Project:	**ServeMe System (SMS)** CSE 5325 – Fall 2021 Project Management
Module:	COCOMO
Deliverable:	COCOMO Estimate Report

Version: **[1.0]** **Date:** **[04/13/2021]**

Prepared by: Sai Theja Bikumalla

1001867581

TABLE OF CONTENTS

1. Introduction

ServeMe Systems (SMS) will be available in web application and app (android and iOS) versions, this application serves as a platform to help the customers in connecting with various service providers in different service categories. This platform enables the customer to avail various services like Appliances, Electrical, Plumbing, Home Cleaning, Tutoring, Packaging and Moving, Computer Repair, Home Repair, Painting, and, Pest Control etc. The primary objective is to empower the service providers and by leveraging the latest technologies to deliver the best service to their customers at their home smoothly and efficiently.

This document provides a summary of the cost estimation of the SMS System using a software cost estimation model (COCOMO II). We estimate the project cost and length by determining the project size in the number of Source Lines Of Code (SLOC) and setting the scale drivers and Cost drivers to the value defined.

Importance of Software cost Estimation: When it comes to completing a good software project, cost analysis is crucial. Estimates are important not just for getting a new contract, but also for determining the project budget, schedule, and resource management. The following are some of the advantages of making reliable cost estimates:

- Building the right team
- Convert More Bids
- Be Flexible
- Build Stronger Client Relationships

COCOMO Model:

The most fundamental calculation in the COCOMO model is the use of the Effort Equation to estimate the number of Person-Months required to develop a project. The COCOMO calculations are based on your estimates of a project's size in Source Lines of Code (SLOC)

$$Effort = 2.94 * EAF * (KSLOC)^{E}$$

KSLOC: Single Lines of Code (K refers thousands)

EAF: Effort Adjustment Factor

E: Is an exponent derived from the five Scale Drivers

$$Duration = 3.67 * (Effort)^{SE}$$

Where

Effort : Is the effort from the COCOMO II effort equation

SE: Is the schedule equation exponent derived from the five Scale Drivers

We have to consider the cost of human resources as well as non-human resources while estimating the cost of the project.

The reasoning behind setting up the 5 Scale drivers and 17 Cost drivers that the COCOMO tool uses to estimate the project's effort, cost, and length is explained in this report.

2. Estimating Factors

2.1 Source of Lines of Code

SLOC is defined such that:

Only Source lines that are DELIVERED as part of the product are included -- test drivers and other support software is excluded

SOURCE lines are created by the project staff -- code created by applications generators are excluded

One SLOC is one logical line of code

Declarations are counted as SLOC

Comments are not counted as SLOC

SLOC | Source Lines Of Code	Value Chosen: 4500
Justification: Since the SMS contains website and app versions with frontend and backend. Some part of the code can be reusable as we are using the same functionalities for the website and app version. As we are having more number of functionalities like about us, google search, login, registration, Account Settings, Appointment Scheduling, Payment methods, Service Provider landing page, Login and Registration for Service Providers and Order history 10 different functionalities assuming 450 lines of each makes 4500 lines of code	

2.2 Scale Drivers

The following is the list of scale drivers, the values applicable to this project and a justification for each value chosen:

PREC | Precendentedness	Value Chosen: **Very High** – Largely Familiar
Precendentedness: Is the new project comparable to projects your team has done before? Justification: Our developers are not trained in Android programming. So as mentioned in the risk and mitigation we will hire 2 Temporary developers who are well versed in android development, as other team members are experienced and very quick learners, they can learn in very little time. So we have chosen Largely Familiar.	

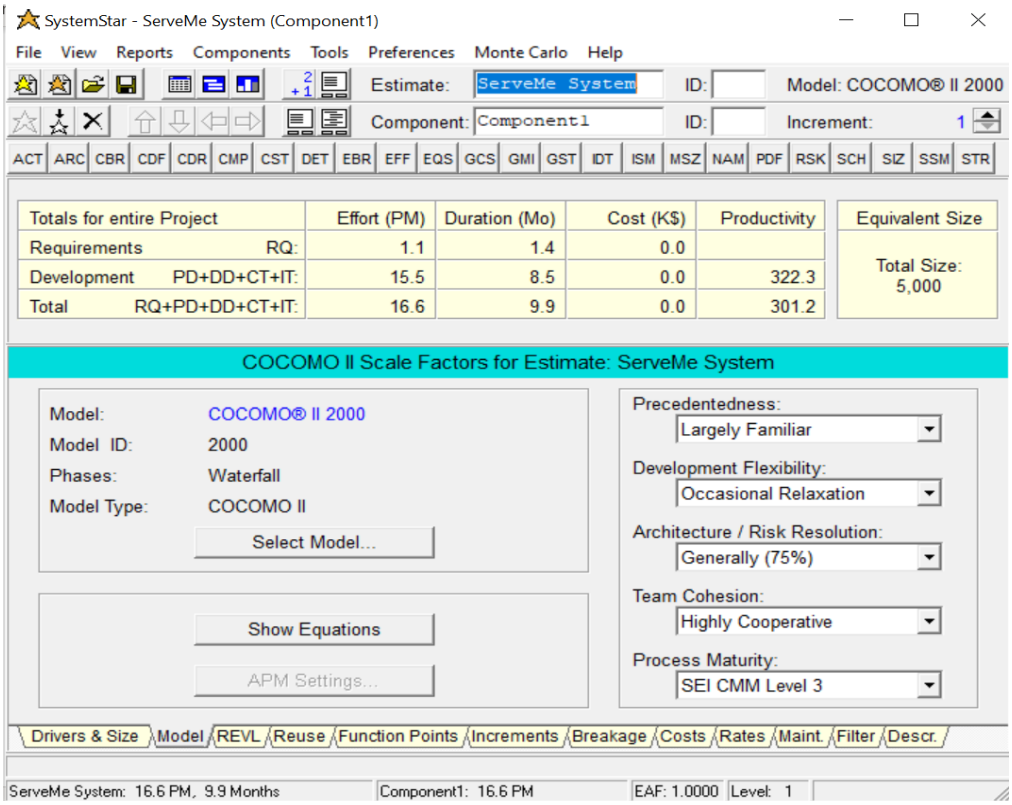
FLEX | Development Flexibility (FLEX)	Value Chosen: **Low** - Occasional Relaxation
Development Flexibility: Are your requirements flexible, or should you meet them all?	

Justification: There will only be very slight relaxations to the requirements since they were fixed during the requirements gathering process.

RESL | Architecture / Risk Resolution	Value Chosen: **High** - Generally (75%)
Architecture / Risk Resolution: To what degree have you already defined the architecture? Justification: We have kept Architecture/ Risk Resolution as High – Generally because the architecture has been well laid out, validated to avoid risks, and there won't be any huge adjustments.	

