SOFTWARE PROJECT PLAN

Version 1.2

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Revision History

Name	Rev.	Description	Author
September 28, 2016	1.0	First Draft	Mo Chen Kundi Yao
November 11, 2016	1.1	The 2nd Version	Mo Chen
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Introduction

The Project Management Plan is one of the most important documents in the overall planning, monitoring, and implementation of a project.

Now, we have a contract to develop an online-shopping website. And the project plan will document planning assumptions and decisions, facilitate communication among project stakeholders, and document approved scope, cost, and schedule baselines. This document will introduce the planning of the whole project. There are several main aspects: lifecycle model, estimation, detailed scheduling and resource allocation.

1. Lifecycle Model and Architecture

1.1 Lifecycle Model

The agile development model has many advantages:

it is fast to market so that the company get earlier revenue from the market,

testing is integrated throughout the lifecycle which allows the product owner to make adjustments if necessary and gives the product team early sight of any quality issues,

it provides excellent visibility for key stakeholders,

small incremental releases made visible to the product owner and product team through its development help to identify any issues early and make it easier to respond to change,

changes are acceptable compared with traditional developing method.

Combined with above advantages, we decided to use agile development lifecycle model for the project.

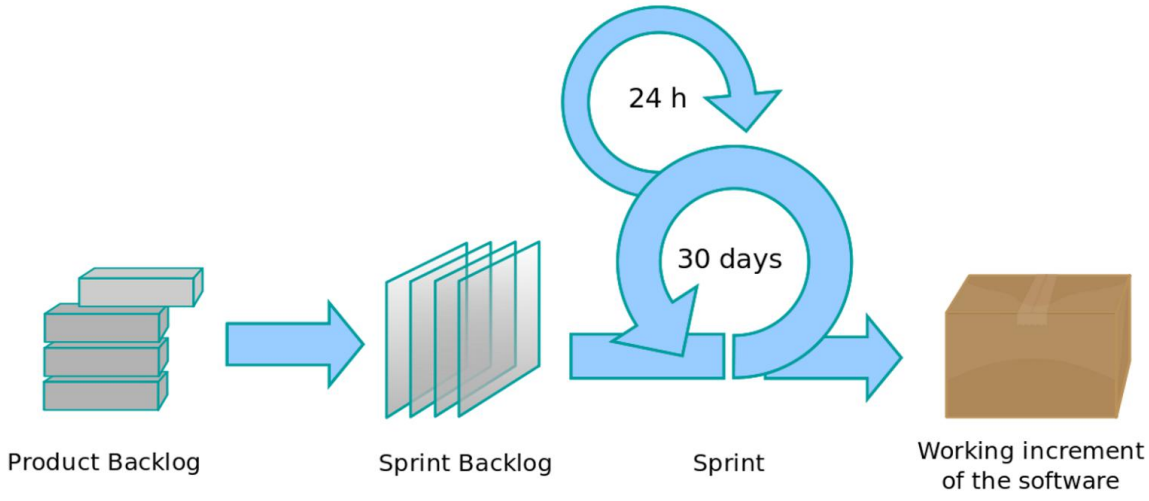


Figure 1.1 Agile Model

1.2 Architecture Overview

Online-shopping website consists of 3 main parts: service, server, database.

The online shopping website developed would be suitable for mainstream browsers. Different service is provided by different servers and the data is stored in the corresponding database.

The architecture is as follows:

