

# MODELING MAINTENANCE PROCESSES FOR DISTRIBUTED APPLICATIONS

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## ABSTRACT:

*Maintenance processes model include actions and tasks based on IT standards are part of the life cycle of distributed applications, making it necessary to ensure their easy assistance after deployment of the application currently in use.*

**Key words: maintenance model; maintainability; life span of the maintenance processes; distributed applications; collaborative systems; databases; GUI; maintenance processes; maintenance metrics; evaluation of maintenance processes.**

## 1. INTRODUCTION

The present research of this article is based on the types and functioning of maintenance processes for distributed applications. Modelling aspects of development processes meet maintenance for distributed applications, type, duration, the management of activities and resources. The research stands for deployment and maintenance processes for managing distributed applications based on the requirements of balancing new data volumes.

## 2. MAINTENANCE PROCESSES CONCEPTS

Based on [DEXD09] the processes represent a set of operations, events and states through which a change is made, evolution, development, courses of actions. Maintenance processes are reflected by changes in project management of complex activities involving similar design applications with periods of deployment and reduced development costs, even taking action on the components of distributed applications already implemented and working in an online environment.

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Based on IT system standards ISO/IEC 12207 [ISIE08] and ISO/IEC 14764 [ISIE06] in table 1 are presented the main tasks and activities of maintenance processes through which the actions that have to be implemented are defined.

Table 1 – Tasks and activities that manage the maintenance process

based on ISO/IEC 12207 standard [ISIE08]

|                     | Activities / Tasks     |
|---------------------|------------------------|
| Aiso <sub>1</sub> . | Process implementation |

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|                          |                                                 |
|--------------------------|-------------------------------------------------|
|                          | Develop procedures and maintenance plan         |
|                          | Develop procedures for change requests          |
|                          | Implement configuration management process      |
| <b>Aiso<sub>2</sub>.</b> | <b>Problem analysis and changes</b>             |
|                          | Conduct initial analysis                        |
|                          | Query the problem                               |
|                          | Documentation of results                        |
|                          | Develop options for implementing changes        |
|                          | Obtaining approval for the modification option  |
| <b>Aiso<sub>3</sub>.</b> | <b>Implementing the change</b>                  |
|                          | Implementing the change                         |
|                          | Development, coding and testing changes         |
| <b>Aiso<sub>4</sub>.</b> | <b>Review and approval of maintenance</b>       |
|                          | Develop book reviews                            |
|                          | Obtaining approval for change                   |
| <b>Aiso<sub>5</sub>.</b> | <b>Migration</b>                                |
|                          | Develop migration plan                          |
|                          | Notifying users of the migration plan           |
|                          | Book reviews post-operative enterprise          |
|                          | Ensuring access to old data                     |
| <b>Aiso<sub>6</sub>.</b> | <b>Retirement</b>                               |
|                          | Develop plan for retirement                     |
|                          | Notifying users on retirement plan              |
|                          | Conducting operations in parallel               |
|                          | Notifying users to start the withdrawal process |
|                          | Ensuring access to old data                     |

The maintenance processes actions based on ISO/IEC 12207 standard involve carrying out tasks that are characterized by actions and operational decisions.

**Aiso<sub>1</sub> action** involves the time to start the maintenance process and involves tasks of:

- Development and plan maintenance procedures that establish critical resources and timeframes for deployment;
- Develop procedures for change requests that fall and determine the type of maintenance identified in the preliminary;
- Implementation of the configuration management process to ensure consistency of compliance retention plan originally developed to complete the maintenance process at a time and achieve optimal performance required in the application trigger maintenance actions.

**Aiso<sub>2</sub> action** corresponds to the analysis phase of the problem and request changes which triggered operations and maintenance process involves the tasks of:

- Scroll to the initial analysis involving detailed analysis of the application made in solving the problem;
- Verification of the problem by making measurements and comparisons with similar systems tailored technical requirements and legislation;
- Documentation of results by making reports and attaching functional requirements, and solving operational requirements change;
- Development of options for implementation by identifying the optimal solution to solve and how best to achieve its purpose;
- Obtain approval for the option to change the presentation of the evidence analyzes and proposed solutions to the outcome of which is the release or abandonment of the maintenance process in accordance with the decisions taken.

