# Intro to Software Maintenance

SE 323 Software Construction, Testing and Maintenance
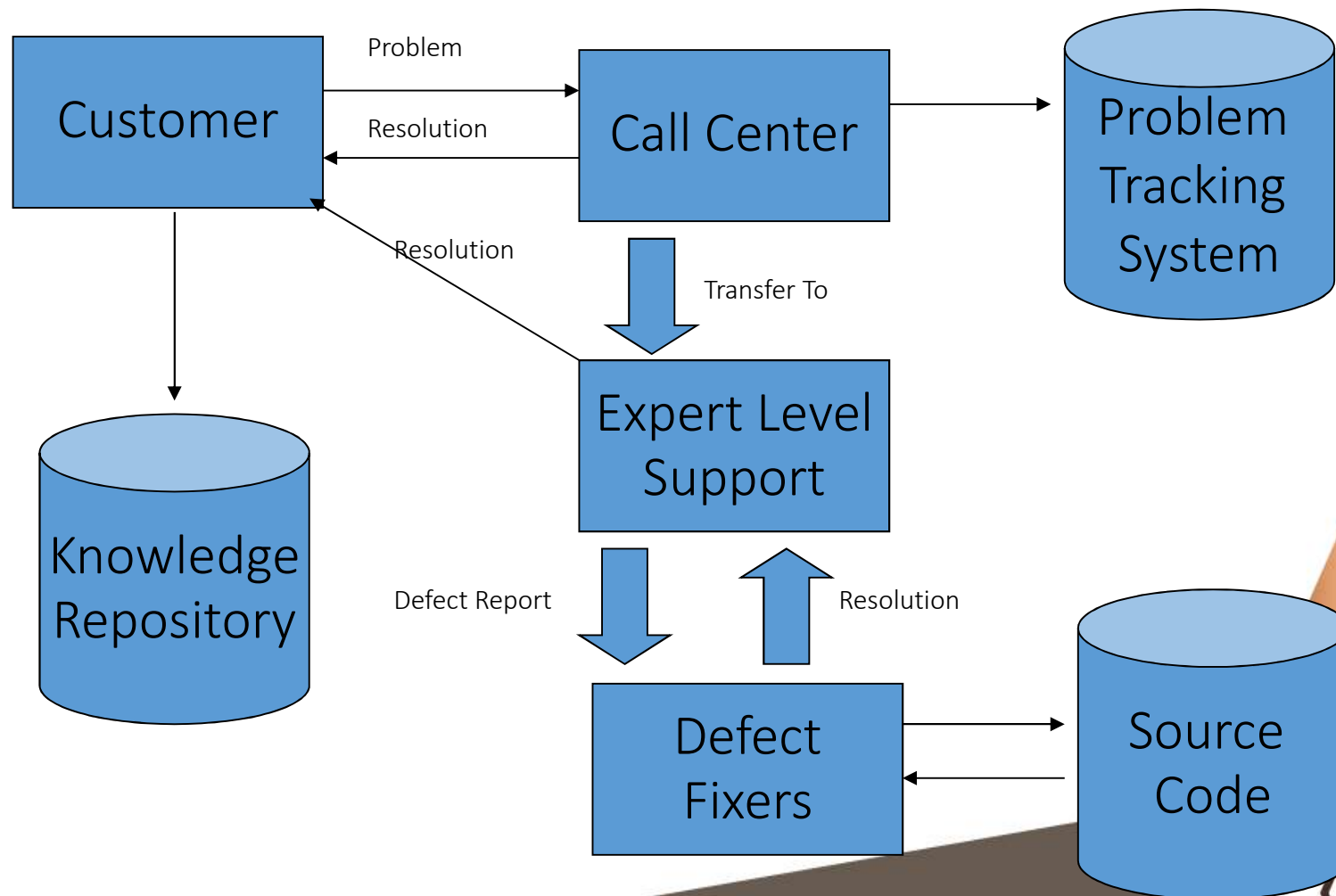
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# Agenda

- Software Maintenance

# Corrective Maintenance

- Customers contact to customer support group
- Product/Software development team ensures the correctness of product

# Corrective Maintenance

# Corrective Maintenance

- Problem should be classified to
  - Environment issue/error
  - Usage issue/error
    - Feedback for correct error is given to the customer
    - Product documents are changed to prevent that problem
  - Known problem (with a solution or workaround)
    - Fix bug before sent to other customers
  - Product error that needs to be corrected

# Adaptive Maintenance

- Changing a software product
- Example
  - When the underlying operating system version changes, DB may have to be changed to work with the new operating system
  - New version of an extensible product is released, the customization may need to be redone
  - New version of database comes into the market, an application may need to be regenerated/reworked to work with the new database release

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# Enhancements Maintenance

• Improve performance of database or operating system

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# Preventive Maintenance

- Newsletter that lists the most commonly encountered problem and suggest solution

- Scheduler of new releases
  - With details of problems that have been fixed

# Maintenance Framework

- Factor which contributes to maintenance activities
- Comprise of 5 components
  - User
  - Environment
  - Maintenance process
  - Software product
  - Maintenance personnel

# Maintenance Framework: User

- Individuals who use the system
  - Also developer and maintenance team
- Request for modification of system

# Maintenance Framework: Environment

- Operating environment
  - Hardware innovations
  - Software innovations
- Organizational Environment
  - Change in policies
  - Competition in the market place

# Maintenance Framework: Maintenance Process

- Capturing change requirement
- Variation in programming practice
- Paradigm shift
- 'Dead' paradigms for 'living' system
- Error detection and correction

# Maintenance Framework:
# Software Product

- Maturity and difficulty of the application domain

- Quality of the document
  - Lack of up-to-date systems' document is one of major problem in software maintenance