TEAM | Team cohesion	Value Chosen**: Very High** – Highly cooperative
Team Cohesion: How would you describe the relationship among stakeholders? Justification: As the team members are well acquainted with each other because they are work closely together on some projects, there is a high level of cooperation among them.	

PMAT | Process maturity	Value Chosen: **High** – CMM Level 3
Process Maturity: How does your organization rate of SEI maturity scale? Justification: The software processes for the project have been standardized, and it has been validated on previous projects. Process optimization and continuous process improvement are also included. After each cycle, a retrospective is held to address and incorporate any improvements to the current method.	



2.3 Cost Drivers

The following is the list of cost drivers, the values applicable to this project and a justification for each value chosen:

Personnel:

ACAP | Analyst Capability	**High** – 75th percentile
Analyst Capability: How capable are the analysts for this project? Justification: As the team is involved in the requirement phase, they are aligned with all the requirements, methods, and processes. So, we have chosen High	

APEX | Application Experience Cost Driver	Value Chosen: **High** – 3 Year
Application Experience Cost Driver: How much experience does your team have with this type of application? Justification: Our developers are not trained in Android programming, but we have recruited new employees. So, we have chosen High.	

PCAP | Programmer Capability Cost Driver	Value Chosen: **High** – 75th percentile
Programmer Capability Cost: How capable are the programmers for this project?	

Justification: Our developers have experience in website designing and new employees are well experienced in android. Hence we have chosen High.

PLEX | Platform Experience Cost Driver	Value Chosen: **High** – 3 Years
Platform Experience Cost Driver: How much experience does your team have with the platform? Justification: The software and hardware tools are very much used by developers for all the project developments and testing, we have chosen the platform experience to be High.	

LTEX | Language and Tool Experience	Value Chosen: **High** – 3 Years
Language and Tool Experience: How much experience does your team have with the language and tools? Justification: Our developers have experience in website developing tools and new developers are experienced in android tools and languages with at least 3 years of experience.	

PCON | Personnel Continuity Cost Driver	Value Chosen: **Very High** – 3% turnover per year
Personnel Continuity Cost Driver: What is the annual turnover rate for your organization? Justification: Developers in the organization are highly motivated and committed to the project, and few established members have been guiding and assisting the team's newcomers, So chosen the personnel continuity to be very high.	

Project:

TOOL | Use of Software Tools Cost Driver	Value Chosen: **High** – Strong, mature life cycle tools, moderately integrated.
Use of Software Tools Cost Driver: What tools will your team use? Justification: Tools like IDE for code, putty for database, as over team has already used these tools, they are well versed with these tools. So we have chosen High – Strong, mature life cycle tools, moderately integrated.	

SITE | Multisite Development Cost Driver	Value Chosen: **Very High** – Same building
Multisite Development Cost Driver: Is the team split among different sites? How do they communicate? Justification: All the developers, testers, and other team reside in the same office. Communication with team members is done through occasional meetings or video conferencing.	

SCED | Development Schedule Cost Driver	Value Chosen: **Nominal** – 100% of Nominal Schedule
Development Schedule Cost Driver: Is the schedule compressed from the Nominal (default) schedule? Justification: As we have very little time, we are a tight development schedule. Also, since the project must be completed within the allocated time, we chose a Nominal development schedule.	

Platform:

TIME | Execution Time Constraint Cost Driver	Value Chosen: **High** – 70% use of available execution time
Execution Time Constraint Cost Driver: How much CPU time will your software use? Justification: SMS has both backend and frontend while using the application we will have many validations in both backend and frontend so it takes more execution time and while using the payment methods we have to be more secure, so we have chosen high execution time.	

STOR – Main Storage Constraint Cost Driver	Value Chosen: **Nominal** - <=50% use of available storage
Main Storage Constraint Cost Driver: How much of the main memory will your software use? Justification: All the data will be stored in the database so very less main memory will be consumed.	

PVOL | Platform Volatility Cost Driver	Value Chosen: **Low** – Major Changes every 12 months.
Platform Volatility Cost Driver: How often will the platform change?	

Justification: The platform volatility value has been set to be low because updates to the coding platform, server, and databases are expected to occur very slow, i.e. once a year, as even the latest version of Android Studio is only published once a year.

Product:

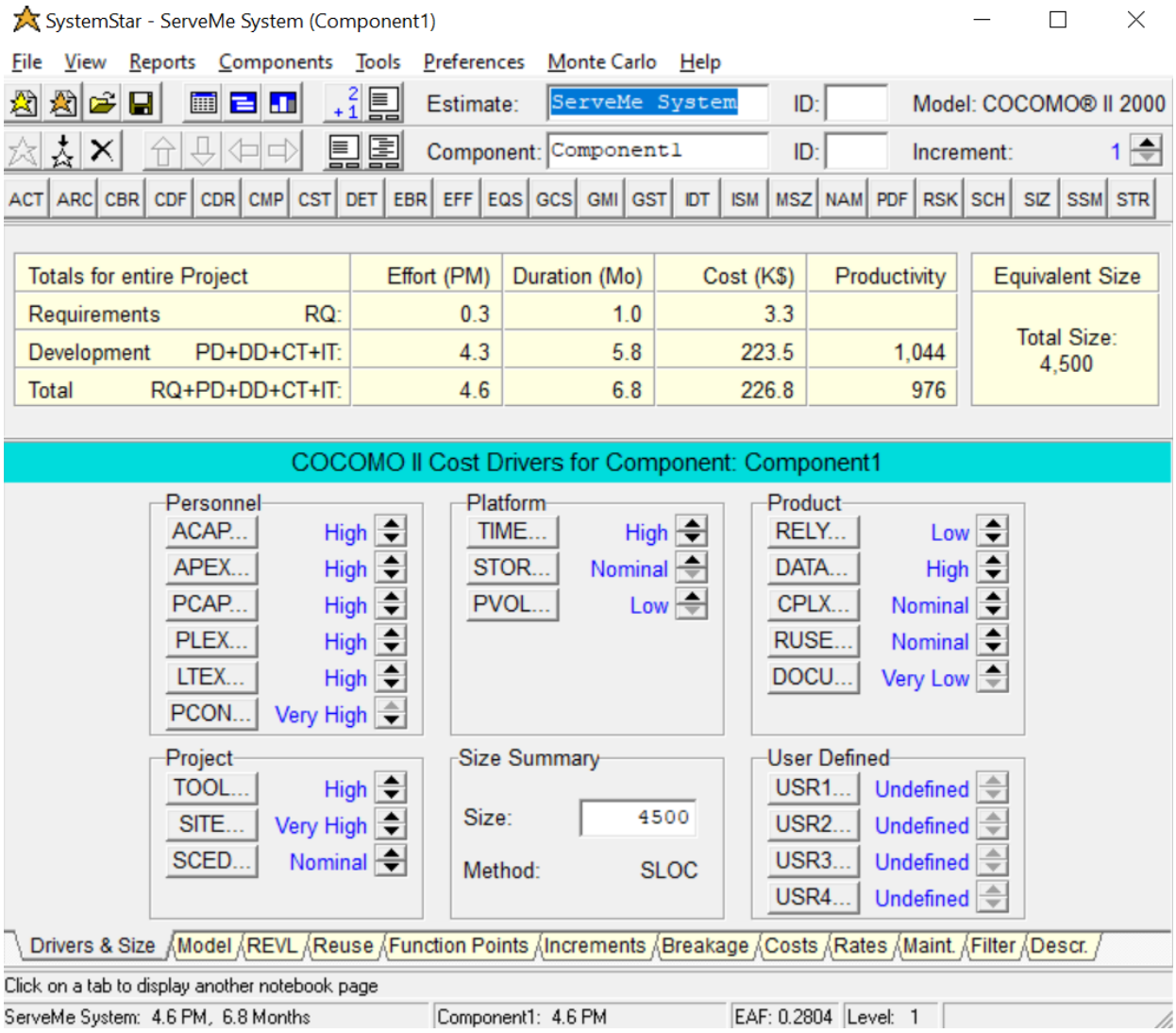
RELY | Required Reliability Cost Driver	Value Chosen: **Low** – Easily recoverable losses
Required Reliability Cost Driver: What is the consequence of software failure? Justification: The backups of the stable versions of the projects are store securely, so if any software failure happens, we can be rollbacked quickly from the backups. we have chosen the required reliability to be Low, easily recoverable losses.	