**Aiso<sub>3</sub> action** corresponds to the implementation phase changes triggered by the successful completion of the action involves analysis and tasks of:

- Detailed analyzes at source code and database structure that requires changes, adaptations and improvements;
- Development, coding and testing the update action changes the structure of databases and programming for implementing changes to address the problem at the physical level of the application;
- Carry out tests on new implementations whose outcome determines advancement to the next phase.

**Aiso<sub>4</sub> action** phase corresponds to review and approval of maintenance and involves tasks of:

- Develop Reviews What the results obtained after implementing changes to support decisions to advance the migration phase which involves launching the new changes;
- Obtaining approval for change based on the results and confirmation reports proving the achievement of the required maintenance of the process triggering statement.

**Aiso<sub>5</sub> action** migration phase corresponds to exploit new application functionality to users and tasks assumed by:

- Developing the migration plan by which to establish terms and conditions for replacement of old and new features containing the modified version;
- Notify users about migration plan by adding messages that offer users operating in parallel implementations of new types of changes that allow this;
- Post-operative enterprise of book reviews that highlight the results obtained by modifying the application and presentation functions punctual modifications undertaken;
- Ensuring access to old data that requires both an adaptation by comparing the new with the old functionality and access to data when it launched a new application whose data is not moved and containing a new database requiring the addition of all data.

**Aiso<sub>6</sub> action** dedicated to the elimination phase corresponds to withdraw or limit access to the old functionality for tasks involving:

- Preparation of the planned withdrawal which means the closure of the old functionality or definitive closure of all independent applications by launching new versions of previous ones;
- Notification to users on the plan to withdraw the notification of the release of the new version and giving training to use old applications within established according to the withdrawal;
- Management of parallel operations that allows users to recover old information and user installing the new version;
- Notifying the users about the withdrawal process begins which involves limiting access to the old functionality for the previous version which required adaptation to new requirements imposed by the environment in which the application and the requirements of the target group;
- Ensuring access to old data by limiting data processing functions and providing facility to view and retrieve raw data series.

Based on research carried out on standard processes for maintenance process model is proposed the following the Maintenance Model of Distributed Applications further noted as MMDA.

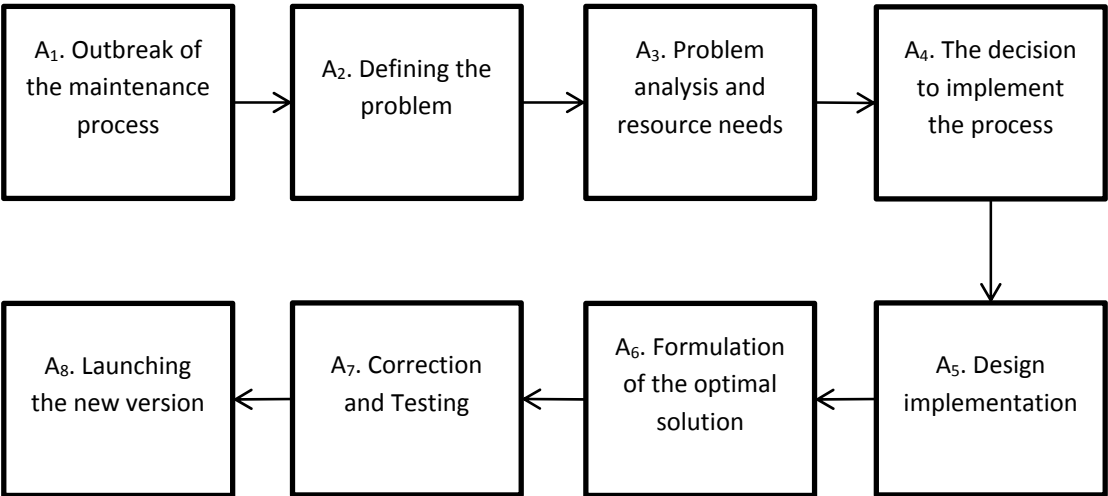


Figure 1 - The activities of the maintenance process

for distributed applications MMDA

A<sub>1</sub>, A<sub>2</sub>, A<sub>3</sub>, A<sub>4</sub>, A<sub>5</sub>, A<sub>6</sub>, A<sub>7</sub>, A<sub>8</sub> activities have specific task or actions detailed in table 2.