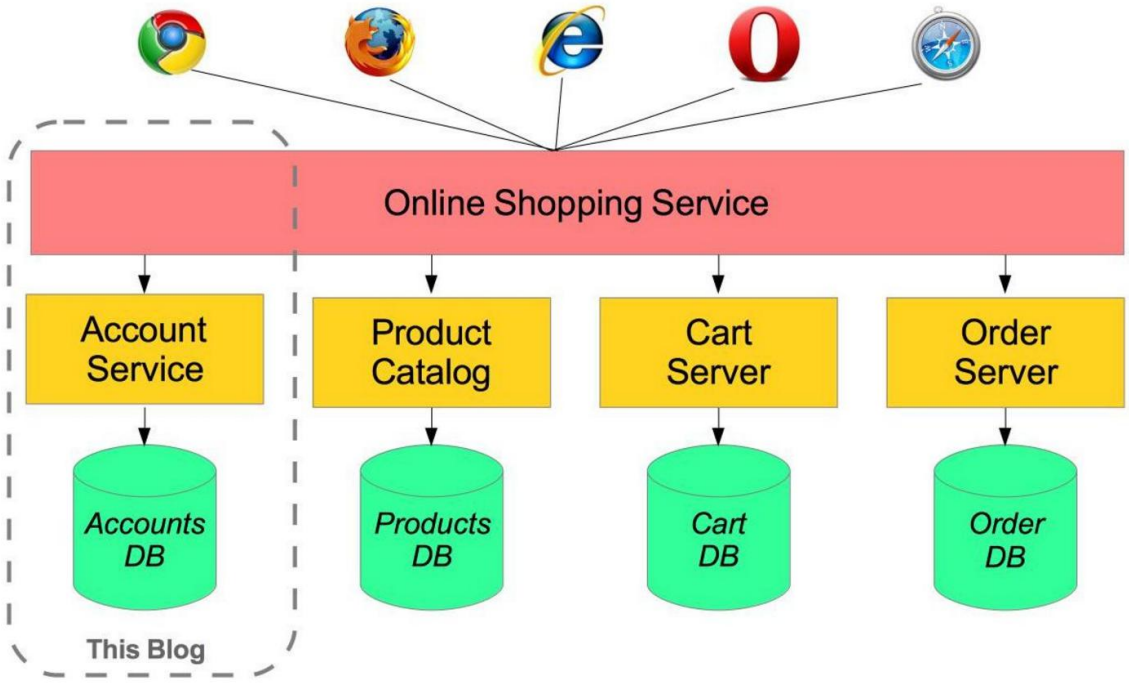


Figure 1.2.1 Architecture Overview

2. User Story and Development Estimation

We are going to figure out user stories in this stage as well as relevant deliverables such as: prioritization, story points, iterations, tasks and so on.

Also, we will analyze if the project is feasible by linear regression model.

2.1 Feasibility Analysis

We decide to apply functional size (function point-based) method to estimate the overall workload. In order to build a reliable estimation model to predict effort accurately, we choose to establish our model by empirical means, which imply that comparing the effort of different estimation models performance according to known model which is concluded from existing data. In our evaluation model, we decide to use linear regression model to predict effort, because of the accuracy, comprehensibility and conciseness of linear model.

We build our linear regression model based on known data. First of all, we need to have a deep understanding on the data set we already have, then we need to make sure our model is easy to implement in industrial environment. We choose COSMIC as our sizing

method, by calculating COSMIC Function points and actual efforts, we can predict effort on future work.

Projects	CFP	Effort
1	111	70
2	379	219
3	190	119
4	157	238
5	202	216
6	224	167
7	183	460
8	8	5
9	115	383
10	32	70.5
11	450	495.25
12	39	15
13	172	312
14	210	314.5
15	69	235
Avg	169.4	221.2833333

$$\text{Average unit cost} = 1ni=1nEffortiSizei$$

$$\text{SizeCFP(change)}=\text{Sizesize(added data movement)}+\text{Sizesize(changed data movement)}+\text{Sizesize(deleted data movement)}$$

$$\text{Effort(estimated)}= \text{Average cost SizeCFP(change)}$$

To begin with, we establish our model based on empirical data. The formulas are listed above, first we need an average unit cost number, which represents the ratio of actual effort to estimated size. Before we use these ratio to actually predict effort, we need to validate the effectiveness and correctness of our model.

Projects	CFP	Actual Effort	Estimate Effort	Effort/Size	Raw Error	Magnitude of Relative Error(Raw Error/Actaul Effo	|MRE|
1	111	70	104.4037581	0.6306306306	34.40375805	0.4914822579	0.4914822579
2	353	419	332.0227621	1.186968839	-86.97723791	-0.2075829067	0.2075829067
3	190	169	178.7091354	0.8894736842	9.709135402	0.05745050533	0.05745050533
4	227	208	213.5103881	0.9162995595	5.510388085	0.02649225041	0.02649225041
5	202	263	189.9960282	1.301980198	-73.00397184	-0.277581642	0.277581642
6	224	168	210.6886649	0.75	42.68866489	0.2540991958	0.2540991958
7	183	155	172.1251146	0.8469945355	17.12511462	0.1104846105	0.1104846105
8	8	5	7.524595175	0.625	2.524595175	0.504919035	0.504919035
9	115	84	108.1660556	0.7304347826	24.16605564	0.2876911385	0.2876911385
10	32	45	30.0983807	1.40625	-14.9016193	-0.3311470956	0.3311470956
11	450	355.25	423.2584786	0.7894444444	68.00847858	0.1914383634	0.1914383634
12	39	34	36.68240148	0.8717948718	2.682401477	0.07889416109	0.07889416109
13	172	282	161.7787963	1.639534884	-120.2212037	-0.4263163253	0.4263163253
14	210	170	197.5206233	0.8095238095	27.52062334	0.1618860196	0.1618860196
15	469	335	441.1293921	0.7142857143	106.1293921	0.3168041556	0.3168041556
Avg	199	184.15		0.9405743969			0.2482846442