DATA | Database Size Cost Driver	Value Chosen: **High** – 100 <= (Database bytes / SLOC) >= 1000
Database Size Cost Driver: How much data is required to test the software? Justification: SMS is giving many functionalities to users and service providers we need to store a much data in the database. The data that is needed to test the software and whether the application is running as per the design, hence we have considered high Database size.	

CPLX – Product Complexity Cost Driver	Value Chosen: **Nominal** – Nested code, standard math routines, multiple files.
Product Complexity Cost Driver: How complex will the software be? Justification: The project is not complex. We have simple use cases with reusable code. So, it would just include multiple types of files for both frontend and backend, standard math routines and nested code.	

RUSE – Required Reusability Cost Driver	Value Chosen: **Nominal** – Across the Project
Required Reusability Cost Driver: Are you developing your software components to be reused? Justification: The software components designed for the SMS framework are reusable throughout the project, which will save a lot of time.	

DOCU – Documentation match to life-cycle needs	Value Chosen: **Very Low** – Some life-cycle needs uncovered
Documentation match to life-cycle needs: How much documentation are you creating? Justification: As we are following agile methodology Customer interaction is given importance over documentation. We have documentation only during requirements, design and cross-check all the test cases. So we have very low documentation.	



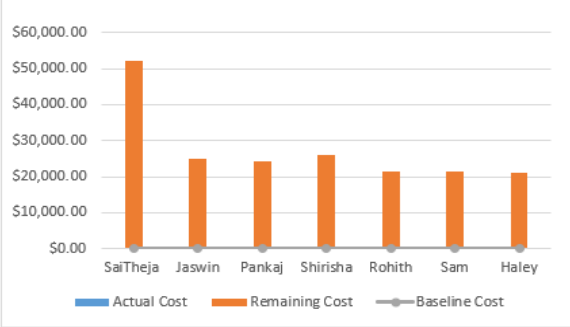
3 Project Final Timeline and Cost Structure

Cost estimation using Microsoft project plan:

RESOURCE COST OVERVIEW

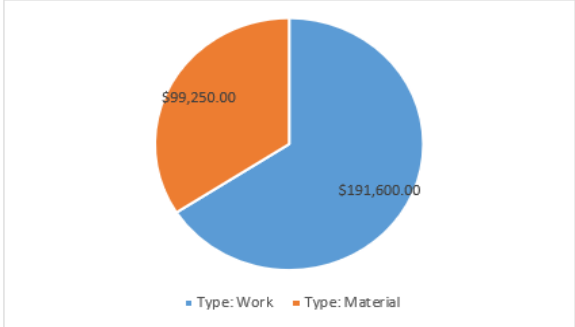
COST STATUS

Cost status for work resources.



COST DISTRIBUTION

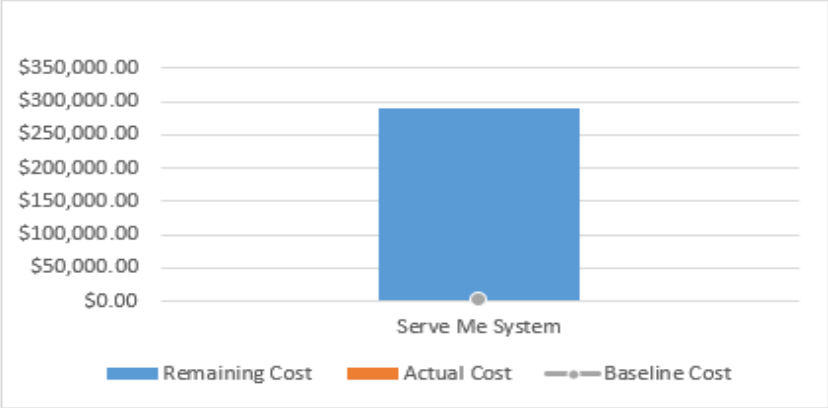
How costs are spread out amongst different resource types.



COST STATUS

Cost status for all top-level tasks. Is your baseline zero?

