Change Control

So far, we have assumed that the nature of the deliverables has not changed. When a document such as the user requirements is being developed there may be many different versions of the document as it undergoes cycles of development and review. Any change control process at this point would be informal and flexible. At some point what is assumed to be the final version will be created. This is baselined, effectively frozen. Baselined products are the foundation for the development of further products - for instance interface design documents may be developed from baselined user requirements.

Changes in scope of a system

A common occurrence with IS development projects is for the size of the system gradually to increase. One cause of this is changes to requirements that are requested by users. The scope of a project needs to be carefully monitored and controlled. One way is to re-estimate the system size in terms of SLOC or function points at key milestones.

Configuration librarian's role

Control of changes and documentation ought to be the responsibility of someone who may variously be named the configuration librarian, the configuration manager or the project librarian.

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The role of configuration librarian:

- **Identifying items that need to be subject to change control -** it is unlikely,for example, that a feasibility report would be subject to change control once agreement has been obtained to start the project
- **Management of a central repository of the master copies of software and documentation**
- **Administering change procedures -** It is important that someone ensures that there is adherence to change control procedures.
- **Maintenance of access records-** A situation to be avoided is where two different developers are making changes to the same software component.

Typical change control process

1. **One or more users might perceive the need for a change -** The user community itself must come to a consensus about whether a proposal for a change should go forward. A change deemed desirable by one part of the user community could cause opposition with other users.

2. **User management decide that the change is valid and worthwhile and pass it to development management**

3. **A developer is assigned to assess the practicality and cost of making the change**
    - 2 and 3. This part of the process often involves a multipart form, initially raised by a user representative and then completed with a response by thedevelopers.
4. **Development management report back to user management on the cost of the change; user management decide whether to go ahead -** There could be achange control board with user and developer representatives that oversees this decision-making process
5. **One or more developers are authorized to make copies of components to bemodified -** The configuration librarian would control this release
6. **Copies modified. After initial testing, a test version might be released to users for acceptance testing -** Note that it is a copy that is modified; the original would still exist as the current operational version
7. **When the development of new versions of the product has been completed the user management will be notified and copies of the software will be released for user acceptance testing.**
8. **When users are satisfied then operational release authorized – master configuration items updated -** The previous version of the configuration items would be archived but preserved. If there are unforeseen problems with the newversion when it is made operational then a fall-back to the previous version could be considered

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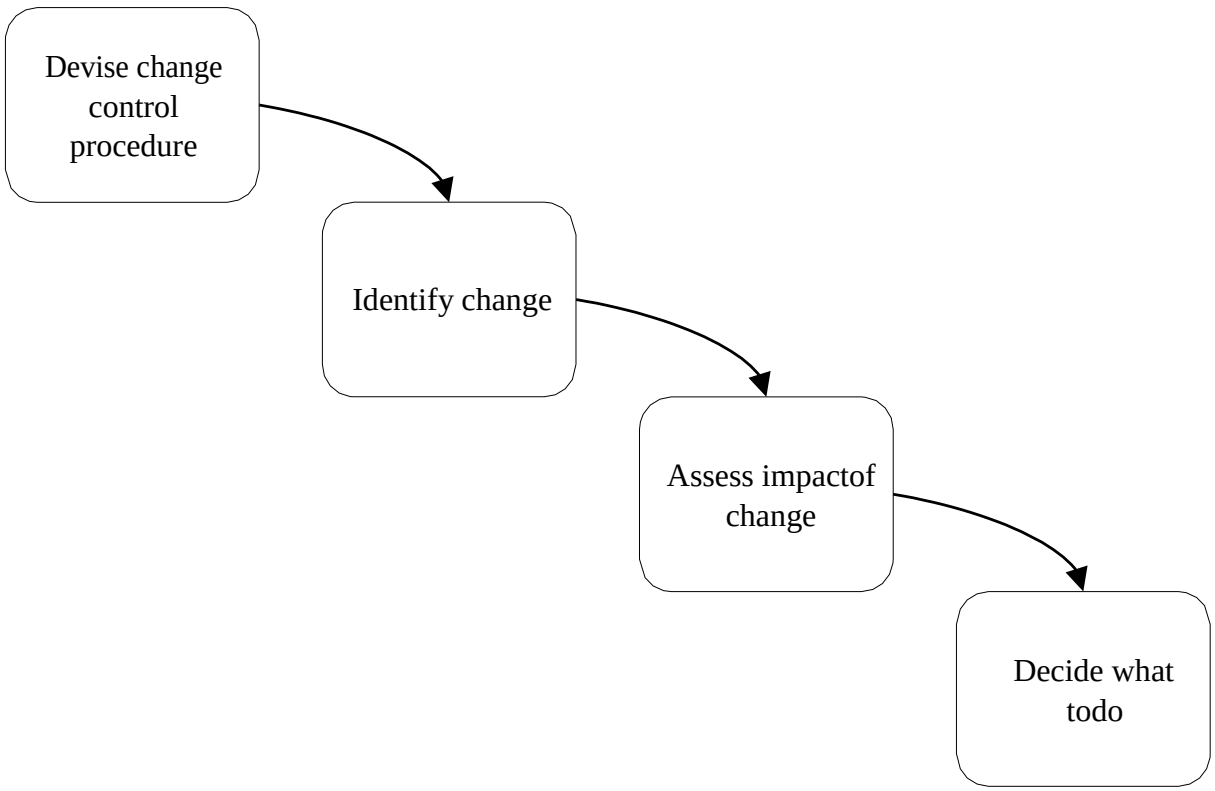
Change control and configuration management



- **Change control**
  - Set of procedures to ensure that changes made only after a considerationof the full impacts.
- **Configuration management**
  - Version control to ensure that all changes are properly recorded and managed – and so that knock-on effects on other projects can be identified.

A definition of software Configuration Management

- "The process of identifying and defining the configuration items in a system,
- controlling the release and change of these items throughout thesystem life cycle,
- recording and reporting the status of configuration items and change requests,
- verifying the completeness and correctness of configurationitems."
- An engineering management procedure that includes
  - configuration identification
  - configuration control
  - configuration status accounting
  - configuration audit

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Difference between version control and change control is

Version control is the management of changes to documents, computerprograms, large web sites, and other collections of information.

Change control is a formal process used to ensure that changes to aproduct or system are introduced in a controlled and coordinated manner.

Earned Value analysis

Definition:

Earned value analysis is a method of performance measurement. Earned value integrates cost, schedule and scope and can be used to forecast future performance and project completion dates. It allows projects to be managed better – on time, on budget.

Three quantities form the basis for cost performance measurement using Earned Value Management. They are

1. Budgeted Cost of Work Scheduled (BCWS) or Planned Value (PV)
2. Budgeted Cost of Work Performed (BCWP) or Earned Value (EV) and
3. Actual Cost of Work Performed (ACWP) or Actual Cost (AC).

The above quantities are defined below.

- **Budgeted Cost of Work Scheduled (BCWS)** or **Planned Value (PV)** – The sum of budgets for all work packages scheduled to be accomplished within a given time period.
- **Budgeted Cost of Work Performed (BCWP)** or **Earned Value (EV)** – The sum of budgets for completed work packages and completed portions of open work packages.
- **Actual Cost of Work Performed (ACWP)** or **Actual Cost (AC)** – The actual cost incurred in accomplishing the work performed within a given time period. For equitable comparison, ACWP is only recorded for the work performed to date against tasks for which a BCWP is also reported.

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From these three quantities we can determine our total program budget as well as make a determination of schedule and cost performance and provide an estimated cost of the project at its completion.

Baseline budget:

- Aggregating the estimated costs of the individual scheduled activities to establish a total COST BASELINE for measuring and budgeting the project
- Inputs: WBS, Activity Cost Estimate, Project Schedule, Resource Calendar, Contracts, Cost Management Plan
- Tools & Techniques: Cost Aggregation, Reserve Analysis, Parametric Estimating (adjustment to the aggregate cost), Funding Limit Reconciliation (can impact the schedule and overall cost)
- Output: Cost Baseline, Expected Cash Flow, Funding Requirements (including Management Reserve), Requested Changes, Updated Cost Management Plan

Additional terms are defined to record cost and schedule performance and program budget:

- **Schedule Variance (SV)** – The difference between the work actually performed (BCWP) and the

work scheduled (BCWS). The schedule variance is calculated in terms of the difference in dollar value between the amount of work that should have been completed in a given time period and the work actually completed.

