Project: Dealership Management System

CSE 5325 – Fall 2019

Project Management

Module: COCOMO

Deliverable: COCOMO Estimate Report

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Prepared by: Megha Vijendra

1001736938

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1. INTRODUCTION

Dealership Management System is a website that allows the customers to look at different ranges of automobile models and compare them in terms of their make, features, cost etc. In addition to that it would also allow employees to login to the web portal, keep track of the customers and their orders, add or delete different models and makes of the automobiles sold through the dealer company, analyze the profits made by the company through the sale of the automobiles and also to keep personalized notes about different information such as requests, to-do items, etc.

This report gives an overview of the cost estimation of the DMS system using a software cost estimation model called Constructive Cost Model (COCOMO II). By Specifying the size of the project in number of Source Lines Of Code (SLOC) and setting up the scale drivers and Cost drivers to the value specified we estimate the project cost and duration.

As we are following the Waterfall model, we are calculating the cost at each phase of the project. While calculating the cost for the overall project we include the cost for the human resources as well as the non- human resources which includes the costs for licensing, setting up server, workstations, etc.

In this report we explain the logic behind setting up of the 5 Scale drivers and 17 Cost drivers which is used by the COCOMO tool in estimating the effort, cost and duration of the project.

2. ESTIMATING FACTORS

2.1 SOURCE LINES OF CODE

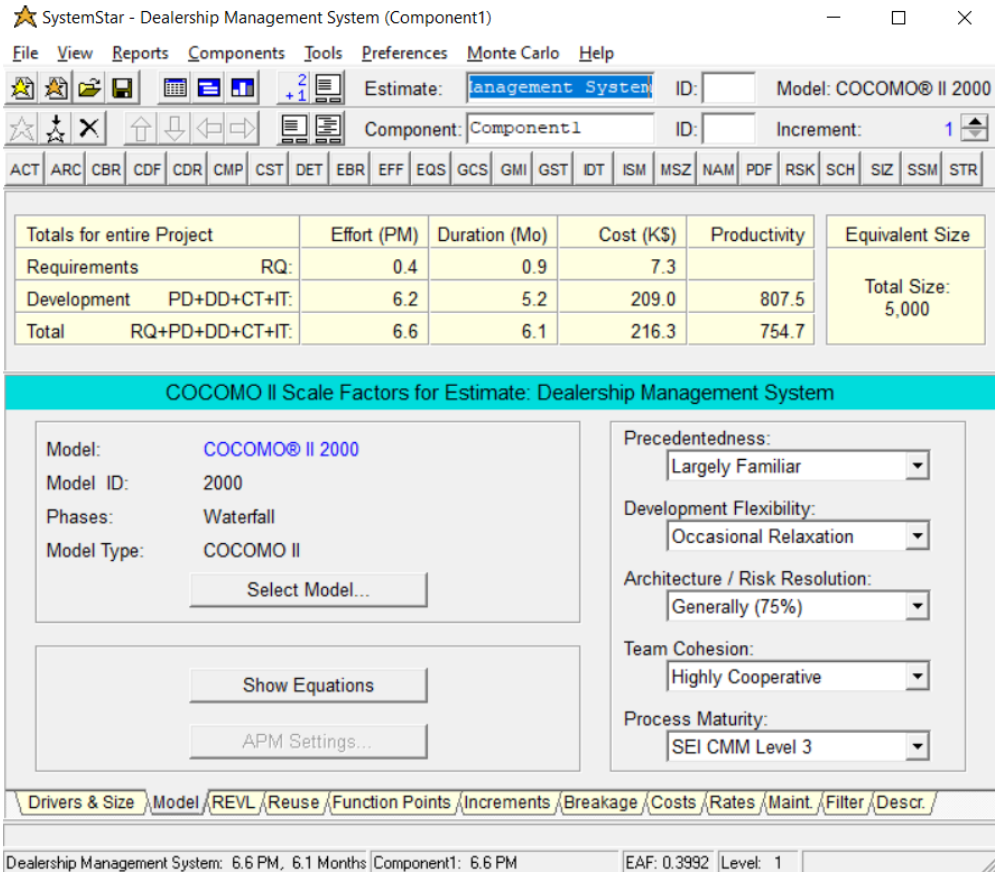
The following is the number of lines of code delivered as part of this project, A justification for the total amount of LOC is provided below:

SLOC | Source Lines Of Code	Value Chosen: 5000
Justification: Since the DMS contains both frontend as well as integrated backend and also the system contains different set of functionalities for customers, merchants and an internal system for the client company, the logical lines of code for the system would be high.	

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
Justification: Since Web Lab technologies are well versed with creating web applications for its clients and the team is highly familiar with the development methodologies, hence the project is largely familiar to the team handling the project.	
FLEX | Development Flexibility (FLEX)	Value Chosen: Low – Occasional Relaxation
Justification: As the requirements are fixed during the requirements gathering phase, there would be just some occasional relaxations to the requirements.	
RESL | Architecture / Risk Resolution	Value Chosen: High - Generally (75%)
Justification: Since the architecture has been laid down well, validated to avoid risks and there wouldn't be any major changes, we have kept Architecture/ Risk Resolution as High – Generally (75%).	
TEAM | Team cohesion	Value Chosen: Very High – Highly cooperative
Justification: As the team members are well acquainted with each other and also there is a high degree of co-operation among the team as they are working closely for the past few years. Hence the team cohesion scale driver is chosen to be highly cooperative.	
PMAT | Process maturity	Value Chosen: High – CMM Level 3
Justification: Since the Organization has defined a set of standard process which is used to maintain consistency across the projects throughout the organization, we have chosen the SEI Maturity Scale to be level 3.	