Try setting as baseline



Name	Cost	ACWP	BCWP	BCWS
Serve Me System	$290,850.00	$0.00	$0.00	$0.00

SaiTheja	Work		PM	Project Manager	100%	$100.00/hr	$140.00/hr	$0.00	Prorated	Standard	HumanResource
Jaswin	Work		J	Full Stack Developer	100%	$50.00/hr	$100.00/hr	$0.00	Prorated	Standard	HumanResource
Pankaj	Work		P	Full Stack Developer	100%	$50.00/hr	$100.00/hr	$0.00	Prorated	Standard	HumanResource
Shirisha	Work		S	Full Stack Developer	100%	$50.00/hr	$100.00/hr	$0.00	Prorated	Standard	HumanResource
Rohith	Work		R	Full Stack Developer	100%	$50.00/hr	$80.00/hr	$0.00	Prorated	Standard	HumanResource
Sam	Work		S	Full Stack Developer	100%	$50.00/hr	$80.00/hr	$0.00	Prorated	Standard	HumanResource
Haley	Work		H	Full Stack Developer	100%	$50.00/hr	$70.00/hr	$0.00	Prorated	Standard	HumanResource
Utilities	Material		U			$12,000.00		$0.00	Prorated		NonHumanResource
Group Health Insurance	Material		G			$13,000.00		$0.00	Prorated		NonHumanResource
Building Costs	Material		B			$26,000.00		$0.00	Prorated		NonHumanResource
Windows Server	Material		W			$17,500.00		$0.00	Prorated		NonHumanResource
Firewall	Material		F			$7,500.00		$0.00	Prorated		NonHumanResource
Anti Virus	Material		A			$12,000.00		$0.00	Prorated		NonHumanResource
Database	Material		D			$6,000.00		$0.00	Prorated		NonHumanResource
SSL Certificate	Material		S			$4,500.00		$0.00	Prorated		NonHumanResource
Operating System	Material		O			$750.00		$0.00	Prorated		NonHumanResource
Android Studio	Material		A			$0.00		$0.00	Prorated		NonHumanResource

COST DETAILS

Cost details for all work resources.

Name	Standard Rate	Work	Work Variance
SaiTheja	$100.00/hr	520 hrs	520 hrs
Jaswin	$50.00/hr	496 hrs	496 hrs
Pankaj	$50.00/hr	488 hrs	488 hrs
Shirisha	$50.00/hr	520 hrs	520 hrs
Rohith	$50.00/hr	432 hrs	432 hrs
Sam	$50.00/hr	432 hrs	432 hrs
Haley	$50.00/hr	424 hrs	424 hrs

Total work hours of developers = 2792

Total work hours of Manager = 520

Total Human Resources cost = (520 *100 + 2792 * 50) = 191,600

Non - Human Resources cost :

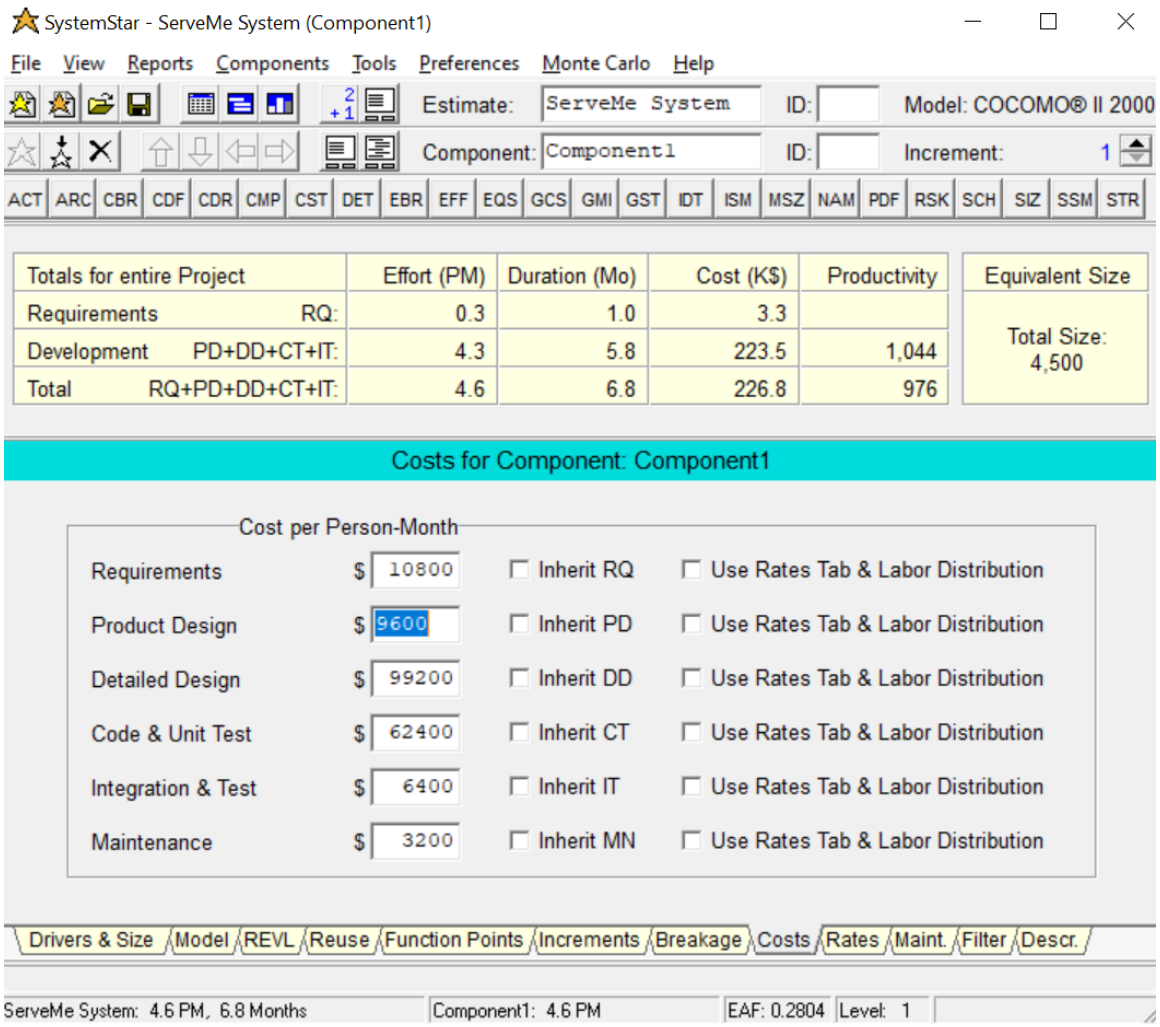
Machine	**Cost**
Utilities	$12,000.00
Group Health Insurance	$13,000.00
Building Costs	$26,000.00
Windows Server	$17,500.00
Firewall	$7,500.00
Anti Virus	$12,000.00
Database	$6,000.00
SSL Certificate	$4,500.00
Operating System	$750.00
Android Studio	0
TOTAL	$ 99,250.00

Human Resources cost	191,600
Hardware cost and other Software costs	99,250
Total	290,850

Total cost 290,850 with of 50% Profit will be $**436,275**. (Cost as per Microsoft project Plan)

Cost Estimation using COCOMO II:

Below is the Cost for each phase:



RQ+PD+DD+CT+IT	226,800
Hardware cost and other Software costs	99,250
Total	326,050

Adding 50% profit in 326,050 gives $**489,075** is the final cost using the COCOMO II estimation.