- **Cost Variance (CV)** – The difference between the planned cost of work performed (BCWP) and actual cost incurred for the work (ACWP). This is the actual dollar value by which a project is either overrunning or under running its estimated cost.

Two Performance Ratios:

- **Cost Performance Index (CPI)** – The ratio of cost of work performed (BCWP) to actual cost (ACWP). CPI of 1.0 implies that the actual cost matches to the estimated cost. CPI greater than 1.0 indicates work is accomplished for less cost than what was planned or budgeted. CPI less than 1.0 indicates the project is facingcost overrun.
- **Schedule Performance Index (SPI)** – The ratio of work accomplished (BCWP) versus work planned (BCWS), for a specific time period. SPI indicates the rate at which the project is progressing.
- **Estimate At Completion (EAC)** – It is a forecast of most likely total project costs based on project performance and risk quantification. At the start of the project BAC and EAC will be equal. EAC will vary from BAC only when actual costs (ACWP) vary from the planned costs (BCWP).

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Earned Value Management Formula:

Name	Formula
Cost Variance (CV)	EV – AC
Schedule Variance (SV)	EV – PV
Time Variance (TV)	Difference between the time when the achievement of the current earned value was planned to occur and the time now
Cost Performance Index (CPI)	EV / AC
Schedule Performance Index (SPI)	EV / PV

Earned value – an example

- Tasks
  - Specify module 5 days
  - Code module 8 days
  - Test module 6 days
- At the beginning of day 20, PV = 19 days

- If everything but testing completed, EV = 13 days
- Schedule variance = EV-PV i.e. 13-19 = -6
- Schedule performance indicator (SPI) = EV/PV

  i.e 13/19 = 0.68
- A negative schedule variance (SV) means that the project is behind schedule as does a SPI that is less than 1.0.
- Actual cost (AC) is also known as Actual cost of work performed (ACWP)
- In previous example, if
- 'Specify module' actually took 3 days (planned 5 days)
- 'Code module' actually took 4 days (planned 8 days)
- Actual cost = 7 days
- Cost variance (CV) = EV-AC

  i.e. 13-7 = 6 days
- Cost performance indicator (CPI) = EV/AC

  i.e = 13/7 = 1.86
- Positive CV or CPI > 1.00 means project under budget or the work is completed better than planned
-

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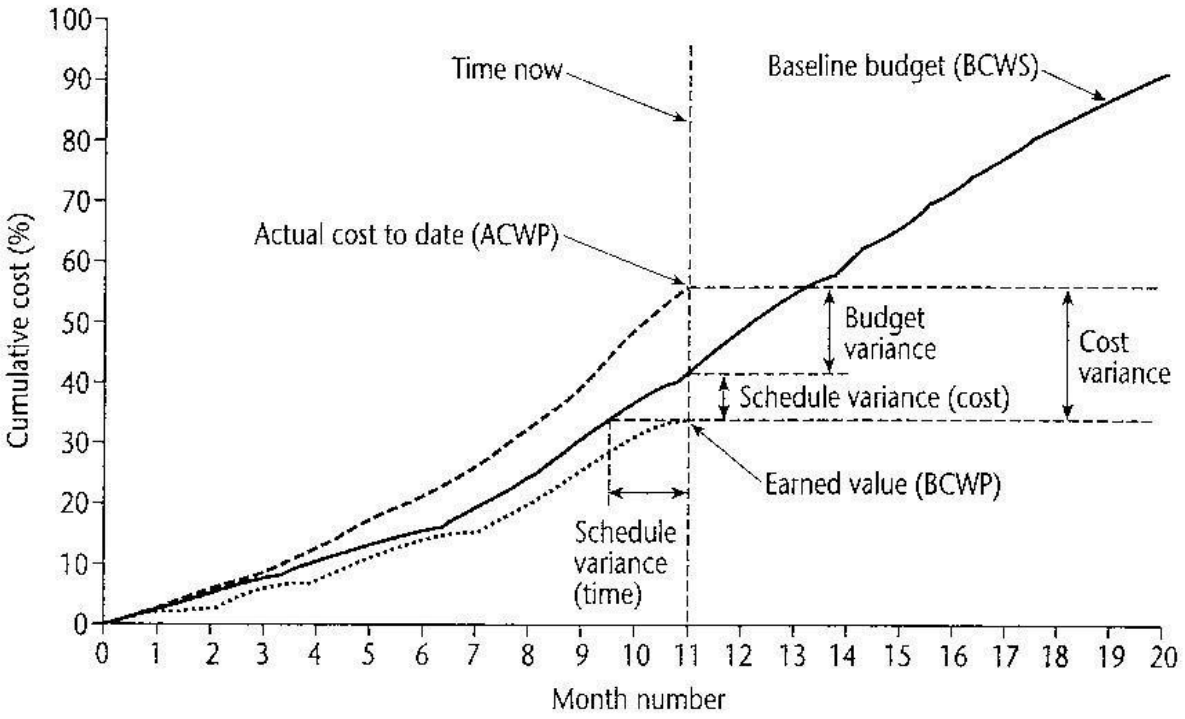
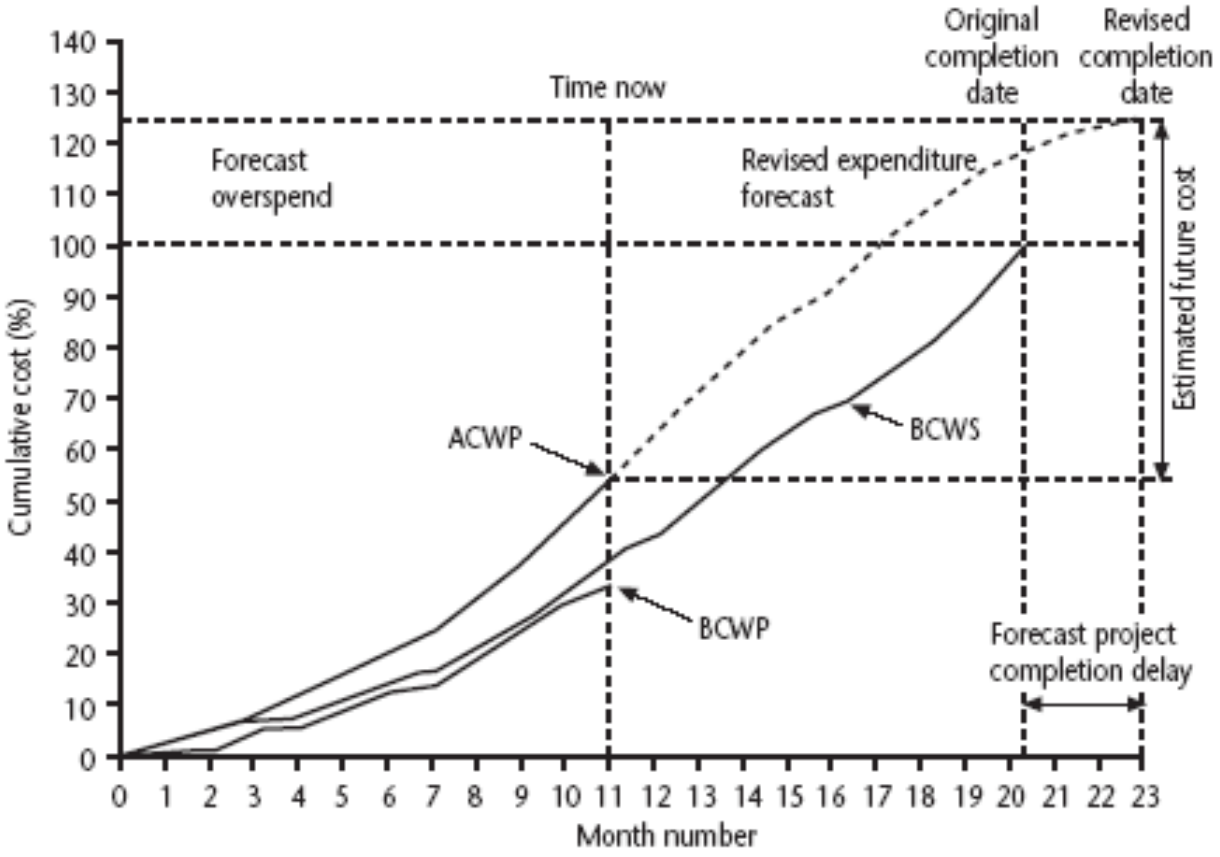
An Earned value tracking chart



Earned value chart with revised forecasts



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- This shows how the planned value (PV), earned value (EV) and actual cost (AC) can be tracked over the lifetime of a project.
- It also shows how the graph can be used to show adjustments to the final estimated cost and duration. A revised assessment of the budget at completion (EAC estimate at completion) can be produced by dividing the original estimated budget at completion (BAC) by the current CPI.
- Similarly a forecast of the actual duration of the project can be derived by dividing the original estimated duration by the SPI.