Average unit cost

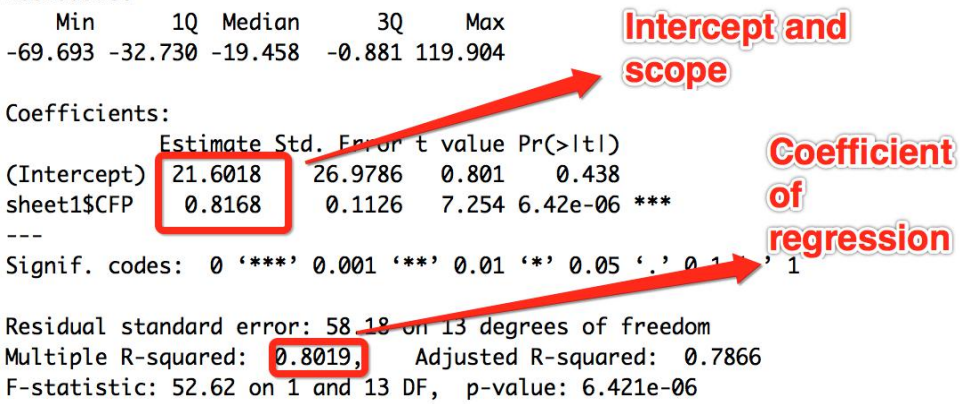
MRE

First we calculate Mean Magnitude Relative Error(MRE), which represent the divergence between values estimated by the model and real values, as percentage and

recommended MRE range in 25%. In our model, MRE value is 24.8%, so this model can be considered as acceptable. The estimation model is:

Effort=0.94*CFP

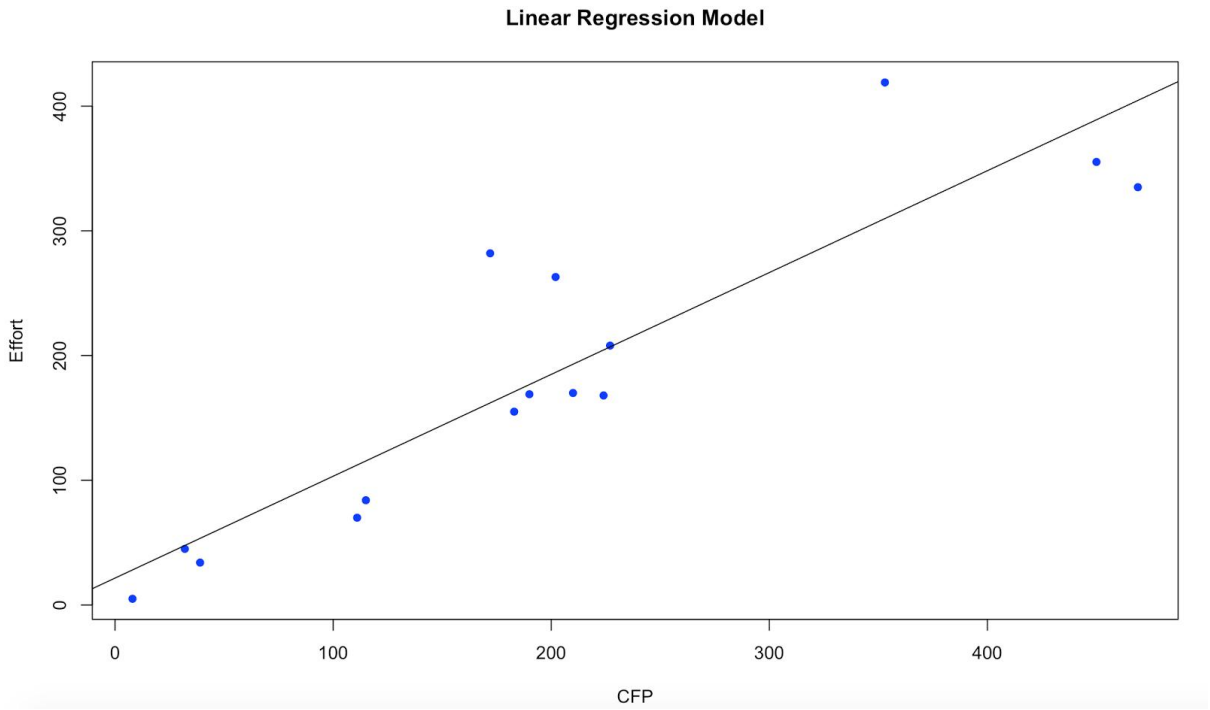
```
Call:
lm(formula = sheet1$Effort ~ sheet1$CFP)

Residuals:
    Min      1Q  Median      3Q     Max
-69.693 -32.730 -19.458  -0.881 119.904

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)  21.6018    26.9786   0.801    0.438
sheet1$CFP    0.8168     0.1126   7.254 6.42e-06 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 58.18 on 13 degrees of freedom
Multiple R-squared:  0.8019,    Adjusted R-squared:  0.7866
F-statistic: 52.62 on 1 and 13 DF,  p-value: 6.421e-06
```



However, because the MRE value is so close to the boundary, we need to find an alternative way to produce a more precise prediction. In that case, we choose linear regression model as our predicting model.