The work estimation Using the Microsoft Project Plan:

	1 Serve Me System	65 days	Mon 01/02/21	Fri 30/04/21		Android Studio[1],A	3,312 hrs
	1.1 Requirements Gathering	6 days	Mon 01/02/21	Mon 08/02/21			168 hrs
	1.2 Project Setup	5 days	Tue 09/02/21	Mon 15/02/21			152 hrs
	1.3 Design and Implementation	39 days	Tue 16/02/21	Fri 09/04/21			2,184 hrs
	1.3.1 Sprint I (Login and Registration Pages for Customers)	5 days	Tue 16/02/21	Mon 22/02/21			280 hrs
	1.3.2 Sprint 2 (Search Functionality and Google Search Integration)	5 days	Tue 23/02/21	Mon 01/03/21			280 hrs
	1.3.3 Sprint 3 (Service request and Order Histroy Functionality)	5 days	Tue 02/03/21	Mon 08/03/21			280 hrs
	1.3.4 Sprint 4 (Appointment Scheduling and Re- Scheduling Functionality)	5 days	Tue 09/03/21	Mon 15/03/21			280 hrs
	1.3.5 Sprint 5 (Account Settings - Customer)	5 days	Tue 16/03/21	Mon 22/03/21			280 hrs
	1.3.6 Sprint 6 (Login and Registration for Service Providers)	5 days	Tue 23/03/21	Mon 29/03/21			280 hrs
	1.3.7 Sprint 7 (Service Provider landing page - List of service requests avaliable and able to give bids)	5 days	Tue 30/03/21	Mon 05/04/21			280 hrs
	1.3.8 Sprint 8 (Pament Options)	4 days	Tue 06/04/21	Fri 09/04/21			224 hrs
	1.4 Testing and Debugging	12 days	Mon 12/04/21	Tue 27/04/21			640 hrs
	1.5 Final Test (2nd testing for important module	2 days	Wed 28/04/21	Thu 29/04/21	56	SaiTheja ,Pankaj,Rol	112 hrs
	1.6 Deployement and Producton Testing	1 day	Fri 30/04/21	Fri 30/04/21	57	SaiTheja ,Pankaj,F	56 hrs

The work estimation before COCOMO II is **3 Months** i.e Starting from 01/02/2021 to 30/04/2021.

The work estimation Using the COCOMO:

Totals for entire Project		Effort (PM)	Duration (Mo)	Cost (K$)	Productivity	Equivalent Size
Requirements	RQ:	0.3	1.0	3.3		Total Size: 4,500
Development	PD+DD+CT+IT:	4.3	5.8	223.5	1,044	
Total	RQ+PD+DD+CT+IT:	4.6	6.8	226.8	976	

From the COCOMO tool, the work estimation is 6.8 Months. So the if the project is started on 01/02/2021 it would take around **7 months** to complete the project. So the Project will be completed by 30/09/2021

4. Conclusion and Recommendations

Cost Comparisons:

Cost Estimation Before COCOMO: **436,275**

Cost Using COCMO tool: **489,075**

There is a deviation in the cost estimation by $52,800

Below are the Factors we did not consider during the Project Plan cost estimation:

Time (Execution Time Constraint Cost Driver)**:**

During the initial estimation, we have not considered the platform execution time. Later on, while estimating using the COCOMO we have realized we forgot about the execution time.

Tool (Use of Software tools)**:** The developers are well experienced with all the software tools except the android studio. We taught it would not make a significant factor.

Platform and Storage**:** Since the storage requirements for the development tools in this project appear to be higher than anticipated (by 50%), As a result, the cost of doing so rises.

Schedule Comparisons:

Time Estimation Before COCOMO : 3 Months

Time Using COCMO tool: 6.8 Months

Reasons for deviation in schedule:

Platform volatility: COCOMO considers things like the project's ability to accommodate big changes. In our initial estimation, we did not account for the time required to accommodate significant changes.

Personnel Continuity: Any organization's team members have the choice to resign. These circumstances influence the plan. Our initial calculation did not take these into account, while COCOMO did.

Recommendations:

As we have a lot of deviation in schedule, we can complete the project in 2 different phases. In the 1st phase, we can develop major functionalities, then incorporate the rest of the functionalities after the major functionalities have been delivered and deployed, after deployment, we can consider consumer feedback and experience, we can improve the initial product. In this way, the project can be delivered in two phases, in the first phase major functionalities and internal system and the second phase containing the rest of the functionalities. Which functionalities should be delivered in the 1st phase will be discussed with the client. If the Client needs the project in less than 7months we can try to estimate an alternate development methodology that is better than agile – sprint planning.

As there is a slight deviation in the cost, we must discuss this with the client. If the client does not accept the extra cost we can reduce our profit by 3 to 4% if the client can promise us to give the further developments and management of SMS, by which we can gain over profit in the future.

Appendices

Additional documents, print screens of COCOMO reports, references.

Reports generated by the COCOMO II tool:

ServeMe System - Detail Report

Print | Export... | Headers | << Back | Next >>

ServeMe System - Detail Report

SystemStar 3.0 Demo April 12, 2021 14:40:32 Page: 1

Estimate Name:	ServeMe System	Estimate ID:	
Model Name:	COCOMO® II 2000	Model ID:	2000
Process Model:	COCOMO® II Model	Phases:	Waterfall

Component Name:	Component1	Component ID:	
Increment:	1	Level:	1
Developed Size:	4,500	EAF:	0.2804

Phase	Effort (Person-Months)	Cost (K$)	Duration (Months)	Staffing
RQ -- Requirements	0.3	3.3	1.0	0.3
PD -- Product Design	0.7	7.0	1.4	0.5
DD -- Detailed Design	1.1	113.6	1.4	0.8
CT -- Code & Unit Test	1.6	97.3	1.8	0.9
IT -- Integration & Test	0.9	5.6	1.2	0.7
Development (PD+DD+CT+IT)	4.3	223.5	5.8	
Totals (RQ+PD+DD+CT+IT)	4.6	226.8	6.8	
MN -- Maintenance (per year)	0.0	0.0		0.0

