Software Evolution And Maintenance

Chapter 4
Management And Organizational Issues

- Managing the maintenance
- Organizational aspects of maintenance
- Maintenance activities and role
- Outsourcing IT maintenance

"Characterizing and understanding software maintenance processes and organizations are necessary, if effective management decisions are to be made and adequate resource allocation is to be provided. "

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Managing the Maintenance

Management Responsibilities

- Large and complex software systems are the ones that present challenges for management because:

- they form an integral part of an organization
- their ability to evolve is at the heart of their operation
- their maintenance requires the services of large numbers of personnel

Managing the Maintenance

Management Responsibilities

- Management has the responsibility of ensuring that the software system under maintenance is of
  - a satisfactory quality,
  - desired changes are effected with the minimum possible delay
  - at the least possible cost
- This can be achieved by:
  - devising a means of managing maintenance personnel
  - selecting a suitable way of organizing maintenance tasks

Enhancing Maintenance Productivity

- It is an aim of management to maximise productivity.
- There are several ways in which this can be done.
  - Find the right people for the job
  - Then to see that they are motivated
  - Given the necessary information
  - Resources to do the job well.

Enhancing Maintenance Productivity

I. Choosing the Right People

- The COCOMO analysis of 24 maintenance projects and 63 development projects indicated that the single most important factor in ***increasing productivity is to get the right people for the job***

II. Motivating Maintenance Personnel

- Software maintenance still has an image problem.
- management has a much more difficult task motivating maintenance personnel than motivating development personnel.
- Attitudes of management can affect the quantity and quality of work that subordinates achieve, and the way that work is completed.
- Some ways of motivating personnel are through **rewards**, **appropriate supervision**, **assignment patterns** and **recognition**

Enhancing Maintenance Productivity

III. Communication

- It is important that management keep maintenance personnel informed.
- Information must flow in both directions in order that the maintenance process may be properly controlled, and information may be gathered on the processes carried out so that benefits may be documented and quantified.

IV. Adequate Resources

- Resources can be viewed in terms of tools - software and hardware - and working environment.

V. Domain Knowledge

- Managers, in order to be effective, must have adequate knowledge of the maintenance process.
- In particular, they need to be aware of the cost implications of the various maintenance stages in order to be able to guide the maintenance process effectively.

Maintenance Teams

- The structure of the maintenance team itself is an important factor in determining the level of productivity.
- Two types of team commonly used in development are egoless programming and the chief programmer team

I. The **egoless programming** team everyone involved in a project should work together to develop the best possible software system.

II. The **chief programmer** team imposes an organizational structure in which discipline, clear leadership and functional separation play a major role

Maintenance Teams

- Martin and McClure have suggested two types of maintenance team: the short-term (temporary) team and the long-term (permanent) team

I. Temporary Team

- *A* temporary team is created on an informal basis when there is a need to perform a specific task, for example a code review.
- The programmers work together to solve the problem at hand.
- Leadership is not fixed; it rotates between the team members.
- The main problem with this arrangement is that program quality, programmer morale and user satisfaction can be compromised.

Maintenance Teams

II. Permanent Team

- A permanent team is a more formal arrangement.
- It allows for specialization, creates communication channels, promotes an egoless, collegiate atmosphere, reduces dependency on individuals and allows for periodic audit checks.
- The team consists of a maintenance leader, a co-leader, a user liaison person, a maintenance administrator and other programmers.

Maintenance Teams

- The **maintenance leader** provides technical support to the whole team. He or she is responsible to the maintenance administrator.
- **Coleader** is an assistant to the maintenance leader.
- **User-liaison** person is charged with linking the users and the maintenance team.
- **Maintenance administrator** is the administrator with a range of responsibilities such as hiring, firing and promotion of staff.
- **Maintenance programmers** perform problem diagnosis and implement change under the supervision of the maintenance leader.

