**Project Plan**

For Multiagent Control of Traffic Signals

Version 1.0

Submitted in partial fulfillment of the requirements of the degree of MSE

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# Introduction

This is the initial project plan for the Multiagent Control of Traffic Signals (MACTS) Masters of Software Engineering project.

## References

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2. November 28, 2011; http://mse.cis.ksu.edu/portfolio.html.
3. Center for Systems and Software Engineering web site, “COCOMO II,” December 4, 2011: http://sunset.usc.edu/csse/research/COCOMOII/cocomo\_main.html.
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5. Naval Postgraduate School web site, “COCOMO II - Constructive Cost Model,” December 4, 2011: http://diana.nps.edu/~madachy/tools/COCOMOII.php.
6. Center for Software Engineering, USC, COCOMO II: Model Definition Manual Version 2.1, 2000.
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8. USC Center for Software Engineering website, “COCOMO II Affiliates,” December 4, 2011: http://csse.usc.edu/csse/affiliate/private/COCOMOII\_Driver+Calc\_Ss/SpreadSheet-COCOMOII.html.

## Terms

COCOMO is short for COnstructive COst MOdel.

SLOC is an acronym for Source Lines Of Code. These are lines of code that are neither comment nor whitespace.

UFP is an acronym for Unadjusted Function Points.

**Data Functionality**

Internal Logical Files (ILF) are files that represent major logical groupings of systems data that are persisted.

External Interface Files (EIF) are files that are shared between software systems.

**Transaction Functionality**

External Inputs (EI) represent data that enters into the system.

External Outputs (EO) represent data that exits or is output by the system.

External Queries (EQ) are counted by examining portions of the system that accept an input and respond immediately with some form of output.

# Cost Estimate

## COCOMO 2.0

### Computing Unadjusted Function Points

Unadjusted function points are used in the early design stage for project estimation. I followed the information I found about computing function points on the Code Project website[9]. Additional information included definitions of the function point types can be found in section 2.2 of COCOMO II: Model Definition Manual[8]. I reviewed my use cases and arrived at the following table:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Use Case | ILF | EIF | EI | EO | EQ | Total |
| 1 | 2 |  |  | 1 |  |  |
| 2 |  |  |  | 2 | 2 |  |
| 3 | 1 |  |  | 1 |  |  |
| 4 | 1 |  |  | 1 |  |  |
| 5 |  | 1 | 1 | 1 | 1 |  |
| 6 | 1 |  |  |  |  |  |
| 7 | 1 | 1 |  | 1 | 1 |  |
| 8 | 1 |  |  | 1 |  |  |
| 9 |  |  | 1 | 1 |  |  |
| 10 | 1 |  |  | 1 |  |  |
| 11 | 1 | 1 |  | 1 | 1 |  |
| Sub Total | 9 | 3 | 2 | 11 | 5 |  |
| All weights Low | 7 | 5 | 3 | 4 | 3 |  |
| weighted | 63 | 15 | 6 | 44 | 15 | **128** |

### Estimate Variables

|  |  |  |  |
| --- | --- | --- | --- |
| Cost Driver | Value (Text) | Factor | Description |
| LANG | Hybrid 3rd/4th Python | 50 | Used for converting from UFP to SLOC |
| PREC | Nominal | 3.72 | Precedentedness |
| FLEX | High | 2.03 | Development Flexibility |
| RELY | Very High | 5 | Required Software Reliability |
| DATA | Low | 2 | Data Size |
| CPLX | Nominal | 4 | Product Complexity |
| RUSE | Low | 0.95 | Required reusability |
| DOCU | Nominal | 3 | Documentation to match life cycle needs |
| RESL | High | 1.41 | Architecture and risk resolution |
| TEAM | High | 2.19 | Team Cohesion |
| ACAP | High | 4 | Analyst Capability |
| PCAP | High | 4 | Programmer Capability |
| PCON | Very High | 5 | Personnel Capability |
| APEX | Nominal | 3 | Application Experience |
| PLEX | Nominal | 3 | Platform Experience |
| LTEX | Low | 2 | Language and Tool Experience |
| PMAT | High | 3.12 | Process Maturity |
| TIME | Very High | 5 | Execution Time |
| STOR | Nominal | 3 | Main Storage Constraint |
| PVOL | Low | 2 | Platform Volatility |
| TOOL | Nominal | 3 | Use of Software Tools |
| SITE | Extra High | 6 | Multisite Development |
| SCED | Nominal | 1.00 | Schedule |

### Time to develop equation

This model is explained in Section 4 of the COCOMO II Design Model Definition document [8].