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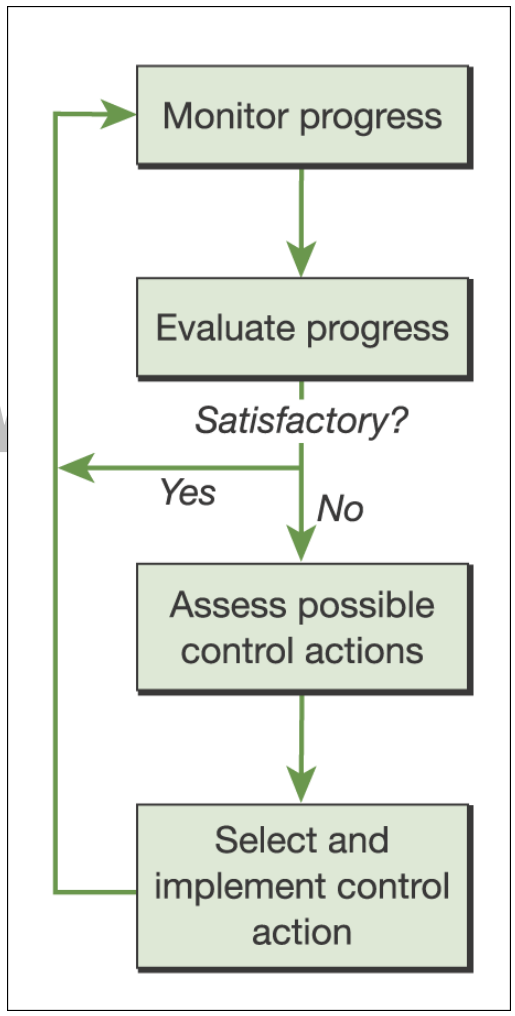
Creating Framework

Exercising control over a project and ensuring that targets are met is a matter of regular monitoring - Finding out what is happening and comparing it with targets. There may be a mismatch between the planned outcomes and the actual ones. Replanning may then be needed to bring the project back on target. Alternatively, the target could have to be revised.

Responsbility

The overall responsibility for ensuring satisfactory progress on a project is oftenthe role of project steering committee, project management board and Project Board. Day to day responsibility is on project manager and team leaders.



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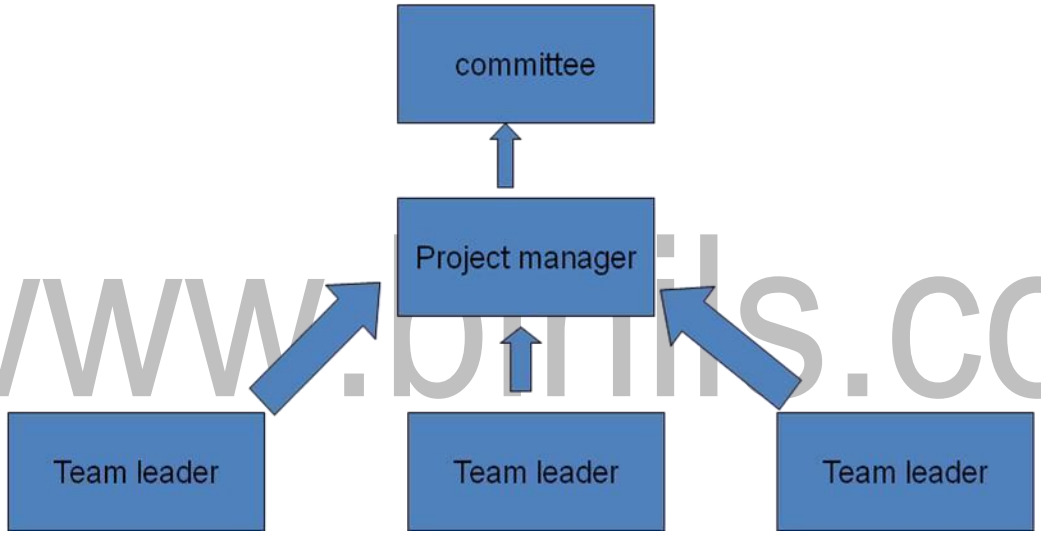

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The concept of a reporting hierarchy is illustrated in the above Figure.

- The main lesson here is that the details relating to project progress have to originate with the people actually doing the work and have then to be fed up through the management structure.
- At each management level there is going to be some summarising and commentary before information is passed up to the next level. This means that there is always a danger of 'information overload' as information passes from the many to the few.

Assessing progress

- Some information used to assess project progress will be collectively routinely, while other information will be triggered by specific events.
- Assessment is based on information collected at regular intervals
- Example whether particular report has been delivered or not

Setting checkpoints

Set a series of checkpoints in the activity plan Check points may be:-

Monthly

Specific events (production of a report)

Checkpoints – predetermined times when progress is checked

- Event driven: check takes place when a particular event has beenachieved
- Time driven: date of the check is pre-determined

Frequency of reporting

- The higher the management level, generally, the longer the gaps betweencheckpoints

Taking snapshots

- The frequency of progress reports will depend upon the size and degree of risk of the project. Team leaders may want to assess progress daily whereas project manager mayfind weekly or monthly reporting appropriate. In general, the higher level, the less frequent and less detailed the reporting needs to be.
- At the level of individual developers, however, strong arguments exist for the formal weekly collection of information. If reporting is to be weekly then it makes sense to have basic units of work that last about a week.
- Major, or project level, progress reviews will generally take place at particular points during the life of a project- commonly known as review points or controlpoints.
  - A *review* is any activity in which a work product is distributed to reviewers whoexamine it and give feedback.
    - Reviews are useful not only for finding and eliminating defects, but also for gaining consensus among the project team, securing approval from stakeholders, and aiding in professional development for team members.
    - Reviews help teams find defects soon after they are injected making themcost less to fix than they would cost if they were found in test.
    - All work products in a software project should be either reviewed or tested.
      - Software requirements specifications, schedules, design documents, code, test plans, test cases, and defect reports shouldall be reviewed.

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Collecting The Data

Manager breaks long activities into more controllable activities of one or two weeks' duration.

It is necessary to Gather information about partially completed activities and forecasts of how much work is left to be completed. It can be difficult to make such forecasts accurately.

- Example:-counting the number of records specifications or screen layoutsproduced.
- In some cases, intermediate products can be used as in-activity milestones.
- How to deal with *partial completions? 99% completion syndrome*

Possible solutions:

- ✓ Control of products, not activities
- ✓ Subdivide into lots of sub-activities

Partial completion reporting

- Projects have to be delivered on time and within budget, hence the concern with monitoring achievements and costs.
- Partial completion is where, for example, data is being collected at the end of Week 2 of an activity that should take four weeks. We want to know if it is about 50% completed.
- An example of the '99% completion syndrome' would be in the above case if the developer reported at the end of weeks 1,2 and 3 that the task was respectively 25%, 50% and 75% complete. However at the end of week 4 it is reported that the task is 99% complete. The same thing is reported at the end of week 5 and so on until the task is actually completed.
- Control on products implies that actual examination of intermediate allows us to verify independently and objectively that sub-tasks have been completed.