- Malleability of programs
  - Vulnerable to undesirable modification

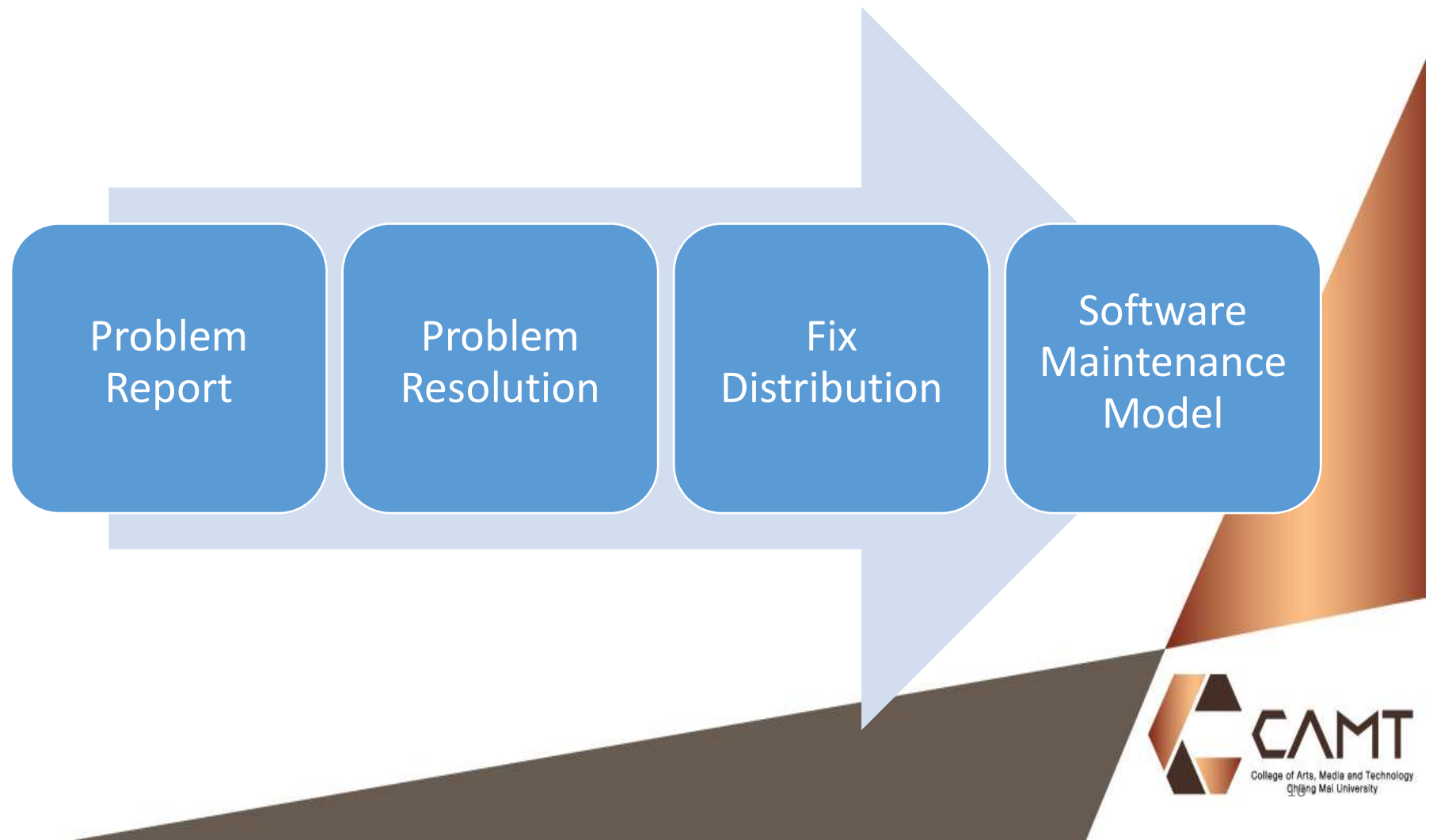- Inherent quality
  - E.g. ability to change easily