Maintenance Organization

- The maintenance organization unit, is structured to meet quite different challenges, such as *randomly occurring daily events and requests from users*, while providing continued service on the software for which it is responsible.
- Some of the unique characteristics of software maintenance, as compared to development activities, are :
  - Maintenance requests (MRs) come in on an irregular basis, and cannot be accounted for individually in the annual budget planning process.
  - MRs are reviewed and prioritized, often at the operational level.
  - The maintenance workload is not managed using project management techniques but, rather, queue management techniques.

Organizational Modes

- Combining development and maintenance activities
- Separate department

- The decision to separate or combine the activities depends on factors such as *the size of the organization* and the *maintenance portfolio* with which it has to deal.

Organizational Modes

I. Combined Development and Maintenance

- The combination of development and maintenance activities may depend on the type of change (change ownership), program modules (module ownership), Activity domains (W-Type), Application domains (A-Type) and life-cycle phase (L-Type).

a) Module Ownership

- The module ownership mode requires that each member of the team is assigned ownership of a module.
- The owner of a module is responsible for effecting any changes that need to be implemented in that module.
- The main advantage with this mode of organization is that the module owner develops a high level of expertise in the module.

Organizational Modes

Weaknesses Of Module Ownership

- Nobody is responsible for the overall software system.
- The workload may not be evenly distributed.
- It is difficult to implement enhancements due to unknown dependencies.
- It is difficult to enforce coding standards

Organizational Modes

b) Change Ownership

- In this mode each person is responsible for one or more change no matter which modules are affected.
- The person is also responsible for the analysis, specification, design, implementation and testing of the change.

- The strengths of the change ownership mode are:
  - There is a tendency to adhere to standards set for the whole software system.
  - Integrity of the change is ensured.
  - Changes can be coded and tested independently.
  - Code inspection tends to be taken seriously.
- Its weaknesses are:
  - Training of new personnel takes much more time than module ownership.
  - Individuals do not have long-lasting responsibilities

Organizational Modes

c) Work-Type

- The key feature of Work-Type mode is that there is 'departmentalization' by work type; analysis, specification, etc.
- Those in the different departments work as a team but with clearly defined responsibilities and roles.
- The main strength: members in each department develop specialised knowledge and skills.
- The drawback is the cost of co-ordinating the different departments.

d) Application-Type

- With the Application-Type mode, division is based on application areas such as health information systems or office automation.
- The advantage with this mode is that members of the team develop specialised application knowledge. Like the Work-Type mode, its drawback is the cost of co-ordinating of the various application domains.

Organizational Modes

II. Separate Maintenance Department

- It is based on the need to maintain a large number of system portfolios, and the increasing business need of keeping software systems operational at all times.
- Its strengths are:
  - There is clear accountability.
  - It allows development staff to concentrate on development of new software systems.
  - It facilitates and motivates acceptance testing just after development.
  - It encourages high quality end-user service.
- Its weaknesses are:
  - There is a danger of demotivation due to status differences.
  - The developers tend to lose system knowledge after the system is installed.
  - There is a high cost involved in the co-ordination of development and maintenance
  - duplication of communication channels.

Organizational Aspects of Maintenance

Characteristics of software maintenance…

- The size and complexity of each small maintenance request are usually handled by one or two maintenance resources.
- The maintenance workload is user-services oriented and application-responsibility oriented.
- Priorities can be shifted around at any time, and requests for corrections of application software errors can take priority over other work in progress.

Maintenance Activities And Role

Some maintenance Activities	Software management (maintenance)	Software development (Creation)
Management of problems (problem resolution interfacing with a help desk	P	A
Acceptance of the software	P	A
Managing transition from development to maintenance	P	A
Establishment of service level agreements (SLAs)	P	A
Planning of maintenance activities (versions, SLA, impact analysis)	P	A
Managing events and service requests	P	A
Supporting daily operations	P	A

Maintenance Activities And Role

- Software maintenance can also be described as a service with the following characteristics [Bouman 1999]:
  - Emphasis on direct sale to the user
  - Frequent and direct contact with the user
  - Service supplied immediately, rather than a few months down the road
  - Short service time
  - The product not always a physical good
  - The product not always fit for storage or transport
  - Services more specialized and more crafted than physical goods

Maintenance Activities And Role

- Software maintenance is considered as one of the five primary processes in the software life cycle processes of the ISO 12207 international standard.