ServeMe System - Cost Report

Print | Export... | Headers | << Back | Next >>

ServeMe System - Cost Report

SystemStar 3.0 Demo April 12, 2021 14:41:29 Page: 1

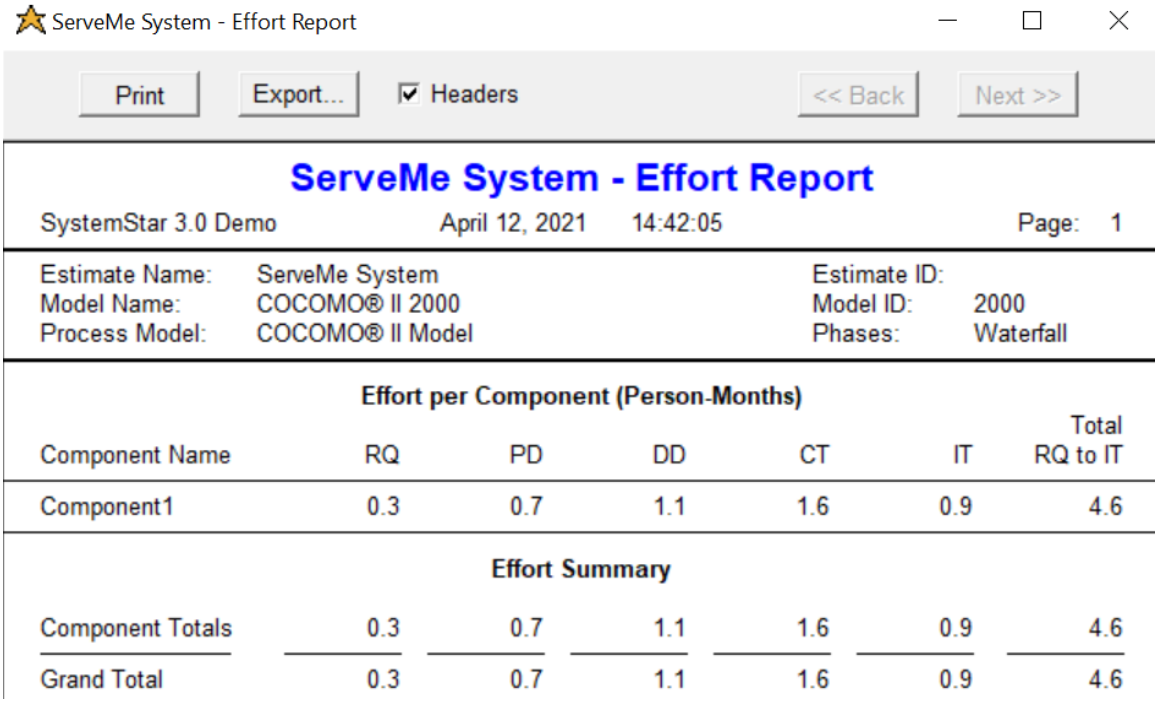
Estimate Name:	ServeMe System	Estimate ID:	
Model Name:	COCOMO® II 2000	Model ID:	2000
Process Model:	COCOMO® II Model	Phases:	Waterfall

Cost per Component (K$)

Component Name	RQ	PD	DD	CT	IT	Total RQ to IT
Component1	3.3	7.0	113.6	97.3	5.6	226.8

Cost Summary

Component Totals	3.3	7.0	113.6	97.3	5.6	226.8
Grand Total	3.3	7.0	113.6	97.3	5.6	226.8



ServeMe System - Effort Report

SystemStar 3.0 Demo April 12, 2021 14:42:05 Page: 1

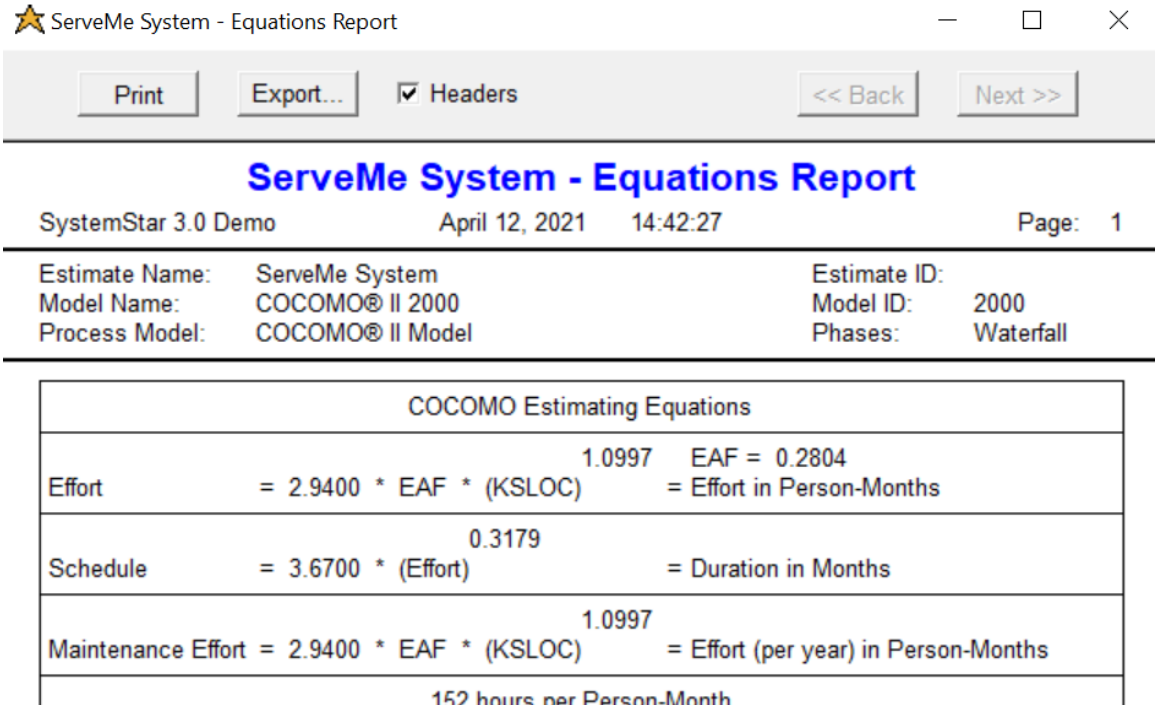
Estimate Name:	ServeMe System	Estimate ID:	
Model Name:	COCOMO® II 2000	Model ID:	2000
Process Model:	COCOMO® II Model	Phases:	Waterfall

Effort per Component (Person-Months)

