ΠΑΝΕΠΙΣΤΗΜΙΟ ΠΕΙΡΑΙΩΣ

ΤΜΗΜΑ ΒΙΟΜΗΧΑΝΙΚΗΣ ΔΙΟΙΚΗΣΗΣ ΚΑΙ ΤΕΧΝΟΛΟΓΙΑΣ

ΜΠΣ ΣΤΗΝ ΟΡΓΑΝΩΣΗ ΚΑΙ ΔΙΟΙΚΗΣΗ ΒΙΟΜΗΧΑΝΙΚΩΝ ΣΥΣΤΗΜΑΤΩΝ (ΚΑΤΕΥΘΥΝΣΗ LOGISTICS)

ΔΙΠΛΩΜΑΤΙΚΗ ΕΡΓΑΣΙΑ

«ΝΟΗΤΙΚΕΣ ΑΠΕΙΚΟΝΙΣΕΙΣ ΚΑΙ ΜΑΘΗΣΙΑΚΟΣ ΕΜΠΛΟΥΤΙΣΜΟΣ ΣΤΗΝ ΑΝΑΠΤΥΞΗ ΕΝΟΣ ΑΛΛΗΛΕΠΙΔΡΑΣΤΙΚΟΥ, ΠΡΟΣΑΡΜΟΣΤΙΚΟΥ, ΒΑΣΙΣΜΕΝΟΥ ΣΤΗΝ ΕΜΠΕΙΡΙΑ ΕΡΓΑΛΕΙΟΥ E-LEARNING ΓΙΑ ΤΗΝ ΕΚΠΑΙΔΕΥΣΗ ΣΤΗ ΔΙΟΙΚΗΣΗ ΕΡΓΟΥ, ΒΑΣΙΣΜΕΝΟ ΣΤΟ ΠΡΟΤΥΠΟ PMBOK® Guide – 4th Edition»

ΕΠΙΒΛΕΠΩΝ ΚΑΘΗΓΗΤΗΣ: ΕΜΙΡΗΣ ΔΗΜΗΤΡΙΟΣ

ΚΟΝΤΟΣΤΑΥΛΑΚΗΣ ΔΙΟΝΥΣΙΟΣ – (ΜΠL 0746)

Πειραιάς 2009

ΕΥΧΑΡΙΣΤΙΕΣ

Ένα μεγάλο ευχαριστώ στον καθηγητή μου κύριο Δημήτρη Εμίρη, ο οποίος με την πολύτιμη καθοδήγηση και αφοσίωση του όχι μόνο συνέβαλλε τα μέγιστα στην ολοκλήρωση της διπλωματικής μου εργασίας, αλλά μου μετέδωσε τη δίψα για δουλειά και δημιουργία μέσα από την ίδια την εργασία όπου υπήρχε έντονο το στοιχείο του πειραματισμού και του συνδυασμού πολλών διαφορετικών συντελεστών για την παραγωγή ενός τελικού αποτελέσματος, όπως ακριβώς συμβαίνει και στη διοίκηση έργου.

Δικαιωματικά λοιπόν του αφιερώνω την παρούσα προσπάθεια, ελπίζοντας και σε άλλες δημιουργικές συνεργασίες μας στο μέλλον.

Τέλος, χρωστάω πολλά ευχαριστώ στους γονείς μου που μου παρείχαν απλόχερα όλα τα απαιτούμενα εκπαιδευτικά εφόδια και υπέμειναν την καυστική κριτική μου σε όλη την ακαδημαϊκή μου πορεία έως σήμερα, αλλά και στους φίλους μου για την αμέριστη συμπαράσταση και υποστήριξη τους.

ΠΕΡΙΕΧΟΜΕΝΑ

(1) - ΕΙΣΑΓΩΓΗ

1.1 Σκοπός της εργασίας

Μέσα από την συγκεκριμένη εργασία επιχειρήθηκε η δημιουργία μιας βάσης γνώσης, βασισμένη στην πιο πρόσφατη έκδοση του προτύπου ***PMBOK® Guide – 4th edition*** του Αμερικανικού Ινστιτούτου για την Διοίκηση Έργου *(PMI).* Ο οδηγός αυτός αποτελεί βελτιωμένη συνέχεια του PMBOK® Guide – 3rd edition (2004), και εμπεριέχει αρκετές διορθώσεις αλλά και επικαιροποιήσεις. Ο στόχος της εργασίας όμως δεν ήταν η απλή καταγραφή όλων των διεργασιών που προτείνονται μέσα από το εν λόγω πρότυπο, αλλά ο περαιτέρω εμπλουτισμός τους με σχετικές ιστοσελίδες και βιβλιογραφία προκειμένου να λειτουργήσει τόσο συμβουλευτικά, σαν ένα επιπλέον εργαλείο στα χέρια στελεχών με εμπειρία σε θέματα διοίκησης έργου, όσο και ως «υποκινητής» για έρευνα και μάθηση από οποιονδήποτε θελήσει να μπει στον μαγικό κόσμο του project management.

1.2 Μεθοδολογία εκπόνησης

Η καταγραφή αυτή όμως δεν έγινε σε κάποιο έντυπο μέσο, αλλά σε ψηφιακή μορφή, και συγκεκριμένα σε ιστοσελίδα έτσι ώστε να καθιστά εύκολη και προπαντός γρήγορη την πρόσβαση και την προσπελασιμότητα στα δεδομένα. Όσον αφορά το τεχνικό μέρος, για την οργάνωση και καταγραφή των διεργασιών των εννέα γνωστικών περιοχών του PMBOK® Guide χρησιμοποιήθηκε η μέθοδος των νοητικών απεικονίσεων (mind-mapping), και συγκεκριμένα το λογισμικό «Mindjet MindManager 8». Εν συνεχεία οι ψηφιακοί αυτοί χάρτες αφού εμπλουτίσθηκαν και με επιπλέον μαθησιακά και ερευνητικά δεδομένα, εξάχθηκαν σε μορφή ιστοσελίδας, η οποία εμπεριέχεται στο συννημένο cd, στο τέλος της εργασίας. Εικονικά στιγμιότυπα αυτής παρατίθενται στο παράρτημα.

1.3 Γνωστικά πεδία

Όπως προαναφέρθηκε, σκοπός της εργασίας δεν ήταν η στείρα μεταφορά δεδομένων ενός βιβλίου-οδηγού (guide-book), σε μια ιστοσελίδα. Χρησιμοποιήθηκε λογισμικό νοητικής απεικόνισης έτσι ώστε να εμφανιστούν οι αλληλεπιδράσεις των διεργασιών της διοίκησης έργου σύμφωνα πάντα με το PMI, αλλά και να δοθεί η δυνατότητα για επιπλέον έρευνα πάνω στην μεθοδολογία των διεργασιών, αλλά και των εργαλείων και τεχνικών που αυτές χρησιμοποιούν. Στη συνέχεια λοιπόν αναφέρονται τα γνωστικά πεδία της διοίκησης έργων, τα οποία ενσωματώνει η συγκεκριμένη εργασία.

Το κεφάλαιο 2 είναι αφιερωμένο στις νοητικές απεικονίσεις (mind maps), οι οποίες αποτελούν και γνώμονα της διπλωματικής εργασίας. Αρχικά παρατίθεται ο ορισμός και τα πεδία χρήσης τους, και στη συνέχεια ο τρόπος με τον οποίο αυτές χρησιμοποιήθηκαν στην οργάνωση και την καταγραφή του συνόλου των διεργασιών του PMBOK® Guide, αλλά και η συμβολή τους στην επιτυχία του τελικού εγχειρήματος.

Στο κεφάλαιο 3 εμπεριέχονται κάποια θεωρητικά στοιχεία σχετικά με τη διοίκηση έργων αλλά και κάποιοι ορισμοί βασισμένοι στην τέταρτη έκδοση του προτύπου PMBOK® Guide. Επίσης αναλύεται ένα πολύ σημαντικό στοιχείο για την επιτυχία ενός έργου, ο τριπλός περιορισμός, ή η «πυραμίδα του τρόμου» όπως αναφέρεται και στα περιεχόμενα της εργασίας. Εν συνεχεία παρουσιάζονται όλες οι διεργασίες του PMBOK® Guide, αρχικά ομαδοποιημένα με βάση το περιεχόμενο τους και στη συνέχεια ανάλογα με την στιγμή εφαρμογής ή αλλιώς «προσανατολισμένα στο προϊόν».

Το κεφάλαιο 4 είναι αφιερωμένο στις επικαιροποιήσεις της τέταρτης έκδοσης του PMBOK® Guide, σε αντιδιαστολή με την τρίτη έκδοση του 2004. Παρουσιάζονται συνοπτικά οι αλλαγές στις διεργασίες αλλά και στο περιεχόμενο τους.

Τέλος το κεφάλαιο 5 αποτελεί και επίλογο της διπλωματικής εργασίας περιλαμβάνοντας συμπεράσματα, αλλά και μελλοντικές χρήσεις της παραχθείσας βάσης γνώσης. Πως προκύπτει η ονομασία “PM-Pedia”;

(2) - ΝΟΗΤΙΚΕΣ ΑΠΕΙΚΟΝΙΣΕΙΣ (mind maps)

2.1 Ορισμός – Χαρακτηριστικά

Μια νοητική απεικόνιση ή αλλιώς ένας νοητικός «χάρτης» είναι ένα διάγραμμα που παραθέτει λέξεις, ιδέες, στόχους ή άλλα στοιχεία που συνδέονται και κατά κάποιο τρόπο συνθέτουν τα στοιχεία μιας κεντρικής βασικής ενότητας. Χρησιμοποιούνται για να παραγάγουν, να απεικονίσουν και να ταξινομήσουν τις ιδέες, αλλά και ως βοήθημα στη μελέτη και οργάνωση των στοιχείων του χάρτη.

Τα στοιχεία μιας νοητικής απεικόνισης ομαδοποιούνται σύμφωνα με το εννοιολογικό τους περιεχόμενο σε σχηματισμούς ομάδας, κλάδων, ή γνωστικών περιοχών, με στόχο την σημασιολογική τους διαφοροποίηση από άλλα αντίστοιχα στοιχεία και η καταγραφή τους μπορεί να γίνει κατά τρόπο ακτινωτό, γραφικό, ή μη-γραμμικό.

Τέλος, μια νοητική απεικόνιση μπορεί να αντιπαραβληθεί με την παρόμοια ιδέα της χαρτογράφησης εννοιών. Η πρώτη ωστόσο, είναι βασισμένη στις ακτινωτές ιεραρχίες και τις δομές δέντρων που δείχνουν τις σχέσεις μέσα σε μια κεντρική βασική έννοια, ενώ η δεύτερη περιγράφει τις συνδέσεις περισσοτέρων της μιας κεντρικών εννοιών σε διαφορετικά επίπεδα.

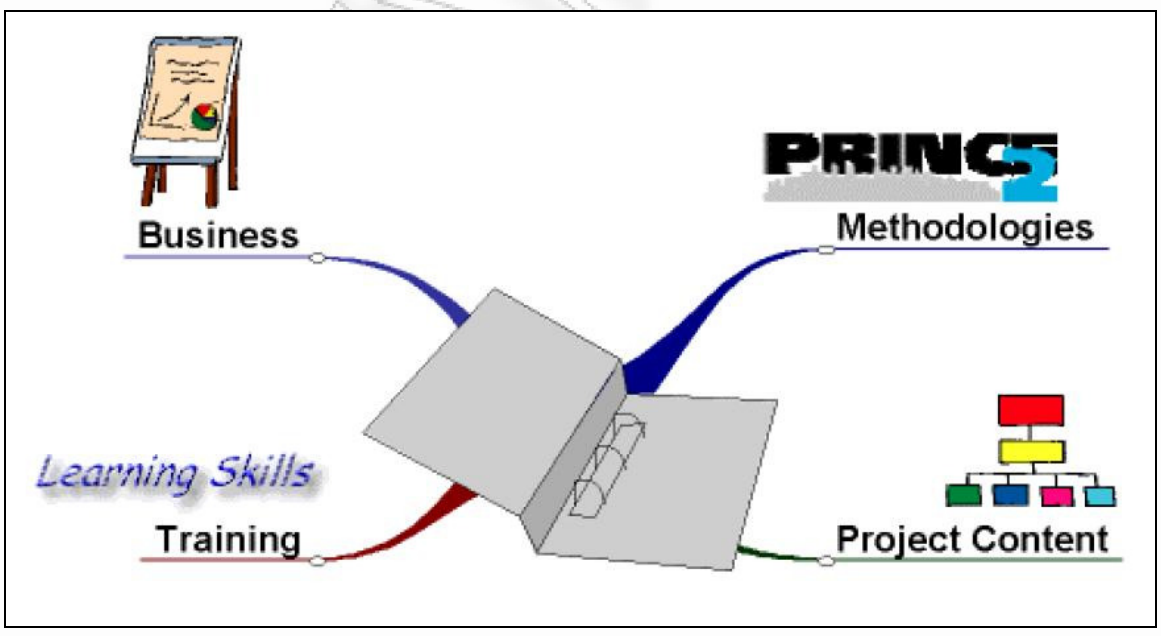
2.2 Πεδία Εφαρμογής

Οι εφαρμογές των νοητικών απεικονίσεων μπορούν να φανούν χρήσιμες τόσο σε προσωπικό και οικογενειακό επίπεδο, όσο και σε εκπαιδευτικές και περισσότερο επιχειρησιακές καταστάσεις, όπως η ανταλλαγή απόψεων (brainstorming), στην οποία οι ιδέες παρεμβάλλονται στο χάρτη ακτινωτά γύρω από τον κεντρικό κόμβο, η επιθεώρηση, η περίληψη ενός θέματος που έχει τεθεί υπό συζήτηση και τέλος η γενική διευκρίνιση και καταγραφή των σκέψεων που εκφράζονται στο «επιχειρηματικό τραπέζι». Για παράδειγμα θα μπορούσε κάποιος που παρακολουθεί μια διάλεξη, να κρατήσει σημειώσεις χρησιμοποιώντας έναν νοητικό χάρτη για τα σημαντικότερα σημεία ή τις λέξεις κλειδιά. Ακόμη είναι πιθανόν οι νοητικές απεικονίσεις να χρησιμοποιηθούν ως μνημονική τεχνική ή ως εργαλείο για την ταξινόμηση μιας περίπλοκης ιδέας.

Πιθανές χρήσεις - πλεονεκτήματα των νοητικών απεικονίσεων:

- Επίλυση προβλημάτων.
- Συμπύκνωση οπτικού υλικού σε σχήμα με ευκολία απομνημόνευσης.
- Εργαλείο για σύνταξη περιλήψεων-αναφορών
- «Χτίσιμο» ομάδας έργου, οργάνωση καθηκόντων των υπαλλήλων.
- Ενίσχυση του ηθικού των εργαζομένων.
- «Πάντρεμα» (συνδυασμός) λέξεων και εικονικών στοιχείων.
- Έκφραση της δημιουργικότητας.

Ένας νοητικός χάρτης μπορεί να σχεδιαστεί με το χέρι, κατά τη διάρκεια μιας επαγγελματικής συνάντησης ή μιας διάλεξης, είτε περισσότερο προσεκτικά και μεθοδικά όταν υπάρχει περιθώριο χρόνου αλλά και εξειδικευμένα προγράμματα παραγωγής νοητικών απεικονίσεων. Στην αγορά μπορεί κανείς να βρει αρκετά διαθέσιμα πακέτα λογισμικού, προσαρμοσμένα στις εκάστοτε ανάγκες του χρήστη.



2.3 Χρηστικότητα στην διπλωματική εργασία

Στην συγκεκριμένη εργασία χρησιμοποιήθηκαν νοητικές απεικονίσεις για τρεις λόγους. Πρώτον, για την καταγραφή των σαράντα δύο (42) διεργασιών του PMBOK® Guide – 4th edition, συμπεριλαμβανομένων των εισόδων, εξόδων και εργαλείων και τεχνικών. Δεύτερον, για τον μαθησιακό εμπλουτισμό των παρεχομένων εργαλείων και μεθόδων με πηγές και άλλα στοιχεία από το διαδίκτυο, και τρίτον για την εξαγωγή των δεδομένων του συνολικού νοητικού χάρτη σε μορφή ιστοσελίδας (Html).

Μέσα από το λογισμικό «Mindjet MindManager 8» επετεύχθη ουσιαστικά η παραγωγή ενός πλήρους «PMBOK® Guide Mind-Map» ο οποίος μπορεί να χρησιμοποιηθεί τόσο για μαθησιακούς, όσο και για πρακτικούς σκοπούς. Το σύνολο των διεργασιών, αλλά και των επιμέρους στοιχείων τους (Inputs-T&T-Outputs) αριθμήθηκαν, ταξινομήθηκαν και συνδέθηκαν λογικά μεταξύ τους με ειδικές «υπερ-συνδέσεις» (hyperlinks), έτσι ώστε η αναπαράσταση τους να προσεγγίζει όσο το δυνατόν περισσότερο το αρχικό πρότυπο PMBOK® Guide - 4th edition.

Τέλος, το «Mindjet MindManager 8» παρέχει τη δυνατότητα εξαγωγής του νοητικού χάρτη σε ποικίλες μορφές (Εικόνα, Pdf, MsWord – Powerpoint – Project – Outlook), αλλά και Html, η οποία εντέλει επιλέχθηκε για την αμεσότητα της στην πρόσβαση, και την ευκολία στην χρήση της από τους πιθανούς ενδιαφερόμενους. Προκειμένου ο επισκέπτης της ιστοσελίδας να ανατρέξει στο κεφάλαιο που επιθυμεί, μπορεί είτε να το επιλέξει από την αριστερή στήλη, με βάση την γνωστική περιοχή, είτε βήμα βήμα από την κεντρική οθόνη, είτε από πάνω δεξιά στην επιλογή «Overview Map».

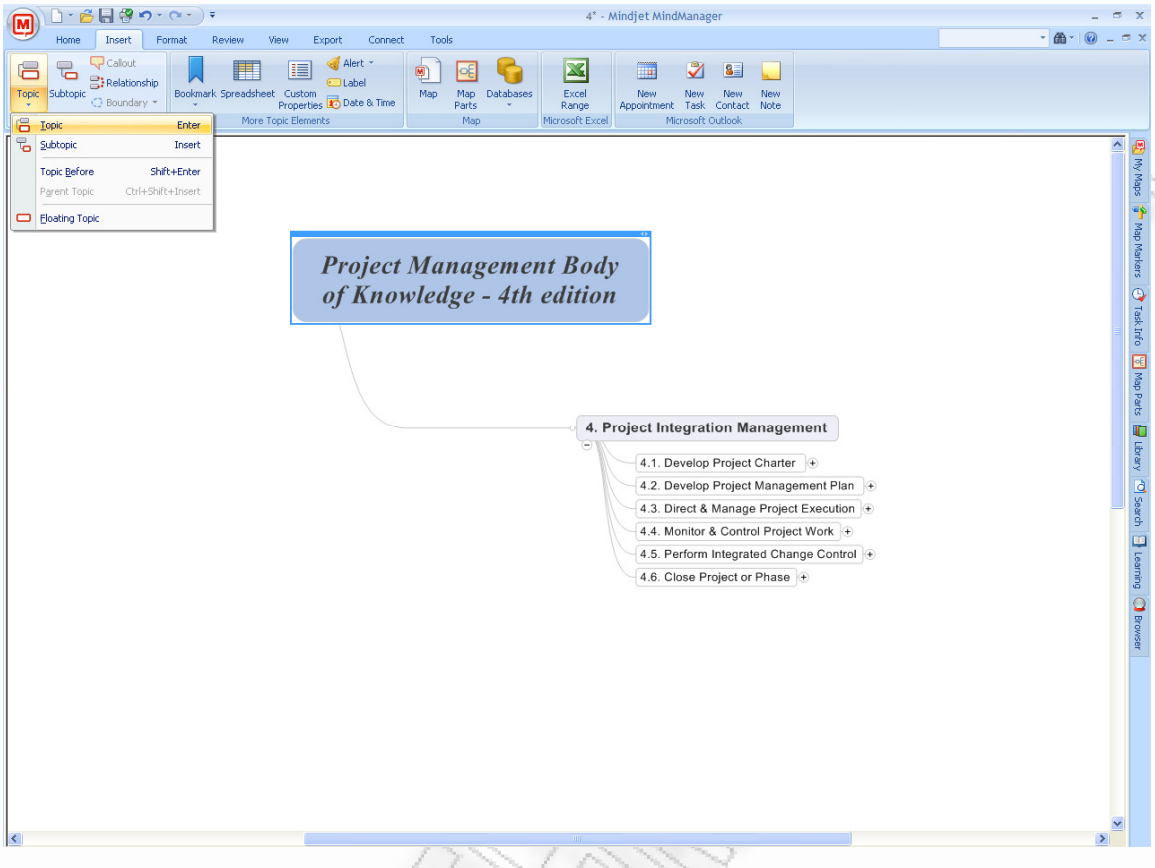
Η κατασκευή της συνολικής νοητικής απεικόνισης του PMBOK® Guide - 4th edition περιελάμβανε τα εξής βήματα με σειρά προτεραιότητας για τις 9 γνωστικές περιοχές:

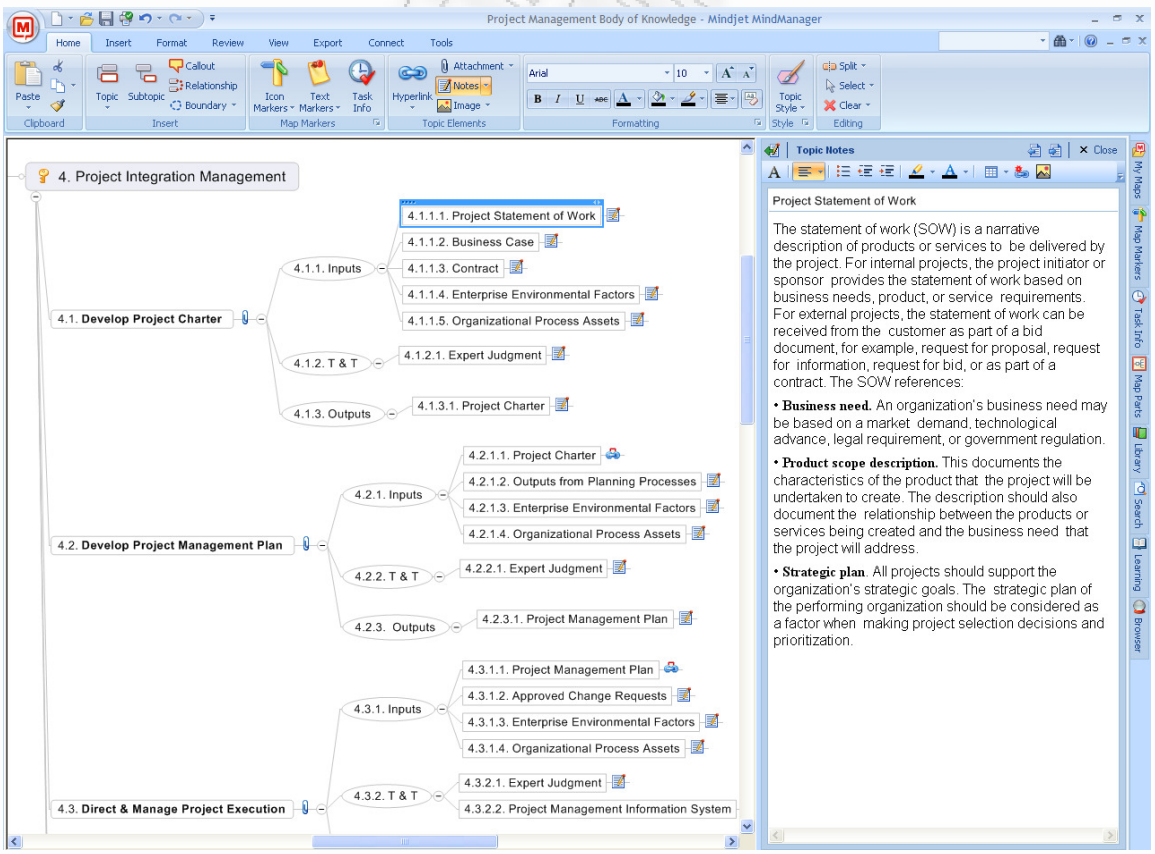
- Δημιουργία ευρύτερης ενότητας με το όνομα "Project Management Body of Knowledge - 4th Edition"
- Δημιουργία υποενότητας με βάση την γνωστική περιοχή (π.χ. Project Cost Mgmt)
- Καταγραφή των αντίστοιχων διεργασιών της γνωστικής περιοχής. (εικόνα 2.1)
- Προσθήκη υποενοτήτων (subtopic) με θέμα "Inputs", "Tools & Techniques", "Outputs" (Είσοδοι - Εργαλεία & Τεχνικές - Έξοδοι).
- Εισαγωγή των στοιχείων στα αντίστοιχα πεδία των εισόδων, εργαλείων και εξόδων σύμφωνα πάντα με το πρότυπο. (εικόνα 2.2)
- Εμπλουτισμός των Εργαλείων και Τεχνικών με περαιτέρω επιστημονικά στοιχεία.(εικόνα 2.3)

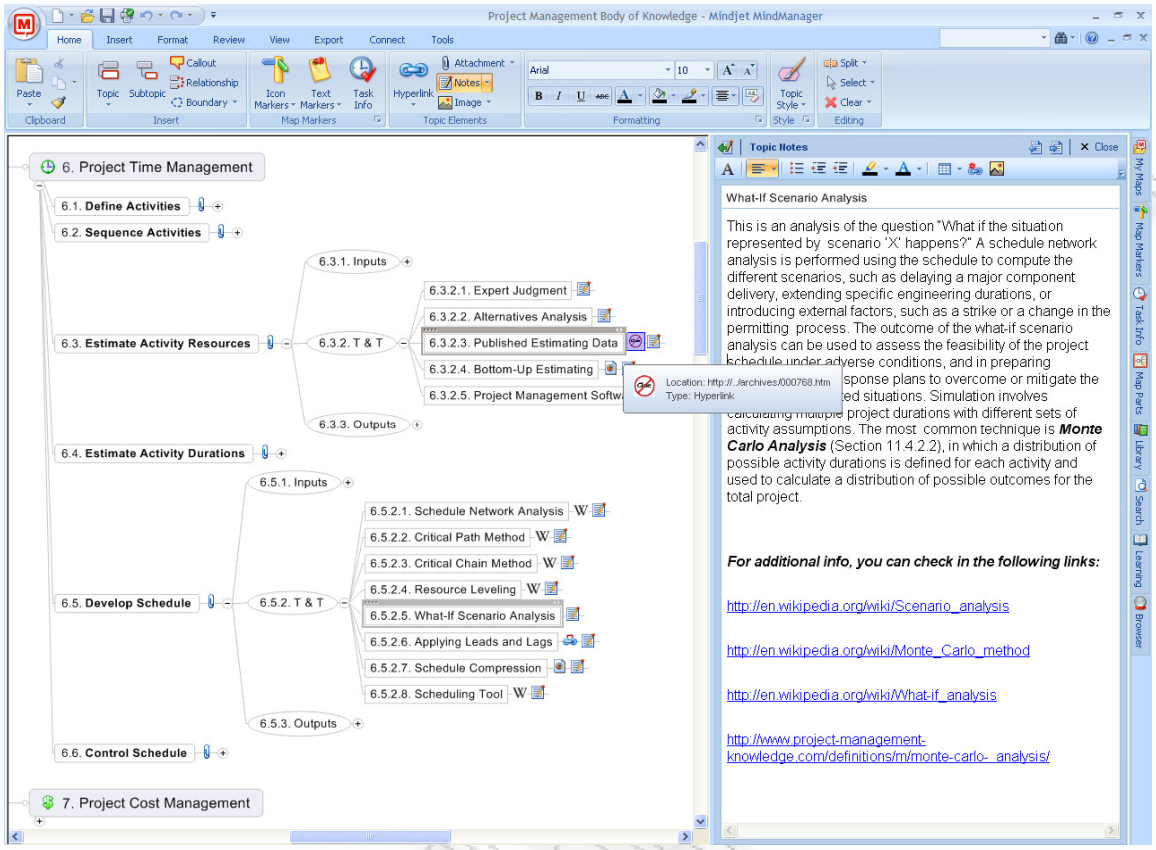
Αφού ολοκληρώθηκε η καταγραφή όλων των διεργασιών ακολούθησαν οι:

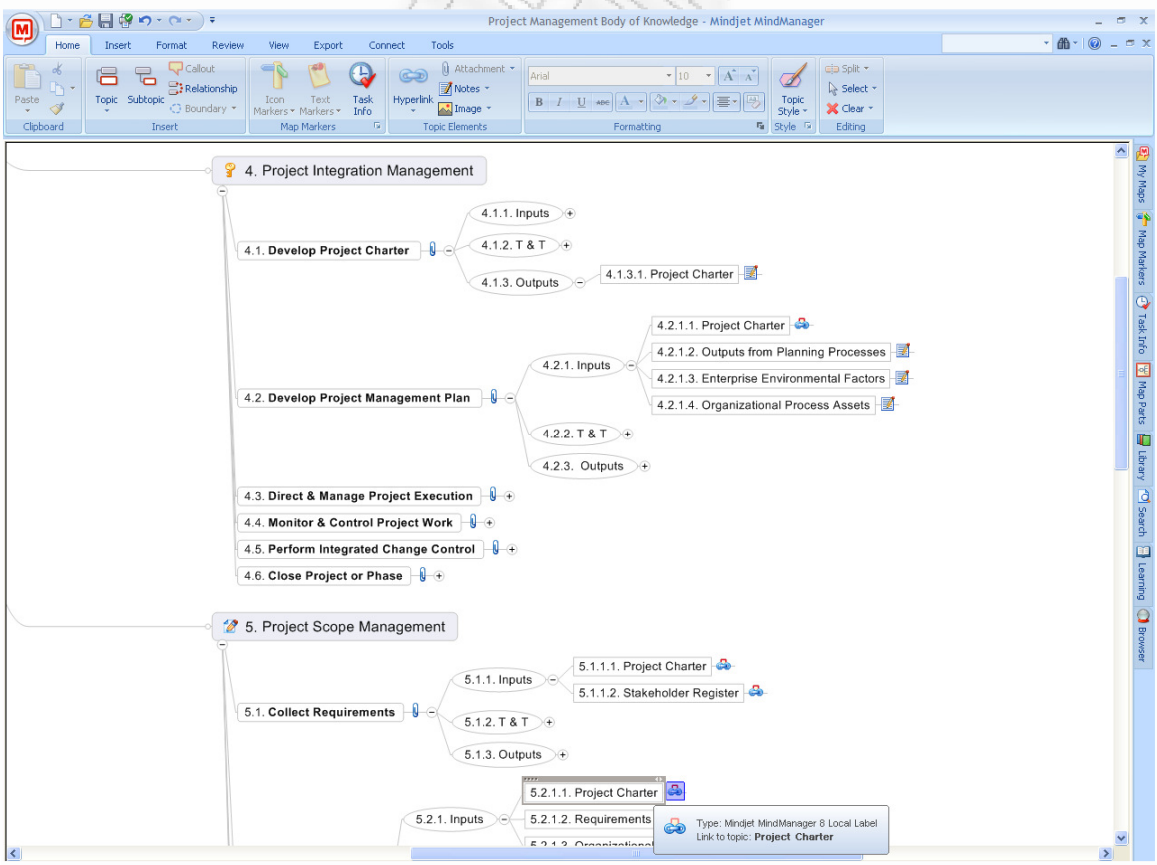
- Νοητική σύνδεση (hyperlink), των εισόδων διεργασιών με εξόδους άλλων διεργασιών και αντιστρόφως όπου αυτό ήταν εφικτό αλλά και αναγκαίο, καθώς αρκετές φορές κάποια από τις εξόδους μιας διεργασίας αποτελούσε είσοδο για μια άλλη διεργασία, όπως για παράδειγμα το καταστατικό του έργου. (εικόνα 2.4)
- Γραφική σύνδεση (με κόκκινα βελάκια επάνω στον νοητικό χάρτη) σχετικών στοιχείων εισόδων και εξόδων, των οποίων το περιεχόμενο θα πρέπει να αλληλοσυσχετιστεί. Για παράδειγμα οι αιτήσεις για αλλαγές (change requests) ως έξοδος της διεργασίας «Διοίκηση και Διαχείριση της Εκτέλεσης Έργου», θα πρέπει να περάσει πρώτα από την διεργασία «Παρακολούθηση και Έλεγχος Εργασιών του Έργου» προτού καταλήξει ως είσοδος στην διεργασία «Ολοκληρωμένος Έλεγχος Αλλαγών». (εικόνα 2.5)
- Τέλος εξαγωγή του νοητικού χάρτη σε ιστοσελίδα μέσα από την επιλογή (Export as Web Pages), και παραμετροποίηση των επιλογών όσων αφορά τη μορφή της ιστοσελίδας. (εικόνα 2.6)

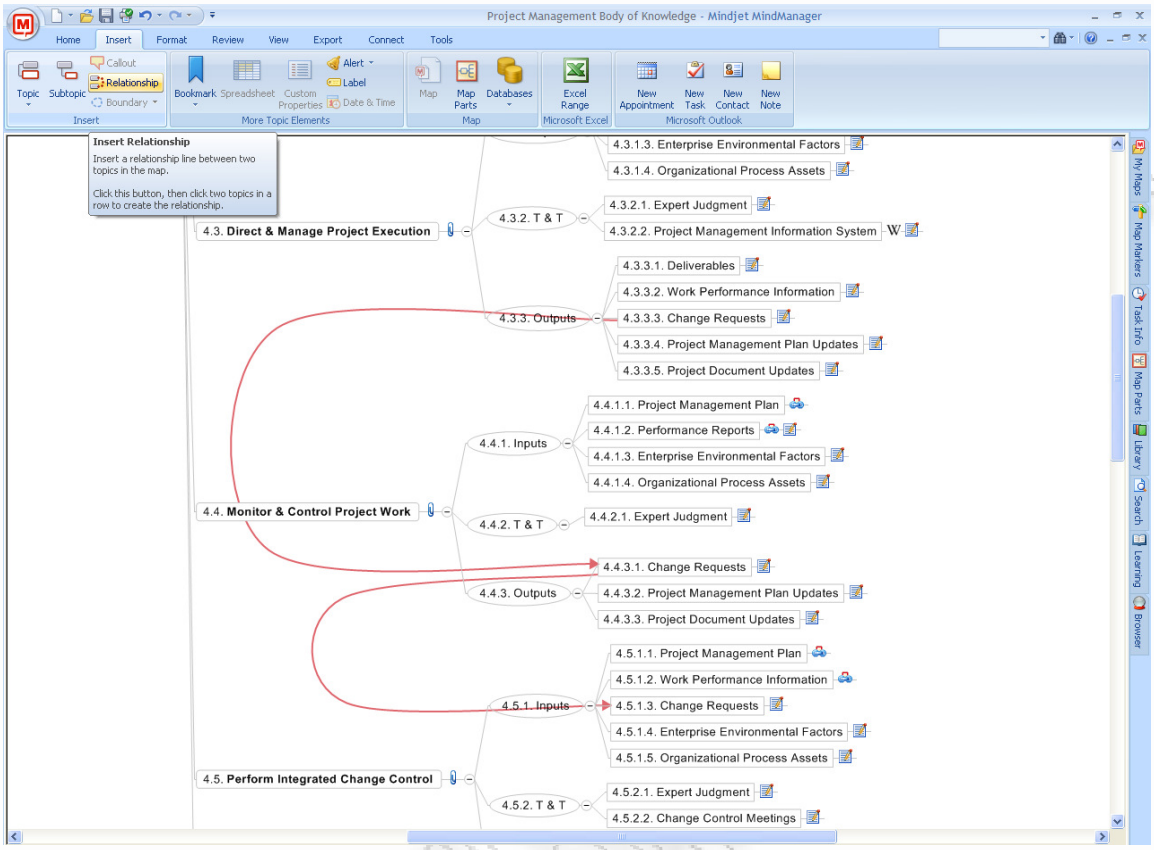
Στις επόμενες τρεις σελίδες ακολουθούν οι εικόνες 2.1 – 2.6, ανά ζεύγη.

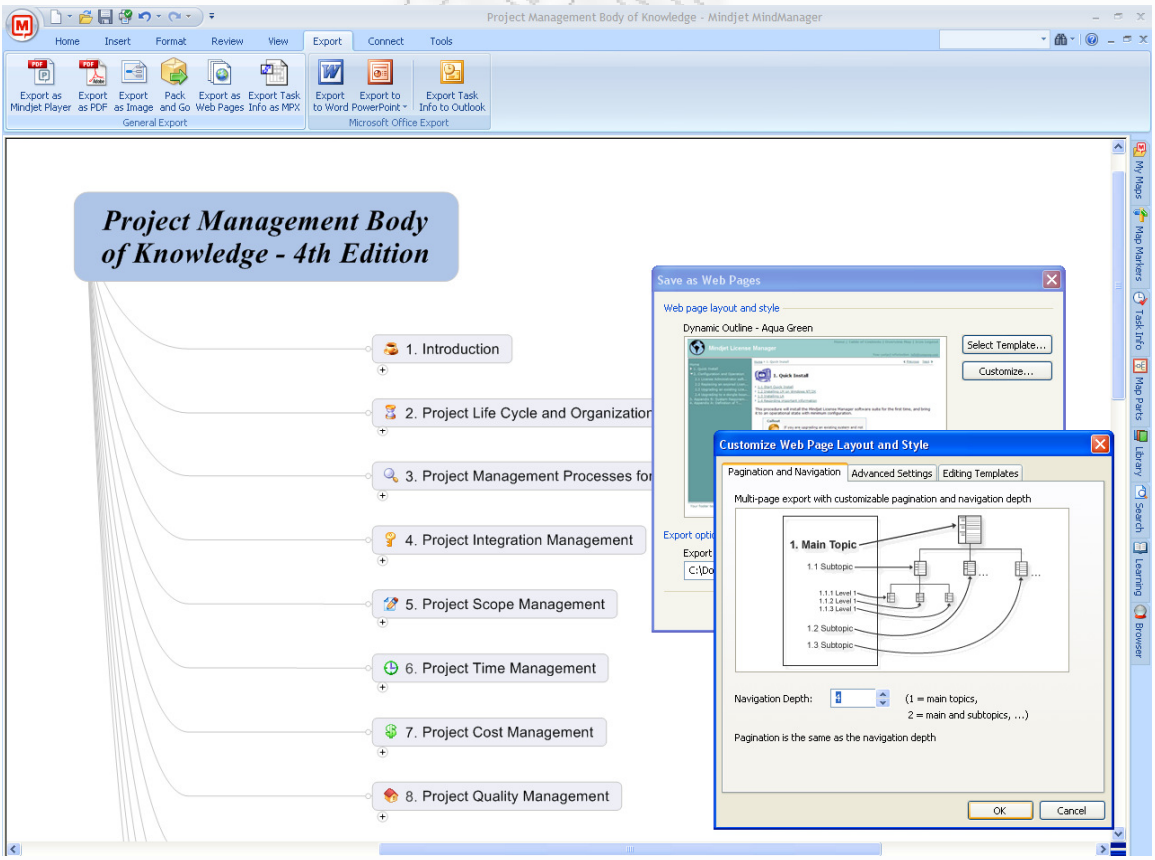

4* - Mindjet MindManager
Project Management Body of Knowledge - 4th edition
4. Project Integration Management
4.1. Develop Project Charter
4.2. Develop Project Management Plan
4.3. Direct & Manage Project Execution
4.4. Monitor & Control Project Work
4.5. Perform Integrated Change Control
4.6. Close Project or Phase


Project Management Body of Knowledge - Mindjet MindManager
4. Project Integration Management
4.1. Develop Project Charter
4.1.1. Inputs
4.1.1.1. Project Statement of Work
4.1.1.2. Business Case
4.1.1.3. Contract
4.1.1.4. Enterprise Environmental Factors
4.1.1.5. Organizational Process Assets
4.1.2. T & T
4.1.2.1. Expert Judgment
4.1.3. Outputs
4.1.3.1. Project Charter
4.2. Develop Project Management Plan
4.2.1. Inputs
4.2.1.1. Project Charter
4.2.1.2. Outputs from Planning Processes
4.2.1.3. Enterprise Environmental Factors
4.2.1.4. Organizational Process Assets
4.2.2. T & T
4.2.2.1. Expert Judgment
4.2.3. Outputs
4.2.3.1. Project Management Plan
4.3. Direct & Manage Project Execution
4.3.1. Inputs
4.3.1.1. Project Management Plan
4.3.1.2. Approved Change Requests
4.3.1.3. Enterprise Environmental Factors
4.3.1.4. Organizational Process Assets
4.3.2. T & T
4.3.2.1. Expert Judgment
4.3.2.2. Project Management Information System
Topic Notes
Project Statement of Work
The statement of work (SOW) is a narrative description of products or services to be delivered by the project. For internal projects, the project initiator or sponsor provides the statement of work based on business needs, product, or service requirements. For external projects, the statement of work can be received from the customer as part of a bid document, for example, request for proposal, request for information, request for bid, or as part of a contract. The SOW references:
• Business need. An organization's business need may be based on a market demand, technological advance, legal requirement, or government regulation.
• Product scope description. This documents the characteristics of the product that the project will be undertaken to create. The description should also document the relationship between the products or services being created and the business need that the project will address.
• Strategic plan. All projects should support the organization's strategic goals. The strategic plan of the performing organization should be considered as a factor when making project selection decisions and prioritization.


Project Management Body of Knowledge - Mindjet MindManager
6. Project Time Management
6.1. Define Activities
6.2. Sequence Activities
6.3. Estimate Activity Resources
6.3.1. Inputs
6.3.2. T & T
6.3.2.1. Expert Judgment
6.3.2.2. Alternatives Analysis
6.3.2.3. Published Estimating Data
6.3.2.4. Bottom-Up Estimating
6.3.2.5. Project Management Softwa
6.3.3. Outputs
6.4. Estimate Activity Durations
6.5. Develop Schedule
6.5.1. Inputs
6.5.2. T & T
6.5.2.1. Schedule Network Analysis
6.5.2.2. Critical Path Method
6.5.2.3. Critical Chain Method
6.5.2.4. Resource Leveling
6.5.2.5. What-If Scenario Analysis
6.5.2.6. Applying Leads and Lags
6.5.2.7. Schedule Compression
6.5.2.8. Scheduling Tool
6.5.3. Outputs
6.6. Control Schedule
7. Project Cost Management
Location: http://../archives/000768.htm
Type: Hyperlink
Topic Notes
What-If Scenario Analysis
This is an analysis of the question "What if the situation represented by scenario 'X' happens?" A schedule network analysis is performed using the schedule to compute the different scenarios, such as delaying a major component delivery, extending specific engineering durations, or introducing external factors, such as a strike or a change in the permitting process. The outcome of the what-if scenario analysis can be used to assess the feasibility of the project schedule under adverse conditions, and in preparing
sponse plans to overcome or mitigate the
ed situations. Simulation involves
project durations with different sets of
activity assumptions. The most common technique is Monte Carlo Analysis (Section 11.4.2.2), in which a distribution of possible activity durations is defined for each activity and used to calculate a distribution of possible outcomes for the total project.
For additional info, you can check in the following links:
http://en.wikipedia.org/wiki/Scenario_analysis
http://en.wikipedia.org/wiki/Monte_Carlo_method
http://en.wikipedia.org/wiki/What-if_analysis
http://www.project-management-knowledge.com/definitions/m/monte-carlo-_analysis/


Project Management Body of Knowledge - Mindjet MindManager
4. Project Integration Management
4.1. Develop Project Charter
4.1.1. Inputs
4.1.2. T & T
4.1.3. Outputs
4.1.3.1. Project Charter
4.2. Develop Project Management Plan
4.2.1. Inputs
4.2.1.1. Project Charter
4.2.1.2. Outputs from Planning Processes
4.2.1.3. Enterprise Environmental Factors
4.2.1.4. Organizational Process Assets
4.2.2. T & T
4.2.3. Outputs
4.3. Direct & Manage Project Execution
4.4. Monitor & Control Project Work
4.5. Perform Integrated Change Control
4.6. Close Project or Phase
5. Project Scope Management
5.1. Collect Requirements
5.1.1. Inputs
5.1.1.1. Project Charter
5.1.1.2. Stakeholder Register
5.1.2. T & T
5.1.3. Outputs
5.2.1.1. Project Charter
5.2.1. Inputs
5.2.1.2. Requirements
Type: Mindjet MindManager 8 Local Label
Link to topic: Project Charter


Project Management Body of Knowledge - Mindjet MindManager
Insert Relationship
Insert a relationship line between two topics in the map.
Click this button, then click two topics in a row to create the relationship.
4.3. Direct & Manage Project Execution
4.3.1.3. Enterprise Environmental Factors
4.3.1.4. Organizational Process Assets
4.3.2. T & T
4.3.2.1. Expert Judgment
4.3.2.2. Project Management Information System
4.3.3. Outputs
4.3.3.1. Deliverables
4.3.3.2. Work Performance Information
4.3.3.3. Change Requests
4.3.3.4. Project Management Plan Updates
4.3.3.5. Project Document Updates
4.4. Monitor & Control Project Work
4.4.1. Inputs
4.4.1.1. Project Management Plan
4.4.1.2. Performance Reports
4.4.1.3. Enterprise Environmental Factors
4.4.1.4. Organizational Process Assets
4.4.2. T & T
4.4.2.1. Expert Judgment
4.4.3. Outputs
4.4.3.1. Change Requests
4.4.3.2. Project Management Plan Updates
4.4.3.3. Project Document Updates
4.5. Perform Integrated Change Control
4.5.1. Inputs
4.5.1.1. Project Management Plan
4.5.1.2. Work Performance Information
4.5.1.3. Change Requests
4.5.1.4. Enterprise Environmental Factors
4.5.1.5. Organizational Process Assets
4.5.2. T & T
4.5.2.1. Expert Judgment
4.5.2.2. Change Control Meetings


Project Management Body of Knowledge - Mindjet MindManager
Project Management Body of Knowledge - 4th Edition
1. Introduction
2. Project Life Cycle and Organization
3. Project Management Processes for
4. Project Integration Management
5. Project Scope Management
6. Project Time Management
7. Project Cost Management
8. Project Quality Management
Save as Web Pages
Web page layout and style
Dynamic Outline - Aqua Green
Select Template...
Customize...
Customize Web Page Layout and Style
Pagination and Navigation
Advanced Settings
Editing Templates
Multi-page export with customizable pagination and navigation depth
1. Main Topic
1.1 Subtopic
1.2 Subtopic
1.3 Subtopic
Navigation Depth:
(1 = main topics, 2 = main and subtopics, ...)
Pagination is the same as the navigation depth
OK
Cancel

(3) - ΘΕΩΡΗΤΙΚΕΣ ΠΡΟΕΚΤΑΣΕΙΣ

Η Διοίκηση Έργου αποτελεί αναπόσπαστο κομμάτι του σύγχρονου μάνατζμεντ εάν αναλογιστεί κανείς το πλήθος των ήδη ολοκληρωμένων, των υπό τέλεση έργων, αλλά και των αναγκών για νέα έργα σε όλο τον κόσμο. Στην Ελλάδα μόνο έχουμε υπάρξει μάρτυρες αρκετών προσπαθειών, λιγότερο ή περισσότερο επιτυχημένων, για κατασκευαστικά και όχι μόνο, έργα. Η γέφυρα Ρίου-Αντιρρίου, το αεροδρόμιο Ελευθέριος Βενιζέλος, η Εγναντία Οδός, οι Ολυμπιακοί Αγώνες του 2004 είναι μόνο μερικά από τα παραδείγματα διοίκησης έργου στον ελλαδικό χώρο. Εντούτοις, δε θα πρέπει σε καμία περίπτωση να ταυτίζεται η έννοια της διοίκησης έργου με τις κατασκευαστικές ή τεχνικές εταιρίες. Παραδείγματος χάριν, έργο αποτελεί η ανάπτυξη ενός νέου προϊόντος, ένα νέο εκπαιδευτικό πρόγραμμα, ή ακόμη και η έρευνα και καθιέρωση κανονισμού για την προστασία του περιβάλλοντος.

Ένα έργο ξεκινάει από μια ανάγκη, από μια απαίτηση της αγοράς, του κράτους, των τεχνολογικών εξελίξεων και μπορεί να έχει ως στόχο το κέρδος είτε να είναι κοινωφελές. Σε κάθε περίπτωση το έργο πρέπει να επιτύχει τους στόχους για τους οποίους έχει εκπονηθεί και για την πραγματοποίηση τους χρησιμοποιεί στοιχεία, τεχνικές, ανθρώπινο δυναμικό, πόρους και χρόνο, που στην πλειοψηφία των περιπτώσεων υπόκεινται σε σκληρούς περιορισμούς. Ο διοικητής έργου με το επιτελείο του είναι αυτός που θα αποφασίσει για τους ανθρώπους, το κόστος, το χρόνο, την ποιότητα, τις επικοινωνίες, την διαχείριση των κινδύνων, τις προμήθειες του έργου, και τελικά αυτός που θα το φέρει εις πέρας ή θα το καταδικάσει. Όπως διαφαίνεται λοιπόν, ένα έργο αποτελεί μια οντότητα αρκετά πολύπλοκη η οποία απαιτεί προσεκτικές κινήσεις τόσο στις προβλέψεις και τον σχεδιασμό αρχικά, όσο και στην υλοποίηση αλλά και την παρακολούθηση του, μετέπειτα.

3.1 Ορισμοί

Σε αυτό το σημείο θα παρατεθούν ορισμένες έννοιες για τη διοίκηση έργων, όπως έχουν εξαχθεί από τον οδηγό ***PMBOK® Guide – 4th edition*** του Project Management Institute.

- Τι είναι έργο

  Έργο είναι μια προσωρινή προσπάθεια που αναλαμβάνεται και εκτελείται προκειμένου να δημιουργηθεί ένα μοναδικό προϊόν, υπηρεσία ή γενικότερα κάποιο αποτέλεσμα.

  Η προσωρινότητα ενός έργου επιβάλλει κατά κάποιο τρόπο μία προσδιορισμένη αρχή και ένα τέλος σε αυτό, και το τέλος επέρχεται μόνο εφόσον ικανοποιούνται οι αντικειμενικοί στόχοι του, ή όταν καταστεί σαφές ότι οι στόχοι του δε επρόκειτο να επιτευχθούν, οπότε και το έργο τερματίζεται. Από την άλλη, προσωρινότητα δε σημαίνει και μικρή διάρκεια καθώς τα περισσότερα έργα μπορεί να διαρκέσουν από μερικούς μήνες, έως και πολλά χρόνια. Σε κάθε περίπτωση η διάρκεια ενός έργου είναι πεπερασμένη κάτι που αναγκάζει την ομάδα έργου σε διάλυση μετά το πέρας του έργου. Τέλος ένα έργο μπορεί να έχει, προτιθέμενες ή μη, κοινωνικοοικονομικές αλλά και περιβαλλοντικές επιδράσεις οι οποίες συνήθως ξεπερνούν κατά πολύ την καθαρή διάρκεια του.

  Κάθε έργο χαρακτηρίζεται από μοναδικότητα, καθώς δημιουργεί ένα μοναδικό προϊόν ή υπηρεσία. Εντούτοις, κάποια στοιχεία μπορεί να επαναλαμβάνονται σε ένα ή περισσότερα παραδοτέα[*1], όπως π.χ. χρήση ίδιων υλικών για την ανέγερση δύο πολυκατοικιών αλλά με διαφορετικό σχεδιασμό της κάθε μιας και άρα δύο εντελώς διαφορετικά έργα. Η επαναληψιμότητα λοιπόν δεν αναιρεί την θεμελιώδη μοναδικότητα του έργου, αλλά έχει ως στόχο την διευκόλυνση

της διαχείρισης μελλοντικών έργων μέσα από δημιουργία μιας βάσης γνώσης ιστορικών στοιχείων ή αλλιώς χαρτοφυλακίου (portfolio).

Η προοδευτική ανάπτυξη των εργασιών αποτελεί γενικότερα μία επαναληπτική διαδικασία αφού ακολουθεί τις υπάρχουσες διεργασίες της επιχείρησης ή οργανισμού που αναλαμβάνει το έργο. Μετά τον προσδιορισμό του φυσικού αντικειμένου[*2] του έργου χρειάζονται συνεχείς έλεγχοι διότι καθώς εξελίσσεται το έργο, το ίδιο συμβαίνει και με τις προδιαγραφές αυτού και των προϊόντων του.

- Τι είναι Διοίκηση Έργου

Διοίκηση Έργου είναι η εφαρμογή γνώσεων, ικανοτήτων, εργαλείων και τεχνικών στις δραστηριότητες ενός έργου, έτσι ώστε να ικανοποιηθούν οι απαιτήσεις του έργου. Η Διοίκηση Έργου επιτυγχάνεται μέσω της κατάλληλης εφαρμογής και ολοκλήρωσης των σαράντα-δύο (42) λογικά ομαδοποιημένων διεργασιών σε πέντε «ομάδες διεργασιών» οι οποίες είναι:

1. Ομάδα Διεργασιών Εκκίνησης
2. Ομάδα Διεργασιών Σχεδιασμού & Προγραμματισμού
3. Ομάδα Διεργασιών Εκτέλεσης
4. Ομάδα Διεργασιών Παρακολούθησης & Ελέγχου
5. Ομάδα Διεργασιών Κλεισίματος

Περαιτέρω ανάλυση επί των διεργασιών αλλά και του περιεχομένου τους γίνεται στο κεφάλαιο 2.3.

Ο διευθυντής έργου είναι ο απόλυτος κυρίαρχος, αλλά και υπεύθυνος για την επίτευξη των στόχων του έργου, όπως υπογράφεται και στο Καταστατικό του Έργου (Διεργασία Εκκίνησης).

- Ποιοι είναι οι συμμέτοχοι σε ένα έργο

Οι συμμέτοχοι του έργου (stakeholders) είναι μεμονωμένα άτομα και οργανισμοί που εμπλέκονται ενεργά στο έργο, και των οποίων τα συμφέροντα ενδέχεται να επηρεασθούν, θετικά ή αρνητικά, από την εκτέλεση και τελικά την ολοκλήρωση του έργου. Συμμέτοχοι μπορεί να είναι οι άμεσοι πελάτες του έργου, οι χορηγοί, η εταιρία που το αναλαμβάνει (ανάδοχος), το κράτος ή ακόμη και οι απλοί πολίτες - το κοινό. Όλοι αυτοί έχουν την δυνατότητα και στις περισσότερες περιπτώσεις ασκούν επιρροή τόσο στο έργο και τα παραδοτέα του, όσο και στα μέλη της ομάδας έργου. Για αυτόν ακριβώς τον λόγο η ομάδα έργου θα πρέπει να αναγνωρίσει και να κατανείμει τους συμμέτοχους σε εσωτερικούς και εξωτερικούς, ανάλογα με την σπουδαιότητα και την επιρροή τους, έτσι ώστε να είναι σε θέση να αποτυπώσει καλύτερα τις ανάγκες και τις απαιτήσεις τους από το έργο.

Η αναγνώριση των συμμετόχων εντούτοις, είναι μια συνεχής και αρκετά επίπονη διεργασία, καθώς προχωρώντας το έργο διαφοροποιούνται και οι ανάγκες, τα δεδομένα, άρα και οι συμμέτοχοι. Είναι δυνατόν να προστεθούν καινούργιοι, να ενισχυθούν οι θέσεις και η επιρροή των ήδη υπαρχόντων αλλά και να αποχωρήσουν όποιοι δεν εμπλέκονται πλέον στο έργο, όπως π.χ. κάποιοι εξωτερικοί συνεργάτες. Το σημαντικότερο στοιχείο, έπειτα από την λεπτομερή αναγνώριση και καταγραφή τους, είναι το ότι θα πρέπει να λαμβάνονται υπόψη οι απόψεις τους, να ταξινομούνται με βάση την σημαντικότητα τους για το έργο, και τέλος να υφίστανται δίαυλοι επικοινωνίας μεταξύ των συμμετόχων και της ομάδας έργου, έτσι ώστε να διευκολύνεται η άμεση επικοινωνία και ανταλλαγή στοιχείων (αναφορές απόδοσης, κλπ.).

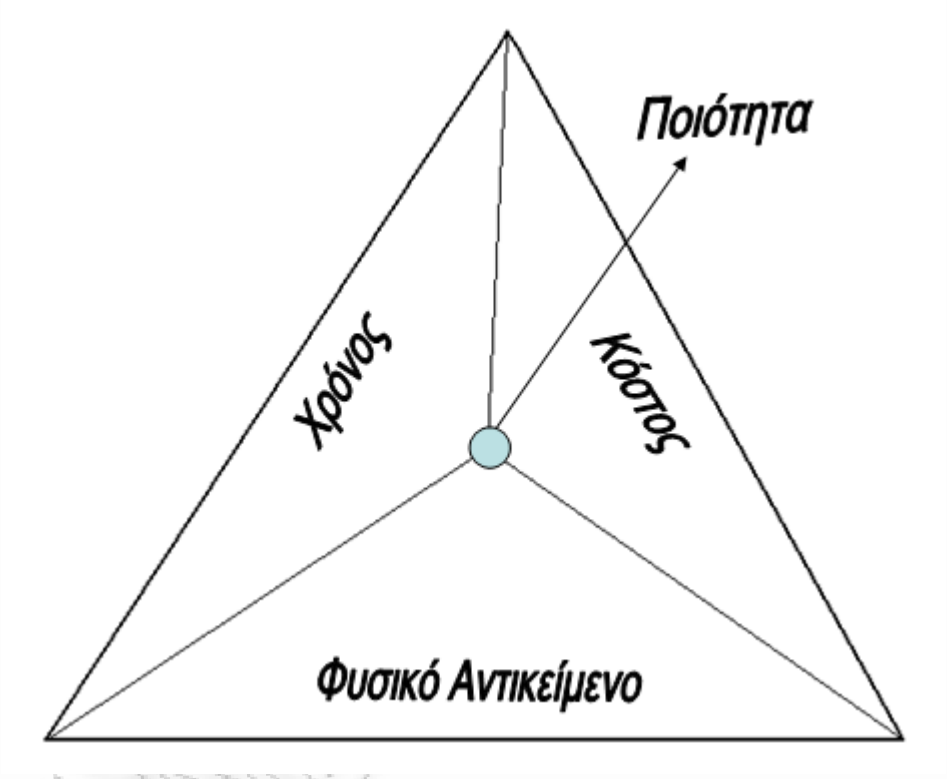
[*1] *παραδοτέο (deliverable): Μοναδικό και επαληθεύσιμο προϊόν, υπηρεσία ή αποτέλεσμα που πρέπει να παραχθεί έτσι ώστε να ολοκληρωθεί μια διεργασία, μια φάση[*3] ή ένα έργο.*

[*2] *φυσικό αντικείμενο (scope): Το άθροισμα των προϊόντων, υπηρεσιών, αποτελεσμάτων που θα παρασχεθούν ως έργο.*

[*3] *φάση ενός έργου (project phase): Μια σειρά από λογικά συνδεδεμένες δραστηριότητες έργου που συνήθως καταλήγουν στην ολοκλήρωση ενός κύριου παραδοτέου.*

3.2 «Η πυραμίδα του τρόμου»

Στη διοίκηση έργου υπάρχουν τέσσερις συνιστώσες, από τον βαθμό ικανοποίησης των οποίων κρίνεται η επιτυχία ενός έργου. Αυτές είναι το φυσικό αντικείμενο του έργου (scope), το συνολικό κόστος του (cost), το χρονικό διάστημα υλοποίησης του (time) και τέλος η ποιότητα και το μέτρο στο οποίο αυτή επιτεύχθηκε (quality). Οι τρείς πρώτες μπορούν να αναπαρασταθούν σαν τις τρεις πλευρές μιας πυραμίδας με κορυφή όλων την ποιότητα.



Σε μια κατάσταση «ισορροπίας του τρόμου» τίποτα δε πρέπει να διαταραχθεί ούτε να μεταβληθεί, γιατί αλλιώς διακυβεύεται η τάξη, η ειρήνη, η αρμονία, και τελικά το αποτέλεσμα που επιδιώκεται εξ'αρχής. Έτσι και σε ένα έργο, μόνο όταν όλα τα παραπάνω στοιχεία βρίσκονται σε ισορροπία, δεν κινδυνεύει η επιτυχής ολοκλήρωση του. Για παράδειγμα, η έγκαιρη και σύμφωνη με τις προδιαγραφές παράδοση ενός έργου μπορεί να εκτοξεύσει τον συνολικό τελικό κόστος σε τέτοιο σημείο που να

απειλήσει ακόμη και την βιωσιμότητα της επιχείρησης που ανέλαβε να το υλοποιήσει. Σε άλλη περίπτωση, η έλλειψη ποιοτικού ελέγχου και επιθεωρήσεων από την ανάδοχο εταιρεία μπορεί από τη μία να επιταχύνει τις διαδικασίες και την τελική παράδοση του έργου, από την άλλη όμως διακινδυνεύει την φήμη της αλλά και επιπλέον ποινές στο μέλλον, λόγω των μη-ποιοτικών παραδοτέων του έργου τα οποία κάποια στιγμή είναι πιθανό θα εμφανίσουν τόσο λειτουργικά όσο και τεχνικά προβλήματα, παραβιάζοντας τους κανόνες ασφάλειας και προκαλώντας ακόμη και ατυχήματα.

Με άλλα λόγια η μείωση σε ένα από τα στοιχεία της πυραμίδας, αντιστρέφει την ισορροπία των υπολοίπων τριών, το οποίο ερμηνεύεται ως μια λογική αντικρουόμενων και ανταγωνιστικών μεταξύ τους, στόχων. Εάν για παράδειγμα ο περιορισμός του χρόνου πρέπει να τηρηθεί πάση θυσία (π.χ. Ολυμπιακοί Αγώνες), είναι δυνατόν να απαιτηθεί η εγκατάλειψη κάποιων προδιαγραφών, ή απλά να επέλθει υπέρβαση κόστους στο βωμό της έγκυρης χρονικής παράδοσης. Μια πιο επιστημονική ονομασία αυτής της έννοιας είναι ο «τριπλός περιορισμός», ή το «τρίγωνο διαχείρισης του έργου».

Τέλος δε θα πρέπει να παραληφθεί πως ο τριπλός περιορισμός τοποθετείται μέσα σε ένα πλαίσιο δυνητικών ευκαιριών και απειλών (risks), οι οποίες συγκαταλέγονται μέσα στο περιβάλλον του έργου (environmental factors). Για άλλη μια φορά λοιπόν τονίζεται η σημαντικότητα του αρχικού σχεδιασμού, της οργάνωσης και του ελέγχου, προκειμένου ο διοικητής έργου και η ομάδα του να είναι σε θέση να αντιμετωπίσουν την όποια δυσκολία εμφανιστεί, χωρίς να απαιτηθεί η ελάττωση σε κάποιον από τους περιορισμούς.