**Maintenance processes for distributed applications and MMDA** involve a set of actions determined by the medium in which they function and are presented in figure 1. Distributed environment involves accessing applications in a shared environment. Distribution of applications in a shared environment determines activities:

- Analysis of the causes triggering the maintenance process by identifying the requirements imposed by law, the needs of the target group and the shared environment is called distributed application by accessing real-time and temporary connection mode that provides real data synchronization and replication;
- Adding new processing sequences and procedures in the competitive environment of data access by adding new features to improve application performance distributed computing;
- Change the sequence and procedures in the source code and database structure to adapt to the requirements of technological change and the needs imposed by the target group and other current legislation by implementing formulas and computer optimization solutions;
- Elimination of sequences and procedures of distributed application due to failure to adapt procedures or uselessness of the old features;
- Testing in a shared environment implies involvement of users in both real-time reporting issues arising from the operation and performance evaluation after making changes to the structure of the application and the database structure based on meeting the need for obtaining a time soon as the information requested;
- Real-time implementation of the new versions running parallel to the old versions to ensure correct sizing changes made based on the characteristics and operating parameters;
- Management by recording all activities in an application management processes functioning of maintenance.

Table 2 presents the sequence of activities and tasks that compose and describe the maintenance for distributed applications.

Table 2 - The activities and tasks of the maintenance process  
for distributed applications

|                      | <b>Activities / tasks</b>                                                             |
|----------------------|---------------------------------------------------------------------------------------|
| <b>A<sub>1</sub></b> | <b>Outbreak of the maintenance process</b>                                            |
|                      | It signals problems identified in distributed application                             |
| <b>A<sub>2</sub></b> | <b>Defining the problem</b>                                                           |
|                      | Analysing the requirements of the trigger                                             |
|                      | Application reads standards team communication                                        |
| <b>A<sub>3</sub></b> | <b>Problem analysis and resource needs</b>                                            |
|                      | It examines the technical application                                                 |
|                      | It analyses the overall demand for distributed application impact on overall          |
| <b>A<sub>4</sub></b> | <b>The decision to implement the process</b>                                          |
|                      | To approve triggering maintenance activities                                          |
| <b>A<sub>5</sub></b> | <b>Design implementation process</b>                                                  |
|                      | Determine the type of modified components                                             |
|                      | Determine the necessary features the following tasks                                  |
|                      | Determine the type of maintenance on the defining characteristics of the changes made |

|                      |                                                                                            |
|----------------------|--------------------------------------------------------------------------------------------|
|                      | An estimated time for the whole process of maintenance                                     |
|                      | It documents changes made                                                                  |
|                      | Form work team                                                                             |
|                      | In delegating the types of specializations required teamwork                               |
|                      | Designing new version                                                                      |
| <b>A<sub>6</sub></b> | <b>Formulation of the optimal solution</b>                                                 |
|                      | Locate the exact source of the error or improved                                           |
|                      | Record shall be established for discussion optimal solution deployment                     |
| <b>A<sub>7</sub></b> | <b>Correction and Testing</b>                                                              |
|                      | Amend the physical level by implementing the optimal solution                              |
|                      | Test changes in a local test                                                               |
|                      | Test changes in the actual implementation                                                  |
|                      | It made the last corrections                                                               |
|                      | It analyzes the results and make the decision to validate                                  |
| <b>A<sub>8</sub></b> | <b>Launching the new version</b>                                                           |
|                      | Planning and notify its intention to implement the new versions                            |
|                      | It replaces the old version with the new version                                           |
|                      | It certifies add new versions                                                              |
|                      | It validates the correctness of the new version and functionalities related to the trigger |

The defining characteristics of the maintenance process activities and tasks are:

- Individual management by automatic acquisition of all tasks within the application period which oversees the process;
- Team is designated persons managing the project for the maintenance process by distributing tasks to oversee the actions taken in the process of maintenance, testing changes made in the source code and database structure and implementing physical changes to the distributed application;
- Functionality and type of components to be replaced or purchased is determined in accordance with the requirements of the application works distributed environment and the characteristics determined by the structure of the application and the depositary data series;
- Validate changes implemented is performed by persons for managing compliance plan maintenance process in conjunction with the target group of distributed application testing environment shared assets operating parameters;
- Actions of distributed applications maintenance process resets if users indicate new parameters that are required in the new version due to insufficient response speed characteristics and application information available methods too complex, incomplete and security issues that involve the loss process General risk erroneous estimate of the resources required to resume or approval of actions by approving the new planning and estimates.