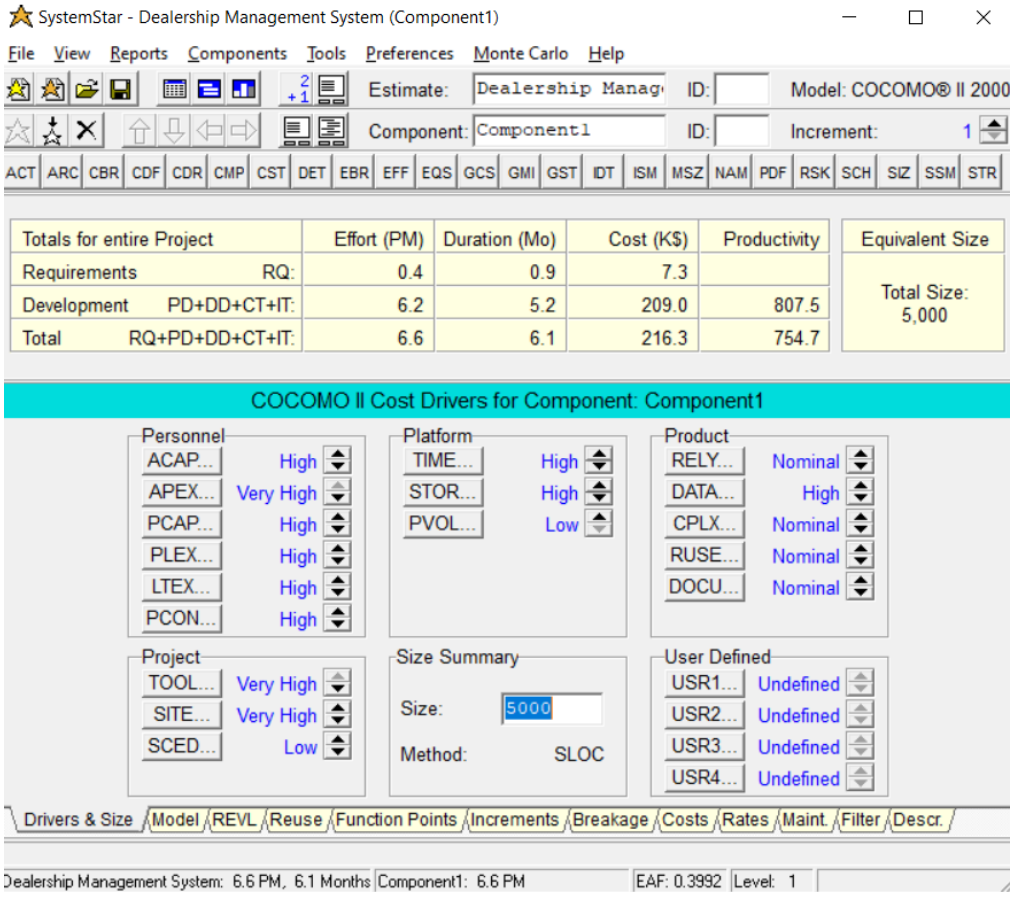
2.3 Cost Drivers

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

ACAP | Analyst Capability	Value Chosen: High – 75th percentile
Justification: As DMS isn't a large-scale project and the team holds designer who will participate in the requirements phase to understand and lay down the requirements thoroughly, we have kept the measure of analyst capability as high.	
APEX | Application experience	Value Chosen: Very High – 6 years
Justification: The team at Web Labs are highly experienced with developing web applications and has substantial amount of knowledge in building the application, hence we have chosen the application experience to be very high.	
PCAP | Programmer capability	Value Chosen: High – 75th percentile
Justification: The programming team is assumed to have high amount of experience in developing web applications and are also well versed in Bootstrap, DB and designing of interactive UI. So, we have chosen programmer capability to be high.	
PLEX | Platform experience	Value Chosen: High – 3 years
Justification: As the team has developed few web applications in the past using the visual studio and other software development packages and also the testers are well versed in using the testing tool efficiently, we have chosen the platform experience to be High.	

LTEX | Language and tool experience	Value Chosen: High – 3 years
Justification: As our development team has significant knowledge and experience of the language and tools because of the projects being done earlier, we have chosen language and tool experience as high.	
PCON | Personnel continuity	Value Chosen: High – 6% turnover per year
Justification: As the teams at Web lab technologies are highly driven and focused towards the project and have experienced members who have been guiding and helping the freshers in the team, we have chosen the personnel continuity to be high.	
TOOL | Use of software tools	Value Chosen: Very High – Mature
Justification: The tools used by the team for the development of the project is highly reusable, and is integrated with different process. Hence, we choose the driver to be very high.	
SITE | Multisite development	Value Chosen: Very High – Same building
Justification: The teams at web lab technologies are collocated in the same building and the communication between the developers, testers and other team members are done through occasional meetings or video conferencing.	
SCED | Development schedule	Value Chosen: Low – 85% of Nominal Schedule
Justification: The schedule of the project needs to be compressed as the estimated time is already exceeding given timeline and also the project needs to be delivered in the allotted timeline so we choose the development schedule to be low.	
TIME | Execution time constraint	Value Chosen: High – 70% use of available execution time
Justification: As DMS is a web-based application it will use very high execution time as there would be both frontend and backend processing and validations during customer operations and the merchant operations and hence we have marked execution time constraint as high.	
STOR | Main storage constraint	Value Chosen: High – 70% use of available storage.
Justification: As the DMS system is a web-based application which also contains the internal system of he company which stores all the details of the employees and also the application will have to display various car makers and models along with their specs. So, we have chosen the main storage constraint to be high.	
PVOL | Platform volatility	Value Chosen: Low – Major Changes every 12 months.
Justification: The platform volatility value is chosen to be low since the changes in the coding platform, server, databases is assumed to be slow i.e. once in a year as even the new version of Visual studio is released merely once every year.	
RELY | Required reliability	Value Chosen: Nominal - Moderate
Justification: As the DMS system would be housed in the client's own data center the major risk of server failure would be handled by the client in the later phases and there won't be any severe consequences because of software failure, we have chosen required reliability to be moderate, easily recoverable losses.	
DATA | Database size	Value Chosen: High
Justification: As DMS system provides different functionalities for different users and also since the application would be used by the employees of the company as well as the	

