Project Plan

For KDD-Research Entity Search Tool (KREST)

Version 2.1

Submitted in partial fulfillment of the Masters of Software Engineering degree.

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<table>
<thead>
<tr>
<th>Version #</th>
<th>Changed By</th>
<th>Release Date</th>
<th>Change Description</th>
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<td>Version 1.0</td>
<td>Eric Davis</td>
<td>10/15/2007</td>
<td>Initial Release</td>
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<td>Eric Davis</td>
<td>11/08/2007</td>
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<td>Eric Davis</td>
<td>01/08/2008</td>
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<td>03/03/2008</td>
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</table>
List of Figures

Figure 1: Project Schedule .................................................................................................................. 2
List of Tables

Table 1: COCOMO Effort Adjustment Factors.................................................................. 3
Table 2: Project Effort Adjustment Factor Values ............................................................ 4
# Table of Contents

Change Log ................................................................................................................................................ ii
List of Figures ............................................................................................................................................... iii
List of Tables ................................................................................................................................................ iv

1. Task Breakdown ........................................................................................................................................ 1
   1.1 Project Phases ....................................................................................................................................... 1
      1.1.1 Inception Phase .......................................................................................................................... 1
      1.1.2 Elaboration Phase ....................................................................................................................... 1
      1.1.3 Production Phase ....................................................................................................................... 2
   1.2 Project Schedule .................................................................................................................................. 2

2. Cost Estimate ............................................................................................................................................. 2
   2.1 Elaboration Phase – COCOMO .......................................................................................................... 3
   2.2 Production Phase Estimates ............................................................................................................... 5

3. Architecture Elaboration Plan ................................................................................................................. 5
   3.1 Vision Document Revision ................................................................................................................. 5
   3.2 Project Plan Revision .......................................................................................................................... 5
   3.3 Architectural Design .......................................................................................................................... 5
   3.4 Prototype Development ...................................................................................................................... 5
   3.5 Test Plan ............................................................................................................................................. 6
   3.6 Formal Technical Inspections ............................................................................................................ 6
   3.7 Formal Requirements Specification ................................................................................................... 6

4. Software Production Plan ....................................................................................................................... 6
   4.1 Test Plan Revision .............................................................................................................................. 6
   4.2 Architectural Design Revision ........................................................................................................... 6
   4.3 Component Design .............................................................................................................................. 6
   4.4 Final Software Executable .................................................................................................................. 7
   4.5 Formal Technical Inspections ............................................................................................................ 7
   4.6 User’s Manual ..................................................................................................................................... 7
   4.7 Test Assessment ................................................................................................................................. 7
   4.8 Technical Instructions for Reuse and Extension ............................................................................... 7
   4.9 Project Assessment ............................................................................................................................ 7
1. Task Breakdown

1.1 Project Phases

The project is broken into three distinct phases: the Inception Phase, the Elaboration Phase, and the Production Phase.

1.1.1 Inception Phase

The inception phase is focused on creating the scope of the project, and developing the formal project requirements. A vision document will be developed during this phase, which details the project scope and requirements. A project plan will also be created during this phase that describes the project schedule and effort estimate. A software quality assurance plan will also be designed which will list the required project documentation as well as the steps that will be taken to ensure a quality project is delivered.

An initial prototype is created during this phase that will show project feasibility. It will demonstrate some of the project requirements listed in the vision document.

The inception phase is complete when the developer has delivered a prototype as well as all required documentation to the supervisory committee, and the supervisory committee has reviewed and approved all items. The first presentation will be given at the end of this phase.

1.1.2 Elaboration Phase

During the elaboration phase the architecture of the project will be finalized into an architectural design plan. In addition, all documents from the inception phase will be updated to include any revisions noted by the supervisory committee from the first project presentation. The project requirements for the project will be formally specified using OCL. Also, a formal test plan will be developed that will include the method of testing, as well as the way of documenting, tracking, and fixing bugs found. Two fellow MSE students will perform technical inspections of the architectural design and will report on their findings.

A second prototype will be created during this phase that expands upon the first prototype. It will demonstrate some of the more challenging project requirements, as well as showing features requested by the supervisory committee.

The elaboration phase is complete after the developer delivers the second version of the prototype and all required documentation, and the supervisory
committee has given its approval. The second presentation will be given at the end of this phase.

