CMMI will be carried out in future. For better understanding of transformation, it is only possible by discussing more case studies consist of complex scenarios.

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Sent : Tuesday, September 7, 2004 11:39 AM

To : ahmad luqman <aluqman@hotmail.com>

CC : cmmi-comments@sei.cmu.edu, ritikab@qaiindia.com, ug@mcmail.com, abhijeetk@qaiindia.com, shyni@qaiindia.com

Subject : Re: Mapping Prince 2 to CMMI

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Received: from smtp01.sei.cmu.edu ([192.58.107.164]) by mc11-f5.hotmail.com with Microsoft SMTPSVC(5.0.2195.6824); Tue, 7 Sep 2004 11:39:38 -0700
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X-Message-Info: JGTYoYF78jFxjDG6ViBc4mz7t9FREuyE
Organization: Software Engineering Institute
User-Agent: Mozilla/5.0 (Windows; U; Windows NT 5.1; en-US; rv:1.7.1) Gecko/20040707
X-Accept-Language: en-us, en
References: <BAY1-F25Nwnap54Ch9I0009694c@hotmail.com>
Return-Path: spm@sei.cmu.edu
X-OriginalArrivalTime: 07 Sep 2004 18:39:39.0449 (UTC) FILETIME=[0849EA90:01C4950A]

Dear Ahmad,

Thank you for contacting the SEI.

Unfortunately we do not have a mapping of the two. You may want check with other users of the CMMI. Check these resources:

Software Engineering Information Repository:

http://seir.sei.cmu.edu

Knowledge Exchange Forum:

http://www.sei.cmu.edu/cmmi/adoption/knowledge-exchange.html

Hope this helps.

Regards,

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Ahmad luqman wrote:

> Hi Readers,
>
> We are carrying out a research "Transformation from Prince 2 to SEI SW-CMMI 1.1"
>
> Did you know any of this kind of research done before?
>
> Looking for your repl.
>
> AHMAD LUQMAN