Coefficient of regression(R2) represents the percentage of variability explained in linear regression model, the value more close to 1 indicates strong relationship. In our model, and R2 is 0.81, according to the standard in the table, our model shows a strong linear relationship and can be used for planning.

If R2 is	The relationship is
0.9R2	Predictive; use it with high confidence
0.7R2<0.9	Strong and can be used for planning
0.5R2<0.7	Adequate for planning but use with caution
R2<0.5	Not reliable for planning purposes



We use R to build our linear model and obtain a linear graph, as illustrated in the scatterplot, it's obvious to see the linear pattern in this plot, and it further validates the veracity of our model. We can conclude the linear regression formula as below:

$$Effort=21.60+0.82*CFP$$

Conclusion: Because the MMR range is between -25% ~ +25%, so the project is feasible.

2.2 User Story

2.2.1 User Story Traceability Matrix and Story Points Estimation

In agile development, we need to split project into several user stories which are short description of a feature written from the perspective of a user or customer.

This traceability matrix map every function process to one user story.

Story points are estimated with **Planning Poker** technique. During the process, each estimator is given a set of cards while each card has a valid story points estimate written on it. Estimators select a card that is his or her estimate. Then discussing the differences and re-estimating until estimates converge.

The results are as follows:

Function Process	User Story	Story Points
FP1. Select Product Group	User Story 1. As a user, I can select product group.	2
FP 2. Search product	User Story 2. As a user, I want to be able to Search product	3
FP 3. Display product	User Story 3. As a user, I want to be able to Display product	3
FP 4. View size chart	User Story 4. As a user, I want I can View size chart	2
FP 5. Select for purchase	User Story 5. As a user, I want to be able to Select for purchase	5
FP 6 Update Order Item	User Story 6. As a user, I can Update Order Item	5
FP 7. Delete Order Item	User Story 7. As a user, I want to be able to Delete Order Item	3
FP 8. Place order	User Story 8. As a user, I can Place order	8
FP 9. Create new customer	User Story 9. As a user, I can Create new customer	5
FP 10. New shipping address	User Story 10. As a user, I want to be able to New shipping address	2
FP 11: Make payment	User Story 11. As a user, I can Make payment	8

Table 2.2.1.1 User Story Matrix

2.2.2 User Story Prioritization

In agile development, we need to assign priority to every user story. We use **T-shirt** method to prioritize the user story. The results are as follows:

(Priority: 1 = advanced-upper 2 = advanced-lower

3 = intermediate-upper 4 = intermediate-lower 5 = low)

User Story	Development cost	Business value	Priority
User Story 1	medium	medium	4
User Story 2	low	high	2
User Story 3	medium	medium	3
User Story 4	high	medium	3
User Story 5	Low	high	1
User Story 6	medium	high	2
User Story7	medium	low	4
User Story 8	medium	high	2
User Story 9	high	low	5
User Story 10	low	medium	2
User Story 11	high	medium	4

Table 2.2.2.1 User Story T-shirt

2.2.3 Iteration Partition

At first, we should estimate the velocity which means the rate of progress of development team. Then, we Completely separates the estimation of effort from the estimation of duration that is derived by seeing how much we complete per iteration.

To our own development team, the **Velocity = 10** story points per iteration. Then, the project manager assign user story to iterations and assure total story points is close to 10 while no more than 10.

And, in order to complete the development, **no more than 70%** complex work to be allocated in one iteration.

The iterations are as follows:

iteration	User Story	Story Points

1	User Story 5 User Story 6	10
2	User Story 8 User Story 10	10
3	User Story 2 User Story 3 User Story 4	8
4	User Story 1 User Story 11	10
5	User Story 7 User Story 9	8

Table 2.2.3.1 Iteration Partition

2.3 Estimation Results

The table below shows the estimation results for the Online Shopping System deliverables. The data below corresponds to the intervals shown in task lists and Gantt charts.

User Story	Duration (days)	Effort (staff-hours)	Budget Allocation
User Story 1	15	80	30,000
User Story 2	10	64	19,200
User Story 3	8	48	16,200
User Story 4	7	35	6,562
User Story 5	20	128	43,200
User Story 6	10	65	26,812
User Story 7	15	90	27,000
User Story 8	14	80	21,000
User Story 9	10	60	11,250
User Story 10	14	80	27,000

User Story 11	14	70	26,250
Total			254,474

Table 2.3.1 Estimation Results

3. Measurement Indicator and Estimation

3.1 Success Criteria and Indicators

For this project, we want to improve the quality of the source code.
Because the quality of the code can be reflected in three aspects, code defects, the cyclomatic complexity and the readability. So we could inspect the quality of code from these indicators as follows:

Indicator	Evaluation	Success criteria
DKLOC	defects/KLOC	$\leq 0.92‰$
ratio of CCMin	CCMin/CCSum	$\geq 80\%$
Code Readability	The Number of GOOD	The Number of GOOD ≥ 2

Table 3.1.1 Measurement Indicator

3.2 Effort Estimation

The technique that we used in the effort estimating is **Delphi**. The detailed steps is described as follows:

1. Coordinator presents each expert with a specification and an estimation form.
2. Coordinator calls a group meeting in which the experts discuss estimation issues with the coordinator and each other.
3. Experts fill out forms anonymously.
4. Coordinator prepares and distributes a summary of the estimates
5. Coordinator calls a group meeting, specifically focusing on having the experts discuss points where their estimates vary widely
6. Experts fill out forms, again anonymously, and steps 4 to 6 are iterated for as many rounds as appropriate.

In this part, the salary standard of the measurement staff is 5000 dollars/month.
The results form is as follows:

Planning Tasks	Effort (Hours)	Start time	End time	Budget (1k Dollars)
Process planning: identify the needs of measurements	16	09/24/16	09/25/16	0.5
Identify the objectives of the organization.	24	09/26/16	09/28/16	0.8
Identify the methods that will be used to achieve the objectives.	16	09/29/16	09/30/16	0.4
Identify the issues that need to be managed, controlled or observed.	16	10/01/16	10/02/16	0.4
Translate each measurement issues into precise, quantifiable and unambiguous measure goals..	16	10/03/16	10/04/16	0.5
Data elements defined	65	10/24/16	11/03/16	1.5
Data collection frequency and points in the software process defined	64	11/04/16	11/13/16	1.5
Timelines defined for measurement result to databases and users	67	11/14/16	11/23/16	2.0
Data collection forms defined	64	11/24/16	12/03/16	1.5
Data collection procedure defined	65	12/04/16	12/13/16	1.5
Data storage, database design, and data retention responsibilities defined	64	12/14/16	12/23/16	1.5
Who will collect and who will access defined data	65	12/24/16	01/03/17	1.5
Data collection	80	01/04/17	02/15/17	2.3
Analysis process	45	10/24/16	12/24/16	1.1
Reporting process	40	12/25/16	02/15/17	1.0
Supporting tools identified and made available	10	12/24/16	12/25/16	0.2
Process Guide for data definition and collection prepared	20	10/24/16	10/31/16	0.4

Prepare and presente report	10	01/05/17	01/15/17	0.2
Review and revise procedure	60	01/16/17	02/15/17	1.1
Evaluate measurement process	30	10/24/16	02/15/17	0.8
Total				17.7

Table 3.2.1 Effort Estimation

4. Risk Management Effort Estimation

The table below shows the detail information about budget, effort and duration. **DELPHI** method and **FP-Based** Cost estimation method are deployed in this part. It is supposed that the salary of one staff is $8,000 per month. We concluded severn risks that may happen during the process:

- R1: Lack of stakeholders' involvement.
- R2: Integrating with third party system.
- R3: Huge change request late in the project.
- R4: Problems caused by new technologies.
- R5: Unexpected software abnormalities ("bugs").
- R6: Key project team member sick/urgent leave/quit.
- R7: Over emphasis on low priority detais.

The table below shows the tasks that derived from the the top risks.

Task	Effort (PM)	Budget (thousands of dollars)
Hold weekly meetings with stakeholders	3.5	28
Hold weekly meetings with third party system providers	2.5	20
Design interface used to communicate with third party system	3.125	25
Total		73

Table 4.1 Risk Effort Estimation

5. Detailed Scheduling

5.1 Task Timeline Table

After getting release backlog and iteration backlog, we develop a detailed scheduling about the whole project. The detailed scheduling is including not only development tasks but also other tasks such as tasks of measurement management, tasks of risk management, etc.
The table below shows the final results of scheduling:

Task	Duration(day)	Start Date	End Date	Effort
Planning	3	09/01/16	09/03/16	16
Staffing	4	09/03/16	09/6/16	16
Training	7	09/6/16	09/12/16	20
Scoping	3	09/12/16	09/14/16	10
Scheduling	2	09/14/16	09/15/16	12
Design	10	09/15/16	09/24/16	40
Iteration 1	30	09/24/16	10/24/16	193
User Story 5	20	09/24/16	10/14/16	128
User Story 6	10	10/14/16	10/24/16	65
Iteration 2	28	10/24/16	11/22/16	160
User Story 8	14	10/24/16	11/08/16	80
User Story 10	14	11/08/16	11/22/16	80
Iteration 3	25	11/22/16	12/17/16	147
User Story 2	10	11/22/16	12/02/16	64
User Story 3	8	12/02/16	12/10/16	48
User Story 4	7	12/10/16	12/17/16	35
Feature Buffer	10	12/17/16	12/27/16	40
Iteration 4	29	12/17/16	01/16/17	150
User Story 1	15	12/17/16	01/02/17	80
User Story 11	14	01/02/17	01/16/17	70