# Maintenance Framework: Maintenance Personnel

- Staff turnover
- Domain expertise
- Working practices

# Maintenance Framework:
# Relations Between the Maintenance Factor
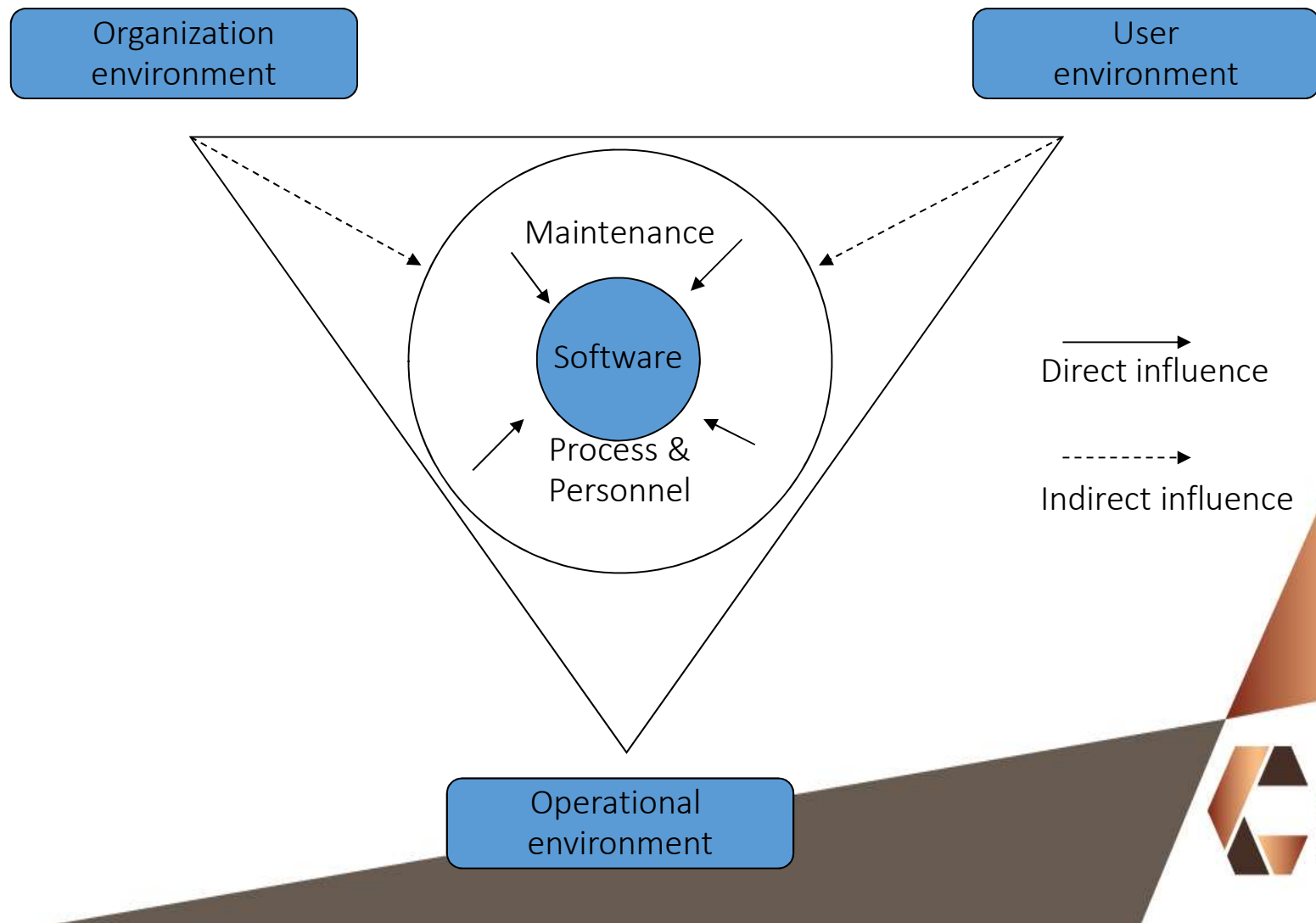
# The Maintenance Process

# Problem Report

- Behavior of the product does not match user's expected view
- What should we do to acknowledge problem ?

# Problem Report:
# Customer-side Activities

- Eliminate obvious usage error
  - Error should not be occurred by user
- Ascertaining the impact of the problem on the business
  - Is the product rendered complete unusable?
  - How many users are effected by the problem?
  - Time-based functionality not working

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# Problem Report:
# Customer-side Activities

- Identifying any ready workaround
  - Sharing experiences across the user to get solution faster
- Gathering the required information for the product organization
- Communicating internally and with the software product vendors

# Problem Report:
# Customer Support Group Role

- Customer filling a problem report
  - Through the internet or a phone call
  - Route it to an appropriate support analyst on the basis of the nature of the problem report
  - Benefit of problems report through internets ?
    - 24 x 7 support
    - Problem repository
    - Problem may be routed to the most appropriate analyst in the intelligent manner
    - Workload may be more transparently distributed across multiple geographic location
    - Most cost-effective from the customer's perspective eliminating the need for long waits on the telephone

# Problem Report:
# Customer Support Group Role

- Ascertaining validity of the customer and the environment
  - Is the customer calling in eligible for support?
    - Normally use a customer code or reference number
  - Is the right person from the customer side making the contact?
  - Is the problem relating to the hardware environment?
  - Is the problem relating to the software environment?
  - Are the right versions of the product(s) begin used

# Problem Report:
# Customer Support Group Role

- Choosing an analyst to service the problem by
  - Product type
  - Platforms
  - Geography
  - Workload and availability

- Getting into problem details ?
  - What are the symptoms of the problem?
  - Which product was running when the problem occurred ?
  - Is the problem reproducible or sporadic?
  - What else was happening on the system when the problem occurred ?
  - How many users are affected by the problem ?

# Problem Report:
# Customer Support Group Role

- Evaluating whether a problem is really a problem
  - Product behavior match what is documented ?
- Ascertaining whether the problem is a known problem
- Does the problem need to be passed on to next level of support (or to development) ?
- Communicating with the customer

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# Problem Report:
# Logistics and Tooling

- Customer repository
  - Store information about customer
  - Validate the eligibility of a customer for support
- Problem knowledgebase
  - FAQ, usage hints, sample programs
- Customer support repository
  - Record all the communication between customer and the support group

# Problem Report:
# Logistics and Tooling

- Diagnostic information capture tool
- Defect repository
- Diagnostic information through instrumentation

# Problem Report:
# Skills Needed

- Evaluate the impact of product and a problem on the customer's business
- Understand the product's external behavior
- Communicate effectively within the organization
- Communicate effectively with the other side

# Problem Report: Challenges

- How do I know whom to call or complain?
- How do I know whether my expectation of the product behavior is appropriate or not?
- How do I get the required information from the customer
  - especially when he or she is angry
- How do we make it easier for the customers to find out the solutions for the problem by themselves?