(Equation 1)

**Symbol Description**

B The scaling base-exponent for the effort equation, currently set to 0.91

C Coefficient that can be calibrated currently set to 3.67

D Scaling base-exponent that can be calibrated currently set to 0.28

E The scaling exponent for the effort equation

PMNS Person-Months estimated without the SCED cost driver (Nominal Schedule)

SCED Required Schedule Compression

TDEV Time to Develop in calendar months

### Early Design Calculations

Early design calculations use composites of the earlier defined cost drivers. See Table B-7, p281 of Royce’s, Software Project Management[1] for a table on how to compute the process exponent.

|  |  |  |
| --- | --- | --- |
| RCPX | 1.33 | RELY + DATA + CPLX + DOCU  Product Reliability and Complexity |
| RUSE | 0.95 | RUSE  Developed for Reusability |
| PDIF | 1.29 | TIME + STOR + PVOL  Platform Difficulty |
| PREX | 1.12 | APEX + PLEX + LTEX  Personnel Experience |
| PERS | 0.63 | ACAP + PCAP + PCON  Personnel Capability |
| FCIL | 0.73 | TOOL + SITE  Facilities |
| SCED | 1.00 | SCED  Required Development Schedule |
| **EArch** | 0.8395 | Product of the above defined composite cost drivers. |
|  | | |
| **Size (KSLOC)** | 6.4 |  |
| Size (UFP) | 128 | Unadjusted Function Points |
| UFP->Lines of Code | 50 | Conversion factor from UFP to SLOC |
| PREC | 0.01 | Precedentedness |
| FLEX | 0.03 | Flexibility |
| RESL | 0.03 | Risk Resolution |
| TEAM | 0.04 | Team cohesiveness and communication |
| PMAT | 0.03 | Process Maturity |
| **Process Exponent** | 1.15 | (A sum of the PREC, FLEX, RESL, TEAM and PMAT parameters) |
|  | | |
| **Effort** | 17.39 | staff-months |
| **TDEV** | 2.82 | time to develop C=3.0, D=0.33, B=1.01 |
| **TDEV Early Design** | 3.47 | time to develop C=3.67, D=0.28, B=0.91 |
| **TDEV 1997 Calibration** | 2.50 | time to develop C=2.66, D=0.33, B=1.01 |

### Discussion

I computed the TDEV estimate with three different sets of constants. The results ranged from 2.5 to 3.47. This seems reasonable.

I had to be a little creative with the UFP to SLOC conversion because Python wasn’t listed in the documentation. I did some research and while Python is sort of 3rd generational it also incorporates more modern dynamic features. My experience is that Python code usually takes the same amount of SLOC or less to do the same thing as Java. Therefore, I choose a conversion rate of 50.

# Architecture Elaboration Plan

The following subsections detail the tasks that will be completed during the elaboration phase of the project.

## Revise Vision Document

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## Revise Project Plan

lorem

## Create Formal Specification

lorem

## Create Architectural Design

lorem

## Create Test Plan

lorem

## Conduct Technical Inspection

lorem

## Create Executable Architecture Prototype

lorem

# Implementation Plan: Deliverables

Deliverables statement

## Action Items

lorem

## Technical Inspection Letters

lorem

## Component Design Document

lorem

## User Manual

lorem

## Source Code

lorem

## Assessment Evaluation

lorem

## Project Evaluation

lorem

## References

A references document that contains references to resources that were used in the project.

# Implementation Plan: Work Breakdown Structure

Figure 1 below is a zoom out of the Gantt chart for this project’s schedule.