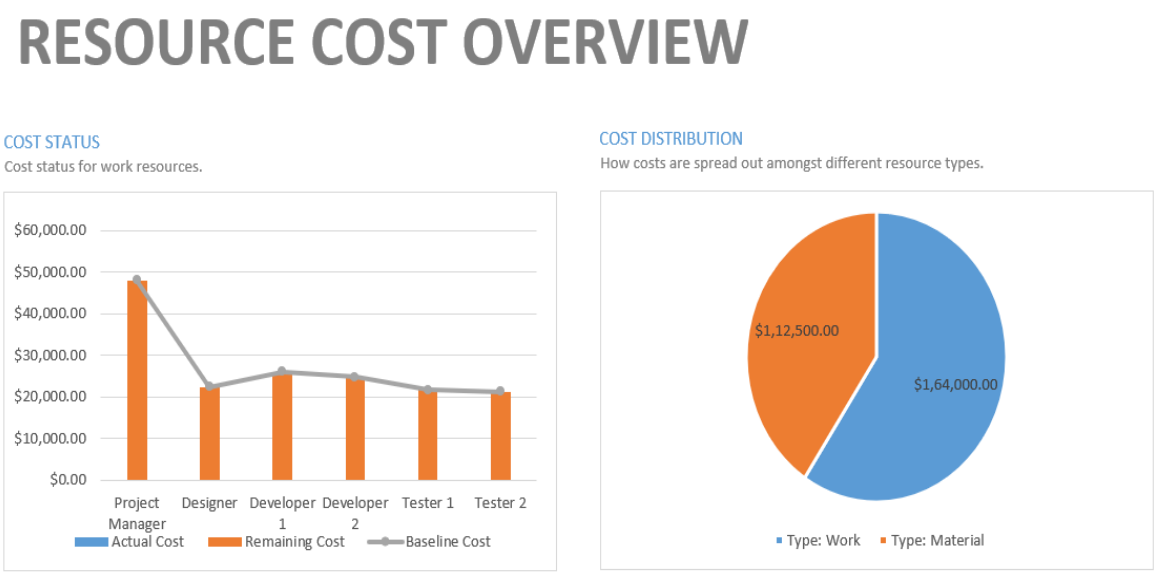
customers, the data that is needed to test the software and whether the application is running as per the design would be High.	
CPLX | Product complexity	Value Chosen: Nominal – Nested code
Justification: The project is assumed to be not highly complex. There wouldn't be frequent hits to the databases and it would just include multiple type of files for both frontend and backend, standard math routines and nested code	
RUSE | Required reusability	Value Chosen: Nominal – Across Project
Justification: The software components developed for the DMS system are reusable across the project as it would save substantial amount of time.	
DOCU | Documentation	Value Chosen: Nominal – Right-sized to life-cycle needs
Justification: As we are following Waterfall methodology, documentation would be done after every phase of the project and these would be done in right amount and at right times. Hence, we have chosen the documentation driver to be Nominal.	

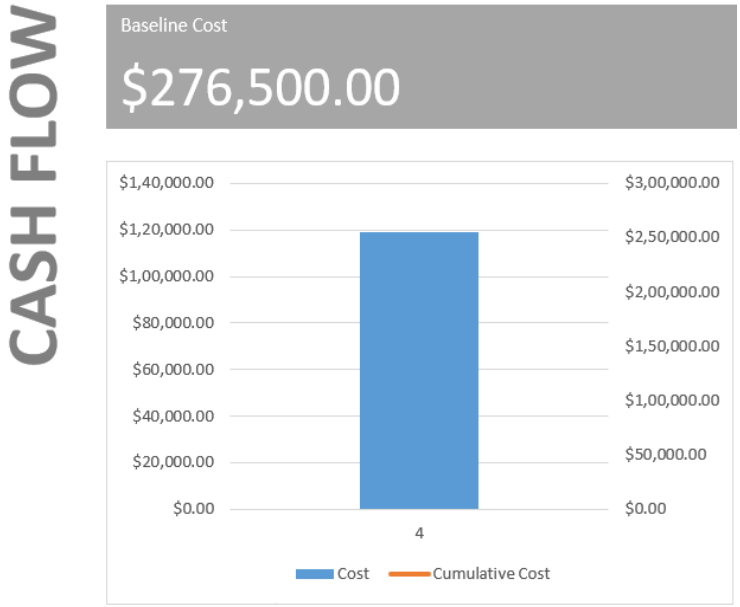


3. PROJECT FINAL TIMELINE AND COST STRUCTURE

1. COST ESTIMATION

1.1 Cost estimation before COCOMO using Microsoft project plan is as follows:





Name	Remaining Cost	Cost
DMS - Project Management	$276,500.00	$276,500.00

Some of the **non-human resources** included in calculating the cost is shown in the following table:

Machine	Specifications	Quantity	Cost	Total
Apple MacBook pro	2.3GHz 8-core Intel Core i9, Turbo Boost up to 4.8GHz, with 16MB shared L3 cache	6	$ 2900	$ 17000
Microsoft visual studio	Enterprise edition with MSDN 2 (yearly subscription for access to Microsoft dev)	6	$ 6000	$36,000.00
Telerik Reporting tool	devCraft Ultimate	1	$ 2200	$ 2200
MongoDB	Atlas M90 Database	1	$38000	$38000
Apache HTTP server	Version 2.4	1	Open-source	$0
Azure Backup Server	Version 3	1	$5000	$5000
Hardware Setup in Clients datacenter			$300	$300
TestComplete Testing tool	PRO Bundle	2	$7000	$14000
			Total	**$112,500**

The cost for the **human resources** is as follows:

Resource	Hourly wage	Monthly wage
Project Manager	$ 100/ hour	$ 16,000 / month
Developer	$ 50/ hour	$ 8,000 / month

COST DETAILS

Cost details for all work resources.