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- The employee fill the time sheet
  - Many organizations use standard accounting systems with weekly timesheets to charge staff time to individual jobs. The staff time bookedto a project indicates the work carried out and the charges to the project.
  - Weekly timesheets are a valuable source of information about resourcesused. They are often used to provide information about what has been achieved.

TIME SHEET

Staff : John smith week ending : 30/3/07

project	Activity code	description	Hours this week	% complete	Scheduled completion date	Estimated completion date
P21	A243	Code mod A3	12	30	24/4/07	24/4/07
P34	A234	Document take-on	20	90	6/4/07	4/4/07
Total recharged hours			32			

Rechargeable hours

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Non- Rechargeable hours

code	description	Hours this week	Comment and authorization
Z99	Day in lieu	8	Authorized by RB
Total non-recharged hours		8	

Red/amber/green (RAG) reporting

One popular way of overcoming the objections to partial completion reporting is to avoid for estimated completion dates, but to ask instead for the team members' estimates of the likelihood of meeting the planned target date. One way of doing thisis the traffic-light method. This consists of the following steps:

- Identify key tasks (first level)
- Break down into sub-tasks (second level)
- Assess each subtasks(second level) as:

  Green – 'on target'

  Amber – 'not on target but recoverable'

  Red – 'not on target and recoverable only with difficulty'

- Review all the second- level assessments to arrive at first- level assessments;
- Review first and second - level assessments to produce an overall assessment.

RAG reporting highlights those activities which need particular attention. The statusof a troubled activity might typically move from green to amber; if corrective action ispossible it might go back to green, otherwise it could switch to red. If there are lots of instances where activities switch directly from green to red, this could indicate more management control.

'Critical tasks' would be those on the critical path and/or reliant on critical resources.

Activity assessment sheet

Staff: Justin

Ref: IoE/P/13 **Activity:** code and test module C

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Week number	13	14	15	16	17	18	
Activity summary	G	A	A	R			
components							**comments**
Screen handling procedures	G	A	A	G			
File update procedures	G	G	R	A			
compilation	G	G	G	A			
Test data runs	G	G	G	A			
Program documentation	G	G	A	R			

A traffic-light assessment of IoE/P/13

Managing Contracts

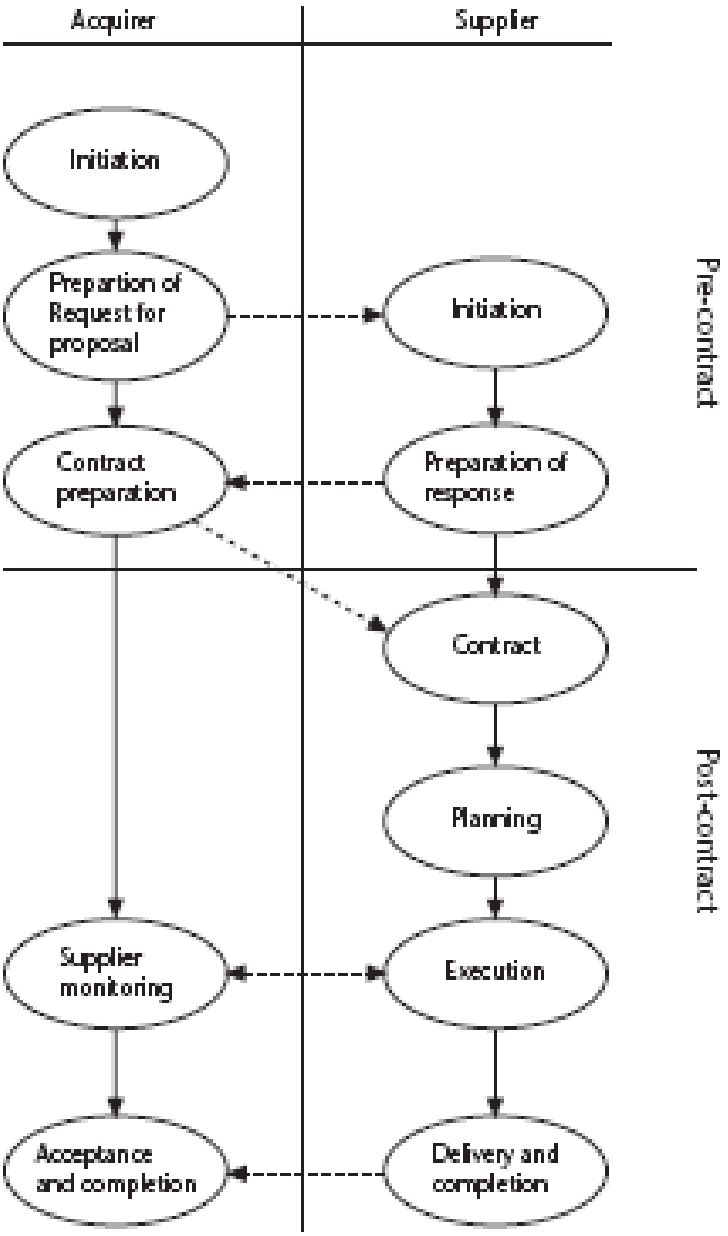
Types of contract

Acquiring software from external supplier

This could be done via:

- a bespoke system - created specifically for the customer;
- off-the-shelf - bought 'as is' – this is sometimes referred to as shrink-wrappedsoftware;
- customized off-the-shelf (COTS) - a core system is customized to meet needs ofa particular customer.

ISO 12207 acquisition and supply process



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Part of the ISO 12207 standard relates to the process by which software can be acquired from an external supplier. As can be seen from the diagram, there are two parallel and complementary processes. The acquirer (who wants the software) has aset of processes to carry out which interact with the processes for which the supplier would be responsible.

Types of contract

1. Fixed price contracts
2. Time and materials contracts
3. Fixed price per delivered unit contracts

Note the difference between goods and services.

Often license to use software is bought rather than the software itself

Fixed price contracts

In this situation a price is fixed when the contract is signed. The customer knows that, if there are no changes in the contract terms, this is the price they pay on completion. Even though the supplier will have to add a margin to the price to deal with contingencies, the cost could still be less than doing the work in-house as the supplier may be able to exploit economies of scale and the expertise that the have from having done similar projects in the past.

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Advantages to customer:

- known expenditure
- supplier motivated to be cost-effective

Disadvantages:

- supplier will increase price to meet contingencies
- difficult to modify requirements
- upward pressure on the cost of changes
- threat to system quality

Time and materials contracts

The customer is charged at a fixed rate per unit of effort, for example per staff- hour. Because suppliers appear to be given a blank cheque, this approach does not normally find favour with customers. However, the employment of contract developers may involve this type of contract.

Advantages to customer:

- easy to change requirements
- lack of price pressure can assist product quality

Disadvantages:

- Customer liability - the customer absorbs all the risk associated with poorly defined or changing requirements
- Lack of incentive for supplier to be cost-effective

Fixed price per delivered unit contracts

Fixed price per delivered unit contract is often associates with function point (FP) counting. The size of the system to be delivered is calculated or estimated at the outset of the project. The size could be estimated in lines of cod, but FPs can be more easily derived from requirements documents. A price per unit is also quoted. The final price is the unit price multiplied by the number of units.

FP count	*Design cost/FP*	*implementation cost/FP*	*total cost/FP*
Up to 2,000	$242	$725	$967
2,001- 2,500	$255	$764	$1,019
2,501-3,000	$265	$793	$1,058
3,001-3,500	$274	$820	$1,094
3,501-4,000	$284	$850	$1,134

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These figures do come from a real source (RDI Technologies in the USA). These are now several year old. The bigger the project, the higher the cost perfunction point. Recall that function points were covered in Lecture/Chapter 5 on software effort estimation.

Example

- Estimated system size 2,600 FPs
- Price
  - 2000 FPs x $967 *plus*
  - 500 FPs x $1,019 *plus*

- – 100 FPs x $1,058
- – i.e. $2,549,300
- What would be charge for 3,200 FPs?

2000 FPs at	$967	=	$1,934,000
500 FPs at	$1019	=	$509,500
500 FPs at	$1058	=	$529,000
200 FPs at	$1094	=	$218,800
total			$3,191,300

Advantages for customer

- customer understanding of how price is calculated
- comparability between different pricing schedules
- emerging functionality can be accounted for
- supplier incentive to be cost-effective

Disadvantages

- difficulties with software size measurement - may need independent FP counter
- Changing (as opposed to new) requirements: how do you charge?

