CHAPTER 16

POSTDELIVERY MAINTENANCE

Agenda

- Development and Maintenance (16.1)
- Why Postdelivery Maintenance is Necessary (16.2)
- What Is Required of Postdelivery Maintenance Programmers? (16.3)
- Management of Postdeliver Maintenance (16.5)
- Postdelivery Maintenance Skills vs. Devleopment Skills (16.7)
- Testing During Post Delivery Maintenance (16.9)
- Metrics for Postdelivery Maintenance (16.11)

16.1 Postdelivery Maintenance

- Postdelivery maintenance
  - *Any* change to *any* component of the product (including documentation) after it has passed the acceptance test

- This is a short chapter
  - But the whole book is essentially on postdelivery maintenance

- In this chapter we explain how to ensure that maintainability is not compromised during postdelivery maintenance

16.2 Why Postdelivery Maintenance Is Necessary

- **Corrective maintenance**
  - To correct residual faults
    - Analysis, design, implementation, documentation, or any other type of faults

Why Postdelivery Maintenance Is Necessary

- Perfective maintenance
  - Client requests changes to improve product effectiveness
    - Add additional functionality
    - Make product run faster
    - Improve maintainability

Why Postdelivery Maintenance Is Necessary.

- Adaptive maintenance
  - Responses to changes in the environment in which the product operates
    - The product is ported to a new compiler, operating system, and/or hardware
    - A change to the tax code
    - 9-digit ZIP codes

16.3 What Is Required of Postdelivery Maintenance Programmers?

- At least 67% of the total cost of a product accrues during postdelivery maintenance

- Maintenance can be a major income source

- Nevertheless, even today many organizations assign maintenance to
  - Unsupervised beginners, and
  - Less competent programmers

16.3 What is Required of Postdelivery Maintenance Programmer ?

- Postdelivery maintenance is one of the most difficult aspects of software production because
  - Postdelivery maintenance incorporates aspects of all other workflows

16.3 What is Required of Postdelivery Maintenance Programmer ?

- Corrective Maintenance
- What tools does the maintenance programmer have to find the fault?
  - The defect report filed by user
  - The source code
  - And often nothing else

16.3 What is Required of Postdelivery Maintenance Programmer ?

- A maintenance programmer must therefore have superb debugging skills
  - The fault could lie anywhere within the product
  - The original cause of the fault might lie in the by now non-existent specifications or design documents

16.3 What is Required of Postdelivery Maintenance Programmer ?

- Suppose that the maintenance programmer has located the fault

- Problem:
  - How to fix it without introducing a regression fault

16.3 What is Required of Postdelivery Maintenance Programmer ?

- How to minimize regression faults
  - Consult the detailed documentation for the product as a whole
  - Consult the detailed documentation for each individual module
- What usually happens
  - There is no documentation at all, or
  - The documentation is incomplete, or
  - The documentation is faulty

16.3 What is Required of Postdelivery Maintenance Programmer ?

- The programmer must deduce from the source code itself all the information needed to avoid introducing a regression fault

- The programmer now changes the source code

16.3 What is Required of Postdelivery Maintenance Programmer ?

- The Programmer Now Must
- Test that the modification works correctly
  - Using specially constructed test cases

- Check for regression faults
  - Using stored test data

- Add the specially constructed test cases to the stored test data for future regression testing

- Document all changes

16.3 What is Required of Postdelivery Maintenance Programmer ?

- Major skills are required for corrective maintenance
  - Superb diagnostic skills
  - Superb testing skills
  - Superb documentation skills

16.3 What is Required of Postdelivery Maintenance Programmer ?

- Adaptive and Perfective Maintenance
- The maintenance programmer must go through the
  - Requirements
  - Specifications
  - Design
  - Implementation and integration

  workflows, using the existing product as a starting point

16.3 What is Required of Postdelivery Maintenance Programmer ?

- Adaptive and Perfective Maintenance
- When programs are developed
  - Specifications are produced by analysis experts
  - Designs are produced by design experts
  - Code is produced by programming experts

- But a maintenance programmer must be expert in all three areas, and also in
  - Testing, and
  - Documentation

The Rewards of Maintenance

- Maintenance is a thankless task in every way
  - Maintainers deal with dissatisfied users
  - If the user were happy, the product would not need maintenance
  - The user's problems are often caused by the individuals who developed the product, not the maintainer
  - The code itself may be badly written
  - Postdelivery maintenance is despised by many software developers
  - Unless good maintenance service is provided, the client will take future development business elsewhere
  - Postdelivery maintenance is the most challenging aspect of software production — and the most thankless

16.3 What is Required of Postdelivery Maintenance Programmer ?

- No form of maintenance
  - Is a task for an unsupervised beginner, or
  - Should be done by a less skilled computer professional

16.5 Management of Postdelivery Maintenance

- Various issues regarding management of postdelivery maintenance are now considered

16.5.1 Management of Postdelivery Maintenance

- Defect Reports
- We need a mechanism for changing a product
- If the product appears to function incorrectly, the user files a defect report
  - It must include enough information to enable the maintenance programmer to recreate the problem
- Ideally, every defect should be fixed immediately
  - In practice, an immediate preliminary investigation is the best we can do

If the Defect Has Been Previously Reported

- How was it handled?
- Is there a work-around?
- Is there a patch?