Component Name	RQ	PD	DD	CT	IT	Total RQ to IT
Component1	0.3	0.7	1.1	1.6	0.9	4.6

Effort Summary

Component Totals	0.3	0.7	1.1	1.6	0.9	4.6
Grand Total	0.3	0.7	1.1	1.6	0.9	4.6

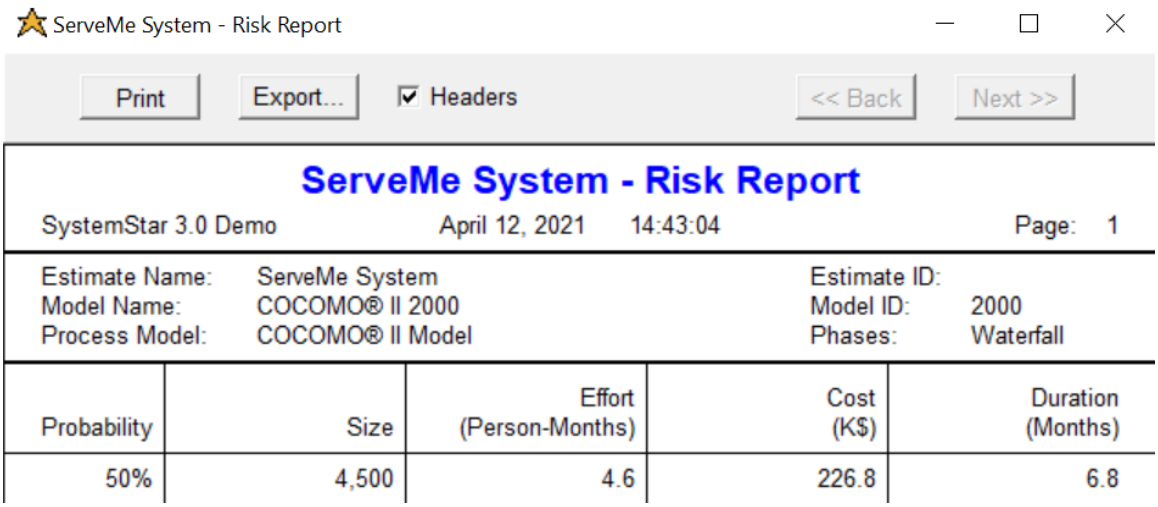


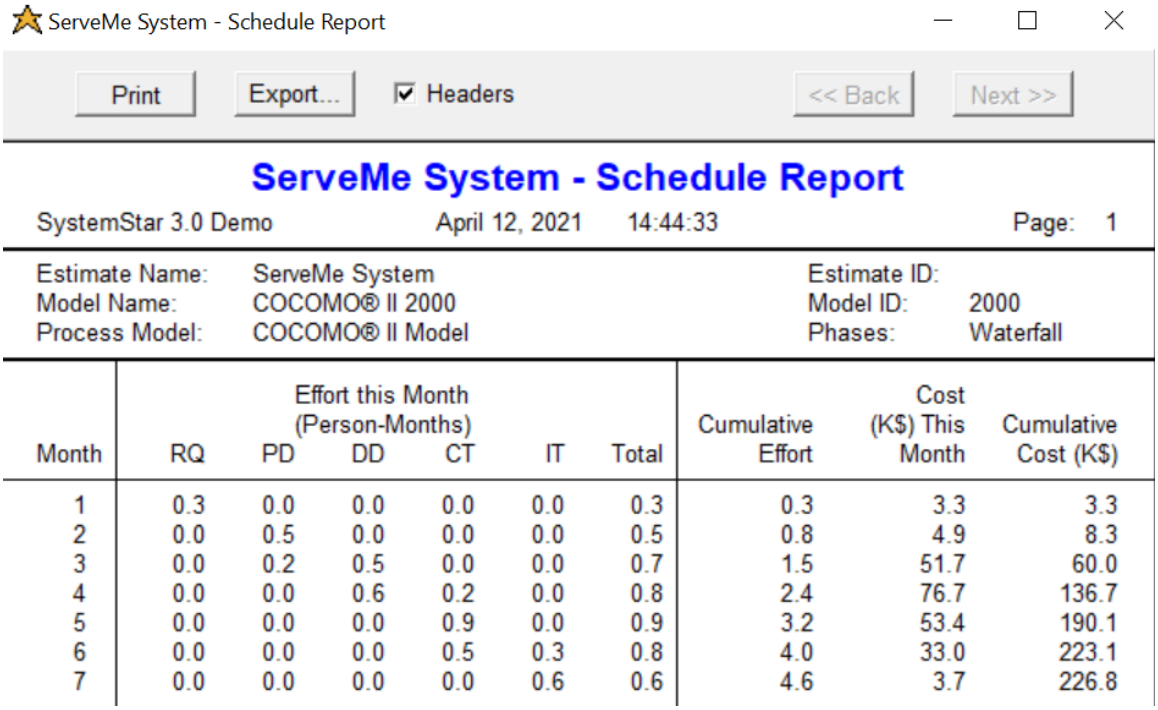
ServeMe System - Equations Report

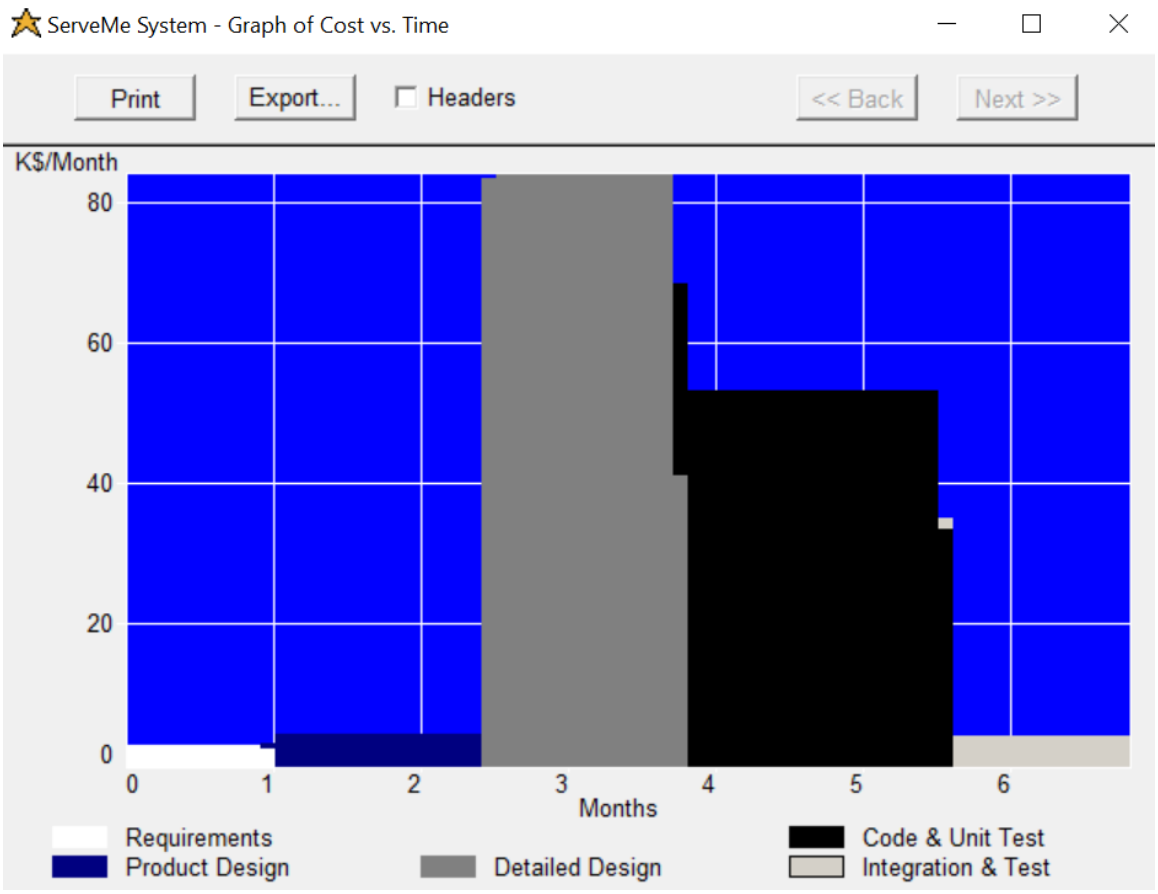
SystemStar 3.0 Demo April 12, 2021 14:42:27 Page: 1