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Stages in Contract Placement

The tendering process

- Open tendering
  - any supplier can bid in response to the *invitation to tender*
  - all tenders must be evaluated in the same way
  - government bodies may have to do this by local/international law
- Restricted tendering process
  - bids only from those specifically invited
  - can reduce suppliers being considered at any stage
- Negotiated procedure
  - negotiate with one supplier e.g. for extensions to software already supplied

Stages in contract placement

Requirements Analysis

The very first step in software development process is requirement analysis. The requirements are gathered from user/customers by user management team and managers and specified in requirement document.

Main sections in a requirement document

1. introduction
2. description of existing system and current environment
3. future strategy or plans
4. system requirements
   - mandatory
   - desirable features
5. Deadlines
   - functions in software, with necessary inputs and outputs
   - standards to be adhered to
   - other applications with which software is to be compatible
   - quality requirements e.g. response times
6. additional information required from bidders

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The requirements document is sometimes referred to as the operational requirement or OR. If a mandatory requirement cannot be met the proposed application would have to be rejected regardless of how good it might be in other ways. A shortfall in one desirable requirement might be compensated for by other qualities or features.

Evaluation plan

- How are proposals to be evaluated?
- Methods could include:
  - reading proposals
  - interviews
  - demonstrations
  - site visits
  - practical tests
- Off the shelf software clearly has an advantage here as there is actually productthat can be

evaluated in existence.

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- Need to assess value for money for each desirable feature
  - Example feeder file saves data
  - input hours a month saved
  - cost of data entry at RM20 an hour
  - system to be used for 4 years
  - if cost of feature RM1000, would it be worth it?

    RM(4 x 20 x 12 x 4) would be saved i.e. RM3,840. The payback period would be just over a year and so this feature would be worth the additional cost.

Invitation to tender (ITT)

- Note that bidder is making an *offer* in response to ITT
- *acceptance* of offer creates a *contract*
- Customer may need further information
- Problem of different technical solutions to the same problem
- ISO 12207 refers to an ITT as a Request for Proposal or RFP.

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Memoranda of agreement (MoA)

- Customer asks for technical proposals
- Technical proposals are examined and discussed
- Agreed technical solution in MoA
- Tenders are then requested from suppliers based in MoA
- Tenders judged on price
- Fee could be paid for technical proposals by customer

Evaluation of proposals

- **Usability of existing package**

  Could try out a demo or ask existing users

- **Usability of application to be built**

  You would have to make stipulation about the process e.g. on the developmentof interface prototypes; you could also specify performance requirements

this could be incorporated in a maintenance agreement and you could compare the terms offered by different potential suppliers; another approach is ask to current users of the

- **Maintenance costs of hardware**

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hardware about their experience of it.

- **Time taken to respond to support requests**

  this could once again be made a contractual matter and the terms offered by different suppliers could be compared; suppliers could be asked to supply evidence of their past performance (but they might refuse, or not tell the truth);you could ask for references from current customers of the supplier;

- **Training**

  once again references could be taken up; you could ask for the CV of thetrainer; you could even get them to give a short presentation

Typical Terms Of A Contract

Some of the major areas of contract document are as follows:

- ❖ Definitions
- ❖ Form of agreement
- ❖ Goods and services to be supplied
- ❖ Ownership of the software
- ❖ Environment
- ❖ Customer commitment
- ❖ Acceptance procedures
- ❖ Standards
- ❖ Project and quality management
- ❖ Timetable
- ❖ Price and payment method
- ❖ Miscellaneous legal requirements

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Definitions

The terminology use in the contract document may need to be defined, e.g. whois meant by the words ‘client’ and ‘supplier’.

Form of agreement

For example, is it a contract of sale, a lease, or a licence?

Goods and services to be supplied

Equipment and software to be supplied – this should include an actual list of the individual pieces of equipment to be delivered, complete with specific model numbers.

Services to be provided

- Training;
- Documentation;
- Installation;
- Conversion of existing files;
- Maintenance agreements;
- Transitional insurance arrangements.

Ownership of the software

Who has Ownership of the software? There may be two key issues here.

1. Whether the customer can sell the software to others
2. Whether the supplier can sell the software to others.

Where an off-the-shelf package is concerned, the supplier often simply grants a licence for the customer to use the software. An *escrow* agreement can be included in the contract so the up-to-date copies of the source code are deposited with a third party. In the UK, the NCC Group provides an escrow service.

Environment

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- Where physical equipment is to be installed, the demarcation line between the supplier's and customer's responsibilities with regard to such matters as accommodation and electrical supply needs to be specified.
- Where software is being supplied, the compatibility of the software with existing hardware and operating system platforms would need to be confirmed.

Customer commitment

Even when work is carried out by external contracts, a development project still needs the participation of the customer. The customer may have to provide accommodation for the suppliers and perhaps other facilities such as telephone lines.

Acceptance procedures

Good practice is to accept a delivered system only after user acceptance tests. Part of the contract would specify such details as the time that the customer will have to conduct the tests, deliverables upon which the acceptance tests depend and the procedure for signing off the testing as completed.

Standards

It covers the standard with which the goods and services should comply. For example, a customer could require the supplier to conform to the ISO 12207 standard relating to the software life cycle and its documentation.

Project and quality management

The arrangements for the management of the project must be agreed. These include the frequency and nature of progress meetings and the progress information to be supplied to the customer. The contract could require that appropriate ISO 9001 standards are followed.

Timetable

This provides a schedule of when the key parts of the project should be completed. The timetable will commit both the supplier and the customer.

Price and payment method

Obviously the price is very important. What also needs to be agreed is when thepayments are to be made. The supplier's desire to be able to meet costs as they are incurred needs to be balanced by the customer's requirement to ensure that goods and services are satisfactory before parting with their money.

Miscellaneous legal requirements

This is legal small print. A contract may require clauses which deals with such matters as the definition of terms used in the contract, the legal jurisdiction that will apply to the contract, what conditions would apply to the subcontracting of the work, liability for damage to third parties, and liquidated damages.

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Contract management

Contracts should include agreement about how customer/supplier relationship is to be managed e.g.

- decision points - could be linked to payment
- quality reviews
- changes to requirements

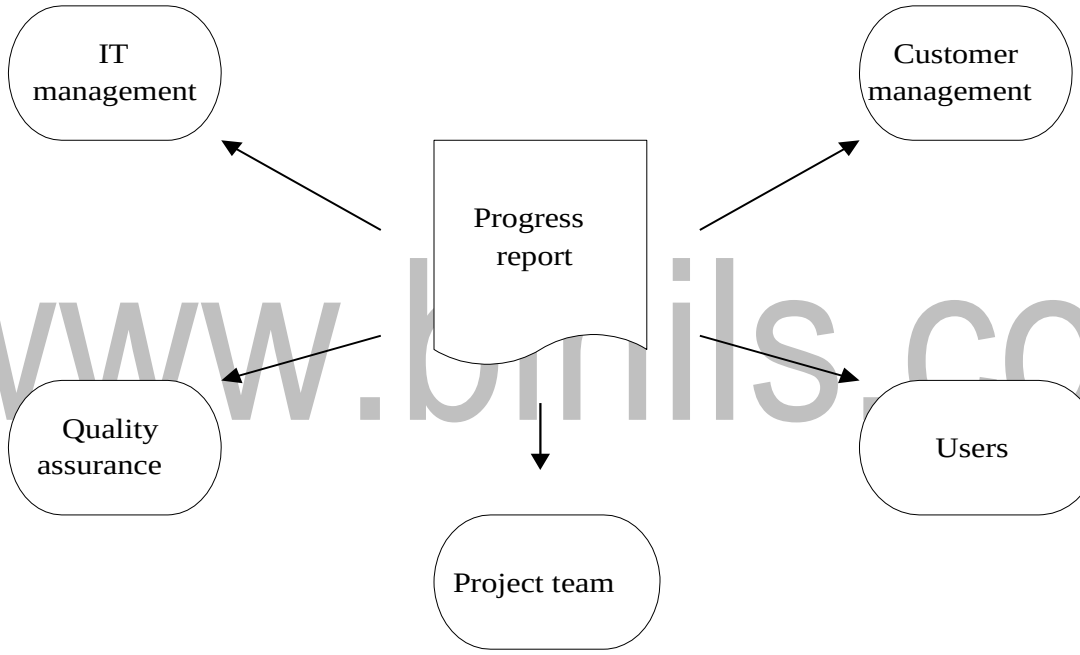
Acceptance

- When work is completed, customer needs to carry out acceptance testing.
- Contract may put a time limit to acceptance testing – customer must performtesting bf time expired.
- Part or all payment to the supplier should depend on acceptance testing

Prioritizing Monitoring - Getting Project Back To Target

After completion of earned value analysis, the progress report has to be sent to the following members.