### 3. CHARACTERISTICS OF THE MAINTENANCE ACTIVITIES

Actions are conducted under maintenance processes are different depending on the problem stated at the time of initiation of maintenance process. Stated problem is solved by making the trigger actions to prepare the application for new features and improve the functioning of distributed application. Depending on the nature of the problem reported when trigger actions the maintenance process are different and to customize the characteristics of the types of maintenance.

**A<sub>1</sub> activity** that involves triggering the maintenance process is determined by the reporting organization software problems using application specifying the need for changes in the way of running the procedures and structures that host functionality modules. Expressed the types of problems occurring during operation indicating different types of maintenance:

- Request information that is made by filling formally or informally through verbal communication paths requires maintenance support to users;
- Results or abnormal behaviours require corrective maintenance calculation formulas for adapting, modifying database structure and how to run the procedures determined by the changes imposed by changes in the meaning and value dimensions used in applications;
- Requirement sets new or changed features and functionalities need to improve maintenance requires perfection by adding facilities designed to raise the performance of your application by providing new results obtained from processing;
- Changing execution environment, uncertainty about the correctness of the program in a modified environment parameters and adaptive maintenance involves predicting changes involving identification purposes by external application and the desire to migrate the application in an environment with new standards and requirements in the processing of the data;
- The need to improve maintainability requires preventive maintenance and insurance operations requires the implementation of documentation and source code readability and modification of modules and database structure to conduct maintenance actions aimed at adapting to new application requirements and application performance lift .

In the last two cases the onset is generally performed even by the organization or team performing maintenance operations. Initial classification of the type of maintenance required is derived from the maintenance process instigated the whole. Initial classification is subject to adjustment during the maintenance process leading up to the re-resolution of the problem as proposed in other maintenance. In that action is specified and the budget resolution's request.

**A<sub>2</sub> activity** involves defining the problem that triggered the process of maintenance by a designated person in charge of management and decision-making in this phase should identify the nature of the problem raised by the alert trigger when the request for change in the distributed application. After analysing the request made to determine whether the nature of the issues rose:

- Resulting from incorrect operation by the user program, the error is signalled by the target group identified by distributed application management;
- Is related to the maintenance process already underway but presented in a different context, which bring new information that is attached to the originally reported problem;
- Belongs to the new problems that need solving which are assigned priority levels and the next step for the maintenance processes.

**A<sub>3</sub> activity** involves the analysis of the problem and the resources needed to conduct maintenance operations required to solve the problem initially set at the onset of the process. This action requires investigation to determine the exact job requirements and part of the application that requires change. The different types of maintenance activities shall cover the following investigations:

- For corrective maintenance error is analysed to determine:
  - an affected part and the nature of the program to identify appropriate knowledge and specialization person or team will be assigned the task of solving;
  - case, its context and when the problem was identified.
- For perfect maintenance is an analysis of the need for change in the formal description of the new requirements in line with current standards used for distributed application needs and current performance analysis application to determine the possibility of achieving the desired level;
- The maintenance of adaptive change is an analysis of the conditions imposed by the new environment in order to identify the nature and extent of the changes imposed on the whole, followed by an analysis of dependencies in order to assess the application of the dependencies in the context of changes that must be undertaken by modifying the parameter variables declared in the source code, how to call the functions and changes to the database to adapt to a new features of the variables;
- Preventative maintenance is undertaken maintainability analysis to identify root causes for a low level of maintainability caused by a lack of documentation and source code readability makes it difficult to understand the changes that need to be made.

Under this action resource requirements are estimated, the overall situation in the context of the application changes required, the cost and time required to solve the problem whose end is identified by launching new versions.

**A<sub>4</sub> activity** involves implementation decision process by taking actions that suggest a detailed analysis of the requests made, identifying the optimal solution solving and physical changes of the application for adding new functionalities. This action requires validation estimates made in the previous phase by the client distributed application where maintenance operations are carried out by an external team of the organization that owns the rights to the application, or the application's project manager overseeing the distribution parameters of the application on its life cycle. If the estimates do not meet allowed budget and time the proposal is rejected to initiate actions that involve amending detailed analysis and physical changes of the application.