1.1.3 Production Phase

The production phase focuses on project implementation and testing. During this phase the developer will complete the coding of the project, as well as produce all supporting documentation (User Manual, Project Evaluation, Test Logs, etc.)

The production phase is complete when the developer has completed all required functionality in the project, has delivered the project and all supporting documentation to the supervisory committee, and the supervisory committee has reviewed and approved all items. The final presentation will be given at the end of this phase.

1.2 Project Schedule

The current schedule for the project is displayed in Figure 1. If viewing this document in digital format, the chart can be seen better by increasing the zoom. (A PDF version of the Gantt chart is also available on the project website.) Note: This schedule held through both the Inception and Elaboration phases of the project.

![Gantt Chart](image)

**Figure 1: Project Schedule**

2. Cost Estimate

Barry Boehm’s Constructive Cost Model (COCOMO) will be used to estimate project effort and time. The COCOMO model was developed in the early 1980’s and has a wide range of applicability to software projects.
2.1 Elaboration Phase – COCOMO

Intermediate COCOMO will be used, which is an extension of Basic COCOMO. It includes an Effort Adjustment Factors (EAF) variable, which adjusts the level of effort due to estimated project attributes. The KDD-Research Entity Search Tool project is an Organic Project in COCOMO terms, because it will be a relatively small software project with somewhat flexible requirements, and a developer with application programming experience.

Effort will be estimated using the formula: $\text{Effort} = 3.2 \times \text{EAF} \times (\text{KLOC})^{1.05}$, where KLOC represents the number of thousands of lines of source code developed. Time will be estimated in months using the formula: $\text{Time} = 2.5 \times \text{Effort}^{0.38}$.

There are a total of 15 Effort Adjustment Factors, which have different values within a given range. Each factor is classified as either very low, low, nominal, high, very high, or extra high. This classification gives a value to the adjustment factor. The 15 Effort Adjustment Factors can be found in Table 1.

<table>
<thead>
<tr>
<th>Identifier</th>
<th>Effort Adjustment Factor</th>
<th>Possible Range of Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>RELY</td>
<td>Required Software Reliability</td>
<td>0.75 – 1.40</td>
</tr>
<tr>
<td>DATA</td>
<td>Size of Application Database</td>
<td>0.94 – 1.16</td>
</tr>
<tr>
<td>CPLX</td>
<td>Complexity of the Product</td>
<td>0.70 – 1.65</td>
</tr>
<tr>
<td>TIME</td>
<td>Run-time Performance Requirements</td>
<td>1.00 – 1.66</td>
</tr>
<tr>
<td>STOR</td>
<td>Memory Constraints</td>
<td>1.00 – 1.56</td>
</tr>
<tr>
<td>VIRT</td>
<td>Virtual Machine Volatility</td>
<td>0.87 – 1.30</td>
</tr>
<tr>
<td>TURN</td>
<td>Required Turnabout Time</td>
<td>0.87 – 1.15</td>
</tr>
<tr>
<td>ACAP</td>
<td>Analyst Capability</td>
<td>1.46 – 0.71</td>
</tr>
<tr>
<td>AEXP</td>
<td>Applications Experience</td>
<td>1.29 – 0.82</td>
</tr>
<tr>
<td>PCAP</td>
<td>Software Engineer Capability</td>
<td>1.42 – 0.70</td>
</tr>
<tr>
<td>VEXP</td>
<td>Virtual Machine Experience</td>
<td>1.21 – 0.90</td>
</tr>
<tr>
<td>LEXP</td>
<td>Programming Language Experience</td>
<td>1.14 – 0.95</td>
</tr>
<tr>
<td>TOOL</td>
<td>Use of Software Tools</td>
<td>1.24 – 0.82</td>
</tr>
<tr>
<td>MODP</td>
<td>Use of Modern Software Practices</td>
<td>1.24 – 0.83</td>
</tr>
<tr>
<td>SCED</td>
<td>Required Development Schedule</td>
<td>1.23 – 1.10</td>
</tr>
</tbody>
</table>

Table 1: COCOMO Effort Adjustment Factors

The values chosen for the KDD-Research Entity Search Tool are given in Table 2, as well as an explanation for the value chosen.