➢ In this international standard, the software engineering processes are divided into three main groups: ***primary***, ***supporting***, and ***organizational***.

- In ISO 12207, the ***primary processes*** include
  - ➢ Acquisition
  - ➢ Development
  - ➢ ***Maintenance***
  - ➢ Software operation activities.

➢ The software ***maintenance process*** includes six major subprocesses
- Process implementation
- Problem and modification analysis
- Modification implementation
- Maintenance review/acceptance
- Migration
- Software retirement

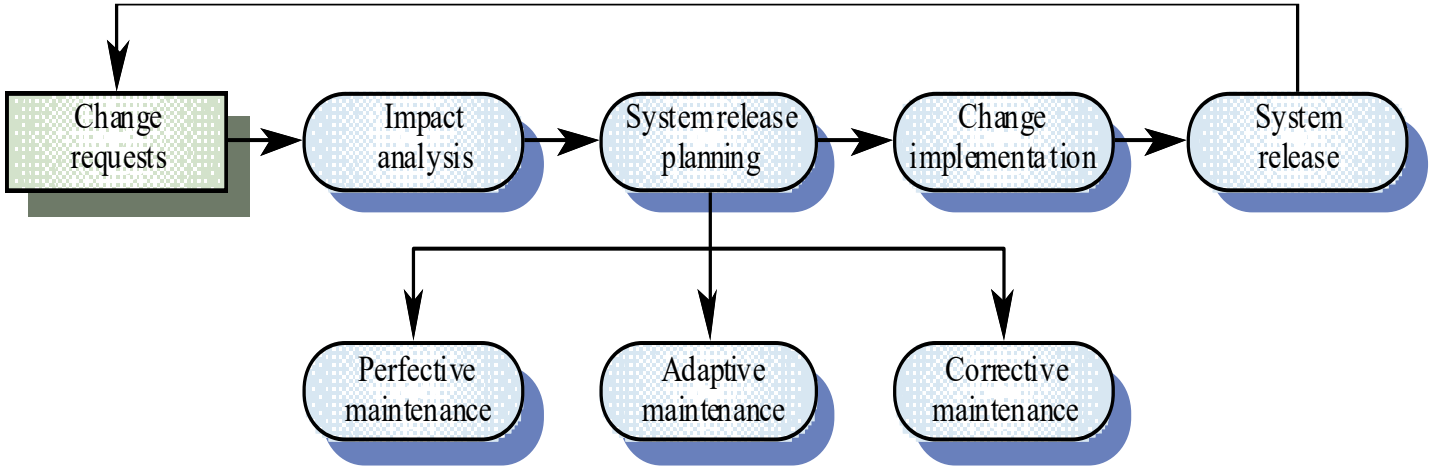
Maintenance Activities And Role

- The ***support processes*** include such activities as
  - Documentation writing
  - Configuration management
  - Quality assurance
  - Verification and Validation
  - Review
  - Audit and
  - Problem resolution
- The ***organizational processes*** are typically offered to the whole organization. These organizational processes include
  - General training
  - Infrastructure
  - Process improvement and
  - Management activities

Maintenance Activities And Role

The maintenance process

- Maintenance is triggered by change requests from customers or marketing requirements
- Changes are normally batched and implemented in a new release of the system
- Programs sometimes need to be repaired without a complete process iteration but this is dangerous as it leads to documentation and programs getting out of step



Outsourcing IT Maintenance

What is Outsourcing?

- "The strategic use of outside resources to perform activities traditionally handled by internal staff and resources" Dave Griffiths

Why Outsource?