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# Problem Report:
# Best Practices and Pitfalls

- Best Practice
  - Centralized customer contact
  - Job rotation for support analyst role

- Pitfalls
  - Not having an objective way of classifying problem priority
  - Not abstracting the problem to the appropriate level

# Problem Report:
# Measurement of Effectiveness

- Number of times the customer can get a fix to his problem by self-service

- Time taken for the customer to reach the right support analyst

- Number of times the problem had to be report to the development for provide actual fix

- Time taken for the support analyst to provide a solution to the customer

# Problem Resolution

- After receive report of problem (Customer side)
- Product development group find and fix the problem
- What should we do ?

# Problem Resolution: Overview

- Categorising the problem
- Prioritising the problem
- Reproducting the problem
- Marking and testing the fix
- Scheduling the fix for release

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# Problem Resolution: Categorising the Problem

- Usage problem
    - Periodically review to customer
    - Update the document to remove any ambiguity

- Environment issues
    - Refer the customer to the relevant section in the installation documentation

- Hardware vendor issue
    - Problem transferred to hardware vendor
    - If the problem is very complex, special team may be needed

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# Problem Resolution: Categorising the Problem

- Third party software vendor
  - Working as in hardware vendor issue
- Known defect and cannot be fixed
  - Due to technical limitation or other reason
  - Support should go back to customer with an answer or a workaround until the future releases
- Known defect, fixed
  - Fix delivery process should kick-in
- New defect
  - Needs a fresh look at the program code or document

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# Problem Resolution: Prioritising the Problem

- Why ?
  - The more severe the impact of the problem on the customer's business, the more urgent is the requirement for the fix
  - Level of design should be assign by the team
  - 1,2,3 may be use

# Problem Resolution: Prioritising the Problem Example

- Severity 1
  - The highest severity of a problem
  - Product defect causes a complete loss of service in the customer environment
  - Example
    - Freezes or hangs the machine
    - Security holes
    - Shopping mall: Lost transactions, security holes
    - Does not allow users to log in (Database software)
    - Does not install

# Problem Resolution:
# Prioritising the Problem Example

- Severity 2
    - Problem/product defect causes a severe impact on the customer's business
    - Operation can continue in a somewhat restricted
    - Example
        - Performance is slow
        - Customer find wrong results
        - Internal software error: return wrong results
        - Severely degraded performance due to software error

# Problem Resolution: Prioritising the Problem Example

- Severity 3
  - Defect causes a minimal impact on the customer's business
  - Impact is minor or inconvenience
  - Example
    - Requiring execution of a few steps manually to accomplish some product functionality
    - Error that customer can accept
    - Minimal degraded performance due to software error
    - Incorrect behavior with minor impact on the operation of the system

# Problem Resolution:
# Complexity of the Problem

- Refers to judgment of effort and skill sets involved in fixing the problem

- Factors contribute to the complexity
  - Problem which are not easily reproducible
  - Problems that occur under heavy or heterogeneous user work load
    - Organization may not have the resources for recreating the environment
  - Problems that involve multiple, potentially third party, component

- Level as high, medium, low complexity

# Problem Resolution: Complexity of the Problem

- SLA : Service Level Agreement
  - Support level agreement between customer and developer

| Complexity Severity | High | Medium | Low |
|---|---|---|---|
| Severity 1 | 1 week | 2days | 1 day |
| Severity 2 | 4 weeks | 3 weeks | 1 week |
| Severity 3 | 8 weeks | 8 weeks | 8 weeks |

# Problem Resolution:
# Identify Developer to Fix the Problem

- What is the severity of the problem
  - The higher severity problems, the most competent people to resolve
- Is the problem in a highly specialize area
- Does the problem require significant inter-group co-ordination ?
- Is any special customer knowledge need?
- Are the appropriate skill sets identified?
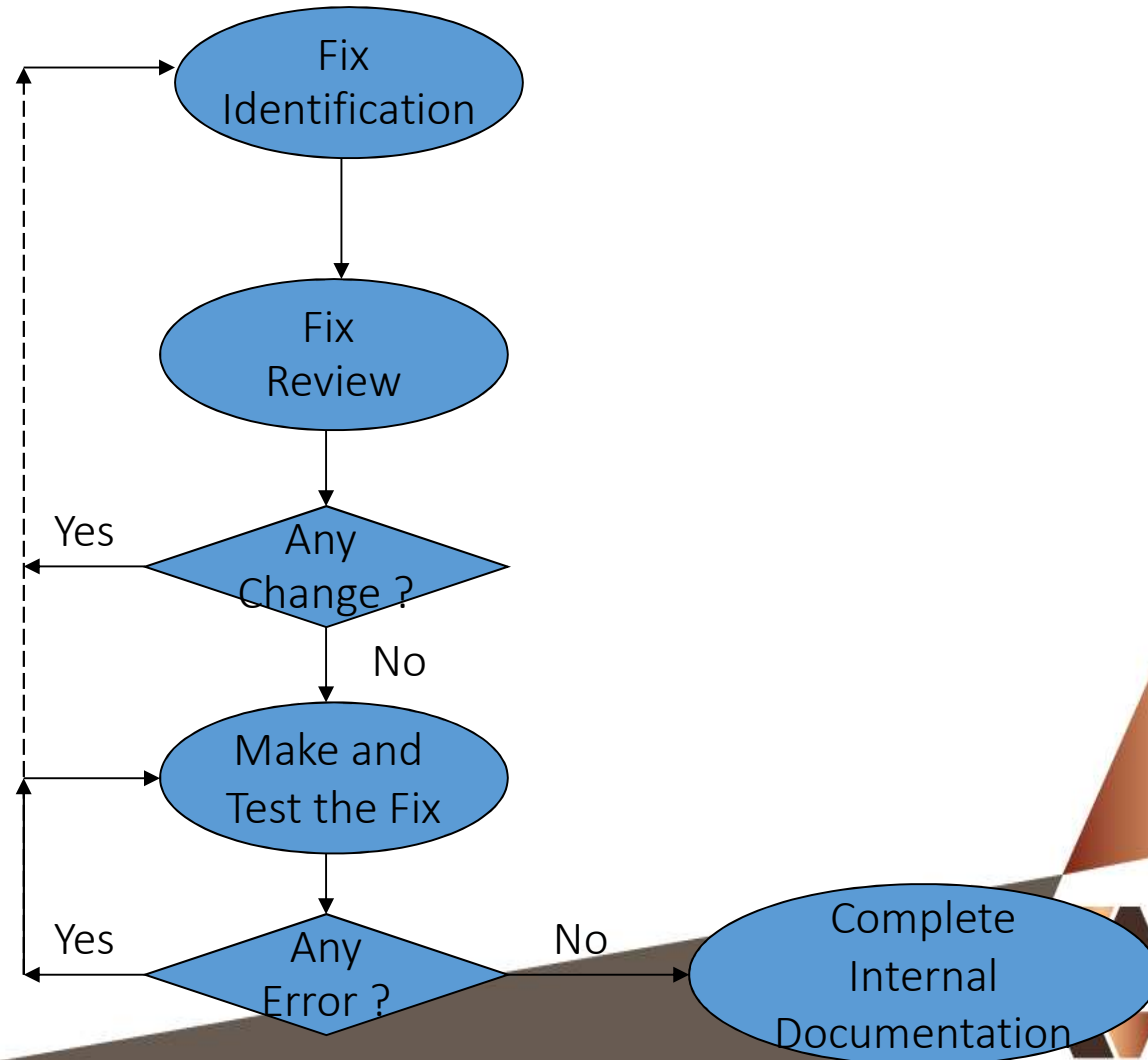- Who is available?