<table>
<thead>
<tr>
<th>Identifier</th>
<th>Classification</th>
<th>Value</th>
<th>Reasoning</th>
</tr>
</thead>
<tbody>
<tr>
<td>RELY</td>
<td>Low</td>
<td>0.88</td>
<td>Project is not safety critical, and does not have to be completely reliable</td>
</tr>
<tr>
<td>DATA</td>
<td>High</td>
<td>1.08</td>
<td>A large number of web pages are needed in order to perform a thorough search</td>
</tr>
<tr>
<td>CPLX</td>
<td>Nominal</td>
<td>1.00</td>
<td>Web crawling, Web Search, and Entity Search are not</td>
</tr>
</tbody>
</table>
Table 2: Project Effort Adjustment Factor Values

<table>
<thead>
<tr>
<th>Factor</th>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>TIME</td>
<td>Nominal 1.00</td>
<td>Response time is important yet not overly critical</td>
</tr>
<tr>
<td>STOR</td>
<td>Very High 1.21</td>
<td>Crawling and searching will require a lot of memory usage</td>
</tr>
<tr>
<td>VIRT</td>
<td>Low 0.87</td>
<td>Low complexity of the hardware and software</td>
</tr>
<tr>
<td>TURN</td>
<td>Low 0.87</td>
<td>Since this is a single developer project, the turnaround time on results is low</td>
</tr>
<tr>
<td>ACAP</td>
<td>High 0.86</td>
<td>Developer has 4+ years experience in software engineering</td>
</tr>
<tr>
<td>AEXP</td>
<td>High 0.91</td>
<td>Developer has 3+ years experience in applications development</td>
</tr>
<tr>
<td>PCAP</td>
<td>High 0.86</td>
<td>Developer has applicable experience</td>
</tr>
<tr>
<td>VEXP</td>
<td>Nominal 1.00</td>
<td>Developer has 2+ years experience developing for Java virtual machine</td>
</tr>
<tr>
<td>LEXP</td>
<td>High 0.95</td>
<td>Developer has 2+ years experience developing using Java</td>
</tr>
<tr>
<td>TOOL</td>
<td>Nominal 1.00</td>
<td>Moderate experience with tools being used</td>
</tr>
<tr>
<td>MODP</td>
<td>Very High 0.83</td>
<td>Developer has 4+ years experience in employing modern software engineering practices</td>
</tr>
<tr>
<td>SCED</td>
<td>Nominal 1.00</td>
<td>Project has a tight schedule, but some slippage is allowable</td>
</tr>
</tbody>
</table>

Based on these numbers, the value for EAF is: 0.95

The estimated size of the project is 2.25 KLOC. This estimated is based determining the KLOC of other the source of available web crawlers. Simple applet web crawlers with minimal extra features average about 0.75 KLOC. The 2 KLOC estimate is calculated by doubling the web crawler estimate to include entity search plus an additional 0.75 KLOC for additional GUI features that are not available in the applets.

Using these figures, the Effort and Time values are calculated as:

- Effort = $3.2 \times 0.95 \times 2.25^{1.05} = 7.12$
- Time = $2.5 \times 7.12^{0.38} = 5.27$

This means that COCOMO estimates that 7.12 staff months will be necessary to complete the project. The Time value estimates that the project can be completed in 5.27 chronological months. I believe that this estimate is fairly accurate. In fact, it is very close to the estimate presented in the Gantt chart in Section 1.2. As can be seen in the Gantt chart, additional time is needed for the project to produce additional documentation for the MSE project.

The COCOMO model is not without its faults however. It is based on projects that were created by teams of members, so it may not apply perfectly to projects where there is a single developer. This estimate also assumes a fairly steady development time, with little interruption – increased project complexity, scope, or misjudged EAF values can cause the estimate to be off.
2.2 Production Phase Estimates
Estimates for the Production Phase were complied differently than those for the Elaboration Phase. At the completion of the Elaboration Phase, there were a total of 2K SLOC developed. This represented the implementation of 29 out of 34 requirements, which means that 85 percent of all requirements have been implemented. Assuming that all requirements represent about the same amount of SLOC to develop, this means that there are about 353 SLOC left to develop \((\frac{2000}{0.85} - 2000)\).