1. Project team
2. Quality assurance
3. IT management
4. Customer management
5. Users



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Progress report should contain the following contents (typical)

- Period covered
- Narrative summary of progress
- Milestones achieved/deliverables completed
- Problems encountered (and solutions)
- Projected completion date
- Costs to date and predicted
- Changes identified and implemented

Prioritizing Monitoring:

- We assumed that all aspects of a project will receive equal treatment in terms ofthe degree of monitoring applied. The monitoring takes time and uses resources that might sometimes be put to better use.
- In this section we list the priorities we might apply in deciding levels ofmonitoring.
- Critical path activities
- Activities with no free float – if delayed later dependent activities are delayed
- Activities with less than a specified float
- High risk activities
- Activities using critical resource

Critical path activities – Any delay in an activity on the critical path will cause a delay in the completion date for the project. By definition, if these are late then theproject as a whole will be delayed. Critical path activities are likely to have a very high priority for close monitoring.

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Activities with no free float – free float was defined in Lecture/Chapter 6. A project with no free float will delay following dependent activities, although the project end date may not be directly threatened.

Activities with less than a specified float – projects when being executed can be verydynamic: some activities will take longer than estimated others less; this could lead to the critical shifting. Activities with small floats are the most likely to find themselves turned into activities on the critical path if their floats get eroded.

High risk activities –If the standard deviation for an activity is large, this indicates that there is a lot of uncertainty about how long it will actually take.

Activities using critical resources – some resources may only be available for alimited period and if the activities that need the resource are delayed the resourcecould become unavailable.

Getting back on track

There are two main strategies to consider when drawing up plans to bring a projectback on target.

1. Try to shorten activities on critical path e.g.
   - Work overtime
   - Re-allocate staff from less pressing work
   - Buy in more staff

2. Reconsider activity dependencies
   - Over-lap the activities so that the start of one activity does not have towait for completion of another
   - Split activities

Renegotiate the deadline (optional) – if not possible then

Shortening the critical path

The overall duration of a project is determined by the current critical peth, so speeding up non-critical path activities will not bring forward a project completion date. The idea is to try to get things done more quickly by adding more staff. Some activities lend themselves to this more readily than others – it is often quite difficult todo this with software development. It also increases costs.

There are several ways in which this might be done.

1. Adding resources;
2. Increase use of current resources;
3. Reallocate staff to critical activities;
4. Reduce scope;
5. Reduce quality.

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Reconsidering activity dependencies – allowing activities to overlap often increasesthe risk of quality shortfalls

Renegotiating the deadline – one way of doing this is to divide the deliverables into‘tranches’ delivering the ones most valuable to the client on or before the deadline, but delaying less valuable ones.

Project Tracking

Prioritizing Monitoring

The list of priorities defined in the level of monitoring are:

- **Critical path activities:** These denote those activities in the critical path that are delayed in project completion date.
- **Activities with no free float:** These delayed activities will have a delay in subsequent ones but still stick on target. These activities can have a serious effect on the resource schedule because the subsequent activities have to wait for its completion.
- **Activities with less than a specified float:** If there is a very little float in the activitysay

less than one week, these activities must be monitored very closely.

- **High risk activities:** These high risks are identified in the risk management plan itself and these results in over spending.
- **Activities using critical resources:** Critical activities are very expensive and are available only for a limited period and require high level of monitoring.

Getting back Project on Target

- Projects are subjected to delays and unexpected events.
- The project manager must ensure that the project scheduled end dates are unaffected at any circumstances.
- To maintain the project within the completed time, duration of some activity of the project can be delayed or shorten to fit into the time limit.
- The strategies involved in getting back the project to target are;
    - Critical path shortening
    - Reconsidering precedence requirements

Critical Path Shortening

- Delayed projects can often be brought back on track by shortening activity times on the critical path.
- Critical path is determined by the overall duration of the project.
- By increasing the resources for the critical path activities results in completion of the activity before time and the resources can be prolonged for a longer duration.
- At the same time, the resources used must be effectively allocated to all the activities sothat no resources are idle at any point of time.
- Swapping of critical and non- critical activities can also be used to shorten the time limitand bring the project back to target.
- One disadvantage of shortening critical path is that, it produces many more paths while shortening which can become critical.

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Reconsidering Precedence Requirements

- The project can be brought back to target by defining constraints to certain activities that affect the other activities for its completion.

- A precedence constraint activity can be sub-divided into a component that can startimmediately.
- Altering these constraints would have a major impact on the quality factors, the risk involved, which can cause a delay in carrying out the activities.

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Software Configuration Management

Throughout development, software consists of a collection of items (such as programs, data and documents) that can easily be changed. During software development, the design, code, and even requirements are often changed, and the changes occur at any time during the development. This easily changeable nature of software and the fact that changes often take place require that changes be done in a controlled manner.

Software configuration management (SCM) is the discipline for systematically controlling the changes that take place during development. Software configuration management is a process independent of the development process largely because most development models cannot accommodate change at any time during development. SCM can be considered as having three major components:

Software configuration identification

Configuration control

Status accounting and auditing

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Configuration identification

The first requirement for any change management is to have clearly agreed-on basis for change. That is, when a change is done, it should be clear to what changes has been applied. This requires baselines to be established. A baseline change is the changing of the established baseline, which is controlled by SCM.

After baseline changes the state of the software is defined by the most recent baseline and the changes that were made. Some of the common baselines are functional or requirements baseline, design baseline, and product or system baseline. Functional or requirement baseline is generally the requirements document that specifies the functional requirements for the software. Design baseline consists of the different components in the software and their designs. Product or system baseline represents the developed system.

It should be clear that a baseline is established only after the product is relatively stable. Though the goal of SCM is to control the establishment and changes to these baselines, treating each baseline as a single unit for the purpose of change is undesirable, as the change may be limited to a very small portion of the baseline.

Configuration control

Most of the decisions regarding the change are generally taken by the configuration control board (CCB), which is a group of people responsible for configuration management, headed by the configuration manager. For smaller projects, the CCB might consist of just one person. A change is initiated by a change request.

The reason for change can be anything. However, the most common reasons are requirement changes, changes due to bugs, platform changes, and enhancement changes. The CR for change generally consists of three parts. The first part describes the change, reason for change, the SCIsthat are affected, the priority of the change, etc.

The second part, filled by the CM, describes the decision taken by the CCB on this CR, the action the CM feels need to be done to implement this change and any other comments the CM may have. The third part is filled by the implementer, which later implements the change. **Status accounting and auditing**

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For status accounting, the main source of information is the CRs and FRs themselves. Generally, a field in the CR/FR is added that specifies its current status. The status could be active, complete, or not scheduled. Information about dates and efforts can also be added to the CR, the information from the CRs/FRs can be used to prepare a summary, which can be usedby the project manager and the CCB to track all the changes.

Visualizing Progress Economic

Assessment:

- ✓ After collecting data the project manager will represent the collected data using static picture. We look at some methods of presenting a picture of the project and its future.
- ✓ Some of these methods are:

1. Gantt charts
2. Slip charts
3. Ball charts
4. timeline

Gantt charts:

- Simplest ,oldest techniques for tracking the project progress
- Indicates scheduled activity dates and durations
- Reported progress is recorded on the chart (by shading activity bars)
- Note that the Gantt chart is named after Henry Gantt (1861-1919) and so should not be written in capitals! You could ask students what they think GANTT stands for before you tell them this to impress this on them. I really find Gantt written as GANTT very, very annoying and threaten students with instantfailure of the module if they do this!