3.3 Οι Διεργασίες της Διοίκησης Έργου (PMBOK® Guide – 4th edition)

Οι διεργασίες της διοίκησης έργου κατά το PMBOK® Guide – 4th edition, ομαδοποιούνται με δύο τρόπους. Πρώτον με βάση το περιεχόμενο τους και δεύτερον με βάση την χρηστικότητα τους και την χρονική στιγμή που θα πρέπει αυτές εμφανίζονται στο έργο ή αλλιώς, «προσανατολισμένες στο προϊόν».

- Βάση περιεχομένου

1. Διαχείριση Ολοκλήρωσης Έργου (Project Integration Mgmt)
2. Διαχείριση Φυσικού Αντικειμένου του Έργου (Project Scope Mgmt)
3. Διαχείριση Χρόνου Έργου (Project Time Mgmt)
4. Διαχείριση Κόστους Έργου (Project Cost Mgmt)
5. Διαχείριση Ποιότητας Έργου (Project Quality Mgmt)
6. Διοίκηση Ανθρώπινου Δυναμικού του Έργου (Human Resource Mgmt)
7. Διαχείριση Επικοινωνιών Έργου (Project Communications Mgmt)
8. Διαχείριση Κινδύνων Έργου (Project Risk Mgmt)
9. Διαχείριση Προμηθειών Έργου (Project Procurement Mgmt)

- Βάση χρηστικότητας – χρονικής στιγμής χρήσης

1. Ομάδα Διεργασιών Εκκίνησης (Initiating Process Group)
2. Ομάδα Διεργασιών Σχεδιασμού & Προγραμματισμού (Planning Process Group)
3. Ομάδα Διεργασιών Εκτέλεσης (Executing Process Group)
4. Ομάδα Διεργασιών Παρακολούθησης & Ελέγχου (Monitoring & Controlling Process Group)
5. Ομάδα Διεργασιών Κλεισίματος (Closing Process Group)

3.3.1 Διαχείριση Ολοκλήρωσης Έργου (Project Integration Mgmt)

Μέσα στο PMBOK® Guide – 4th edition, η διαχείριση ολοκλήρωσης έργου αναλύεται στο κεφάλαιο 4, και περιγράφει όλες τις απαιτούμενες διεργασίες, έτσι ώστε να εξασφαλιστεί η ορθότητα και η συνέπεια στον προσδιορισμό, συντονισμό, συνδυασμό και τέλος στην συνεργασία των στοιχείων της διοίκησης έργου. Επίσης εμπεριέχει τεχνικές για την χάραξη της στρατηγικής του έργου, αλλά και ένα σύστημα για παρακολούθηση, έλεγχο και εφαρμογή των όποιων αλλαγών απαιτηθούν. Αποτελείται από τις παρακάτω έξι (6) διεργασίες:

4.1 Ανάπτυξη Καταστατικού του Έργου (Develop Project Charter)
4.2 Ανάπτυξη Σχεδίου Διοίκησης Έργου (Develop Project Mgmt Plan)
4.3 Διοίκηση και Διαχείριση της Εκτέλεσης Έργου (Direct & Manage Project Execution)
4.4 Παρακολούθηση και Έλεγχος Εργασιών του Έργου (Monitor & Control Project Work)
4.5 Ολοκληρωμένος Έλεγχος Αλλαγών (Perform Integrated Change Control)
4.6 Κλείσιμο Έργου ή Φάσης (Close Project or Phase)

3.3.2 Διαχείριση Φυσικού Αντικειμένου του Έργου (Project Scope Mgmt)

Η διαχείριση του φυσικού αντικειμένου, αναλύεται στο κεφάλαιο 5 του PMBOK® Guide και περιγράφει τις διεργασίες εκείνες που διασφαλίζουν ότι το έργο θα περιλαμβάνει μόνο τις αναγκαίες εργασίες, και μόνον αυτές, που θα του επιτρέψουν να ολοκληρωθεί επιτυχώς. Είναι πολύ σημαντικό για ένα έργο να γίνει μια «διήθηση» των υποψήφιων εργασιών, έτσι ώστε να αποσαφηνιστεί ποιες είναι απολύτως αναγκαίες και ποιες όχι. Ένα εργαλείο για την οργάνωση του φυσικού αντικειμένου είναι η δημιουργία της Δομής Ανάλυσης Εργασιών (WBS).

Ακολουθούν οι διεργασίες:

5.1 Συλλογή Απαιτήσεων (Collect Requirements)
5.2 Ορισμός Φυσικού Αντικειμένου (Define Scope)
5.3 Δημιουργία Δομής Ανάλυσης Εργασιών (Create WBS)
5.4 Επαλήθευση Φυσικού Αντικειμένου (Verify Scope)
5.5 Έλεγχος Φυσικού Αντικειμένου (Control Scope)

3.3.3 Διαχείριση Χρόνου του Έργου (Project Time Mgmt)

Η διαχείριση του χρόνου σε ένα έργο αποτελεί την πλέον σημαντική πτυχή στην τελική επιτυχία του και αναλύεται στο κεφάλαιο 6 του PMBOK® Guide. Σε αυτή την ενότητα παρουσιάζονται οι διεργασίες που συντελούν στην έγκαιρη ολοκλήρωση του έργου, και οι οποίες κατανέμονται στις παρακάτω:

6.1 Ορισμός Δραστηριοτήτων (Define Activities)
6.2 Ανάπτυξη Ακολουθίας Δραστηριοτήτων (Sequence Activities)
6.3 Εκτίμηση Παραγωγ.Δυναμικού Δραστηριοτήτων (Estimate Activity Resources)
6.4 Εκτίμηση Διάρκειας Δραστηριοτήτων (Estimate Activity Durations)
6.5 Ανάπτυξη Χρονοδιαγράμματος (Develop Schedule)
6.6 Έλεγχος Χρονοδιαγράμματος (Control Schedule)

3.3.4 Διαχείριση Κόστους του Έργου (Project Cost Mgmt)

Στο κεφάλαιο 7 του PMBOK® Guide περιγράφονται όλες εκείνες τις διεργασίες που εμπλέκονται στον προγραμματισμό, την εκτίμηση, την παρακολούθηση και τον έλεγχο του κόστους σε ένα έργο, ούτος ώστε αυτό να ολοκληρωθεί εντός του εγκεκριμένου προϋπολογισμού που έχει συμφωνηθεί. Οι σχετικές διεργασίες είναι τρεις (3):

7.1 Εκτίμηση Κόστους (Estimate Costs)
7.2 Προϋπολογισμός Κόστους (Determine Budget)
7.3 Έλεγχος Κόστους (Control Costs)

3.3.5 Διαχείριση Ποιότητας Έργου (Project Quality Mgmt)

Το κεφάλαιο 8 του PMBOK® Guide καταγράφει τις απαιτούμενες διεργασίες προκειμένου να διασφαλιστεί ότι το έργο θα ικανοποιεί τις ανάγκες για τις οποίες αναλήφθηκε. Επιπλέον παρέχουν τα απαιτούμενα εργαλεία και τεχνικές για την ορθή συμμόρφωση στα πρότυπα ποιότητας που έχουν τεθεί τόσο από τους πελάτες, όσο και από τους προμηθευτές αλλά και την ισχύουσα νομοθεσία, και είναι οι εξής:

8.1 Σχεδιασμός Ποιότητας (Plan Quality)
8.2 Εκτέλεση Διασφάλισης Ποιότητας (Perform Quality Assurance)
8.3 Εκτέλεση Ελέγχου Ποιότητας (Perform Quality Control)

3.3.6 Διοίκηση Ανθρώπινου Δυναμικού Έργου (Project Human Resource Mgmt)

Η διοίκηση ανθρώπινων πόρων σε ένα έργο αποτελεί πρόκληση λόγω της φύσης του έργου το οποίο ενσωματώνει συνήθως πολλούς και διαφορετικούς επαγγελματικούς κλάδους. Το κεφάλαιο 9, λοιπόν, του PMBOK® Guide επιχειρεί να δώσει λύσεις και μεθόδους αντιμετώπισης μέσα από τις ακόλουθες τέσσερις (4) διεργασίες:

9.1 Ανάπτυξη Σχεδίου Διοίκησης Ανθρώπινου Δυναμικού (Develop Human Resource Plan)
9.2 Απόκτηση Ομάδας Έργου (Acquire Project Team)
9.3 Ανάπτυξη Ομάδας Έργου (Develop Project Team)
9.4 Διοίκηση Ομάδας Έργου (Manage Project Team)

3.3.7 Διαχείριση Επικοινωνιών Έργου (Project Communications Mgmt)

Οι επικοινωνίες για ένα έργο είναι ότι και το κυκλοφορικό σύστημα για τον άνθρωπο. Η πολυπλοκότητα αλλά ταυτόχρονα η ανάγκη για έγκυρη και έγκαιρη πληροφόρηση

ανάγκασε τους ειδικούς του PMI να αφιερώσουν το κεφάλαιο 10 του PMBOK® Guide στην διαχείριση των επικοινωνιών και κατέληξαν στις εξής διεργασίες:

10.1 Αναγνώριση Συμμετόχων (Identify Stakeholders)
10.2 Σχεδιασμός Επικοινωνιών (Plan Communications)
10.3 Διανομή Πληροφοριών (Distribute Information)
10.4 Διαχείριση των Απαιτήσεων των Συμμετόχων (Manage Stakeholders Expectations)
10.5 Αναφορά Απόδοσης (Report Performance)

3.3.8 Διαχείριση Κινδύνων του Έργου (Project Risk Mgmt)

Η διαχείριση κινδύνων έργου περιλαμβάνει διεργασίες που προσανατολίζονται στον σχεδιασμό, τη διαχείριση, την ανάλυση, την απόκριση και την παρακολούθηση των κινδύνων αλλά και των ευκαιριών που μπορεί να παρουσιαστούν σε ένα έργο. Παραθέτει εργαλεία τόσο για την ορθή αναγνώριση, όσο και αντιμετώπιση των ευκαιριών – απειλών. Τμηματοποιείται στις ακόλουθες έξι (6) διεργασίες:

11.1 Σχεδιασμός Διαχείρισης Κινδύνων (Plan Risk Mgmt)
11.2 Προσδιορισμός Κινδύνων (Identify Risks)
11.3 Ποιοτική Ανάλυση Κινδύνων (Perform Qualitative Risk Analysis)
11.4 Ποσοτική Ανάλυση Κινδύνων (Perform Quantitative Risk Analysis)
11.5 Σχεδιασμός Απόκρισης σε Κινδύνους (Plan Risk Responses)
11.6 Παρακολούθηση και Έλεγχος Κινδύνων (Monitor & Control Risks)

3.3.9 Διαχείριση Προμηθειών Έργου

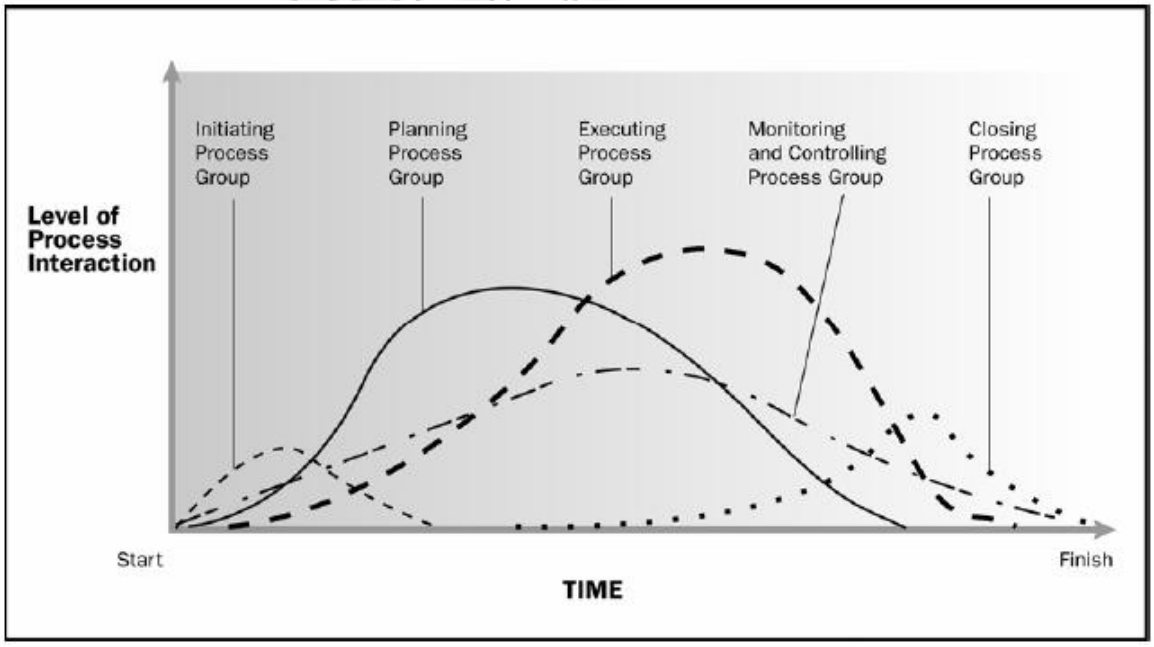
Το τελευταίο κεφάλαιο της διαχείρισης προμηθειών έργου ασχολείται με την απόκτηση των αναγκαίων προϊόντων, υπηρεσιών ή αποτελεσμάτων από το εξωτερικό περιβάλλον της ομάδας έργου, για την εκτέλεση των εργασιών και την ολοκλήρωση των

παραδοτέων. Εκτός όμως από τις αγορές, περιλαμβάνει και διαδικασίες διαχείρισης, καθώς και περάτωσης των συμβάσεων. Εμπεριέχει τέσσερις (4) βασικές διεργασίες:

12.1 Σχεδιασμός Προμηθειών (Plan Procurements)
12.2 Υλοποίηση Προμηθειών (Conduct Procurements)
12.3 Διαχείριση Προμηθειών (Administer Procurements)
12.4 Περάτωση Προμηθειών (Close Procurements)

Μετά το πέρας της ομαδοποίησης ανάλογα με το περιεχόμενο τους, ακολουθεί η ομαδοποίηση προσανατολισμένη στο προϊόν, σύμφωνα πάντα με το PMBOK® Guide.

Όλες οι διεργασίες έχουν κάποιες δεδομένα-εισόδους (inputs), κατόπιν αυτά επεξεργάζονται από τα εργαλεία και τεχνικές (tools & techniques) και καταλήγουν σε κάποιο αποτέλεσμα-έξοδο (outputs), το οποίο τις περισσότερες φορές αποτελεί μία ή και παραπάνω εισόδους σε κάποια από τις επόμενες διεργασίες. Μοιραία λοιπόν οι αλληλεπιδράσεις ανάμεσα στις διεργασίες είναι αναπόφευκτες.



Ο παραπάνω πίνακας παριστάνει τον βαθμό αλληλεπίδρασης των διεργασιών, ανάλογα με το επίπεδο ομαδοποίησης στο οποίο βρίσκονται. Συμπεραίνει κανείς πως οι διεργασίες έναρξης και τέλους απασχολούν την ομάδα έργου για πολύ μικρότερο χρονικό διάστημα σε σχέση με τις διεργασίες ελέγχου οι οποίες συναντώνται σε ολόκληρη την χρονική έκταση ενός έργου. Από την άλλη όμως, ο βαθμός ενασχόλησης της ομάδας έργου με τον έλεγχο είναι ηπιότερος από τον σχεδιασμό και την εκτέλεση του έργου καθώς οι διεργασίες σχεδιασμού έχουν εντονότερες αλληλεπιδράσεις στην αρχή, ενώ οι αντίστοιχες της εκτέλεσης ενδυναμώνονται περίπου στη μέση του έργου.

Στην ιστοσελίδα, το κεφάλαιο της ομαδοποίησης με βάση την χρηστικότητα αναλύεται στο κεφάλαιο 3 (Project Management Processes for a Project).

3.3.10 Ομάδα Διεργασιών Εκκίνησης (Initiating Process Group)

Η ομάδα διεργασιών εκκίνησης του έργου αποτελείται από τις διεργασίες εκείνες που εκτελούνται για να καθορίσουν την αρχή ενός έργου ή μια νέα φάση ενός ήδη υπάρχοντος έργου και επιπλέον να πάρουν την έγκριση για να αρχίσει και επίσημα το έργο ή η φάση. Μέσα στις διαδικασίες έναρξης, ορίζεται το αρχικό φυσικό αντικείμενο και δεσμεύονται οι πρώτοι οικονομικοί πόροι. Επίσης προσδιορίζονται οι εσωτερικοί και εξωτερικοί συμμέτοχοι που θα αλληλεπιδράσουν και θα επηρεάσουν τη γενική έκβαση του έργου. Τέλος καθορίζεται ο διευθυντής έργου, εάν δεν έχει ήδη οριστεί. Οι ανωτέρω πληροφορίες περιλαμβάνονται στις διεργασίες:

4.1 Ανάπτυξη Καταστατικού του Έργου (Develop Project Charter)

10.6 Αναγνώριση Συμμετόχων (Identify Stakeholders)

3.3.11 Ομάδα Διεργασιών Σχεδιασμού & Προγραμματισμού (Planning Process Group)

Η ομάδα σχεδιασμού αποτελείται από τις διεργασίες εκείνες που εκτελούνται για να καθορίσουν το συνολικό φυσικό αντικείμενο και τους στόχους του έργου, αλλά επίσης να αναπτύξουν το σχέδιο δράσης που απαιτείται για την επιτυχία των αντικειμενικών στόχων. Οι διαδικασίες προγραμματισμού αναπτύσσουν το σχέδιο διοίκησης του έργου αλλά και τα σχετικά έγγραφα του έργου τα οποία θα χρησιμεύσουν στην περαιτέρω εκτέλεση του έργου. Εντούτοις, καθώς μέρα με τη μέρα περισσότερες πληροφορίες σχετικές με το έργο γίνονται γνωστές, συνήθως απαιτείται πρόσθετος προγραμματισμός. Προσθετικά σε αυτό λειτουργούν και κάποιες σημαντικές και απαιτούμενες αλλαγές, οι οποίες αναγκάζουν στον επαναπροσδιορισμό και την ανατροφοδότηση μιας ή περισσοτέρων διεργασιών της ομάδας σχεδιασμού ή ακόμη και της ομάδας έναρξης. Τέλος η ομάδα διεργασιών σχεδιασμού και προγραμματισμού περιλαμβάνει τις περισσότερες διεργασίες και επιπλέον από όλες τις γνωστικές περιοχές:

- ***4.2 Ανάπτυξη Σχεδίου Διοίκησης Έργου (Develop Project Mgmt Plan)***
- ***5.1 Συλλογή Απαιτήσεων (Collect Requirements)***
- ***5.2 Ορισμός Φυσικού Αντικειμένου (Define Scope)***
- ***5.3 Δημιουργία Δομής Ανάλυσης Εργασιών (Create WBS)***
- ***6.1 Ορισμός Δραστηριοτήτων (Define Activities)***
- ***6.2 Ανάπτυξη Ακολουθίας Δραστηριοτήτων (Sequence Activities)***
- ***6.3 Εκτίμηση Παραγωγικού Δυναμικού Δραστηριοτήτων (Estimate Activity Resources)***
- ***6.4 Εκτίμηση Διάρκειας Δραστηριοτήτων (Estimate Activity Durations)***
- ***6.5 Ανάπτυξη Χρονοδιαγράμματος (Develop Schedule)***
- ***6.6 Έλεγχος Χρονοδιαγράμματος (Control Schedule)***
- ***7.1 Εκτίμηση Κόστους (Estimate Costs)***
- ***7.2 Προϋπολογισμός Κόστους (Determine Budget)***
- ***8.1 Σχεδιασμός Ποιότητας (Plan Quality)***
- ***9.1 Ανάπτυξη Σχεδίου Διοίκησης Ανθρώπινου Δυναμικού (Develop Human Resource Plan)***
- ***10.2 Σχεδιασμός Επικοινωνιών (Plan Communications)***

11.1 Σχεδιασμός Διαχείρισης Κινδύνων (Plan Risk Mgmt)

11.2 Προσδιορισμός Κινδύνων (Identify Risks)

11.3 Ποιοτική Ανάλυση Κινδύνων (Perform Qualitative Risk Analysis)

11.4 Ποσοτική Ανάλυση Κινδύνων (Perform Quantitative Risk Analysis)

11.5 Σχεδιασμός Απόκρισης σε Κινδύνους (Plan Risk Responses)

12.1 Σχεδιασμός Προμηθειών (Plan Procurements)

3.3.12 Ομάδα Διεργασιών Εκτέλεσης (Executing Process Group)

Η «εκτελεστική» ομάδα διεργασιών εμπεριέχει όλα αυτά που πρέπει να γίνουν έτσι ώστε να ολοκληρωθούν οι εργασίες που καθορίστηκαν στο σχέδιο διοίκησης του έργου, με σκοπό πάντα την ικανοποίηση των προδιαγραφών του έργου. Για να επιτευχθεί κάτι τέτοιο, θα πρέπει να συντονιστούν άνθρωποι και πόροι για την ορθότερη εκτέλεση των δραστηριοτήτων που έχουν οριστεί από το σχέδιο διοίκησης έργου. Κατά τη διάρκεια της εκτέλεσης των εργασιών, είναι πιθανόν να απαιτηθεί αναπροσαρμογή σε κάποια στοιχεία του προγράμματος (χρονοδιάγραμμα, προϋπολογισμός, κίνδυνοι). Τα αποτελέσματα της ανάλυσης δύναται να προκαλέσουν αιτήματα αλλαγής που, εάν εγκρίνονται, μπορούν να τροποποιήσουν το σχέδιο διοίκησης έργου ή και άλλα σχετικά έγγραφα(cost baseline, κλπ). Συνοπτικά οι διεργασίες εκτέλεσης:

4.3 Διοίκηση και Διαχείριση της Εκτέλεσης Έργου (Direct & Manage Project Execution)

8.2 Εκτέλεση Διασφάλισης Ποιότητας (Perform Quality Assurance)

9.2 Απόκτηση Ομάδας Έργου (Acquire Project Team)

9.3 Ανάπτυξη Ομάδας Έργου (Develop Project Team)

9.4 Διοίκηση Ομάδας Έργου (Manage Project Team)

10.3 Διανομή Πληροφοριών (Distribute Information)

10.4 Διαχείριση των Απαιτήσεων των Συμμετόχων (Manage Stakeholders Expectations)

12.2 Υλοποίηση Προμηθειών (Conduct Procurements)

3.3.13 Ομάδα Διεργασιών Παρακολούθησης & Ελέγχου (Monitoring & Controlling Process Group)

Οι διεργασίες που σχετίζονται με την παρακολούθηση και τον έλεγχο δε θα μπορούσαν παρά να ανιχνεύουν, να μετρούν και να κατευθύνουν σύμφωνα με τις προδιαγραφές, την πρόοδο και την αποδοτικότητα του έργου. Να διακρίνουν τις περιοχές του σχεδίου διοίκησης, στις οποίες είναι αναγκαία η εφαρμογή αλλαγών (π.χ. προϋπολογισμός, χρονοδιάγραμμα) και να εκκινούν τις διαδικασίες διόρθωσης, αντικατάστασης, ή επανεργασίας, όπου αυτό απαιτείται. Επίσης να επαληθεύουν και να επικυρώνουν τα παραδοτέα κάθε φάσης. Το σημαντικότερο όμως στοιχείο στον τρόπο λειτουργίας αυτής της ομάδας διεργασιών, είναι οι προγραμματισμένοι έλεγχοι και επιθεωρήσεις, με σκοπό την εύρεση τυχόν αποκλίσεων από τις αρχικές βάσεις αναφοράς (κόστους, χρόνου, ποιότητας, κλπ.). Διεργασίες ελέγχου συναντώνται σε όλες σχεδόν τις γνωστικές περιοχές του PMBOK® Guide, εκτός από το κεφάλαιο 9.

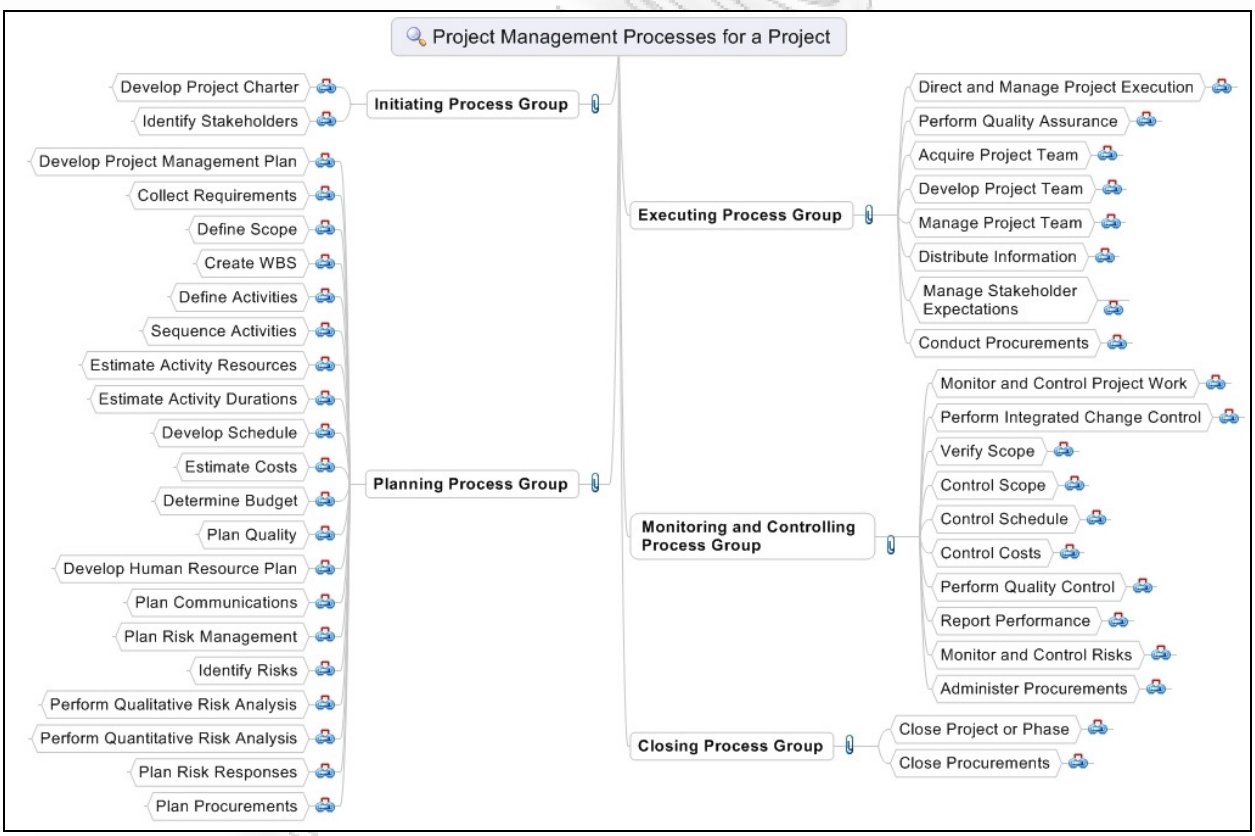
- ***4.4 Παρακολούθηση και Έλεγχος Εργασιών του Έργου (Monitor & Control Project Work)***
- ***4.5 Ολοκληρωμένος Έλεγχος Αλλαγών (Perform Integrated Change Control)***
- ***5.4 Επαλήθευση Φυσικού Αντικειμένου (Verify Scope)***
- ***5.5 Έλεγχος Φυσικού Αντικειμένου (Control Scope)***
- ***6.6 Έλεγχος Χρονοδιαγράμματος (Control Schedule)***
- ***7.3 Έλεγχος Κόστους (Control Costs)***
- ***8.3 Εκτέλεση Ελέγχου Ποιότητας (Perform Quality Control)***
- ***10.5 Αναφορά Απόδοσης (Report Performance)***
- ***11.6 Παρακολούθηση και Έλεγχος Κινδύνων (Monitor & Control Risks)***
- ***12.3 Διαχείριση Προμηθειών (Administer Procurements)***

3.3.14 Ομάδα Διεργασιών Κλεισίματος (Closing Process Group)

Η τελευταία ομάδα διεργασιών του PMBOK® Guide αποτελείται από δύο διεργασίες, οι οποίες χρησιμοποιούνται προκειμένου να τερματιστεί επισήμως ένα έργο, μία φάση ή μια σύμβασης με υπολειπόμενους όρους. Όταν τελεστούν όλες οι απαιτούμενες δραστηριότητες, και αφού ελεγχθούν για τις προδιαγραφές τους, επιβεβαιώνονται ως «ολοκληρωμένες» από τις διεργασίες κλεισίματος και πλέον το έργο ή η φάση θεωρείται «εις πέρας». Οι δύο (2) αυτές διεργασίες είναι οι ακόλουθες:

4.6 Κλείσιμο Έργου ή Φάσης (Close Project or Phase)

12.4 Περάτωση Προμηθειών (Close Procurements)



Εικόνα 3.1 - Νοητική απεικόνιση των 42 διεργασιών του PMBOK® Guide - 4th edition με ομαδοποίηση προσανατολισμένη στο προϊόν.

(4) - ΔΙΑΦΟΡΕΣ/ΕΠΙΚΑΙΡΟΠΟΙΗΣΕΙΣ 4ης ΕΚΔΟΣΗΣ

Η νέα επικαιροποιημένη έκδοση του PMI εμπεριέχει στο σύνολο της δύο διεργασίες λιγότερες σε σχέση με το PMBOK® Guide – 3rd edition, ενώ χρησιμοποιεί την σύνταξη «Ρήμα – Ουσιαστικό» και ενεργητική φωνή στην πλειοψηφία των διεργασιών. Ακολουθούν πίνακες με τις αντίστοιχες αλλαγές στις γνωστικές περιοχές του PMBOK® Guide – 4th edition

4.1 Αλλαγές στη Διαχείριση Ολοκλήρωσης Έργου (κεφ.4)

Κύριο στοιχείο: Η αφαίρεση της διεργασίας «Ανάπτυξη Προκαταρκτικής Έκθεσης Φυσικού Αντικειμένου του Έργου», καθώς πολλά από τα στοιχεία της εμπεριέχονται τόσο στο καταστατικό του έργου, όσο και στον ορισμό του φυσικού αντικειμένου.

Ενότητες 3ης Έκδοσης (2004)	**Ενότητες 4ης Έκδοσης (2008)**
4.1 Ανάπτυξη Καταστατικού Έργου	4.1 Ανάπτυξη Καταστατικού Έργου
4.2 Ανάπτυξη Προκαταρκτικής Έκθεσης Φυσικού Αντικειμένου του Έργου	(απαλείφθηκε)
4.3 Ανάπτυξη Σχεδίου Διοίκησης Έργου	4.2 Ανάπτυξη Σχεδίου Διοίκησης Έργου
4.4 Διοίκηση και Διαχείριση της Εκτέλεσης Έργου	4.3 Διοίκηση και Διαχείριση της Εκτέλεσης Έργου
4.5 Παρακολούθηση και Έλεγχος Εργασιών Έργου	4.4 Παρακολούθηση και Έλεγχος Εργασιών Έργου
4.6 Ολοκληρωμένος Έλεγχος Αλλαγών	4.5 Ολοκληρωμένος Έλεγχος Αλλαγών
4.7 Κλείσιμο Έργου	4.6 Κλείσιμο Έργου ή Φάσης

4.2 Αλλαγές στη Διαχείριση Φυσικού Αντικειμένου του Έργου (κεφ.5)

Κύριο στοιχείο: Η αντικατάσταση της διεργασίας «Σχεδιασμός Φυσικού Αντικειμένου» με την νέα διεργασία «Συλλογή Απαιτήσεων». Το «μητρώο συμμετόχων», το οποίο αποτελεί παράγωγο αυτής της νέα διεργασίας, βοηθά στην αναγνώριση των αναγκών και των απαιτήσεων των εμπλεκομένων στο έργο.

Ενότητες 3ης Έκδοσης (2004)	**Ενότητες 4ης Έκδοσης (2008)**
5.1 Σχεδιασμός Φυσικού Αντικειμένου	5.1 Συλλογή Απαιτήσεων
5.2 Ορισμός Φυσικού Αντικειμένου	5.2 Ορισμός Φυσικού Αντικειμένου
5.3 Δημιουργία WBS	5.3 Δημιουργία WBS
5.4 Επαλήθευση Φυσικού Αντικειμένου	5.4 Επαλήθευση Φυσικού Αντικειμένου
5.5 Έλεγχος Φυσικού Αντικειμένου	5.5 Έλεγχος Φυσικού Αντικειμένου

4.3 Αλλαγές στη Διαχείριση Χρόνου του Έργου (κεφ.6)

Κύριο στοιχείο: Η χρήση ενεργητικής φωνής στις διεργασίες. (αποδίδεται καλύτερα στην αγγλική γλώσσα: π.χ. η "Activity Definition" έγινε "Define Activities".

Ενότητες 3ης Έκδοσης (2004)	**Ενότητες 4ης Έκδοσης (2008)**
6.1 Ορισμός Δραστηριοτήτων	6.1 Ορισμός Δραστηριοτήτων
6.2 Ανάπτυξη Ακολουθίας Δραστηριοτήτων	6.2 Ανάπτυξη Ακολουθίας Δραστηριοτήτων
6.3 Εκτίμηση Παραγωγικού Δυναμικού Δραστηριοτήτων	6.3 Εκτίμηση Παραγωγικού Δυναμικού Δραστηριοτήτων
6.4 Εκτίμηση Διάρκειας Δραστηριοτήτων	6.4 Εκτίμηση Διάρκειας Δραστηριοτήτων
6.5 Ανάπτυξη Χρονοδιαγράμματος	6.5 Ανάπτυξη Χρονοδιαγράμματος
6.6 Έλεγχος Χρονοδιαγράμματος	6.6 Έλεγχος Χρονοδιαγράμματος

4.4 Αλλαγές στη Διαχείριση Κόστους του Έργου (κεφ.7)

Κύριο στοιχείο: Προστέθηκε ο δείκτης "To-Complete Performance Index" στα εργαλεία και τεχνικές της διεργασίας «Έλεγχος Κόστους».

Ενότητες 3ης Έκδοσης (2004)	Ενότητες 4ης Έκδοσης (2008)
7.1 Εκτίμηση Κόστους	7.1 Εκτίμηση Κόστους
7.2 Προϋπολογισμός Κόστους	7.2 Προϋπολογισμός Κόστους
7.3 Έλεγχος Κόστους	7.3 Έλεγχος Κόστους

4.5 Αλλαγές στη Διαχείριση Ποιότητας του Έργου (κεφ.8)

Κύριο στοιχείο: Παρέμειναν οι ίδιες

Ενότητες 3ης Έκδοσης (2004)	Ενότητες 4ης Έκδοσης (2008)
8.1 Σχεδιασμός Ποιότητας	8.1 Σχεδιασμός Ποιότητας
8.2 Εκτέλεση Διασφάλισης Ποιότητας	8.2 Εκτέλεση Διασφάλισης Ποιότητας
8.3 Έλεγχος Ποιότητας	8.3 Έλεγχος Ποιότητας

4.6 Αλλαγές στη Διοίκηση Ανθρώπινου Δυναμικού του Έργου (κεφ.9)

Κύριο στοιχείο: Η ανάπτυξη και διοίκηση των ομάδων έργου εμπλουτίσθηκαν με σκοπό την αναγνώριση των απαιτούμενων δεξιοτήτων των μελών της ομάδα έργου.

Ενότητες 3ης Έκδοσης (2004)	Ενότητες 4ης Έκδοσης (2008)
9.1 Προγραμματισμός Ανθρώπινου Δυναμικού	9.1 Προγραμματισμός Ανθρώπινου Δυναμικού
9.2 Απόκτηση Ομάδας Έργου	9.2 Απόκτηση Ομάδας Έργου
9.3 Ανάπτυξη Ομάδας Έργου	9.3 Ανάπτυξη Ομάδας Έργου
9.4 Διοίκηση Ομάδας Έργου	9.4 Διοίκηση Ομάδας Έργου

4.7 Αλλαγές στη Διαχείριση Επικοινωνιών του Έργου (κεφ.10)

Κύριο στοιχείο: Η αυξημένη σε σχέση την προηγούμενη έκδοση, σημασία που δίδεται στους συμμετόχους, στις ανάγκες τους αλλά και στο τι αυτοί περιμένουν από το έργο. Για αυτό τον λόγο προστέθηκε η πρώτη νέα διεργασία, ενώ και όλες οι υπόλοιπες επικεντρώθηκαν γύρω από την καλύτερη πληροφόρηση και επικοινωνία σε πραγματικό χρόνο, τόσο μεταξύ της ομάδας έργου, όσο και με εξωτερικούς συνεργάτες.

Ενότητες 3ης Έκδοσης (2004)	**Ενότητες 4ης Έκδοσης (2008)**
10.1 Σχεδιασμός Επικοινωνιών	10.1 Αναγνώριση Συμμετόχων
10.2 Διανομή Πληροφοριών	10.2 Σχεδιασμός Επικοινωνιών
10.3 Αναφορά Απόδοσης	10.3 Διανομή Πληροφοριών
10.4 Διοίκηση Συμμετόχων	10.4 Διαχείριση των Απαιτήσεων των Συμμετόχων
	10.5 Αναφορά Απόδοσης

4.8 Αλλαγές στη Διαχείριση Κινδύνων του Έργου (κεφ.11)

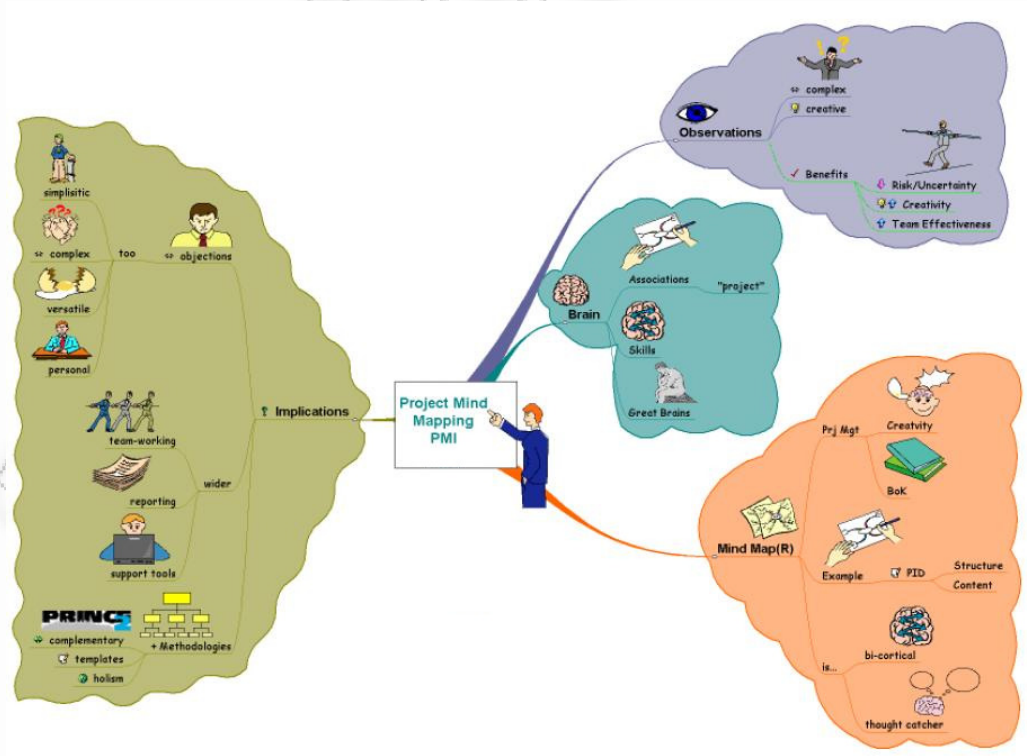
Κύριο στοιχείο: Παρέμειναν οι ίδιες

Ενότητες 3ης Έκδοσης (2004)	**Ενότητες 4ης Έκδοσης (2008)**
11.1 Σχεδιασμός Διαχείρισης Κινδύνων	11.1 Σχεδιασμός Διαχείρισης Κινδύνων
11.2 Προσδιορισμός Κινδύνων	11.2 Προσδιορισμός Κινδύνων
11.3 Ποιοτική Ανάλυση Κινδύνων	11.3 Ποιοτική Ανάλυση Κινδύνων
11.4 Ποσοτική Ανάλυση Κινδύνων	11.4 Ποσοτική Ανάλυση Κινδύνων
11.5 Σχεδιασμός Απόκρισης σε Κινδύνους	11.5 Σχεδιασμός Απόκρισης σε Κινδύνους
11.6 Παρακολούθηση και Έλεγχος Κινδύνων	11.6 Παρακολούθηση και Έλεγχος Κινδύνων

4.9 Αλλαγές στη Διαχείριση Προμηθειών του Έργου (κεφ.12)

Κύριο στοιχείο: Σύμπτυξη έξι διεργασιών σε τέσσερις, αντικατάσταση της λέξης «σύμβαση» από τον όρο «προμήθειες» και τέλος συνδυασμός του σχεδιασμού αγορών και συμβάσεων του στη νέα διεργασία «Σχεδιασμός Προμηθειών», αλλά και της αίτησης απάντησης και επιλογής προμηθευτών στην «Υλοποίηση Προμηθειών».

Ενότητες 3ης Έκδοσης (2004)	Ενότητες 4ης Έκδοσης (2008)
12.1 Σχεδιασμός Αγορών και Αποκτήσεων	12.1 Σχεδιασμός Προμηθειών
12.2 Σχεδιασμός Συμβάσεων	12.2 Υλοποίηση Προμηθειών
12.3 Αίτηση Απαντήσεων Προμηθευτών	12.3 Διαχείριση Προμηθειών
12.4 Επιλογή Προμηθευτών	12.4 Περάτωση Προμηθειών
12.5 Διαχείριση Συμβάσεων	
12.6 Περάτωση Συμβάσεων	



(5) – ΕΠΙΛΟΓΟΣ και ΣΥΜΠΕΡΑΣΜΑΤΑ

Στο προηγούμενο κεφάλαιο αναφέρεται ότι στην 4η έκδοση του προτύπου προτιμήθηκε η ενεργητική φωνή για την περιγραφή των διεργασιών και την ανάλυση των σχέσεων τους σε ένα εικονικό έργο

Πρόκειται δηλαδή για ένα βιβλίο – οδηγό (Guidebook) και όχι για ένα επιστημονικό βιβλίο (Textbook), το οποίο κατευθύνει με συγκεκριμένα βήματα και τεχνικές τους αναγνώστες του. Αυτό ήταν εν μέρει και το έναυσμα για την ανάληψη και παραγωγή της συγκεκριμένης εργασίας. Να ξεφύγει δηλαδή ένα βιβλίο οδηγός από την μονομερή καθοδήγηση και την «βήμα προς βήμα» προσέγγιση, και να εμπλουτισθεί με επιστημονικές και άλλες σχετικές πληροφορίες. Επιπλέον η μορφή του ως ιστοσελίδα, αλλά και ως νοητικός χάρτης είναι εύκολο να υποστεί επικαιροποιήσεις και προσθήκες «ζωντανών» παραδειγμάτων από τον κόσμο του management όπως φύλλων εργασίας (worksheets), αναφορών εργασίας, βίντεο κλπ., όπου αυτό χρειάζεται, αλλά και να συνεργαστεί με άλλα αντίστοιχα e-learning εργαλεία, έτσι ώστε να μπορέσει να συμβάλλει ακόμα και σε περιπτώσεις αξιολόγησης σε πραγματικό εκπαιδευτικό ή εργασιακό περιβάλλον.

Με λίγα λόγια δημιουργήθηκε μια βάση γνώσης με έντονο το αλληλεπιδραστικό στοιχείο αλλά και την δυνατότητα για μελλοντικό εμπλουτισμό και διορθώσεις, ανάλογα πάντα με τις ανάγκες, τις τάσεις και τα νέα δεδομένα που εισάγονται συνεχώς στον τομέα της διοίκησης έργου. Μια βάση γνώσης, η οποία θα μπορούσε εύκολα να χαρακτηριστεί ως μια ***"PM-Pedia"***.

(6) – ΠΗΓΕΣ/ΒΙΒΛΙΟΓΡΑΦΙΑ

Έντυπη

- Project Management Institute, "A guide to the project management body of knowledge" (PMBOK® Guide - 4th edition - 2008)
- Rita Mulcahy, "PMP® Exam Prep - Accelerated Learning to Pass PMI's PMP Exam on your First Try" (RMC Publications - 2005)
- Δημήτρης Εμίρης (Μετάφραση - Επιστημονική Επιμέλεια), «Οδηγός Βασικών Γνώσεων στη Διοίκηση Έργων» (PMBOK® Guide - 3rd edition - 2004)
- Patrick Mayfield (Pierce Mayfield Associates), "Using Mind Mapping® in Project Management" (2001)

Ηλεκτρονική

- http://en.wikipedia.org/wiki/Main_Page
- http://www.pmi.org/Pages/default.aspx
- http://www.ipma.ch/Pages/default.aspx
- http://www.certifiedprojectmanager.org
- http://www.apmgroup.co.uk/home/home.asp
- http://www.microsoft.com/learning/en/us/certification/cert-default.aspx
- http://it.toolbox.com/blogs/enterprise-solutions
- http://www.project-management-knowledge.com
- http://pmcrunch.com/project_management_process
- http://www.pmlinks.com/information/templates
- http://www.anticlue.net
- http://www.enotes.com/management-encyclopedia
- http://www.pmforum.org

(7) – ΠΑΡΑΡΤΗΜΑ

7.1 Πίνακας Εργαλείων και Τεχνικών που έχουν εμπλουτισθεί περαιτέρω

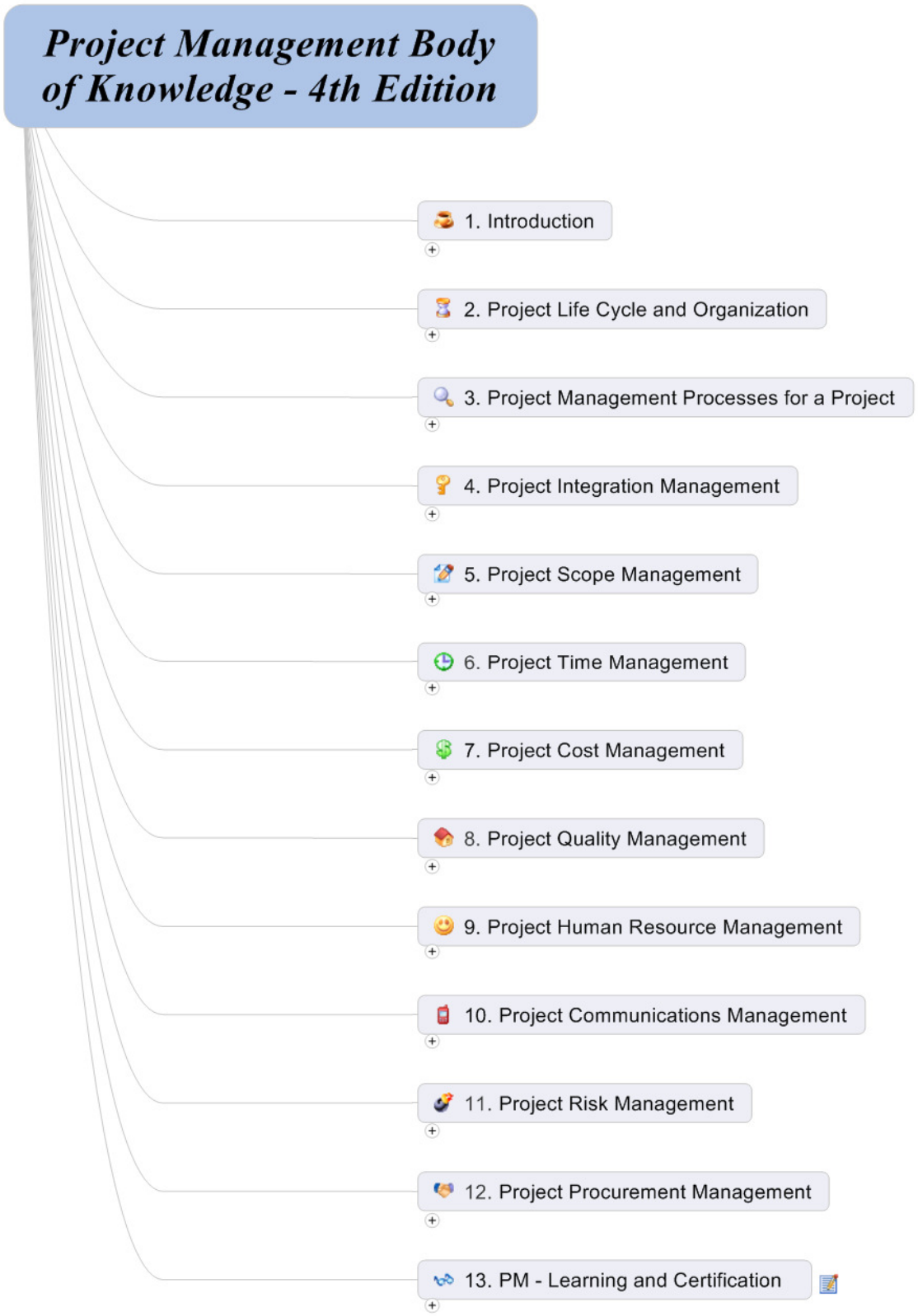
Tools & Techniques	Enriched	Non-Enriched
Expert Judgment		✓
Project Management Information System	✓	
Change Control Meetings		✓
Interviews		✓
Focus groups		✓
Facilitated Workshops		✓
Group Creativity Techniques		✓
Group Decision Making Techniques		✓
Questionnaires and Surveys		✓
Observations		✓
Prototypes		✓
Product Analysis	✓	
Alternatives Identification		✓
Facilitated Workshops		✓
Decomposition	✓	
Inspection	✓	
Variance Analysis	✓	
Rolling Wave Planning	✓	
Templates	✓	
Precedence Diagramming Method (PDM)	✓	
Dependency Determination		✓
Applying Leads and Lags	✓	
Schedule Network Templates	✓	
Alternatives Analysis	✓	
Published Estimating Data	✓	
Bottom-Up Estimating	✓	
Project Management Software	✓	
Analogous Estimating	✓	

Parametric Estimating	✓	
Three-Point Estimating	✓	
Reserve Analysis	✓	
Schedule Network Analysis	✓	
Critical Path Method	✓	
Critical Chain Method	✓	
Resource Leveling	✓	
What-If Scenario Analysis	✓	
Schedule Compression	✓	
Scheduling Tool	✓	
Performance Reviews	✓	
Cost of Quality (COQ)	✓	
Vendor Bid Analysis	✓	
Cost Aggregation		✓
Historical Relationships		✓
Funding Limit Reconciliation		✓
Earned Value Measurement (EVM)	✓	
Forecasting	✓	
To-Complete Performance Index (TCPI)	✓	
Cost-Benefit Analysis	✓	
Control Charts	✓	
Benchmarking	✓	
Design of Experiments	✓	
Statistical Sampling	✓	
Flowcharting	✓	
Proprietary Quality Management Methodologies	✓	
Additional Quality Planning Tools	✓	
Quality Audits	✓	
Process Analysis		✓
Cause and Effect Diagrams	✓	
Histogram	✓	
Pareto Chart	✓	
Run Chart	✓	
Scatter Diagram	✓	
Inspection	✓	
Approved Change Requests Review		✓

Organization Charts and Position Descriptions	✓	
Networking		✓
Organizational Theory	✓	
Pre-Assignment		✓
Negotiation		✓
Acquisition		✓
Virtual Teams	✓	
Interpersonal Skills		✓
Training		✓
Team-Building Activities	✓	
Ground Rules		✓
Co-location		✓
Recognition and Rewards		✓
Observation and Conversation		✓
Project Performance Appraisals	✓	
Conflict Management	✓	
Issue Log	✓	
Interpersonal Skills		✓
Stakeholder Analysis	✓	
Communication Requirements Analysis	✓	
Communication Technology		✓
Communication Models		✓
Communication Methods		✓
Information Distribution Tools		✓
Management Skills		✓
Forecasting Methods	✓	
Reporting Systems		✓
Planning Meetings and Analysis		✓
Documentation Reviews		✓
Information Gathering Techniques	✓	
Checklist Analysis	✓	
Assumptions Analysis	✓	
Diagramming Techniques	✓	
SWOT Analysis	✓	
Risk Probability and Impact Assessment	✓	

Probability and Impact Matrix	✓	
Risk Data Quality Assessment	✓	
Risk Categorization		✓
Risk Urgency Assessment		✓
Data Gathering and Representation Techniques	✓	
Quantitative Risk Analysis and Modeling Techniques	✓	
Strategies for Negative Risks or Threats		✓
Strategies for Positive Risks or Opportunities		✓
Contingent Response Strategies		✓
Risk Reassessment		✓
Risk Audits	✓	
Variance and Trend Analysis	✓	
Technical Performance Measurement	✓	
Status Meetings		✓
Make-or-Buy Analysis	✓	
Contract Types	✓	
Bidder Conferences	✓	
Proposal Evaluation Techniques	✓	
Independent Estimates		✓
Advertising		✓
Internet Search		✓
Procurement Negotiations		✓
Contract Change Control System		✓
Procurement Performance Reviews		✓
Inspections and Audits		✓
Performance Reporting	✓	
Payment Systems		✓
Claims Administration		✓
Records Management System		✓
Procurement Audits		✓
Negotiated Settlements		✓
Records Management System		✓
TOTAL :	74	57

7.2 Το συνολικό Mind Map σε μορφή κειμένου



1 Introduction

1.1 About this project

Every little thing in the world does exist for a reason...

Well, the reason to build this website-portal, apart from its purpose as a master thesis for my post-graduate program in Logistics, supervised by Dimitrios Emiris, assistant professor in University of Peiraius; was to create a knowledge basis in project management which can be used not only as a tool in managers' hands, but also as a research initiator due to its numerous scientific references.

The utilized structure and processes mentioned, belong to the **"A Guide to the Project Management Body of Knowledge (PMBOK® Guide) - Fourth Edition"**, published in 2008 from the Project Management Institute (PMI).

The initial concept was to create a mind map of the last edition of PMBOK® Guide, but as we were working, we decided to create an even wider aspect of just a guide or a pathway to the processes of project management. Nevertheless, project management is not something stable like a pack of rules or the principle laws in physics. On the contrary, it is evolving and can be diversified and adapted to the needs of every single project. According to the american standard: "Every project is a temporary endeavor undertaken to create a unique product, service, or result". This particular uniqueness would only be amended if the webpage was built in such a manner that would enable it to be used in many different ways, and also by all people regardless of their knowledge in project management.

The mind-mapping tool used, was "MindManager 8" by Mindjet, and the whole mind map was exported in webpages.

1.2 Theories and terms

1.2.1 What is a Project?

A project is a temporary endeavor undertaken to create a unique product, service, or result. The temporary nature of projects indicates a definite beginning and end. The end is reached when the project's objectives have been achieved or when the project is terminated because its objectives will not or cannot be met, or when the need for the project no longer exists. Temporary does not necessarily mean short in duration. Temporary does not generally apply to the product, service, or result created by the project; most projects are undertaken to create a lasting outcome. For example, a project to build a national monument will create a result expected to last centuries. Projects can also have social, economic, and environmental impacts that far outlast the projects themselves.

Every project creates a unique product, service, or result. Although repetitive elements may be present in some project deliverables, this repetition does not change the fundamental uniqueness of the project work. For example, office buildings are constructed with the same or similar materials or by the same team, but each location is unique—with a different design, different circumstances, different contractors, and so on.

An ongoing work effort is generally a repetitive process because it follows an organization's existing procedures. In contrast, because of the unique nature of projects, there may be uncertainties about the products, services, or results that the project creates. Project tasks can be new to a project team, which necessitates more dedicated planning than other routine work. In addition, projects are undertaken at all organizational levels. A project can involve a single person, a single organizational unit, or multiple organizational units.

A project can create:

• A product that can be either a component of another item or an end item in itself,

• A capability to perform a service (e.g., a business function that supports production or distribution), or

• A result such as an outcome or document (e.g., a research project that develops knowledge that can be used to determine whether a trend is present or a new process will benefit society).

Examples of projects include, but are not limited to:

• Developing a new product or service,

• Affecting a change in the structure, staffing, or style of an organization,

• Developing or acquiring a new or modified information system,

• Constructing a building or infrastructure, or

• Implementing a new business process or procedure.

1.2.2 What is Project Management?

Project management is the application of knowledge, skills, tools, and techniques to project activities to meet project requirements. Project management is accomplished through the appropriate application and integration of the forty-two logically grouped project management processes comprising the five process groups. These five process groups are:

• Initiating,

• Planning,

• Executing,

• Monitoring and Controlling, and

• Closing.

Managing a project typically includes:

• Identifying requirements,

• Addressing the various needs, concerns, and expectations of the stakeholders as the project is planned and carried out,

• Balancing the competing project constraints including, but not limited to:

- Scope,
- Quality,
- Schedule,
- Budget,
- Resources, and
- Risk.

The specific project will influence the constraints on which the project manager needs to focus. The relationship among these factors is such that if any one factor changes, at least one other factor is likely to be affected. For example, if the schedule is shortened, often the budget needs to be increased to add additional resources to complete the same amount of work in less time. If a budget increase is not possible, the scope or quality may be reduced to deliver a product in less time for the same budget. Project stakeholders may have differing ideas as to which factors are the most important, creating an even greater challenge. Changing the project requirements may create additional risks. The project team must be able to assess the situation and balance the demands in order to deliver a successful project. Because of the potential for change, the project management plan is iterative and goes through progressive elaboration throughout the project's life cycle. Progressive elaboration involves continuously improving and detailing a plan as more-detailed and specific information and more accurate ***estimates*** become available. Progressive elaboration allows a project management team to manage to a greater level of detail as the project evolves.

1.2.3 Stakeholders

Stakeholders are persons and organizations such as customers, sponsors, the performing organization, and the public, who are actively involved in the project or those whose interests may be positively or negatively affected by the performance or completion of the project. Stakeholders may also exert influence over the project, its deliverables and the project team members. The project management team must identify both internal and external stakeholders in order to determine the project requirements and expectations of all parties involved. Furthermore, the project manager must manage the influence of the various stakeholders in relation to the project requirements to ensure a successful outcome. Figure 2-6 illustrates the relationship between the project, the project team, and other common stakeholders.

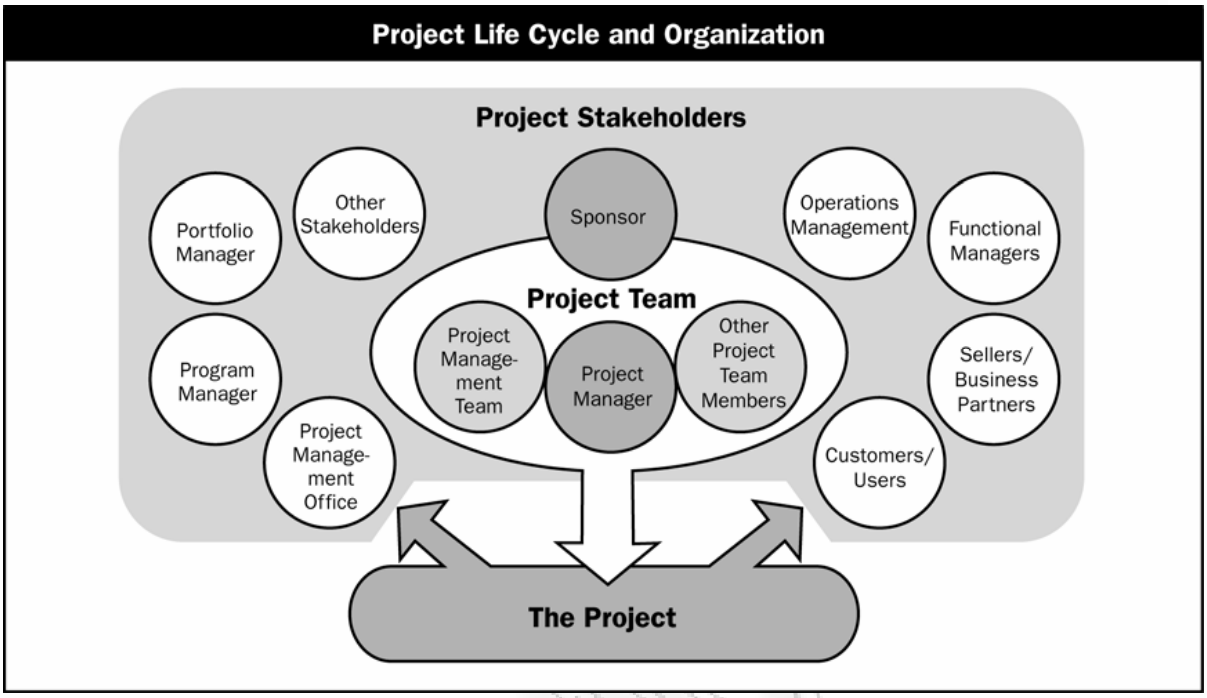


Figure 2-6. The Relationship Between Stakeholders and the Project

Stakeholders have varying levels of responsibility and authority when participating on a project and these can change over the course of the project life cycle. Their responsibility and authority may range from occasional contributions in surveys and focus groups to full project sponsorship, which includes providing financial and political support. Stakeholders can have an adverse impact on the project objectives.

Stakeholder identification is a continuous process and can be difficult. For instance, it could be argued that an assembly- line worker whose future employment depends on the outcome of a new product-design project is a stakeholder. Identifying stakeholders and understanding their relative degree of influence on a project is critical. Failure to do so can extend the timeline and raise costs substantially. An example is late recognition that the legal department is a significant stakeholder which results in delays and increased expenses due to legal requirements.

A project can be perceived as having both positive and negative results by the stakeholders. Some stakeholders benefit from a successful project, while other stakeholders perceive negative outcomes from a project's success. For example, business leaders from a community that will benefit from an industrial expansion project by positive economic benefits to the community. In the case of stakeholders with positive expectations from the project, their interests are best served by helping the project succeed. The interests of negative stakeholders are served by impeding the project's progress. Overlooking negative stakeholders can result in an increased likelihood of failure. An important part of a project manager's responsibility is to manage stakeholder expectations. This can be difficult because stakeholders often have very different or conflicting objectives. Part of the project manager's responsibility is to balance these

interests and ensure that the project team interacts with stakeholders in a professional and cooperative manner. The following are some examples of project stakeholders.

¢ **Customers/users.** The customers/users are the persons or organizations that will use the project's product or service or result. Customers/users may be internal and/or external to the performing organization. There may also be multiple layers of customers. For example, the customers for a new pharmaceutical product can include the doctors who prescribe it, the patients who use it and the insurers who pay for it. In some application areas, customers and users are synonymous, while in others, customers refer to the entity acquiring the project's product and users refer to those who will directly utilize the project's product.

¢ **Sponsor.** A sponsor is the person or group that provides the financial resources, in cash or in kind, for the project. When a project is first conceived, the sponsor champions the project. This includes serving as spokesperson to higher levels of management to gather support throughout the organization and promote the benefits that the project will bring. The sponsor leads the project through the engagement or selection process until formally authorized, and plays a significant role in the development of the initial scope and charter.