At the completion of the Elaboration Phase, software productivity was calculated as 17.86 SLOC per hour. This means that the time remaining in software development during the production phase should be about 20 hours \((\frac{353}{17.86})\). Due to the developer only being able to devote about 2 hours a day to software development, this represents about 10 days worth of coding remaining. The original estimates for testing (21 days) and documentation (25 days) still hold. This means that the time required for the Production Phase should be 56 days \((10 + 21 + 25)\).

3. Architecture Elaboration Plan
This section details all of the documents and artifacts that are to be completed by the end of the Elaboration phase before the second presentation.

3.1 Vision Document Revision
Suggestions from the supervisory committee during the first project presentation regarding the vision document will be included in a revision of the vision document. The document will also be updated to include a complete requirements listing. The requirements will be ranked in order of importance, and will have unique identifiers. The major professor will approve the changes to the document.

3.2 Project Plan Revision
Suggestions from the supervisory committee during the first project presentation regarding the project plan will be included in a revision of the project plan. The Gantt chart will be updated with any changes in schedule, and the COCOMO estimate will be updated based on any changes regarding the cost estimate. The major professor will approve the changes to the document.

3.3 Architectural Design
The architectural design document will use UML to create the architectural components. It will include all state, sequence, class, and data models for the projects. The major professor will approve the architectural design document.

3.4 Prototype Development
The prototype developed during the Inception Phase will be expanded upon during the Elaboration Phase. Additions will include new functionality, as well as
suggestions from the supervisory committee during the first project presentation. The features implemented for the prototype will be approved by the major professor.

3.5 Test Plan
A test plan will be developed that ensures that all requirements specified in the Vision Plan are met. The document will contain detailed instructions on how to evaluate the product, and will be approved by the major professor.

3.6 Formal Technical Inspections
Two MSE students will provide input into the project by completing formal technical inspections. The inspectors will use a formal inspection checklist that will be produced during the Elaboration Phase. Both inspectors will produce a report based on their findings.

3.7 Formal Requirements Specification
The web crawling portion of the project will be specified using OCL. This section was chosen rather than the entity search portion of the project because it will allow for a more substantial formal specification. The specification will be done using the USE (UML-based Specification Environment) tool. The major professor will approve the formal requirements specification.

4. Software Production Plan
This section details all of the documents and artifacts that are to be completed by the end of the Production phase before the third presentation.

4.1 Test Plan Revision
Suggestions from the supervisory committee during the second project presentation regarding the test plan will be included in a revision of the document. The document will also be updated with specific file names to be loaded. The major professor will approve the changes to the document.

4.2 Architectural Design Revision
Suggestions from the supervisory committee during the second project presentation regarding the design will be included in a revision of the Architectural Design document. The major professor will approve the changes to the document.

4.3 Component Design
The component design document will use UML to convey detailed information about the software components. It will include all attributes and methods for the classes in the project. The major professor will approve the component design document.
4.4 Final Software Executable
The prototype developed during the Architecture Elaboration Phase will be expanded upon during the Production Phase. Additions will include all remaining required functionality, as well as late suggestions from the supervisory committee during the second project presentation. The features implemented for the final executable will be approved by the major professor.

4.5 Formal Technical Inspections
Two MSE students will provide input into the project by completing formal technical inspections. The inspectors will use a formal inspection checklist that was produced during the Elaboration Phase. Both inspectors will produce a report based on their findings.

4.6 User’s Manual
At the completion of software development, the developer will create a User’s Manual, which will act as a guide for using the completed system. The manual will be broken up into different sections for performing various tasks within the system, and will act as a basic walkthrough of the system. The manual will also list various troubleshooting problems and solutions.

4.7 Test Assessment
At the completion of software development, the developer will run the tests contained in the Test Plan document, and will record the results. The Test Assessment document will contain the results of running these tests.

4.8 Technical Instructions for Reuse and Extension
At the completion of software development, the developer shall produce a guide that explains how to reuse the project in the future for other MSE projects. The document shall also describe how to extend various features within the project to adapt the project for different types of use.

4.9 Project Assessment
At the completion of software development and testing, the developer will write up a document containing the developer’s opinion on the project. The document will describe in detail what went well, what could have been better, and what simply did not work. The Project Assessment will also contain the final metrics for the project.