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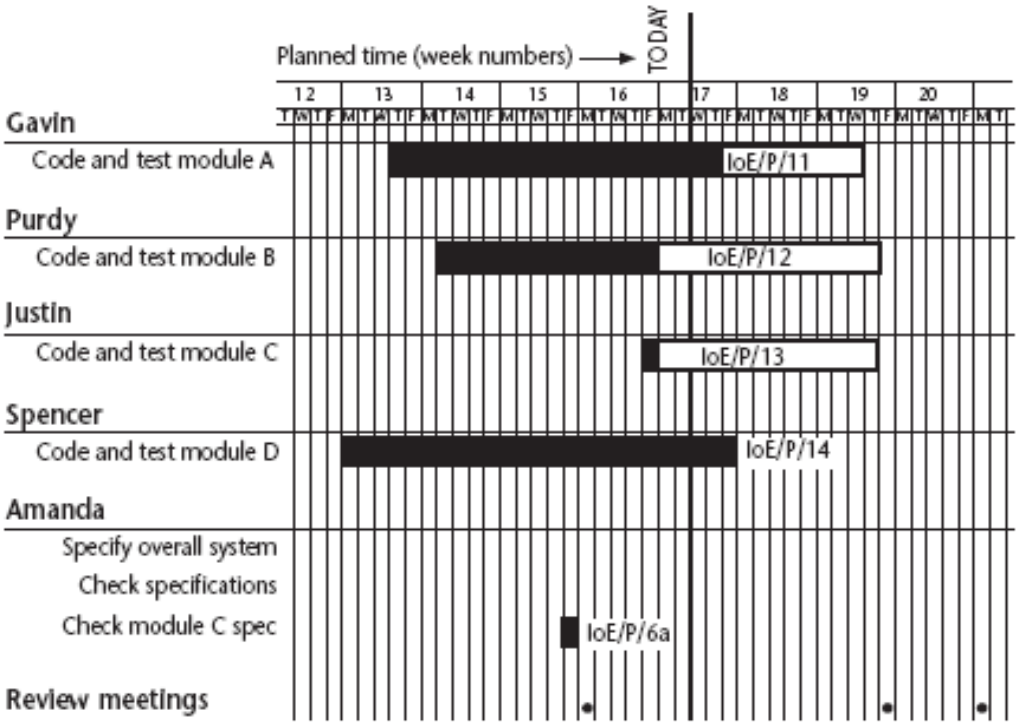
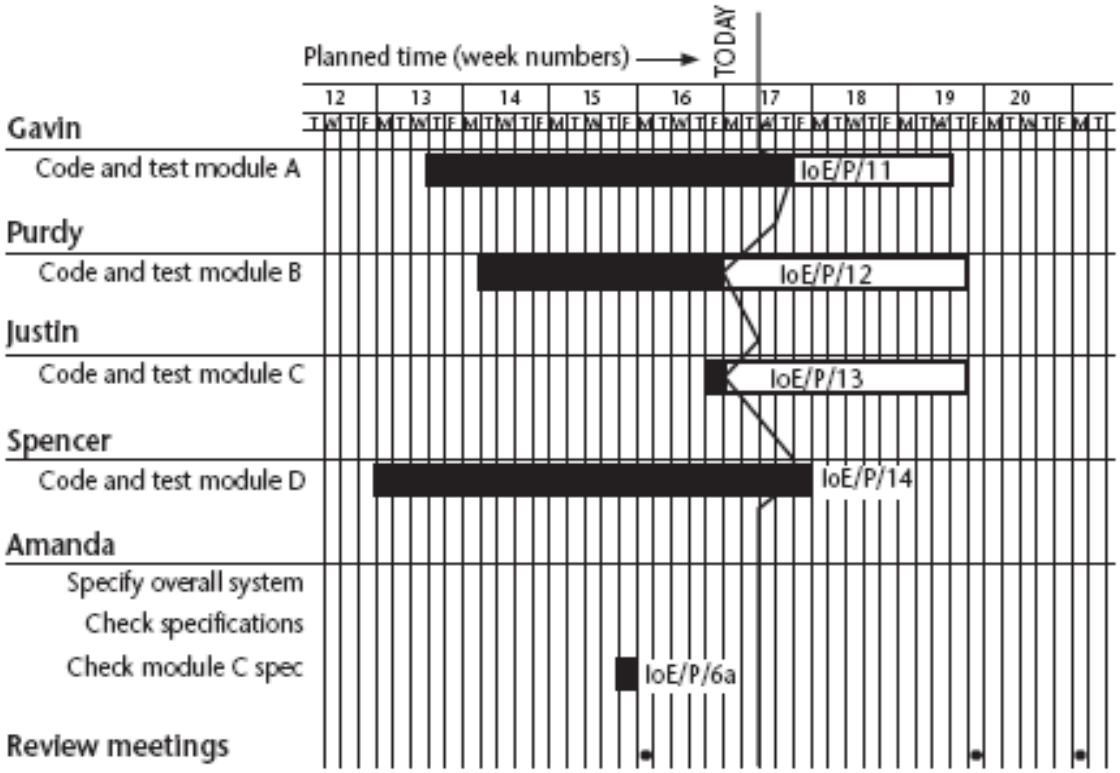


- The format of the Gantt chart here differs from the format used in Microsoft project as the activities for each team member are grouped together. You could input the details so that

they came out in this format, but it would not occurautomatically.

Slip charts:

- Provide more striking visual indication of those activities that are not progressing to schedule
- The more the slip line bends ,greater variation from the plan.
- A slip chart is a version of the Gantt chart where a line is drawn from top to bottom. To the left of the line are all the completed activities and to the rightthose activities (or parts of activities) that have not been completed.



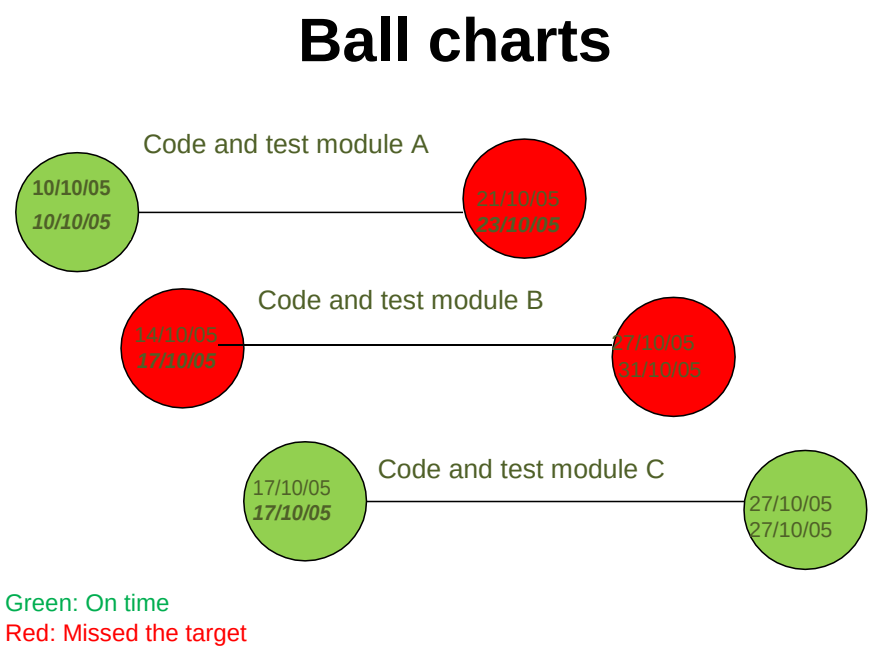
- The more jagged the line, the more it means that that there are some activities that are lagging to various degrees and some that are ahead of themselves. A very jagged line means that there is scope for re-planning to move resources from those activities that are ahead to those that are behind.

Ball charts:

- To show whether targets have been met or not
- Circles indicate start date & competition date
- Whenever revisions are made the revised date is put in to the circle
- Circles, which represent the start or finish of activities, start with the initial target dates. If these are modified then the second dates are changed. When theevent actually takes place, the colour of the circle is changed to green if it is ontarget and to red if it has missed the

target.