# Problem Resolution:
# Reproducing the Problem

- Support team provides steps to recreate the problem
- A few problem types cannot reproduce easily
  - Performance problem
    - Profiling tools
  - Memory leaks and memory initialization issue

# Problem Resolution: Reproducing the Problem

- If problem cannot reproduce
  - Getting a snapshot (Memory dump) of the customer environment from the customer at the time when the problem occurred
  - Sending a special instrumented code that is run in a controlled fashion at the customer site
  - Performing remote diagnostic
  - Site visit by development teams

# Problem Resolution: Making the Fix and Test It



Fix Identification → Fix Review → Any Change?
- Yes → (loop back to Fix Identification)
- No → Make and Test the Fix → Any Error?
  - Yes → (loop back to Make and Test the Fix)
  - No → Complete Internal Documentation

# Problem Resolution:
# Making the Fix and Test It

- Fix Identification  question guideline
  - Is the product behavior in consonance with the documentation
  - Is the product behavior is in consonance with the documentation, is the behavior right?
  - What changes would I have to bring about in the product to satisfy the execution of the user?
  - Are there alternative ways in which I can accomplish what the user wants?
  - If the changes are made, for each of the alternatives, will it cause other implications for either this user or for other users?

# Problem Resolution:
# Making the Fix and Test It

- Fix Identification  question guideline
  - How can I test that the proposed changes would accomplish what the user want?
  - How can I ensure that the proposed change does not cause any new problems?

# Problem Resolution:
# Fix Review

- Fix-related
  - Is the defect fixed in accordance with the architecture ?
  - Does the code written to fix the problem address the problem in totality and not partially?
  - Does the code written to fix the problem follow the coding standard?
  - Are any potential memory leak issues possible with the fix?
  - Are any side effects possible because of the fix?
  - Have multiple options been considered ?

# Problem Resolution:
# Fix Review

- Testing-related
  - Is the customer supplied test case run to ensure that the fix does fix the problem?
  - Are all relevant test suites pertaining to the code changes made run ?
  - Is the regression test suite updated to reflect on the current fix?
  - Have the regression tests been run successfully?

# Problem Resolution:
# Fix Review

- Configuration Management-related
  - What are files that have been changed?
  - Was the problem exist before ? If it has been introduced in any earlier release, which are these releases ?
  - Should the patch be made available for earlier release ?
  - Is the fix going to create any problems for new feature that developers are already working on?

# Problem Resolution:
# Fix Review

- Documented related
  - Is the requisite information on problem rediscovery available?
  - Are the appropriate documentation complete ?

# Problem Resolution: Skills Needed

- Good product usage knowledge
- Problem solving ability
- Good debugging skills
- Ability to word with source code not written by them
- Good attitude
- Good communication skills

# Problem Resolution: Challenges

- Whose problem is it?
- The original developer may not be available for comments or review
- Inability to reproduce the problem and lack of access to the customer

# Problem Resolution:
# Best Practice

- Introducing customer supplied test cases in test suites
- Document standards
  - Describing problem in a simple language
  - Avoiding reference to any customer names
- Configuration management
- Effective SQA practices

# Problem Resolution: Measurement of Effectiveness

- Number of times a customer is approached for obtaining information about a problem
- Mean time to eventually fix the problem
- Mean time to review and test the fix
- Number of times that an old problem reappeared

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# Fix Distribution

- Fix delivery
- Bundling the fixes and delivering them to customer "patch bundles"

# Fix Distribution: Overview

- Choosing the method of distribution
- Fix composition
- Testing the shipment
- Scheduling the fix for release

# Fix Distribution:
# Choosing the Method of Distribution

- Distributing the individual fixes
  - Users want the fix as soon as possible
  - Inability of customer to wait for the 'patch bundle'
- How are individual fixes installed?
  - Installation steps (README.txt)
  - Self installing patches
    - Verify that sufficient disk space available
    - Check for presence of the correct environment
    - Rebuild one or more components automatically