For issues that are beyond the control of the project manager, the sponsor serves as an escalation path. The sponsor may also be involved in other important issues such as authorizing changes in scope, phase-end reviews, and go/no-go decisions when risks are particularly high.

¢ **Portfolio managers/portfolio review board.** Portfolio managers are responsible for the high-level governance of a collection of projects or programs, which may or may not be interdependent. Portfolio review boards are committees usually made up of the organization's executives who act as a project selection panel. They review each project for its return on investment, the value of the project, risks associated with taking on the project, and other attributes of the project.

¢ **Program managers.** Program managers are responsible for managing related projects in a coordinated way to obtain benefits and control not available from managing them individually. Program managers interact with each project manager to provide support and guidance on individual projects.

¢ **Project management office.** A project management office (PMO) is an organizational body or entity assigned various responsibilities related to the centralized and coordinated management of those projects under its domain. The responsibilities of a PMO can range from providing project management support functions to actually being responsible for the direct management of a project. The PMO can be a stakeholder if it has direct or indirect responsibility for the outcome of the project. The PMO can provide but is not limited to:

- Administrative support services such as policies, methodology and templates;
- Training, mentoring and coaching of project managers;
- Project support, guidance and training on how to manage projects and the use of tools;
- Resource alignment of project staff; and/or

- Centralized communication among project managers, project sponsors, managers, and other stakeholders.

• **Project managers.** Project managers are assigned by the performing organization to achieve the project objectives. This is a challenging, high-profile role with significant responsibility and shifting priorities. It requires flexibility, good judgment, strong leadership and negotiating skills and a solid knowledge of project management practices. A project manager must be able to understand project detail, but manage from the overall project perspective. As the person responsible for the success of the project, a project manager is in charge of all aspects of the project including, but not limited to:

- Developing the project management plan and all related component plans,
- Keeping the project on track in terms of schedule and budget
- Identifying, monitoring, and responding to risk, and
- Providing accurate and timely reporting of project metrics.

The project manager is the lead person responsible for communicating with all stakeholders, particularly the project sponsor, project team, and other key stakeholders. The project manager occupies the center of the interactions between stakeholders and the project itself.

• **Project team.** A project team is comprised of the project manager, project management team, and other team members who carry out the work but who are not necessarily involved with management of the project. This team is comprised of individuals from different groups with knowledge of a specific subject matter or with a specific skill set who carry out the work of the project.

• **Functional managers.** Functional managers are key individuals who play a management role within an administrative or functional area of the business, such as human resources, finance, accounting, or procurement. They are assigned their own permanent staff to carry out the ongoing work, and they have a clear directive to manage all tasks within their functional area of responsibility. The functional manager may provide subject matter expertise or their function may provide services to the project.

• **Operations management.** Operations managers are individuals who have a management role in a core business area, such as research and development, design, manufacturing, provisioning, testing, or maintenance. Unlike functional managers, these managers deal directly with producing and maintaining the saleable products or services of the enterprise. Depending on the type of project, a formal handoff occurs upon completion to pass technical project documentation and other permanent records into the hands of the appropriate operations management group. Operations management would then incorporate the handed off project into normal operations and provide the long term support.

• **Sellers/business partners.** Sellers, also called vendors, suppliers or contractors, are external companies that enter into a contractual agreement to provide components or services necessary for the project. Business partners are also external companies, but they have a special relationship with the enterprise, sometimes attained through a

certification process. Business partners provide specialized expertise or fill a specified role such as installation, customization, training, or support.

1.2.4 Enterprise Environmental Factors

Organizational process assets include any or all process related assets, from any or all of the organizations involved in the project that can be used to influence the project's success. These process assets include formal and informal plans, policies, procedures, and guidelines. The process assets also include the organization's knowledge bases such as lessons learned and historical information. Organizational process assets may include completed schedules, risk data, and earned value data. Updating and adding to the organizational process assets as necessary throughout the project is generally the responsibility of the project team members. Organizational process assets may be grouped into two categories:

.1 Processes and Procedures

The organization's processes and procedures for conducting work include but are not limited to:

• Organizational standard processes such as standards, policies (e.g., safety and health policy, ethics policy, and project management policy), standard product and project life cycles, and quality policies and procedures (e.g., process audits, improvement targets, checklists, and standardized process definitions for use in the organization);

• Standardized guidelines, work instructions, proposal evaluation criteria, and performance measurement criteria;

• Templates (e.g., risk, work breakdown structure, project schedule network diagram, and contract templates);

• Guidelines and criteria for tailoring the organization's set of standard processes to satisfy the specific needs of the project;

• Organization communication requirements (e.g., specific communication technology available, allowed communication media, record retention policies, and security requirements);

• Project closure guidelines or requirements (e.g., final project audits, project evaluations, product validations, and acceptance criteria);

• Financial controls procedures (e.g., time reporting, required expenditure and disbursement reviews, accounting codes, and standard contract provisions);

• Issue and defect management procedures defining issue and defect controls, issue and defect identification and resolution, and action item tracking;

• Change control procedures, including the steps by which official company standards, policies, plans, and procedures—or any project documents—will be modified, and how any changes will be approved and validated;

• Risk control procedures, including risk categories, probability definition and impact, and probability and impact matrix; and

• Procedures for prioritizing, approving, and issuing work authorizations.

.2 Corporate Knowledge Base

The organizational corporate knowledge base for storing and retrieving information includes but is not limited to:

• Process measurement databases used to collect and make available measurement data on processes and products,

• Project files (e.g., scope, cost, schedule, and quality baselines, performance measurement baselines, project calendars, project schedule network diagrams, risk registers, planned response actions, and defined risk impact),

• Historical information and lessons learned knowledge bases (e.g., project records and documents, all project closure information and documentation, information about both the results of previous project selection decisions and previous project performance information, and information from the risk management effort),

• Issue and defect management databases containing issue and defect status, control information, issue and defect resolution, and action item results,

• Configuration management knowledge bases containing the versions and baselines of all official company standards, policies, procedures, and any project documents, and

• Financial databases containing information such as labor hours, incurred costs, budgets, and any project cost overruns.

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1.2.6 What is Mind Mapping?

Mind Mapping is a useful technique that improves the way of taking notes, and supports and enhances creative problem solving.

By using Mind Maps, it is easier to identify and understand the structure of a subject, and the way that pieces of information fit together, as well as recording the raw facts contained in normal notes.

Mind Maps are more compact than conventional notes, often taking up one side of paper. This helps a lot in making associations easily and last but not least, if more information becomes available after the initial drawing of the main Mind Map, there is no problem in just adding it in.

Mind Maps are also useful for:

- Summarizing information;
- Consolidating information from different research sources;
- Thinking through complex problems; and
- Presenting information in a format that shows the overall structure of the subject.

Mind Mapping is an extremely effective method of taking notes. Mind Maps show not only facts, but also the overall structure of a subject and the relative importance of individual parts of it. In a nutshell, they help in associating ideas and making connections that might be not otherwise made.

2 Project Life Cycle and Organization

2.1 Project Life Cycle

A project life cycle is a collection of generally sequential and sometimes overlapping project phases whose name and number are determined by the management and control needs of the organization or organizations involved in the project, the nature of the project itself and its area of application. A life cycle can be documented with a methodology. The project life cycle can be determined or shaped by the unique aspects of the organization, industry or technology employed. While every project has a definite start and a definite end, the specific deliverables and activities that take place in between will vary widely with the project. The life cycle provides the basic framework for managing the project, regardless of the specific work involved.

Projects vary in size and complexity. No matter how large or small, simple or complex, all projects can be mapped to the following life cycle structure (see Figure 2-1):

• Starting the project,

• Organizing and preparing,

• Carrying out the project work, and

• Closing the project.

This generic life cycle structure is often referred to when communicating with upper management or other entities less familiar with the details of the project. This high - level view can provide a common frame of reference for comparing projects - even if they are dissimilar in nature.

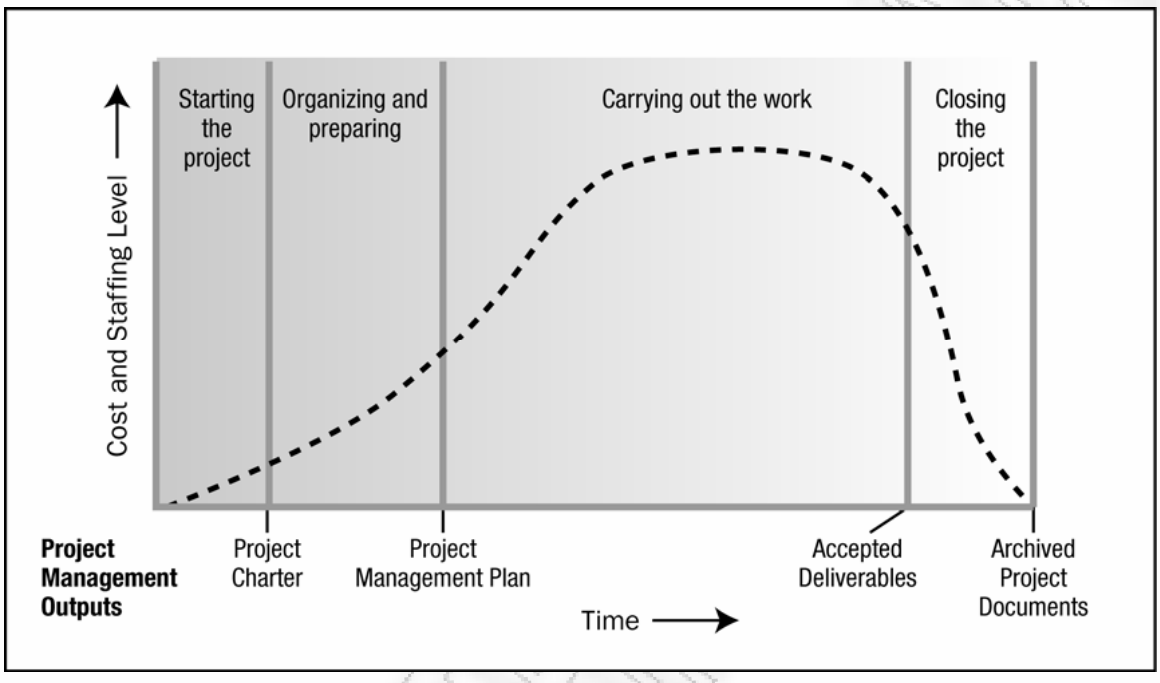

Figure 2-1. Typical Cost and Staffing Levels Across the Project Life Cycle

The generic life cycle structure generally displays the following characteristics:

• Cost and staffing levels are low at the start, peak as the work is carried out, and drop rapidly as the project draws to a close. The dashed line in Figure 2-1 illustrates this typical pattern.

• Stakeholder influences, risk, and uncertainty, (as illustrated in Figure 2-2) are greatest at the start of the project. These factors decrease over the life of the project.

• Ability to influence the final characteristics of the project's product, without significantly impacting cost, is highest at the start of the project and decreases as the project progresses towards completion. Figure 2-2 illustrates the idea that the cost of changes and correcting errors typically increases substantially as the project approaches completion.

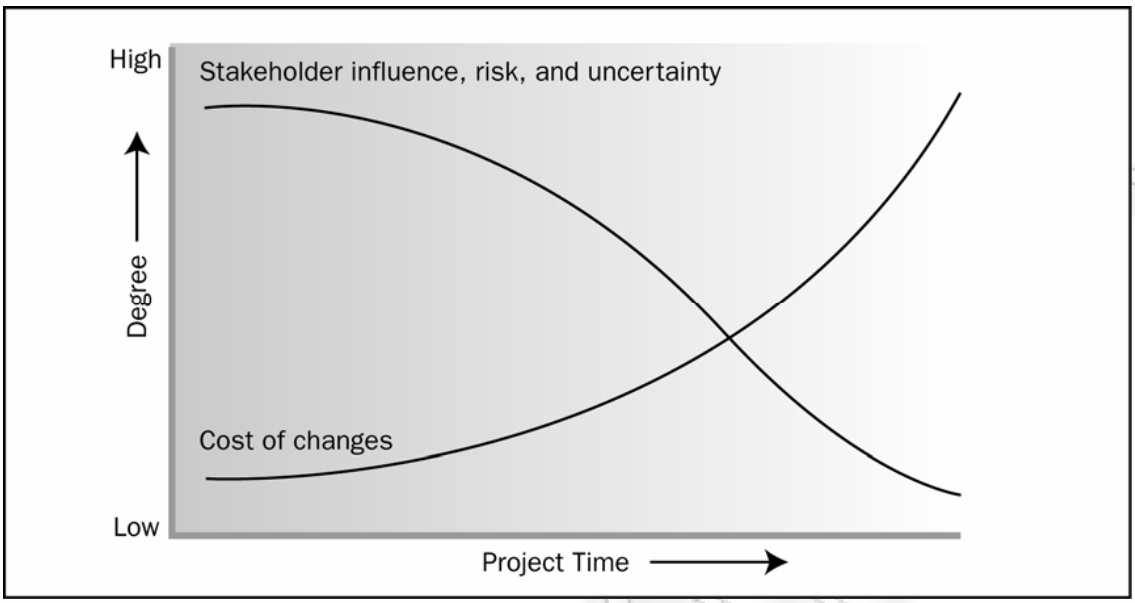

Figure 2-2. Impact of Variable Based on Project Time

Within the context of the generic life cycle structure, a project manager may determine the need for more effective control over certain deliverables. Large and complex projects in particular may require this additional level of control. In such instances, the work carried out to complete the project's objective may benefit from being formally divided into phases.

2.2 Product vs. Project Life Cycle Relationships

The product life cycle consists of generally sequential, non-overlapping product phases determined by the manufacturing and control need of the organization. The last product life cycle phase for a product is generally the product's retirement. Generally, a project life cycle is contained within one or more product life cycles. Care should be taken to distinguish the project life cycle from the product life cycle. All projects have a purpose or objective, but in those cases where the objective is a service or result, there may be a life cycle for the service or result, not a product life cycle.

When the output of the project is related to a product, there are many possible relationships. For instance, the development of a new product could be a project on its own. Alternatively, an existing product might benefit from a project to add new functions or features, or a project might be created to develop a new model. Many facets of the product life cycle lend themselves to being run as projects, for example: performing a feasibility study, conducting market research, running an advertising campaign, installing a product, holding focus groups, conducting a product trial in a test market, etc. In each of these examples the project life cycle would differ from the product life cycle.

Since one product may have many projects associated with it, additional efficiencies may be gained by managing all related projects collectively. For instance, a number of

separate projects may be related to the development of a new automobile. Each project may be distinct, but still contributes a key deliverable necessary to bring the automobile to market. Oversight of all projects by a higher authority could significantly increase the likelihood of success.

2.3 Project Phases

Project phases are divisions within a project where extra control is needed to effectively manage the completion of a major deliverable. Project phases are typically completed sequentially, but can overlap in some project situations. The high level nature of project phases makes them an element of the project life cycle. A project phase is not a project management process group.

The phase structure allows the project to be segmented into logical subsets for ease of management, planning and control. The number of phases, the need for phases and the degree of control applied depend on the size, complexity and potential impact of the project. Regardless of the number of phases comprising a project, all phases have similar characteristics:

• When phases are sequential, the close of a phase ends with some form of transfer or handoff of the work product produced as the phase deliverable. This phase end represents a natural point to reassess the effort underway and to change or terminate the project if necessary. These points are referred to as phase exits, milestones, phase gates, decision gates, stage gate or kill points.

• The work has a distinct focus that differs from any other phase. This often involves different organizations and different skill sets.

• The primary deliverable or objective of the phase requires an extra degree of control to be successfully achieved. The repetition of processes across all five process groups, as described in Chapter 3, provides that additional degree of control, and defines the boundaries of the phase.

Although many projects may have similar phase names with similar deliverables, few are identical. Some will have only one phase, as shown in Figure 2-3. Other projects may have many phases. Figure 2-4 shows an example of a project with three phases. Different phases typically have a different duration or length.

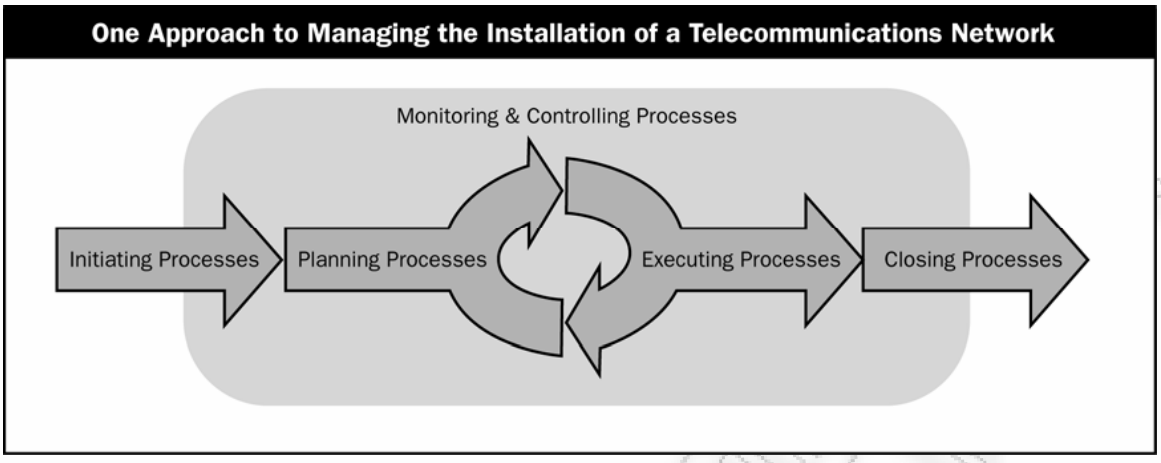

Figure 2-3. Example of a Single-Phase Project

There is no single way to define the ideal structure for a project. Although industry common practices will often lead to the use of a preferred structure, projects in the same industry—or even in the same organization—may have significant variation. Some organizations have established policies that standardize all projects, while others allow the project management team to choose the most appropriate for their individual project. For instance, one organization may treat a feasibility study as routine pre-project work, another may treat it as the first phase of a project, and a third might treat the feasibility study as a separate, stand-alone project. Likewise, one project team might divide a project into two phases where a different project team might choose to manage all the work as a single phase. Much depends on the nature of the specific project and the style of the project team or organization.

.1 Project Governance Across the Life Cycle

Project governance provides a comprehensive, consistent method of controlling the project and ensuring its success. The project governance approach should be described in the project management plan. A project's governance must fit within the larger context of the program or organization sponsoring it.

Within those constraints, as well as the additional limitations of time and budget, it is up to the project manager and the project management team to determine the most appropriate method of carrying out the project. Decisions must be made regarding who will be involved, what resources are necessary, and the general approach to completing the work. Another important consideration is whether more than one phase will be involved and, if so, the specific phased structure for the individual project.

The phase structure provides a formal basis for control. Each phase is formally initiated to specify what is allowed and expected for that phase. A management review is often held to reach a decision to start the activities of a phase. This is especially true when a prior phase has not yet completed. An example would be when an organization chooses a life cycle where more than one phase of the project progresses simultaneously. The beginning of a phase is also a time to revalidate earlier assumptions, review risks and define in more detail the processes necessary to complete the phase deliverable(s). For example, if a particular phase does not require purchasing any new materials or

equipment, there would be no need to carry out the activities or processes associated with procurement.

A project phase is generally concluded and formally closed with a review of the deliverables to determine completeness and acceptance. A phase-end review can achieve the combined goal of obtaining authorization to close the current phase and start the subsequent one. The end of a phase represents a natural point to reassess the effort underway and to change or terminate the project if necessary. A review of both key deliverables and project performance to date to **a)** "determine if the project should continue into its next phase" and **b)** "detect and correct errors cost effectively", should be regarded as good practice. Formal phase completion does not necessarily include authorizing the subsequent phase. For instance, if the risk is deemed to be too great for the project to continue or if the objectives are no longer required, a phase can be closed with the decision to not initiate any other phases.

.2 Phase-to-Phase Relationships

When projects are multi-phased, the phases are part of a generally sequential process designed to ensure proper control of the project and attain the desired product, service, or result. However, there are situations when a project might benefit from overlapping or concurrent phases.

There are three basic types of phase-to-phase relationships:

• ***A sequential relationship***, where a phase can only start once the previous phase is complete. Figure 2-4 shows an example of a project with entirely sequential phases. The step-by-step nature of this approach reduces uncertainty, but may eliminate options for reducing the schedule.

• ***An overlapping relationship***, where the phase starts prior to completion of the previous one (see Figure 2-5). This can sometimes be applied as an example of the schedule compression technique called fast tracking. Overlapping phases may increase risk and can result in rework if a subsequent phase progresses before accurate information is available from the previous phase.

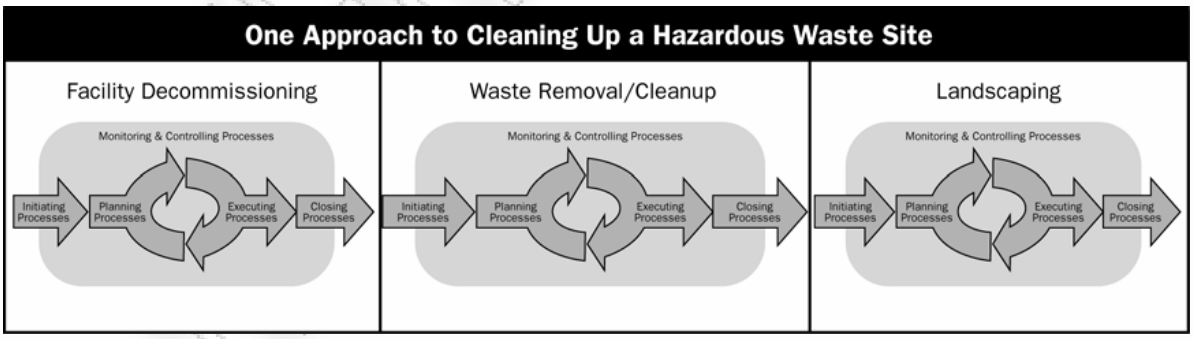

Figure 2-4. Example of a Three-Phase Project

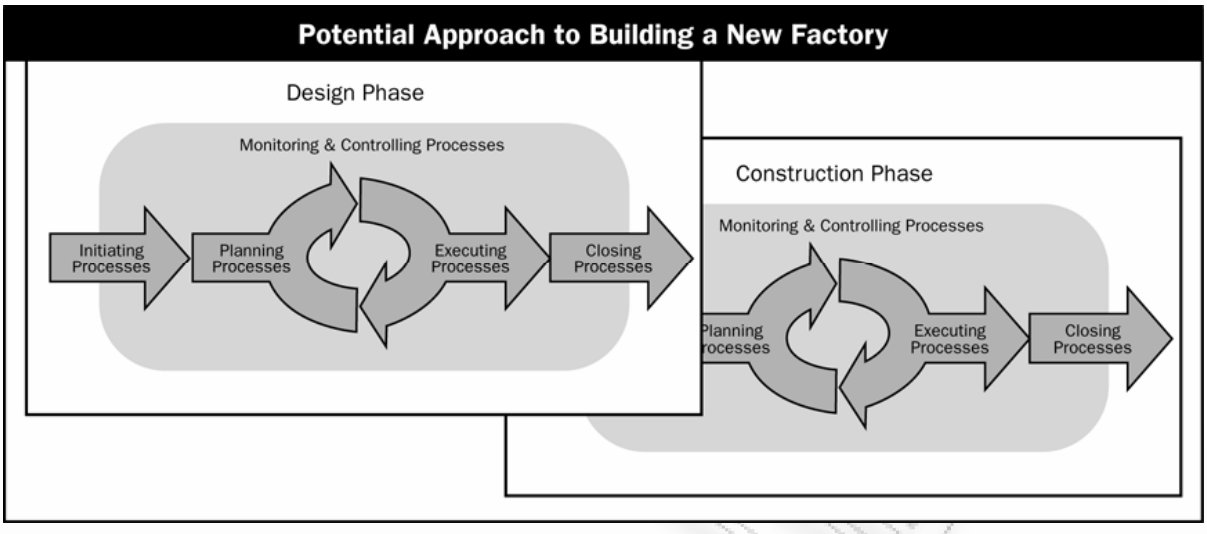

Figure 2-5. Example of a Project with Overlapping Phases

• ***An iterative relationship***, where only one phase is planned at any given time and the planning for the next is carried out as work progresses on the current phase and deliverables. This approach is useful in largely undefined, uncertain, or rapidly changing environments such as research, but it can reduce the ability to provide long term planning The scope is then managed by continuously delivering increments of the product and prioritizing requirements to minimize project risks and maximize product business value. It also can entail having all of the project team members (e.g. designers, developers, etc.) available throughout the project or at a minimum for two consecutive phases.

For multi-phase projects, more than one phase-to-phase relationship could occur during the project life cycle. Considerations such as level of control required, effectiveness and degree of uncertainty determine the relationship to be applied between phases. Based on those considerations, all three relationships could occur between different phases of a single project.

2.4 Projects vs. Operational Work

Organizations perform work to achieve a set of objectives. In many organizations the work performed can be categorized as either project or operations work. These two types of work share a number of characteristics as follows:

• Performed by individuals,

• Limited by constraints, including resource constraints,

• Planned, executed, monitored and controlled, and

• Performed to achieve organizational objectives or strategic plans.

Projects and operations differ primarily in that operations are ongoing and produce repetitive products, services or results. Projects (along with team members and often the opportunity) are temporary and end. Conversely, operations work is ongoing and sustains the organization over time. Operations work does not terminate when its current objectives are met but instead follow new directions to support the organization's strategic plans.

Operations work supports the business environment where projects are executed. As a result, there is generally a significant amount of interaction between the operations departments and the project team as they work together to achieve project goals. An example of this is when a project is created to redesign a product. The project manager may work with multiple operational managers to research consumer preferences, draw up technical specifications, build a prototype, test it, and begin manufacturing. The team will interface with the operational departments to determine the manufacturing capacity of current equipment, or to determine the most appropriate time to transition production lines to produce the new product.

The amount of resources supplied from operations will vary from project to project. One example of this interaction is when individuals from operations are assigned as dedicated project resources. Their operational expertise is used to carry out and assist in the completion of project deliverables by working with the rest of the project team to complete the project.

Depending on the nature of the project, the deliverables may modify or contribute to the existing operations work. In this case, the operations department will integrate the deliverables into future business practices. Examples of these types of projects can include, but are not limited to:

• Developing a new product or service that is added to an organization's product line to be marketed and sold,

• Installing products or services that will require ongoing support,

• Internal projects that will affect the structure, staffing levels, or culture of an organization, or

• Developing, acquiring, or enhancing an operational department's information system.

2.5 Organizational Cultures, Styles and Structure

The organizational culture, style, and structure influence how projects are performed. An organization's degree of project management maturity and its project management systems can also influence the project. When a project involves external entities as part of a joint venture or partnering, the project will be influenced by more than one enterprise. The following sections describe organizational characteristics and structures within an enterprise that are likely to influence the project.

2.5.1 Organizational Cultures and Styles

Cultures and styles may have a strong influence on a project's ability to meet its objectives. Cultures and styles are typically known as "cultural norms." The "norms" include a common knowledge regarding how to approach getting the work done, what means are considered acceptable for getting the work done, and who is influential in facilitating the work getting done.

Most organizations have developed unique cultures that manifest in numerous ways including, but not limited to:

- Shared visions, values, norms, beliefs, and expectations,
- Policies, methods, and procedures,
- View of authority relationships, and
- Work ethic and work hours.

The organizational culture is an enterprise environmental factor as described in Section 1.8. Therefore, a project manager should understand the different organizational styles and cultures that may affect a project. For example, in some cases the person shown at the top of an organization chart may be a figurehead who is not truly in charge. The project manager must know which individuals in the organization are the decision makers and work with them to influence project success.

2.5.2 Organizational Structure

Organizational structure is an enterprise environmental factor which can affect on the availability of resources and influence how projects are conducted. Organizational structures range from functional to projectized, with a variety of matrix structures in between. Table 2-1 shows key project-related characteristics of the major types of organizational structures.

Organization Structure / Project Characteristics	Functional	*Matrix*			Projectized
		Weak Matrix	Balanced Matrix	Strong Matrix	
Project Manager's Authority	Little or None	Limited	Low to Moderate	Moderate to High	High to Almost Total
Resource Availability	Little or None	Limited	Low to Moderate	Moderate to High	High to Almost Total
Who controls the project budget	Functional Manager	Functional Manager	Mixed	Project Manager	Project Manager
Project Manager's Role	Part-time	Part-time	Full-time	Full-time	Full-time
Project Management Administrative Staff	Part-time	Part-time	Part-time	Full-time	Full-time

The classic **functional organization**, shown in Figure 2-7, is a hierarchy where each employee has one clear superior. Staff members are grouped by specialty, such as production, marketing, engineering, and accounting at the top level. Specialties may be further subdivided into functional organizations, such as mechanical and electrical engineering. Each department in a functional organization will do its project work independent of other departments.

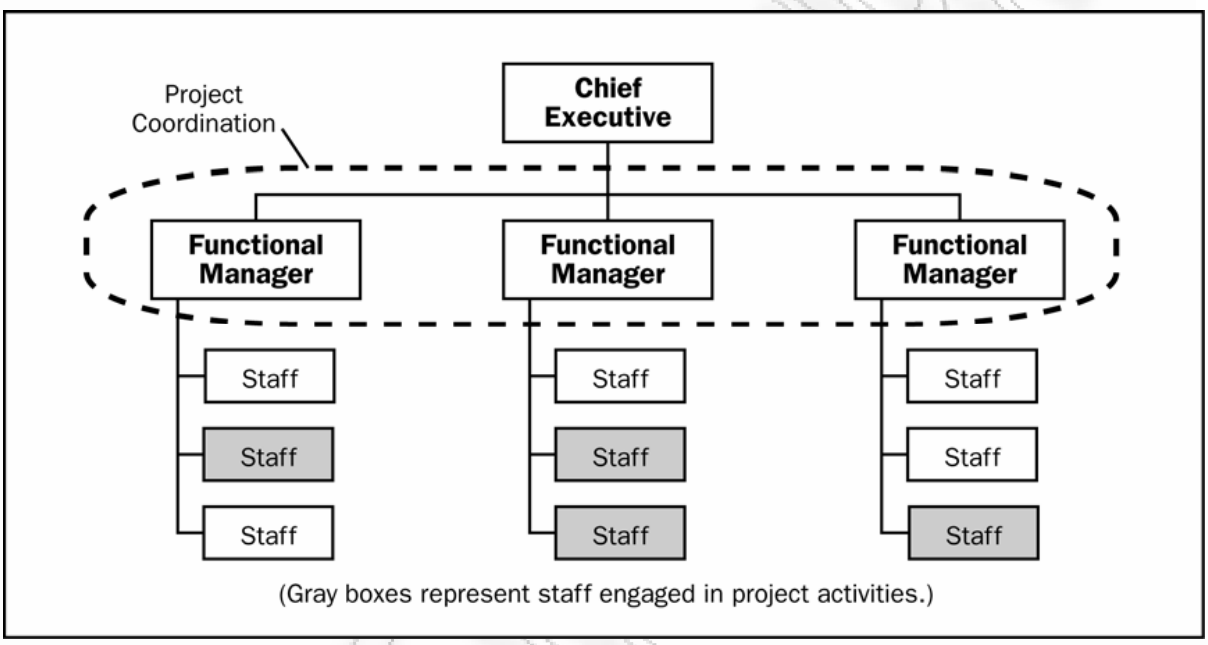

Figure 2-7. Functional Organization

Matrix organizations, as shown in Figures 2-8 through 2-10, are a blend of functional and projectized characteristics. Weak matrices maintain many of the characteristics of a functional organization, and the project manager role is more of a coordinator or expediter than that of a true project manager. Strong matrices have many of the characteristics of the projectized organization, and can have full-time project managers with considerable authority and full-time project administrative staff. While the balanced matrix organization recognizes the need for a project manager, it does not provide the project manager with the full authority over the project and project funding. Table 2-1 provides additional details of the various matrix organizational structures.

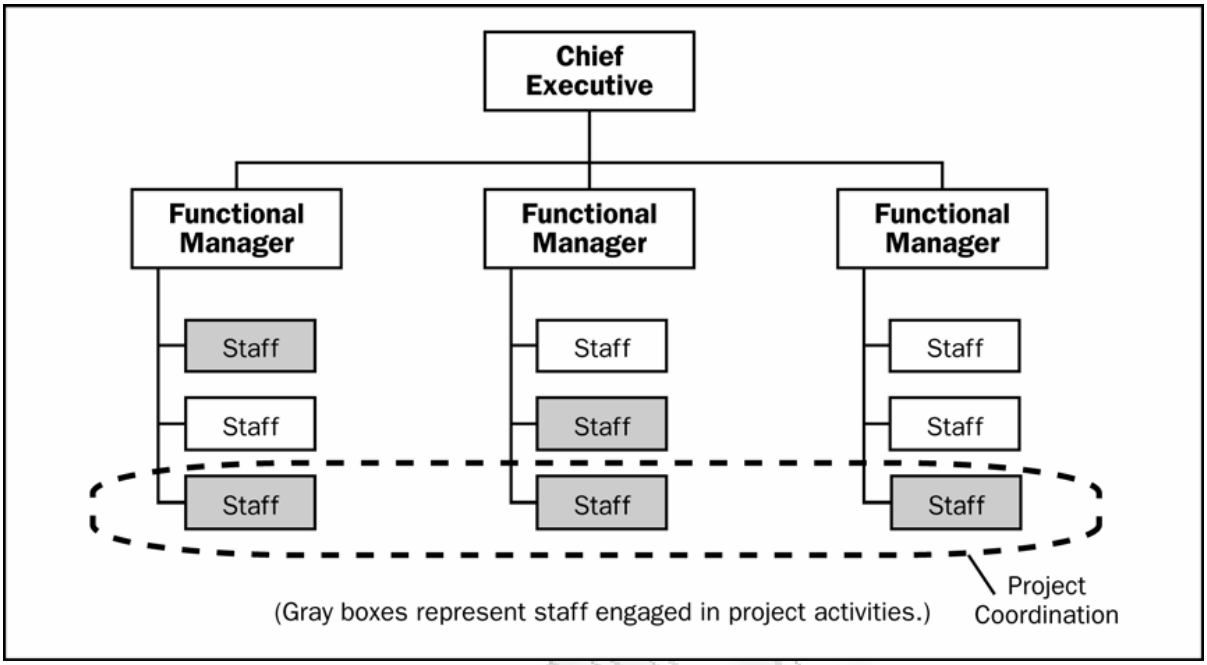

Figure 2-8. Weak Matrix Organization

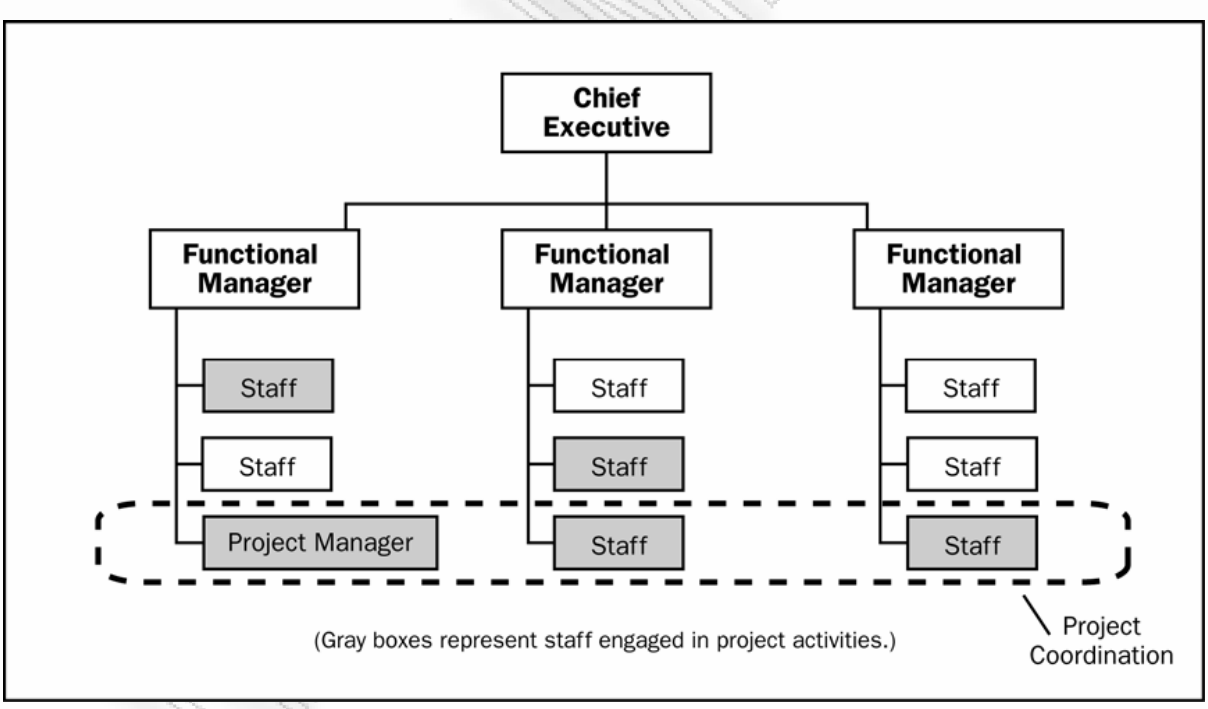

Figure 2-9. Balanced Matrix Organization

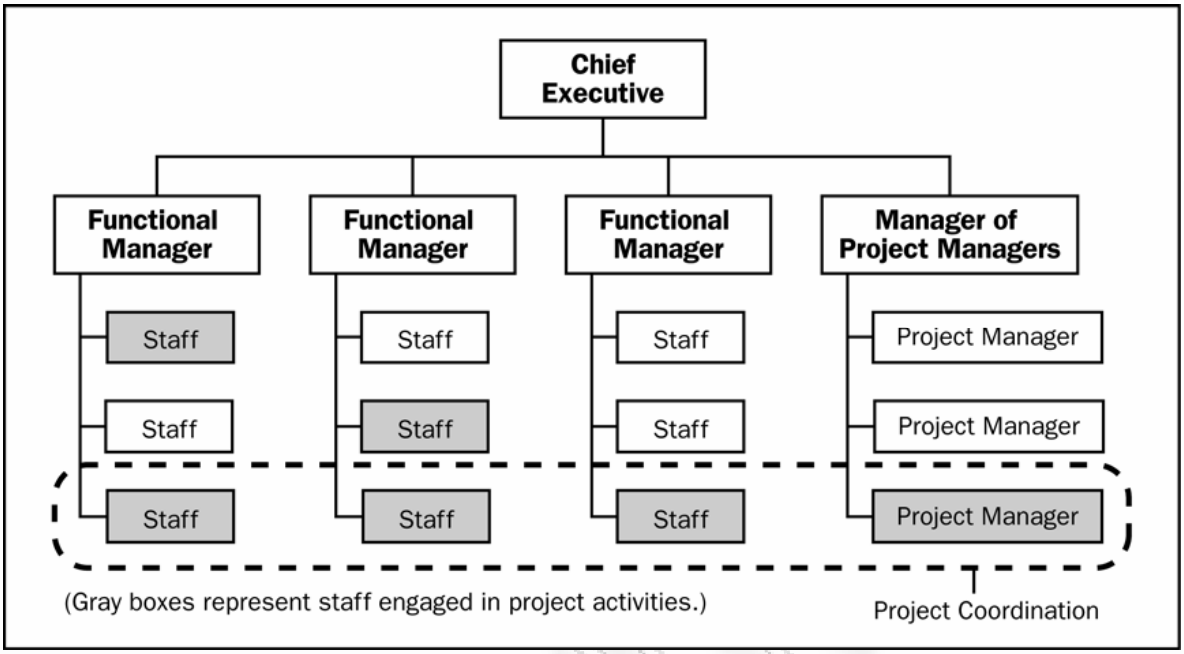

Figure 2-10. Strong Matrix Organization

At the opposite end of the spectrum to the functional organization is the **projectized organization**, shown in Figure 2- 11. In a projectized organization, team members are often colocated, most of the organization's resources are involved in project work, and project managers have a great deal of independence and authority. Projectized organizations often have organizational units called departments, but these groups either report directly to the project manager or provide support services to the various projects.

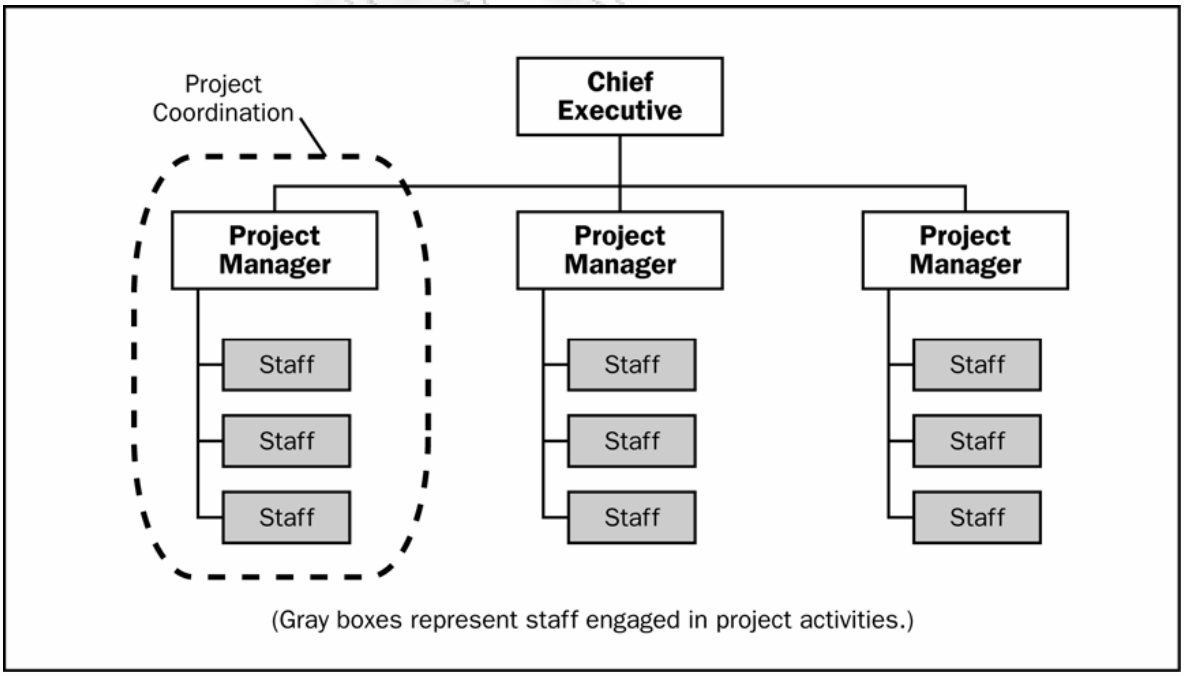

Figure 2-11. Projectized Organization

Many organizations involve all these structures at various levels, as shown in Figure 2-12 (**composite organization**). For example, even a fundamentally functional organization may create a special project team to handle a critical project. Such a team may have many of the characteristics of a project team in a projectized organization. The team may include full-time staff from different functional departments, may develop its own set of operating procedures, and may operate outside the standard, formalized reporting structure.

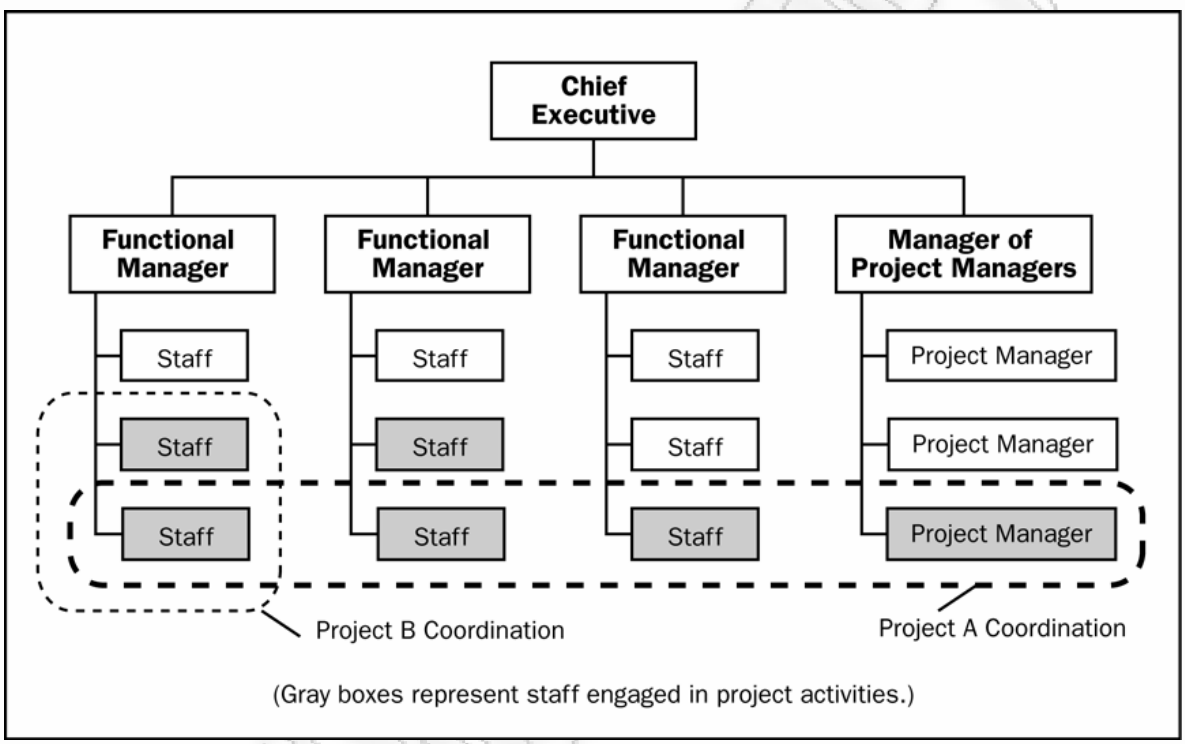

Figure 2-12. Composite Organization

3 Project Management Processes for a Project

3.1 Common Project Management Process Interactions

The project management processes are presented as discrete elements with well-defined interfaces. However, in practice they overlap and interact in ways that are not completely detailed here. Most experienced project management practitioners recognize there is more than one way to manage a project. The required process groups and their constituent processes are guides for applying appropriate project management knowledge and skills during the project. The application of the project management processes is iterative, and many processes are repeated during the project.

The integrative nature of project management requires the monitoring and controlling process group to interact with the other process groups, as shown in Figure 3-1. In addition, since management of a project is a finite effort, the initiating process group begins the project, and the closing process group ends it.

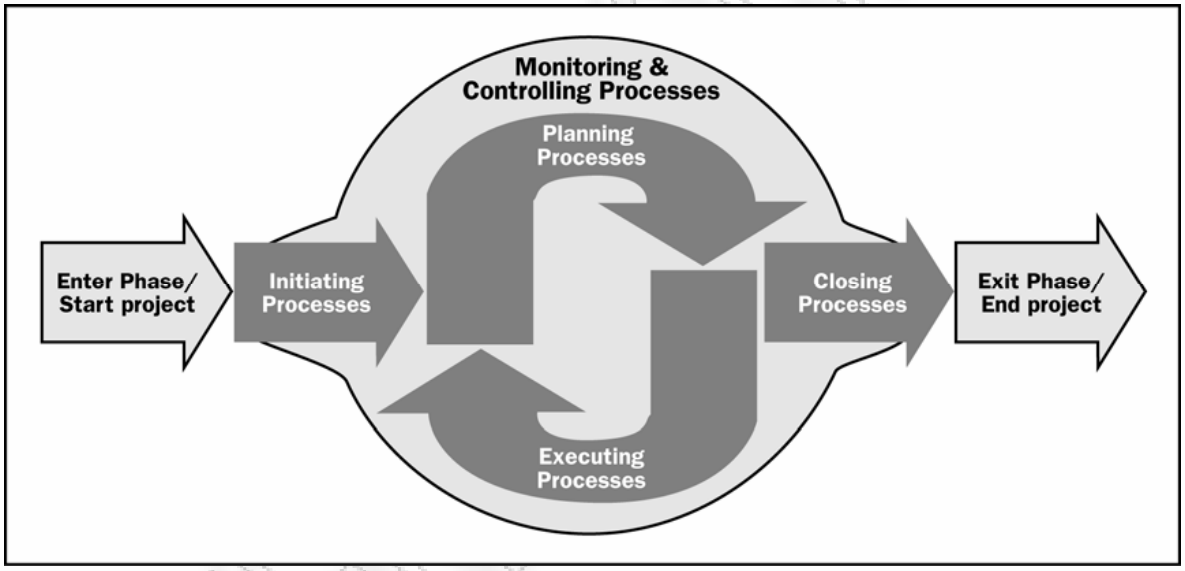

Figure 3-1. Project Management Process Groups

Project management process groups are linked by the outputs they produce. The process groups are seldom either discrete or one-time events; they are overlapping activities that occur throughout the project. The output of one process generally becomes an input to another process or is a deliverable of the project. The planning process group provides the executing process group with the project management plan and project documents, and, as the project progresses, it often entails updates to the project management plan and the project documents. Figure 3-2 illustrates how the process groups interact and shows the level of overlap at various times. If the project is divided into phases, the process groups interact within each phase.

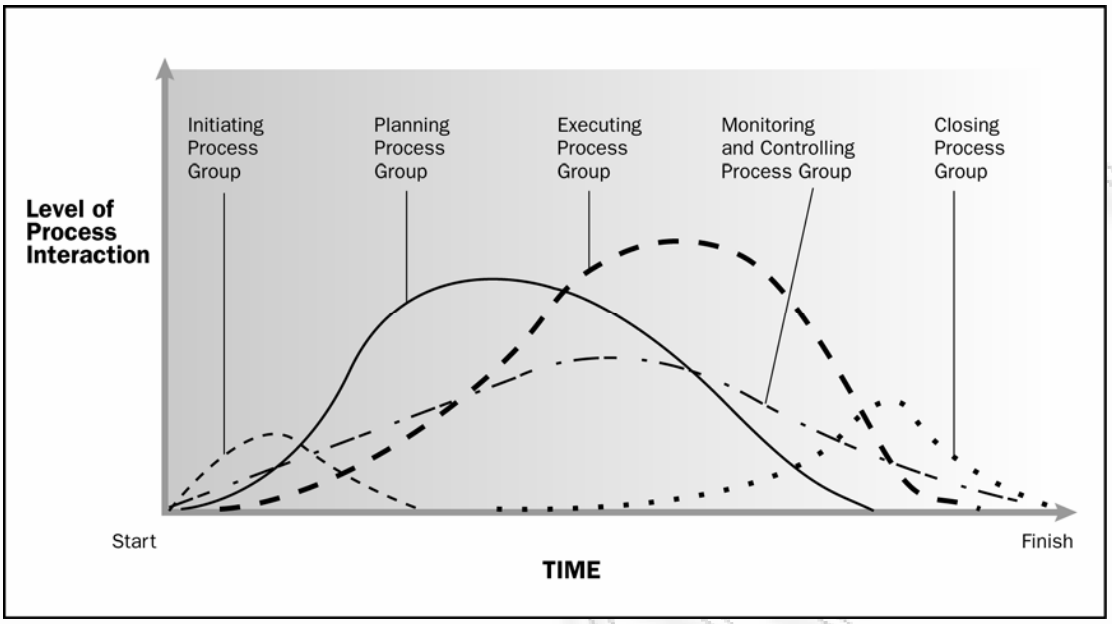

Figure 3-2. Process Groups Interact in a Phase or Project

An example of this would be the exit of a design phase, which requires customer acceptance of the design document. Once it is available, the design document provides the product description for the planning and executing process groups in one or more subsequent phases. When a project is divided into phases, the process groups are invoked as appropriate to effectively drive the project to completion in a controlled manner. In multi-phase projects, processes are repeated within each phase until the criteria for phase completion have been satisfied. Additional information on project life cycles and project phases is provided in Chapter 2.

3.2 Project Management Process Groups

The following sections identify and describe the five project management process groups required for any project. These five process groups have clear dependencies and are typically performed in the same sequence on each project. They are independent of application areas or industry focus. Individual process groups and individual constituent processes are often iterated prior to completing the project. The constituent processes can have interactions within a process group and among process groups. The nature of these interactions varies from project to project and may or may not be performed in a particular order.

The process flow diagram, Figure 3-3, provides an overall summary of the basic flow and interactions among process groups and specific stakeholders. A process group includes the constituent project management processes that are linked by the respective inputs and outputs where the result or outcome of one process becomes the input to another. **The process groups are not project phases.** When large or complex projects are separated into distinct phases or subprojects such as feasibility study, concept development, design, prototype, build, test, etc., all of the process group processes would normally be repeated for each phase or subproject.

Table 3-1 reflects the mapping of the 42 project management processes into the five Project Management Process Groups and the nine Project Management Knowledge Areas. The project management processes are shown in the process group in which **most** of the activity takes place. For example, when a process that normally takes place in the planning process group is updated in the execution process group, it is not considered a new process.

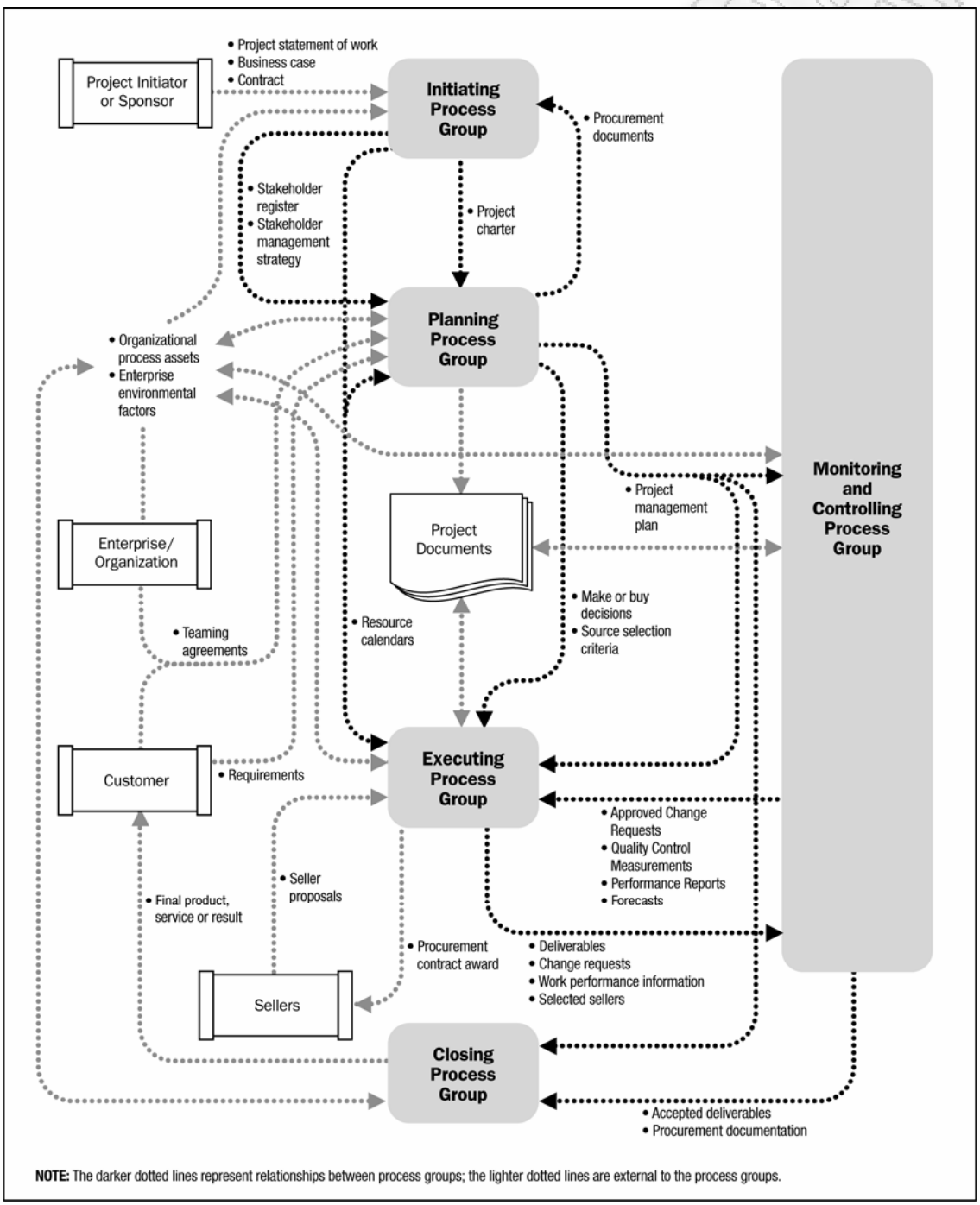

Figure 3-3. Project Management Process Interactions

Knowledge Areas	Project Management Process Groups				
	Initiating Process Group	Planning Process Group	Executing Process Group	Monitoring & Controlling Process Group	Closing Process Group
4. Project Integration Management	4.1 Develop Project Charter	4.2 Develop Project Management Plan	4.3 Direct and Manage Project Execution	4.4 Monitor and Control Project Work 4.5 Perform Integrated Change Control	4.6 Close Project or Phase
5. Project Scope Management		5.1 Collect Requirements 5.2 Define Scope 5.3 Create WBS		5.4 Verify Scope 5.5 Control Scope	
6. Project Time Management		6.1 Define Activities 6.2 Sequence Activities 6.3 Estimate Activity Resources 6.4 Estimate Activity Durations 6.5 Develop Schedule		6.6 Control Schedule	
7. Project Cost Management		7.1 Estimate Costs 7.2 Determine Budget		7.3 Control Costs	
8. Project Quality Management		8.1 Plan Quality	8.2 Perform Quality Assurance	8.3 Perform Quality Control	
9. Project Human Resource Management		9.1 Develop Human Resource Plan	9.2 Acquire Project Team 9.3 Develop Project Team 9.4 Manage Project Team		
10. Project Communications Management	10.1 Identify Stakeholders	10.2 Plan Communications	10.3 Distribute Information 10.4 Manage Stakeholder Expectations	10.5 Report Performance	
11. Project Risk Management		11.1 Plan Risk Management 11.2 Identify Risks 11.3 Perform Qualitative Risk Analysis 11.4 Perform Quantitative Risk Analysis 11.5 Plan Risk Responses		11.6 Monitor and Control Risks	
12. Project Procurement Management		12.1 Plan Procurements	12.2 Conduct Procurements	12.3 Administer Procurements	12.4 Close Procurements

Table 3-1. Project Management Process Groups and Knowledge Areas Mapping.

3.3 Initiating Process Group

See attachment(s): Initiating.JPG

3.3.1 Develop Project Charter

See also: Develop Project Charter

3.3.2 Identify Stakeholders

See also: Identify Stakeholders

3.4 Planning Process Group

See attachment(s): Planning.JPG

3.4.1 Develop Project Management Plan

See also: Develop Project Management Plan

3.4.2 Collect Requirements

See also: Collect Requirements

3.4.3 Define Scope

See also: Define Scope

3.4.4 Create WBS

See also: Create WBS

3.4.5 Define Activities

See also: Define Activities

3.4.6 Sequence Activities

See also: Sequence Activities

3.4.7 Estimate Activity Resources

See also: Estimate Activity Resources

3.4.8 Estimate Activity Durations

See also: Estimate Activity Durations

3.4.9 Develop Schedule

See also: Develop Schedule

3.4.10 Estimate Costs

See also: Estimate Costs

3.4.11 Determine Budget

See also: Determine Budget

3.4.12 Plan Quality

See also: Plan Quality

3.4.13 Develop Human Resource Plan

See also: Develop Human Resource Plan

3.4.14 Plan Communications

See also: Plan Communications

3.4.15 Plan Risk Management

See also: Plan Risk Management

3.4.16 Identify Risks

See also: Identify Risks

3.4.17 Perform Qualitative Risk Analysis

See also: Perform Qualitative Risk Analysis

3.4.18 Perform Quantitative Risk Analysis

See also: Perform Quantitative Risk Analysis

3.4.19 Plan Risk Responses

See also: Plan Risk Responses

3.4.20 Plan Procurements

See also: Plan Procurements

3.5 Executing Process Group

See attachment(s): Executing.JPG

3.5.1 Direct and Manage Project Execution

See also: Direct & Manage Project Execution

3.5.2 Perform Quality Assurance

See also: Perform Quality Assurance

3.5.3 Acquire Project Team

See also: Acquire Project Team

3.5.4 Develop Project Team

See also: Develop Project Team

3.5.5 Manage Project Team

See also: Manage Project Team

3.5.6 Distribute Information

See also: Distribute Information

3.5.7 Manage Stakeholder Expectations

See also: Manage Stakeholder Expectations

3.5.8 Conduct Procurements

See also: Conduct Procurements

3.6 Monitoring and Controlling Process Group

See attachment(s): Monitoring.JPG

3.6.1 Monitor and Control Project Work

See also: Monitor & Control Project Work

3.6.2 Perform Integrated Change Control

See also: Perform Integrated Change Control

3.6.3 Verify Scope

See also: Verify Scope

3.6.4 Control Scope

See also: Control Scope

3.6.5 Control Schedule

See also: Control Schedule

3.6.6 Control Costs

See also: Control Costs

3.6.7 Perform Quality Control

See also: Perform Quality Control

3.6.8 Report Performance

See also: Report Performance

3.6.9 Monitor and Control Risks

See also: Monitor and Control Risks

3.6.10 Administer Procurements

See also: Administer Procurements

3.7 Closing Process Group

See attachment(s): Closing.JPG

3.7.1 Close Project or Phase

See also: Close Project or Phase

3.7.2 Close Procurements

See also: Close Procurements

4 Project Integration Management

4.1 Develop Project Charter

See attachment(s): 4.1.JPG

4.1.1 Inputs

4.1.1.1 Project Statement of Work

The statement of work (SOW) is a narrative description of products or services to be delivered by the project. For internal projects, the project initiator or sponsor provides the statement of work based on business needs, product, or service requirements. For external projects, the statement of work can be received from the customer as part of a bid document, for example, request for proposal, request for information, request for bid, or as part of a contract. The SOW references:

• **Business need.** An organization's business need may be based on a market demand, technological advance, legal requirement, or government regulation.

• **Product scope description.** These documents the characteristics of the product that the project will be undertaken to create. The description should also document the relationship between the products or services being created and the business need that the project will address.

• **Strategic plan**. All projects should support the organization's strategic goals. The strategic plan of the performing organization should be considered as a factor when making project selection decisions and prioritization.