Name	Standard Rate	Work
Project Manager	$100.00/hr	480 hrs
Designer	$50.00/hr	448 hrs
Developer 1	$50.00/hr	520 hrs
Developer 2	$50.00/hr	496 hrs
Tester 1	$50.00/hr	432 hrs
Tester 2	$50.00/hr	424 hrs

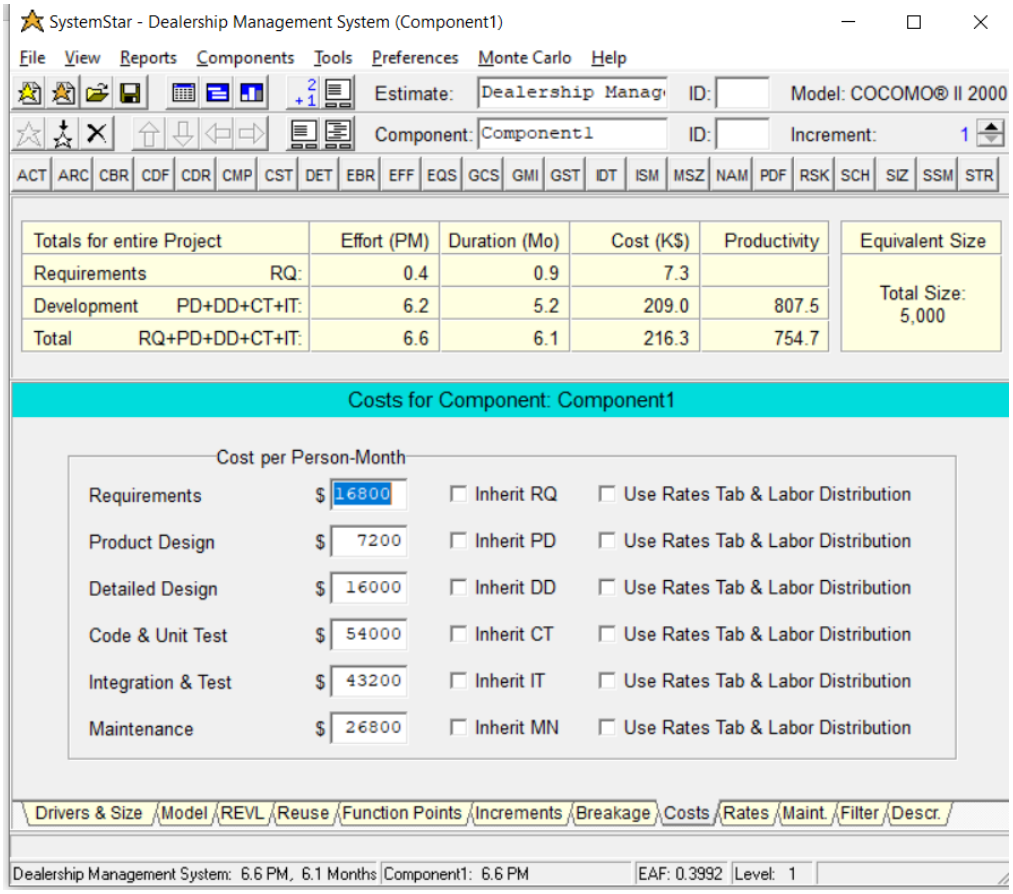
Final cost estimation before using Microsoft project plan is as follows:

Human Resources cost	$ 164,000
Hardware cost and other Software costs	$ 112,500
Total Cost	**$ 276,500**

1.2 Cost Estimation using COCOMO II is as follows:

Since we are using Waterfall process model, we calculate cost at each phase of the software development.

Development phases wise cost is as follows:



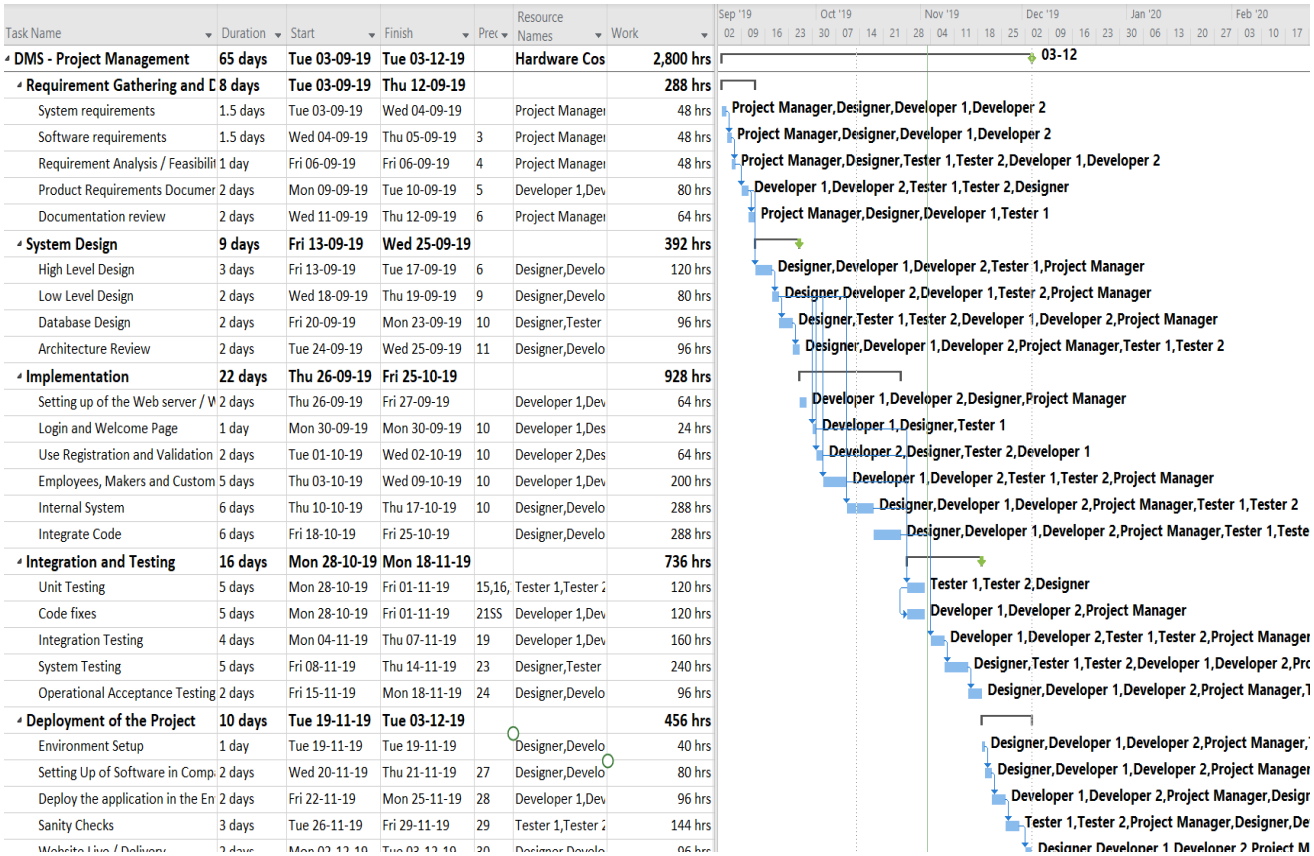
Final cost estimation using COCOMO II is as follows:

RQ+PD+DD+CT+IT	$ 216,300
Hardware cost and other Software costs	$ 112,500
Total Cost	**$ 328,800**

Total Cost estimation after adding **50% profit is $493,200**.
Hence, we charge our client **$493,200.**

2. WORK AND TIME ESTIMATION

2.1 Work and Time estimation before COCOMO using Microsoft project plan is as follows:



Task Name	Duration	Start	Finish	Prec	Resource Names	Work
DMS - Project Management	**65 days**	**Tue 03-09-19**	**Tue 03-12-19**		**Hardware Cos**	**2,800 hrs**
Requirement Gathering and D	**8 days**	**Tue 03-09-19**	**Thu 12-09-19**			**288 hrs**
System requirements	1.5 days	Tue 03-09-19	Wed 04-09-19		Project Manager	48 hrs
Software requirements	1.5 days	Wed 04-09-19	Thu 05-09-19	3	Project Manager	48 hrs
Requirement Analysis / Feasibilit	1 day	Fri 06-09-19	Fri 06-09-19	4	Project Manager	48 hrs
Product Requirements Documer	2 days	Mon 09-09-19	Tue 10-09-19	5	Developer 1,Dev	80 hrs
Documentation review	2 days	Wed 11-09-19	Thu 12-09-19	6	Project Manager	64 hrs
System Design	**9 days**	**Fri 13-09-19**	**Wed 25-09-19**			**392 hrs**
High Level Design	3 days	Fri 13-09-19	Tue 17-09-19	6	Designer,Develo	120 hrs
Low Level Design	2 days	Wed 18-09-19	Thu 19-09-19	9	Designer,Develo	80 hrs
Database Design	2 days	Fri 20-09-19	Mon 23-09-19	10	Designer,Tester	96 hrs
Architecture Review	2 days	Tue 24-09-19	Wed 25-09-19	11	Designer,Develo	96 hrs
Implementation	**22 days**	**Thu 26-09-19**	**Fri 25-10-19**			**928 hrs**
Setting up of the Web server / W	2 days	Thu 26-09-19	Fri 27-09-19		Developer 1,Dev	64 hrs
Login and Welcome Page	1 day	Mon 30-09-19	Mon 30-09-19	10	Developer 1,Des	24 hrs
Use Registration and Validation	2 days	Tue 01-10-19	Wed 02-10-19	10	Developer 2,Des	64 hrs
Employees, Makers and Custom	5 days	Thu 03-10-19	Wed 09-10-19	10	Developer 1,Dev	200 hrs
Internal System	6 days	Thu 10-10-19	Thu 17-10-19	10	Designer,Develo	288 hrs
Integrate Code	6 days	Fri 18-10-19	Fri 25-10-19		Designer,Develo	288 hrs
Integration and Testing	**16 days**	**Mon 28-10-19**	**Mon 18-11-19**			**736 hrs**
Unit Testing	5 days	Mon 28-10-19	Fri 01-11-19	15,16,	Tester 1,Tester 2	120 hrs
Code fixes	5 days	Mon 28-10-19	Fri 01-11-19	21SS	Developer 1,Dev	120 hrs
Integration Testing	4 days	Mon 04-11-19	Thu 07-11-19	19	Developer 1,Dev	160 hrs
System Testing	5 days	Fri 08-11-19	Thu 14-11-19	23	Designer,Tester	240 hrs
Operational Acceptance Testing	2 days	Fri 15-11-19	Mon 18-11-19	24	Designer,Develo	96 hrs
Deployment of the Project	**10 days**	**Tue 19-11-19**	**Tue 03-12-19**			**456 hrs**
Environment Setup	1 day	Tue 19-11-19	Tue 19-11-19		Designer,Develo	40 hrs
Setting Up of Software in Comp	2 days	Wed 20-11-19	Thu 21-11-19	27	Designer,Develo	80 hrs
Deploy the application in the En	2 days	Fri 22-11-19	Mon 25-11-19	28	Developer 1,Dev	96 hrs
Sanity Checks	3 days	Tue 26-11-19	Fri 29-11-19	29	Tester 1,Tester 2	144 hrs

Time estimated with Microsoft Project Planner is 3 months.

Start Date is 3rd September and estimated End date is 3rd December.

2.2 Work and Time estimation using COCOMO II is as follows:

As we are using Waterfall Process model, the time required to complete all the phases of the Waterfall Model according to COCOMO II is estimated to be 6.1 months. This estimate is calculated based on the 5 scale drivers and the 17cost drivers. So, the actual time to deliver this project would be around 6 months.

Totals for entire Project		Effort (PM)	Duration (Mo)	Cost (K$)	Productivity	Equivalent Size
Requirements	RQ:	0.4	0.9	7.3		Total Size: 5,000
Development	PD+DD+CT+IT:	6.2	5.2	209.0	807.5	
Total	RQ+PD+DD+CT+IT:	6.6	6.1	216.3	754.7	

Time Estimated using the COCOMO II tool is 6 months.

Start Date is 3rd September,2019 and the estimated end date is 3rd March,2020.