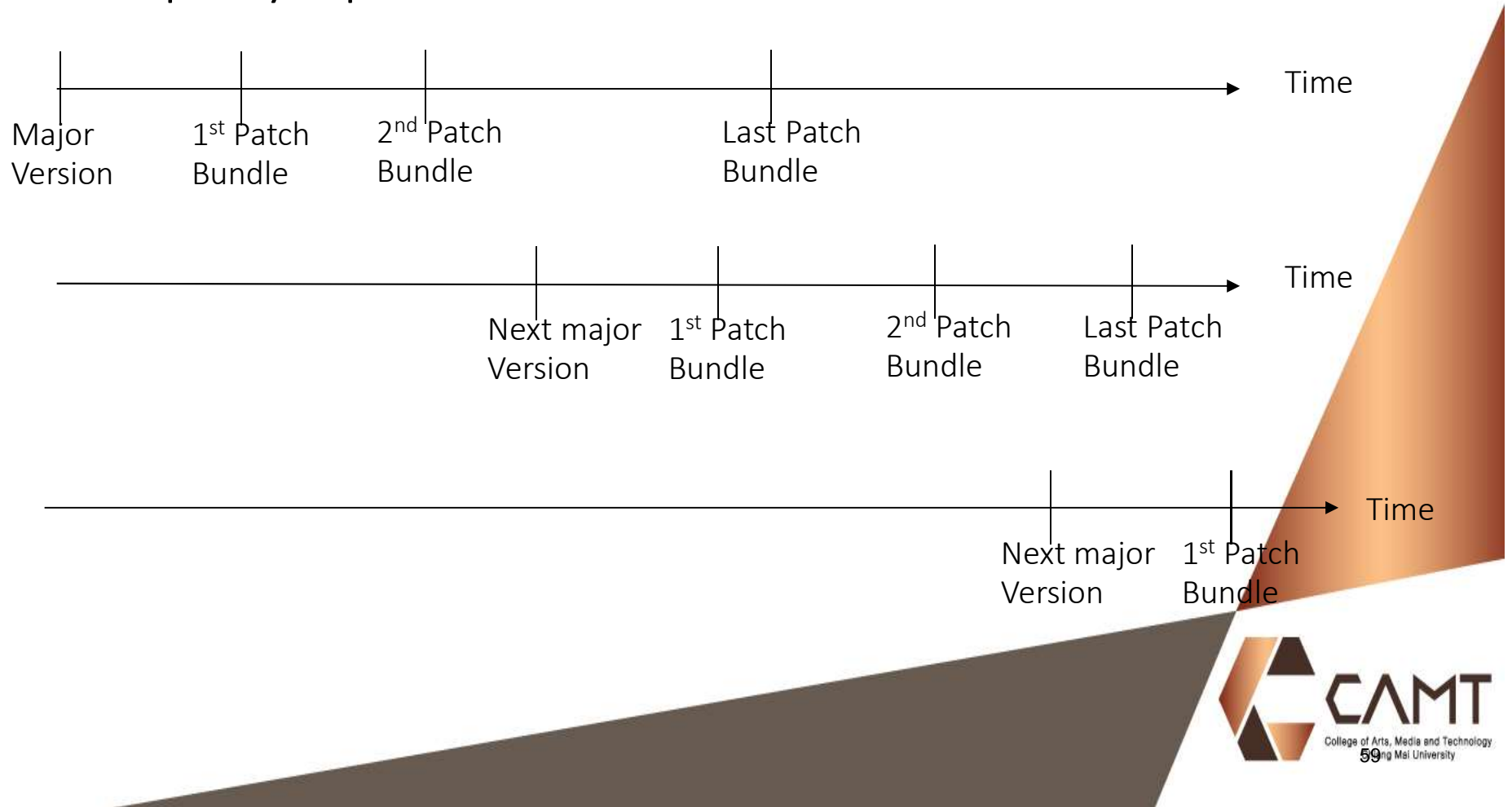# Fix Distribution: Choosing the Method of Distribution

- Patch bundles
  - Collection of individual defect fixes
  - To provide well-tested, fix
- Advantage
  - Quality
  - Ease of deployment
  - Simpler configuration management
  - Reduced overall cost
  - Better chance of customer acceptance

# Fix Distribution:
# Choosing the Method of Distribution

- Frequency of patch bundles
    - When is the next product's major version due?
    - Number of bugs in the product
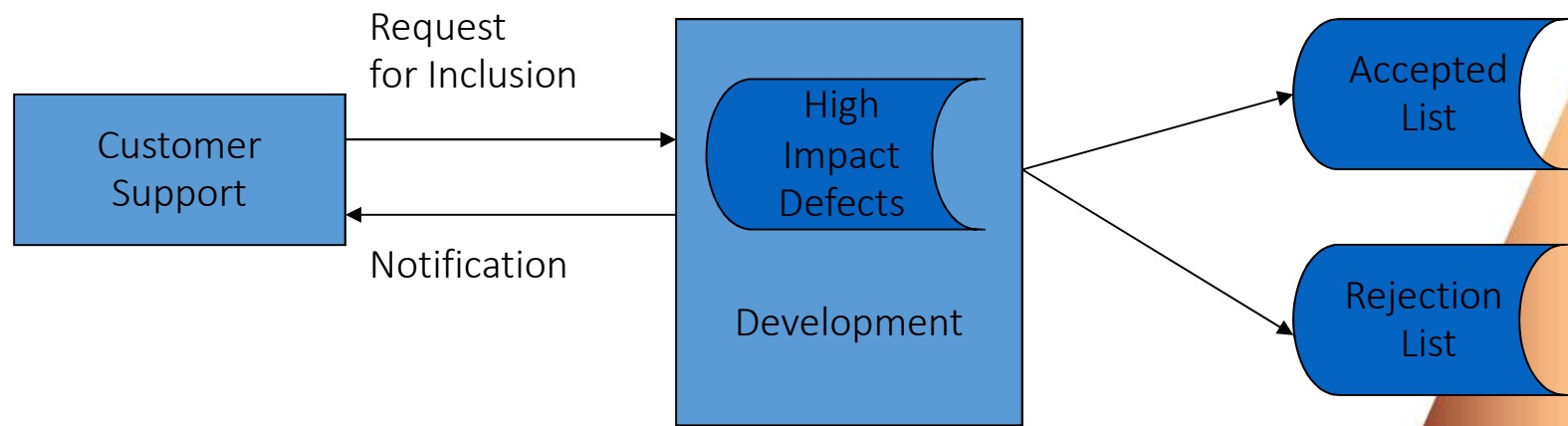    - Complexity of installation of the patch bundle