4.1.1.2 Business Case

The business case or similar document provides the necessary information from a business standpoint to determine whether or not the project is worth the required investment. Typically the business need and the cost benefit analysis are contained in the business case to justify the project. The requesting organization or customer, in the case of external projects, may write the business case. The business case is created as a result of one or more of the following:

• Market demand (e.g., a car company authorizing a project to build more fuel-efficient cars in response to gasoline shortages),

• Organizational need (e.g., a training company authorizing a project to create a new course to increase its revenues),

• Customer request (e.g., an electric utility authorizing a project to build a new substation to serve a new industrial park),

• Technological advance (e.g., an electronics firm authorizing a new project to develop a faster, cheaper, and smaller laptop after advances in computer memory and electronics technology),

• Legal requirement (e.g., a paint manufacturer authorizing a project to establish guidelines for handling toxic materials),

• Ecological impacts (e.g., a company undertakes a project to lessen its environmental impact), or

• Social need (e.g., a non-governmental organization in a developing country authorizing a project to provide potable water systems, latrines, and sanitation education to communities suffering from high rates of cholera).

In the case of multi-phase projects, the business case may be periodically reviewed to ensure that the project is on track to deliver the business benefits. In the early stages of the project lifecycle, periodic review of the business case by the sponsoring organization also helps to confirm that the project is still required.

4.1.1.3 Contract

A contract is an input if the project is being done for an external customer.

4.1.1.4 Enterprise Environmental Factors

The enterprise environmental factors that can influence the Develop Project Charter process include, but are not limited to:

• Governmental or industry standards,

• Organization infrastructure, and

• Marketplace conditions.

4.1.1.5 Organizational Process Assets

The organizational process assets that can influence the Develop Project Charter process include, but are not limited to:

• Organizational standard processes, policies, and standardized process definitions for use in the organization;

• Templates (e.g., project charter template); and

• Historical information and lessons learned knowledge base.

4.1.2 T & T

4.1.2.1 Expert Judgment

Expert judgment is often used to assess the inputs used to develop the project charter. Such judgment and expertise is applied to any technical and management details during this process.

Such expertise is provided by any group or individual with specialized knowledge or training, and is available from many sources, including:

• Other units within the organization,

• Consultants,

• Stakeholders, including customers or sponsors,

• Professional and technical associations,

• Industry groups,

• Subject matter experts, and

• Project management office (PMO).

4.1.3 Outputs

4.1.3.1 Project Charter

The project charter documents the business needs, current understanding of the customer's needs, and the new product, service, or result that it is intended to satisfy, such as:

• Project purpose or justification,

• Measurable project objectives and related success criteria,

• High-level requirements,

• High-level project description,

• High-level risks,

• Summary milestone schedule,

• Summary budget,

• Project approval requirements (what constitutes project success, who decides the project is successful, and who signs off on the project),

• Assigned project manager, responsibility, and authority level, and

• Name and authority of the sponsor or other person(s) authorizing the project charter.

4.2 Develop Project Management Plan

See attachment(s): 4.2.JPG

4.2.1 Inputs

4.2.1.1 Project Charter

See also: Project Charter

4.2.1.2 Outputs from Planning Processes

Outputs from many of the planning processes described in Chapters 5 through 12 are integrated to create the project management plan. Any baselines and subsidiary management plans that are an output from other planning processes are inputs to this process. In addition, updates to these documents can necessitate updates to the project management plan.

4.2.1.3 Enterprise Environmental Factors

The enterprise environmental factors that can influence the Develop Project Management Plan process include, but are not limited to:

• Governmental or industry standards,

• Project management information systems (e.g., an automated tool, such as a scheduling software tool, a configuration management system, an information collection and distribution system, or web interfaces to other online automated systems),

• Organizational structure and culture,

• Infrastructure (e.g., existing facilities and capital equipment), and

• Personnel administration (e.g., hiring and firing guidelines, employee performance reviews, and training records).

4.2.1.4 Organizational Process Assets

The organizational process assets that can influence the Develop Project Management Plan process include, but are not limited to:

• Standardized guidelines, work instructions, proposal evaluation criteria, and performance measurement criteria,

• Project management plan template—Elements of the project management plan that may be updated include, but are not limited to:

  - Guidelines and criteria for tailoring the organization's set of standard processes to satisfy the specific needs of the project, and
  - Project closure guidelines or requirements like the product validation and acceptance criteria,

• Change control procedures including the steps by which official company standards, policies, plans, and procedures, or any project documents will be modified and how any changes will be approved and validated,

• Project files from past projects (e.g., scope, cost, schedule and, performance measurement baselines, project calendars, project schedule network diagrams, risk registers, planned response actions, and defined risk impact),

• Historical information and lessons learned knowledge base, and

• Configuration management knowledge base containing the versions and baselines of all official company standards, policies, procedures, and any project documents.

4.2.2 T & T

4.2.2.1 Expert Judgment

When developing the project management plan, expert judgment is applied utilized to:

• Tailor the process to meet the project needs,

• Develop technical and management details to be included in the project management plan,

• Determine resources and skill levels needed to perform project work,

• Define the level of configuration management to apply on the project, and

• Determine which project documents will be subject to the formal change control process.

4.2.3 Outputs

4.2.3.1 Project Management Plan

The project management plan integrates and consolidates all of the subsidiary management plans and baselines from the planning processes and includes but is not limited to:

• The life cycle selected for the project and the processes that will be applied to each phase,

• Results of the tailoring by the project management team as follows:

o Project management processes selected by the project management team,

o Level of implementation of each selected process,

o Descriptions of the tools and techniques to be used for accomplishing those processes, and

o How the selected processes will be used to manage the specific project, including the dependencies and interactions among those processes, and the essential inputs and outputs.

• How work will be executed to accomplish the project objectives,

• A change management plan that documents how changes will be monitored and controlled,

• A configuration management plan that documents how configuration management will be performed,

• How integrity of the performance measurement baselines will be maintained,

• Need and techniques for communication among stakeholders, and

• Key management reviews for content, extent, and timing to facilitate addressing open issues and pending decisions.

The project management plan can be either summary level or detailed, and can be composed of one or more subsidiary plans. Each of the subsidiary plans is detailed to the extent required by the specific project. Once the project management plan is baselined, it may only be changed when a change request is generated and approved through the Perform Integrated Change Control Process.

Project baselines include, but are not limited to:

• Schedule baseline,

• Cost performance baseline, and

• Scope baseline.

Subsidiary plans include, but are not limited to:

• Scope management plan (introduction to Chapter 5),

• Requirements management plan (Section 5.1.3.2),

• Schedule management plan (introduction to Chapter 6),

• Cost management plan (introduction to Chapter 7),

• Quality management plan (Section 8.1.3.1),

• Process improvement plan (Section 8.1.3.4),

• Human resource plan (Section 9.1.3.1),

• Communications management plan (Section 10.2.3.1),

• Risk management plan (Section 11.1.3.1), and

• Procurement management plan (Section 12.1.3.1).

Often the scope, schedule, and cost baseline will be combined into a performance measurement baseline that is used as an overall project baseline against which integrated performance can be measured. The performance measurement baseline is used for earned value measurements.

4.3 Direct & Manage Project Execution

See attachment(s): 4.3.JPG

4.3.1 Inputs

4.3.1.1 Project Management Plan

See also: Project Management Plan

4.3.1.2 Approved Change Requests

As part of the Perform Integrated Change Control process a change control status update will indicate that some changes are approved and some are not. Approved change requests are scheduled for implementation by the project team. Approved change requests are the documented, authorized changes to expand or reduce project scope. The approved change requests can also modify policies, the project management plan, procedures, costs or budgets, or revise schedules. Approved change requests may require implementation of preventive or corrective actions.

4.3.1.3 Enterprise Environmental Factors

The enterprise environmental factors which can influence the Direct and Manage Project Execution process include, but are not limited to:

• Organizational, company or customer culture and structure,

• Infrastructure (e.g., existing facilities and capital equipment),

• Personnel administration (e.g., hiring and firing guidelines, employee performance reviews, and training records),

• Stakeholder risk tolerances, and.

• Project management information systems (e.g., an automated tool suite, such as a scheduling software tool, a configuration management system, an information collection and distribution system or web interfaces to other online automated systems).

4.3.1.4 Organizational Process Assets

The organizational process assets that can influence the Direct and Manage Project Execution process include, but are not limited to:

• Standardized guidelines and work instructions;

• Communication requirements defining allowed communication media, record retention, and security requirements;

• Issue and defect management procedures defining issue and defect controls, issue and defect identification and resolution, and action item tracking;

• Process measurement database used to collect and make available measurement data on processes and products;

• Project files from prior projects (e.g., scope, cost, schedule, performance measurement baselines, project calendars, project schedule, network diagrams, risk registers, planned response actions, and defined risk impact); and

• Issue and defect management database containing historical issue and defect status, control information, issue and defect resolution, and action item results.

4.3.2 T & T

4.3.2.1 Expert Judgment

Expert judgment is used to assess the inputs needed to direct and manage execution of the project management plan. Such judgment and expertise is applied to all technical and management details during this process. This expertise is provided by the project manager and the project management team using specialized knowledge or training. Additional expertise is available from many sources, including:

• Other units within the organization,

• Consultants,

• Stakeholders, including customers or sponsors, and

• Professional and technical associations.

4.3.2.2 Project Management Information System

See document: Project_management_software

The project management information system, part of the enterprise environmental factors, provides access to an automated tool, such as a scheduling software tool, a configuration management system, an information collection and distribution system, or web interfaces to other online automated systems used during the Direct and Manage Project Execution effort.

4.3.3 Outputs

4.3.3.1 Deliverables

An approved deliverable is any unique and verifiable product, result, or capability to perform a service that must be produced to complete a process, phase, or project.

4.3.3.2 Work Performance Information

Information from project activities is routinely collected as the project progresses. This information can be related to various performance results including, but not limited to:

• Deliverable status,

• Schedule progress, and

• Costs incurred.

4.3.3.3 Change Requests

See also: Change Requests

When issues are found while project work is being performed, change requests are issued which may modify project policies or procedures, project scope, project cost or budget, project schedule, or project quality. Other change requests cover needed preventive or corrective actions to forestall negative impact later in the project. Requests for a change can be direct or indirect, externally or internally initiated, and can be optional or legally/contractually mandated and can include:

• **Corrective action.** Documented direction for executing the project work to bring expected future performance of the project work in line with the project management plan.

• **Preventive action.** A documented direction to perform an activity that can reduce the probability of negative consequences associated with project risks.

• **Defect repair.** The formally documented identification of a defect in a project component with a recommendation to either repair the defect or completely replace the component.

• **Updates.** Changes to formally controlled documentation, plans, etc., to reflect modified or additional ideas or content.

4.3.3.4 Project Management Plan Updates

Elements of the project management plan that may be updated include, but are not limited to:

• Requirements management plan,

• Schedule management plan,

• Cost management plan,

• Quality management plan,

• Human resource plan,

• Communications management plan,

• Risk management plan,

• Procurement management plan, and

• Project baselines.

4.3.3.5 Project Document Updates

Project documents that may be updated include, but are not limited to:

• Requirements documents,

• Project logs (issue, assumptions, etc.),

• Risk register, and

• Stakeholder register.

4.4 Monitor & Control Project Work

See attachment(s): 4.4.JPG

4.4.1 Inputs

4.4.1.1 Project Management Plan

4.4.1.2 Performance Reports

See also: Performance Reports

Reports should be prepared by the project team detailing activities, accomplishments, milestones, identified issues, and problems. Performance reports can be used to report the key information including, but not limited to:

• Current status,

• Significant accomplishments for the period,

• Scheduled activities,

• Forecasts, and

• Issues.

4.4.1.3 Enterprise Environmental Factors

The enterprise environmental factors that can influence the Monitor and Control Project Work process include, but are not limited to:

• Governmental or industry standards (e.g., regulatory agency regulations, product standards, quality standards and workmanship standards),

• Company work authorization system,

• Stakeholder risk tolerances, and.

• Project management information systems (e.g., an automated tool suite, such as a scheduling software tool, a configuration management system, an information collection and distribution system or web interfaces to other online automated systems).

4.4.1.4 Organizational Process Assets

The organizational process assets that can influence the Monitor and Control Project Work process include but are not limited to:

• Organization communication requirements,

• Financial controls procedures (e.g., time reporting, accounting codes, expenditure and disbursement reviews, and standard contract provisions),

• Issue and defect management procedures,

• Risk control procedures including risk categories, probability definition and impact, and probability and impact matrix,

• Process measurement database used to make available measurement data on processes and products, and

• Lessons learned database.

4.4.2 T & T

4.4.2.1 Expert Judgment

Expert judgment is used by the project management team to interpret the information provided by the monitor and control processes. The project manager, in collaboration with the team, determines the actions required to ensure project performance matches expectations.

4.4.3 Outputs

4.4.3.1 Change Requests

See also: Change Requests

As a result of comparing planned results to actual results, change requests may be issued which may expand, adjust, or reduce project or product scope. Changes can impact the project management plan, project documents, or product deliverables. Changes may include, but are not limited to the following:

• **Corrective action.** A documented direction for executing the project work to bring expected future performance of the project work in line with the project management plan.

• **Preventive action.** A documented direction to perform an activity that can reduce the probability of negative consequences associated with project risks.

• **Defect repair.** The formally documented identification of a defect in a project component with a recommendation to either repair the defect or completely replace the component.

4.4.3.2 Project Management Plan Updates

Project management plan elements that may be updated include, but are not limited to:

• Schedule management plan,

• Cost management plan,

• Quality management plan,

• Scope baseline,

• Schedule baseline, and

• Cost performance baseline.

4.4.3.3 Project Document Updates

Project documents that may be updated include, but are not limited to:

• Forecasts,

• Performance reports, and

• Issue log.

4.5 Perform Integrated Change Control

See attachment(s): 4.5.JPG

4.5.1 Inputs

4.5.1.1 Project Management Plan

See also: Project Management Plan

4.5.1.2 Work Performance Information

See also: Work Performance Information

4.5.1.3 Change Requests

All of the monitoring and control processes and many of the executing processes produce change requests as an output. Change requests can include corrective action, preventive action, and defect repairs. However, corrective and preventive actions do not normally affect the project baselines, only the performance against the baselines.

4.5.1.4 Enterprise Environmental Factors

The following enterprise environmental factor can influence the Integrated Change Control process: project management information system (e.g., an automated tool, such as a scheduling software tool, a configuration management system, an information collection and distribution system or web interfaces to other online automated systems). This is not a complete list, but it should be considered on most projects.

4.5.1.5 Organizational Process Assets

The organizational process assets that can influence the Perform Integrated Change Control process include, but are not limited to:

• Change control procedures, including the steps by which official company standards, policies, plans, and other project documents will be modified, and how any changes will be approved, validated, and implemented;

• Procedures for approving and issuing change authorizations;

• Process measurement database used to collect and make available measurement data on processes and products;

• Project files (e.g., scope, cost, schedule and, performance measurement baselines, project calendars, project schedule network diagrams, risk registers, planned response actions, and defined risk impact); and

• Configuration management knowledge base containing the versions and baselines of all official company standards, policies, procedures, and any project documents.

4.5.2 T & T

4.5.2.1 Expert Judgment

In addition to the project management team's expert judgment, stakeholders may be asked to provide their expertise and may be asked to sit on the change control board. Such judgment and expertise is applied to any technical and management details during this process and may be provided by various sources, for example:

• Consultants,

• Stakeholders, including customers or sponsors,

• Professional and technical associations,

• Industry groups,

• Subject matter experts, and

• Project management office (PMO).

4.5.2.2 Change Control Meetings

A change control board is responsible for meeting and reviewing the change requests and approving or rejecting those change requests. The roles and responsibilities of these boards are clearly defined and are agreed upon by appropriate stakeholders. All change control board decisions are documented and communicated to the stakeholders for information and follow-up actions.

4.5.3 Outputs

4.5.3.1 Change Request Status Updates

Change requests are processed according to the change control system by the project manager or by an assigned team member. Approved change requests will be implemented by the Direct and Manage Project Execution process. The status of all changes, approved or not, will be updated in the change request log as part of the project document updates.

4.5.3.2 Project Management Plan Updates

Elements of the project management plan that may be updated include but are not limited to:

• Any subsidiary management plans, and

• Baselines that are subject to the formal change control process.

Changes to baselines should only show the changes from the current time forward. Past performance may not be changed. This protects the integrity of the baselines and the historical data of past performance.

4.5.3.3 Project Document Updates

Project documents that may be updated as a result of the Perform Integrated Change Control process include the change request log and any documents that are subject to the formal change control process.

4.6 Close Project or Phase

See attachment(s): 4.6.JPG

4.6.1 Inputs

4.6.1.1 Project Management Plan

4.6.1.2 Accepted Deliverables

See also: Accepted Deliverables

4.6.1.3 Organizational Process Assets

The organizational process assets that can influence the Close Project or Phase process include, but are not limited to:

• Project or phase closure guidelines or requirements (e.g., project audits, project evaluations, and transition criteria), and

• Historical information and lessons learned knowledge base (e.g., project records and documents, all project closure information and documentation, information about both the results of previous project selection decisions and previous project performance information and information from the risk management effort).

4.6.2 T & T

4.6.2.1 Expert Judgment

Expert judgment is applied when performing administrative closure activities. These experts ensure the project or phase closure is performed to the appropriate standards.

4.6.3 Outputs

4.6.3.1 Final Product, Service, or Result Transition

This output refers to the transition of the final product, service, or result that the project was authorized to produce (or in the case of phase closure, the intermediate product, service, or result of that phase).

4.6.3.2 Organizational Process Assets Updates

The organizational process assets that are updated as a result of the Close Project or Phase process

include, but are not limited to:

• **Project files.** Documentation resulting from the project's activities, for example, project management plan, scope, cost, schedule and project calendars, risk registers, change management documentation, planned risk response actions, and risk impact.

• **Project or phase closure documents**. Project or phase closure documents, consisting of formal documentation that indicates completion of the project or phase and the transfer of the completed project or phase deliverables to others, such as an operations group or to the next phase. During project closure the project manager reviews prior phase documentation, customer acceptance documentation from Scope Verification (5.4) and the contract (if applicable), to ensure that all project requirements are complete prior to finalizing the closure of the project. If the project was terminated prior to completion, the formal documentation indicates why the project was terminated and formalizes the procedures for the transfer of the finished and unfinished deliverables of the cancelled project to others.

• **Historical information.** Historical information and lessons learned information are transferred to the lessons learned knowledge base for use by future projects or phases. This can include information on issues and risks as well as techniques that worked well that can be applied to future projects.

5 Project Scope Management

5.1 Collect Requirements

See attachment(s): 5.1.JPG

5.1.1 Inputs

5.1.1.1 Project Charter

See also: Project Charter

5.1.1.2 Stakeholder Register

See also: Stakeholder Register

5.1.2 T & T

5.1.2.1 Interviews

An interview is a formal or informal approach to discover information from stakeholders by talking to them directly. It is typically performed by asking prepared and spontaneous questions and recording the responses. Interviews are often conducted "one-on-one," but may involve multiple interviewers and/or multiple interviewees. Interviewing experienced project participants, stakeholders, and subject matter experts can aid in identifying and defining the features and functions of the desired project deliverables.

5.1.2.2 Focus groups

Focus groups bring together prequalified stakeholders and subject matter experts to learn about their expectations and attitudes about a proposed product, service or result. A trained moderator guides the group through an interactive discussion, designed to be more conversational than a one-on-one interview.

5.1.2.3 Facilitated Workshops

Requirements workshops are focused sessions that bring key cross-functional stakeholders together to define product requirements. Workshops are considered a primary technique for quickly defining cross-functional requirements and reconciling stakeholder differences. Because of their interactive group nature, well-facilitated sessions can build trust, foster relationships and improve communication among the participants which can lead to increased stakeholder consensus. Another benefit of this technique is that issues can be discovered and resolved more quickly than in individual sessions.

For example, facilitated workshops called Joint Application Development (or Design) (JAD) sessions are used in the software development industry. These facilitated sessions focus on bringing users and the development team together to improve the software development process. In the manufacturing industry, Quality Function Deployment (QFD) is an example of another facilitated workshop technique that helps determine critical characteristics for new product development. QFD starts by collecting customer needs, also known as Voice of the Customer (VOC). These needs are then objectively sorted and prioritized, and goals are set for achieving them.

5.1.2.4 Group Creativity Techniques

Several group activities can be organized to identify project and product requirements. Some of the roup creativity techniques that can be used are:

• **Brainstorming.** A technique used to generate and collect multiple ideas related to project and product requirements.

• **Nominal group technique.** This technique enhances brainstorming with a voting process used to rank the most useful ideas for further brainstorming or for prioritization.

• **The Delphi Technique.** A selected group of experts answers questionnaires and provides feedback regarding the responses from each round of requirements gathering. The responses are only available to the facilitator to maintain anonymity.

• **Idea/mind mapping.** Ideas created through individual brainstorming are consolidated into a single map to reflect commonality and differences in understanding, and generate new ideas.

• **Affinity diagram.** This technique allows large numbers of ideas to be sorted into groups for review and analysis.

5.1.2.5 Group Decision Making Techniques

Group decision making is an assessment process of multiple alternatives with an expected outcome in the form of future actions resolution. These techniques can be used to generate, classify and prioritize product requirements.

There are multiple methods of reaching a group decision, for example:

• **Unanimity.** Everyone agrees on a single course of action.

• **Majority.** Support from more than 50% of the members of the group.

• **Plurality.** The largest block in a group decides even if a majority is not achieved.

• **Dictatorship.** One individual makes the decision for the group.

Almost any of the decision methods described previously can be applied to the group techniques used in the requirements gathering process.

5.1.2.6 Questionnaires and Surveys

Questionnaires and surveys are written sets of questions designed to quickly accumulate information from a wide number of respondents. Questionnaires and/or surveys are most appropriate with broad audiences, when quick turnaround is needed, and where statistical analysis is appropriate.

5.1.2.7 Observations

Observations provide a direct way of viewing individuals in their environment and how they perform their jobs or tasks and carry out processes. It is particularly helpful for detailed processes when the people that use the product have difficulty or are reluctant to articulate their requirements. Observation, also called "job shadowing," is usually done externally by the observer viewing the user performing his or her job. It can also be done by a "participant observer" who actually performs a process or procedure to experience how it is done to uncover hidden requirements.

5.1.2.8 Prototypes

Prototyping is a method of obtaining early feedback on requirements by providing a working model of the expected product before actually building it. Since prototypes are tangible, it allows stakeholders to experiment with a model of their final product rather than only discussing abstract representations of their requirements. Prototypes support the concept of progressive elaboration because they are used in iterative cycles of mock-up creation, user experimentation, feedback generation, and prototype revision. When enough feedback cycles have been performed, the requirements obtained from the prototype are sufficiently complete to move to a design or build phase.

5.1.3 Outputs

5.1.3.1 Requirements Documentation

Requirements documentation describes how individual requirements meet the business need for the project. Requirements may start out at a high-level and become progressively more detailed as more is known. Before being baselined, requirements

must be unambiguous (measurable and testable), traceable, complete, consistent and acceptable to key stakeholders. The format of a requirements document may range from a simple document listing all the requirements categorized by stakeholder and priority, to more elaborate forms containing executive summary, detailed descriptions, and attachments.

Components of requirements documentation can include, but, are not limited to:

• Business need or opportunity to be seized, describing the limitations of the current situation and why the project has been undertaken;

• Business and project objectives for traceability;

• Functional requirements, describing business processes, information, and interaction with the product, as appropriate which can be documented textually in a requirements list, in models, or both;

• Non-functional requirements, such as level of service, performance, safety, security, compliance, supportability, retention/purge, etc.;

• Quality requirements;

• Acceptance criteria;

• Business rules stating the guiding principles of the organization;

• Impacts to other organizational areas, such as the call center, sales force, technology groups;

• Impacts to other entities inside or outside the performing organization;

• Support and training requirements; and

• Requirements assumptions and constraints.

5.1.3.2 Requirements Management Plan

The requirements management plan documents how requirements will be analyzed, documented, and managed throughout the project. The project manager must choose the most effective relationship for the project and document this approach in the requirements management plan. Many of the requirements management plan components are based on that relationship.

Components of the requirements management plan can include, but are not limited to:

• How requirements activities will be planned, tracked, and reported;

• Configuration management activities such as how changes to the product, service or result requirements will be initiated, how impacts will be analyzed, how they will be traced, tracked, and reported, as well as the authorization levels required to approve these changes;

• Requirements prioritization process;

• Product metrics that will be used and the rationale for using them; and

• Traceability structure, that is, which requirements attributes will be captured on the traceability matrix and to which other project documents requirements will be traced.

5.1.3.3 Requirements Traceability Matrix

The requirements traceability matrix is a table that links requirements to their origin and traces them throughout the project life cycle. The implementation of a requirements traceability matrix helps ensure that each requirement adds business value by linking it to the business and project objectives. It provides a means to track requirements throughout the project life cycle, helping to ensure that requirements approved in the requirements documentation are delivered at the end of the project. Finally, it provides a structure for managing changes to the product scope.

This process includes, but is not limited to tracing:

• Requirements to business needs, opportunities, goals, and objectives;

• Requirements to project objectives;

• Requirements to project scope/WBS deliverables;

• Requirements to product design;

• Requirements to product development;

• Requirements to test strategy and test scenarios; and

• High-level requirements to more detailed requirements.

Attributes associated with each requirement can be recorded in the requirements traceability matrix. These attributes help to define key information about the requirement. Typical attributes used in the requirements traceability matrix may include: a unique identifier, a textual description of the requirement, the rationale for inclusion, owner, source, priority, version, current status (such as active, cancelled, deferred, added, approved) and date completed. Additional attributes to ensure that the requirement has met stakeholders' satisfaction may include stability, complexity, and acceptance criteria.

5.2 Define Scope

See attachment(s): 5.2.JPG

5.2.1 Inputs

5.2.1.1 Project Charter

See also: Project Charter

5.2.1.2 Requirements Documentation

See also: Requirements Documentation

5.2.1.3 Organizational Process Assets

Examples of organizational process assets that can influence the Define Scope process include, but are not limited to:

• Policies, procedures, and templates for a project scope statement,

• Project files from previous projects, and

• Lessons learned from previous phases or projects.

5.2.2 T & T

5.2.2.1 Expert Judgment

Expert judgment is often used to analyze the information needed to develop the project scope statement. Such judgment and expertise is applied to any technical details. Such expertise is provided by any group or individual with specialized knowledge or training, and is available from many sources, including:

• Other units within the organization,

• Consultants,

• Stakeholders, including customers or sponsors,

• Professional and technical associations,

• Industry groups, and

• Subject matter experts.

5.2.2.2 Product Analysis

For projects that have a product as a deliverable, as opposed to a service or result, product analysis can be an effective tool. Each application area has one or more generally accepted methods for translating high-level product descriptions into tangible deliverables. Product analysis includes techniques such as product breakdown, systems analysis, requirements analysis, systems engineering, value engineering, and value analysis.

For additional info, you can check in the following links:

http://en.wikipedia.org/wiki/Product_breakdown_structure

http://web.archive.org/web/20070822025602/http://pespmc1.vub.ac.be/ASC/SYSTEM_ANALY.html

http://en.wikipedia.org/wiki/Requirements_analysis

http://en.wikipedia.org/wiki/Value_engineering

5.2.2.3 Alternatives Identification

Identifying alternatives is a technique used to generate different approaches to execute and perform the work of the project. A variety of general management techniques can be used such as brainstorming, lateral thinking, pair wise comparisons, etc.

5.2.2.4 Facilitated Workshops

See also: Facilitated Workshops

5.2.3 Outputs

5.2.3.1 Project Scope Statement

The project scope statement describes, in detail, the project's deliverables and the work required to create those deliverables. The project scope statement also provides a common understanding of the project scope among project stakeholders. It may contain explicit scope exclusions that can assist in managing stakeholder expectations. It enables the project team to perform more detailed planning, guides the project team's work during execution, and provides the baseline for evaluating whether requests for changes or additional work are contained within or outside the project's boundaries. The degree and level of detail to which the project scope statement defines the work that will be performed and the work that is excluded can determine how well the project management team can control the overall project scope. The detailed project scope statement includes, either directly, or by reference to other documents, the following:

• **Product scope description.** Progressively elaborates the characteristics of the product, service, or result described in the project charter and requirements documentation.

• **Product acceptance criteria.** Defines the process and criteria for accepting completed products, services or results.

• **Project deliverables.** Deliverables include both the outputs that comprise the product or service of the project, as well as ancillary results, such as project management reports and documentation. The deliverables may be described at a summary level or in great detail.

• **Project exclusions.** Generally identifies what is excluded as from the project. Explicitly stating what is out of scope for the project helps to manage stakeholders' expectations.

• **Project constraints.** Lists and describes the specific project constraints associated with the project scope that limits the team's options, for example, a predefined budget or any imposed dates or schedule milestones that are issued by the customer or performing organization. When a project is performed under contract, contractual provisions will generally be constraints. Information on constraints may be listed in the project scope statement or in a separate log.

• **Project assumptions.** Lists and describes the specific project assumptions associated with the project scope and the potential impact of those assumptions if they prove to be false. Project teams frequently identify, document, and validate assumptions as part of

their planning process. Information on assumptions may be listed in the project scope statement or in a separate log.

5.2.3.2 Project Document Updates

Project documents that may be updated include, but are not limited to:

- Stakeholder register,
- Requirements documentation, and
- Requirements traceability matrix.

5.3 Create WBS

See attachment(s): 5.3.JPG

5.3.1 Inputs

5.3.1.1 Project Scope Statement

See also: Project Scope Statement

5.3.1.2 Requirements Documentation

See also: Requirements Documentation

5.3.1.3 Organizational Process Assets

The organizational process assets that can influence the Create WBS process include, but are not limited to:

- Policies, procedures, and templates for the WBS,
- Project files from previous projects, and
- Lessons learned from previous projects.

5.3.2 T & T

5.3.2.1 Decomposition

See attachment(s): WBS_Aircraft_System.jpg

Decomposition is the subdivision of project deliverables into smaller, more manageable components until the work and deliverables are defined to the work package level. The work package level is the lowest level in the WBS, and is the point at which the cost and activity durations for the work can be reliably estimated and managed. The level of detail for work packages will vary with the size and complexity of the project.

Decomposition of the total project work into work packages generally involves the following activities:

- Identifying and analyzing the deliverables and related work,
- Structuring and organizing the WBS,

• Decomposing the upper WBS levels into lower level detailed components,

• Developing and assigning identification codes to the WBS components, and

• Verifying that the degree of decomposition of the work is necessary and sufficient.

A portion of a WBS with some branches of the WBS decomposed down through the work package level is shown in Figure 5-8.

The WBS structure can be created in a number of forms, such as:

• Using phases of the project life cycle as the first level of decomposition, with the product and project deliverables inserted at the second level, as shown in Figure 5- 9;

• Using major deliverables as the first level of decomposition, as shown in Figure 5 10; and

• Using subprojects which may be developed by organizations outside the project team, such as contracted work. The seller then develops the supporting contract work breakdown structure as part of the contracted work.

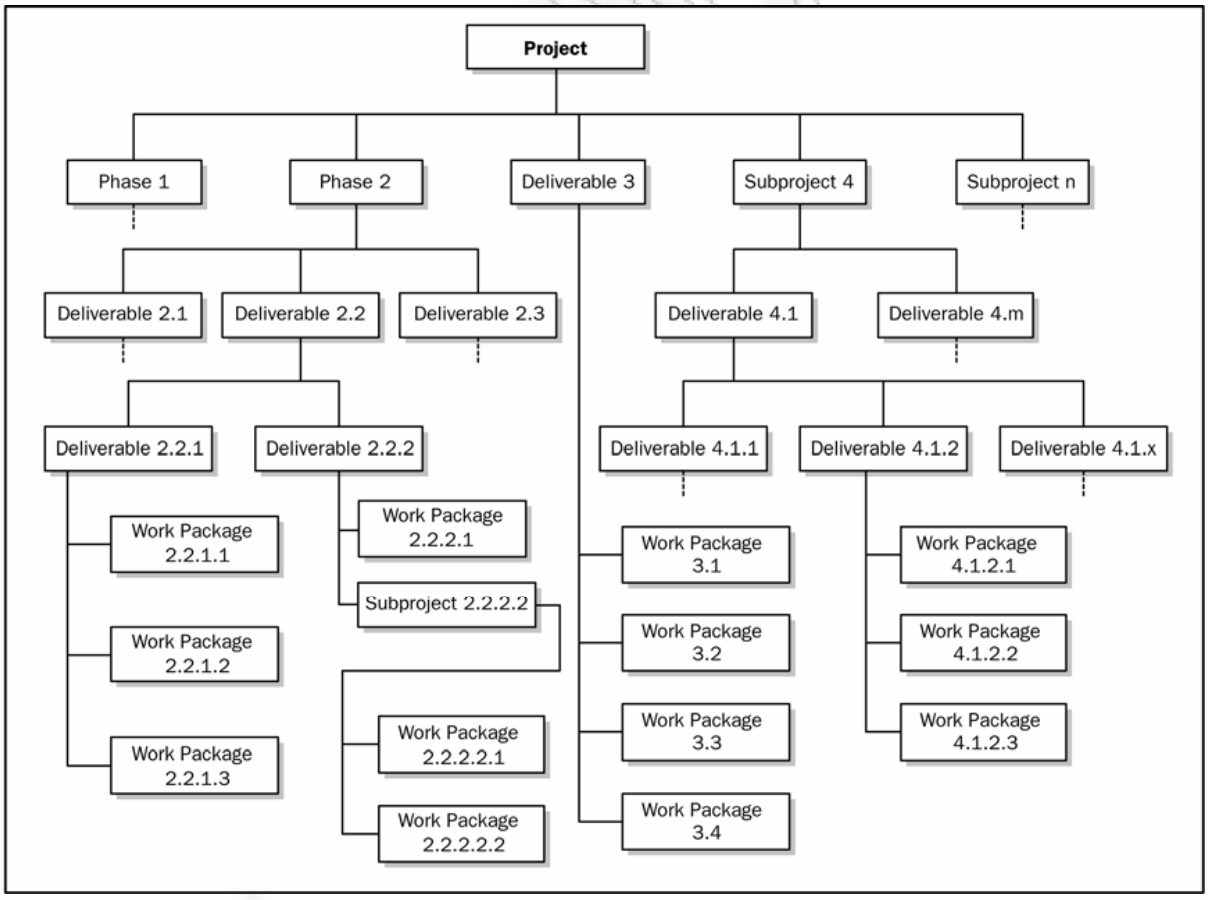

Figure 5-8. Sample Work Breakdown Structure with Some Branches Decomposed Down Through Work Packages

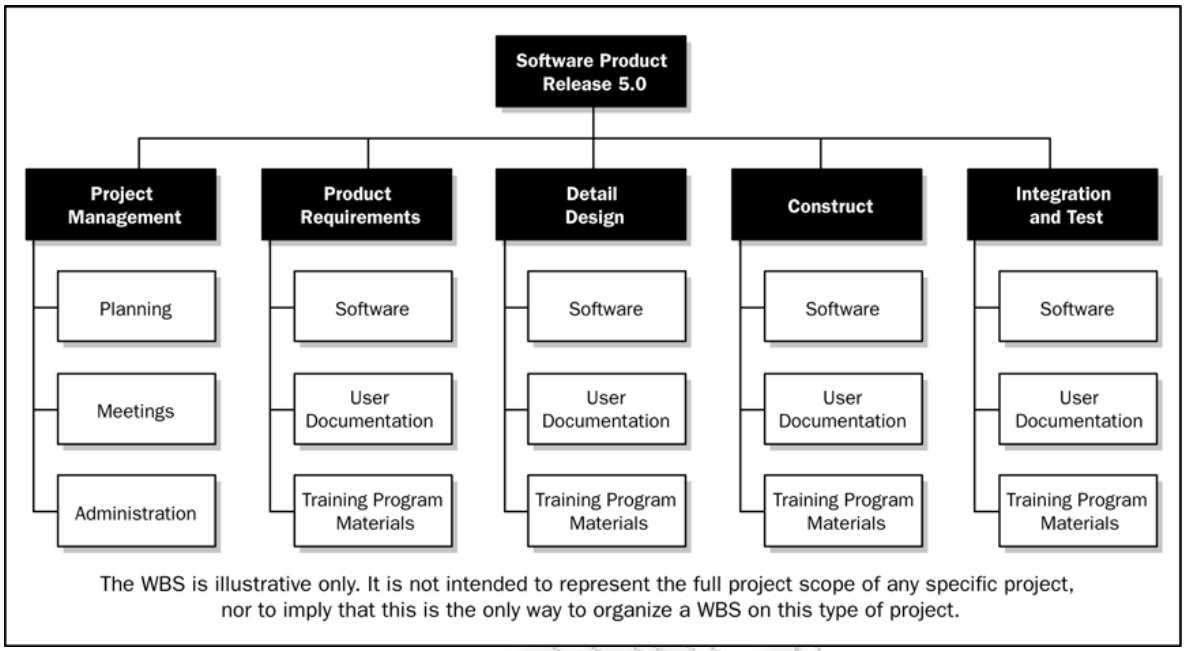

Figure 5-9. Sample Work Breakdown Structure Organized by Phase

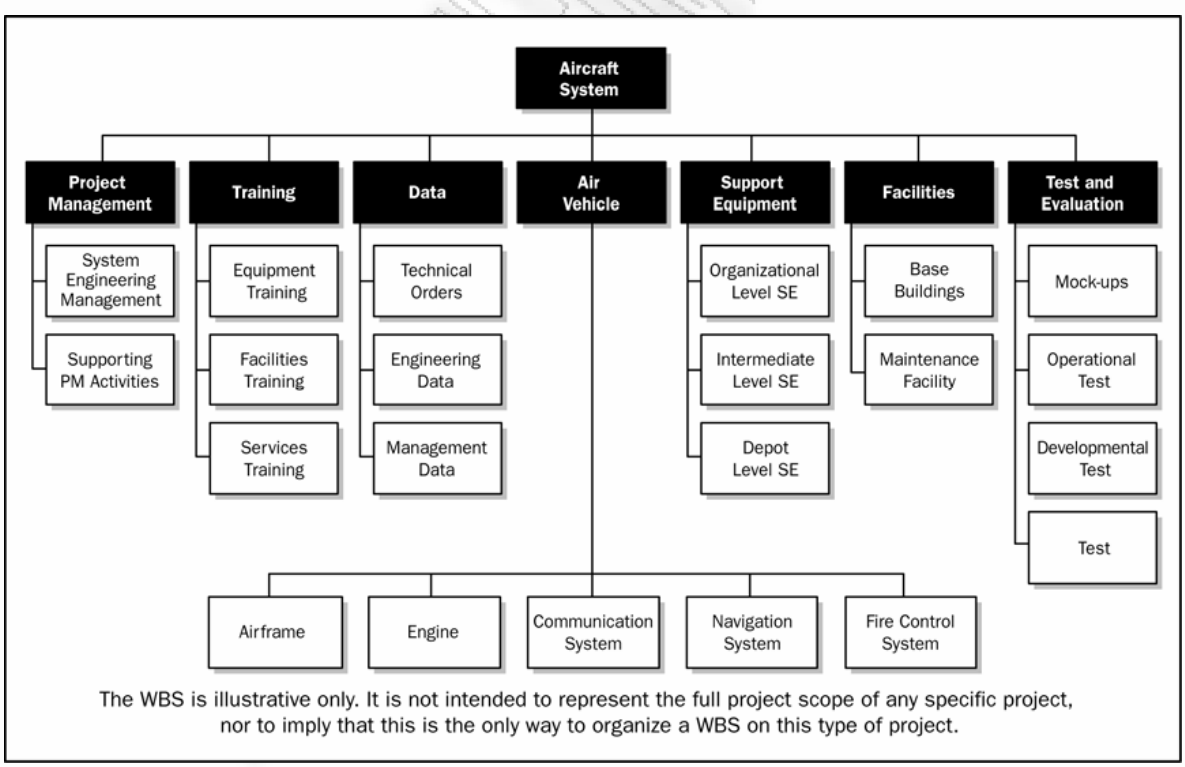

Figure 5-10. Sample Work Breakdown with Major Deliverables

Decomposition of the upper level WBS components requires subdividing the work for each of the deliverables or subprojects into its fundamental components, where the WBS components represent verifiable products, services, or results. The WBS can be structured as an outline, an organizational chart, a fishbone diagram or other method. Verifying the correctness of the decomposition requires determining that the lower-level WBS components are those that are necessary and sufficient for completion of the corresponding higher level deliverables. Different deliverables can have different levels of decomposition. To arrive at a work package, the work for some deliverables needs to be decomposed only to the next level, while others need additional levels of decomposition. As the work is decomposed to greater levels of detail, the ability to plan, manage, and control the work is enhanced. However, excessive decomposition can lead to non-productive management effort, inefficient use of resources, and decreased efficiency in performing the work.

Decomposition may not be possible for a deliverable or subproject that will be accomplished far into the future. The project management team usually waits until the deliverable or subproject is clarified so the details of the WBS can be developed. This technique is sometimes referred to as rolling wave planning.

The WBS represents all product and project work, including the project management work. The total of the work at the lowest levels must roll up to the higher levels so that nothing is left out and no extra work is completed. This is sometimes called the 100% rule.

The PMI Practice Standard for Work Breakdown Structures provides guidance for the generation, development, and application of work breakdown structures. This standard contains industry-specific examples of WBS templates that can be tailored to specific projects in a particular application area.

5.3.3 Outputs

5.3.3.1 WBS

The WBS is a deliverable-oriented hierarchical decomposition of the work to be executed by the project team, to accomplish the project objectives and create the required deliverables, with each descending level of the WBS representing an increasingly detailed definition of the project work. The WBS is finalized by establishing control accounts for the work packages and a unique identifier from a code of accounts. These identifiers provide a structure for hierarchical summation of costs, schedule, and resource information. A control account is a management control point where scope, cost, and schedule are integrated and compared to the earned value for performance measurement. Control accounts are placed at selected management points in the WBS. Each control account may include one or more work packages, but each of the work packages must be associated with only one control account.

5.3.3.2 WBS Dictionary

The WBS dictionary is a document generated by the Create WBS process that supports the WBS. The WBS dictionary provides more detailed descriptions of the components in

the WBS, including work packages and control accounts. Information in the WBS dictionary includes, but is not limited to:

• Code of account identifier,

• Description of work,

• Responsible organization,

• List of schedule milestones,

• Associated schedule activities,

• Resources required,

• Cost estimates,

• Quality requirements,

• Acceptance criteria,

• Technical references, and

• Contract information.

5.3.3.3 Scope Baseline

The scope baseline is a component of the project management plan. Components of the scope baseline include:

• **Project scope statement.** The project scope statement includes the product scope description, the project deliverables and defines the product user acceptance criteria.

• **WBS.** The WBS defines each deliverable and the decomposition of the deliverables into work packages.

• **WBS dictionary.** The WBS dictionary has a detailed description of work and technical documentation for each WBS element.

5.3.3.4 Project Document Updates

Project documents that may be updated include, but are not limited to requirements documentation. If approved change requests result from the Create WBS process, then the requirements documentation may need to be updated to include approved changes.

5.4 Verify Scope

See attachment(s): 5.4.JPG

5.4.1 Inputs

5.4.1.1 Project Management Plan

See also: Project Management Plan

The project management plan described in Section 4.2.3.1 contains the scope baseline.

Components of the scope baseline include:

• **Project scope statement.** The project scope statement includes the product scope description, the project deliverables and defines the product user acceptance criteria.

• **WBS.** The WBS defines each deliverable and the decomposition of the deliverables into work packages.

• **WBS dictionary.** The WBS dictionary has a detailed description of work and technical documentation for each WBS element

5.4.1.2 Requirements Documentation

See also: Requirements Documentation

5.4.1.3 Requirements Traceability Matrix

See also: Requirements Traceability Matrix

5.4.1.4 Validated Deliverables

See also: Validated Deliverables

5.4.2 T & T

5.4.2.1 Inspection

See document: deliverable-inspection-amp-audit-reports-30154

Inspection includes activities such as measuring, examining, and verifying to determine whether work and deliverables meet requirements and product acceptance criteria. Inspections are sometimes called reviews, product reviews, audits, and walkthroughs. In some application areas, these different terms have narrow and specific meanings.

5.4.3 Outputs

5.4.3.1 Accepted Deliverables

Deliverables that meet the acceptance criteria are formally signed off and approved by the customer or sponsor. Formal documentation received from the customer or sponsor acknowledging formal stakeholder acceptance of the project's deliverables is forwarded to the Close Project or Phase process (4.6).

5.4.3.2 Change Requests

See also: Change Requests

Those completed deliverables that have not been formally accepted are documented, along with the reasons for non-acceptance. Those deliverables may require a change request for defect repair. The change requests are processed for review and disposition through the Perform Integrated Change Control process (see Section 4.5).

5.4.3.3 Project Document Updates

Project documents that may be updated as a result of the Verify Scope process include any documents that define the product or report status on product completion.

5.5 Control Scope

See attachment(s): 5.5.JPG

5.5.1 Inputs

5.5.1.1 Project Management Plan

See also: Project Management Plan

The project management plan described in Section 4.2.3.1 contains the following information that is used to control scope:

• **Scope baseline.** The scope baseline is compared to actual results to determine if a change, corrective action or preventive action is necessary.

• **Scope management plan.** The scope management plan describes how the project scope will be managed and controlled.

• **Change management plan.** The change management plan defines the process for managing change on the project.

• **Configuration management plan.** The configuration management plan defines those items that are configurable, those items that require formal change control, and the process for controlling changes to such items.

• **Requirements management plan.** The requirements management plan can includes how requirements activities will be planned, tracked, and reported and how changes to the product, service or result requirements will be initiated. It also describes how impacts will be analyzed and the authorization levels required to approve these changes

5.5.1.2 Work Performance Information

See also: Work Performance Information

Information about project progress, such as which deliverables have started, their progress and which deliverables have finished.

5.5.1.3 Requirements Documentation

See also: Requirements Documentation

5.5.1.4 Requirements Traceability Matrix

See also: Requirements Traceability Matrix

5.5.1.5 Organizational Process Assets

The organizational process assets that can influence the Control Scope process include but are not limited to:

• Existing formal and informal scope control-related policies, procedures, and guidelines,

• Monitoring and reporting methods to be used.

5.5.2 T & T

5.5.2.1 Variance Analysis

See document: Variance_analysis

Project performance measurements are used to assess the magnitude of variation from the original scope baseline. Important aspects of project scope control include determining the cause and degree of variance relative to the scope baseline (Section 5.3.3.3) and deciding whether corrective or preventive action is required.

5.5.3 Outputs

5.5.3.1 Work Performance Measurements

Measurements can include planned vs. actual technical performance or other scope performance measurements. This information is documented and communicated to stakeholders.

5.5.3.2 Organizational Process Assets Updates

Organizational process assets that may be updated include, but are not limited to:

• Causes of variances,

• Corrective action chosen and the reasons, and

• Other types of lessons learned from project scope control.

5.5.3.3 Change Requests

See also: Change Requests

Analysis of scope performance can result in a change request to the scope baseline or other components of the project management plan. Change requests can include preventive or corrective actions or defect repairs. Change requests are processed for review and disposition according to the Perform Integrated Change Control process (Section 4.5).

5.5.3.4 Project Management Plan Updates

• **Scope Baseline Updates.** If the approved change requests have an effect upon the project scope, then the scope statement, the WBS, and the WBS dictionary are revised and reissued to reflect the approved changes.

• **Other Baseline Updates.** If the approved change requests have an effect on the project scope, then the corresponding cost baseline and schedule baselines are revised and reissued to reflect the approved changes.

5.5.3.5 Project Document Updates

Project documents that may be updated include, but are not limited to:

• Requirements documentation,

• Requirements traceability matrix

6 Project Time Management

6.1 Define Activities

See attachment(s): 6.1.JPG

6.1.1 Inputs

6.1.1.1 Scope Baseline

See also: Scope Baseline

6.1.1.2 Enterprise Environmental Factors

The enterprise environmental factors that can influence the Define Activities process include, but are not limited to, the project management information system (PMIS).

6.1.1.3 Organizational Process Assets

The organizational process assets that can influence the Define Activities process include, but are not limited to:

• Existing formal and informal activity planning-related policies, procedures, and guidelines, such as the scheduling methodology, that are considered in developing the activity definitions, and

• Lessons-learned knowledge base containing historical information regarding activities lists used by previous similar projects.

6.1.2 T & T

6.1.2.1 Decomposition

The technique of decomposition, as applied to defining activities, involves subdividing the project work packages into smaller, more manageable components called activities. Activities represent the effort needed to complete a work package. The Define Activities process defines the final outputs as activities rather than deliverables, as done in the Create WBS process (Section 5.3).

The activity list, WBS, and WBS dictionary can be developed either sequentially or concurrently, with the WBS and WBS dictionary as the basis for development of the final activity list. Each work package within the WBS is decomposed into the activities required to produce the work package deliverables. Involving team members in the decomposition can lead to better and more accurate results.

6.1.2.2 Rolling Wave Planning

Rolling wave planning is a form of progressive elaboration planning where the work to be accomplished in the near term is planned in detail and future work is planned at a higher level of the WBS. Therefore, work can exist at various levels of detail depending on where it is in the project lifecycle. For example, during early strategic planning, when information is less defined, work packages may be decomposed to the milestone level. As more is known about the upcoming events in the near term it can be decomposed into activities.

For additional info, you can check in the following links:

http://www.catalystpm.com/NP02.PDF

http://www.project-management-knowledge.com/definitions/r/rolling-wave-planning/

http://pmcrunch.com/project_management_process/rolling-wave-planning-and-progressive- elaboration/

6.1.2.3 Templates

See document: templates

A standard activity list or a portion of an activity list from a previous project is often usable as a template for a new project. The related activity attributes information in the templates can also contain other descriptive information useful in defining activities. Templates can also be used to identify typical schedule milestones.

6.1.2.4 Expert Judgment

Project team members or other experts, who are experienced and skilled in developing detailed project scope statements, the WBS, and project schedules, can provide expertise in defining activities.

6.1.3 Outputs

6.1.3.1 Activity List

The activity list is a comprehensive list including all schedule activities required on the project. The activity list includes the activity identifier and a scope of work description for each activity in sufficient detail to ensure that project team members understand what work is required to be completed.

6.1.3.2 Activity Attributes

Activity attributes extend the description of the activity by identifying the multiple components associated with each activity. The components for each activity evolve over time. During the initial stages of the project they include the Activity ID, WBS ID, and Activity Name, and when completed may include activity codes, activity description, predecessor activities, successor activities, logical relationships, leads and lags (Section 6.2.2.3), resource requirements, imposed dates, constraints, and assumptions. Activity attributes can be used to identity the person responsible for executing the work, geographic area or place where the work has to be performed, and activity type such as level of effort (LOE), discrete effort, and apportioned effort (AE). Activity attributes are used for schedule development and for selecting, ordering, and sorting the planned schedule activities in various ways within reports. The number of attributes varies by application area.

6.1.3.3 Milestone List

A milestone is a significant point or event in the project. A milestone list identifies all milestones and indicates whether the milestone is mandatory, such as those required by contract, or optional, such as those based upon historical information.

6.2 Sequence Activities

See attachment(s): 6.2.JPG

6.2.1 Inputs

6.2.1.1 Activity List

See also: Activity List

6.2.1.2 Activity Attributes

See also: Activity Attributes

6.2.1.3 Milestone List

See also: Milestone List

6.2.1.4 Project Scope Statement

See also: Project Scope Statement

6.2.1.5 Organizational Process Assets

The organizational process assets that can influence the Sequence Activities process include, but are not limited to, project files from the corporate knowledge base used for scheduling methodology.

6.2.2 T & T

6.2.2.1 Precedence Diagramming Method (PDM)

See document: pdms-precedence-diagram-method.html

PDM is a method used in Critical Path Methodology (CPM) for constructing a project schedule network diagram that uses boxes or rectangles, referred to as nodes, to represent activities, and connects them with arrows that show the logical relationships that exist between them. Figure 6-7 shows a simple project schedule network diagram drawn using PDM. This technique is also called Activity-On-Node (AON), and is the method used by most project management software packages. PDM includes four types of dependencies or logical relationships:

• **Finish-to-start (FS).** The initiation of the successor activity depends upon the completion of the predecessor activity.

• **Finish-to-finish (FF).** The completion of the successor activity depends upon the completion of the predecessor activity.

• **Start-to-start (SS).** The initiation of the successor activity depends upon the initiation of the predecessor activity.

• **Start-to-finish (SF).** The completion of the successor activity depends upon the initiation of the predecessor activity.

In PDM, finish-to-start is the most commonly used type of precedence relationship. The start-to-finish relationship is rarely used but is included here for a complete list of the PDM relationship types.

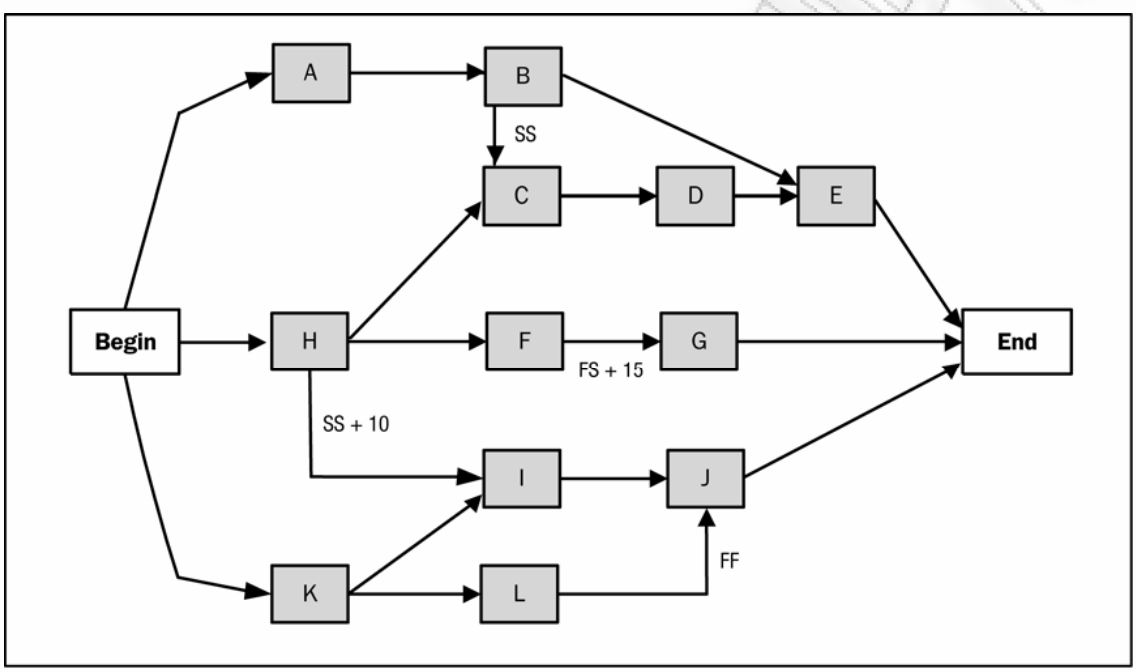

Figure 6-7. Network Diagram

6.2.2.2 Dependency Determination

Three types of dependencies are used to define the sequence among the activities:

• **Mandatory dependencies.** Mandatory dependencies are those that are contractually required or inherent in the nature of the work. The project team determines which dependencies are mandatory during the process of sequencing the activities. Mandatory dependencies often involve physical limitations, such as on a construction project where it is impossible to erect the superstructure until after the foundation has been built, or on an electronics project, where a prototype must be built before it can be tested. Mandatory dependencies are also sometimes referred to as hard logic.

• **Discretionary dependencies.** The project team determines which dependencies are discretionary during the process of sequencing the activities. Discretionary dependencies are sometimes referred to as preferred logic, preferential logic, or soft logic. Discretionary dependencies are established based on knowledge of best practices within

a particular application area or some unusual aspect of the project where a specific sequence is desired, even though there may be other acceptable sequences. Discretionary dependencies should be fully documented since they can create arbitrary total float values and can limit later scheduling options. When fast tracking techniques are employed, these discretionary dependencies should be reviewed and considered for modification or removal.

• **External dependencies.** The project management team determines which dependencies are external during the process of sequencing the activities. External dependencies involve a relationship between project activities and non-project activities. These dependencies are usually outside the project team's control. For example, the testing activity in a software project can be dependent on the delivery of hardware from an external source, or governmental environmental hearings may need to be held before site preparation can begin on a construction project.

6.2.2.3 Applying Leads and Lags

The project management team determines the dependencies that may require a lead or a lag to accurately define the logical relationship. The use of leads and lags should not replace schedule logic. Activities and their related assumptions should be documented.

A lead allows an acceleration of the successor activity. For example, on a project to construct a new office building the landscaping could be scheduled to start 2 weeks prior to the scheduled punch list completion. This would be shown as a finish-to-start with a 2 week lead.

A lag directs a delay in the successor activity. For example, a technical writing team can begin editing the draft of a large document fifteen days after they begin writing it. This could be shown as a start-to-start relationship with a fifteen-day lag.

For additional info, you can check in the following links:

http://www.project-management-knowledge.com/definitions/l/lead-technique/

http://www.project-management-knowledge.com/definitions/l/lag/

6.2.2.4 Schedule Network Templates

See document: 000767.htm

Standardized schedule network diagram templates can be used to expedite the preparation of networks of project activities. They can include an entire project or only a portion of it. Portions of a project schedule network diagram are often referred to as a subnetwork or a fragment network. Subnetwork templates are especially useful when a project includes several identical or nearly identical deliverables, such as floors on a high-rise office building, clinical trials on a pharmaceutical research project, coding program modules on a software project, or the start-up phase of a development project.

6.2.3 Outputs

6.2.3.1 Project Schedule Network Diagrams

Project schedule network diagrams are schematic displays of the project's schedule activities and the logical relationships among them, also referred to as dependencies. Figure 6-7 illustrates a project schedule network diagram. A project schedule network diagram can be produced manually or by using project management software. It can include full project details, or have one or more summary activities. A summary narrative can accompany the diagram and describe the basic approach used to sequence the activities. Any unusual activity sequences within the network should be fully described within the narrative.

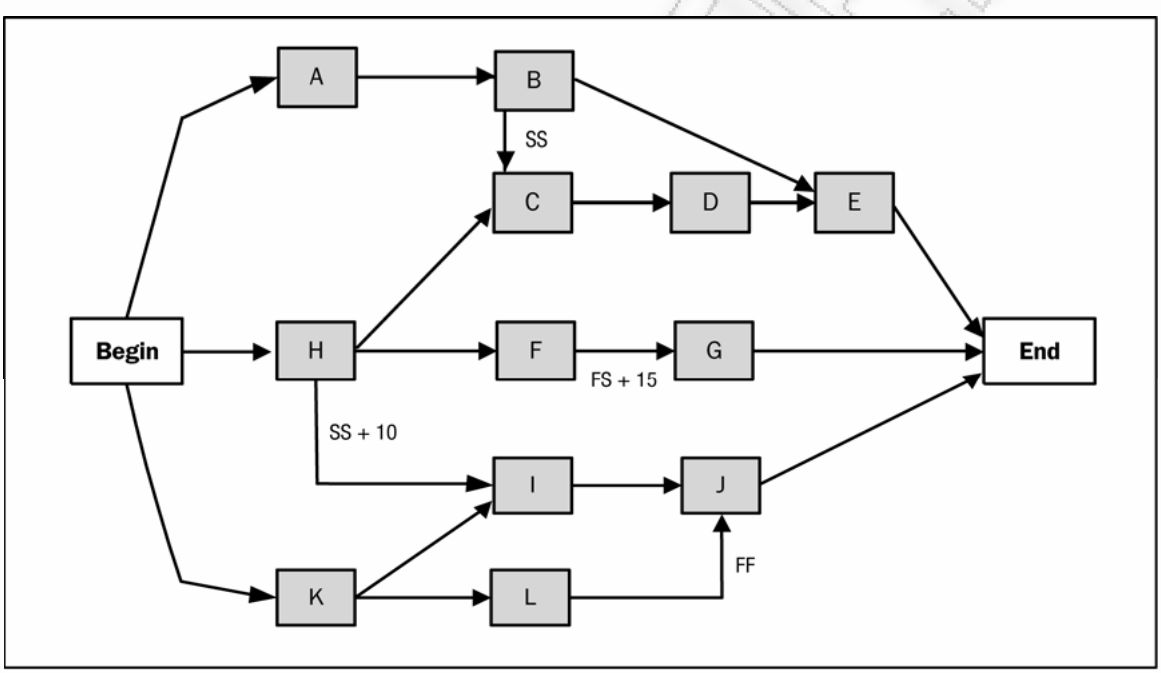

Figure 6-7. Network Diagram

6.2.3.2 Project Document Updates

Project documents that may be updated include, but are not limited to:

- Activity lists,
- Activity attributes, and
- Risk register.

6.3 Estimate Activity Resources

See attachment(s): 6.3.JPG

6.3.1 Inputs

6.3.1.1 Activity List

See also: Activity List

6.3.1.2 Activity Attributes

See also: Activity Attributes

6.3.1.3 Resource Calendars

See also: Resource Calendars
See also: Resource Calendars

Information on which resources (such as people, equipment, and material) are potentially available during planned activity period, described in Sections 9.2.3.2 and 12.2.3.3, is used for estimating resource utilization. Resource calendars specify when and how long identified project resources will be available during the project. This information may be at the activity or project level. This knowledge includes consideration of attributes such as resource experience and/or skill level, as well as various geographical locations from which the resources originate and when they may be available.

The composite resource calendar includes the availability, capabilities, and skills of human resources (Section 9.2). For example, during the early phases of an engineering design project, the pool of resources might include junior and senior engineers in large numbers. During later phases of the same project, however, the pool can be limited to those individuals who are knowledgeable about the project as a result of having worked on the earlier phases of the project.

6.3.1.4 Enterprise Environmental Factors

The enterprise environmental factors that can influence the Estimate Activity Resources process include but are not limited to resource availability and skills.

6.3.1.5 Organizational Process Assets

The organizational process assets that can influence the Estimate Activity Resources process include but are not limited to:

• Policies and procedures regarding staffing,

• Policies and procedures relating to rental and purchase of supplies and equipment, and

• Historical information regarding types of resources used for similar work on previous projects.

6.3.2 T & T

6.3.2.1 Expert Judgment

Expert judgment is often required to assess the resource-related inputs to this process. Any group or person with specialized knowledge in resource planning and estimating can provide such expertise.

6.3.2.2 Alternatives Analysis

Many schedule activities have alternative methods of accomplishment. They include using various levels of resource capability or skills, different size or type of machines, different tools (hand versus automated), and make-or-buy decisions regarding the resource (Section 12.1.3.3).

For additional info, you can check in the following links:

http://www.enotes.com/management-encyclopedia/make-buy-decisions

http://www.anticlue.net/archives/000768.htm

6.3.2.3 Published Estimating Data

See document: 000768.htm

Several companies routinely publish updated production rates and unit costs of resources for an extensive array of labor trades, material, and equipment for different countries and geographical locations within countries.

6.3.2.4 Bottom-Up Estimating

See document: bottom-up-estimating-technique

When an activity cannot be estimated with a reasonable degree of confidence, the work within the activity is decomposed into more detail. The resource needs are estimated. These estimates are then aggregated into a total quantity for each of the activity's resources. Activities may or may not have dependencies between them that can affect the application and use of resources. If there are dependencies, this pattern of resource usage is reflected and documented in the estimated requirements of the activity.