Iteration 5	25	01/16/17	02/10/17	150
User Story 7	15	01/16/17	01/31/17	90
User Story 9	10	01/31/17	02/10/17	60
Plan Measurement	10	09/24/16	10/04/16	88
Perform Measurement	110	10/24/16	02/15/17	534
Analysis Measurement	110	10/24/16	02/15/17	215
Hold weekly meetings with stakeholders	140	09/24/16	02/13/17	560
Hold weekly meetings with third party system providers	140	09/24/16	02/13/17	400
Design interface used to communicate with third party system	140	09/24/16	02/13/17	500
Testing	40	02/10/17	03/22/17	180
Communication	20	03/22/17	04/11/17	80
Documentation	15	04/11/17	04/26/17	120

Table 5.1.1 Task Timeline

5.2 Milestone

The milestone list is a basic table of the milestone descriptions, planned completion dates, whether they're mandatory or optional milestones, and how the completion of the milestone will be verified. This document provides an easy reference to all project stakeholders on what milestones are included in the project and when they will occur. Like all project documentation, any proposed changes must be subject to the project's change management process and communicated to all stakeholders. Since milestones are significant events and can impact the project in many ways, changes often require approval from the project sponsor.
The milestone table is as follows:

Project			**Date**
Milestone NO.	Milestone	Mandatory/Optional	Due Date
0	Complete Planning	Mandatory	09/03/16
1	Complete Training	Mandatory	09/12/16

2	Complete Designing	Mandatory	09/24/16
3	Complete Coding	Mandatory	02/10/17
4	Complete Measurement	Mandatory	02/15/17
5	Complete Risk Management	Mandatory	02/13/17
6	Complete Documentation	Mandatory	04/26/17

Table 5.2.1 Milestone

6. Work Plan

6.1 Work Breakdown Structure

The work breakdown structure(WBS) is a key project deliverable that organizes the whole work into manageable sections. The WBS provides a common framework for the natural development of the overall planning and divides work into definable increments from which the statement of work can be developed and technical, schedule, cost, and labor hour reporting can be established.

WBS is as follow:

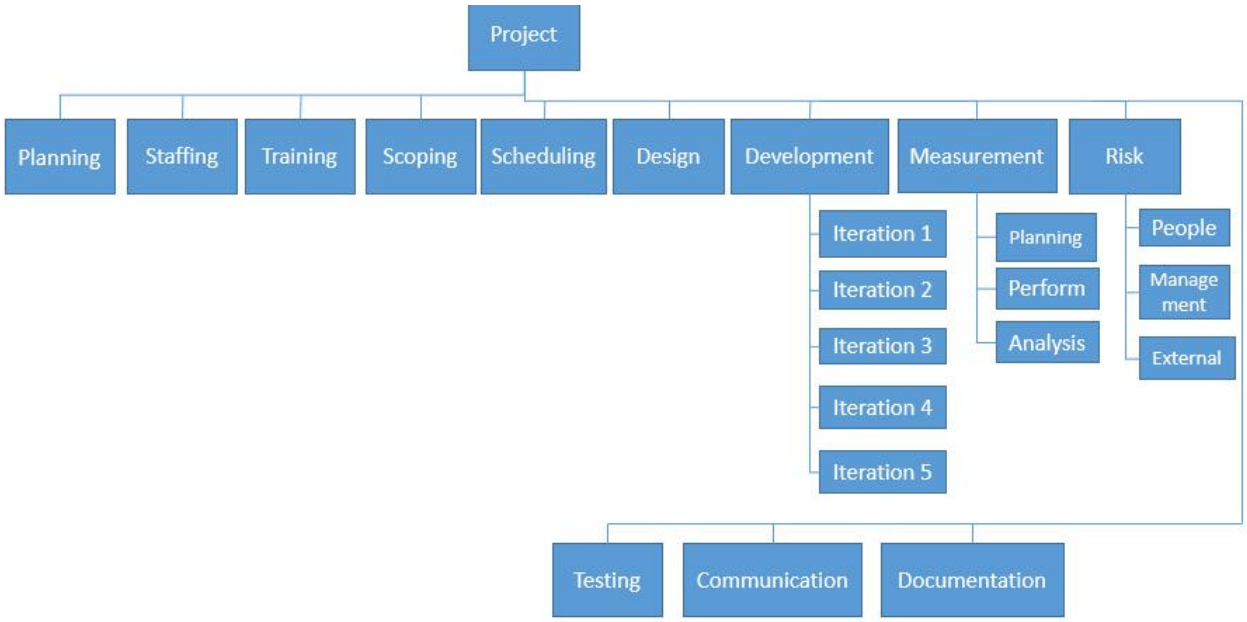


Figure 6.1.1 WBS

Gantt charts illustrate duration, predecessors, Resources names, the start and finish dates of the terminal elements and summary elements of a project. And the charts show the dependency relationships between activities. It is help to organize the work schedule and develop work line for the whole project.