# Fix Distribution:
# Choosing the Method of Distribution

- Frequency of patch bundles



Time

| Major Version | 1st Patch Bundle | 2nd Patch Bundle | Last Patch Bundle |

Time

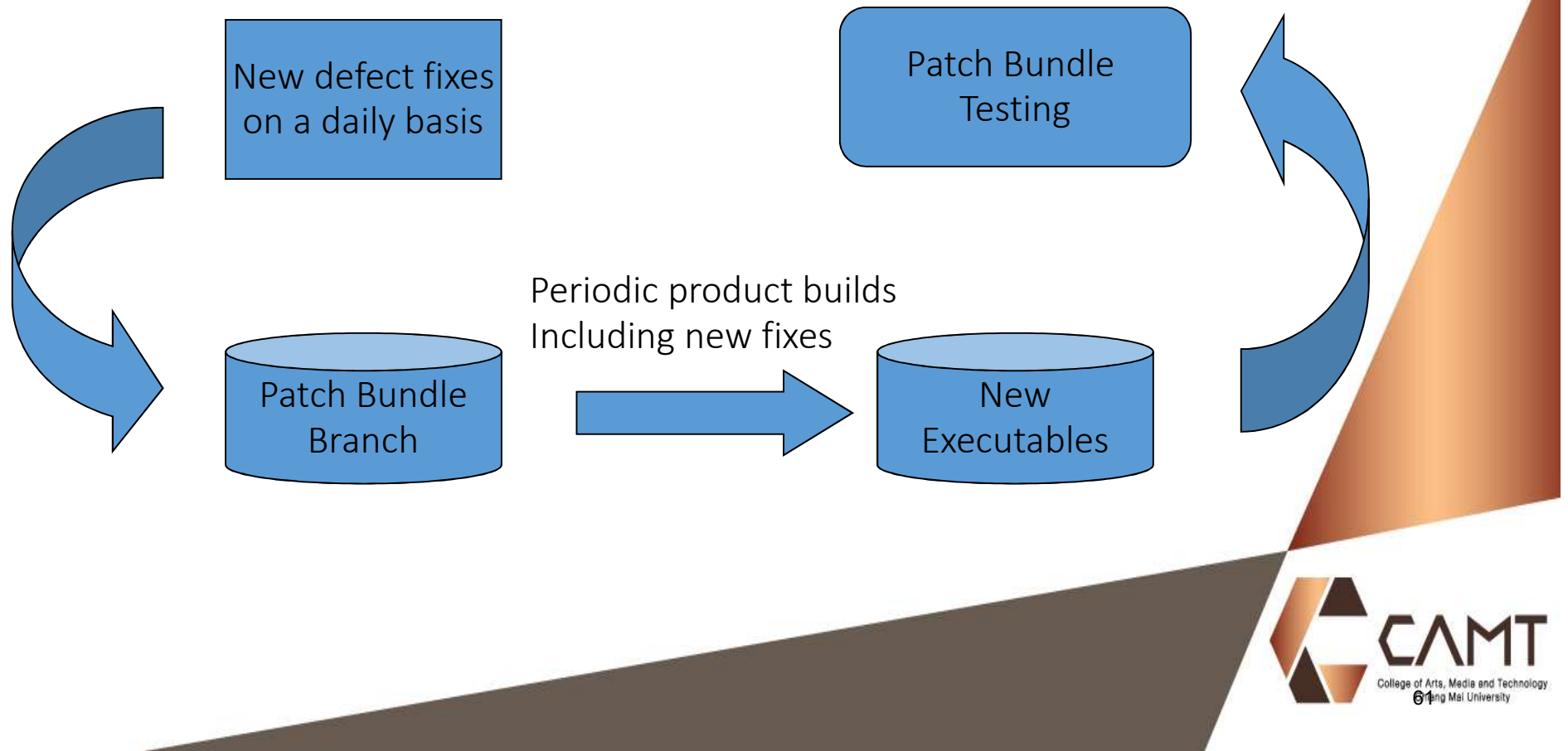| Next major Version | 1st Patch Bundle | 2nd Patch Bundle | Last Patch Bundle |

Time

| Next major Version | 1st Patch Bundle |

# Fix Distribution: Composing the Fix

- Deciding what defects are fixed in a patch bundle

# Fix Distribution: Composing the Fix

- Composing and Merging the fix

New defect fixes on a daily basis

Patch Bundle Testing

Patch Bundle Branch

Periodic product builds Including new fixes

New Executables

# Fix Distribution:
# Composing the Fix

- Preparing documentation for the bundle
  - A list of source and object files that will be packaged together – "Bill of material"
  - A list of all the defects whose fixes from the patch bundle