6.3.2.5 Project Management Software

See document: Project_management_software

Project management software has the capability to help plan, organize, and manage resource pools and develop resource estimates. Depending on the sophistication of the software, resource breakdown structures, resource availability, resource rates and various resource calendars can be defined to assist in optimizing resource utilization.

6.3.3 Outputs

6.3.3.1 Activity Resource Requirements

The output of the Estimate Activity Resources process identifies the types and quantities of resources required for each activity in a work package. These requirements can then be aggregated to determine the estimated resources for each work package. The amount of detail and the level of specificity of the resource requirement descriptions can vary by application area. The resource requirements documentation for each activity can include the basis of estimate for each resource, as well as the assumptions that were made in determining which types of resources are applied, their availability, and what quantities are used.

6.3.3.2 Resource Breakdown Structure

The resource breakdown structure is a hierarchical structure of the identified resources by resource category and resource type. Examples of resource categories include labor, material, equipment, and supplies. Resource types can include the skill level, grade level or other information as appropriate to the project. The resource breakdown structure is useful for organizing and reporting project schedule data with resource utilization information.

6.3.3.3 Project Document Updates

Project documents that may be updated include, but are not limited to:

- Activity list,
- Activity attributes, and
- Resource calendars.

6.4 Estimate Activity Durations

See attachment(s): 6.4.JPG

6.4.1 Inputs

6.4.1.1 Activity List

See also: Activity List

6.4.1.2 Activity Attributes

See also: Activity Attributes

6.4.1.3 Activity Resource Requirements

See also: Activity Resource Requirements

6.4.1.4 Resource Calendars

See also: Resource Calendars

See also: Resource Calendars

The resource calendar (Section 6.3.1.3), developed as part of the Activity Resource Estimating process, can include the type, availability, and capabilities of human resources (Section 9.2.3.2). The type, quantity, availability, and capability, when applicable, of both equipment and material resources, which could significantly influence the duration of schedule activities, are also considered. For example, when a senior and a junior staff member are assigned full time, a senior staff member can generally be expected to complete a given activity in less time than a junior staff member.

6.4.1.5 Project Scope Statement

See also: Project Scope Statement

The constraints and assumptions from the project scope statement (Section 5.2.3.1) are considered when estimating the activity durations. Examples of assumptions include, but are not limited to:

• Existing conditions,

• Availability of information, and

• Length of the reporting periods.

Examples of constraints include, but are not limited to:

• Available skilled resources, and

• Contract terms and requirements.

6.4.1.6 Enterprise Environmental Factors

The enterprise environmental factors that can influence the Estimate Activity Durations process include, but are not limited to:

• Duration estimating databases and other reference data,

• Productivity metrics, and

• Published commercial information.

6.4.1.7 Organizational Process Assets

The organizational process assets that can influence the Estimate Activity Durations process include but are not limited to:

• Historical duration information,

• Project calendars,

• Scheduling methodology, and

• Lessons learned.

6.4.2 T & T

6.4.2.1 Expert Judgment

Expert judgment, guided by historical information, can provide duration estimate information or recommended maximum activity durations from prior similar projects. Expert judgment can also be used to determine whether to combine methods of estimating and how to reconcile differences between them.

6.4.2.2 Analogous Estimating

See document: analogous-estimating

Analogous estimating uses parameters such as duration, budget, size, weight, and complexity, from a previous, similar project, as the basis for estimating the same parameter or measure for a future project. When estimating durations, this technique relies on the actual duration of previous, similar projects as the basis for estimating the duration of the current project. It is a gross value estimating approach, sometimes adjusted for known differences in project complexity.

Analogous duration estimating is frequently used to estimate project duration when there is a limited amount of detailed information about the project for example, in the early phases of a project. Analogous estimating uses historical information and expert judgment.

Analogous estimating is generally less costly and time consuming than other techniques, but it is also generally less accurate. Analogous cost estimates can be applied to a total project or to segments of a project and may be used in conjunction with other estimating methods. Analogous estimating is most reliable when the previous activities are similar in fact and not just in appearance, and the project team members preparing the estimates have the needed expertise.

6.4.2.3 Parametric Estimating

See document: parametric-estimating

Parametric estimating uses a statistical relationship between historical data and other variables (e.g., square footage in construction) to calculate an estimate for activity parameters, such as cost, budget, and duration.

Activity durations can be quantitatively determined by multiplying the quantity of work to be performed by labor hours per unit of work. For example, activity duration can be estimated on a design project by the number of drawings multiplied by the number of labor hours per drawing, or a cable installation in meters of cable multiplied by the number of labor hours per meter. For example, if the assigned resource is capable of installing 25 meters of cable per hour, the duration required to install 1,000 meters would be 40 hours. (1,000 meters divided by 25 meters per hour).

This technique can produce higher levels of accuracy depending upon the sophistication and underlying data built into the model. Parametric time estimates can be applied to a total project or to segments of a project, in conjunction with other estimating methods.

6.4.2.4 Three-Point Estimates

See document: Three-point_estimation

The accuracy of activity duration estimates can be improved by considering estimation uncertainty and risk. This concept originated with the Program Evaluation and Review Technique (PERT). PERT uses three estimates to define an approximate range for an activity's duration:

• **Most likely (t_M)**. The duration of the activity, given the resources likely to be assigned, their productivity, realistic expectations of availability for the activity, dependencies on other participants, and interruptions.

• **Optimistic (t_O)**. The activity duration is based on analysis of the best-case scenario for the activity.

• **Pessimistic (t_P)**. The activity duration is based on analysis of the worst- case scenario for the activity.

PERT analysis calculates an **Expected (t_E)** activity duration using a weighted average of these three estimates:

$$t_E = \frac{t_O + 4t_M + t_P}{6}$$

Duration estimates based on this equation (or even on a simple average of the three points) may provide more accuracy, and the three points clarify the range of uncertainty of the duration estimates.

6.4.2.5 Reserve Analysis

See document: reserve-analysis

Duration estimates may include contingency reserves, (sometimes referred to as time reserves, or buffers) into the overall project schedule to account for schedule uncertainty. The contingency reserve may be a percentage of the estimated activity duration, a fixed number of work periods, or may be developed by using quantitative analysis methods.

As more precise information about the project becomes available the contingency reserve may be used, reduced or eliminated. Contingency should be clearly identified in schedule documentation.

6.4.3 Outputs

6.4.3.1 Activity Duration Estimates

Activity duration estimates are quantitative assessments of the likely number of work periods that will be required to complete an activity. Duration estimates do not include any lags as described in 6.2.2.3. Activity duration estimates may include some indication of the range of possible results.

For example:

• 2 weeks ± 2 days to indicate that the activity will take at least eight days and no more than twelve (assuming a five-day workweek).

• 15% probability of exceeding three weeks to indicate a high probability—85% percent—that the activity will take three weeks or less.

6.4.3.2 Project Document Updates

Project documents that may be updated include, but are not limited to:

• Activity attributes, and

• Assumptions made in developing the activity duration estimate such as skill levels and availability.

6.5 Develop Schedule

See attachment(s): 6.5.JPG

6.5.1 Inputs

6.5.1.1 Activity List

See also: Activity List

6.5.1.2 Activity Attributes

See also: Activity Attributes

6.5.1.3 Project Schedule Network Diagrams

See also: Project Schedule Network Diagrams

6.5.1.4 Activity Resource Requirements

See also: Activity Resource Requirements

6.5.1.5 Resource Calendars

See also: Resource Calendars

6.5.1.6 Activity Duration Estimates

See also: Activity Duration Estimates

6.5.1.7 Project Scope Statement

See also: Project Scope Statement

6.5.1.8 Enterprise Environmental Factors

The enterprise environmental factors that can influence the Develop Schedule process include, but are not limited to, a scheduling tool that can be used in developing the schedule.

6.5.1.9 Organizational Process Assets

The organizational process assets that can influence the Develop Schedule process include, but are not limited to:

• Scheduling methodology, and

• Project calendar.

6.5.2 T & T

6.5.2.1 Schedule Network Analysis

See document: Event_chain_methodology

Schedule network analysis is a technique that generates the project schedule. It employs various analytical techniques, such as critical path method, critical chain method, what-if analysis, and resource leveling to calculate the early and late start and finish dates for the uncompleted portions of project activities. Some network paths may have points of path convergence or path divergence that can be identified and used in schedule compression analysis or other analyses.

6.5.2.2 Critical Path Method

See document: Critical_Path_Method

The critical path method calculates the theoretical early start and finish dates, and late start and finish dates, for all activities without regard for any resource limitations, by performing a forward and backward pass analysis through the schedule network. The resulting early and late start and finish dates are not necessarily the project schedule; rather, they indicate the time periods within which the activity could be scheduled, given activity durations, logical relationships, leads, lags, and other known constraints.

Calculated early start and finish dates, and late start and finish dates, may be affected by activity total float, which provides schedule flexibility and, may be positive, negative, or zero. On any network path, the schedule flexibility is measured by the positive difference between early and late dates, and is termed “total float.” Critical paths have either a zero or negative total float, and schedule activities on a critical path are called “critical activities.” A critical path is normally characterized by zero total float on the critical path. Networks can have multiple near critical paths. Adjustments to activity durations, logical relationships, leads and lags, or other schedule constraints may be necessary to produce network paths with a zero or positive total float. Once the total float for a network path has been calculated then the free float, the amount of time that an activity can be delayed without delaying the early start date of any immediate successor activity within the network path, can also be determined.

6.5.2.3 Critical Chain Method

See document: Critical_Chain_Project_Management
See also: Performance Reviews

Critical chain is a schedule network analysis technique that modifies the project schedule to account for limited resources. Initially, the project schedule network diagram is built using duration estimates with required dependencies and defined constraints as inputs.

The critical path is then calculated. After the critical path is identified, resource availability is entered and the resourcelimited schedule result is determined. The resulting schedule often has an altered critical path.

The resource-constrained critical path is known as the critical chain. The critical chain method adds duration buffers that are non- work schedule activities to manage uncertainty. One buffer, placed at the end of the critical chain, is known as the project buffer and protects the target finish date from slippage along the critical chain. Additional buffers, known as feeding buffers, are placed at each point that a chain of dependent tasks not on the critical chain feeds into the critical chain. Feeding buffers thus protect the critical chain from slippage along the feeding chains. The size of each buffer should account for the uncertainty in the duration of the chain of dependent tasks leading up to that buffer. Once the buffer schedule activities are determined, the planned activities are scheduled to their latest possible planned start and finish dates. Consequently, in lieu of managing the total float of network paths, the critical chain method focuses on managing remaining buffer durations against the remaining durations of task chains.

6.5.2.4 Resource Leveling

See document: Resource_Leveling

Resource leveling is a schedule network analysis technique applied to a schedule that has already been analyzed by the critical path method. Resource leveling can be used when shared or critical required resources are only available at certain times, are only available in limited quantities, or to keep resource usage at a constant level. Resource leveling is necessary when resources have been over-allocated, such as when a resource has been assigned to two or more activities during the same time period, when shared or critical required resources are only available at certain times or are only available in limited quantities. Resource leveling can often cause the original critical path to change.

6.5.2.5 What-If Scenario Analysis

This is an analysis of the question "What if the situation represented by scenario 'X' happens?" A schedule network analysis is performed using the schedule to compute the different scenarios, such as delaying a major component delivery, extending specific engineering durations, or introducing external factors, such as a strike or a change in the permitting process. The outcome of the what-if scenario analysis can be used to assess the feasibility of the project schedule under adverse conditions, and in preparing contingency and response plans to overcome or mitigate the impact of unexpected situations. Simulation involves calculating multiple project durations with different sets of activity assumptions. The most common technique is ***Monte Carlo Analysis*** (Section 11.4.2.2), in which a distribution of possible activity durations is defined for each activity and used to calculate a distribution of possible outcomes for the total project.

For additional info, you can check in the following links:

http://en.wikipedia.org/wiki/Scenario_analysis

http://en.wikipedia.org/wiki/Monte_Carlo_method

http://en.wikipedia.org/wiki/What-if_analysis

http://www.project-management- knowledge.com/definitions/m/monte-carlo- analysis/

6.5.2.6 Applying Leads and Lags

See also: Applying Leads and Lags

Leads and lags (Section 6.2.2.3) are refinements applied during network analysis to develop a viable schedule.

6.5.2.7 Schedule Compression

See document: schedule-compression

Schedule compression shortens the project schedule *without* changing the project scope, to meet schedule constraints, imposed dates, or other schedule objectives. Schedule compression techniques include:

• **Crashing.** A schedule compression technique in which cost and schedule tradeoffs are analyzed to determine how to obtain the greatest amount of compression for the least incremental cost. Examples of crashing could include approving overtime, bringing in additional resources, or paying to expedite delivery to activities on the critical path. Crashing only works for activities where additional resources will shorten the duration. Crashing does not always produce a viable alternative and may result in increased risk and/or cost.

• **Fast tracking.** A schedule compression technique in which phases or activities normally performed in sequence are performed in parallel. An example is constructing the foundation for a building before completing all the architectural drawings. Fast tracking may result in rework and increased risk. Fast tracking only works if activities can be overlapped to shorten the duration.

6.5.2.8 Scheduling Tool

See document: Project_management_software

Automated scheduling tools expedite the scheduling process by generating start and finish dates based on the inputs of activities, network diagrams, resources and activity durations. A scheduling tool can be used in conjunction with other project management software applications as well as manual methods.

6.5.3 Outputs

6.5.3.1 Project Schedule

As a minimum, the project schedule includes a planned start date and planned finish date for each activity. If resource planning is done at an early stage, then the project schedule would remain preliminary until resource assignments have been confirmed and scheduled start and finish dates are established. This process usually happens no later than completion of the project management plan (Section 4.2.3.1). A project target schedule may also be developed with a defined target start and target finish for each activity. The project schedule may be presented in summary form, sometimes referred to as the master schedule or milestone schedule, or presented in detail. Although a project schedule can be presented in tabular form, it is more often presented graphically, using one or more of the following formats:

• **Milestone charts.** These charts are similar to bar charts, but only identify the scheduled start or completion of major deliverables and key external interfaces. An example is the milestone schedule portion of Figure 6-14.

• **Bar charts.** These charts, with bars representing activities, show activity start and end dates, as well as expected durations. Bar charts are relatively easy to read, and are frequently used in management presentations. For control and management communication, the broader, more comprehensive summary activity, sometimes referred to as a hammock activity, is used between milestones or across multiple interdependent work packages, and is displayed in bar chart reports. An example is the summary schedule portion of Figure 6-14 that is presented in a WBS structured format.

• **Project schedule network diagrams.** These diagrams, with activity date information, usually show both the project network logic and the project's critical path schedule activities. These diagrams can be presented in the activity-on-node diagram format, as shown in Figure 6-7, or presented in a time-scaled schedule network diagram format that is sometimes called a logic bar chart, as shown for the detailed schedule in Figure 6-14. This example also shows how each work package is planned as a series of related activities.

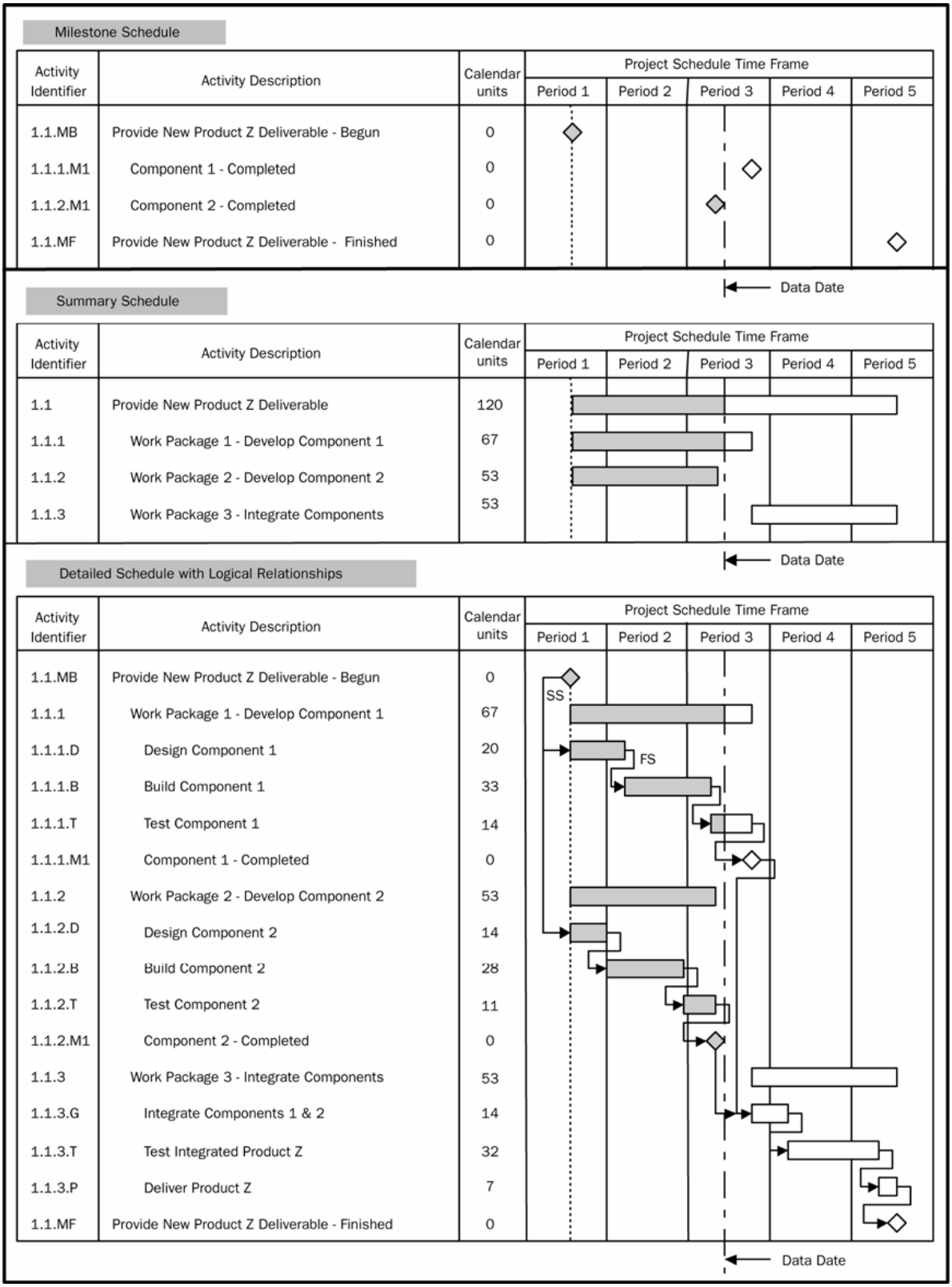

Figure 6-14. Project Schedule—Graphic Examples

Figure 6-14 shows the schedule for a sample project being executed, with the work in progress reported through the data date, which is sometimes also called the as-of date or status date. For a simple project schedule, Figure 6-14 gives a graphic display of a Milestone Schedule, a Summary Schedule, and a Detailed Schedule. Figure 6-14 also visually shows the relationships among the three different levels of schedule presentation.

6.5.3.2 Schedule Baseline

A schedule baseline is a specific version of the project schedule developed from the schedule network analysis. It is accepted and approved by the project management team as the schedule baseline with baseline start dates and baseline finish dates. The schedule baseline is a component of the project management plan.

6.5.3.3 Schedule Data

The schedule data for the project schedule includes at least the schedule milestones, schedule activities, activity attributes, and documentation of all identified assumptions and constraints. The amount of additional data varies by application area. Information frequently supplied as supporting detail includes, but is not limited to:

• Resource requirements by time period, often in the form of a resource histogram,

• Alternative schedules, such as best-case or worst-case, not resource- leveled, or resourceleveled, with or without imposed dates, and

• Scheduling of contingency reserves.

Schedule data could include such items as resource histograms, cash- flow projections, and order and delivery schedules.

6.5.3.4 Project Document Updates

Project documents that may be updated include, but are not limited to:

• **Activity resource requirements.** Resource leveling can have a significant effect on preliminary estimates of the types and quantities of resources required. If the resourceleveling analysis changes the project resource requirements, then the project resource requirements are updated.

• **Activity attributes.** Activity attributes (Section 6.1.3.2) are updated to include any revised resource requirements and any other revisions generated by the Develop Schedule process.

• **Calendar.** The calendar for each project may use different calendar units as the basis for scheduling the project.

• **Risk register.** The risk register may need to be updated to reflect opportunities or threats perceived through scheduling assumptions.

6.6 Control Schedule

See attachment(s): 6.6.JPG

6.6.1 Inputs

6.6.1.1 Project Management Plan

See also: Project Management Plan

The project management plan described in Section 4.2.3.1 contains the schedule management plan and the schedule baseline. The schedule management plan describes how the schedule will be managed and controlled. The schedule baseline is used to compare with actual results to determine if a change, corrective action, or preventive action is necessary.

6.6.1.2 Project Schedule

See also: Project Schedule

The most recent version of the project schedule with notations to indicate updates, completed activities, and started activities as of the indicated data date.

6.6.1.3 Work Performance Information

See also: Work Performance Information

6.6.1.4 Organizational Process Assets

The organizational process assets that influence the Control Schedule process include but are not limited to:

• Existing formal and informal schedule control-related policies, procedures, and guidelines;

• Schedule control tools; and

• Monitoring and reporting methods to be used.

6.6.2 T & T

6.6.2.1 Performance Reviews

See document: Evm

Performance reviews measure, compare and analyze schedule performance such as actual start and finish dates, percent complete and remaining duration for work in progress. If earned value management (EVM) is utilized the schedule variance (SV) (Section 7.3.2.1) and schedule performance index (SPI) (Section 7.3.2.3) are used to assess the magnitude of schedule variations. An important part of schedule control is to decide if the schedule variation requires corrective action. For example, a major delay on any activity not on the critical path may have little effect on the overall project schedule, while a much shorter delay on a critical or near- critical activity may require immediate action.

If using the critical chain scheduling method (6.5.2.3), comparing the amount of buffer remaining to the amount of buffer needed to protect the delivery data can help determine schedule status. The difference between the buffer needed and the buffer remaining can determine whether corrective action is appropriate.

6.6.2.2 Variance Analysis

See document: Variance_analysis
See also: Schedule Baseline

Schedule performance measurements (SV, SPI) are used to assess the magnitude of variation to the original schedule baseline. The total float variance is also an essential planning component to evaluate project time performance. Important aspects of project schedule control include determining the cause and degree of variance relative to the schedule baseline (Section 6.5.3.2) and deciding whether corrective or preventive action is required.

6.6.2.3 Project Management Software

See document: Project_management_software

Project management software for scheduling provides the ability to track planned dates versus actual dates, and to forecast the effects of changes to the project schedule.

6.6.2.4 Resource Leveling

See also: Resource Leveling

6.6.2.5 What-If Scenario Analysis

See also: What-If Scenario Analysis

6.6.2.6 Applying Leads and Lags

See also: Applying Leads and Lags

6.6.2.7 Schedule Compression

See also: Schedule Compression

6.6.2.8 Scheduling Tool

See document: Project_management_software

Schedule data is updated and compiled into the schedule to reflect actual progress of the project and remaining work to be completed. The scheduling tool and the supporting schedule data are used in conjunction with manual methods or other project management software to perform schedule network analysis to generate an updated project schedule.

6.6.3 Outputs

6.6.3.1 Work Performance Measurements

See also: Work Performance Measurements

The calculated SV and SPI values for WBS components, in particular the work packages and control accounts, are documented and communicated to stakeholders.

6.6.3.2 Organizational Process Assets Updates

Organizational process assets that may be updated include but are not limited to:

• Causes of variances,

• Corrective action chosen and the reasons, and

• Other types of lessons learned from project schedule control.

6.6.3.3 Change Requests

See also: Change Requests

Schedule variance analysis, along with review of progress reports, results of performance measures, and modifications to the project schedule can result in change requests to the schedule baseline and/or to other components of the project management plan. Change requests are processed for review and disposition through the Perform Integrated Change Control process (4.5). Preventive actions may include recommended changes to reduce the probability of negative schedule variances.

6.6.3.4 Project Management Plan Updates

Elements of the project management plan that may be updated include but are not limited to:

• **Schedule baseline.** Changes to the schedule baseline are incorporated in response to approved change requests (Section 4.4.3.1) related to project scope changes, activity resources, or activity duration estimates.

• **Schedule management plan.**

• **Cost baseline.** The cost baseline may be updated to reflect changes caused by compression or crashing techniques.

6.6.3.5 Project Document Updates

Project documents that may be updated include but are not limited to:

• **Schedule Data.** New project schedule network diagrams may be developed to display approved remaining durations and modifications to the work plan. In some cases, project schedule delays can be so severe that development of a new target schedule with forecasted start and finish dates is needed to provide realistic data for directing the work, and for measuring performance and progress.

• **Project Schedule.** An updated project schedule will be generated from the updated schedule data to reflect the schedule changes and manage the project.

7 Project Cost Management

7.1 Estimate Costs

See attachment(s): 7.1.JPG

7.1.1 Inputs

7.1.1.1 Scope Baseline

See also: Scope Baseline

• **Scope statement.** The scope statement (Section 5.2.3.1) provides the product description, acceptance criteria, key deliverables, project boundaries, assumptions, and constraints about the project. One basic assumption that needs to be made when estimating project costs is whether the estimates will be limited to direct project costs only or whether the estimates will also include indirect costs. Indirect costs are those costs that cannot be directly traced to a specific project and therefore will be accumulated and allocated equitably over multiple projects by some approved and documented accounting procedure. One of the most common constraints for many projects is a limited project budget. Examples of other constraints are required delivery dates, available skilled resources, and organizational policies.

• **Work breakdown structure.** The project WBS (Section 5.3.3.1) provides the relationships among all the components of the project and the project deliverables (Section 4.3.3.1).

• **WBS dictionary.** The WBS dictionary (Section 5.3.3.2) and related detailed statements of work provide an identification of the deliverables and a description of the work in each WBS component required to produce each deliverable.

Additional information that may be found in the scope baseline that includes requirements with contractual and legal implications are health, safety, security, performance, environmental, insurance, intellectual property rights, licenses, and permits. All of this information should be considered when developing the cost estimates.

7.1.1.2 Project Schedule

See also: Project Schedule

The type and quantity of resources and the amount of time which those resources are applied to complete the work of the project are major factors in determining the project cost. Schedule activity resources and their respective durations are used as key inputs to this process. Estimate Activity Resources (Section 6.3) involves determining the availability and quantities required of staff and material needed to perform schedule activities. It is closely coordinated with cost estimating. Activity duration estimates (Section 6.4.3.1) will affect cost estimates on any project where the project budget includes an allowance for the cost of financing (including interest charges) and where resources are applied per unit of time for the duration of the activity. Activity duration estimates can also affect cost estimates that have time- sensitive costs included in them,

such as union labor with regularly expiring collective bargaining agreements or materials with seasonal cost variations.

7.1.1.3 Human Resource Plan (9.1)

7.1.1.4 Risk Register (11.2)

7.1.1.5 Enterprise Environmental Factors

The enterprise environmental factors that influence the Estimate Costs process include, but are not limited to:

• **Market conditions.** Market conditions describe what products, services, and results are available in the market, from whom, and under what terms and conditions. Regional and/or global supply and demand conditions greatly influence resource costs.

• **Published commercial information.** Resource cost rate information is often available from commercial databases that track skills and human resource costs, and provide standard costs for material and equipment. Published seller price lists are another source of information.

7.1.1.6 Organizational Process Assets

The organizational process assets that influence the Estimate Costs process include but are not limited to:

• Cost estimating policies,

• Cost estimating templates,

• Historical information, and

• Lessons learned.

7.1.2 T & T

7.1.2.1 Expert Judgment

Cost estimates are influenced by numerous variables such as labor rates, material costs, inflation, risk factors and other variables. Expert judgment, guided by historical information, provides valuable insight about the environment and information from prior similar projects. Expert judgment can also be used to determine whether to combine methods of estimating and how to reconcile differences between them.

7.1.2.2 Analogous Estimating

See document: analogous-estimating

Analogous cost estimating uses the values of parameters, such as scope, cost, budget, and duration or measures of scale such as size, weight, and complexity, from a previous, similar project, as the basis for estimating the same parameter or measure for a current project. When estimating costs, this technique relies on the actual cost of previous, similar projects as the basis for estimating the cost of the current project. It is a gross

value estimating approach, sometimes adjusted for known differences in project complexity.

Analogous cost estimating is frequently used to estimate a parameter when there is a limited amount of detailed information about the project, for example, in the early phases of a project. Analogous cost estimating uses historical information and expert judgment.

Analogous cost estimating is generally less costly and time consuming than other techniques, but it is also generally less accurate. Analogous cost estimates can be applied to a total project or to segments of a project, used in conjunction with other estimating methods. Analogous estimating is most reliable when the previous projects are similar in fact and not just in appearance, and the project team members preparing the estimates have the needed expertise.

7.1.2.3 Parametric Estimating

See document: parametric-estimating

Parametric estimating uses a statistical relationship between historical data and other variables (e.g., square footage in construction) to calculate an estimate for activity parameters, such as cost, budget, and duration. This technique can produce higher levels of accuracy depending upon the sophistication and underlying data built into the model. Parametric cost estimates can be applied to a total project or to segments of a project, in conjunction with other estimating methods.

7.1.2.4 Bottom-Up Estimating

See document: bottom-up-estimating-technique

Bottom-up estimating is a method of estimating a component of work. The cost of individual work packages or activities is estimated with the greatest level of specified detail. The detailed cost is then summarized or "rolled up" to higher levels for subsequent reporting and tracking purposes. The cost and accuracy of bottom-up cost estimating is typically influenced by the size and complexity of the individual activity or work package.

7.1.2.5 Three-Point Estimates

See document: Three-point_estimation

The accuracy of single-point activity cost estimates can be improved by considering estimation uncertainty and risk. This concept originated with the Program Evaluation and Review Technique (PERT). PERT uses three estimates to define an approximate range for an activity's cost:

• **Most likely (cM)**. The cost of the activity, based on realistic effort assessment for the required work and any predicted expenses.

• **Optimistic (cO)**. The activity cost based on analysis of the best-case scenario for the activity.

• **Pessimistic (cP)**. The activity cost based on analysis of the worst-case scenario for the activity.

PERT analysis calculated an **Expected (cE)** activity cost using a weighted average of these three estimates:

$$cE = \frac{cO + 4cM + cP}{6}$$

Cost estimates based on this equation (or even on a simple average of the three points) may provide a more accuracy, and the three points clarify the range of uncertainty of the cost estimates.

7.1.2.6 Reserve Analysis

See document: reserve-analysis

Cost estimates may include contingency reserves (sometimes called contingency allowances) to account for cost uncertainty. The contingency reserve may be a percentage of the estimated cost, a fixed number, or may be developed by using quantitative analysis methods.

As more precise information about the project becomes available the contingency reserve may be used, reduced or eliminated. Contingency should be clearly identified in schedule documentation. Contingency reserves are part of the funding requirements.

7.1.2.7 Cost of Quality (COQ)

See also: Cost of Quality (COQ)

7.1.2.8 Project Management Estimating Software

See document: Project_management_software

Project management cost estimating software applications, computerized spreadsheets, simulation, and statistical tools are becoming more widely accepted to assist with cost estimating. Such tools can simplify the use of some cost estimating techniques and thereby facilitate rapid consideration of cost estimate alternatives.

7.1.2.9 Vendor Bid Analysis

See document: Vendor-Bid-Analysis.html

Cost estimating methods may include analysis of what the project should cost, based on the responsive bids from qualified vendors. Where projects are awarded to a vendor under competitive processes, additional cost estimating work can be required of the project team to examine the price of individual deliverables and to derive a cost that supports the final total project cost.

7.1.3 Outputs

7.1.3.1 Activity Cost Estimates

Activity cost estimates are quantitative assessments of the probable costs required to complete project work. Cost estimates can be presented in summary form or in detail. Costs are estimated for all resources that are applied to the activity cost estimate. This

includes, but is not limited to, direct labor, materials, equipment, services, facilities, information technology, and special categories such as an inflation allowance or a cost contingency reserve. Indirect costs, if they are included in the project estimate, can be included at the activity level or at higher levels.

7.1.3.2 Basis of Estimates

The amount and type of additional details supporting the cost estimate vary by application area. Regardless of the level of detail, the supporting documentation should provide a clear and complete understanding of how the cost estimate was derived.

Supporting detail for activity cost estimates may include:

• Documentation of the basis of the estimate (i.e., how it was developed),

• Documentation of all assumptions made,

• Documentation of any known constraints,

• Indication of the range of possible estimates (e.g., $10,000 (±10%) to indicate that the item is expected to cost between a range of values), and

• Indication of the confidence level of the final estimate.

7.1.3.3 Project Document Updates

Project documents that may be updated include, but are not limited to, the risk register.

7.2 Determine Budget

See attachment(s): 7.2.JPG

7.2.1 Inputs

7.2.1.1 Activity Cost Estimates

See also: Activity Cost Estimates

7.2.1.2 Basis of Estimates

See also: Basis of Estimates

7.2.1.3 Scope Baseline

See also: Scope Baseline

• **Scope Statement.** Formal limitations by period for the expenditure of project funds can be mandated by the organization, by contract (Section 12.2.3.2) or by other entities such as government agencies. These funding constraints are reflected in the project scope statement.

• **Work breakdown structure.** The project WBS (Section 5.3.3.1) provides the relationships among all the project deliverables and their various components.

• **WBS dictionary.** The WBS dictionary (Section 5.3.3.2) and related detailed statements of work provide an identification of the deliverables and a description of the work in each WBS component required to produce each deliverable.

7.2.1.4 Project Schedule

See also: Project Schedule

7.2.1.5 Resource Calendars

See also: Resource Calendars

7.2.1.6 Contracts

See also: Procurement Contract Award

7.2.1.7 Organizational Process Assets

The organizational process assets that influence the Determine Budget process include, but are not limited to:

• Existing formal and informal cost budgeting-related policies, procedures, and guidelines,

• Cost budgeting tools, and

• Reporting methods.

7.2.2 T & T

7.2.2.1 Cost Aggregation

Cost estimates are aggregated by work packages in accordance with the WBS. The work package cost estimates are then aggregated for the higher component levels of the WBS (such as control accounts) and ultimately for the entire project.

7.2.2.2 Reserve Analysis

See document: reserve-analysis

Budget reserve analysis can establish both the contingency reserves and the management reserves for the project. Contingency reserves are allowances for unplanned but potentially required changes that can result from realized risks identified in the risk register. Management reserves are budgets reserved for unplanned changes to project scope and cost. The project manager may be required to obtain approval before obligating or spending management reserve. Reserves are not a part of the project cost baseline, but may be included in the total budget for the project. They are not included as a part of the earned value measurement calculations.

7.2.2.3 Expert Judgment

Judgment provided based upon expertise in an application area, knowledge area, discipline, industry, etc., as appropriate for the activity being performed should be used in determining the budget. Such expertise may be provided by any group or person with

specialized education, knowledge, skill, experience, or training. Expert judgment is available from many sources, including, but not limited to:

• Other units within the performing organization,

• Consultants,

• Stakeholders, including customers,

• Professional and technical associations, and

• Industry groups.

7.2.2.4 Historical Relationships

Any historical relationships that result in parametric estimates or analogous estimates involve the use of project characteristics (parameters) to develop mathematical models to predict total project costs. Such models can be simple (e.g., residential home construction is based on a certain cost per square foot of space) or complex (e.g., one model of software development costing uses multiple separate adjustment factors, each of which has numerous points within it).

Both the cost and accuracy of analogous and parametric models can vary widely. They are most likely to be reliable when:

• Historical information used to develop the model is accurate,

• Parameters used in the model are readily quantifiable, and

• Models are scalable, such that they work for a large project, a small project, and phases of a project.

7.2.2.5 Funding Limit Reconciliation

The expenditure of funds should be reconciled with any funding limits on the commitment of funds for the project. A variance between the funding limits and the planned expenditures will sometimes necessitate the rescheduling of work to level out the rate of expenditures. This can be accomplished by placing imposed date constraints for work into the project schedule.

7.2.3 Outputs

7.2.3.1 Cost Performance Baseline

The cost performance baseline is an authorized time-phased budget at completion (BAC) used to measure, monitor, and control overall cost performance on the project. It is developed as a summation of the approved budgets by time period and is typically displayed in the form of an S-curve, as is illustrated in Figure 7-6. In the earned value management technique the cost performance baseline is referred to as the performance measurement baseline (PMB).

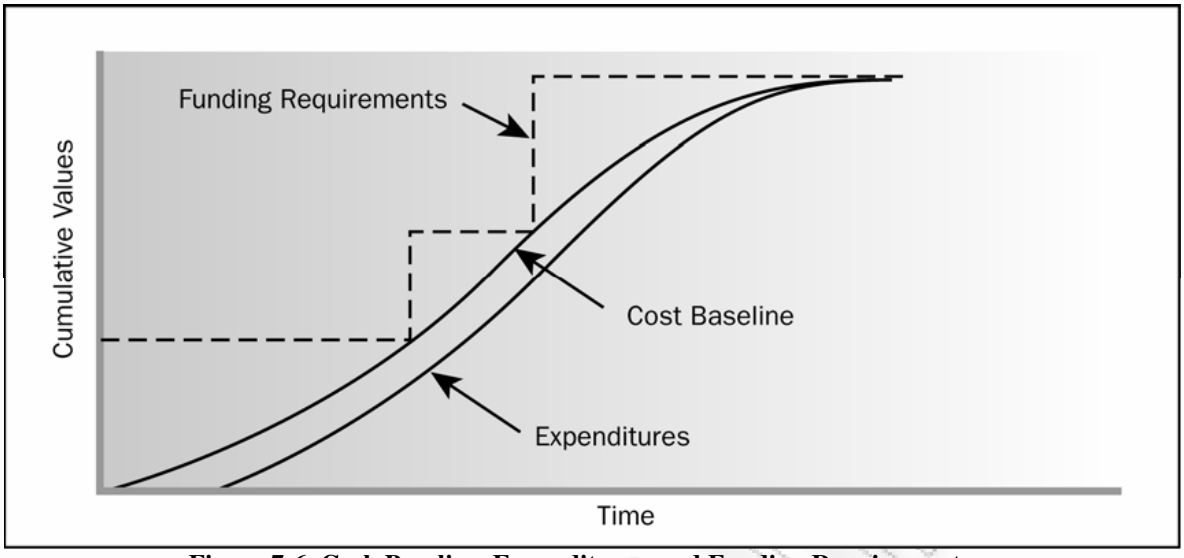

Figure 7-6. Cash Baseline, Expenditures, and Funding Requirements

7.2.3.2 Project Funding Requirements

Total funding requirements and periodic funding requirements (e.g., quarterly, annually) are derived from the cost baseline. The cost baseline will include projected expenditures plus anticipated liabilities. Funding often occurs in incremental amounts that are not continuous, which appear as steps as shown in Figure 7-6. The total funds required are those included in the cost baseline, plus management reserves, if any.

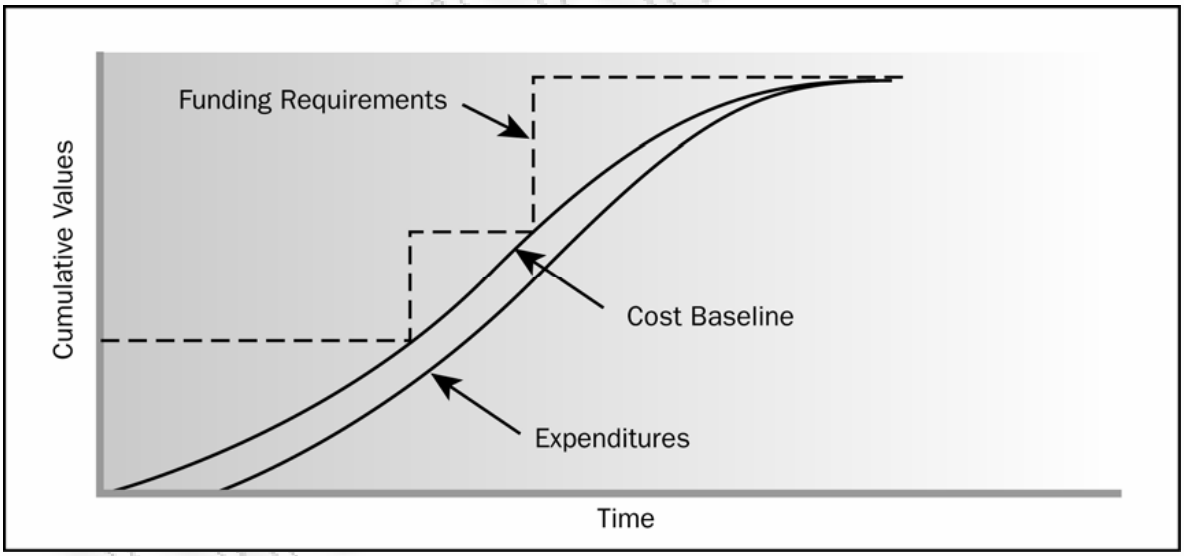

Figure 7-6. Cash Baseline, Expenditures, and Funding Requirements

7.2.3.3 Project Document Updates

Project documents that may be updated include but are not limited to:

• Risk register,

• Cost estimates, and Project schedule.

7.3 Control Costs

See attachment(s): 7.3.JPG

7.3.1 Inputs

7.3.1.1 Project Management Plan

See also: Project Management Plan

The project management plan described in Section 4.2.3.1 contains the following information that is used to control cost:

• **Cost Performance baseline.** The cost performance baseline is compared with actual results to determine if a change, corrective action or preventive action is necessary.

• **Cost management plan.** The cost management plan describes how the project costs will be managed and controlled (Introduction to Chapter 7).

7.3.1.2 Project Funding Requirements

See also: Project Funding Requirements

7.3.1.3 Work Performance Information

See also: Work Performance Information

Work performance information includes information about project progress, such as which deliverables have started, their progress and which deliverables have finished. Information also includes costs that have been authorized and incurred, and estimates for completing project work.

7.3.1.4 Organizational Process Assets

The organizational process assets that can influence the Control Costs process include, but are not limited to:

• Existing formal and informal cost control-related policies, procedures, and guidelines;

• Cost control tools; and

• Monitoring and reporting methods to be used.

7.3.2 T & T

7.3.2.1 Earned Value Measurement (EVM)

See document: Earned_value_management

Earned value measurement (EVM) in its various forms is a commonly used method of performance measurement. It integrates project scope, cost, and schedule measures to help the project management team assess and measure project performance and progress. It is a project management technique that requires the formation of an integrated baseline against which performance can be measured for the duration of the project. The principles of EVM can be applied to all projects, in any industry. EVM develops and monitors three key dimensions for each work package and control account:

• **Planned value.** Planned value (PV) is the authorized budget assigned to the work to be accomplished for an activity or work breakdown structure component. It includes the detailed authorized work, plus the budget for such authorized work, allocated by phase over the life of the project. The total of the PV is sometimes referred to as the performance measurement baseline (PMB). The total planned value for the project is also known as Budget At Completion (BAC).

• **Earned value.** Earned value (EV) is the value of work performed expressed in terms of the approved budget assigned to that work for an activity or work breakdown structure component. It is the authorized work that has been completed, plus the authorized budget for such completed work. The EV being measured must be related to the PV baseline (PMB), and the EV measured cannot be greater than the authorized PV budget for a component. The term EV is often used to describe the percentage completion of a project. A progress measurement criteria should be established for each WBS component to measure work in progress. Project managers monitor EV, both incrementally to determine current status and cumulatively to determine the long-term performance trends.

• **Actual cost.** Actual cost (AC) is the total cost actually incurred and recorded in accomplishing work performed for an activity or work breakdown structure component. It is the total cost incurred in accomplishing the work that the EV measured. The AC has to correspond in definition to whatever was budgeted for in the PV and measured in the EV (e.g., direct hours only, direct costs only, or all costs including indirect costs). The AC will have no upper limit; whatever is spent to achieve the EV will be measured. Variances from the approved baseline will also be monitored:

• **Schedule variance.** Schedule variance (SV) is a measure of schedule performance on a project. It is equal to the earned value (EV) minus the planned value (PV). The EVM schedule variance is a useful metric in that it can indicate a project falling behind its baseline schedule. The EVM schedule variance will ultimately equal zero when the project is completed because all of the planned values will have been earned. EVM SVs are best used in conjunction with critical path methodology (CPM) scheduling and risk management. Equation: SV = EV – PV.

• **Cost variance.** Cost variance (CV) is a measure of cost performance on a project. It is equal to the earned value (EV) minus the actual costs (AC). The cost variance at the end of the project will be the difference between the budget at completion (BAC) and the actual amount spent. The EVM CV is particularly critical because it indicates the relationship of physical performance to the costs spent. Any negative EVM CV is often non-recoverable to the project. Equation: CV= EV – AC.

The SV and CV values can be converted to efficiency indicators to reflect the cost and schedule performance of any project for comparison against all other projects or within a portfolio of projects. The variances and indices are useful for determining project status and providing a basis for estimating project cost and schedule outcome.

• **Schedule performance index.** The schedule performance index (SPI) is a measure of progress achieved compared to progress planned on a project. It is sometimes used in conjunction with the cost performance index (CPI) to forecast the final project completion estimates. An SPI value less than 1.0 indicates less work was completed than

was planned. An SPI greater than 1.0 indicates that more work was completed than was planned. Since the SPI measures all project work, the performance on the critical path must also be analyzed to determine whether the project will finish ahead of or behind its planned finish date. The SPI is equal to the ratio of the EV to the PV. Equation: SPI = EV/PV.

• **Cost performance index.** The cost performance index (CPI) is a measure of the value of work completed compared to the actual cost or progress made on the project. It is considered the most critical EVM metric and measures the cost efficiency for the work completed. A CPI value less than 1.0 indicates a cost overrun for work completed. A CPI value greater than 1.0 indicates a cost underrun of performance to date. The CPI is equal to the ratio of the EV to the AC. Equation: CPI = EV/AC.

The three parameters of planned value, earned value, and actual cost can be monitored and reported on both a period- by-period basis (typically weekly or monthly) and on a cumulative basis. Figure 7-9 uses S-curves to display EV data for a project that is performing over budget and behind the work plan.

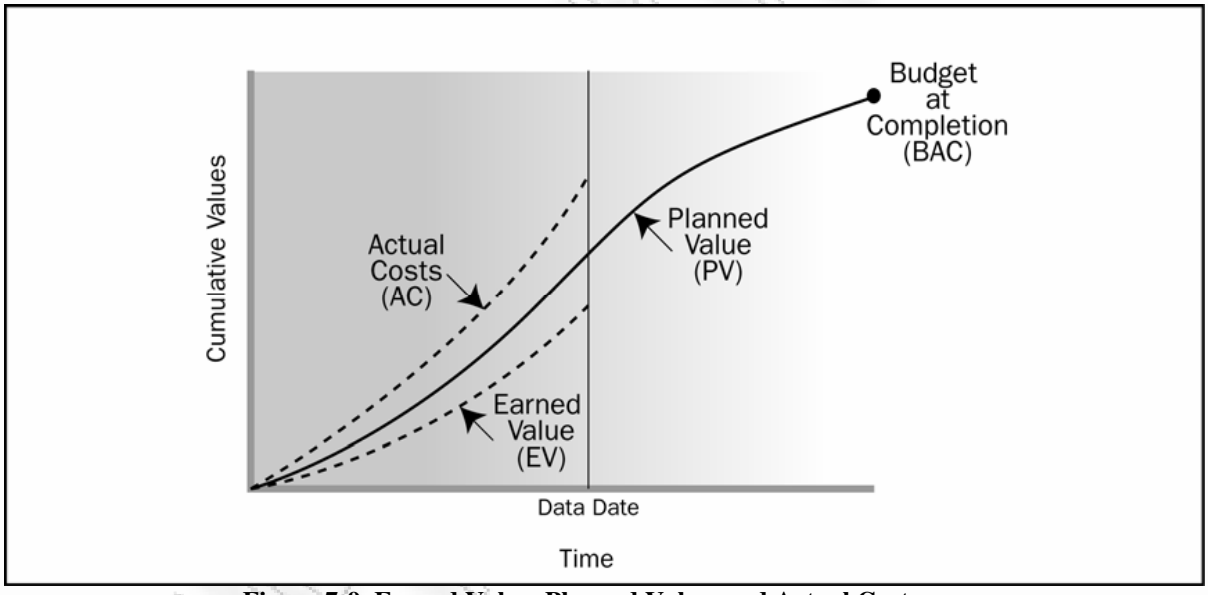

Figure 7-9. Earned Value, Planned Value, and Actual Costs

7.3.2.2 Forecasting

See document: forecasts

As the project progresses, the project team can develop a forecast for the estimate at completion (EAC) that may differ from the budget at completion (BAC) based on the project performance. If it becomes obvious that the BAC is no longer viable, the project manager should develop a forecasted EAC. Forecasting the EAC involves making estimates or predictions of conditions and events in the project's future based on information and knowledge available at the time of the forecast. Forecasts are generated, updated, and reissued based on work performance information (Section 4.3.3.2) provided as the project is executed. The work performance information covers the

project's past performance and any information that could impact the project in the future.

EACs are typically based on the actual costs incurred for work completed, plus an estimate to complete (ETC) the remaining work. It is incumbent on the project team to predict what it may encounter to perform the ETC, based on its experience to date. The EVM method works well in conjunction with manual forecasts of the required EAC costs. The most common EAC forecasting approach is a manual, bottom-up summation by the project manager and project team.

The project manager's bottom-up EAC method builds upon the actual costs and experience incurred for the work completed, and requires a new estimate to complete the remaining project work. This method may be problematic in that it interferes with the conduct of project work. The personnel who are performing the project work have to stop working to provide a detailed bottom-up ETC of the remaining work. Typically there is no separate budget to perform the ETC, so additional costs are incurred for the project to conduct the ETC. Equation: EAC = AC + bottom-up ETC.

The project manager's manual EAC can be quickly compared with a range of calculated EACs representing various risk scenarios. While EVM data can quickly provide many statistical EACs, only three of the more common methods are described as follows:

• **EAC forecast for ETC work performed at the budgeted rate.** This EAC method accepts the actual project performance to date (whether favorable or unfavorable) as represented by the actual costs, and predicts that all future ETC work will be accomplished at the budgeted rate. When actual performance is unfavorable, the assumption that future performance will improve should be accepted only when supported by project risk analysis. Equation: EAC = AC + BAC – EV.

• **EAC forecast for ETC work performed at the present CPI.** This method assumes what the project has experienced to date can be expected to continue in the future. The ETC work is assumed to be performed at the same cumulative cost performance index (CPI) as that incurred by the project to date. Equation: EAC = BAC / cumulative CPI.

• **EAC forecast for ETC work considering both SPI and CPI factors.** In this forecast, the ETC work will be performed at an efficiency rate that considers both the cost and schedule performance indices. It assumes both a negative cost performance to date, and a requirement to meet a firm schedule commitment by the project. This method is most useful when the project schedule is a factor impacting the ETC effort. Variations of this method weigh the CPI and SPI at different values (e.g., 80/20, 50/50, or some other ratio) according to the project manager's judgment. Equation: AC + [(BAC – EV) / (cumulative CPI x cumulative SPI)].

Each of these approaches can be correct for any given project and will provide the project management team with an "early warning" signal if the EAC forecasts are not within acceptable tolerances.

7.3.2.3 To-Complete Performance Index (TCPI)

The to-complete performance index (TCPI) is the calculated projection of cost performance that must be achieved on the remaining work to meet a specified management goal, such as the BAC or the EAC. If it becomes obvious that the BAC is no longer viable, the project manager develops a forecasted estimate at completion (EAC). Once approved, the EAC effectively supersedes the BAC as the cost performance goal. Equation for the TCPI based on the BAC: (BAC – EV) / (BAC – AC).

The TCPI is conceptually displayed in 7-10. The equation for the TCPI is shown in the lower left as the work remaining (defined as the BAC minus the EV) divided by the funds remaining (which can be either the BAC minus the AC, or the EAC minus the AC).

If the cumulative CPI falls below the baseline plan (as shown in Figure 7- 6), all future work of the project will need to immediately be performed in the range of the TCPI (BAC) (as reflected in the top line of Figure 7-6) to stay within the authorized BAC. Whether this level of performance is achievable is a judgment call based on a number of considerations, including risks, schedule, and technical performance. Once management acknowledges that the BAC is no longer attainable, the project manager will prepare a new estimate at completion (EAC) for the work, and once approved, the project will work to the new EAC value. This level of performance is displayed as the TCPI (EAC) line. The equation for the TCPI based on the EAC: (BAC – EV) / (EAC – AC).

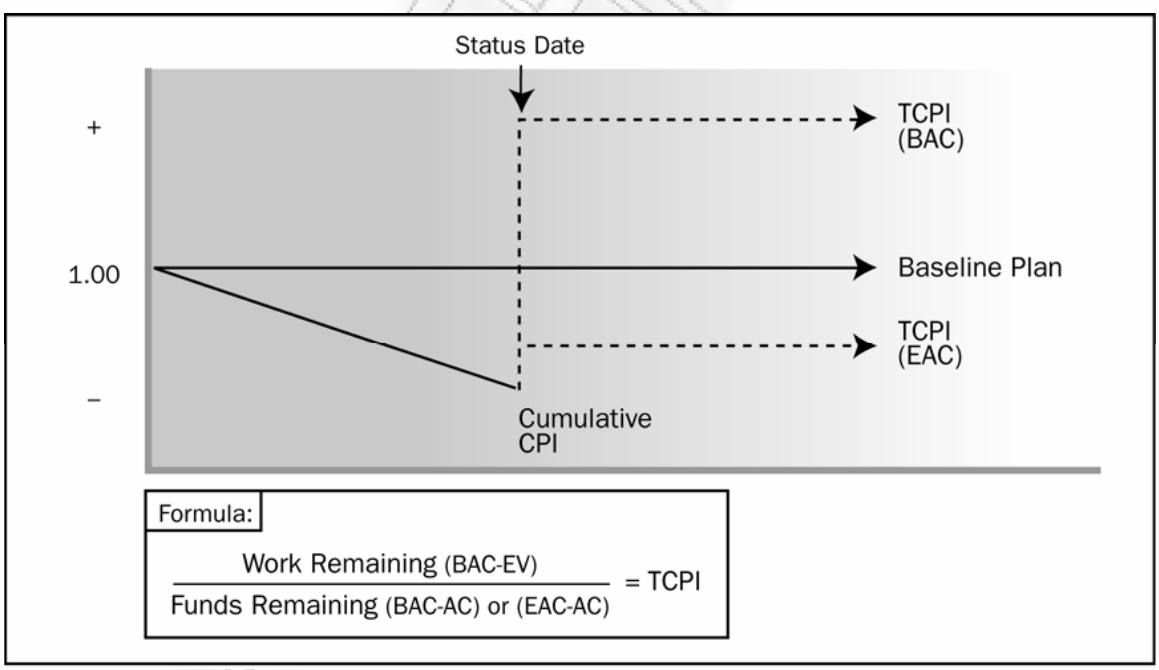

Figure 7-10. To Complete the Work Performance Index (TCPI)

For additional info, you can check in the following links:

http://www.aof.mod.uk/aofcontent/tactical/ppm/content/evm/tcpi.htm

http://guidebook.dcma.mil/79/evhelp/var.htm#To%20Complete%20Performance%20Index%20(TCPI)

http://www.pmforum.org/library/second-edition/2009/PDFs/june/Fleming-Koppelman-EVM-paper.pdf

7.3.2.4 Performance Reviews

Performance reviews compare cost performance over time, schedule activities or work packages overrunning and under running the budget, and estimated funds needed to complete work in progress. If EVM is being used the following information is determined:

• **Variance analysis.** Variance analysis as used in EVM compares actual project performance to planned or expected performance. Cost and schedule variances are the most frequently analyzed.

• **Trend analysis.** Trend analysis examines project performance over time to determine if performance is improving or deteriorating. Graphical analysis techniques are valuable for understanding performance to date and for comparison to future performance goals in the form of BAC versus EAC and completion dates.

• **Earned value performance.** Earned value management compares the baseline plan to actual schedule and cost performance.

7.3.2.5 Variance Analysis

See document: Variance_analysis

Cost performance measurements (CV, CPI) are used to assess the magnitude of variation to the original cost baseline. Important aspects of project cost control include determining the cause and degree of variance relative to the cost performance baseline (Section 7.2.3.1) and deciding whether corrective or preventive action is required. The percentage range of acceptable variances will tend to decrease as more work is accomplished. The larger percentage variances allowed at the start of the project can decrease as the project nears completion.

7.3.2.6 Project Management Software

See document: Project_management_software

Project management software is often used to monitor the three EVM dimensions (PV, EV, and AC), to display graphical trends, and to forecast a range of possible final project results.

7.3.3 Outputs

7.3.3.1 Work Performance Measurements

See also: Work Performance Measurements

The calculated CV, SV, CPI, and SPI values for WBS components, in particular the work packages and control accounts, are documented and communicated to stakeholders.

7.3.3.2 Budget Forecasts

Either a calculated EAC value or a bottom-up EAC value is documented and communicated to stakeholders.

7.3.3.3 Organizational Process Assets Updates

Organizational process assets that may be updated include, but are not limited to:

- Causes of variances,
- Corrective action chosen and the reasons, and
- Other types of lessons learned from project cost control.

7.3.3.4 Change Requests

See also: Change Requests

Analysis of project performance can result in a change request to the cost performance baseline or other components of the project management plan. Change requests can include preventive or corrective actions and are processed for review and disposition through the Perform Integrated Change Control process (Section 4.5).

7.3.3.5 Project Management Plan Updates

Elements of the project management plan that may be updated include, but are not limited to:

- **Cost performance baseline.** Changes to the cost performance baseline are incorporated in response to approved changes in scope, activity resources or cost estimates. In some cases, cost variances can be so severe that a revised cost baseline is needed to provide a realistic basis for performance measurement.
- **Cost management plan.**

7.3.3.6 Project Document Updates

Project documents that may be updated include, but are not limited to:

- Cost estimates, and
- Basis of estimates.

8 Project Quality Management

8.1 Plan Quality

See attachment(s): 8.1.JPG

8.1.1 Inputs

8.1.1.1 Scope Baseline

See also: Scope Baseline

• **Scope statement.** The scope statement contains the project description, major project deliverables, and acceptance criteria. The product scope description will often contain details of technical issues and other concerns that can affect quality planning. The definition of acceptance criteria can significantly increase or decrease project costs quality costs. Satisfying all acceptance criteria implies the needs of the customer have been met.

• **WBS.** The WBS identifies the deliverables, the work packages and the control accounts used to measure project performance.

• **WBS Dictionary.** The WBS dictionary defines technical information for WBS elements.

8.1.1.2 Stakeholder Register

See also: Stakeholder Register

8.1.1.3 Cost Performance Baseline

See also: Cost Performance Baseline

8.1.1.4 Schedule Baseline

See also: Schedule Baseline

8.1.1.5 Risk Register

See also: Risk Register

8.1.1.6 Enterprise Environmental Factors

The enterprise environmental factors that influence the Plan Quality process include, but are not limited to:

• Governmental agency regulations,

• Rules, standards, and guidelines specific to the application area, and

• Working/operating conditions of the project/product which may affect project quality.

8.1.1.7 Organizational Process Assets

The organizational process assets that influence the Plan Quality process include, but are not limited to:

• Organizational quality policies, procedures, and guidelines,

• Historical databases,

• Lessons learned from previous projects, and

• Quality policy, as endorsed by senior management, which sets the intended direction of a performing organization with regard to quality. The quality policy of the performing organization for their products often can be adopted "as is" for use by the project. If the performing organization lacks a formal quality policy, or if the project involves multiple performing organizations (as with a joint venture), the project management team will need to develop a quality policy for the project. Regardless of the origin of the quality policy, the project management team must ensure that the project stakeholders are fully aware of the policy used for the project through the appropriate distribution of information.

8.1.2 T & T

8.1.2.1 Cost-Benefit Analysis

See document: Cost-benefit_Analysis

The primary benefits of meeting quality requirements can include less rework, higher productivity, lower costs, and increased stakeholder satisfaction. A business case for each quality activity compares the cost of the quality step to the expected benefit.

8.1.2.2 Cost of Quality (COQ)

See document: Cost_of_quality

Cost of quality includes all costs incurred over the life of the product by investment in preventing nonconformance to requirements, appraising the product or service for conformance to requirements, and failing to meet requirements (rework). Failure costs are often categorized into internal (found by the project) and external (found by the customer). Failure costs are also called cost of poor quality. Figure 8-4 provides some examples to consider in each area.

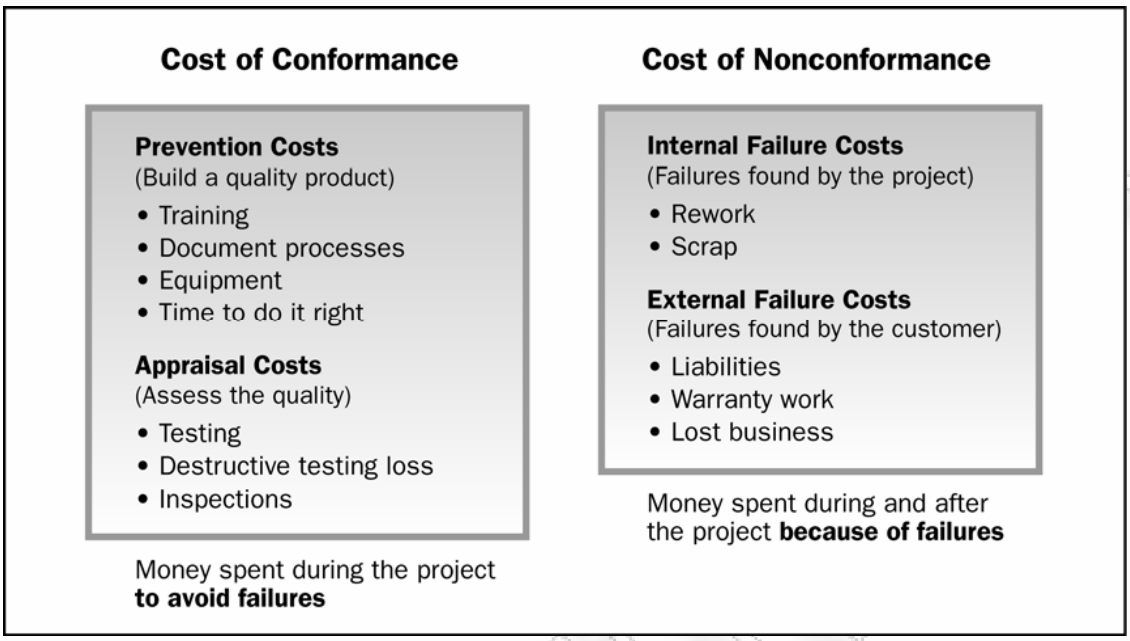

Figure 8-4. Costs of Quality

8.1.2.3 Control Charts

See document: Control_chart

Control charts are used to determine whether or not a process is stable or has predictable performance. Upper and lower specification limits are based on requirements of the contract. They reflect the maximum and minimum values allowed. There may be penalties associated with exceeding the specification limits. Upper and lower control limits are set by the project manager and appropriate stakeholders to reflect the points at which corrective action will be taken to prevent exceeding specification limits. For repetitive processes, the control limits are generally ± 3Σ. A process is considered out of control when a data point exceeds a control limit or if seven consecutive points are above or below the mean.