4. CONCLUSION AND RECOMMENDATIONS

By using COCOMO II we get an accurate idea of how much time the DMS project will take and the accurate cost needed to develop the project. By considering all the scale factors and the cost factors in accordance to our Web Lab Technologies and by using the effort and the duration equation we get an estimate of the project cost and duration.

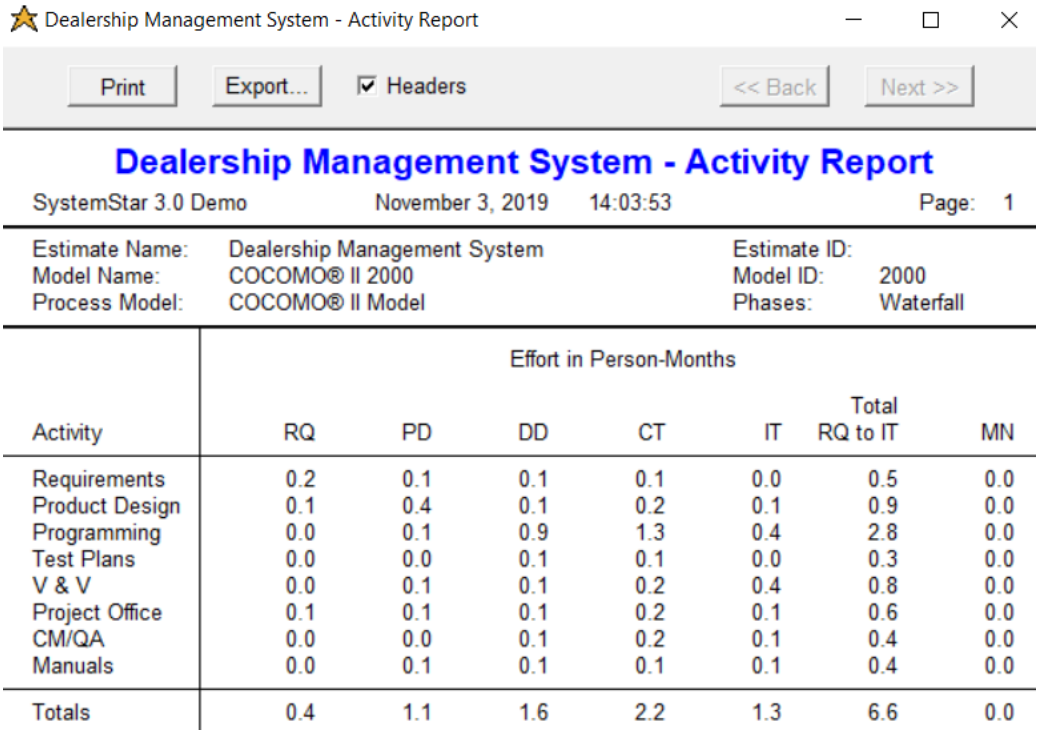
The duration of the project would be 6.1 months as estimated by the COCOMO II tool and we determine that the project would not be completed within the allotted 3 months of time period. It is because of many factors like the expected number of functionalities, experience of the developers and testers, database size, familiarity with using the software development tools, etc. The project would cost $493,200 including the 50% profit for the duration of 6.1 months.

As our team consists of 2 developers, 2 testers, 1 designer and 1 project manager it would be too ambitious to complete the entire project within the allotted time frame. As the time schedule is very limited and aggressive it is very ambitious to use waterfall process model for the development of the project. One recommendation would be to provide the major functionalities of the system first then integrate rest of the functionalities later once the major functionalities have been delivered and deployed and taking into consideration the customers response and behavior towards the initial product and improvising it. In this way the project can be delivered in two phases – first phase including the major functionalities and internal system and second phase containing the rest of the functionalities.

If following the timeline is a strict constraint then it is recommended to use Rapid application development model also called the incremental model. Here the phases of the project are developed in parallel as if they are a project of its own and then integrated to form the final product.

5. Appendices

Some of the reports generated by the COCOMO II tool is as follows :



Dealership Management System - Activity Report

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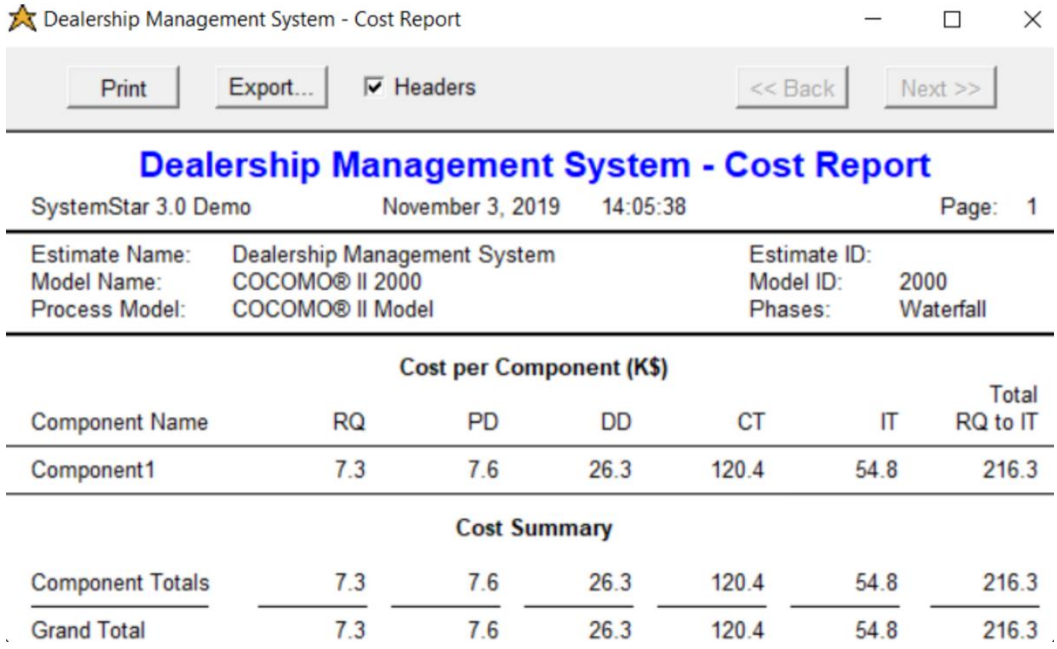
Dealership Management System - Activity Report