- Provide services that are scalable, secure, and efficient, while improving overall service and reducing costs

Outsourcing IT Maintenance

- Service quality measures for software maintenance services have been proposed in the literature and divided into three categories:
  I. Internal service-level agreement
  II. Maintenance service contract
  III. Outsourcing contract
- A third type of service agreement is the software maintenance outsourcing contact.
- This contract moves the software maintenance to a third party for a period varying from 5 to 10 years.
- An outsourcing contract is often a global agreement with an IS/IT supplier or an industry leader with an important foothold in the IS/IT sector.

Outsourcing IT Maintenance

- ***The main justifications for outsourcing software maintenance are:***
- **Traditional role - reaction to problem**
  - Promises of decreasing costs
  - Access to the expertise of the outsourcer's personnel
  - Move from a fixed-cost structure to a variable-cost structure
  - Collect revenue from the sale of an asset
- **Modern role – business strategy**
  - IS/IT not being one of the company's strategic activities
  - Transfer of technical details and problems to the outsourcer
  - Creating value for the organization and its customers
  - Building partnerships

Outsourcing IT Maintenance

What Can be Outsourced?

- System integration
- Data network
- Mainframe data center
- Voice network,
- internet/intranet
- Maintenance/repair
- Applications development
- E-commerce
- End-user support system

Problems With Outsourcing

-Loss of staff or moral problems

-Time consuming

-Provider may not understand business environment

-Provider slow to react to changes in strategy

-Too dependent on service provider

-Loss of Control

-Increased cash outflow

-Confidentiality and security

-Selection of supplier

Managing the Maintenance

- ***Maintenance management***. This process is used to manage the maintenance service, which is not the same as managing individual CRs.
- An organization process is set up and run by the senior management.
- They create a structure of the maintenance team so that service-level agreement can be executed.
  - In addition to fulfilling the roles of regular processes, such as project management and quality assurance
  - maintenance management handles events, change control, and configuration control.

Managing the Maintenance

- For software under maintenance production system failures occur randomly, and user requests come in on an irregular basis.
- Without agreed-upon and mature queue-management mechanisms supported by detailed SLAs, users will often get service that does not meet their real and stated priorities.
- When they get poor maintenance services, some users overreact and rank all requests as high priority and demand that all problems and requests be addressed at the same time.
- Given that production-system failures are random events, and that they need to be addressed first, such users perceive that work on their requests is not progressing as they would expect.
- When customers become frustrated with the slow delivery of services, some will consider developing local solutions to solve their problems, or might consider subcontracting or outsourcing maintenance work altogether.

Managing the Maintenance

- Software-maintenance management should, therefore, do a better job of communicating the many maintenance activities, especially the value-added ones.
- To do this, it is important that management understand the maintainers' processes and services and their many challenges.
- Software maintainers must set up, and better communicate, that there is a fair and efficient queue and priority process in place that manages and monitors the status of each maintenance request/event.

Managing the Maintenance

- This queue management process in software maintenance has many inputs and concurrent interrupting sources, such as:
  - *Operators* who report system failures,
  - *Users* who notice service degradation,
  - *Development project managers* who require current software information and inputs in reengineering studies, and
  - *Customers* who require urgent information.
  - And when there is contention in requests for his or her services, the software maintainer must refer to the SLA and clearly point out the process in place to manage priorities based upon agreed upon service criteria.