Control charts can be used to monitor various types of output variables. Although used most frequently to track repetitive activities required for producing manufactured lots, control charts may also be used to monitor cost and schedule variances, volume and frequency of scope changes, or other management results to help determine if the project management processes are in control. Figure 8-5 shows a control chart that tracks recorded project hours. Figure 8-6 shows measured product defects compared to fixed limits.

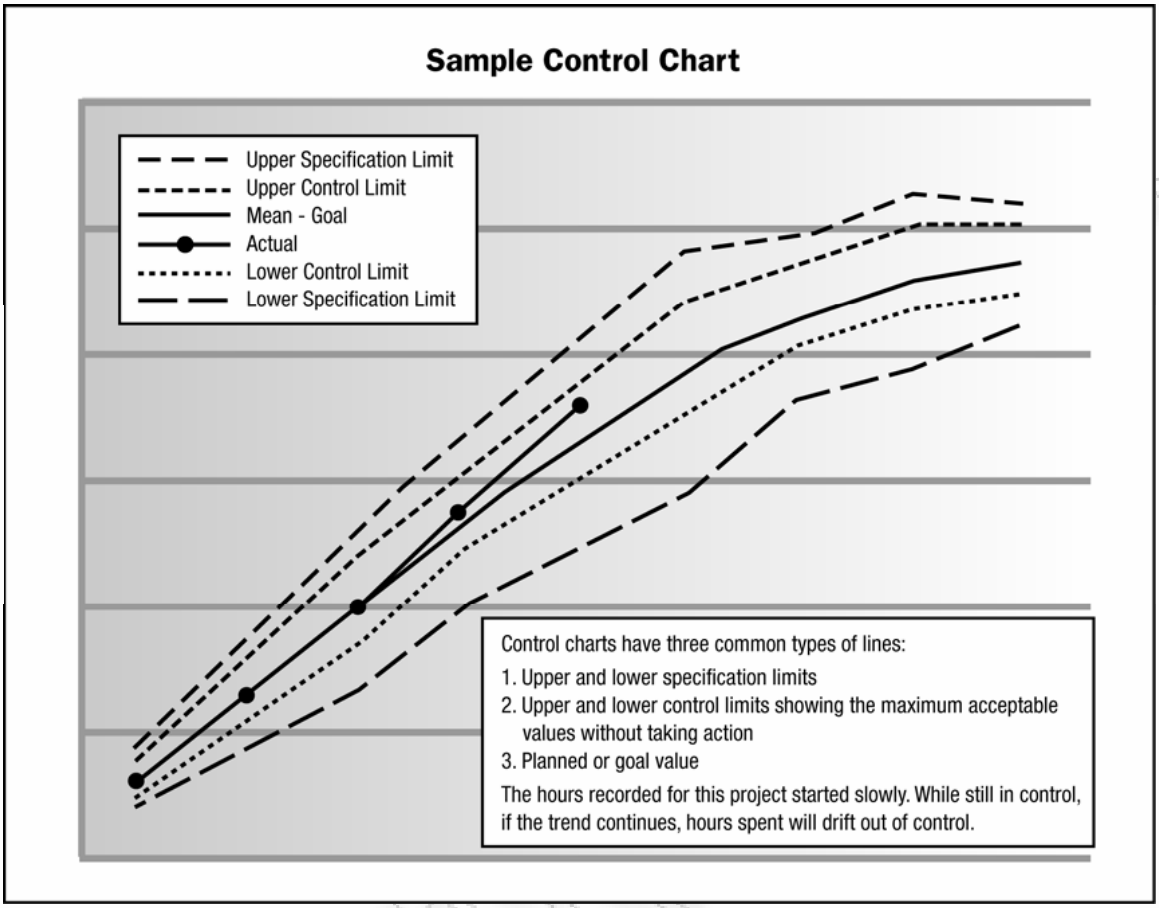

Figure 8-5. Sample Control Chart

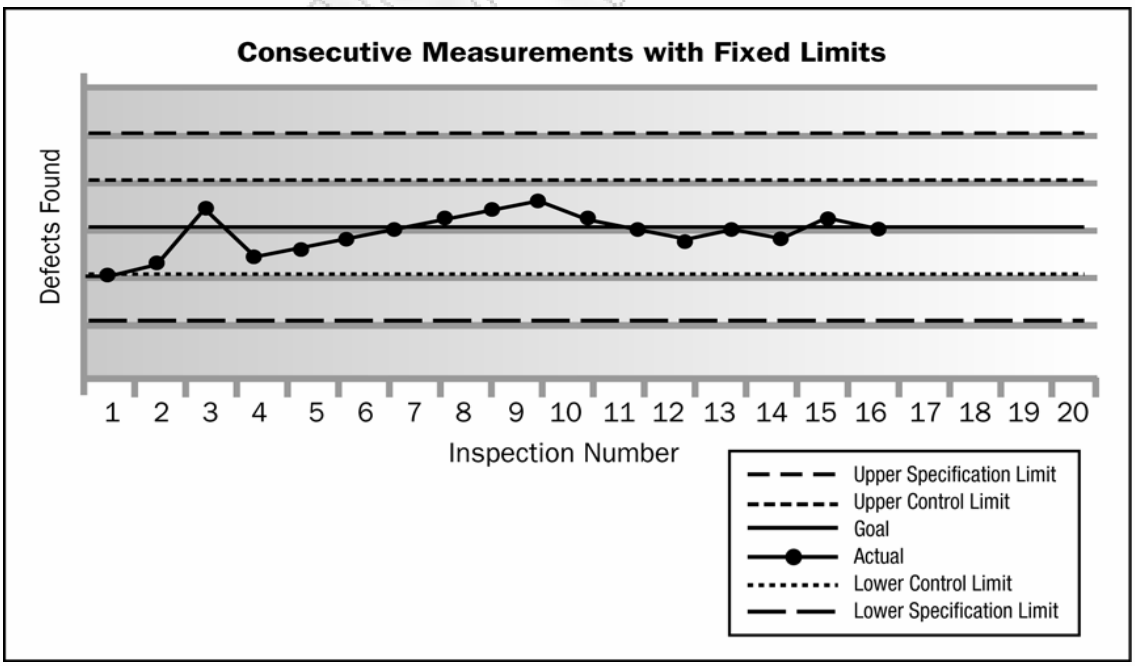

Figure 8-6. Control Chart of Consecutive Measurements with Fixed Limits

8.1.2.4 Benchmarking

See document: Benchmarking

Benchmarking involves comparing actual or planned project practices to those of comparable projects to identify best practices, generate ideas for improvement, and provide a basis for measuring performance. These other projects can be within the performing organization or outside of it and can be within the same or in another application area.

8.1.2.5 Design of Experiments

See document: Design_of_Experiments

Design of experiments (DOE) is a statistical method for identifying which factors may influence specific variables of a product or process under development or in production. DOE should be used during the Plan Quality process to determine the number and type of tests and their impact on cost of quality.

DOE also plays a role in the optimization of products or processes. DOE can be used to reduce the sensitivity of product performance to sources of variations caused by environmental or manufacturing differences. One important aspect of this technique is that it provides a statistical framework for systematically changing all of the important factors, rather than changing the factors one at a time. Analysis of the experimental data should provide the optimal conditions for the product or process, highlight the factors that influence the results, and reveal the presence of interactions and synergy among the factors. For example, automotive designers use this technique to determine which combination of suspension and tires will produce the most desirable ride characteristics at a reasonable cost.

8.1.2.6 Statistical Sampling

See document: Statistical_sampling

Statistical sampling involves choosing part of a population of interest for inspection (for example, selecting ten engineering drawings at random from a list of seventy-five). Sample frequency and sizes should be determined during the Plan Quality process so the cost of quality will include the number of tests, expected scrap, etc.

There is a substantial body of knowledge on statistical sampling. In some application areas it may be necessary for the project management team to be familiar with a variety of sampling techniques to assure the sample selected actually represents the population of interest.

8.1.2.7 Flowcharting

See document: Flowchart

A flowchart is a graphical representation of a process showing the relationships among process steps. There are many styles, but all process flowcharts show activities, decision points, and the order of processing. During quality planning, flowcharting can help the project team anticipate quality problems that might occur. An awareness of potential problems can result in the development of test procedures or approaches for dealing with them. Figure 8-7 is an example of a process flowchart for design reviews.

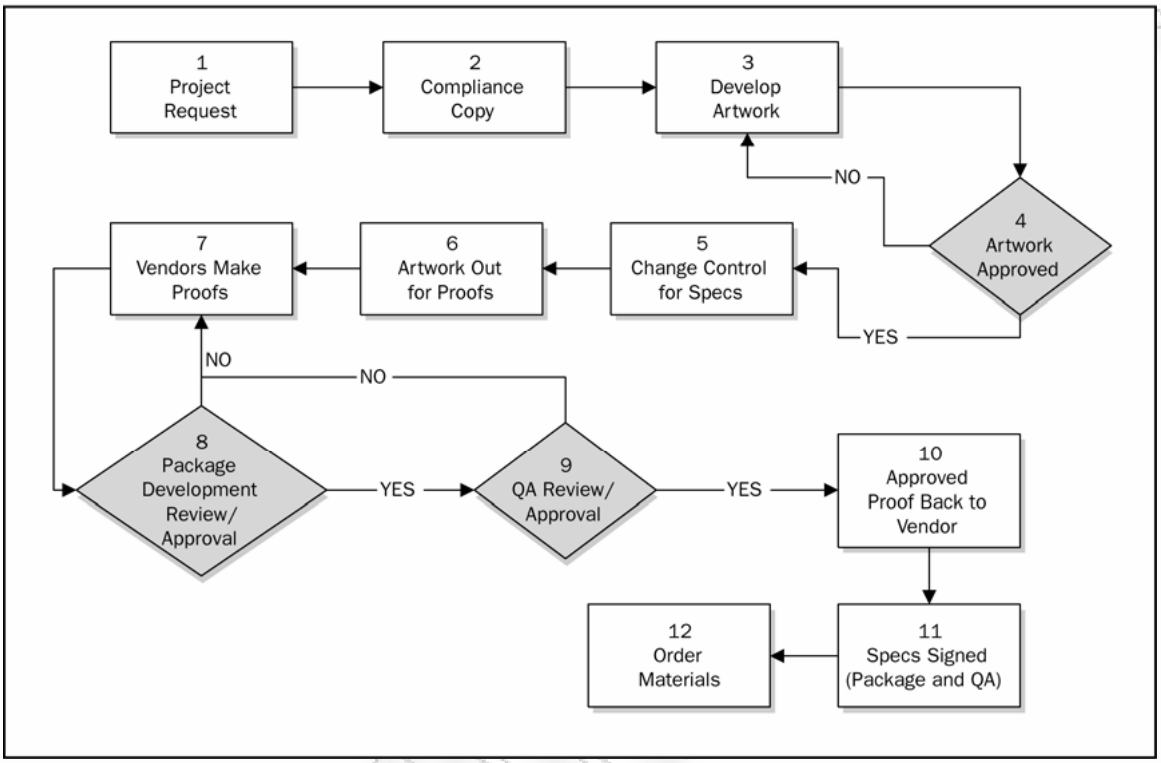

Figure 8-7. Process Flowchart

8.1.2.8 Proprietary Quality Management Methodologies

These include Six Sigma, Lean Six Sigma, Quality Function Deployment, CMMI®, etc. Many other methodologies exist—this is not intended to be a recommended or complete list of examples.

For additional info, you can check in the following links:

http://en.wikipedia.org/wiki/Six_Sigma

http://en.wikipedia.org/wiki/Quality_Function_Deployment

http://en.wikipedia.org/wiki/CMMI

8.1.2.9 Additional Quality Planning Tools

See document: Seven_Management_and_Planning_Tools

Other quality planning tools are often used to better define the quality requirements and plan effective quality management activities. These include, but are not limited to:

• Brainstorming (defined in Section 11.2.2.2).

• Affinity diagrams, used to visually identify logical groupings based on natural relationships.

• Force field analysis, which are diagrams of the forces for and against change.

• Nominal group techniques, to allow ideas to be brainstormed in small groups and then reviewed by a larger group.

• Matrix diagrams, which include two, three, or four groups of information and show relationships between factors, causes, and objectives. Data in a matrix is organized in rows and columns with intersecting cells that can be filled with information that describes the demonstrated relationship between the items located in the row and column.

• Prioritization matrices, which provide a way of ranking a diverse set of problems and/or issues (usually generated through brainstorming) by their importance.

For additional info, you can check in the following links:

http://en.wikipedia.org/wiki/Brainstorming

http://en.wikipedia.org/wiki/Affinity_diagram

http://en.wikipedia.org/wiki/Force_field_analysis

http://en.wikipedia.org/wiki/Nominal_group_technique

8.1.3 Outputs

8.1.3.1 Quality Management Plan

The quality management plan describes how the project management team will implement the performing organization's quality policy. It is a component or a subsidiary plan of the project management plan (Section 4.2.3.1).

The quality management plan provides input to the overall project management plan and includes quality control, quality assurance, and continuous process improvement approaches for the project.

The quality management plan may be formal or informal, highly detailed, or broadly framed. The style and detail is determined by the requirements of the project. The quality management plan should be reviewed early in the project to ensure that decisions are based on accurate information. The benefits of this review can include reduction of cost and schedule overruns caused by rework.

8.1.3.2 Quality Metrics

A quality metric is an operational definition that describes, in very specific terms, a project or product attribute and how the quality control process will measure it. A measurement is an actual value. The tolerance defines the allowable variations on the metrics. For example, a metric related to the quality objective of staying within the approved budget by ± 10% could be to measure the cost of every deliverable and determine the percent variance from the approved budget for that deliverable. Quality metrics are used in the quality assurance and quality control processes. Some examples of quality metrics include on-time performance, budget control, defect frequency, failure rate, availability, reliability, and test coverage.

8.1.3.3 Quality Checklists

A checklist is a structured tool, usually component-specific, used to verify that a set of required steps has been performed. Checklists range from simple to complex based on project requirements and practices. Many organizations have standardized checklists available to ensure consistency in frequently performed tasks. In some application areas checklists are also available from professional associations or commercial service providers. Quality checklists are used in the quality control process.

8.1.3.4 Process Improvement Plan

The process improvement plan is a subsidiary of the project management plan (Section 4.2.3.1). The process improvement plan details the steps for analyzing processes to identify activities which enhance their value. Areas to consider include:

• **Process boundaries.** Describes the purpose of processes, their start and end, their inputs/outputs, the data required, the owner, and the stakeholders.

• **Process configuration.** A graphic depiction of processes, with interfaces identified, used to facilitate analysis.

• **Process metrics.** Along with control limits, allows analysis of process efficiency.

• **Targets for improved performance.** Guides the process improvement activities.

8.1.3.5 Project Document Updates

Project documents that may be updated include, but are not limited to:

• Stakeholder register, and

• Responsibility Assignment Matrix (Section 9.1.2.1).

8.2 Perform Quality Assurance

See attachment(s): 8.2.JPG

8.2.1 Inputs

8.2.1.1 Project Management Plan

See also: Project Management Plan

The project management plan described in Section 4.2.3.1 contains the following information that is used to assure quality:

• **Quality management plan.** The quality management plan describes how quality assurance will be performed within the project.

• **Process improvement plan.** The process improvement plan details the steps for analyzing processes to identify activities which enhance their value.

8.2.1.2 Quality Metrics

See also: Quality Metrics

8.2.1.3 Work Performance Information

See also: Work Performance Information

Performance information from project activities is routinely collected as the project progresses. Performance results which may support the audit process include, but are not limited to:

• Technical performance measures,

• Project deliverables status,

• Schedule progress, and

• Costs incurred.

8.2.1.4 Quality Control Measurements

See also: Quality Control Measurements

Quality control measurements are the results of quality control activities. They are used to analyze and evaluate the quality standards and processes of the performing organization (Section 8.3.3.1).

8.2.2 T & T

8.2.2.1 Plan Quality and Perform Quality Control Tools & Techniques

T & T from: 8.1.2 -8.3.2

8.2.2.2 Quality Audits

See document: Quality_audit

A quality audit is a structured, independent review to determine whether project activities comply with organizational and project policies, processes, and procedures. The objectives of a quality audit are:

• Identify all the good/best practices being implemented,

• Identify all the gaps/shortcomings,

• Share the good practices introduced or implemented in similar projects in the organization and/or industry,

• Proactively offer assistance in a positive manner to improve implementation of processes to help the team raise productivity, and

• Highlight contributions of each audit in the lessons learned repository of the organization.

The subsequent effort to correct any deficiencies should result in a reduced cost of quality and an increase in sponsor or customer acceptance of the project's product. Quality audits may be scheduled or random and may be conducted by internal or external auditors.

Quality audits can confirm the implementation of approved change requests including corrective actions, defect repairs, and preventive actions.

8.2.2.3 Process Analysis

Process analysis follows the steps outlined in the process improvement plan to identify needed improvements. This analysis also examines problems experienced, constraints experienced, and non-value-added activities identified during process operation. Process analysis includes root cause analysis - a specific technique to identify a problem, discover the underlying causes that lead to it, and develop preventive actions.

8.2.3 Outputs

8.2.3.1 Organizational Process Assets Updates

Elements of the organizational process assets that may be updated include, but are not limited to, the quality standards.

8.2.3.2 Change Requests

See also: Change Requests

Quality improvement includes taking action to increase the effectiveness and/or efficiency of the policies, processes, and procedures of the performing organization. Change requests are created and used as input into the Perform Integrated Change Control (Section 4.5) process to allow full consideration of the recommended improvements. Change requests can be used to take corrective action or preventive action or to perform defect repair.

8.2.3.3 Project Management Plan Updates

Elements of the project management plan that may be updated include, but are not limited to:

• Quality management plan,

• Schedule management plan, and

• Cost management plan.

8.2.3.4 Project Document Updates

Project documents that may be updated include, but are not limited to:

• Quality audits reports,

• Training plans, and

• Process documentation.

8.3 Perform Quality Control

See attachment(s): 8.3.JPG

8.3.1 Inputs

8.3.1.1 Project Management Plan

See also: Project Management Plan

8.3.1.2 Quality Metrics

See also: Quality Metrics

8.3.1.3 Quality Checklists

See also: Quality Checklists

8.3.1.4 Work Performance Measurements

Outputs from: 5.5.3.1 - 6.6.3.1 - 7.3.3.1

Work performance measurements are used to produce project activity metrics to evaluate actual progress as compared to planned progress. These metrics include, but are not limited to:

• Planned vs. actual technical performance,

• Planned vs. actual schedule performance, and

• Planned vs. actual cost performance.

8.3.1.5 Approved Change Requests

As part of the Perform Integrated Change Control process a change control status update will indicate that some changes are approved and some are not. Approved change

requests can include modifications such as defect repairs, revised work methods and revised schedule. The timely implementation of approved changes needs to be verified.

8.3.1.6 Deliverables

See also: Deliverables

8.3.1.7 Organizational Process Assets

The organizational process assets that can influence the Perform Quality Control process include, but are not limited to:

- Quality standards and policies,
- Standard work guidelines, and
- Issue and defect reporting procedures and communication policies.

8.3.2 T & T

8.3.2.1 Cause and Effect Diagrams

See document: Ishikawa_diagram

Cause and effect diagrams, also called Ishikawa diagrams or fishbone diagrams, illustrate how various factors might be linked to potential problems or effects. Figures 8-12 and 8-13 are examples of cause and effect diagrams. A possible root cause can be uncovered by continuing to ask "why" or "how" along one of the lines. "Why- Why" and "How-How" diagrams may be used in root cause analysis. Cause and effect diagrams are also used in risk analysis (Section 11.2.2.5).

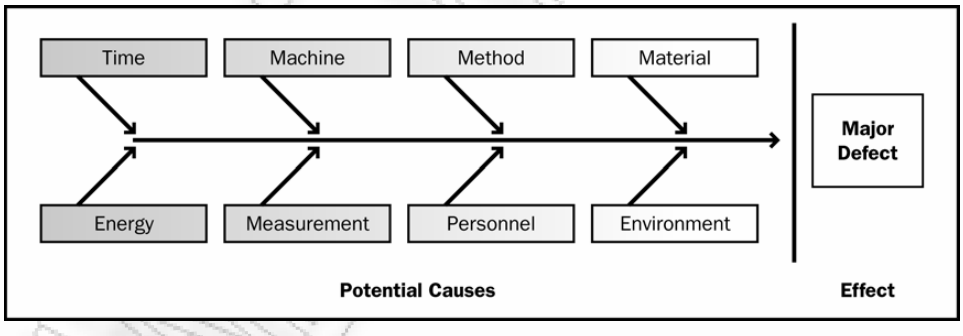

Figure 8-12 Classic Sources of Problems to Consider

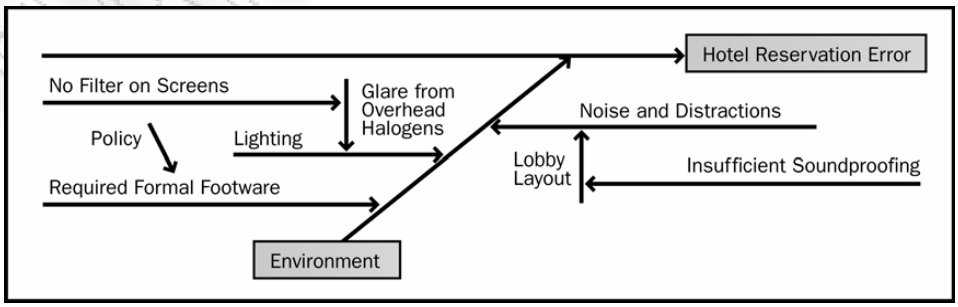

Figure 8-13 Environment Bone Expanded by Brainstorming

8.3.2.2 Control Charts

See also: Control Charts

Control charts are described in Section 8.1.2.3. In this process, the appropriate data is collected and analyzed to indicate the quality status of project processes and products. Control charts illustrate how a process behaves over time and when a process is subject to special cause variation, resulting in an out-of-control condition. They graphically answer the question: "Is this process variance within acceptable limits?" The pattern of data points on a control chart may reveal random fluctuating values, sudden process jumps, or a gradual trend in increased variation. By monitoring the output of a process over time, a control chart can help assess whether the application of process changes resulted in the desired improvements.

When a process is within acceptable limits it is in control and does not need to be adjusted. Conversely, when a process is outside acceptable limits, the process should be adjusted. Seven consecutive points outside the upper or lower control limits indicate a process that is out of control. The upper control limit and lower control limit are usually set at ±3Σ, where 1Σ is one standard deviation.

8.3.2.3 Flowcharting

See also: Flowcharting

8.3.2.4 Histogram

See document: Histogram

A histogram is a vertical bar chart showing how often a particular variable state occurred. Each column represents an attribute or characteristic of a problem/situation. The height of each column represents the relative frequency of the characteristic. This tool helps illustrates the most common cause of problems in a process by the number and relative heights of the bars. Figure 8-14 is an example of an unordered histogram showing causes of late time entry by a project team.

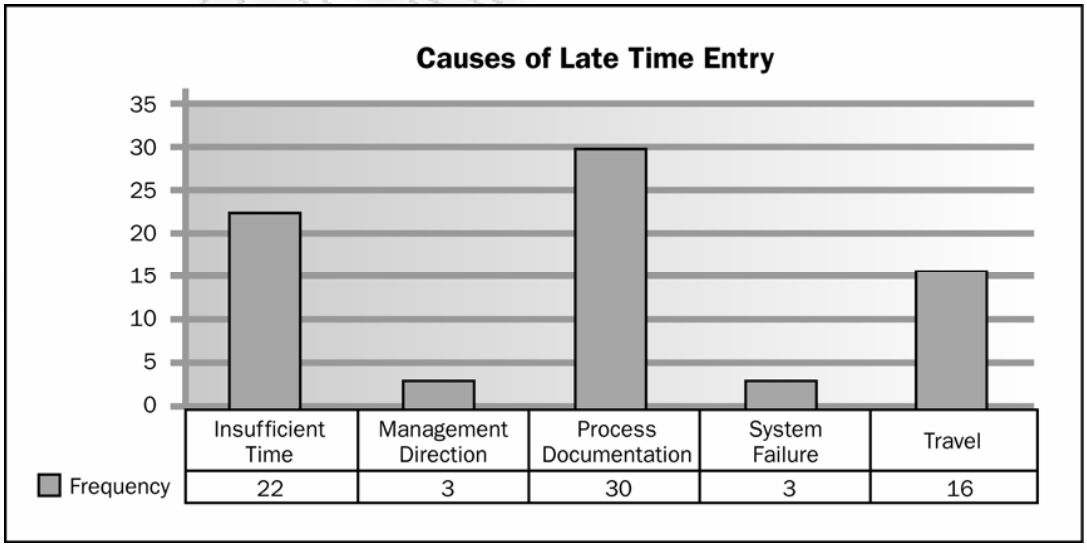

Figure 8-14. Histogram

8.3.2.5 Pareto Chart

See document: Pareto_Chart

A Pareto chart, also referred to as a Pareto diagram, is a specific type of histogram, ordered by frequency of occurrence. It shows how many defects were generated by type or category of identified cause (Figure 8-15). Rank ordering is used to focus corrective action. The project team should address the causes creating the greatest number of defects first.

Pareto diagrams are conceptually related to Pareto's Law, which holds that a relatively small number of causes will typically produce a majority of the problems or defects. This is commonly referred to as the 80/20 principle, where 80% of the problems are due to 20% of the causes. Pareto diagrams can also be used to summarize various types of data for 80/20 analyses.

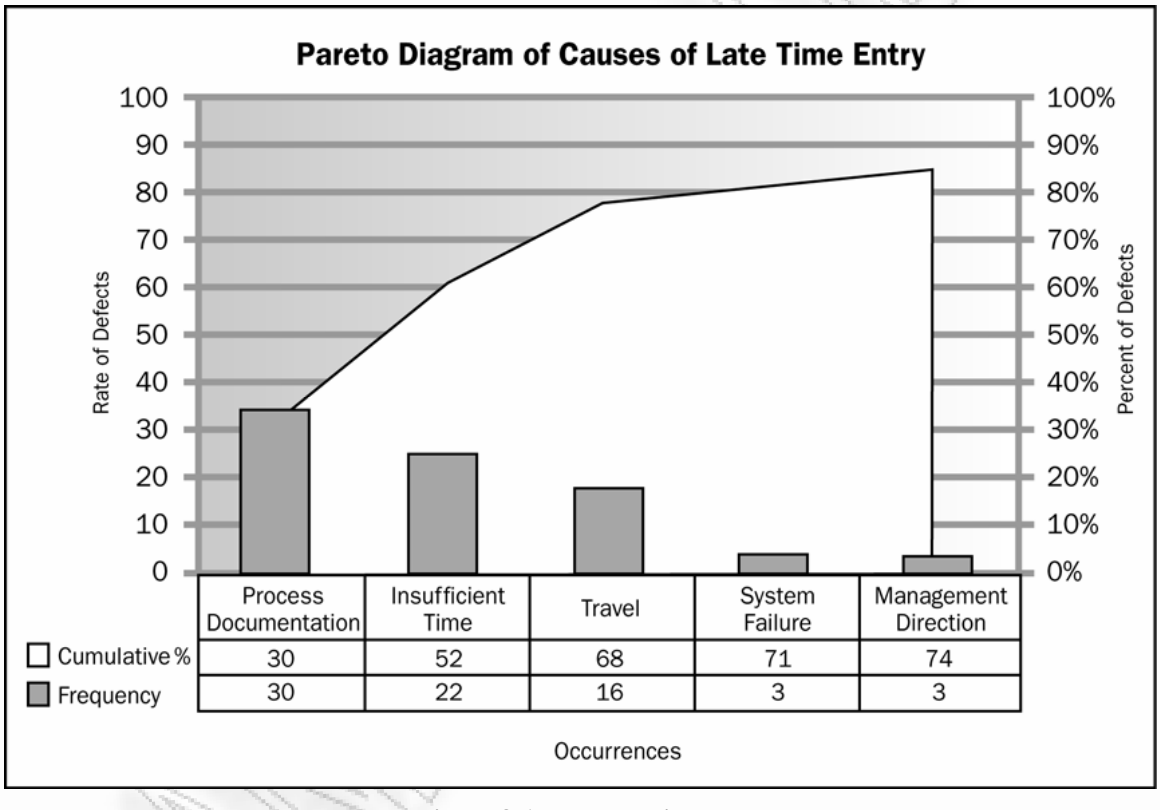

Figure 8-15. Pareto Diagram

8.3.2.6 Run Chart

See document: Run_chart

Similar to a control chart without displayed limits, a run chart shows the history and pattern of variation. A run chart is a line graph that shows data points plotted in the order in which they occur. Run charts show trends in a process over time, variation over time, or declines or improvements in a process over time. Trend analysis is performed using run charts and involves mathematical techniques to forecast future outcomes based on historical results. Trend analysis is often used to monitor:

• **Technical performance.** How many errors or defects have been identified, and how many remain uncorrected?

• **Cost and schedule performance.** How many activities per period were completed with significant variances?

8.3.2.7 Scatter Diagram

See document: Scatter_diagram

A scatter diagram (Figure 8-16) shows the relationship between two variables. This tool allows the quality team to study and identify the possible relationship between changes observed in two variables. Dependent variables versus independent variables are plotted. The closer the points are to a diagonal line, the more closely they are related. Figure 8-16 shows the correlation between the timecard submission date and the number of days traveling per month.

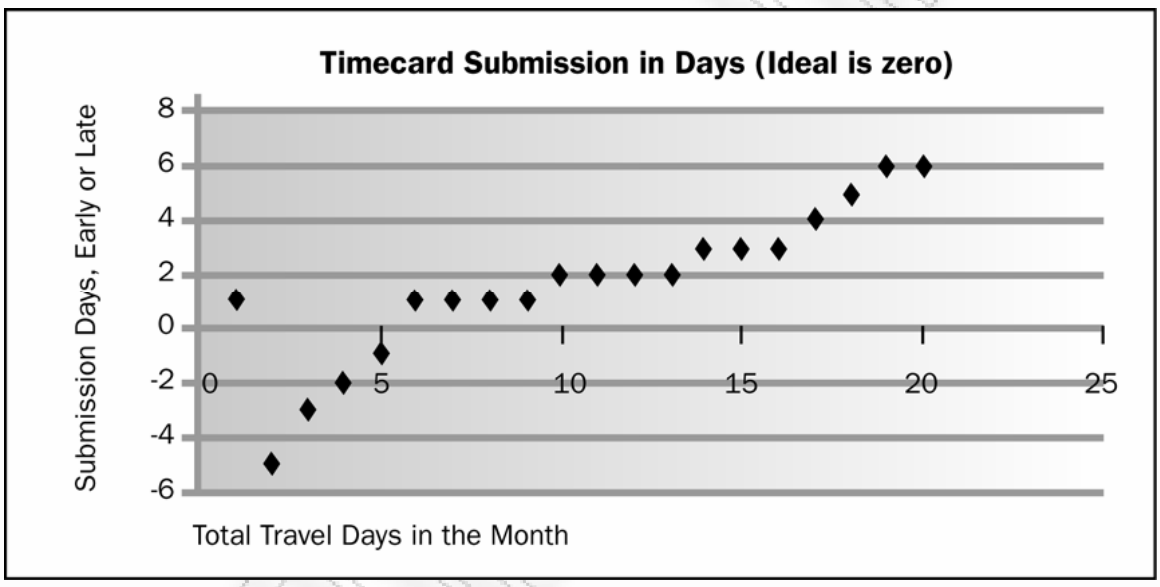

Figure 8-16. Scatter Diagram

8.3.2.8 Statistical Sampling

See also: Statistical Sampling

8.3.2.9 Inspection

See document: inspection

An inspection is the examination of a work product to determine whether it conforms to documented standards. The results of an inspection generally include measurements and may be conducted at any level. For example, the results of a single activity can be inspected, or the final product of the project can be inspected. Inspections may be called reviews, peer reviews, audits, or walkthroughs. In some application areas these terms have narrow and specific meanings. Inspections are also used to validate defect repairs.

8.3.2.10 Approved Change Requests Review

All approved change requests should be reviewed to verify that they were implemented as approved.

8.3.3 Outputs

8.3.3.1 Quality Control Measurements

Quality control measurements are the documented results of quality control activities in the format specified during quality planning.

8.3.3.2 Validated Changes

Any changed or repaired items are inspected and will be either accepted or rejected before notification of the decision is provided. Rejected items may require rework.

8.3.3.3 Validated Deliverables

A goal of quality control is to determine the correctness of deliverables. The results of the execution quality control processes are validated deliverables. Validated deliverables are an input to Verify Scope (5.4.1.4) for formalized acceptance.

8.3.3.4 Organization Process Assets Updates

See also: Organizational Process Assets

Elements of the organizational process assets that may be updated include, but are not limited to:

• **Completed checklists**. When checklists are used, the completed checklists become part of the project's records (Section 4.1.1.5).

• **Lessons learned documentation.** The causes of variances, the reasoning behind the corrective action chosen, and other types of lessons learned from quality control are documented so they become part of the historical database for both the project and the performing organization. Lessons learned are documented throughout the project life cycle, but at a minimum, during project closure.

8.3.3.5 Change Requests

See also: Change Requests

8.3.3.6 Project Management Plan Updates

Elements of the project management plan that may be updated include, but are not limited to:

• Quality management plan, and

• Process improvement plan.

8.3.3.7 Project Document Updates

Project documents that may be updated include, but are not limited to, quality standards.

9 Project Human Resource Management

9.1 Develop Human Resource Plan

See attachment(s): 9.1.JPG

9.1.1 Inputs

9.1.1.1 Activity Resource Requirements

See also: Activity Resource Requirements

9.1.1.2 Enterprise Environmental Factors

The enterprise environmental factors (Section 1.8) that can influence the Develop Human Resource Plan process include, but are not limited to:

• Organizational culture and structure,

• Existing human resources,

• Personnel administration policies, and

• Marketplace conditions.

9.1.1.3 Organizational Process Assets

The organizational process assets that can influence the project team with the Develop Human Resource Plan process include, but are not limited to:

• Organizational standard processes and policies and standardized role descriptions,

• Templates for organizational charts and position descriptions, and

• Historical information on organizational structures that have worked in previous projects.

9.1.2 T & T

9.1.2.1 Organization Charts and Position Descriptions

See document: Organizational_chart

Various formats exist to document team member roles and responsibilities. Most of the formats fall into one of three types (Figure 9-4): hierarchical, matrix, and text-oriented. Additionally, some project assignments are listed in subsidiary project management plans such as the risk, quality, or communication plans. Regardless of the method utilized, the objective is to ensure that each work package has an unambiguous owner and that all team members have a clear understanding of their roles and responsibilities.

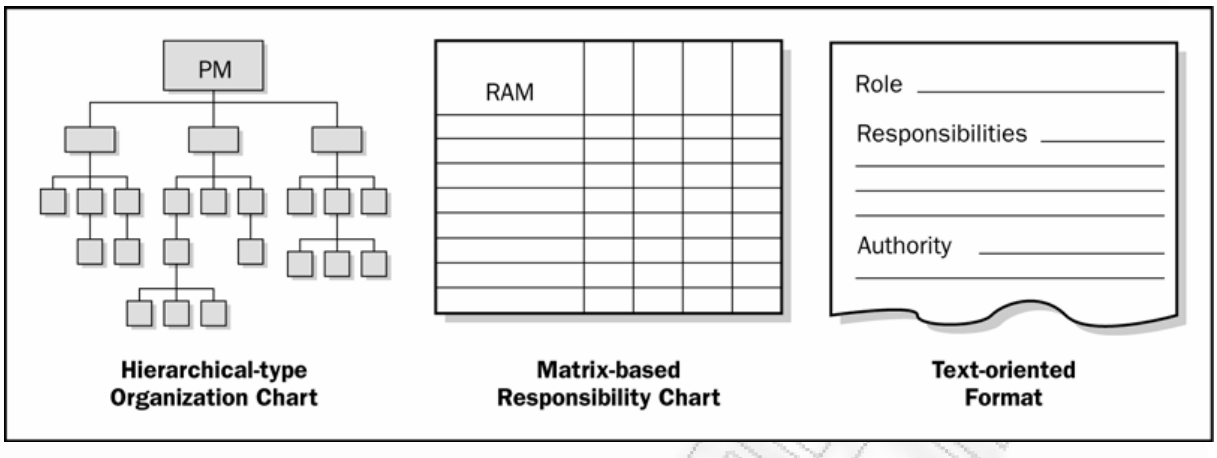

Figure 9-4. Roles and Responsibility Definition Formats

• **Hierarchical-type charts.** The traditional organization chart structure can be used to show positions and relationships in a graphic, top-down format. Work breakdown structures (WBS) designed to show how project deliverables are broken down into work packages provide a way of showing high-level areas of responsibility. While the WBS shows a breakdown of project deliverables, the organizational breakdown structure (OBS) is arranged according to an organization's existing departments, units, or teams with the project activities or work packages listed under each department. An operational department such as information technology or purchasing can see all of its project responsibilities by looking at its portion of the OBS. The resource breakdown structure is another hierarchical chart used to break down the project by types of resources. For example, a resource breakdown structure can depict all of the welders and welding equipment being used in different areas of a ship even though they can be scattered among different branches of the OBS and WBS. The resource breakdown structure is helpful in tracking project costs and can be aligned with the organization's accounting system. It can contain resource categories other than human resources.

• **Matrix-based charts.** A responsibility assignment matrix (RAM) is used to illustrate the mconnections between work packages or activities and project team members. On larger projects, RAMs can be developed at various levels. For example, a high-level RAM can define what a project team group or unit is responsible for within each component of the WBS, while lower-level RAMs are used within the group to designate roles, responsibilities, and levels of authority for specific activities. The matrix format shows all activities associated with one person and all people associated with one activity. This also ensures that there is only one person accountable for any one task to avoid confusion. One example of a RAM is a RACI (responsible, accountable, consult, and inform) chart, shown in Figure 9-5. The sample chart shows the work to be done in the left column as activities. The assigned resources can be shown as individuals or groups. The RACI is just one type of RAM; the project manager can select other options such as "lead" and "resource" designations or others as appropriate for the project. The RACI is particularly important when the team consists of internal and external resources to ensure clear divisions of roles and expectations.

RACI Chart	Person				
Activity	Ann	Ben	Carlos	Dina	Ed
Define	A	R	I	I	I
Design	I	A	R	C	C
Develop	I	A	R	C	C
Test	A	I	I	R	I

R = Responsible A = Accountable C = Consult I = Inform

Figure 9-5. Responsibility Assignment Matrix (RAM) Using a RACI Format

• **Text-oriented formats.** Team member responsibilities that require detailed descriptions can be specified in text- oriented formats. Usually in outline form, the documents provide information such as responsibilities, authority, competencies, and qualifications. The documents are known by various names including position descriptions and roleresponsibility-authority forms. These documents can be used as templates for future projects, especially when the information is updated throughout the current project by applying lessons learned.

• **Other sections of the project management plan.** Some responsibilities related to managing the project are listed and explained in other sections of the project management plan. For example, the risk register lists risk owners, the communication plan lists team members responsible for communication activities, and the quality plan designates those responsible for carrying out quality assurance and quality control activities.

9.1.2.2 Networking

Networking is the formal and informal interaction with others in an organization, industry or professional environment. It is a constructive way to understand political and interpersonal factors that will impact the effectiveness of various staffing management options. Human resources networking activities include proactive correspondence, luncheon meetings, informal conversations including meetings and events, trade conferences, and symposia. Networking can be a useful technique at the beginning of a project. It can also be an effective way to enhance project management professional development during the project and after the project ends.

9.1.2.3 Organizational Theory

See document: Organizational_theory

Organizational theory provides information regarding the way in which people, teams, and organizational units behave. Effective use of this information can shorten the amount of time, cost, and effort needed to create the human resource planning outputs and improve the likelihood that the planning will be effective. It is important to recognize that different organizational structures have different individual response, individual performance, and personal relationship characteristics.

9.1.3 Outputs

9.1.3.1 Human Resource Plan

The human resource plan, a part of the project management plan, provides guidance on how project human resources should be defined, staffed, managed, controlled, and eventually released. The human resource plan should include, but not be limited to, the following:

• **Roles and responsibilities.** The following should be addressed when listing the roles and responsibilities needed to complete a project:

o *Role*. The label describing the portion of a project for which a person is accountable. Examples of project roles are civil engineer, court liaison, business analyst, and testing coordinator. Role clarity concerning authority, responsibilities, and boundaries should be documented.

o *Authority.* The right to apply project resources, make decisions, and sign approvals. Examples of decisions that need clear authority include the selection of a method for completing an activity, quality acceptance, and how to respond to project variances. Team members operate best when their individual levels of authority match their individual responsibilities.

o *Responsibility.* The work that a project team member is expected to perform in order to complete the project™s activities.

o *Competency.* The skill and capacity required to complete project activities. If project team members do not possess required competencies, performance can be jeopardized. When such mismatches are identified, proactive responses such as training, hiring, schedule changes, or scope changes are initiated.

• **Project organization charts.** A project organization chart is a graphic display of project team members and their reporting relationships. It can be formal or informal, highly detailed or broadly framed, based on the needs of the project. For example, the project organization chart for a 3,000-person disaster response team will have greater detail than a project organization chart for an internal, twenty-person project.

• **Staffing management plan.** The staffing management plan, a part of the human resources plan within the project management plan, describes when and how human resource requirements will be met. The staffing management plan can be formal or informal, highly detailed or broadly framed, depending upon the needs of the project. The plan is updated continually during the project to direct ongoing team member acquisition

and development actions. Information in the staffing management plan varies by application area and project size, but items to consider include:

- *Staff acquisition.* A number of questions arise when planning the acquisition of project team members. For example, will the human resources come from within the organization or from external, contracted sources? Will team members need to work in a central location or can they work from distant locations? What are the costs associated with each level of expertise needed for the project? How much assistance can the organization™s human resource department and functional managers provide to the project management team?

- *Resource Calendars.* The staffing management plan describes necessary time frames for project team members, either individually or collectively, as well as when acquisition activities such as recruiting should start. One tool for charting human resources is a resource histogram. This bar chart illustrates the number of hours a person, department, or entire project team will be needed each week or month over the course of the project. The chart can include a horizontal line that represents the maximum number of hours available from a particular resource. Bars that extend beyond the maximum available hours identify the need for a resource leveling strategy, such as adding more resources or modifying the schedule. An example of a resource histogram is illustrated in Figure 9-6.

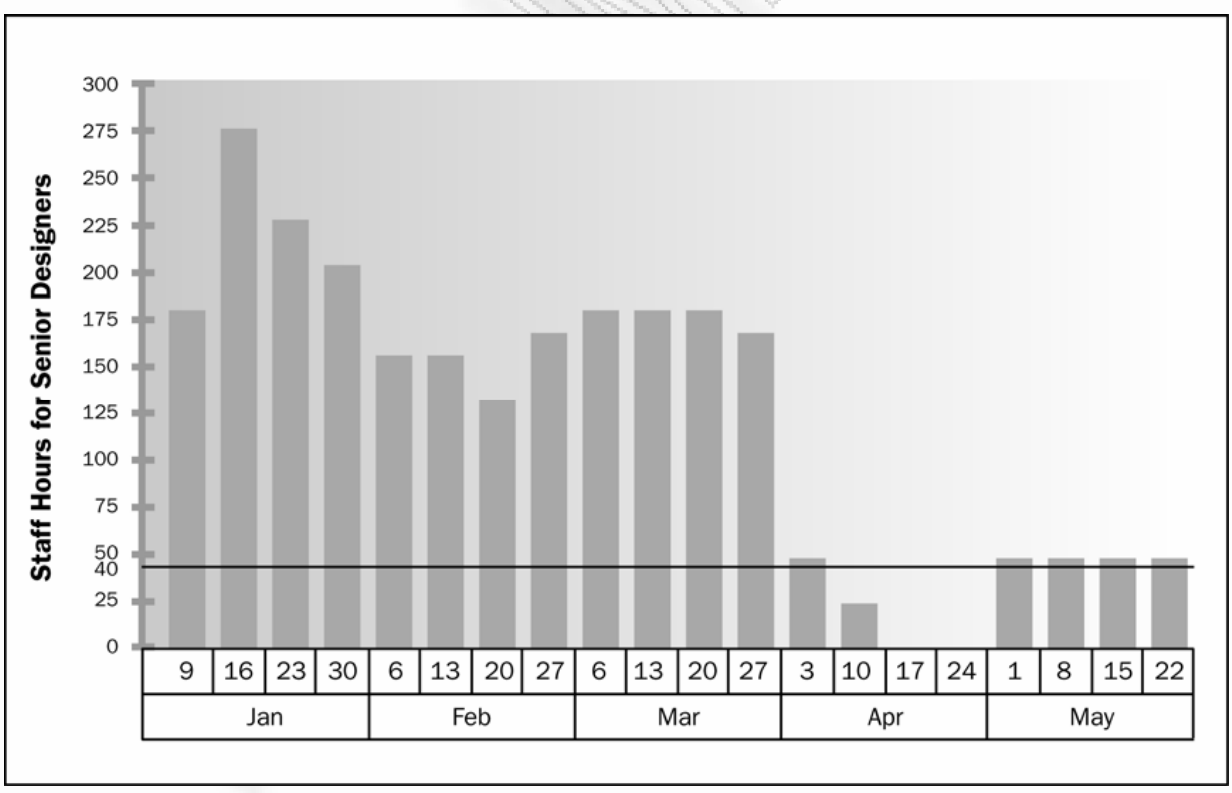

Figure 9-6. Illustrative Resource Histogram

- *Staff release plan.* Determining the method and timing of releasing team members benefits both the project and team members. When team members are released from a project, the costs associated with those resources are no longer charged to the project, thus reducing project costs. Morale is improved when smooth transitions to upcoming projects are already planned. A staff release plan also helps mitigate human resource risks that may occur during or at the end of a project.

- *Training needs.* If the team members to be assigned are not expected to have the required competencies, a training plan can be developed as part of the project. The plan can also include ways to help team members obtain certifications that would support their ability to benefit the project.

- *Recognition and rewards.* Clear criteria for rewards and a planned system for their use helps promote and reinforce desired behaviors. To be effective, recognition and rewards should be based on activities and performance under a person's control. For example, a team member who is to be rewarded for meeting cost objectives should have an appropriate level of control over decisions that affect expenses. Creating a plan with established times for distribution of rewards ensures that recognition takes place and is not forgotten. Recognition and rewards are part of the Develop Project Team process (Section 9.3).

- *Compliance.* The staffing management plan can include strategies for complying with applicable government regulations, union contracts, and other established human resource policies.

- *Safety.* Policies and procedures that protect team members from safety hazards can be included in the staffing management plan as well as the risk register.

9.2 Acquire Project Team

See attachment(s): 9.2.JPG

9.2.1 Inputs

9.2.1.1 Project Management Plan

See also: Project Management Plan

The project management plan described in Section 4.2.3.1 contains the human resource plan which has the following information that is used to provide guidance on how project human resources should be identified, staffed, managed, controlled, and eventually released. It includes:

• Roles and responsibilities defining the positions, skills, and competencies that the project demands,

• Project organization charts indicating the number of people needed for the project, and

• Staffing management plan delineating the time periods each project team member will be needed and other information important to acquiring the project team.

9.2.1.2 Enterprise Environmental Factors

The enterprise environmental factors that can influence the Acquire Project Team process include, but are not limited to:

• Existing information for human resources including who is available, their competency levels, their prior experience, their interest in working on the project and their cost rate;

• Personnel administration policies such as those that affect outsourcing;

• Organizational structure, and

• Location or multiple locations.

9.2.1.3 Organizational Process Assets

The organizational process assets that can influence the Acquire Project Team process include, but are not limited to, organization standard policies, processes, and procedures.

9.2.2 T & T

9.2.2.1 Pre-Assignment

When project team members are selected in advance they are considered pre-assigned. This situation can occur if the project is the result of specific people being promised as part of a competitive proposal, if the project is dependent upon the expertise of particular persons, or if some staff assignments are defined within the project charter.

9.2.2.2 Negotiation

Staff assignments are negotiated on many projects. For example, the project management team may need to negotiate with:

• Functional managers to ensure that the project receives appropriately competent staff in the required time frame, and that the project team members will be able, willing, and authorized to work on the project until their responsibilities are completed,

• Other project management teams within the performing organization to appropriately assign scarce or specialized human resources, and

• External organizations, vendors, suppliers, contractors, etc., for appropriate, scarce, specialized, qualified, certified, or other such specified human resources. Special consideration should be given to external negotiating policies, practices, processes, guidelines, legal, and other such criteria.

The project management team's ability to influence others plays an important role in negotiating staff assignments, as do the politics of the organizations involved. For example, a functional manager will weigh the benefits and visibility of competing projects when determining where to assign exceptional performers requested by various project teams.

9.2.2.3 Acquisition

When the performing organization lacks the in-house staff needed to complete a project the required services may be acquired from outside sources. This can involve hiring individual consultants or subcontracting work to another organization.

9.2.2.4 Virtual Teams

See document: Virtual_Teams

The use of virtual teams creates new possibilities when acquiring project team members. Virtual teams can be defined as groups of people with a shared goal who fulfill their roles with little or no time spent meeting face to face. The availability of electronic communication such as e-mail, audio conferencing, web-based meetings and video conferencing has made such teams feasible. The virtual team format makes it possible to:

• Form teams of people from the same company who live in widespread geographic areas,

• Add special expertise to a project team even though the expert is not in the same geographic area,

• Incorporate employees who work from home offices,

• Form teams of people who work different shifts or hours,

• Include people with mobility limitations or disabilities, and

• Move forward with projects that would have been ignored due to travel expenses.

Communication planning becomes increasingly important in a virtual team environment. Additional time may be needed to set clear expectations, facilitate communications, develop protocols for resolving conflict, include people in decision- making, and share credit in successes.

9.2.3 Outputs

9.2.3.1 Project Staff Assignments

The project is staffed when appropriate people have been assigned through the previously described methods. The documentation of these assignments can include a project team directory, memos to team members, and names inserted into other parts of the project management plan, such as project organization charts and schedules.

9.2.3.2 Resource Calendars

Resource calendars document the time periods that each project team member can work on the project. Creating a reliable schedule (Section 6.5.3.1) depends on having a good understanding of each person's schedule conflicts, including vacation time and commitments to other projects, to accurately document team member availability.

9.2.3.3 Project Management Plan Updates

Elements of the project management plan that may be updated include, but are not limited to the human resources plan. For example, when specific people are assigned to project roles and responsibilities, there may not be an exact fit between the staffing requirements indicated in the human resource plan and the individual.

9.3 Develop Project Team

See attachment(s): 9.3.JPG

9.3.1 Inputs

9.3.1.1 Project Staff Assignments

See also: Project Staff Assignments

9.3.1.2 Project Management Plan

See also: Project Management Plan

The project management plan described in Section 4.2.3.1 contains the human resource plan (Section 9.1.3.1), which identifies training strategies and plans for developing the project team. Items such as rewards, feedback, additional training, and disciplinary actions can be added to the plan as a result of ongoing team performance assessments and other forms of project team management.

9.3.1.3 Resource Calendars

See also: Resource Calendars

9.3.2 T & T

9.3.2.1 Interpersonal Skills

These are sometimes known as "soft skills," and are particularly important to team development. The project management team can greatly reduce problems and increase cooperation by understanding the sentiments of project team members, anticipating their actions, acknowledging their concerns, and following up on their issues. Skills such as empathy, influence, creativity, and group facilitation are valuable assets when managing the project team.

9.3.2.2 Training

Training includes all activities designed to enhance the competencies of the project team members. Training can be formal or informal. Examples of training methods include classroom, online, computer-based, on-the-job training from another project team member, mentoring, and coaching. If project team members lack necessary management or technical skills, such skills can be developed as part of the project work. Scheduled training takes place as stated in the human resource plan. Unplanned training takes place

as a result of observation, conversation, and project performance appraisals conducted during the controlling process of managing the project team.

9.3.2.3 Team-Building Activities

See document: Team_building

Team-building activities can vary from a five-minute agenda item in a status review meeting to an off-site, professionally facilitated experience designed to improve interpersonal relationships. The objective of team- building activities is to help individual team members work together effectively. Team-building strategies are particularly valuable when team members operate from remote locations without the benefit of face-to- face contact. Informal communication and activities can help in building trust and establishing good working relationships.

One of the most important skills in developing a team environment involves handling project team problems and discussing these as team issues. The entire team should be encouraged to work collaboratively to resolve these issues. To build effective project teams, project managers should obtain top management support, obtain commitment of team members, introduce appropriate rewards and recognition, create a team identity, manage conflicts effectively, promote trust and open communication among team members, and, above all, provide good team leadership.

As an ongoing process, team building is crucial to project success. While team building is essential during the front end of a project, it is a never-ending process. Changes in a project environment are inevitable, and to manage them effectively a continued or a renewed teambuilding effort should be applied. The project manager should continually monitor team functioning and performance to determine if any actions are needed to prevent or correct various team problems.

One theory states that there are five stages of development that teams may go through. Usually these stages occur in order. However, it's not uncommon for a team to get stuck in a particular stage or slip to an earlier stage. . Also, projects with team members who have worked together in the past could skip a stage.

• **Forming**. This phase is where the team meets and learns about the project and what their formal roles and responsibilities are. Team members tend to be independent and not as open in this phase. For more information, refer to the Tuckman ladder of team development [**6**].

• **Storming**. During this phase the team begins to address the project work, technical decisions, and the project management approach. If team members are not collaborative and open to differing ideas and perspectives the environment can become destructive.

• **Norming.** In the norming phase team members begin to work together and adjust work habits and behaviors that support the team. The team begins to trust each other.

• **Performing.** Teams that reach the performing stage function as a well-organized unit. They are interdependent and work through issues smoothly and effectively.

• **Adjourning.** In the adjourning phase the team completes the work and moves on from the project.

The duration of a particular stage depends upon team dynamics, team size, and team leadership. Project managers should have a good understanding of team dynamics in order to move their team members through all stages in an effective manner.

9.3.2.4 Ground Rules

Ground rules establish clear expectations regarding acceptable behavior by project team members. Early commitment to clear guidelines decreases misunderstandings and increases productivity. Discussing ground rules allows team members to discover values that are important to one another. All project team members share responsibility for enforcing the rules once they are established.

9.3.2.5 Co-location

Co-location involves placing many or all of the most active project team members in the same physical location to enhance their ability to perform as a team. Co-location can be temporary, such as at strategically important times during the project, or for the entire project. Co-location strategies can include a team meeting room, places to post schedules, and other conveniences that enhance communication and a sense of community. While co-location is considered a good strategy, the use of virtual teams is sometimes unavoidable.

9.3.2.6 Recognition and Rewards

Part of the team development process involves recognizing and rewarding desirable behavior. The original plans concerning ways in which to reward people are developed during the Develop Human Resource Plan process. It is important to recognize that a particular reward given to any individual will only be effective if it satisfies a need which is valued by that individual. Award decisions are made, formally or informally, during the process of managing the project team through project performance appraisals (Section 9.4.2.2). Cultural differences should be considered when determining recognition and rewards. For example, developing appropriate team rewards in a culture that encourages individualism can be difficult.

Only desirable behavior should be rewarded. For example, the willingness to work overtime to meet an aggressive schedule objective should be rewarded or recognized; needing to work overtime as the result of poor planning by the team member should not be rewarded. However, the team members should not be punished for poor planning and consistently unrealistic expectations imposed by senior management. Win-lose (zero sum) rewards that only a limited number of project team members can achieve, such as team member of the month, can hurt team cohesiveness. Rewarding behavior that everyone can achieve, such as turning in progress reports on time, tends to increase support among team members.

People are motivated if they feel they are valued in the organization and this value is demonstrated by the rewards given to them. Generally, money is viewed by most as a very tangible aspect of any reward system, but other intangible rewards are also effective. Most project team members are motivated by an opportunity to grow, accomplish, and apply their professional skills to meet new challenges. Public recognition of good performance creates positive reinforcement. A good strategy for

project managers is to give the team all possible recognition during the life cycle of the project rather than after the project is completed.

9.3.3 Outputs

9.3.3.1 Team Performance Assessments

As project team development efforts such as training, team building, and co- location are implemented, the project management team makes formal or informal assessments of the project team's effectiveness. Effective team development strategies and activities are expected to increase the team's performance, which increases the likelihood of meeting project objectives. Team performance assessment criteria should be determined by all appropriate parties and incorporated in the Develop Project Team inputs. This is especially important in contract-related or collective bargaining projects.

The performance of a successful team is measured in terms of technical success according to agreed-upon project objectives, performance on project schedule (finished on time), and performance on budget (finished within financial constraints). High performance teams are characterized by these task-oriented and results- oriented outcomes. They also exhibit specific job-related and people-related qualities that represent indirect measures of project performance.

The evaluation of a team's effectiveness may include indicators such as:

• Improvements in skills that allow individuals to perform assignments more effectively,

• Improvements in competencies that help the team perform better as a team,

• Reduced staff turnover rate, and

• Increased team cohesiveness where team members share information and experiences openly and help each other to improve the overall project performance.

As a result of conducting an evaluation of the team's overall performance, the project management team can identify the specific training, coaching, mentoring, assistance, or changes required to improve the team's performance. This should also include identification of the proper or required resources necessary to achieve and implement the improvements identified in the assessment. These resources and recommendations for team improvement should be well documented and forwarded to the appropriate parties. This is especially important when team members are part of a union, involved in collective bargaining, bound by contract performance clauses, or other related situations.

9.3.3.2 Enterprise Environmental Factors Updates

The enterprise environmental factors that may be updated as a result of the Develop Project Team process include, but are not limited to, personnel administration, including updates for employee training records and skill assessments.

9.4 Manage Project Team

See attachment(s): 9.4.JPG

9.4.1 Inputs

9.4.1.1 Project Staff Assignments

See also: Project Staff Assignments

9.4.1.2 Human Resource Plan

See also: Human Resource Plan

The human resource plan includes, but is not limited to:

- Roles and responsibilities,
- Project organization, and
- The staffing management plan.

9.4.1.3 Team Performance Assessments

See also: Team Performance Assessments

The project management team makes ongoing formal or informal assessments of the project team's performance. By continually assessing the project team's performance, actions can be taken to resolve issues, modify communication, address conflict, and improve team interaction.

9.4.1.4 Performance Reports

See also: Performance Reports

Performance reports (Section 10.5.3.1) provide documentation about the current project status compared to project forecasts. Performance areas that can help with project team management include results from schedule control, cost control, quality control, and scope verification. The information from performance reports and related forecasts assists in determining future human resource requirements, recognition and rewards, and updates to the staffing management plan.

9.4.1.5 Organizational Process Assets

The organizational process assets that can influence the Manage Project Team process include, but are not limited to:

- Certificates of appreciation,
- Newsletters,
- Web sites,
- Bonus structures,
- Corporate apparel, and
- Other organizational perquisites.

9.4.2 T & T

9.4.2.1 Observation and Conversation

Observation and conversation are used to stay in touch with the work and attitudes of project team members. The project management team monitors progress toward project deliverables, accomplishments that are a source of pride for team members, and interpersonal issues.

9.4.2.2 Project Performance Appraisals

See document: Performance_appraisal

Objectives for conducting performance appraisals during the course of a project can include clarification of roles and responsibilities, constructive feedback to team members, discovery of unknown or unresolved issues, development of individual training plans, and the establishment of specific goals for future time periods.

The need for formal or informal project performance appraisals depends on the length of the project, complexity of the project, organizational policy, labor contract requirements, and the amount and quality of regular communication.

9.4.2.3 Conflict Management

See document: Conflict_management

Conflict is inevitable in a project environment. Sources of conflict include scarce resources, scheduling priorities, and personal work styles. Team ground rules, group norms, and solid project management practices like communication planning and role definition, reduce the amount of conflict.

Successful conflict management results in greater productivity and positive working relationships. When managed properly, differences of opinion can lead to increased creativity and better decision making. If the differences become a negative factor, project team members are initially responsible for their resolution. If conflict escalates, the project manager should help facilitate a satisfactory resolution. Conflict should be addressed early and usually in private, using a direct, collaborative approach. If disruptive conflict continues, formal procedures may be used, including disciplinary actions.

When handling conflict in a team environment, project managers should recognize the following characteristics of conflict and the conflict management process:

- Conflict is natural and forces a search for alternatives,
- Conflict is a team issue,
- Openness resolves conflict,
- Conflict resolution should focus on issues, not personalities, and
- Conflict resolution should focus on the present, not the past.

The success of project managers in managing their project teams often depends a great deal on their ability to resolve conflict. Different project managers may have different conflict resolution styles. Factors that influence conflict resolution methods include:

• Relative importance and intensity of the conflict,

• Time pressure for resolving the conflict,

• Position taken by players involved, and

• Motivation to resolve conflict on a long-term or a short-term basis.

There are six general techniques for resolving conflict. As each one has its place and use, these are not given in any particular order:

• **Withdrawing/Avoiding.** Retreating from an actual or potential conflict situation.

• **Smoothing/Accommodating.** Emphasizing areas of agreement rather than areas of difference.

• **Compromising.** Searching for solutions that bring some degree of satisfaction to all parties.

• **Forcing.** Pushing one's viewpoint at the expense of others; offers only win-lose solutions.

• **Collaborating.** Incorporating multiple viewpoints and insights from differing perspectives; leads to consensus and commitment.

• **Confronting/Problem Solving.** Treating conflict as a problem to be solved by examining alternatives; requires a give-and-take attitude and open dialogue.

9.4.2.4 Issue Log

Issues arise in the course of managing the project team. A written log documents and helps monitor who is responsible for resolving specific issues by a target date. Issue resolution addresses obstacles that can block the team from achieving its goals.

You can find issue log templates at the links below:

http://www.cs.toronto.edu/~sme/CSC444F/handouts/inspection_issue_log.pdf

http://www.state.mn.us/mn/externalDocs/OET/Issue%20Log_030502_Issue_Log_Template_(Word)_053006.doc

9.4.2.5 Interpersonal Skills

Project managers use a combination of technical, human, and conceptual skills to analyze situations and interact appropriately with team members. Using appropriate interpersonal skills aids project managers in capitalizing on the strengths of all team members.

There is a wide body of knowledge about interpersonal skills that is appropriate to project work and non-project work. That body of knowledge is too in-depth to cover in

this publication. There is expanded coverage of some of the most relevant interpersonal skills used in project management in Appendix F. Some of the interpersonal skills the project managers use most often are briefly covered below.

• **Leadership.** Successful projects require strong leadership skills. Leadership is important through all phases of the project life cycle. It is especially important to communicate the vision and inspire the project team to achieve high performance.

• **Influencing.** Since project managers often have little or no direct authority over their team members in a matrix environment, their ability to influence stakeholders on a timely basis is critical to project success. Key influencing skills include:

- Ability to be persuasive and clearly articulate points and positions,
- High levels of active and effective listening skills,
- Consideration of the various perspectives in any situation, and
- Gathering relevant and critical information to address important issues and reach agreements while maintaining mutual trust.