SystemStar 3.0 Demo November 3, 2019 14:03:53 Page: 1

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

Effort in Person-Months

Activity	RQ	PD	DD	CT	IT	Total RQ to IT	MN
Requirements	0.2	0.1	0.1	0.1	0.0	0.5	0.0
Product Design	0.1	0.4	0.1	0.2	0.1	0.9	0.0
Programming	0.0	0.1	0.9	1.3	0.4	2.8	0.0
Test Plans	0.0	0.0	0.1	0.1	0.0	0.3	0.0
V & V	0.0	0.1	0.1	0.2	0.4	0.8	0.0
Project Office	0.1	0.1	0.1	0.2	0.1	0.6	0.0
CM/QA	0.0	0.0	0.1	0.2	0.1	0.4	0.0
Manuals	0.0	0.1	0.1	0.1	0.1	0.4	0.0
Totals	0.4	1.1	1.6	2.2	1.3	6.6	0.0



Dealership Management System - Cost Report

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Dealership Management System - Cost Report

SystemStar 3.0 Demo November 3, 2019 14:05:38 Page: 1

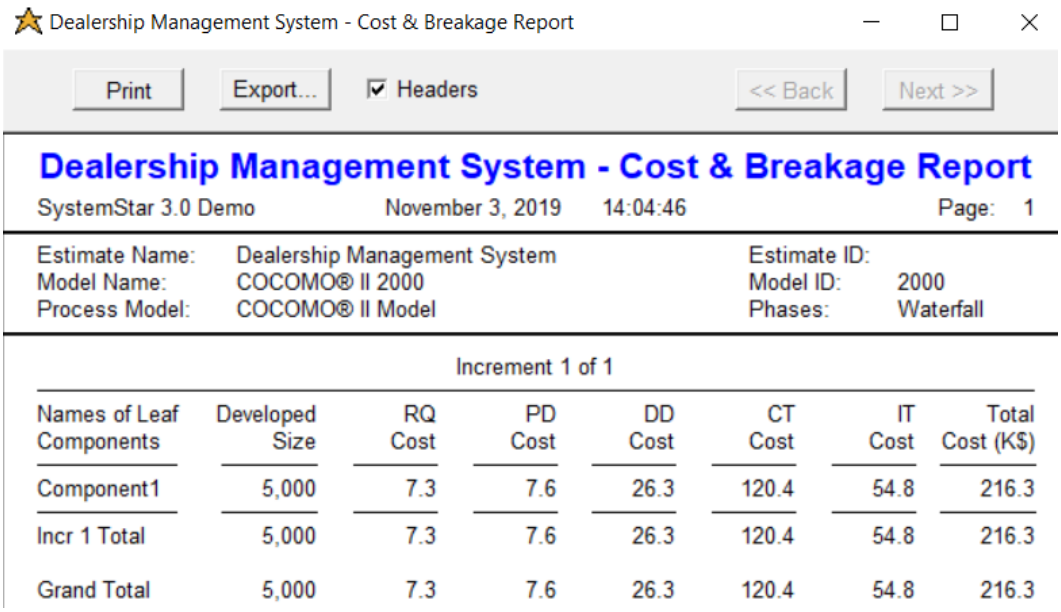
Estimate Name:	Dealership Management System	Estimate ID:	
Model Name:	COCOMO® II 2000	Model ID:	2000
Process Model:	COCOMO® II Model	Phases:	Waterfall

Cost per Component (K$)

Component Name	RQ	PD	DD	CT	IT	Total RQ to IT
Component1	7.3	7.6	26.3	120.4	54.8	216.3

Cost Summary

Component Totals	7.3	7.6	26.3	120.4	54.8	216.3
Grand Total	7.3	7.6	26.3	120.4	54.8	216.3