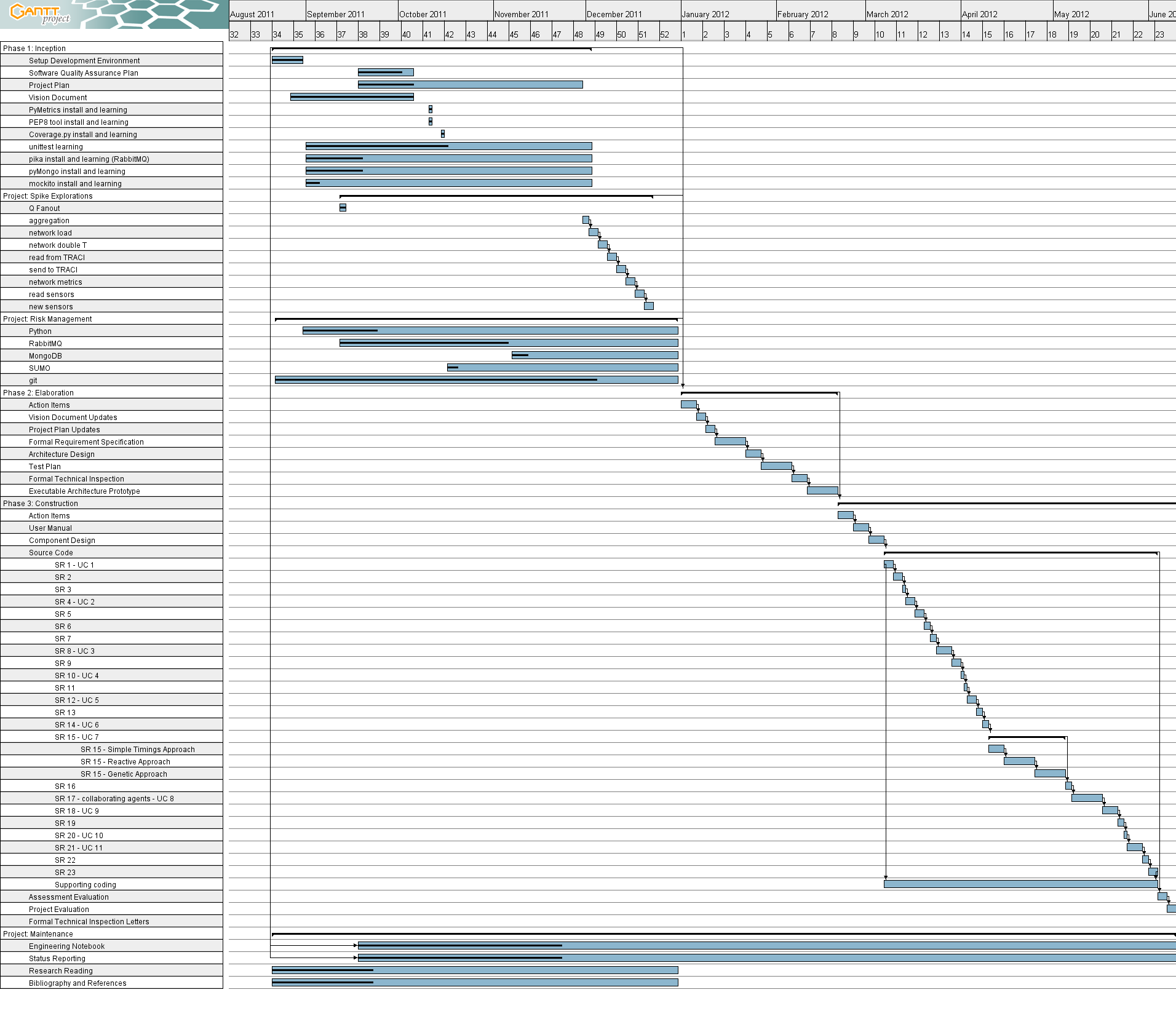


Figure 1Project Gantt Chart

## Inception Phase

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Setup Development Environment

Software Quality Assurance Plan

Project Plan

Vision Document

PyMetrics install and learning

PEP8 tool install and learning

Coverage.py install and learning

unittest learning

pika install and learning (RabbitMQ)

pyMongo install and learning

mockito install and learning

Initial Prototype

## Project Spike Explorations

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Q Fanout

aggregation

network load

network double T

read from TRACI

send to TRACI

network metrics

read sensors

new sensors

## Project Risk Management

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SUMO

Python

RabbitMQ

MongoDB

git

## Elaboration Phase

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Action Items

Vision Document Updates

Project Plan Updates

Formal Requirement Specification

Architecture Design

Test Plan

Formal Technical Inspection

Executable Architecture Prototype

## Construction Phase

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Action Items

User Manual

Component Design

Source Code for SR1-SR23 and supporting code

Assessment Evaluation

Project Evaluation

Formal Technical Inspection Letters

## Project Maintenance

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Engineering Notebook

Status Reporting

Research Reading

Bibliography and References