# Fix Distribution:
# Testing the Shipment Unit

- **Test Process**

Patch bundle testing stage
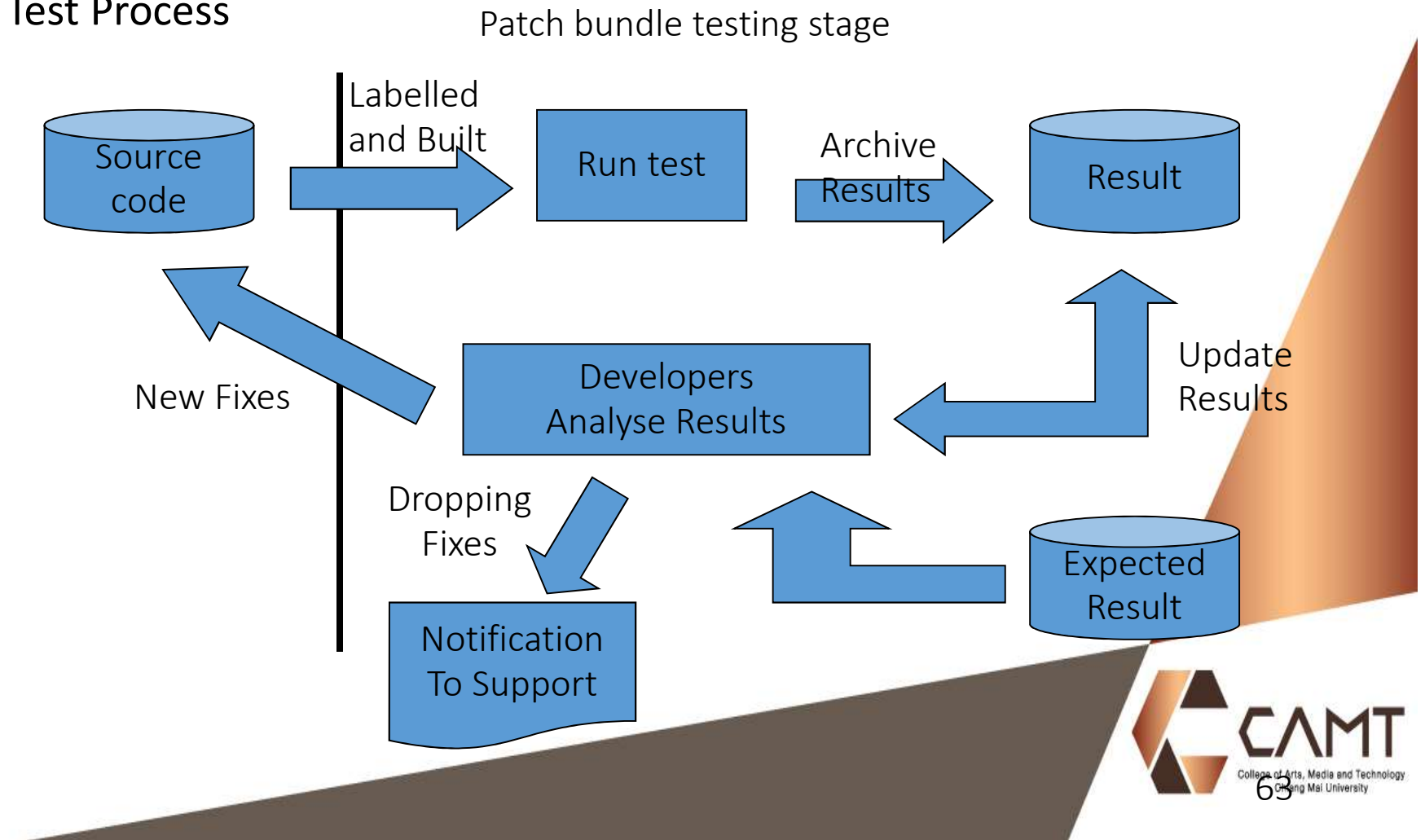
# Fix Distribution:
# Delivery model

- Traditional media install deployment model
- Bundles -> Media -> Shipping -> Customer install
- Cost
  - Media costs
  - Replication cost
  - Transportation costs
  - Time delays
  - Local h/w cost
  - Installation cost
  - Upgrade cost

# Fix Distribution: Delivery model

- Web based deployment model

- Bundles->Post on web-> customer install

- Advantage
  - No replication costs
  - No media costs
  - No transportation
  - Global instantaneous available

# Fix Distribution: Delivery model

- Hosted Model
- Bundles-> Host on professionally managed central sites -> access through simple browser
- Using ASP (Application service provider) site
- Advantage
  - No local h/w costs
  - No local upgrade cost/time
  - High availability
  - Professionally managed

# Fix Distribution:
# People needed

- Assign release coordinator or release manager
  - Coordinate of all activities starting from identifying product till patch bundles
  - Carry out the fix inclusion process
  - Identify machine resource and human resource for running test
  - Analyzing the test result to highlight any potential problems
  - Coordinate with other groups like documentation and support
  - Scheduling the patch bundles and communicating to customer (via support team)
  - Resolving conflicts between new version priorities and patch bundle priority

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# Tools for Maintenance

- Following the given criteria
- Assignment
  - Select one tools
  - Do a report how it can help the Software Maintenance
  - 1,000 – 1,500 words
  - With less than 15 % plagiarism checking by Turnitin.com
  - Enroll to turn it in using the given id

  Class ID **20803885**
  Enrollment key **953323**

  - Due date  on the 5$^{th}$ of April before midnight

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Q&A