Dealership Management System - Cost & Breakage Report
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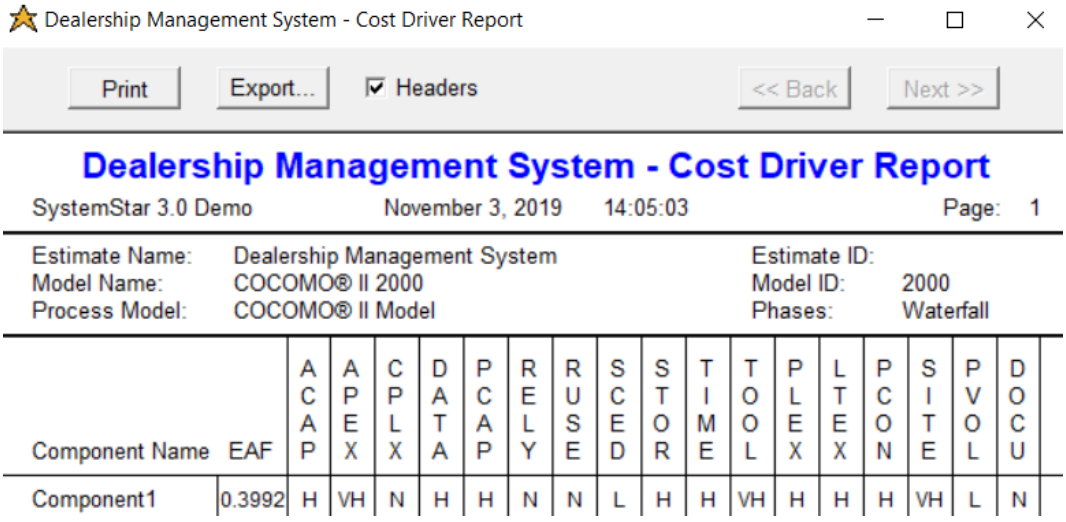
Dealership Management System - Cost & Breakage Report
SystemStar 3.0 Demo November 3, 2019 14:04:46 Page: 1
Estimate Name: Dealership Management System
Model Name: COCOMO® II 2000
Process Model: COCOMO® II Model
Estimate ID:
Model ID: 2000
Phases: Waterfall
Increment 1 of 1
Names of Leaf Components | Developed Size | RQ Cost | PD Cost | DD Cost | CT Cost | IT Cost | Total Cost (K$)
Component1 | 5,000 | 7.3 | 7.6 | 26.3 | 120.4 | 54.8 | 216.3
Incr 1 Total | 5,000 | 7.3 | 7.6 | 26.3 | 120.4 | 54.8 | 216.3
Grand Total | 5,000 | 7.3 | 7.6 | 26.3 | 120.4 | 54.8 | 216.3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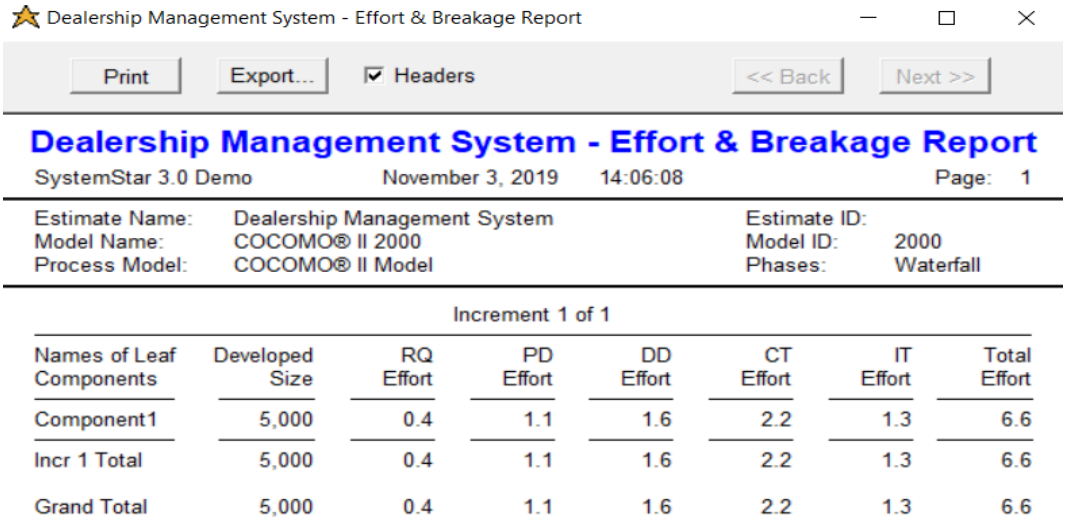
Dealership Management System - Cost Driver Report
SystemStar 3.0 Demo November 3, 2019 14:05:03 Page: 1
Estimate Name: Dealership Management System
Model Name: COCOMO® II 2000
Process Model: COCOMO® II Model
Estimate ID:
Model ID: 2000
Phases: Waterfall
Component Name | EAF | ACAP | APEX | CPLX | DATA | PCAP | RELY | RUSE | SCED | STOR | TIME | TOOL | PLEX | LTEX | PCON | SITE | PVOL | DOCU
Component1 | 0.3992 | H | VH | N | H | H | N | N | L | H | H | VH | H | H | H | VH | L | N


Dealership Management System - Effort & Breakage Report
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Dealership Management System - Effort & Breakage Report
SystemStar 3.0 Demo November 3, 2019 14:06:08 Page: 1
Estimate Name: Dealership Management System
Model Name: COCOMO® II 2000
Process Model: COCOMO® II Model
Estimate ID:
Model ID: 2000
Phases: Waterfall
Increment 1 of 1
Names of Leaf Components | Developed Size | RQ Effort | PD Effort | DD Effort | CT Effort | IT Effort | Total Effort
Component1 | 5,000 | 0.4 | 1.1 | 1.6 | 2.2 | 1.3 | 6.6
Incr 1 Total | 5,000 | 0.4 | 1.1 | 1.6 | 2.2 | 1.3 | 6.6
Grand Total | 5,000 | 0.4 | 1.1 | 1.6 | 2.2 | 1.3 | 6.6

Dealership Management System - Detail Report

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Dealership Management System - Detail Report

SystemStar 3.0 Demo November 3, 2019 14:05:55 Page: 1

Estimate Name:	Dealership Management 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:	5,000	EAF:	0.3992

Phase	Effort (Person-Months)	Cost (K$)	Duration (Months)	Staffing
RQ -- Requirements	0.4	7.3	0.9	0.5
PD -- Product Design	1.1	7.6	1.3	0.8
DD -- Detailed Design	1.6	26.3	1.2	1.4
CT -- Code & Unit Test	2.2	120.4	1.6	1.4
IT -- Integration & Test	1.3	54.8	1.1	1.1
Development (PD+DD+CT+IT)	6.2	209.0	5.2	
Totals (RQ+PD+DD+CT+IT)	6.6	216.3	6.1	
MN -- Maintenance (per year)	0.0	0.0		0.0

Dealership Management System - Component Structure Report

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Component Structure Report

SystemStar 3.0 Demo November 3, 2019 14:06:52 Page: 1

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

Level	Component Name	Developed Size	Effort in Person-Months	Cost (K$)	Incre-ment
1	Component1	5,000	6.6	216.3	1

Dealership Management System - Schedule Report

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Dealership Management System - Schedule Report

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

	Effort this Month (Person-Months)								
Month	RQ	PD	DD	CT	IT	Total	Cumulative Effort	Cost (K$) This Month	Cumulative Cost (K$)
1	0.4	0.1	0.0	0.0	0.0	0.5	0.5	7.9	7.9
2	0.0	0.8	0.0	0.0	0.0	0.8	1.3	5.9	13.9
3	0.0	0.1	1.1	0.0	0.0	1.3	2.6	19.2	33.0
4	0.0	0.0	0.5	0.9	0.0	1.4	4.0	54.9	88.0
5	0.0	0.0	0.0	1.4	0.0	1.4	5.4	74.0	162.0
6	0.0	0.0	0.0	0.0	1.1	1.1	6.5	48.8	210.8
7	0.0	0.0	0.0	0.0	0.1	0.1	6.6	5.5	216.3

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