• **Effective Decision Making.** This involves the ability to negotiate and influence the organization and the project management team. Some guidelines for decision making include:

- Focus on goals to be served,
- Follow a decision-making process,
- Study the environmental factors,
- Develop personal qualities of the team members,
- Stimulate team creativity, and
- Manage opportunity and risk.

9.4.3 Outputs

9.4.3.1 Enterprise Environmental Factors Updates

Enterprise environmental factors that may require updates as a result of the Manage Project Team process include, but are not limited to:

• Input to organizational performance appraisals, and

• Personnel skill updates.

9.4.3.2 Organizational Process Assets Updates

Organizational process assets that may require updates as a result of the Manage Project Team process include, but are not limited to:

• Historical information and lessons learned documentation,

• Templates, and

• Organizational standard processes.

9.4.3.3 Change Requests

See also: Change Requests

Staffing changes, whether by choice or by uncontrollable events, can affect the rest of the project management plan. When staffing issues disrupt the project management plan, such as causing the schedule to be extended or the budget to be exceeded, a change request can be processed through the Perform Integrated Change Control process. Staffing changes can include moving people to different assignments, outsourcing some of the work, and replacing team members who leave.

Preventive actions are those that can be developed to reduce the probability and/or impact of problems before they occur. These actions may include cross-training to reduce problems during project team member absences and additional role clarification to ensure all responsibilities are fulfilled.

9.4.3.4 Project Management Plan Updates

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10 Project Communications Management

10.1 Identify Stakeholders

See attachment(s): 10.1.JPG

10.1.1 Inputs

10.1.1.1 Project Charter

See also: Project Charter

The project charter can provide information about internal and external parties involved in and affected by the project, such as project sponsor(s), customers, team members, groups and departments participating in the project, and other people or organizations affected by the project.

10.1.1.2 Procurement Documents

See also: Procurement Documents

If a project is the result of procurement activity or is based on an established contract, the parties in that contract are key project stakeholders. Other relevant parties, such as suppliers, should also be considered as part of the project stakeholders list.

10.1.1.3 Enterprise Environmental Factors

The enterprise environmental factors that can influence the Identify Stakeholders process include, but are not limited to:

• Organizational or company culture and structure, and

• Governmental or industry standards (e.g. regulations, product standards).

10.1.1.4 Organizational Process Assets

The organizational process assets that can influence the Identify Stakeholders process include, but are not limited to:

• Stakeholder register templates,

• Lessons learned from previous projects, and

• Stakeholder registers from previous projects.

10.1.2 T & T

10.1.2.1 Stakeholder Analysis

See document: Stakeholder_Analysis

Stakeholder analysis is a process of systematically gathering and analyzing quantitative and qualitative information to determine whose interests should be taken into account throughout the project. It identifies the interests, expectations, and influence of the stakeholders and relates them to the purpose of the project. It also helps identify stakeholder relationships that can be leveraged to build coalitions and potential partnerships to enhance the project's chance of success.

Stakeholder analysis generally follows the steps described below:

• **Step 1:** Identify all potential project stakeholders and relevant information, such as their roles, departments, interests, knowledge levels, expectations, and influence levels. Key stakeholders are usually easy to identify. They include anyone in a decision-making or management role who is impacted by the project outcome, such as the sponsor, the project manager, and the primary customer.

o Identifying other stakeholders is usually done by interviewing identified stakeholders and expanding the list until all potential stakeholders are included.

• **Step 2:** Identify the potential impact or support each stakeholder could generate, and classify them so as to define an approach strategy. In large stakeholder communities it is important to prioritize the key stakeholders to ensure the efficient use of effort to communicate and manage their expectations. There are multiple classification models available including, but not limited to:

o Power/Interest grid, grouping the stakeholders based on their level of authority ("power") and their level or concern ("interest") regarding the project outcomes;

o Power/Influence grid, grouping the stakeholders based on their level of authority ("power") and their active involvement ("influence") in the project;

o Influence/Impact grid, grouping the stakeholders based on their active involvement ("influence") in the project and their ability to effect changes to the project's planning or execution ("impact"); and

o Salience model, describing classes of stakeholders based on their power (ability to impose their will), urgency (need for immediate attention) and legitimacy (their involvement is appropriate).

Figure 10-4 presents an example of a power/interest grid with A-H representing the placement of generic stakeholders.

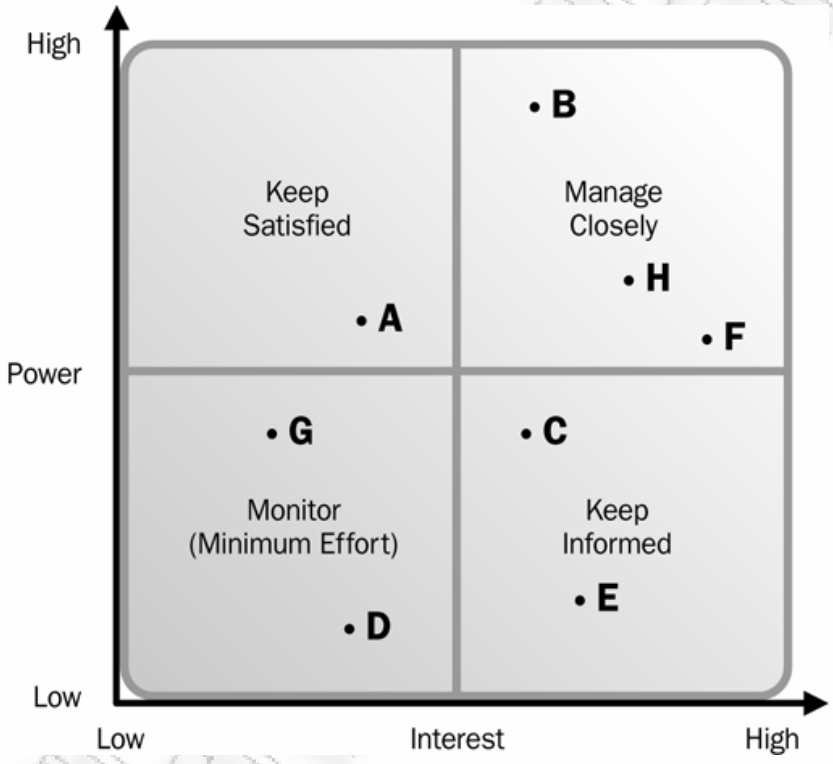

Figure 10-4. Example Power/Interest Grid with Stakeholders

• **Step 3:** Assess how key stakeholders are likely to react or respond in various situations, in order to plan how to influence them to enhance their support and mitigate potential negative impacts.

10.1.2.2 Expert Judgment

To ensure comprehensive identification and listing of stakeholders, judgment and expertise should be sought from groups or individuals with specialized training or knowledge on the subject area such as:

• Senior management,

• Other units within the organization,

• Identified key stakeholders,

• Project managers who have worked on projects in the same area (directly or through lessons learned),

• Subject matter experts (SMEs) in business or project area,

• Industry groups and consultants, and

• Professional and technical associations.

Expert judgment can be obtained through individual consultations (one-on-one meetings, interviews, etc.) or through a panel format (focus groups, surveys etc).

10.1.3 Outputs

10.1.3.1 Stakeholder Register

The main output of the Identify Stakeholders process is the stakeholder register. This contains all details related to the identified stakeholders including, but not limited to:

• **Identification information:** Name, organizational position, location, role in the project, contact information;

• **Assessment information:** Major requirements, main expectations, potential influence in the project, phase in the lifecycle with the most interest; and

• **Stakeholder classification:** Internal/external, supporter/neutral/resistor, etc.

10.1.3.2 Stakeholder Management Strategy

The stakeholder management strategy defines an approach to increase the support and minimize negative impacts of stakeholders throughout the entire project life cycle. It includes elements such as:

• Key stakeholders who can significantly impact the project,

• Level of participation in the project desired for each identified stakeholder, and

• Stakeholder groups and their management (as groups).

A common way of representing the stakeholder management strategy is a stakeholder analysis matrix. An example of a blank matrix with column headers is provided in Figure 10-5.

Stakeholder	Stakeholder Interest(s) in the Project	Assessment of Impact	Potential Strategies for Gaining Support or Reducing Obstacles

Figure 10-5. Sample Stakeholder Analysis Matrix

Some of the information related to certain stakeholder management strategies could be too sensitive to be included in a shared document. The project manager must exercise

judgment with regard to the type of information and the level of detail to be included in the stakeholder management strategy.

10.2 Plan Communications

See attachment(s): 10.2.JPG

10.2.1 Inputs

10.2.1.1 Stakeholder Register

See also: Stakeholder Register

10.2.1.2 Stakeholder Management Strategy

See also: Stakeholder Management Strategy

10.2.1.3 Enterprise Environmental Factors

All enterprise environmental factors are used as inputs for this process since communication must be adapted to the project environment

10.2.1.4 Organizational Process Assets

All organizational process assets are used as inputs for the Plan Communications process. Of these, lessons learned and historical information are of particular importance because they can provide insights on both the decisions taken regarding communications issues and the results of those decisions in previous similar projects. These can be used as guiding information to plan the communication activities for the current project.

10.2.2 T & T

10.2.2.1 Communication Requirements Analysis

See document: communications-requirements-analysis

The analysis of the communication requirements determines the information needs of the project stakeholders. These requirements are defined by combining the type and format of information needed with an analysis of the value of that information. Project resources are expended only on communicating information that contributes to success, or where a lack of communication can lead to failure.

The project manager should also consider the number of potential communication channels or paths as an indicator of the complexity of a project's communications. The total number of potential communication channels is ***n(n-1)/2***, where ***n*** represents the number of stakeholders. Thus, a project with 10 stakeholders has 10(10-1)/2 = 45 potential communication channels. A key component of planning the project's actual communications, therefore, is to determine and limit who will communicate with whom and who will receive what information.

Information typically used to determine project communication requirements includes:

• Organization charts,

• Project organization and stakeholder responsibility relationships,

• Disciplines, departments, and specialties involved in the project,

• Logistics of how many persons will be involved with the project and at which locations,

• Internal information needs (e.g., communicating across organizations),

• External information needs (e.g., communicating with the media, public or contractors), and

• Stakeholder information from the stakeholder register and the stakeholder management strategy.

10.2.2.2 Communication Technology

The methods used to transfer information among project stakeholders can vary significantly. For example, a project team may use techniques from brief conversations all the way through to extended meetings, or from simple written documents to material (e.g., schedules and databases) that is accessible online as methods of communication.

Factors that can affect the project include:

• **Urgency of the need for information.** Is project success dependent upon having frequently updated information available on a moment's notice, or would regularly issued written reports suffice?

• **Availability of technology.** Are appropriate systems already in place or do project needs warrant change? For example, do the intended stakeholder(s) have access to a selected communications technology?

• **Expected project staffing.** Are the proposed communication systems compatible with the experience and expertise of the project participants, or is extensive training and learning required?

• **Duration of the project.** Is the available technology likely to change before the project is over?

• **Project environment.** Does the team meet and operate on a face-to-face basis or in a virtual environment?

10.2.2.3 Communication Models

A basic model of communication, shown in Figure 10-8, demonstrates how information is sent and received between two parties, defined as the sender and the receiver. The key components of the model include:

• **Encode.** To translate thoughts or ideas into a language that is understood by others.

• **Message and feedback-message.** The output of encoding.

• **Medium.** The method used to convey the message.

• **Noise.** Anything that interferes with the transmission and understanding of the message (e.g., distance, unfamiliar technology, lack of background information).

• **Decode.** To translate the message back into meaningful thoughts or ideas.

Figure 10-8 is a basic communication model. Inherent in the model is an action to acknowledge a message. Acknowledgement means that the receiver signals receipt of the message, but not necessarily agreement with the message. Another action is the response to a message, which means that the receiver has decoded, understands, and is replying to the message.

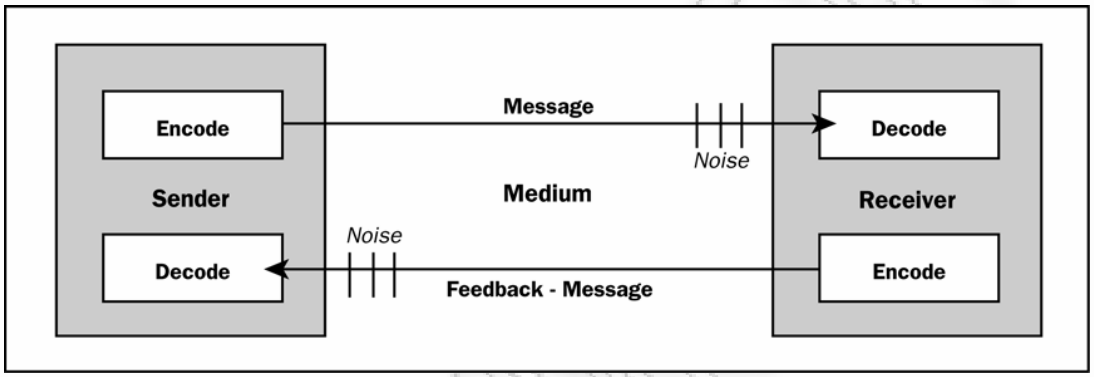

Figure 10-8. Basic Communication Model

The components in the communications model need to be taken into account when discussing project communications. As part of the communications process, the sender is responsible for making the information clear and complete so that the receiver can receive it correctly, and for confirming that it is properly understood. The receiver is responsible for making sure that the information is received in its entirety, understood correctly, and acknowledged. A failure in communication can negatively impact the project.

There are many challenges in using these components to effectively communicate with project stakeholders. Consider a highly technical, multinational project team. For one team member to successfully communicate a technical concept to another team member in a different country can involve encoding the message in the appropriate language, sending the message using a variety of technologies, and having the receiver decode the message and reply or provide feedback. Any noise introduced along the way compromises the original meaning of the message.

10.2.2.4 Communication Methods

There are several communication methods used to share information among project stakeholders.

These methods can be broadly classified into:

• **Interactive communication.** Between two or more parties performing a multidirectional exchange of information. It is the most efficient way to ensure a

common understanding by all participants on specified topics, and includes meetings, phone calls, video conferencing, etc.

• **Push communication.** Sent to specific recipients who need to know the information. This ensures that the information is distributed but does not certify that it actually reached or was understood by the intended audience. Push communication includes letters, memos, reports, emails, faxes, voice mails, press releases etc.

• **Pull communication.** Used for very large volumes of information, or for very large audiences, that requires the recipients to access the communication content at their own discretion. These methods include intranet sites, e-learning, and knowledge repositories, etc.

The project manager decides, based on communication requirements, what, how, and when communication methods are to be used in the project.

10.2.3 Outputs

10.2.3.1 Communications Management Plan

The communications management plan is contained in, or is a subsidiary of the project management plan (Section 4.2.3.1). The communications management plan can be formal or informal, highly detailed or broadly framed, and based on the needs of the project.

The communications management plan usually provides:

• Stakeholder communication requirements;

• Information to be communicated, including language, format, content, and level of detail;

• Reason for the distribution of that information;

• Time frame and frequency for the distribution of required information;

• Person responsible for communicating the information;

• Person responsible for authorizing release of confidential information;

• Person or groups who will receive the information;

• Methods or technologies used to convey the information, such as memos, e-mail, and/or press releases;

• Resources allocated for communication activities, including time and budget;

• Escalation process identifying time frames and the management chain (names) for escalation of issues that cannot be resolved at a lower staff level;

• Method for updating and refining the communications management plan as the project progresses and develops;

• Glossary of common terminology;

• Flow charts of the information flow in the project, workflows with possible sequence of authorization, list of reports, and meeting plans, etc.; and

• Communication constraints, usually derived from specific legislation or regulation, technology, and organizational policies, etc.

The communications management plan can also include guidelines and templates for project status meetings, project team meetings, e-meetings, and e-mail. The use of a project web site and project management software can also be included if they are used in the project.

10.2.3.2 Project Document Updates

Project documents that may be updated include but are not limited to:

• Project schedule,

• Stakeholder register, and

• Stakeholder management strategy.

10.3 Distribute Information

See attachment(s): 10.3.JPG

10.3.1 Inputs

10.3.1.1 Project Management Plan

See also: Project Management Plan

The project management plan (Section 4.2.3.1) contains the communications management plan described in Section 10.2.3.1.

10.3.1.2 Performance Reports

See also: Performance Reports

Performance reports are used to distribute project performance and status information, should be made available prior to project meetings, and should be as precise and current as possible.

Forecasts are updated and reissued based on work performance measurements provided as the project is executed. This information is about the project's past performance that could impact the project in the future, for example, estimates at completion and estimates to complete. Forecast information is often generated using earned value methods (see Section 7.3.2.2), but may use other methods such as analogy with past projects, re-estimating remaining work, inclusion of impact of external events in the schedule, and others. This information should be available along with performance information and other important information that must be distributed for decision-making purposes. Forecasting methods are described in Section 10.5.2.2. Additional information on performance reports is provided in Section 10.5.3.1.

10.3.1.3 Organizational Process Assets

The organizational process assets (see Section 2.4.3) that can influence the Distribute Information process include, but are not limited to:

• Policies, procedures, and guidelines regarding information distribution,

• Templates, and

• Historical information and lessons learned.

10.3.2 T & T

10.3.2.1 Communication Methods

Individual and group meetings, video and audio conferences, computer chats, and other remote communications methods are used to distribute information.

10.3.2.2 Information Distribution Tools

Project information can be distributed using a variety of tools, including:

• Hard-copy document distribution, manual filing systems, press releases, and sharedaccess electronic databases;

• Electronic communication and conferencing tools, such as e-mail, fax, voice mail, telephone, video and web conferencing, web sites and web publishing; and

• Electronic tools for project management, such as web interfaces to scheduling and project management software, meeting and virtual office support software, portals, and collaborative work management tools.

10.3.3 Outputs

10.3.3.1 Organizational Process Assets Updates

The organizational process assets which may be updated include, but are not limited to:

• **Stakeholder notifications.** Information may be provided to stakeholders about resolved issues, approved changes, and general project status.

• **Project reports.** Formal and informal project reports describe project status and include lessons learned, issues logs, project closure reports, and outputs from other Knowledge Areas (Chapters 4–12).

• **Project presentations.** The project team provides information formally or informally to any or all of the project stakeholders. The information and presentation method should be relevant to the needs of the audience.

• **Project records.** Project records can include correspondence, memos, meeting minutes, and other documents describing the project. This information should, to the extent possible and appropriate, be maintained in an organized manner. Project team members can also maintain records in a project notebook or register, which could be physical or electronic.

• **Feedback from stakeholders.** Information received from stakeholders concerning project operations can be distributed and used to modify or improve future performance of the project.

• **Lessons learned documentation.** Documentation includes the causes of issues, reasoning behind the corrective action chosen, and other types of lessons learned about information distribution. Lessons learned are documented and distributed so that they become part of the historical database for both the project and the performing organization.

10.4 Manage Stakeholder Expectations

See attachment(s): 10.4.JPG

10.4.1 Inputs

10.4.1.1 Stakeholder Register

See also: Stakeholder Register

10.4.1.2 Stakeholder Management Strategy

See also: Stakeholder Management Strategy

10.4.1.3 Project Management Plan

See also: Project Management Plan

The project management plan (Section 4.2.3.1) contains the communications management plan described in Section 10.2.3.1. Stakeholder requirements and expectations provide an understanding of stakeholder goals, objectives, and level of communication required during the project. The needs and expectations are identified, analyzed, and documented in the communications management plan, which is a subsidiary of the project management plan.

10.4.1.4 Issue Log

An issue log or action item log can be used to document and monitor the resolution of issues. It can be used to facilitate communication and ensure a common understanding of issues. Issues do not usually rise to the importance of becoming a project or activity but are usually addressed in order to maintain good, constructive working relationships among various stakeholders, including team members.

The issues are clearly stated and categorized based on urgency and potential impact. An owner is assigned an action item for resolution, and a target date is usually established for closure. Unresolved issues can be a major source of conflict and project delays.

10.4.1.5 Change Log

A change log is used to document changes that occur during a project. These changes, and their impact to the project in terms of time, cost, and risk, must be communicated to the appropriate stakeholders.

10.4.1.6 Organizational Process Assets

The organizational process assets that can influence the Manage Stakeholder Expectations process include, but are not limited to:

• Organizational communication requirements,

• Issue management procedures,

• Change control procedures, and

• Historical information about previous projects.

10.4.2 T & T

10.4.2.1 Communication Methods

See also: Communications Management Plan

The methods of communication identified for each stakeholder in the communications management plan are utilized during stakeholder management.

10.4.2.2 Interpersonal Skills

The project manager applies appropriate interpersonal skills to manage stakeholder expectations.

For example:

• Building trust,

• Resolving conflict,

• Active listening, and

• Overcoming resistance to change.

More information on interpersonal skills is found in Appendix G.

10.4.2.3 Management Skills

Management is the act of directing and controlling a group of people for the purpose of coordinating and harmonizing the group towards accomplishing a goal beyond the scope of individual effort. Management skills used by the project manager include but are not limited to:

• Presentation skills,

• Negotiating,

• Writing skills, and

• Public speaking.

10.4.3 Outputs

10.4.3.1 Organizational Process Assets Updates

Organizational process assets that may be updated include, but are not limited to:

• Causes of issues,

• Reasoning behind corrective actions chosen, and

• Lessons learned from managing stakeholder expectations.

10.4.3.2 Change Requests

See also: Change Requests

Managing stakeholder expectations may result in a change request to the product or the project. It may also include corrective or preventive actions as appropriate.

10.4.3.3 Project Management Plan Updates

Elements of the project management plan that may be updated include, but are not limited to, a communications management plan. This is updated when new or changed communication requirements are identified.. For example, some communications may no longer be necessary, an ineffective communication method may be replaced by another method, or a new communication requirement may be identified.

10.4.3.4 Project Document Updates

Project documents that may be updated include, but are not limited to:

• **Stakeholder management strategy.** This is updated as a result of addressing concerns and resolving issues. For example, it may be determined that a stakeholder has additional informational needs.

• **Stakeholder register.** This is updated as information on stakeholders change, when new stakeholders are identified or if registered stakeholders are no longer involved in or impacted by the project, or other updates for specific stakeholders are required.

• **Issue log.** This is updated as new issues are identified and current issues are resolved.

10.5 Report Performance

See attachment(s): 10.5.JPG

10.5.1 Inputs

10.5.1.1 Project Management Plan

The project management plan provides information on project baselines. The performance measurement baseline is an approved plan for the project work to which the project execution is compared, and deviations are measured for management control. The performance measurement baseline typically integrates scope, schedule, and cost parameters of a project, but may also include technical and quality parameters.

10.5.1.2 Work Performance Information

See also: Work Performance Information

Information from project activities is collected on performance results such as:

• Deliverables status,

• Schedule progress, and

• Costs incurred.

10.5.1.3 Work Performance Measurements

Outputs from: 5.5.3.1 - 6.6.3.1 - 7.3.3.1

Work performance information is used to generate project activity metrics to evaluate actual progress compared to planned progress. These metrics include, but are not limited to:

• Planned versus. actual schedule performance,

• Planned versus actual cost performance, and

• Planned versus actual technical performance.

10.5.1.4 Budget Forecasts

See also: Budget Forecasts

Budget forecast information from the Control Cost (7.3.3.2) provide information on the additional funds that are expected to be required for the remaining work, as well as estimates for the completion of the total project work.

10.5.1.5 Organizational Process Assets

The organizational process assets that can influence the Report Performance process include, but are not limited to:

• Report templates,

• Policies and procedures that define the measures and indicators to be used, and

• Organizationally defined variance limits.

10.5.2 T & T

10.5.2.1 Variance Analysis

See document: Variance_analysis

Variance analysis is an after-the-fact look at what caused a difference between the baseline and the actual performance. The process for performing variance analysis may vary depending on the application area, the standard used and the industry. Common steps are:

• Verify the quality of the information collected to ensure that it is complete, consistent with past data and credible when comparing with other project or status information,

• Determine variances, comparing the actual information with the project baseline and noting all differences both favorable and unfavorable to the project outcome. Earned value management uses specific equations to quantify variances. The technique is explained in detail in Section 7.3.2.1.

• Determine the impact of the variances in the project cost and schedule as well as in other areas of the project (i.e., quality performance adjustments and scope changes, etc.).

If applicable, analyze the trends of the variances and document any findings about the sources of variation and the impact area.

10.5.2.2 Forecasting Methods

See document: Forecasting

Forecasting is the process of predicting future project performance based on the actual performance to date. Forecasting methods may be classified in different categories:

• **Time series methods.** Time series methods use historical data as the basis for estimating future outcomes. Examples of methods in this category may include earned value, moving average, extrapolation, linear prediction, trend estimation and growth curve.

• **Causal/econometric methods.** Some forecasting methods use the assumption that it is possible to identify the underlying factors that might influence the variable that is being forecasted. For example, sales of umbrellas might be associated with weather conditions. If the causes are understood, projections of the influencing variables can be made and used in the forecast. Examples of methods in this category include regression analysis using linear regression or non-linear regression, autoregressive moving average (ARMA) and econometrics.

• **Judgmental methods.** Judgmental forecasting methods incorporate intuitive judgments, opinions and probability estimates. Examples of methods in this category are composite forecasts, surveys, Delphi method, scenario building, technology forecasting, and forecast by analogy.

• **Other methods.** Other methods may include simulation, probabilistic forecasting, and ensemble forecasting.

10.5.2.3 Communication Methods

See also: Communication Methods

Status review meetings can be used to exchange and analyze information about the project progress and performance. The project manager generally uses a push communication technique as defined in 10.2.2.4 to distribute performance reports.

10.5.2.4 Reporting Systems

A reporting system provides a standard tool for the project manager to capture, store, and distribute information to stakeholders about the project cost, schedule progress, and performance. Software packages allow the project manager to consolidate reports from several systems and facilitate report distribution to the project stakeholders. Examples of distribution formats may include table reporting, spreadsheet analysis, and presentations. Graphic capabilities can be used to create visual representations of project performance information.

10.5.3 Outputs

10.5.3.1 Performance Reports

Performance reports organize and summarize the information gathered, and present the results of any analysis as compared to the performance measurement baseline. Reports should provide the status and progress information, at the level of detail required by various stakeholders, as documented in the communications management plan. Common formats for performance reports include bar charts, S- curves, histograms, and tables. Variance analysis, earned value analysis, and forecast data is often included as part of performance reporting. Figure 10-15 gives a tabular view of earned value data (Section 7.3.2.1).

Performance reports are issued periodically and their format may range from a simple status report to more elaborate reports. A simple status report might show only performance information such as percent complete, or status dashboards for each area (e.g., scope, schedule, cost, and quality). More elaborate reports may include:

- Analysis of past performance,
- Current status of risks and issues,
- Work completed during the reporting period,
- Work to be completed during the next reporting period,
- Summary of changes approved in the period,
- Results of variance analysis,
- Forecasted project completion (including time and cost), and
- Other relevant information to be reviewed and discussed.

	Values			Variance		Performance Index	
WBS Element	Planned Value (PV)	Earned Value (EV)	Actual Cost (AC)	Schedule EV - PV	Cost EV - AC	Schedule EV ÷ PV	Cost EV ÷ AC
1.0 Pre-Pilot Plan	63,000	58,000	62,500	(5,000)	(4,500)	0.92	0.93
2.0 Checklists	64,000	48,000	46,800	(16,000)	1,200	0.75	1.03
3.0 Curriculum	23,000	20,000	23,500	(3,000)	(3,500)	0.87	0.85
4.0 Mid-Term Evaluation	68,000	68,000	72,500	–	(4,500)	1.00	0.94
5.0 Implementation Support	12,000	10,000	10,000	(2,000)	–	0.83	1.00
6.0 Practice Manual	7,000	6,200	6,000	(800)	-200	0.89	1.03
7.0 Roll-Out Plan	20,000	13,500	18,100	(6,500)	(4,600)	0.68	0.75
Totals	**257,000**	**223,700**	**239,400**	**(33,300)**	**(15,700)**	**0.87**	**0.93**

Figure 10-15. Tabular Performance Report Sample

10.5.3.2 Organizational Process Assets Updates

The organizational process assets that can be updated include, but are not limited to report formats and lessons learned documentation, including the causes of issues, reasoning behind the corrective action chosen, and other types of lessons learned about performance reporting. Lessons learned are documented so that they become part of the historical database for both this project and the performing organization.

10.5.3.3 Change Requests

See also: Change Requests

Analysis of project performance often generates change requests. These change requests are processed through the Perform Integrated Change Control process (Section 4.5) as follows:

• Recommended corrective actions include changes that bring the expected future performance of the project in line with the project management plan, and

• Recommended preventive actions can reduce the probability of incurring future negative project performance.

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11 Project Risk Management

11.1 Plan Risk Management

See attachment(s): 11.1.JPG

11.1.1 Inputs

11.1.1.1 Project Scope Statement

See also: Project Scope Statement

The project scope statement provides a clear sense of the range of possibilities associated with the project and its deliverables and establishes the framework for how significant the risk management effort may ultimately become.

11.1.1.2 Cost Management Plan

See also: Outputs

The project cost management plan defines how risk budgets, contingencies, and management reserves will be reported and accessed.

11.1.1.3 Schedule Management Plan

See also: Outputs

The schedule management plan defines how schedule contingencies will be reported and assessed.

11.1.1.4 Communications Management Plan

See also: Communications Management Plan

The project communications management plan defines the interactions that will occur on the project, and determines who will be available to share information on various risks and responses at different times (and locations).

11.1.1.5 Enterprise Environmental Factors

The enterprise environmental factors that can influence the Plan Risk Management process include, but are not limited to, risk attitudes and tolerances that describe the degree of risk that an organization will withstand.

11.1.1.6 Organizational Process Assets

The organizational process assets that can influence the Plan Risk Management process include, but are not limited to:

• Risk categories,

• Common definitions of concepts and terms,

• Risk statement formats,

• Standard templates,

• Roles and responsibilities,

• Authority levels for decision-making,

• Lessons learned, and

• Stakeholder registers, which are also critical assets to be reviewed as components of establishing effective risk management plans.

11.1.2 T & T

11.1.2.1 Planning Meetings and Analysis

Project teams hold planning meetings to develop the risk management plan. Attendees at these meetings may include the project manager, selected project team members and stakeholders, anyone in the organization with responsibility to manage the risk planning and execution activities, and others, as needed.

High-level plans for conducting the risk management activities are defined in these meetings. Risk management cost elements and schedule activities will be developed for

inclusion in the project budget and schedule, respectively. Risk contingency reserve application approaches may be established or reviewed. Risk management responsibilities will be assigned. General organizational templates for risk categories and definitions of terms such as levels of risk, probability by type of risk, impact by type of objectives, and the probability and impact matrix will be tailored to the specific project. If templates for other steps in the process do not exist they may be generated in these meetings. The outputs of these activities will be summarized in the risk management plan.

11.1.3 Outputs

11.1.3.1 Risk Management Plan

The risk management plan describes how risk management will be structured and performed on the project. It becomes a subset of the project management plan (Section 4.2.3.1). The risk management plan includes the following:

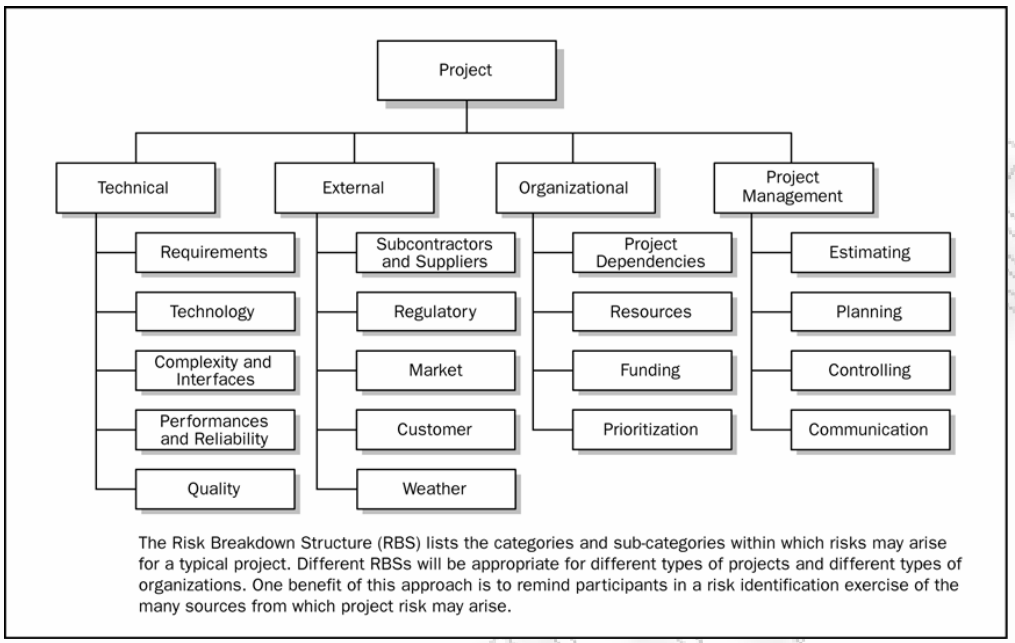
• **Methodology.** Defines the approaches, tools, and data sources that may be used to perform risk management on the project.

• **Roles and responsibilities.** Defines the lead, support, and risk management team members for each type of activity in the risk management plan, and clarifies their responsibilities.

• **Budgeting.** Assigns resources, estimates funds needed for risk management for inclusion in the cost performance baseline, and establishes protocols for application of contingency reserve (Section 7.2.3.1).

• **Timing.** Defines when and how often the risk management process will be performed throughout the project life cycle, establishes protocols for application of schedule contingency reserves, and establishes risk management activities to be included in the project schedule (Section 6.5.3.1).

• **Risk categories.** Provides a structure that ensures a comprehensive process of systematically identifying risks to a consistent level of detail and contributes to the effectiveness and quality of the Identify Risks process. An organization can use a previously prepared categorization framework which might take the form of a simple list of categories or might be structured into a Risk Breakdown Structure (RBS). The RBS is a hierarchically organized depiction of the identified project risks arranged by risk category and subcategory that identifies the various areas and causes of potential risks. An example is shown in Figure 11-4.



The Risk Breakdown Structure (RBS) lists the categories and sub-categories within which risks may arise for a typical project. Different RBSs will be appropriate for different types of projects and different types of organizations. One benefit of this approach is to remind participants in a risk identification exercise of the many sources from which project risk may arise.

Figure 11-4. Example of a Risk Breakdown Structure (RBS)

• **Definitions of risk probability and impact.** The quality and credibility of the Perform Qualitative Risk Analysis process requires that different levels of the risks' probabilities and impacts be defined. General definitions of probability levels and impact levels are tailored to the individual project during the Plan Risk Management process for use in the Perform Qualitative Risk Analysis process (Section 11.3). Figure 11-5 is an example of definitions of negative impacts that could be used in evaluating risk impacts related to four project objectives. (Similar tables could be established with a positive impact perspective). The figure illustrates both relative and numeric (in this case, nonlinear) approaches.

Defined Conditions for Impact Scales of a Risk on Major Project Objectives
(Examples are shown for negative impacts only)

	Relative or numerical scales are shown				
Project Objective	Very low /.05	Low /.10	Moderate /.20	High /.40	Very high /.80
Cost	Insignificant cost increase	<10% cost increase	10-20% cost increase	20-40% cost increase	>40% cost increase
Time	Insignificant time increase	<5% time increase	5-10% time increase	10-20% time increase	>20% time increase
Scope	Scope decrease barely noticeable	Minor areas of scope affected	Major areas of scope affected	Scope reduction unacceptable to sponsor	Project end item is effectively useless
Quality	Quality degradation barely noticeable	Only very demanding applications are affected	Quality reduction requires sponsor approval	Quality reduction unacceptable to sponsor	Project end item is effectively useless

This table presents examples of risk impact definitions for four different project objectives. They should be tailored in the Risk Management Planning process to the individual project and to the organization's risk thresholds. Impact definitions can be developed for opportunities in a similar way.

Figure 11-5. Definition of Impact Scales for Four Project Objectives

• **Probability and impact matrix.** Risks are prioritized according to their potential implications for having an effect on the project's objectives. A typical approach to prioritizing risks is to use a look-up table or a Probability and Impact Matrix (Section 11.3.2.2). The specific combinations of probability and impact that lead to a risk being rated as "high," "moderate," or "low" importance, with the corresponding importance for planning responses to the risk (Section 11.5), are usually set by the organization.

• **Revised stakeholders' tolerances.** Stakeholders' tolerances, as they apply to the specific project, may be revised in the Plan Risk Management process.

• **Reporting formats.** Defines how the outcomes of the risk management processes will be documented, analyzed, and communicated. It describes the content and format of the risk register as well as any other risk reports required.

• **Tracking.** Documents how risk activities will be recorded for the benefit of the current project, as well as for future needs and lessons learned, as well as whether and how risk management processes will be audited.

11.2 Identify Risks

See attachment(s): 11.2.JPG

11.2.1 Inputs

11.2.1.1 Risk Management Plan

See also: Risk Management Plan

Key inputs from the risk management plan to the Identify Risks process are the assignments of roles and responsibilities, provision for risk management activities in the budget and schedule, and categories of risk (Section 11.1), which are sometimes expressed in a risk breakdown structure (Figure 11-4).

11.2.1.2 Activity Cost Estimates

See also: Activity Cost Estimates

Activity cost estimate reviews are useful in identifying risk as they provide a quantitative assessment of the likely cost to complete scheduled activities and ideally are expressed as a range, with the width of the range indicating the degree(s) of risk. The review may result in projections indicating the estimate is either sufficient or insufficient to complete the activity (and hence pose a risk to the project).

11.2.1.3 Activity Duration Estimates

See also: Activity Duration Estimates

Activity duration estimate reviews are useful in identifying risks related to the time allowances for the activities or project as a whole, again with the width of the range of such estimates indicating the relative degree(s) of risk.

11.2.1.4 Scope Baseline

See also: Scope Baseline

Project assumptions are found in the project scope statement (Section 5.2.3.1). Uncertainty in project assumptions should be evaluated as potential causes of project risk.

The WBS is a critical input to identifying risks as it facilitates an understanding of the potential risks at both the micro and macro levels. Risks can be identified and subsequently tracked at summary, control account and/or work package levels.

11.2.1.5 Stakeholder Register

See also: Stakeholder Register

Information about the stakeholders will be useful in soliciting inputs for identifying risks as this will ensure that key stakeholders, especially the customer, are interviewed or otherwise participate during the "Identify Risks" process.

11.2.1.6 Cost Management Plan

See also: Outputs

The risk identification process requires an understanding of the cost management plans found in the project management plan (Section 7.0). The project-specific approach to cost management may generate or alleviate risk by its nature or structure.

11.2.1.7 Schedule Management Plan

See also: Outputs

The risk identification process also requires an understanding of the schedule management plan found in the project management plan (Section 6.0). The project-specific approach to schedule management may generate or alleviate risk by its nature or structure.

11.2.1.8 Quality Management Plan

See also: Quality Management Plan

The risk identification process also requires an understanding of the quality management plan found in the project management plan (Section 8.1.3.1). The project-specific approach to quality management may generate or alleviate risk by its nature or structure.

11.2.1.9 Project Documents

Project documents include, but are not limited to:

- Assumptions log,
- Work performance reports,
- Earned value reports,
- Network diagrams,
- Baselines, and

• Other project information proven to be valuable in identifying risks.

11.2.1.10 Enterprise Environmental Factors

The enterprise environmental factors that can influence the Identify Risks process include, but are not limited to:

• Published information, including commercial databases,

• Academic studies,

• Published checklists,

• Benchmarking,

• Industry studies, and

• Risk attitudes.

11.2.1.11 Organizational Process Assets

The organizational process assets that can influence the Identify Risks process include, but are not limited to:

• Project files, including actual data,

• Organizational and project process controls,

• Risk statement templates, and

• Lessons learned.

11.2.2 T & T

11.2.2.1 Documentation Reviews

A structured review may be performed of project documentation, including plans, assumptions, previous project files, contracts and other information. The quality of the plans, as well as consistency between those plans and the project requirements and assumptions, can be indicators of risk in the project.

11.2.2.2 Information Gathering Techniques

Examples of information gathering techniques used in identifying risk can include:

• **Brainstorming.** The goal of brainstorming is to obtain a comprehensive list of project risks. The project team usually performs brainstorming, often with a multidisciplinary set of experts who are not part of the team. Ideas about project risk are generated under the leadership of a facilitator, either in a traditional free-form brainstorm session with ideas contributed by participants, or structured using mass interviewing techniques such as the nominal group technique. Categories of risk, such as a risk breakdown structure, can be used as a framework. Risks are then identified and categorized by type of risk and their definitions are sharpened.

• **Delphi technique.** The Delphi technique is a way to reach a consensus of experts. Project risk experts participate in this technique anonymously. A facilitator uses a questionnaire to solicit ideas about the important project risks. The responses are summarized and are then recirculated to the experts for further comment. Consensus may be reached in a few rounds of this process. The Delphi technique helps reduce bias in the data and keeps any one person from having undue influence on the outcome.

• **Interviewing.** Interviewing experienced project participants, stakeholders, and subject matter experts can identify risks.

• **Root cause analysis.** Root cause analysis is a specific technique to identify a problem, discover the underlying causes that lead to it, and develop preventive action.

For additional info, you can check in the following links:

http://en.wikipedia.org/wiki/Brainstorming

http://en.wikipedia.org/wiki/Delphi_method

http://en.wikipedia.org/wiki/Root_cause_analysis

11.2.2.3 Checklist Analysis

See document: summary_checklist_analysis.doc

Risk identification checklists can be developed based on historical information and knowledge that has been accumulated from previous similar projects and from other sources of information. The lowest level of the RBS can also be used as a risk checklist. While a checklist can be quick and simple, it is impossible to build an exhaustive one. The team should make sure to explore items that do not appear on the checklist. The checklist should be reviewed during project closure to incorporate new lessons learned and improve it for use on future projects.

11.2.2.4 Assumptions Analysis

See document: assumptions-analysis-technique

Every project and every identified project risk is conceived and developed based on a set of hypotheses, scenarios, or assumptions. Assumptions analysis explores the validity of assumptions as they apply to the project. It identifies risks to the project from inaccuracy, instability, inconsistency, or incompleteness of assumptions.

11.2.2.5 Diagramming Techniques

Risk diagramming techniques may include:

• **Cause-and-effect diagrams** (Section 8.3.2.1). These are also known as Ishikawa or fishbone diagrams, and are useful for identifying causes of risks.

• **System or process flow charts.** These show how various elements of a system interrelate, and the mechanism of causation (Section 8.3.2.3).

• **Influence diagrams.** These are graphical representations of situations showing causal influences, time ordering of events, and other relationships among variables and outcomes.

For additional info, you can check in the following links:

http://en.wikipedia.org/wiki/Ishikawa_diagram

http://en.wikipedia.org/wiki/Flowchart

http://en.wikipedia.org/wiki/Influence_diagrams

11.2.2.6 SWOT Analysis

See document: SWOT_analysis

This technique examines the project from each of the SWOT (strengths, weaknesses, opportunities and threats) perspectives to increase the breadth of identified risks by including internallygenerated risks. The technique starts with identification of strengths and weaknesses of the organization, focusing on either the project organization or the wider business. These factors are often identified using brainstorming. SWOT analysis then identifies any opportunities for the project that arise from organizational strengths, and any threats arising from organizational weaknesses. SWOT analysis also examines the degree to which organizational strengths offset threats and opportunities that may serve to overcome weaknesses.

11.2.2.7 Expert Judgment

Risks can be identified directly by experts with relevant experience of similar projects or business areas. Such experts should be identified by the project manager and invited to consider all aspects of the project and suggest possible risks based on their previous experience and areas of expertise. The experts' bias should be taken into account in this process.

11.2.3 Outputs

11.2.3.1 Risk Register

See also: Risk Register Updates

The primary outputs from Identify Risks are the initial entries into the risk register. The risk register ultimately contains the outcomes of the other risk management processes as they are conducted, resulting in an increase in the level and type of information contained in the risk register over time. The preparation of the risk register begins in the

Identify Risks process with the following information, and then becomes available to other project management and Project Risk Management processes.

• **List of identified risks.** The identified risks are described in as much detail as is reasonable. A simple structure for risks in the list may be applied, such as EVENT may occur, causing IMPACT, or If CAUSE, EVENT may occur, leading to EFFECT. In addition to the list of identified risks, the root causes of those risks may become more evident. These are the fundamental conditions or events that may give rise to one or more identified risks. They should be recorded and used to support future risk identification for this and other projects.

• **List of potential responses.** Potential responses to a risk may sometimes be identified during the Identify Risks process. These responses, if identified in this process, may be useful as inputs to the Plan Risk Responses process (Section 11.5).

11.3 Perform Qualitative Risk Analysis

See attachment(s): 11.3.JPG

11.3.1 Inputs

11.3.1.1 Risk Register

See also: Risk Register

11.3.1.2 Risk Management Plan

See also: Risk Management Plan

Key elements of the risk management plan for Perform Qualitative Risk Analysis include roles and responsibilities for conducting risk management, budgets, schedule activities for risk management, risk categories, definitions of probability and impact, the probability and impact matrix, and revised stakeholders' risk tolerances. These inputs are usually tailored to the project during the Plan Risk Management process (Section 11.1). If they are not available they can be developed during the Perform Qualitative Risk Analysis process (Section 11.3).

11.3.1.3 Project Scope Statement

See also: Project Scope Statement

Projects of a common or recurrent type tend to have more well-understood risks. Projects using state-of-the-art or first-of-its-kind technology, and highly complex projects, tend to have more uncertainty. This can be evaluated by examining the project scope statement (Section 5.2.3.1).

11.3.1.4 Organizational Process Assets

The organizational process assets that can influence the Perform Qualitative Risk Analysis process include, but are not limited to:

• Information on prior, similar completed projects,

• Studies of similar projects by risk specialists, and

• Risk databases that may be available from industry or proprietary sources.

11.3.2 T & T

11.3.2.1 Risk Probability and Impact Assessment

See document: 000817.htm

Risk probability assessment investigates the likelihood that each specific risk will occur. Risk impact assessment investigates the potential effect on a project objective such as schedule, cost, quality, or performance, including both negative effects for threats and positive effects for opportunities.

Probability and impact are assessed for each identified risk. Risks can be assessed in interviews or meetings with participants selected for their familiarity with the risk categories on the agenda. Project team members and, perhaps, knowledgeable persons from outside the project, are included.

The level of probability for each risk and its impact on each objective is evaluated during the interview or meeting. Explanatory detail, including assumptions justifying the levels assigned, is also recorded. Risk probabilities and impacts are rated according to the definitions given in the risk management plan (Section 11.1.3.1). Risks with low ratings of probability and impact will be included on a watchlist for future monitoring.

11.3.2.2 Probability and Impact Matrix

See document: probability-and-impact-matrix

Risks can be prioritized for further quantitative analysis and response based on their risk rating. Usually, these risk-rating rules are specified by the organization in advance of the project and included in organizational process assets. Risk-rating rules can be tailored to the specific project in the Plan Risk Management process (Section 11.1). Evaluation of each risk's importance and, hence, priority for attention, is typically conducted using a look-up table or a probability and impact matrix (Figure 11-10). Such a matrix specifies combinations of probability and impact that lead to rating the risks as low, moderate, or high priority. The dark gray area (with the largest numbers) represents high risk, the medium gray area (with the smallest numbers) represents low risk, and the light gray area (with in-between numbers) represents moderate risk.

Probability and Impact Matrix

Probability	Threats					Opportunities				
0.90	0.05	0.09	0.18	0.36	0.72	0.72	0.36	0.18	0.09	0.05
0.70	0.04	0.07	0.14	0.28	0.56	0.56	0.28	0.14	0.07	0.04
0.50	0.03	0.05	0.10	0.20	0.40	0.40	0.20	0.10	0.05	0.03
0.30	0.02	0.03	0.06	0.12	0.24	0.24	0.12	0.06	0.03	0.02
0.10	0.01	0.01	0.02	0.04	0.08	0.08	0.04	0.02	0.01	0.01
	0.05	0.10	0.20	0.40	0.80	0.80	0.40	0.20	0.10	0.05

Impact (relative scale) on an objective (e.g., cost, time, scope or quality)

Each risk is rated on its probability of occurring and impact on an objective if it does occur. The organization's thresholds for low, moderate or high risks are shown in the matrix and determine whether the risk is scored as high, moderate or low for that objective.

Figure 11-10 Probability and Impact Matrix

As illustrated in Figure 11-5, an organization can rate a risk separately for each objective (e.g., cost, time, and scope). In addition, it can develop ways to determine one overall rating for each risk. An overall project rating scheme can be developed to reflect the organization's preference for one objective over another and using those preferences to develop a weighting of the risks that are assessed by objective. Finally, opportunities and threats can be handled in the same matrix using definitions of the different levels of impact that are appropriate for each.

The risk rating helps guide risk responses. For example, risks that have a negative impact on objectives if they occur (threats), and that are in the high-risk (dark gray) zone of the matrix, may require priority action and aggressive response strategies. Threats in the low-risk (medium gray) zone may not require proactive management action beyond being placed on a watchlist or adding a contingency reserve.

Similarly, opportunities in the high-risk (dark gray) zone that can be obtained most easily and offer the greatest benefit should be targeted first. Opportunities in the low-risk (medium gray) zone should be monitored. The values provided in 11.4.2.1 are representative. The number of steps in the scale is organizationally determined and organizationally dependent.

11.3.2.3 Risk Data Quality Assessment

See document: WHU-ROS-017-Baba-DQA.pdf

A qualitative risk analysis requires accurate and unbiased data if it is to be credible. Analysis of the quality of risk data is a technique to evaluate the degree to which the data

about risks is useful for risk management. It involves examining the degree to which the risk is understood and the accuracy, quality, reliability, and integrity of the data regarding the risk. If data quality is unacceptable, it may be necessary to gather higher-quality data.

11.3.2.4 Risk Categorization

Risks to the project can be categorized by sources of risk (e.g., using the RBS), the area of the project affected (e.g., using the WBS), or other useful category (e.g., project phase) to determine areas of the project most exposed to the effects of uncertainty. Grouping risks by common root causes can lead to developing effective risk responses.

11.3.2.5 Risk Urgency Assessment

Risks requiring near-term responses may be considered more urgent to address. Indicators of priority can include time to affect a risk response, symptoms and warning signs, and the risk rating. In some qualitative analyses the assessment of risk urgency can be combined with the risk ranking determined from the probability and impact matrix to give a final risk severity rating.

11.3.2.6 Expert Judgment

Expert judgment is required to assess the probability and impact of each risk to determine their locations in the matrix shown in Figure 11-10. Experts generally are those having experience with similar projects that occurred in the not-too-distant past. In addition, those who are planning and managing the specific project are experts, particularly about the specifics of that project. Securing expert judgment is often accomplished with the use of risk facilitation workshops or interviews. The experts' bias should be taken into account in this process.

11.3.3 Outputs

11.3.3.1 Risk Register Updates

See also: Risk Register Updates

The risk register is started during the Identify Risks process. The risk register is updated with information from Perform Qualitative Risk Analysis and the updated risk register is included in the project documents. The risk register updates from Perform Qualitative Risk Analysis include:

• **Relative ranking or priority list of project risks.** The probability and impact matrix can be used to classify risks according to their individual significance. Using combinations of each risk's probability of occurring and the impact on objectives if it were to occur, risks will be prioritized relative to each other by sorting them into groups of "high risk," "moderate risk" and "low risk." Risks may be listed by priority separately for schedule, cost and performance, since organizations may value one objective over another. The project manager can then use the prioritized list of risks to focus attention on those items of high significance (high risk) to the most important objectives, where responses can lead to better project outcomes. A description of the basis for the assessed probability and impact should be included for risks assessed as important to the project.

• **Risks grouped by categories.** Risk categorization can reveal common root causes of risk or project areas requiring particular attention. Discovering concentrations of risk may improve the effectiveness of risk responses.

• **Causes of risk or project areas requiring particular attention.** Discovering concentrations of risk may improve the effectiveness of risk responses.

• **List of risks requiring response in the near-term.** Those risks that require an urgent response and those that can be handled at a later date may be put into different groups.

• **List of risks for additional analysis and response.** Some risks might warrant more analysis, including Quantitative Risk Analysis, as well as response action.

• **Watchlists of low-priority risks.** Risks that are not assessed as important in the Perform Qualitative Risk Analysis process can be placed on a watchlist for continued monitoring.

• **Trends in qualitative risk analysis results.** As the analysis is repeated, a trend for particular risks may become apparent, and can make risk response or further analysis more or less urgent/important.

11.4 Perform Quantitative Risk Analysis

See attachment(s): 11.4.JPG

11.4.1 Inputs

11.4.1.1 Risk Register

See also: Risk Register

11.4.1.2 Risk Management Plan

See also: Risk Management Plan

11.4.1.3 Cost Management Plan

See also: Project Cost Management

The project cost management plan sets the format and establishes criteria for planning, structuring, estimating, budgeting, and controlling project costs (Section 7.0). Those controls may help determine the structure and/or application approach for quantitative analysis of the budget or cost plan.

11.4.1.4 Schedule Management Plan

See also: Project Time Management

The project schedule management plan sets the format and establishes criteria for developing and controlling the project schedule (Section 6.0). Those controls and the nature of the schedule itself may help determine the structure and/or application approach for quantitative analysis of the schedule.

11.4.1.5 Organizational Process Assets

The organizational process assets that can influence the Perform Quantitative Risk Analysis process include, but are not limited to:

• Information on prior, similar completed projects,

• Studies of similar projects by risk specialists, and

• Risk databases that may be available from industry or proprietary sources.

11.4.2 T & T

11.4.2.1 Data Gathering and Representation Techniques

• **Interviewing.** Interviewing techniques draw on experience and historical data to quantify the probability and impact of risks on project objectives. The information needed depends upon the type of probability distributions that will be used. For instance, information would be gathered on the optimistic (low), pessimistic (high), and most likely scenarios for some commonly used distributions. Examples of three point estimates for cost are shown in Figure 11-13. Additional information on three point estimates is in Estimate Activity Durations (Section 6.4.2.4) and Estimate Costs (Section 7.1.2.5). Documenting the rationale of the risk ranges and the assumptions behind them are important components of the risk interview because they can provide insight on the reliability and credibility of the analysis.

Range of Project Cost Estimates

WBS Element	Low	Most Likely	High
Design	$4M	$6M	$10M
Build	$16M	$20M	$35M
Test	$11M	$15M	$23M
Total Project	$31M	$41M	$68M

Interviewing relevant stakeholders helps determine the three-point estimates for each WBS element for triangular, beta or other distributions. In this example, the likelihood of completing the project at or below the most likely estimate of $41 million is relatively small as shown in the simulation results in Figure 11-16 (Cost Risk Simulation Results).

Figure 11-13. Range of Project Cost Estimates Collected During the Risk Interview

• **Probability distributions.** Continuous probability distributions, used extensively in modeling and simulation (11.4.2.2) represent the uncertainty in values such as durations of schedule activities and costs of project components. Discrete distributions can be used to represent uncertain events such as the outcome of a test or a possible scenario in a

decision tree. Two examples of widely used continuous distributions are shown in Figure 11-14. These distributions depict shapes that are compatible with the data typically developed during the quantitative risk analysis. Uniform distributions can be used only if there is no obvious value that is more likely than any other between specified high and low bounds, such as in the early concept stage of design.

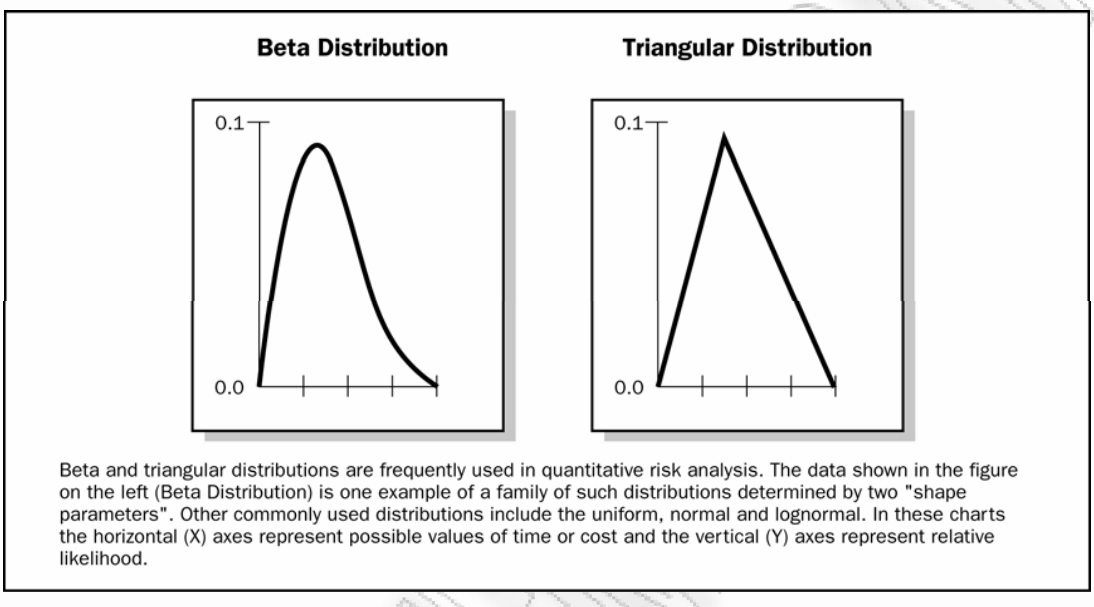


Figure 11-14. Examples of Commonly Used Probability Distributions

For additional info, you can check in the following links:

http://en.wikipedia.org/wiki/Probability_distributions

11.4.2.2 Quantitative Risk Analysis and Modeling Techniques

Commonly used techniques include both event-oriented and project- oriented analysis approaches including:

• **Sensitivity analysis.** Sensitivity analysis helps to determine which risks have the most potential impact on the project. It examines the extent to which the uncertainty of each project element affects the objective being examined when all other uncertain elements are held at their baseline values. One typical display of sensitivity analysis is the tornado diagram, which is useful for comparing relative importance and impact of variables that have a high degree of uncertainty to those that are more stable.

• **Expected monetary value analysis.** Expected monetary value (EMV) analysis is a statistical concept that calculates the average outcome when the future includes scenarios that may or may not happen (i.e., analysis under uncertainty). The EMV of opportunities will generally be expressed as positive values, while those of risks will be negative. EMV requires a risk-neutral assumption, neither risk averse, nor risk seeking.

EMV for a project is calculated by multiplying the value of each possible outcome by its probability of occurrence and adding the products together. A common use of this type of analysis is in decision tree analysis (Figure 11-15).

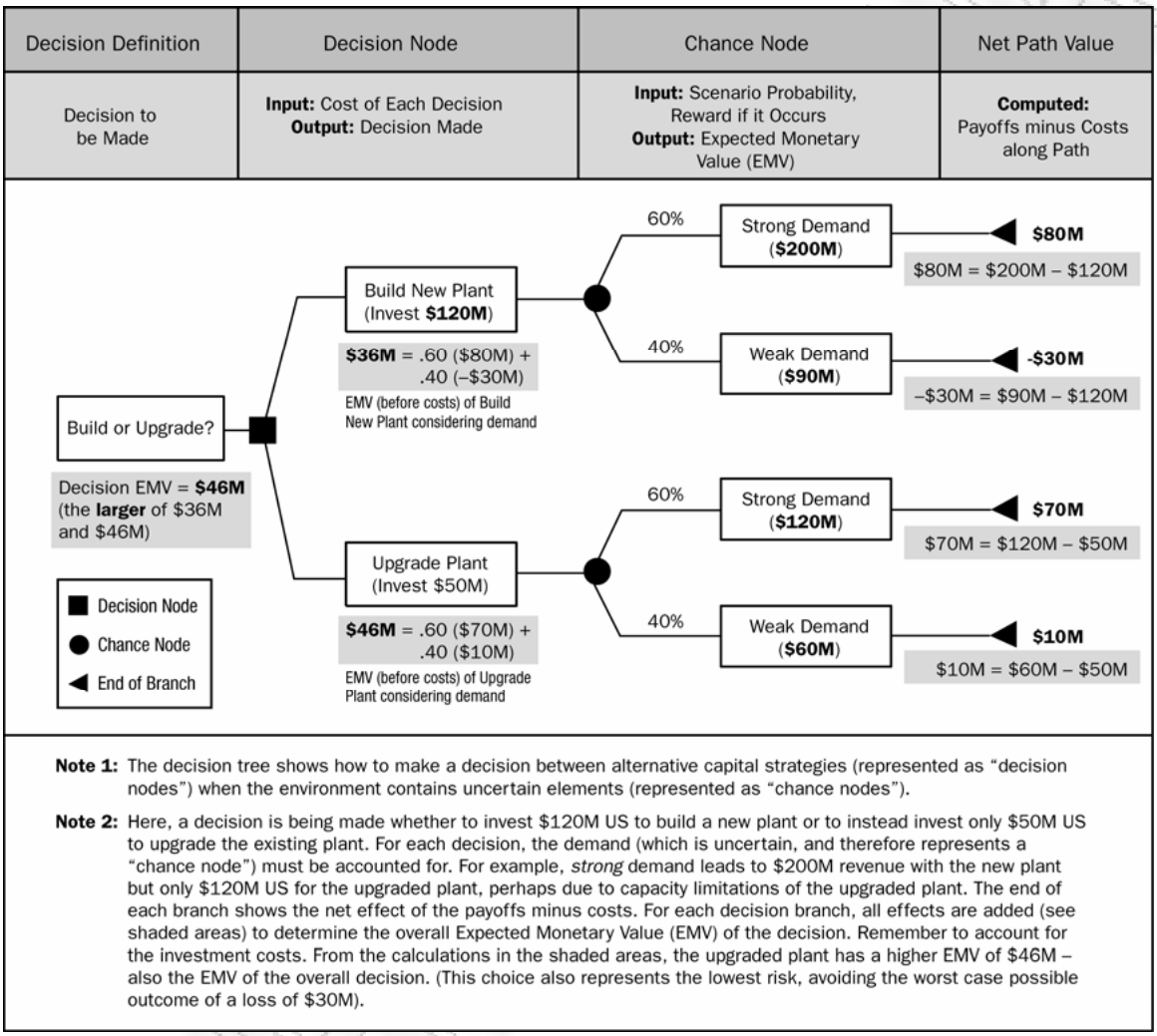


Figure 11-15. Decision Tree Diagram

• **Modeling and simulation.** A project simulation uses a model that translates the specified detailed uncertainties of the project into their potential impact on project objectives. Iterative simulations are typically performed using the Monte Carlo technique. In a simulation, the project model is computed many times (iterated), with the input values (e.g., cost estimates or activity durations) chosen at random for each iteration from the probability distributions of these variables. A probability distribution (e.g., total cost or completion date) is calculated from the iterations. For a cost risk analysis, a simulation uses cost estimates. For a schedule risk analysis, the schedule network diagram and duration estimates are used. The output from a cost risk simulation

is shown in Figure 11-16. It illustrates the respective likelihood of achieving specific cost targets. Similar curves can be developed for schedule outcomes.