- The idea is that this chart is put on a wall in a prominent position as a constantreminder to the project team of the current situation – hence it is often referredto as ‘balls on the wall’.



The timeline:

- This records the way that targets have changed throughout the project.
- Planned time is plotted on the horizontal axis, and actual time on the verticalaxis. The bendy lines going from top to bottom represent the scheduled completion date for each activity e.g.
- ‘analyse existing system’ – at start this was due finish on the Monday of week 3 and it did finish then
- ‘obtain user requirements’ was originally planned to finish on the Thursday ofweek 5, but at the end of the first week it was rescheduled to finish on the Tuesday of week 6.

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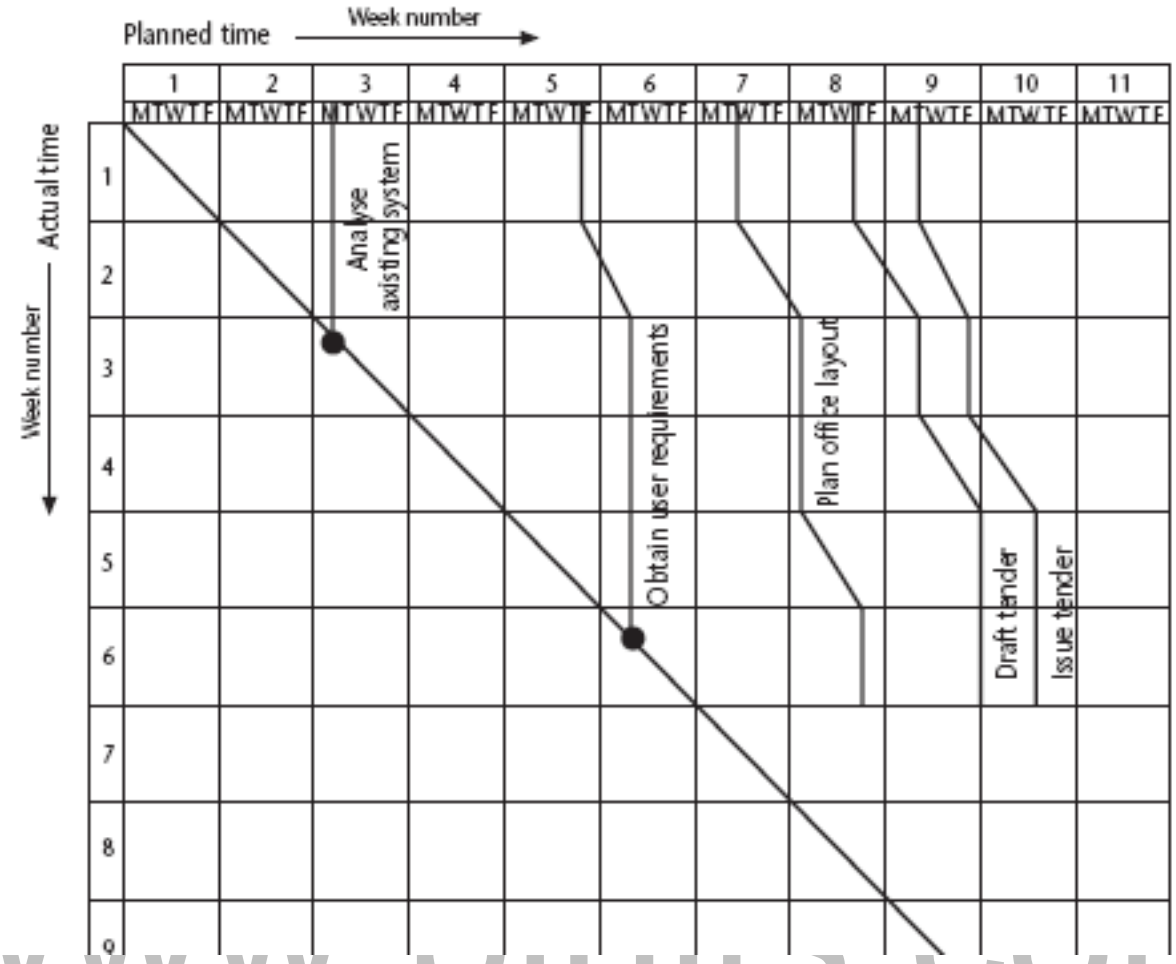

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Cost Monitoring

- A project could be late because the staff originally committed, have not beendeployed
- In this case the project will be ***behind time*** but ***underbudget***
- A project could be ***on time*** but only because additional resources have beenadded and so by ***over budget***
- Need to monitor both ***achievements*** and ***costs***

Cost Management

- Cost Management includes:
  - Cost Estimation
  - Cost Budgeting
  - Cost Control
- Estimation & Budgeting – Main Tools & Techniques
  - Estimation Techniques
  - Reserve Analysis (Risk, Unknown, Cost of Quality)
  - Cost Baseline
  - Funding Requirements & Cash Flow

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- Cost Control.
  - Performance Measurement Analysis: Planned value, Actual Cost, Cost Variance, Cost Performance Index, Estimate to Complete
  - Approved Change Requests

Estimating Schedule Activity

- Estimation Cost of the Resources Needed to complete the activity
- Includes variations to the cost estimate (Risk, Etc)
- Take into consideration Alternative Costing for the overall project timeperiod
  - Cost of extended design effort VS. additional maintenance costs
- Cost estimates include ALL resources that will be charged to the projectincluding Inflation Forecast, Salary Increase, Contingency cost.

  ROM (Rough Order of Magnitude, E.G: –50/+100%) is allowed in the first stages.

  Refinement is required at later stages (E.G: -10/+15%).

Activity Estimating – Inputs & Tools

- Inputs
  - External Factors: Marketplace Condition, External Cost InformationDatabases
  - Organization Assets: Historical Information, Estimating Policies andTemplates, Team Knowledge
  - Project Factors: Scope, WBS, Management Plan, Schedule Plan, Staffing Plan, Risk
- Tools
  - Analogous Estimates
  - Resource Cost Rates
  - Parametric Estimates (Function Points Etc)
  - Vendor Bid Analysis
  - Project Management Software
- Reserve Analysis (Contingency Allowance)
  - Will Be Used at the Discretion of the Project Manager
  - Budgeting Project Unknowns
- Risks
  - Will Be budgeted according to their severity level and probabilities
  - The budget will cover mitigation activities and workarounds and will be implemented upon the project manager decision.
- Cost of Quality (COQ)
  - Costs added to the project in order to ensure conformance with qualitystandards
  - Cost of Non Quality – Failure Cost/Rework. Costs that will added as a result of bugs and non-quality project activities

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Activity Estimating - Output

- Activity Cost Estimating – Most likely estimates of all the activity resources
- Estimate Details
  - Basis for the estimate (how it was developed)
  - Assumptions made
  - Constraints
  - Possible range of the estimate (100000$ -10%/+15%)

- Requested Changes (If the estimate analysis recommends a change)
- CA – Control Account (the corporate accounting number that will incur the cost of the activity)
- Cost Management Plan (Update)

Cost Baseline

- Aggregating the estimated costs of the individual scheduled activities to establish a total COST BASELINE for measuring and budgeting the project
- Inputs: WBS, Activity Cost Estimate, Project Schedule, Resource Calendar, Contracts, Cost Management Plan
- Tools & Techniques: Cost Aggregation, Reserve Analysis, Parametric Estimating (adjustment to the aggregate cost), Funding Limit Reconciliation(can impact the schedule and overall cost)
- Output: Cost Baseline, Expected Cash Flow, Funding Requirements (includingManagement Reserve), Requested Changes, Updated Cost Management Plan

Cost control

- Assuring the Potential Cost Overrun do not exceed the authorized funding PERIODICALLY and in TOTAL
- Monitoring cost PERFORMANCE to detect andunderstand Variances from theBaseline
- Detect Changes as they occur
- Prevent unapproved changes
- Ensuring Requested Changes are Agreed Upon
- Report Changes to Stakeholders
- Acting to bring expected overruns within acceptable limits
- Influencing factors that creates changes to the cost baseline

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