**A<sub>5</sub> activity** involves the design implementation process corresponding step in which possible changes are designed in terms of the result after understanding the problem that triggered the maintenance process. Depending on the types of maintenance activities are developed and studied possible variants of solving:

- The corrective maintenance required changes in the module and the database internal parameters to adapt to changes in environmental requirements imposed by the application works;
- For perfect maintenance required changes by adding new features and modules which improve software performance characteristics and raises the quality of the processed data;
- For adaptive maintenance changes the structure of the application to ensure the required standards of the new or amended application to migrate;
- Documenting preventative maintenance and refurbishment is reconsidering parts of the program to carry out other types of maintenance.

Design phase involves implementation and evaluation of the consequences of application for revision under the design phase of implementation. For each proposed solution considers the following criteria:

- The number and nature of software components including testing and documenting changes to be made, designed and matched;
- The effect on overall application complexity does not lead to redundancies or inconsistencies of operation;
- Facilities available for testing or evaluation of performance improvement solution;
- The additional impact on:
  - an attribute of the performance of the application in order to incorporate amendments to the modular structure of the application;
  - a managed application data to determine the necessary compatibility;
  - operational activities available to reinsert a modified parties by launching new versions;
  - operational planning requires preparation for the launch of new versions and service users on this.
- Adapting to budget, time and cost spent implementing changes suggested by the beneficiary or trigger maintenance process.

**A<sub>6</sub> activity** of choice involves formulating the optimal solution to the problem of action to be taken in this case in terms of various proposed solutions and their impact entails documenting and proposing optimal choices taken at the physical changes in the application. Operations are undertaken are:

- Based on documentary analyzes performed to obtain the optimal solution;
- Measurements are taken of the indicators identified in the application which is to determine the current level of return values;
- The decision to implement the proposed solution which corresponds to the next phase of the maintenance process;
- Request for proposal profound analysis of optimal solutions, which leads to the reinitiation of the previous phase;

- Abandonment problem set without undertaking activities by referring only change the decision and the reasons therefor by documentation which is determined by various reasons such as lack of resources or the rarity of the problem, related to the costs that are necessary to solve it.

**A<sub>7</sub> activity** involves correcting and testing by making changes to the source code and tests for validating changes. Regardless of the type of maintenance activities is required:

- Availability of all resources required to implement the solution adopted, human or material;
- Availability configuration characteristics that are altered;
- Develop comprehensive test plan that includes test implementation, testing and acceptance network as appropriate.
- Testing requires to achieve two objectives:
  - Testing of new or modified components interact with parts of the application unchanged;
  - Testing the behavior of the components that were omitted from the amendment if remained unchanged.

If testing in real environment has an unintended response are restated or modified performance evaluation analysis which leads to the reconsideration phase sequence and analysis, and documentation solution.

It certifies that the implementation of the solution was the right answer to the problem reported and requested changes. The activities in this phase depends directly solving the original problem and includes additional testing or not depending on the type of maintenance work. Approval requires validation controls:

- For corrective maintenance problem no longer occurs;
- For maintenance of new or modified functionality perfect answer requests and improve performance required was obtained;
- Adaptive maintenance changes made to determine the application's operation under conditions imposed by the new environment;
- Preventative maintenance has improved maintainability.

**A<sub>8</sub> action** is identified with the launch phase of the new version involving modified when the application is installed in the operational environment by replacing the old version. Depending on the type of application implemented, different characteristics ranging from simply providing new versions and installation instructions to the need for critical components management department approval. Maintenance process involves the installation of the new version is the responsibility of the maintenance team, but is generally accepted as the last phase of the maintenance process.

#### 4. CONCLUSION

At the completion of the intervention is undertaken following before launching new versions of the applications by users:

- Controlling the successful completion of the procedures for quality assurance and compliance testing plan;

- Configuration of new or modified components for attaching the modular system of distributed applications;
- Record of changes made in the application of management of process activities to ensure necessary records for administrative purposes and evaluation;
- Formal approval of changes to the target group of users represented and shutter maintenance process.

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