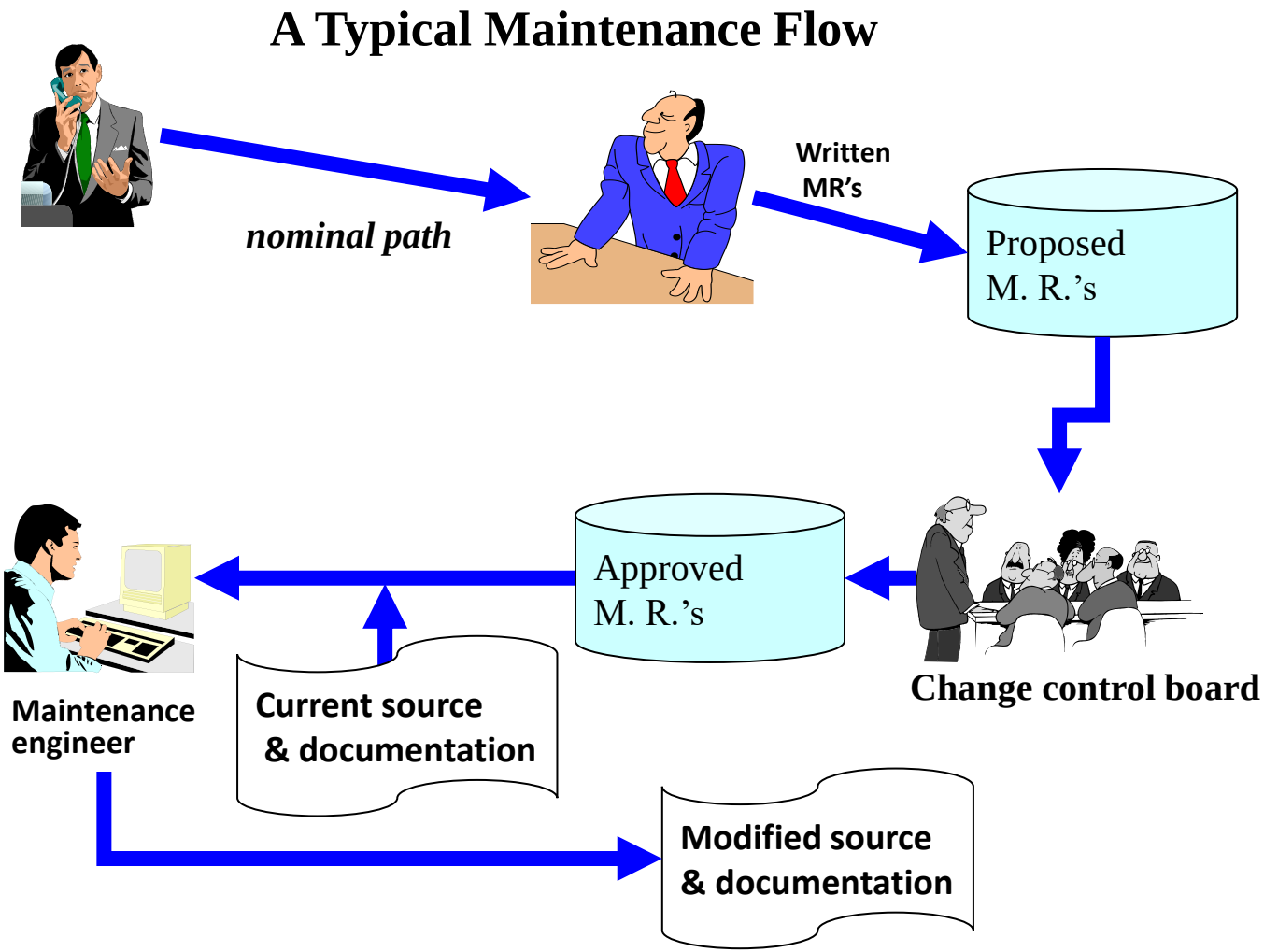
Managing the Maintenance

- Maintenance has a poor image amongst development staff as it is not seen as challenging and creative
- Maintenance costs increase as the software is maintained
- The amount of software which has to be maintained increases with time
- Inadequate configuration management often means that the different representations of a system are out of step

Problems in Managing Maintenance

- ***Changing priorities***
  - Chaotic nature of maintenance requests, the length of maintenance tasks causing new requests to come along before an ongoing task is done.
- ***Inadequate testing methods***
  - Lack of time set aside for testing, of comprehensive test data, of rigorous testing requirements as a standard for signing off.
- ***Performance measurement difficulties***
  - How do you measure individual or group performance?
- ***System documentation incomplete or non-existent***
  - Training takes a long time for learning an application so programmers get stuck on one piece of software.
- ***Adapting to the rapidly changing business environment***
  - Hardware and software also become obsolete.

Managing the Maintenance



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