If it Is a New Defect

- The maintenance programmer should try to find
  - The cause,
  - A way to fix it, and
  - A way to work around the problem

- The new defect is now filed in the defect report file, together with supporting documentation
  - Listings
  - Designs
  - Manuals

Management of Postdelivery Maintenance

- In an ideal world
  - We fix every defect immediately
  - Then we distribute the new version of the product to all the sites

- In the real world
  - We distribute defect reports to all sites
  - We do not have the staff for instant maintenance
  - It is more practical/cheaper to make a number of changes at the same time, particularly if there are multiple sites

16.5.2 Authorizing Changes to the Product

- Corrective maintenance
  - Assign a maintenance programmer to determine the fault and its cause, then repair it
  - Test the fix, test the product as a whole (regression testing)
  - Update the documentation to reflect the changes made
  - Update the prologue comments to reflect
    - What was changed,
    - Why it was changed,
    - By whom, and
    - When

16.5.2 Authorizing Changes to the Product

- Adaptive and perfective maintenance
  - Same as with corrective maintenance, except there is no defect report
  - There is a change in requirements instead

Authorizing Changes to the Product

- What if the programmer has not tested the fix adequately?
  - Before the product is distributed, it must be tested by the SQA group

- Postdelivery maintenance is extremely hard

- Testing is difficult and time consuming
  - Performed by the SQA group

Authorizing Changes to the Product

- The technique of baselines and private copies must be followed

- The programmer makes changes to private copies of code artifacts, tests them

- The programmer freezes the previous version, and gives the modified version to SQA to test

- SQA performs tests on the current baseline version of all code artifacts

16.5.3 Ensuring Maintainability

- Maintenance is not a one-time effort
- We must plan for maintenance over the entire life cycle
  - Design workflow — use information-hiding techniques
  - Implementation workflow — select variable names meaningful to future maintenance programmers
  - Documentation must be complete and correct, and reflect the current version of every artifact

16.5.3 Ensuring Maintainability

- During postdelivery maintenance, maintainability must not be compromised
  - Always be conscious of the inevitable further maintenance

- Principles leading to maintainability are equally applicable to postdelivery maintenance itself

16.5.4 Problem of Repeated Maintenance

- The moving target problem
- The problem is exacerbated during postdelivery maintenance
- The more changes there are
  - The more the product deviates from its original design
  - The more difficult further changes become
  - Documentation becomes even less reliable than usual
  - Regression testing files are not up to date
  - A total rewrite may be needed for further maintenance

16.5.4 Problem of Repeated Maintenance

- The moving target problem
- Apparent solution
  - Freeze the specifications once they have been signed off until delivery of the product
  - After each request for perfective maintenance, freeze the specifications for (say) 3 months or 1 year

- In practice
  - The client can order changes the next day
  - If willing to pay the price, the client can order changes on a daily basis

- "He who pays the piper calls the tune"

16.6 Maintenance of Object-Oriented Software

- In general
  - Can be better partitioned
  - Can have better cohesion
  - Can be easier to understand
- It is easier to maintain, in general
- However, even object-oriented can be done badly.
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16.7 Postdelivery Maintenance versus Development Skills

- The skills needed for maintenance include
  - The ability to determine the cause of failure of a large product
    - Also needed during integration and product testing

  - The ability to function effectively without adequate documentation
    - Documentation is rarely complete until delivery

  - Skills in analysis, design, implementation, and testing
    - All four activities are carried out during development

Postdelivery Maintenance vs. Development Skills

- The skills needed for postdelivery maintenance are the same as those for the other workflows

- Key Point
  - Maintenance programmers must not merely be skilled in a broad variety of areas, they must be *highly* skilled in *all* those areas
  - Specialization is impossible for the maintenance programmer

- Postdelivery maintenance is the same as development, only more so

16.9 Testing during Postdelivery Maintenance

- Maintainers tend to view a product as a set of loosely related components
  - They were not involved in the development of the product

- Regression testing is essential
  - Store test cases and their outcomes, modify as needed

16.11 Metrics

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- Code artifacts with high complexity is a likely candidate for inducing a regression fault.
- Measures relating to software defect reports,
- Number of defects reported and classification of those defects by severity and type.

The End