# Software Cost Estimation

- Estimation involves answering the following questions
  - How much effort is required to complete each activity?
  - How much calendar time is needed to complete each activity?
  - What is the total cost of each activity?
- Project cost estimation and project scheduling are normally carried out together.
- The costs of development are primarily the costs of the effort involved, so the effort computation is used in both the cost and the schedule estimate.
- Some cost estimation can be done before detailed schedules are drawn up. These initial estimates may be used to establish a budget for the project or to set a price for the software for a customer.
- There are three parameters involved in computing the total cost of the software development project
  - Hardware and software costs including maintenance
  - Travel and training costs
  - Effort costs (the costs of paying software engineers)

# Software Cost Estimation

- For most projects the dominant cost is the effort cost.
- Computers are relatively cheap and travel cost can be reduced by using electronic communication like email and video conferencing.
- Effort cost is not just the salaries of software engineers who are involved in the project but also the total cost of running the organisation.

- Therefore the following costs are all part of total effort cost
  - Cost of providing, heating and lighting office space
  - Cost of support staff such as accountants, administrators, system managers, cleaners and technicians
  - Cost of networking and communications
  - Cost of central facilities such as library or recreational facilities
  - Cost of social security and employee benefits such as pension and health insurance

# Software Productivity

- The productivity can be measured by counting the number of units that are produced and dividing this number by the number of person hours required to produce them.
- However for any software problem there are many different solutions each of which has different attributes. One solution may execute more efficiently while another may be more readable and easier to maintain. When solutions with different attributes are produced, comparing their production rates is not really meaningful
- A project manager estimates the productivity of software engineers to help define the project cost or schedule, to inform investment decision or to asses whether process or technology improvements are effective

# Software Productivity

- Productivity estimates are usually based on measuring attributes of the software and dividing this by the total effort required for development. There are two types of metrics that can be used
  - Size related metrics – These are related to size of some output from an activity. The most commonly used size related metric is lines of delivered source code. Other metrics that may be used are the number of delivered object code instructions or the number of pages of system documentation
  - Function related metrics – These are related to the overall functionality of the delivered software. Productivity is expressed in terms of the amount of useful functionality produced in some given time. Function points and object points are best known metrics of this type
- The software productivity in an organisation is affected by number of factors given in the table below

# Factors Affecting Software Productivity

| Factor | Description |
| --- | --- |
| Application Domain Experience | Knowledge of application domain is essential for effective software development. Engineers who already understand a domain are likely to be more productive |
| Process Quality | The development process used can have significant effect on productivity |
| Project Size | The larger the project the more time required for team communications and less time for development there by reducing productivity |
| Technology Support | Good support technology such as CASE tools and configuration management systems can improve productivity |
| Working Environment | A quiet work environment with private work areas contribute to improved productivity |

# Different Cost Estimation Techniques

| Technique | Description |
|---|---|
| Algorithmic cost modelling | A model is developed using historical cost information that relates some software metric (usually its size) to the project cost. An estimate is made of that metric and the model predicts the effort required. |
| Expert judgement | Several experts on the proposed software development techniques and the application domain are consulted. They each estimate the project cost. These estimates are compared and discussed. The estimation process iterates until an agreed estimate is reached. |
| Estimation by analogy | This technique is applicable when other projects in the same application domain have been completed. The cost of a new project is estimated by analogy with these completed projects. Myers (Myers, 1989) gives a very clear description of this approach. |
| Parkinson's Law | Parkinson's Law states that work expands to fill the time available. The cost is determined by available resources rather than by objective assessment. If the software has to be delivered in 12 months and 5 people are available, the effort required is estimated to be 60 person-months. |
| Pricing to win | The software cost is estimated to be whatever the customer has available to spend on the project. The estimated effort depends on the customer's budget and not on the software functionality. |