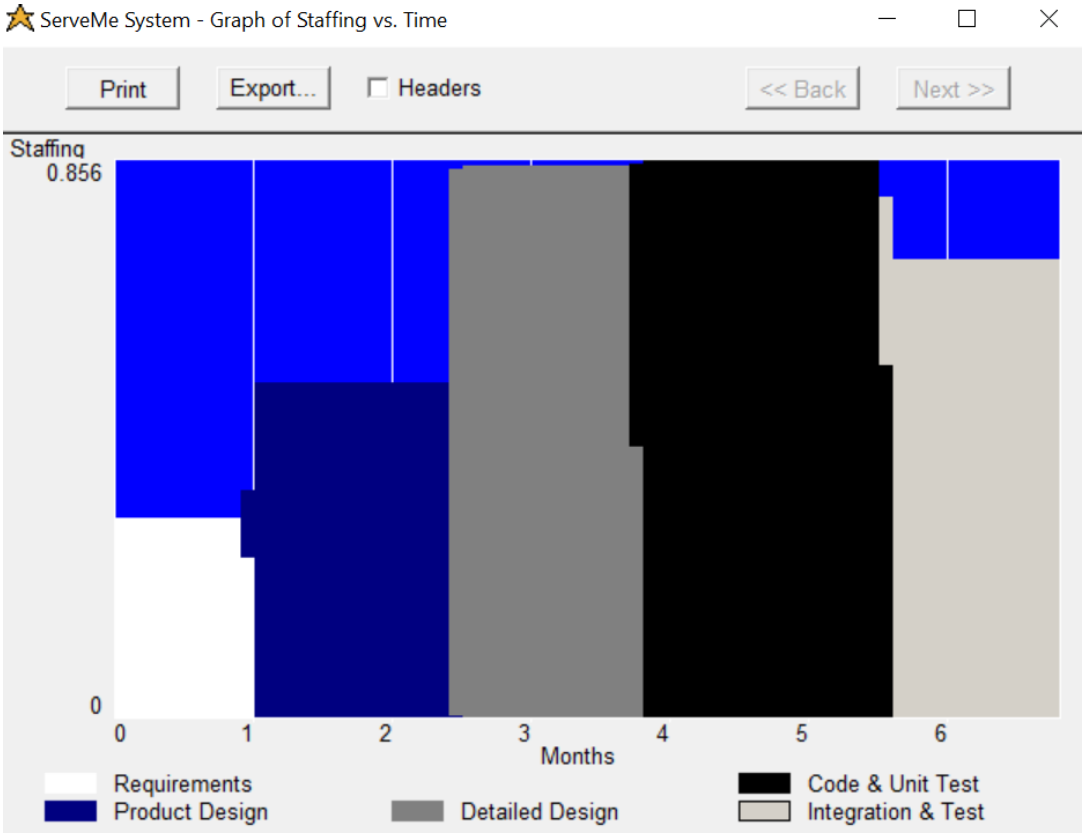
Estimate Name:	ServeMe System	Estimate ID:	
Model Name:	COCOMO® II 2000	Model ID:	2000
Process Model:	COCOMO® II Model	Phases:	Waterfall

COCOMO Estimating Equations	
Effort	$= 2.9400 * EAF * (KSLOC)^{1.0997}$ EAF = 0.2804 = Effort in Person-Months
Schedule	$= 3.6700 * (Effort)^{0.3179}$ = Duration in Months
Maintenance Effort	$= 2.9400 * EAF * (KSLOC)^{1.0997}$ = Effort (per year) in Person-Months
152 hours per Person-Month	


ServeMe System - Risk Report
Print
Export...
Headers
<< Back
Next >>
ServeMe System - Risk Report
SystemStar 3.0 Demo
April 12, 2021
14:43:04
Page: 1
Estimate Name: ServeMe System
Model Name: COCOMO® II 2000
Process Model: COCOMO® II Model
Estimate ID:
Model ID: 2000
Phases: Waterfall
Probability
Size
Effort (Person-Months)
Cost (K$)
Duration (Months)
50%
4,500
4.6
226.8
6.8


ServeMe System - Schedule Report
Print
Export...
Headers
<< Back
Next >>
ServeMe System - Schedule Report
SystemStar 3.0 Demo
April 12, 2021
14:44:33
Page: 1
Estimate Name: ServeMe System
Model Name: COCOMO® II 2000
Process Model: COCOMO® II Model
Estimate ID:
Model ID: 2000
Phases: Waterfall
Month
Effort this Month (Person-Months)
RQ
PD
DD
CT
IT
Total
Cumulative Effort
Cost (K$) This Month
Cumulative Cost (K$)
1 0.3 0.0 0.0 0.0 0.0 0.3 0.3 3.3 3.3
2 0.0 0.5 0.0 0.0 0.0 0.5 0.8 4.9 8.3
3 0.0 0.2 0.5 0.0 0.0 0.7 1.5 51.7 60.0
4 0.0 0.0 0.6 0.2 0.0 0.8 2.4 76.7 136.7
5 0.0 0.0 0.0 0.9 0.0 0.9 3.2 53.4 190.1
6 0.0 0.0 0.0 0.5 0.3 0.8 4.0 33.0 223.1
7 0.0 0.0 0.0 0.0 0.6 0.6 4.6 3.7 226.8


ServeMe System - Graph of Cost vs. Time
Print
Export...
Headers
<< Back
Next >>
K$/Month
80
60
40
20
0
0
1
2
3
4
5
6
Months
Requirements
Product Design
Detailed Design
Code & Unit Test
Integration & Test


ServeMe System - Graph of Staffing vs. Time
Print
Export...
Headers
<< Back
Next >>
Staffing
0.856
0
0
1
2
3
4
5
6
Months
Requirements
Product Design
Detailed Design
Code & Unit Test
Integration & Test

References:

http://www.softstarsystems.com/index.html

https://en.wikipedia.org/wiki/COCOMO

https://www.youtube.com/watch?v=mYjzbpEUXDk

https://estimate.wanhive.com/advantage.php