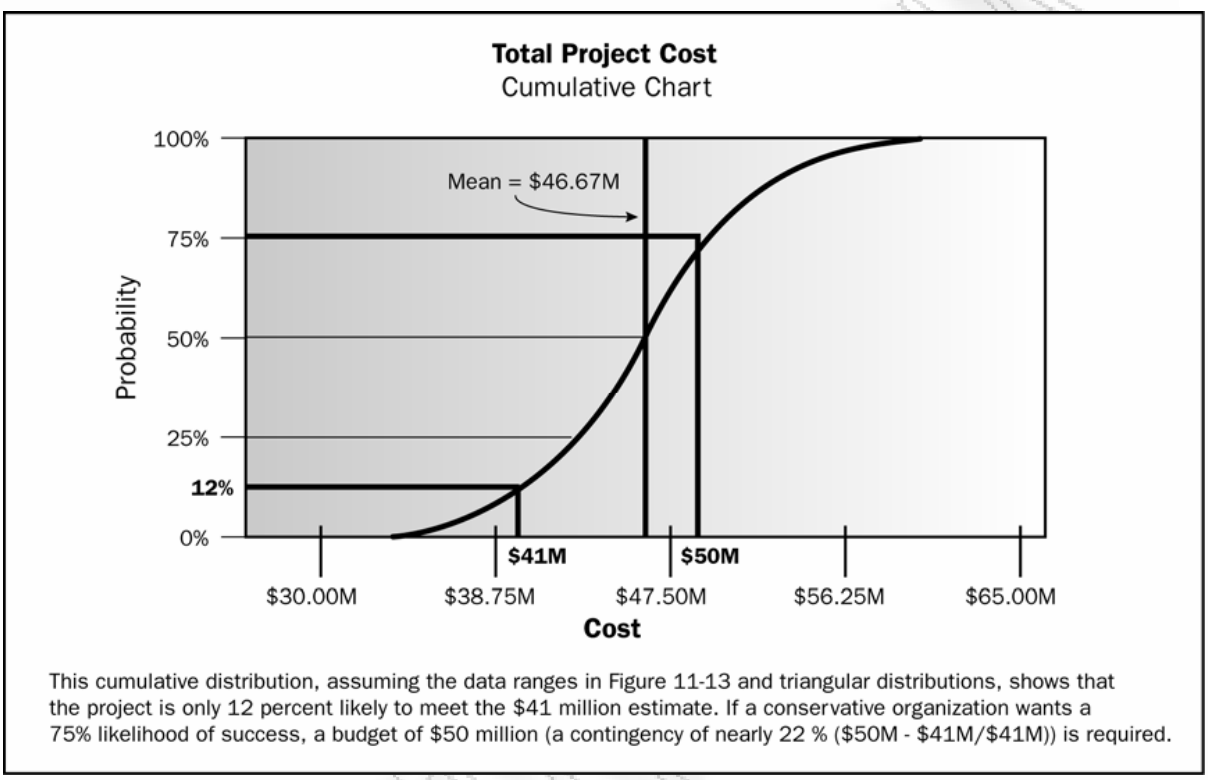


Figure 11-16. Cost Risk Simulation Results

For additional info, you can check in the following links:

http://en.wikipedia.org/wiki/Sensitivity_analysis

http://www.project-management-knowledge.com/definitions/e/expected-monetary-value-analysis/

http://www.vanguardsw.com/dphelp4/dph00076.htm

http://en.wikipedia.org/wiki/Monte_Carlo_method

11.4.2.3 Expert Judgment

Expert judgment (ideally using experts with relevant, recent experience) is required to identify potential cost and schedule impacts, to evaluate probability and to define inputs (such as probability distributions) into the tools.

Expert judgment also comes into play in the interpretation of the data. Experts should be able to identify the weaknesses of the tools as well as their relative strengths. Experts may determine when a specific tool may or may not be more appropriate given the organization's capabilities and culture.

11.4.3 Outputs

11.4.3.1 Risk Register Updates

See also: Risk Register Updates

The risk register is further updated to include a quantitative risk report detailing quantitative approaches, outputs, and recommendations. Updates include the following main components:

• **Probabilistic analysis of the project.** Estimates are made of potential project schedule and cost outcomes listing the possible completion dates and costs with their associated confidence levels. This output, often expressed as a cumulative distribution, can be used with stakeholder risk tolerances to permit quantification of the cost and time contingency reserves. Such contingency reserves are needed to bring the risk of overrunning stated project objectives to a level acceptable to the organization. For instance, in Figure 11-16, the cost contingency to the 75th percentile is $9 million US, or about 22% when compared to the $41 million US sum of the most likely estimates shown in Figure 11-13.

• **Probability of achieving cost and time objectives.** With the risks facing the project, the probability of achieving project objectives under the current plan can be estimated using quantitative risk analysis results. For instance, in Figure 11-16, the likelihood of achieving the cost estimate of $41 million US (from Figure 11-13) is about 12%.

• **Prioritized list of quantified risks.** This list of risks includes those that pose the greatest threat or present the greatest opportunity to the project. These include the risks that may have the greatest effect on cost contingency and those that are most likely to influence the critical path. These risks may be identified, in some cases, through a tornado diagram generated as a result of the simulation analyses.

• **Trends in quantitative risk analysis results.** As the analysis is repeated, a trend may become apparent that leads to conclusions affecting risk responses. Organizational historical information on project schedule, cost, quality and performance should reflect new insights gained through the Perform Quantitative Risk Analysis process. Such history may take the form of a quantitative risk analysis report. This report may be separate from, or linked to, the risk register.

11.5 Plan Risk Responses

See attachment(s): 11.5.JPG

11.5.1 Inputs

11.5.1.1 Risk Register

See also: Risk Register

The risk register refers to identified risks, root causes of risks, lists of potential responses, risk owners, symptoms and warning signs, the relative rating or priority list of project risks, a list of risks requiring response in the near term, a list of risks for additional analysis and response, trends in qualitative analysis results, and a watchlist of low-priority risks.

11.5.1.2 Risk Management Plan

See also: Risk Management Plan

Important components of the risk management plan include roles and responsibilities, risk analysis definitions, timing for reviews (and for eliminating risks from review) and risk thresholds for low, moderate, and high risks. Risk thresholds help identify those risks for which specific responses are needed.

11.5.2 T & T

11.5.2.1 Strategies for Negative Risks or Threats

Three of the following strategies typically deal with threats or risks that may have negative impacts on project objectives if they occur. The fourth strategy, accept, can be used for negative risks or threats as well as positive risks or opportunities. These strategies, described below, are to avoid, transfer, mitigate, or accept.

• **Avoid.** Risk avoidance involves changing the project management plan to eliminate the threat entirely. The project manager may also isolate the project objectives from the risk's impact or change the objective that is in jeopardy. Examples of this include extending the schedule, changing the strategy, or reducing scope. The most radical avoidance strategy is to shut down the project entirely. Some risks that arise early in the project can be avoided by clarifying requirements, obtaining information, improving communication, or acquiring expertise.

• **Transfer.** Risk transfer requires shifting some or all of the negative impact of a threat, along with ownership of the response, to a third party. Transferring the risk simply gives another party responsibility for its management—it does not eliminate it. Transferring liability for risk is most effective in dealing with financial risk exposure. Risk transference nearly always involves payment of a risk premium to the party taking on the risk. Transference tools can be quite diverse and include, but are not limited to, the use of insurance, performance bonds, warranties, guarantees, etc. Contracts may be used to transfer liability for specified risks to another party. For example, when a buyer has capabilities that the seller does not possess, it may be prudent to transfer some work and its concurrent risk contractually back to the buyer. In many cases, use of a cost-plus

contract may transfer the cost risk to the buyer, while a fixed-price contract may transfer risk to the seller.

• **Mitigate.** Risk mitigation implies a reduction in the probability and/or impact of an adverse risk event to be within acceptable threshold limits. Taking early action to reduce the probability and/or impact of a risk occurring on the project is often more effective than trying to repair the damage after the risk has occurred. Adopting less complex processes, conducting more tests, or choosing a more stable supplier are examples of mitigation actions. Mitigation may require prototype development to reduce the risk of scaling up from a bench-scale model of a process or product. Where it is not possible to reduce probability, a mitigation response might address the risk impact by targeting linkages that determine the severity. For example, designing redundancy into a systemmay reduce the impact from a failure of the original component.

• **Accept.** This strategy is adopted because it is seldom possible to eliminate all threats from a project. This strategy indicates that the project team has decided not to change the project management plan to deal with a risk, or is unable to identify any other suitable response strategy. This strategy can be either passive or active. Passive acceptance requires no action except to document the strategy, leaving the project team to deal with the risks as they occur. The most common active acceptance strategy is to establish a contingency reserve, including amounts of time, money, or resources to handle the risks.

11.5.2.2 Strategies for Positive Risks or Opportunities

Three of the four responses are suggested to deal with risks with potentially positive impacts on project objectives. The fourth strategy, accept, can be used for negative risks or threats as well as positive risks or opportunities. These strategies, described below, are to exploit, share, enhance, or accept.

• **Exploit.** This strategy may be selected for risks with positive impacts where the organization wishes to ensure that the opportunity is realized. This strategy seeks to eliminate the uncertainty associated with a particular upside risk by ensuring the opportunity definitely happens. Examples of directly exploiting responses include assigning an organization's most talented resources to the project to reduce the time to completion or to provide lower cost than originally planned.

• **Share.** Sharing a positive risk involves allocating some or all of the ownership of the opportunity to a third party who is best able to capture the opportunity for the benefit of the project. Examples of sharing actions include forming risk-sharing partnerships, teams, special-purpose companies, or joint ventures, which can be established with the express purpose of taking advantage of the opportunity so that all parties gain from their actions.

• **Enhance.** This strategy is used to increase the probability and/or the positive impacts of an opportunity. Identifying and maximizing key drivers of these positive- impact risks may increase the probability of their occurrence. Examples of enhancing opportunities include adding more resources to an activity to finish early.

• **Accept.** Accepting an opportunity is being willing to take advantage of it if it comes along, but not actively pursuing it.

11.5.2.3 Contingent Response Strategies

Some responses are designed for use only if certain events occur. For some risks, it is appropriate for the project team to make a response plan that will only be executed under certain predefined conditions, if it is believed that there will be sufficient warning to implement the plan. Events that trigger the contingency response, such as missing intermediate milestones or gaining higher priority with a supplier, should be defined and tracked.

11.5.2.4 Expert Judgment

Expert judgment is input from knowledgeable parties pertaining to the actions to be taken on a specific and defined risk. Expertise may be provided by any group or person with specialized education, knowledge, skill, experience, or training in establishing risk responses.

11.5.3 Outputs

11.5.3.1 Risk Register Updates

See also: Risk Register Updates

In the Plan Risk Responses process, appropriate responses are chosen, agreed upon, and included in the risk register. The risk register should be written to a level of detail that corresponds with the priority ranking and the planned response. Often, the high and moderate risks are addressed in detail. Risks judged to be of low priority are included in a "watchlist" for periodic monitoring. Components of the risk register at this point can include:

• Identified risks, their descriptions, area(s) of the project (e.g., WBS element) affected, their causes (e.g., RBS element), and how they may affect project objectives;

• Risk owners and assigned responsibilities;

• Outputs from the Perform Qualitative Analysis process (Section 11.3), including prioritized lists of project risks;

• Agreed-upon response strategies;

• Specific actions to implement the chosen response strategy;

• Triggers, symptoms and warning signs of risks' occurrence;

• Budget and schedule activities required to implement the chosen responses;

• Contingency plans and triggers that call for their execution;

• Fallback plans for use as a reaction to a risk that has occurred and the primary response proves to be inadequate;

• Residual risks that are expected to remain after planned responses have been taken, as well as those that have been deliberately accepted;

• Secondary risks that arise as a direct outcome of implementing a risk response; and

• Contingency reserves that are calculated based on the quantitative risk analysis of the project and the organization's risk thresholds.

11.5.3.2 Risk-Related Contract Decisions

Decisions to transfer risk, such as agreements for insurance, services, and other items as appropriate are selected in this process. This may happen as a result of mitigating or transferring part or all of the threat or enhancing or sharing part or all of the opportunity. The contract type selected also provides a mechanism for sharing the risks. These decisions are inputs to the Plan Procurements (Section 12.1) process.

11.5.3.3 Project Management Plan Updates

Elements of the project management plan that may be updated include, but are not limited to:

• **Schedule management plan.** The schedule management plan (Section 6.0) is updated to reflect changes in process and practice driven by the risk responses. This may include changes in tolerance or behavior related to resource loading and leveling, as well as updates to the schedule itself.

• **Cost management plan.** The cost management plan (Section 7.0) is updated to reflect changes in process and practice driven by the risk responses. This may include changes in tolerance or behavior related to cost accounting, tracking, and reports, as well as updates to the budget and the consumption of contingency reserves.

• **Quality management plan.** The quality management plan (Section 8.1.3.1) is updated to reflect changes in process and practice driven by the risk responses. This may include changes in tolerance or behavior related to requirements, quality assurance or quality control, as well as updates to the requirements documentation.

• **Procurement management plan.** The procurement management plan (Section 12.1.3.1) may be updated to reflect changes in strategy, such as alterations in the make-or-buy decision or contract type(s) driven by the risk responses.

• **Human resource management plan.** The staffing management plan, part of the human resource plan (Section 9.1.3.1), is updated to reflect changes in project organizational structure and resource applications driven by the risk responses. This may include changes in tolerance or behavior related to staff allocation, as well as updates to the resource loading.

• **Work breakdown structure.** Because of new work (or omitted work) generated by the risk responses, the WBS (Section 5.3.3.1) may be updated to reflect those changes.

• **Schedule baseline.** Because of new work (or omitted work) generated by the risk responses, the schedule baseline (Section 6.5.3.2) may be updated to reflect those changes.

• **Cost performance baseline.** Because of new work (or omitted work) generated by the risk responses, the cost performance baseline (Section 7.2.3.1) may be updated to reflect those changes.

11.5.3.4 Project Document Updates

Project documents that may be updated include, but are not limited to:

• **Assumptions log updates**. As new information becomes available through the application of risk responses, assumptions will inherently change. The assumptions log must be revisited to accommodate this new information. Assumptions may be incorporated in the scope statement or in a separate assumptions log.

• **Technical documentation updates**. As new information becomes available through the application of risk responses, technical approaches and physical deliverables may change. Any supporting documentation must be revisited to accommodate this new information.

11.6 Monitor and Control Risks

See attachment(s): 11.6.JPG

11.6.1 Inputs

11.6.1.1 Risk Register

See also: Risk Register

The risk register has key inputs that include identified risks and risk owners, agreed-upon risk responses, specific implementation actions, symptoms and warning signs of risk, residual and secondary risks, a watchlist of low-priority risks, and the time and cost contingency reserves.

11.6.1.2 Project Management Plan

See also: Project Management Plan

The project management plan described in Section 4.2.3.1 contains the risk management plan, which includes risk tolerances, protocols and the assignment of people (including the risk owners), time, and other resources to project risk management.

11.6.1.3 Work Performance Information

See also: Work Performance Information

Work performance information related to various performance results includes, but is not limited to:

• Deliverable status,

• Schedule progress, and

• Costs incurred.

11.6.1.4 Performance Reports

See also: Performance Reports

Performance reports (Section 10.5.3.1) take information from performance measurements and analyze it to provide project work performance information including variance analysis, earned value data, and forecasting data.

11.6.2 T & T

11.6.2.1 Risk Reassessment

Monitor and Control Risks often results in identification of new risks, reassessment of current risks and the closing of risks that are outdated. Project risk reassessments should be regularly scheduled. The amount and detail of repetition that is appropriate depends on how the project progresses relative to its objectives.

11.6.2.2 Risk Audits

See document: Audit_risk

Risk audits examine and document the effectiveness of risk responses in dealing with identified risks and their root causes, as well as the effectiveness of the risk management process. The project manager is responsible for ensuring that risk audits are performed at an appropriate frequency, as defined in the project's risk management plan. Risk audits may be included during routine project review meetings, or separate risk audit meetings may be held. The format for the audit and its objectives should be clearly defined before the audit is conducted.

11.6.2.3 Variance and Trend Analysis

Many control processes employ variance analysis to compare the planned results to the actual results. For the purposes of monitoring and controlling risk events, trends in the project's execution should be reviewed using performance information. Earned value analysis (Section 7.3.2.1) and other methods of project variance and trend analysis may be used for monitoring overall project performance. Outcomes from these analyses may forecast potential deviation of the project at completion from cost and schedule targets. Deviation from the baseline plan may indicate the potential impact of threats or opportunities.

For additional info, you can check in the following links:

http://en.wikipedia.org/wiki/Earned_Value_Analysis

http://en.wikipedia.org/wiki/Trend_analysis

http://en.wikipedia.org/wiki/Variance_analysis

11.6.2.4 Technical Performance Measurement

See document: Performance_measurement

Technical performance measurement compares technical accomplishments during project execution to the project management plan's schedule of technical achievement. It requires definition of objective quantifiable measures of technical performance which can be used to compare actual results against targets. Such technical performance measures might include weight, transaction times, number of delivered defects, storage capacity, etc. Deviation, such as demonstrating more or less functionality than planned at a milestone, can help to forecast the degree of success in achieving the project's scope, and it may expose the degree of technical risk faced by the project.

11.6.2.5 Reserve Analysis

See document: reserve-analysis

Throughout execution of the project some risks may occur, with positive or negative impacts on budget or schedule contingency reserves (Sections 6.5.3.3 and 7.1.2.6). Reserve analysis compares the amount of the contingency reserves remaining to the amount of risk remaining at any time in the project in order to determine if the remaining reserve is adequate.

11.6.2.6 Status Meetings

Project risk management should be an agenda item at periodic status meetings. The amount of time required for that item will vary, depending upon the risks that have been identified, their priority, and difficulty of response. Risk management becomes easier the more often it is practiced. Frequent discussions about risk makes it more likely that people will identify risks and opportunities.

11.6.3 Outputs

11.6.3.1 Risk Register Updates

An updated risk register includes, but is not limited to:

• Outcomes of risk reassessments, risk audits, and periodic risk reviews. These outcomes may include identification of new risk events, updates to probability, impact, priority, response plans, ownership, and other elements of the risk register. Outcomes can also include closing risks that are no longer applicable and releasing their associated reserves.

• Actual outcomes of the project's risks and of the risk responses. This information can help project managers to plan for risk throughout their organizations, as well as on future projects.

11.6.3.2 Organizational Process Assets Updates

The six Project Risk Management processes produce information that can be used for future projects, and should be captured in the organizational process assets. The organizational process assets that may be updated include, but are not limited to:

• Templates for the risk management plan, including the probability and impact matrix, and risk register;

• Risk breakdown structure; and

• Lessons learned from the project risk management activities.

These documents should be updated as needed and at project closure. Final versions of the risk register and the risk management plan templates, checklists, and risk breakdown structure are included.

11.6.3.3 Change Requests

See also: Change Requests

Implementing contingency plans or workarounds sometimes results in a change request. Change requests are prepared and submitted to the Perform Integrated Change Control process (Section 4.5). Change requests can include recommended corrective and preventive actions as well.

• **Recommended corrective actions.** Recommended corrective actions include contingency plans and workaround plans. The latter are responses that were not initially planned, but are required to deal with emerging risks that were previously unidentified or accepted passively.

• **Recommended preventive actions.** Recommended preventive actions are used to bring the project into compliance with the project management plan.

11.6.3.4 Project Management Plan Updates

If the approved change requests have an effect on the risk management processes, the corresponding component documents of the project management plan are revised and reissued to reflect the approved changes. The elements of the project management plan that may be updated are the same as those in the Plan Risk Responses process (Section 11.5).

11.6.3.5 Project Document Updates

Project documents that may be updated as a result of the Monitor and Control Risks process are the same as those in the Plan Risk Responses process (Section 11.5).

12 Project Procurement Management

12.1 Plan Procurements

See attachment(s): 12.1.JPG

12.1.1 Inputs

12.1.1.1 Scope Baseline

See also: Scope Baseline

The scope baseline (Section 5.3.3.3) describes the need, justification, requirements, and current boundaries for the project. It consists of the following components:

• **Scope statement.** The project scope statement contains the product scope description, service description and result description, the list of deliverables, and acceptance criteria, as well as important information regarding technical issues or concerns that could impact cost estimating. Examples of constraints are required delivery dates, available skilled resources, and organizational policies.

• **WBS.** (Section 5.3.3.1).

• **WBS dictionary.** The WBS dictionary (Section 5.3.3.2) and related detailed statements of work provide an identification of the deliverables and a description of the work in each WBS component required to produce each deliverable.

12.1.1.2 Requirements Documentation

See also: Requirements Documentation

Requirements documentation may include:

• Important information about project requirements that is considered during planning for procurements.

• Requirements with contractual and legal implications that may include health, safety, security, performance, environmental, insurance, intellectual property rights, equal employment opportunity, licenses, and permits—all of which are considered when planning for procurements.

12.1.1.3 Teaming Agreements

Teaming agreements are legal contractual agreements between two or more entities to form a partnership or joint venture, or some other arrangement as defined by the parties. The agreement defines buyer-seller roles for each party. Whenever the new business opportunity ends, the teaming agreement also ends. Whenever a teaming agreement is in effect, the planning process for the project is significantly impacted. Thus whenever a teaming agreement is in place on a project, the roles of buyer and seller are predetermined, and such issues as scope of work, competition requirements, and other critical issues are generally predefined.

12.1.1.4 Risk Register

See also: Risk Register

The risk register includes risk-related information such as the identified risks, risk owners, and risk responses.

12.1.1.5 Risk-Related Contract Decisions

See also: Risk-Related Contract Decisions

Risk-related contract decisions include agreements including insurance, bonding, services, and other items as appropriate, that are prepared to specify each party's responsibility for specific risks.

12.1.1.6 Activity Resource Requirements

See also: Activity Resource Requirements

Activity resource requirements contain information on specific needs such as people, equipment, or location.

12.1.1.7 Project Schedule

See also: Project Schedule

Project schedule contains information on required timelines or mandated deliverable dates.

12.1.1.8 Activity Cost Estimates

See also: Activity Cost Estimates

Cost estimates developed by the procuring activity are used to evaluate the reasonableness of the bids or proposals received from potential sellers.

12.1.1.9 Cost Performance Baseline

See also: Cost Performance Baseline

The cost performance baseline provides detail on the planned budget over time.

12.1.1.10 Enterprise Environmental Factors

The enterprise environmental factors that can influence the Plan Procurements process include, but are not limited to:

• Marketplace conditions;

• Products, services, and results that are available in the marketplace;

• Suppliers, including past performance or reputation;

• Typical terms and conditions for products, services, and results or for the specific industry; and

• Unique local requirements.

12.1.1.11 Organizational Process Assets

The organizational process assets that influence the Plan Procurement process include, but are not limited to:

• Formal procurement policies, procedures, and guidelines. Most organizations have formal procurement policies and buying organizations. When such procurement support is not available, the project team will have to supply both the resources and the expertise to perform such procurement activities.

• Management systems that are considered in developing the procurement management plan and selecting the contract types to be used.

• An established multi-tier supplier system of pre-qualified sellers based on prior experience.

12.1.2 T & T

12.1.2.1 Make-or-Buy Analysis

See document: make-buy-decisions

A make-or-buy analysis is a general management technique used to determine whether particular work can best be accomplished by the project team or must be purchased from outside sources. Sometimes a capability may exist within the project organization, but may be committed to working on other projects, in which case the project may need to source such effort from outside the organization in order to meet its schedule commitments.

Budget constraints may influence make-or-buy decisions. If a buy decision is to be made, then a further decision of whether to purchase or lease is also made. A make- or-buy analysis should consider all related costs; both direct costs as well as indirect support costs. For example, the buy-side of the analysis includes both the actual out- of-pocket costs to purchase the product, as well as the indirect costs of supporting the purchasing process and purchased item.

12.1.2.2 Expert Judgment

Expert technical judgment will often be used to assess the inputs to and outputs from this process. Expert purchasing judgment can also be used to develop or modify the criteria that will be used to evaluate seller proposals. Expert legal judgment may involve the services of legal staff to assist with unique procurement issues, terms, and conditions. Such judgment, including business and technical expertise, can be applied to both the technical details of the acquired products, services, or results and to various aspects of the procurement management processes.

12.1.2.3 Contract Types

See document: FARTOCP16.html

The risk shared between the buyer and seller is determined by the contract type. Although the firm-fixed-price type of contractual arrangement is typically the preferred type which is encouraged and often demanded by most organizations, there are times

when another contract form may be in the best interests of the project. If a contract type other than fixed-price is intended, it is incumbent on the project team to justify its use. The type of contract to be used and the specific contract terms and conditions fix the degree of risk being assumed by the buyer and seller.

All legal contractual relationships generally fall into one of two broad families, either fixedprice or cost reimbursable. Also, there is a third hybrid-type commonly in use called the time and materials contract. The more popular of the contract types in use are discussed below as discrete types, but in practice it is not unusual to combine one or more types into a single procurement.

• **Fixed-price contracts.** This category of contracts involves setting a fixed total price for a defined product or service to be provided. Fixed-price contracts may also incorporate financial incentives for achieving or exceeding selected project objectives, such as schedule delivery dates, cost and technical performance, or anything that can be quantified and subsequently measured. Sellers under fixed- price contracts are legally obligated to complete such contracts, with possible financial damages if they do not. Under the fixed-price arrangement, buyers must precisely specify the product or services being procured. Changes in scope can be accommodated, but generally at an increase in contract price.

o **Firm Fixed Price Contracts (FFP).** The most commonly used contract type is the FFP. It is favored by most buying organizations because the price for goods is set at the outset and not subject to change unless the scope of work changes. Any cost increase due to adverse performance is the responsibility of the seller, who is obligated to complete the effort. Under the FFP contract, the buyer must precisely specify the product or services to be procured, and any changes to the procurement specification can increase the costs to the buyer.

o **Fixed Price Incentive Fee Contracts (FPIF).** This fixed-price arrangement gives the buyer and seller some flexibility in that it allows for deviation from performance, with financial incentives tied to achieving agreed to metrics. Typically such financial incentives are related to cost, schedule, or technical performance of the seller. Performance targets are established at the outset, and the final contract price is determined after completion of all work based on the seller's performance. Under FPIF contracts, a price ceiling is set, and all costs above the price ceiling are the responsibility of the seller, who is obligated to complete the work.

o **Fixed Price with Economic Price Adjustment Contracts (FP-EPA).** This contract type is used whenever the seller's performance period spans a considerable period of years, as is desired with many long-term relationships. It is a fixed-price contract, but with a special provision allowing for pre-defined final adjustments to the contract price due to changed conditions, such as inflation changes, or cost increases (or decreases) for specific commodities. The EPA clause must relate to some reliable financial index which is used to precisely adjust the final price. The FP-EPA contract is intended to protect both buyer and seller from external conditions beyond their control.

• **Cost-reimbursable contracts.** This category of contract involves payments (cost reimbursements) to the seller for all legitimate actual costs incurred for completed work, plus a fee representing seller profit. Cost-reimbursable contracts may also include

financial incentive clauses whenever the seller exceeds, or falls below, defined objectives such as costs, schedule, or technical performance targets. Three of the more common types of cost-reimbursable contracts in use are Cost Plus Fixed Fee (CPFF), Cost Plus Incentive Fee (CPIF), and Cost Plus Award Fee (CPAF).

A cost-reimbursable contract gives the project flexibility to redirect a seller whenever the scope of work cannot be precisely defined at the start and needs to be altered, or when high risks may exist in the effort.

- **Cost Plus Fixed Fee Contracts (CPFF).** The seller is reimbursed for all allowable costs for performing the contract work, and receives a fixed fee payment calculated as a percentage of the initial estimated project costs. Fee is paid only for completed work and does not change due to seller performance. Fee amounts do not change unless the project scope changes.

- **Cost Plus Incentive Fee Contracts (CPIF).** The seller is reimbursed for all allowable costs for performing the contract work and receives a predetermined incentive fee based upon achieving certain performance objectives as set forth in the contract. In CPIF contracts, if the final costs are less or greater than the original estimated costs, then both the buyer and seller share costs from the departures based upon a pre-negotiated cost sharing formula, e.g., an 80/20 split over/under target costs based on the actual performance of the seller.

- **Cost Plus Award Fee Contracts (CPAF).** The seller is reimbursed for all legitimate costs, but the majority of the fee is only earned based on the satisfaction of certain broad subjective performance criteria defined and incorporated into the contract. The determination of fee is based solely on the subjective determination of seller performance by the buyer, and is generally not subject to appeals.

• **Time and Material Contracts (T&M).** Time and material contracts are a hybrid type of contractual arrangement that contain aspects of both cost- reimbursable and fixed-price contracts. They are often used for staff augmentation, acquisition of experts, and any outside support when a precise statement of work cannot be quickly prescribed.

These types of contracts resemble cost-reimbursable contracts in that they can be left open ended and may be subject to a cost increase for the buyer. The full value of the agreement and the exact quantity of items to be delivered may not be defined by the buyer at the time of the contract award. Thus, T&M contracts can increase in contract value as if they were cost-reimbursable contracts. Many organizations require not-toexceed values and time limits placed in all T&M contracts to prevent unlimited cost growth. Conversely, T&M contracts can also resemble fixed unit price arrangements when certain parameters are specified in the contract. Unit labor or material rates can be preset by the buyer and seller, including seller profit, when both parties agree on the values for specific resource categories, such as senior engineers at specified rates per hour, or categories of materials at specified rates per unit.

12.1.3 Outputs

12.1.3.1 Procurement Management Plan

The procurement management plan describes how the procurement processes will be managed from developing procurement documents through contract closure. The procurement management plan can include guidance for:

• Types of contracts to be used;

• Risk management issues;

• Whether independent estimates will be used and if they are needed as evaluation criteria;

• Those actions the project management team can take unilaterally, if the performing organization has a prescribed procurement, contracting, or purchasing department;

• Standardized procurement documents, if they are needed;

• Managing multiple suppliers;

• Coordinating procurement with other project aspects, such as scheduling and performance reporting;

• Any constraints and assumptions that could affect planned procurements;

• Handling the required lead times to purchase items from sellers and coordinating them with the project schedule development;

• Handling the make-or-buy decisions and linking them into the Estimate Activity Resource and Develop Schedule processes;

• Setting the scheduled dates in each contract for the contract deliverables and coordinating with the schedule development and control processes;

• Identifying requirements for performance bonds or insurance contracts to mitigate some forms of project risk;

• Establishing the direction to be provided to the sellers on developing and maintaining a work breakdown structure (WBS);

• Establishing the form and format to be used for the procurement/contract statements of work;

• Identifying pre-qualified sellers, if any, to be used; and

• Procurement metrics to be used to manage contracts and evaluate sellers.

A procurement management plan can be formal or informal, can be highly detailed or broadly framed, and is based upon the needs of each project. The procurement management plan is a subsidiary component of the project management plan (Section 4.2.3.1).

12.1.3.2 Procurement Statements of Work

The statement of work (SOW) for each procurement is developed from the project scope baseline and defines only that portion of the project scope that is to be included within

the related contract. The procurement SOW describes the procurement item in sufficient detail to allow prospective sellers to determine if they are capable of providing the products, services, or results. Sufficient detail can vary based on the nature of the item, the needs of the buyer, or the expected contract form. Information included in a SOW can include specifications, quantity desired, quality levels, performance data, period of performance, work location, and other requirements.

The procurement SOW is written to be clear, complete, and concise. It includes a description of any collateral services required, such as performance reporting or post-project operational support for the procured item. In some application areas, there are specific content and format requirements for a procurement SOW. Each individual procurement item requires a SOW. However, multiple products or services can be grouped as one procurement item within a single SOW.

The procurement SOW can be revised and refined as required as it moves through the procurement process until incorporated into a signed contract award.

12.1.3.3 Make-or-Buy Decisions

Make-or-buy decisions document the conclusions reached regarding what project products, services, or results will be acquired from outside the project organization, or will be performed internally by the project team. This may also include decisions to require insurance policies or performance bond contracts to address some of the identified risks. The make-or-buy decisions document can be as simple as a listing that includes a short justification for the decisions. These decisions can be altered as subsequent procurement activities indicate a requirement for a different approach.

12.1.3.4 Procurement Documents

Procurement documents are used to solicit proposals from prospective sellers. Terms such as bid, tender, or quotation are generally used when the seller selection decision will be based on price (as when buying commercial or standard items), while a term such as proposal is generally used when other considerations, such as technical capability or technical approach are paramount. Common terms are in use for different types of procurement documents and may include request for information (RFI), invitation for bid (IFB), request for proposal (RFP), request for quotation (RFQ), tender notice, invitation for negotiation, and seller initial response. Specific procurement terminology used may vary by industry and location of the procurement.

The buyer structures procurement documents to facilitate an accurate and complete response from each prospective seller and to facilitate easy evaluation of the responses. These documents include a description of the desired form of the response, the relevant procurement statement of work (SOW) and any required contractual provisions. With government contracting, some or all of the content and structure of procurement documents can be defined by regulation.

The complexity and level of detail of the procurement documents should be consistent with the value of, and risks associated with, the planned procurement. Procurement documents must be sufficient to ensure consistent, appropriate responses, but flexible

enough to allow consideration of any seller suggestions for better ways to satisfy the same requirements.

Issuing a procurement request to potential sellers to submit a proposal or bid is normally done in accordance with the policies of the buyer's organization, which can include publication of the request in public newspapers, in trade journals, in public registries, or on the internet.

12.1.3.5 Source Selection Criteria

Selection criteria are often included as a part of the procurement solicitation documents. Such criteria are developed and used to rate or score seller proposals, and can be objective or subjective.

Selection criteria can be limited to purchase price if the procurement item is readily available from a number of acceptable sellers. Purchase price in this context includes both the cost of the item and all ancillary expenses such as delivery.

Other selection criteria can be identified and documented to support an assessment for more complex products, services, or results. Some examples are shown below.

• **Understanding of need.** How well does the seller's proposal address the procurement statement of work?

• **Overall or life-cycle cost.** Will the selected seller produce the lowest total cost of ownership (purchase cost plus operating cost)?

• **Technical capability.** Does the seller have, or can the seller be reasonably expected to acquire, the technical skills and knowledge needed?

• **Risk.** How much risk is embedded in the statement of work, how much risk will be assigned to the selected seller and how does the seller mitigate risk?

• **Management approach.** Does the seller have, or can the seller be reasonably expected to develop, management processes and procedures to ensure a successful project?

• **Technical approach.** Do the seller's proposed technical methodologies, techniques, solutions, and services meet the procurement documents requirements or are they likely to provide more or less than the expected results?

• **Warranty.** What does the seller propose to warrant for the final product, and through what time period?

• **Financial capacity.** Does the seller have, or can the seller reasonably be expected to obtain, the necessary financial resources?

• **Production capacity and interest.** Does the seller have the capacity and interest to meet potential future requirements?

• **Business size and type.** Does the seller's enterprise meet a specific category of business such as small, women-owned, or disadvantaged small business, as defined by the buyer or established by governmental agency and set forth as a condition of the contract award?

• **Past performance of sellers.** What has been the past experience with selected sellers?

• **References.** Can the seller provide references from prior customers verifying the seller's work experience and compliance with contractual requirements?

• **Intellectual property rights.** Does the seller assert intellectual property rights in the work processes or services they will use or in the products they will produce for the project?

• **Proprietary rights.** Does the seller assert proprietary rights in the work processes or services they will use or in the products they will produce for the project?

12.1.3.6 Change Requests

See also: Change Requests

Change requests (Section 4.3.3.3) to the project management plan, its subsidiary plans and other components may result from the Plan Procurements process. Change requests are processed for review and disposition through the Perform Integrated Change Control process (Section 4.5).

12.2 Conduct Procurements

See attachment(s): 12.2.jpg

12.2.1 Inputs

12.2.1.1 Project Management Plan

See also: Project Management Plan

The procurement management plan, part of the project management plan described in 4.2.3.1, is an input to Conduct Procurements and describes how the procurement processes will be managed from developing procurement documentation through contract closure (Section 12.1.3.1).

12.2.1.2 Procurement Documents

See also: Procurement Documents

12.2.1.3 Source Selection Criteria

See also: Source Selection Criteria

Source selection criteria can include information on the supplier's required capabilities, capacity, delivery dates, product cost, life-cycle cost, technical expertise, and the approach to the contract.

12.2.1.4 Qualified Seller List

A listing of sellers who have been pre-screened for their qualifications and past experience, so that procurements are directed to only those sellers who can perform on any resulting contracts.

12.2.1.5 Seller Proposals

Seller proposals prepared in response to a procurement document package form the basic set of information that will be used by an evaluation body to select one or more successful bidders (sellers).

12.2.1.6 Project Documents

Project documents that are often considered include:

- Risk register (Section 11.5.1.1), and
- Risk-related contract decisions (Section 11.5.3.2).

12.2.1.7 Make-or-Buy Decisions

See also: Make-or-Buy Decisions

12.2.1.8 Teaming Agreements

See also: Teaming Agreements

Whenever a teaming agreement is in place, the buyer and seller roles will have already been decided by executive management. In some cases the seller may already be working under some form of interim contract funded by the buyer or jointly by both parties. The effort of the buyer and seller in this process is to collectively prepare a procurement statement of work that will satisfy the requirements of the project. The parties will then negotiate a final contract for award.

12.2.1.9 Organizational Process Assets

Elements of the organizational process assets that can influence the Conduct Procurements process include, but are not limited to:

- Listings of prospective and previously qualified sellers, and
- Information on relevant past experience with sellers, both good and bad.

12.2.2 T & T

12.2.2.1 Bidder Conferences

See document: pre-bid-discussions.php

Bidder conferences (sometimes called contractor conferences, vendor conferences, and pre-bid conferences) are meetings with all prospective sellers and buyers prior to submittal of a bid or proposal. They are used to ensure that all prospective sellers have a clear and common understanding of the procurement (both technical and contractual requirements), and that no bidders receive preferential treatment. Responses to questions can be incorporated into the procurement documents as amendments. To be fair, buyers must take great care to ensure that all prospective sellers hear every question from any individual prospective seller and every answer from the buyer.

12.2.2.2 Proposal Evaluation Techniques

On complex procurements, where source selection will be made based on seller responses to previously defined weighted criteria, a formal evaluation review process will be defined by the buyer's procurement policies. The evaluation committee will make their selection for approval by management prior to the award.

For additional info, you can check in the following links:

http://www.tricare.mil/tps/Eval_Guide.htm

http://www.rect.muni.cz/veda/6RP/ges_200301_en.doc

12.2.2.3 Independent Estimates

For many procurement items, the procuring organization may elect to either prepare its own independent estimate, or have an estimate of costs prepared by an outside professional estimator, to serve as a benchmark on proposed responses. Significant differences in cost estimates can be an indication that the procurement statement of work was deficient, ambiguous, and/or that the prospective sellers either misunderstood or failed to respond fully to the procurement statement of work.

12.2.2.4 Expert Judgment

Expert judgment may be used in evaluating seller proposals. The evaluation of proposals may be accomplished by a multi-discipline review team with expertise in each of the areas covered by the procurement documents and proposed contract. This can include expertise from functional disciplines such as contracting, legal, finance, accounting, engineering, design, research, development, sales, and manufacturing.

12.2.2.5 Advertising

Existing lists of potential sellers can often be expanded by placing advertisements in general circulation publications such as selected newspapers or in specialty trade publications. Some government jurisdictions require public advertising of certain types of procurement items, and most government jurisdictions require public advertising of pending government contracts.

12.2.2.6 Internet Search

The internet has a major influence on most project procurements and supply chain acquisitions in organizations. While many commodities, components, and off-the-shelf-items can be quickly located and secured at a fixed-price on the internet, the high- risk, highly complex, procurement effort that must be closely monitored cannot be obtained by this means.

12.2.2.7 Procurement Negotiations

Negotiations clarify the structure, requirements and other terms of the purchases so that mutual agreement can be reached prior to signing the contract. Final contract language reflects all agreements reached. Subjects covered should include responsibilities, authority to make changes, applicable terms and governing law, technical, and business management approaches, proprietary rights, contract financing, technical solutions, overall schedule, payments, and price. Negotiations conclude with a contract document that can be executed by both buyer and seller.

For complex procurement items, contract negotiation can be an independent process with inputs (e.g., issues or an open items listing) and outputs (e.g., documented decisions) of its own.

For simple procurement items, the terms and conditions of the contract can be previously set and non-negotiable, and only need to be accepted by the seller.

The project manager may not be the lead negotiator on procurements. The project manager and other members of the project management team may be present during negotiations to provide assistance, and if needed to add clarification of the project's technical, quality, and management requirements.

12.2.3 Outputs

12.2.3.1 Selected Sellers

The sellers selected are those sellers who have been judged to be in a competitive range based upon the outcome of the proposal or bid evaluation, and who have negotiated a draft contract that will become the actual contract when an award is made. Final approval of all complex, high-value, high-risk procurements will generally require organizational senior management approval prior to award.

12.2.3.2 Procurement Contract Award

A procurement contract is awarded to each selected seller. The contract can be in the form of simple purchase order or a complex document. Regardless of the document's complexity, a contract is a mutually binding legal agreement that obligates the seller to provide the specified products, services, or results, and obligates the buyer to compensate the seller. A contract is a legal relationship subject to remedy in the courts. The major components in a contract document will vary, but will sometimes include the following:

- Statement of work or deliverables,
- Schedule baseline,
- Performance reporting,
- Period of performance,
- Roles and responsibilities,
- Seller's place of performance,

• Pricing,

• Payment terms,

• Place of delivery,

• Inspection and acceptance criteria,

• Warranty,

• Product support,

• Limitation of liability,

• Fees and retainage,

• Penalties,

• Incentives,

• Insurance and performance bonds,

• Subordinate subcontractor approvals,

• Change request handling, and

• Termination and alternative dispute resolution (ADR) mechanisms. The ADR method can be decided in advance as a part of the procurement award.

12.2.3.3 Resource Calendars

See also: Resource Calendars

The quantity and availability of contracted resources and those dates on which each specific resource can be active or idle are documented.

12.2.3.4 Change Requests

See also: Change Requests

Change requests to the project management plan, its subsidiary plans and other components, are processed for review and disposition through the Perform Integrated Change Control process (Section 4.5).

12.2.3.5 Project Management Plan Updates

Elements of the Project Management Plan that may be updated include, but are not limited to:

• Cost baseline,

• Scope baseline,

• Schedule baseline, and

• Procurement management plan.

12.2.3.6 Project Document Updates

Project documents that may be updated include, but are not limited to:

• Requirements documentation,

• Requirements traceability documentation, and

• Risk register.

12.3 Administer Procurements

See attachment(s): 12.3.JPG

12.3.1 Inputs

12.3.1.1 Procurement Documents

See also: Procurement Documents

Procurement documents contain complete supporting records for administration of the procurement processes. This includes procurement contract awards and the statement of work.

12.3.1.2 Project Management Plan

See also: Project Management Plan

The procurement management plan, part of the project management plan is an input to Conduct Procurements and describes how the procurement processes will be managed from developing procurement documentation through contract closure (Section 12.1.3.1).

12.3.1.3 Contract

See also: Procurement Contract Award

12.3.1.4 Performance Reports

See also: Performance Reports

Seller performance-related documentation includes:

• Seller-developed technical documentation and other deliverable information provided in accordance with the terms of the contract, and

• Seller performance reports (Section 10.5.3.1). The seller's performance reports indicate which deliverables have been completed and which have not.

12.3.1.5 Approved Change Requests

Approved change requests can include modifications to the terms and conditions of the contract including the procurement statement of work, pricing, and description of the products, services, or results to be provided. All changes are formally documented in writing and approved before being implemented.

12.3.1.6 Work Performance Information

See also: Work Performance Information

Work performance information (Section 4.3.3.2) including the extent to which quality standards are being satisfied, what costs have been incurred or committed, and which seller invoices have been paid, are all collected as part of project execution.

12.3.2 T & T

12.3.2.1 Contract Change Control System

A contract change control system defines the process by which the procurement can be modified. It includes the paperwork, tracking systems, dispute resolution procedures, and approval levels necessary for authorizing changes. The contract change control system is integrated with the integrated change control system.

12.3.2.2 Procurement Performance Reviews

A procurement performance review is a structured review of the seller's progress to deliver project scope and quality, within cost and on schedule, as compared to the contract. It can include a review of seller-prepared documentation and buyer inspections, as well as quality audits conducted during seller's execution of the work. The objective of a performance review is to identify performance successes or failures, progress with respect to the procurement statement of work, and contract non-compliance, which allow the buyer to quantify the seller's demonstrated ability or inability to perform work. Such reviews may take place as a part of project status reviews which would include key suppliers.

12.3.2.3 Inspections and Audits

Inspections and audits required by the buyer and supported by the seller as specified in the procurement contract can be conducted during execution of the project to verify compliance in the seller's work processes or deliverables. If authorized by contract, some inspection and audit teams can include buyer procurement personnel.

12.3.2.4 Performance Reporting

Performance reporting provides management with information about how effectively the seller is achieving the contractual objectives.

You can find issue log templates at the links below:

http://www.drum.army.mil/sites/directorates/docs/ppims.doc

http://128.121.134.164/rfps/supportingfiles/07-R-0018/Contractor%20Performance%20Report.doc

12.3.2.5 Payment Systems

Payments to the seller are typically processed by the accounts payable system of the buyer after certification of satisfactory work by an authorized person on the project team. All payments should be made and documented in strict accordance with the terms of the contract.

12.3.2.6 Claims Administration

Contested changes and potential constructive changes are those requested changes where the buyer and seller cannot reach an agreement on compensation for the change, or cannot agree that a change has occurred. These contested changes are variously called claims, disputes, or appeals. Claims are documented, processed, monitored, and managed throughout the contract life cycle, usually in accordance with the terms of the contract. If the parties themselves do not resolve a claim it may have to be handled in accordance with alternative dispute resolution (ADR) typically following procedures established in the contract. Settlement of all claims and disputes through negotiation is the preferred method.

12.3.2.7 Records Management System

A records management system is used by the project manager to manage contract and procurement documentation and records. It consists of a specific set of processes, related control functions, and automation tools that are consolidated and combined as part of the project management information system (Section 4.3.2.2). The system contains a retrievable archive of contract documents and correspondence.

12.3.3 Outputs

12.3.3.1 Procurement Documentation

Procurement documentation includes, but is not limited to, the procurement contract with all supporting schedules, requested unapproved contract changes, and approved change requests. Procurement documentation also includes any seller-developed technical documentation and other work performance information such as deliverables, seller performance reports, warranties, financial documents including invoices and payment records, and the results of contract-related inspections.

12.3.3.2 Organizational Process Assets Updates

Elements of the organizational process assets that may be updated include, but are not limited to:

• **Correspondence.** Contract terms and conditions often require written documentation of certain aspects of buyer/seller communications, such as the need for warnings of unsatisfactory performance and requests for contract changes or clarification. This can include the reported results of buyer audits and inspections that indicate weaknesses the seller needs to correct. In addition to specific contract requirements for documentation, a complete and accurate written record of all written and oral contract communications, as well as actions taken and decisions made, are maintained by both parties.

• **Payment schedules and requests.** All payments should be made in accordance with the procurement contract terms and conditions.

• **Seller performance evaluation documentation**. Seller performance evaluation documentation is prepared by the buyer. Such performance evaluations document the seller's ability to continue to perform work on the current contract, indicate if the seller can be allowed to perform work on future projects, or rate how well the seller is

performing the project work. These documents can form the basis for early termination of the seller's contract or determine how contract penalties, fees, or incentives are administered. The results of these performance evaluations can also be included in the appropriate qualified seller lists (Section 12.2.1.4).

12.3.3.3 Change Requests

See also: Change Requests

Change requests to the project management plan, its subsidiary plans and other components, such as the cost baseline, project schedule (Section 6.5.3.1) and procurement management plan (Section 12.1.3.1), may result from the Administer Procurements process. Change requests are processed for review and approval through the Perform Integrated Change Control process (Section 4.5).

Requested but unresolved changes can include direction provided by the buyer, or actions taken by the seller, that the other party considers a constructive change to the contract. Since any of these constructive changes may be disputed by one party and can lead to a claim against the other party, such changes are uniquely identified and documented by project correspondence.

12.3.3.4 Project Management Plan Updates

Elements of the project management plan that may be updated include, but are not limited to:

• **Procurement management plan.** The procurement management plan (Section 12.1.3.1) is updated to reflect any approved change requests that affect procurement management, including impacts to costs or schedules.

• **Baseline schedule.** If there are slippages that impact overall project performance, the baseline schedule may need to be updated to reflect the current expectations.

12.4 Close Procurements

See attachment(s): 12.4.JPG

12.4.1 Inputs

12.4.1.1 Project Management Plan

See also: Project Management Plan

12.4.1.2 Procurement Documentation

See also: Procurement Documentation

To close the contract, all procurement documentation is collected, indexed, and filed. Information on contract schedule, scope, quality, and cost performance along with all contract change documentation, payment records, and inspection results are catalogued. This information can be used for lessons learned information and as a basis for evaluating contractors for future contracts.

12.4.2 T & T

12.4.2.1 Procurement Audits

A procurement audit is a structured review of the procurement process originating from the Plan Procurements process (Section 12.1) through Administer Procurements (Section 12.3). The objective of a procurement audit is to identify successes and failures that warrant recognition in the preparation or administration of other procurement contracts on the project, or on other projects within the performing organization.

12.4.2.2 Negotiated Settlements

In all procurement relationships the final equitable settlement of all outstanding issues, claims, and disputes by negotiation is a primary goal. Whenever settlement cannot be achieved through direct negotiation, some form of alternative dispute resolution (ADR) including mediation or arbitration may be explored. When all else fails, litigation in the courts is the least desirable option.

12.4.2.3 Records Management System

See also: Records Management System

12.4.3 Outputs

12.4.3.1 Closed Procurements

The buyer, usually through its authorized procurement administrator, provides the seller with formal written notice that the contract has been completed. Requirements for formal procurement closure are usually defined in the terms and conditions of the contract and are included in the procurement management plan.

12.4.3.2 Organizational Process Assets Updates

Elements of the organizational process assets that may be updated include, but are not limited to:

• **Procurement file.** A complete set of indexed contract documentation, including the closed contract, is prepared for inclusion with the final project files.

• **Deliverable acceptance.** The buyer, usually through its authorized procurement administrator, provides the seller with formal written notice that the deliverables have been accepted or rejected. Requirements for formal deliverable acceptance, and how to address non-conforming deliverables, are usually defined in the contract.

• **Lessons learned documentation.** Lessons learned, what has been experienced, and process improvement recommendations should be developed for the project file to improve future procurements.

13 PM - Learning and Certification

In an international scale, there are 2 major non-profitable project management organisations, but also other smaller ones which can equally offer more specialized accreditation to project managers. The American Project Management Institute (PMI), and the International Project Management Association (IPMA) consist two of the widely-known organisations which promote project management to corporations around the world and offer globally recognized credentials. In addition to these associations, there are other, less known ones, through which anyone, with knowledge and adequate experience in PM, can be officially accredited as a PM Associate, Professional, or Master.

13.1 PMI

See document: PMICredentialOverview.aspx

Standards - Knowledge Base

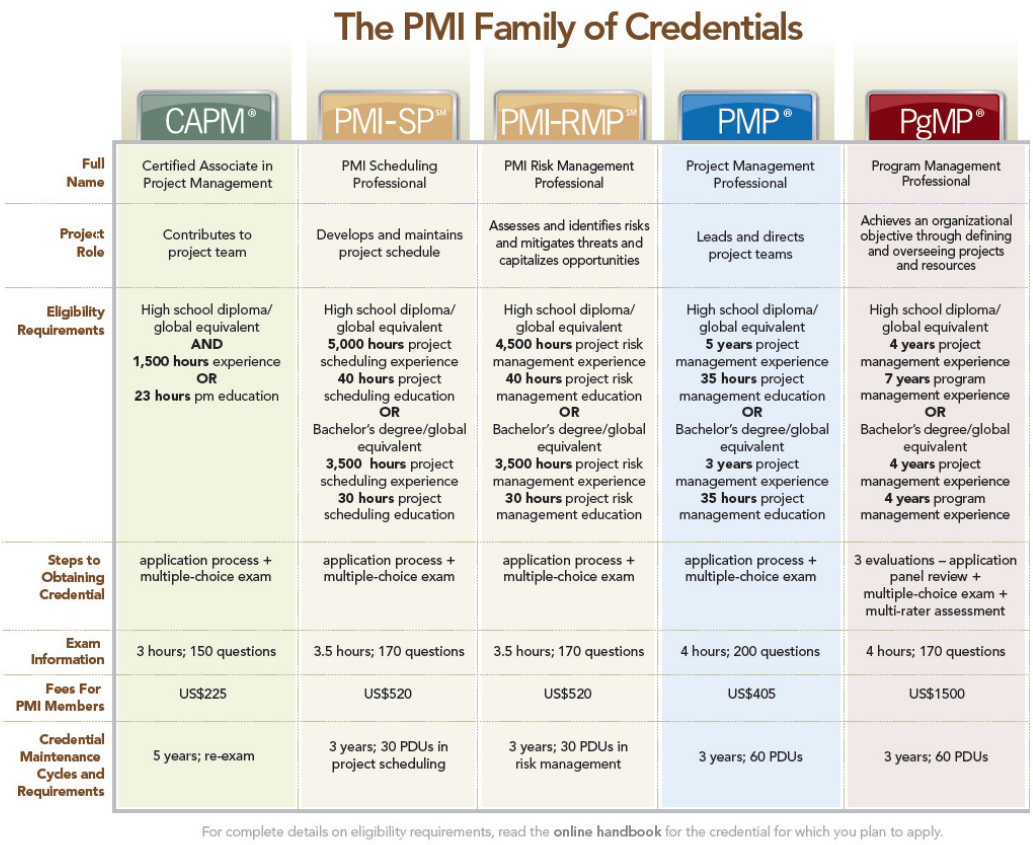
The PM Institute publishes the "PMBOK" (Project Mgmt Body of Knowledge), which contains processes, techniques and methods to follow in various projects. It is updated and re-published every 4-5 years. The most recent version was distributed in 2009. Chapters 2 - 12 are based on this standard.

(PMBOK® Guide) - 4th Edition

Accreditation

In PMI there are five types of credentials. The CAPM, PMI-SP, PMI- RMP, PMP and finally PgMP.

The following table contains all the requirements and necessary exam information for candidates.



The PMI Family of Credentials

	CAPM®	PMI-SP℠	PMI-RMP℠	PMP®	PgMP®
Full Name	Certified Associate in Project Management	PMI Scheduling Professional	PMI Risk Management Professional	Project Management Professional	Program Management Professional
Project Role	Contributes to project team	Develops and maintains project schedule	Assesses and identifies risks and mitigates threats and capitalizes opportunities	Leads and directs project teams	Achieves an organizational objective through defining and overseeing projects and resources
Eligibility Requirements	High school diploma/ global equivalent **AND** **1,500 hours** experience **OR** **23 hours** pm education	High school diploma/ global equivalent **5,000 hours** project scheduling experience **40 hours** project scheduling education **OR** Bachelor's degree/global equivalent **3,500 hours** project scheduling experience **30 hours** project scheduling education	High school diploma/ global equivalent **4,500 hours** project risk management experience **40 hours** project risk management education **OR** Bachelor's degree/global equivalent **3,500 hours** project risk management experience **30 hours** project risk management education	High school diploma/ global equivalent **5 years** project management experience **35 hours** project management education **OR** Bachelor's degree/global equivalent **3 years** project management experience **35 hours** project management education	High school diploma/ global equivalent **4 years** project management experience **7 years** program management experience **OR** Bachelor's degree/global equivalent **4 years** project management experience **4 years** program management experience
Steps to Obtaining Credential	application process + multiple-choice exam	application process + multiple-choice exam	application process + multiple-choice exam	application process + multiple-choice exam	3 evaluations – application panel review + multiple-choice exam + multi-rater assessment
Exam Information	3 hours; 150 questions	3.5 hours; 170 questions	3.5 hours; 170 questions	4 hours; 200 questions	4 hours; 170 questions
Fees For PMI Members	US$225	US$520	US$520	US$405	US$1500
Credential Maintenance Cycles and Requirements	5 years; re-exam	3 years; 30 PDUs in project scheduling	3 years; 30 PDUs in risk management	3 years; 60 PDUs	3 years; 60 PDUs

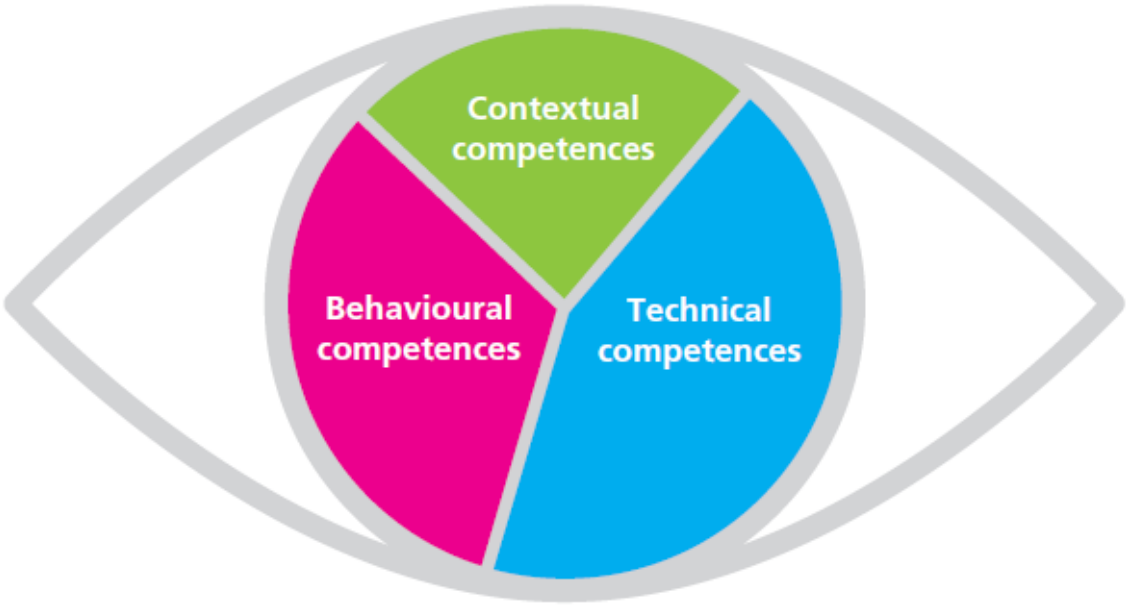
For complete details on eligibility requirements, read the **online handbook** for the credential for which you plan to apply.

13.2 IPMA

See document: default.aspx

Standards - Knowledge Base

Moreover the I.P.M.Association provides a standard called "IPMA Competence Baseline (ICB)" which is the basis for the IPMA 4 Level certification system, and sets out the knowledge and experience expected from the managers of projects, programmes and project portfolios. It contains basic terms, practices, methods and tools for professional project management, as well as specialist knowledge and experience. Just like the PMBOK of PMI, ICB is updated and distributed. The most up-to-date version is 3.0 (2006).



The Eye of Competence

Accreditation

In IPMA there four types of credentials, from A to D, depending on its importance.

(I.P.M.A. - Types of credentials)

13.3 IPMC

See document: www.certifiedprojectmanager.org

INTERNATIONAL PROJECT MANAGEMENT COMMISSION FOR PROJECT MANAGEMENT CERTIFICATION

Accreditation:

MPM - Master Project Manager ™

CIPM - Certified International Project Manager ™

PME - Project Manager E-Business ™

CPE - Certified Planning Engineer ™

CPRM - Project Risk Manager ™

CEC - Certified E-Commerce Consultant ™

MQM - Master Quality Manager ™

13.4 APMG-UK

PRINCE2

"PRINCE2" 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 is the de-facto standard for project management in the UK and is practiced worldwide. "PRINCE2" is a part of "APMG-UK" which specialises in the accreditation and certification of organisations, processes and people, within a range of industries and management disciplines.

For further info, click on the link provided.

http://www.apmgroup.co.uk/PRINCE2/PRINCE2Home.asp

PPM Certificate & Diploma

The APM Group and the Chartered Management Institute (CMI) jointly developed the Level 5 Diploma in Programme and Project Management to satisfy the market need from Program/Project Managers for a degree level qualification specific to their professions. Known as the PPM Diploma, this qualification provides candidates with the opportunity to develop and extend their knowledge and skills, over all areas of a project or programme life cycle.

PPM DIPLOMA

The Certificate in Programme and Project Management is an intermediate level, practical qualification created as a stepping-stone to the elite degree-level Diploma.

PPM CERTIFICATE

For further info, click on the link provided.

http://www.apmgroup.co.uk/PPMDiploma/PPMDiplomaHome.asp

13.5 MS Project 2007

Microsoft Project Management Certification

The Microsoft Certified Technology Specialist ***(MCTS)*** certifications enable professionals to target specific technologies and distinguish themselves by demonstrating in-depth knowledge and expertise in their specialized technologies. More than a product certification, the new Office Project 2007 certification family is designed specifically to help project managers apply the leading project management best practices and methodologies as established by the Project Management Institute (PMI), resulting in better project outcomes, greater efficiency, and optimal resource management.

Microsoft Certified Technology Specialist (MCTS): Managing Projects with Office Project 2007 - (70-632)

The MCTS: Microsoft Office Project 2007 credential for managing projects validates the skills of project managers who use Office Project 2007. Candidates for this credential may work on projects as a team member, project lead, project manager, scheduler, or another role that requires the ability to formulate well thought-out project plans and to manage projects effectively. MCTS candidates may be responsible for the scheduling, estimating, coordinating, controlling, budgeting, and staffing of projects. Candidates may also provide support to other Microsoft Office Project users. Candidates should be familiar with key project management concepts and terminology.

Microsoft Certified Technology Specialist (MCTS): Enterprise Project Management with Office Project Server 2007 - (70-633)

The MCTS: Microsoft Office Project Server 2007 certification for managing projects provides industry recognition to project managers and other professionals who use Microsoft Office Project Professional 2007 and Office Project Server 2007 to manage and support projects in an enterprise environment. Candidates for this credential may use Office Project 2007 or Office Project Server 2007 to manage project and non- project efforts, risks, issues, documents, task progress, and timesheets. Candidates should be familiar with the key project management concepts and terminology found in the Project Management Institute's "A Guide to the Project Management Book of Knowledge" (PMBOK Guide).

Microsoft Certified IT Professional (MCITP): Enterprise Project Management with Office Project Server 2007

The Microsoft Certified IT Professional (MCITP) credential lets you highlight your specific area of expertise. Now you can easily distinguish yourself as an expert in database administration, database development, business intelligence, support, or project management. More than a product certification, the new Microsoft Office Project 2007 certification family is designed specifically to help project managers apply the leading project management best practices and methodologies as established by the Project Management Institute (PMI), resulting in better project outcomes, greater efficiency, and optimal resource management.