The **Gantt charts table** is as follows:

No.	Task Name	Duration (days)	Start	Finish	Predecessor	Resource names
0	**Planning**	3	09/01/16	09/03/16		Project Manager
1	**Staffing**	4	09/03/16	09/6/16	0	Project Manager

2	**Training**	7	09/6/16	09/12/16	1	Project Manager
3	**Scoping**	3	09/12/16	09/14/16	2	Project Manager
4	**Scheduling**	2	09/14/16	09/15/16	3	Stakeholders
5	**Design**	10	09/15/16	09/24/16	4	Development Manager
6	**Iteration 1**	30	09/24/16	10/24/16	5	Develop Team
7	User Story 5	20	09/24/16	10/14/16	6	Develop Team
8	User Story 6	10	10/14/16	10/24/16	7	Develop Team
9	**Iteration 2**	28	10/24/16	11/22/16	8	Develop Team
10	User Story 8	14	10/24/16	11/08/16	9	Develop Team
11	User Story 10	14	11/08/16	11/22/16	10	Develop Team
12	**Iteration 3**	25	11/22/16	12/17/16	11	Develop Team
13	User Story 2	10	11/22/16	12/02/16	12	Develop Team
14	User Story 3	8	12/02/16	12/10/16	13	Develop Team
15	User Story 4	7	12/10/16	12/17/16	14	Develop Team
16	**Feature Buffer**	10	12/17/16	12/27/16	12	Develop Team
17	**Iteration 4**	29	12/17/16	01/16/17	15	Develop Team
18	User Story 1	15	12/17/16	01/02/17	17	Develop Team
19	User Story 11	14	01/02/17	01/16/17	18	Develop Team
20	**Iteration 5**	25	01/16/17	02/10/17	19	Develop Team
21	User Story 7	15	01/16/17	01/31/17	20	Develop Team
22	User Story 9	10	01/31/17	02/10/17	21	Develop Team
23	**Plan Measurement**	10	09/24/16	10/04/16	6	Measurement Manager
24	**Perform Measurement**	145	10/24/16	02/15/17	6	Measurement Manager
25	**Analysis**	145	10/24/16	02/15/17	6	Measurement

	Measurement					Manager
26	**People Risk**	140	09/24/16	02/13/17	5	Risk Manager
27	**Management Risk**	140	09/24/16	02/13/17	5	Risk Manager
28	**External Risk**	140	09/24/16	02/13/17	5	Risk Manager
29	**Testing**	40	02/10/17	03/22/17	22	Tester
30	**Communication**	20	03/22/17	04/11/17	29	Project Manager
31	**Documentation**	15	04/11/17	04/26/17	30	Project team

Table 6.1.2 Gantt Chart Table

The **Gantt Chart graph** gives a direct view to activities work line. Some activities are executed sequentially while others concurrently.

It is as follow:

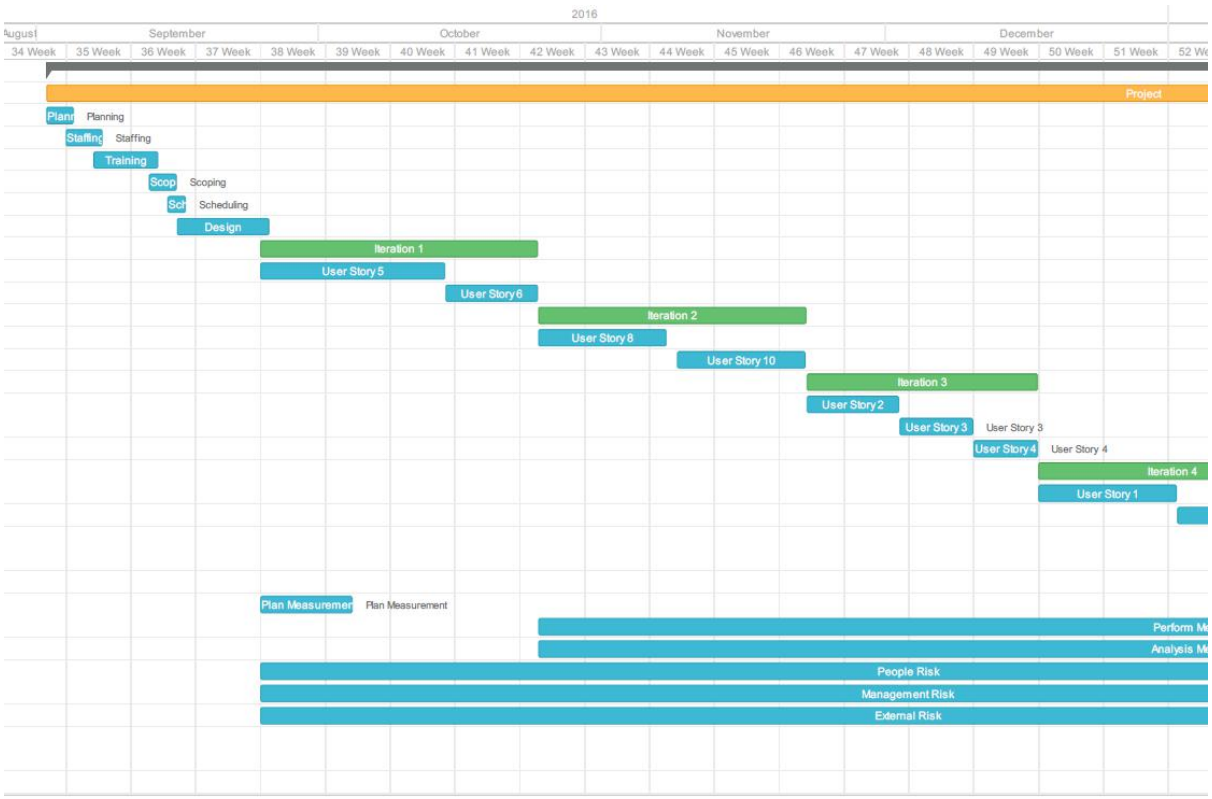


Figure 6.1.3 Gantt Chart Graph

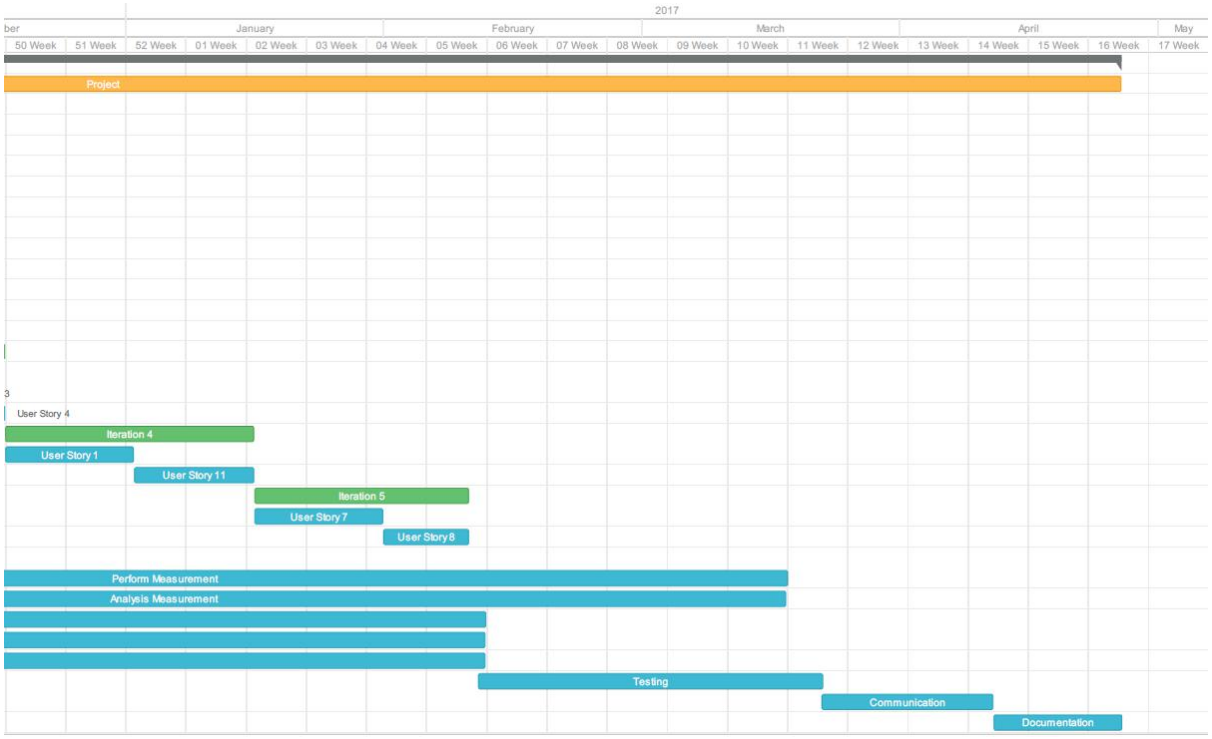


Figure 6.1.4 Gantt Chart Graph

6.2 Schedule Allocation

The essential technique for using CPM is to construct a model of the project that includes the following:

1. A list of all activities required to complete the project,
2. The time (duration) that each activity will take to complete,
3. The dependencies between the activities and,
4. Logical end points such as milestones or deliverable items.

The focus of **CPM** is calculating float to determine which activities have the least scheduling flexibility. It produces expected schedule of tasks with projected start times, durations, and end times is produced

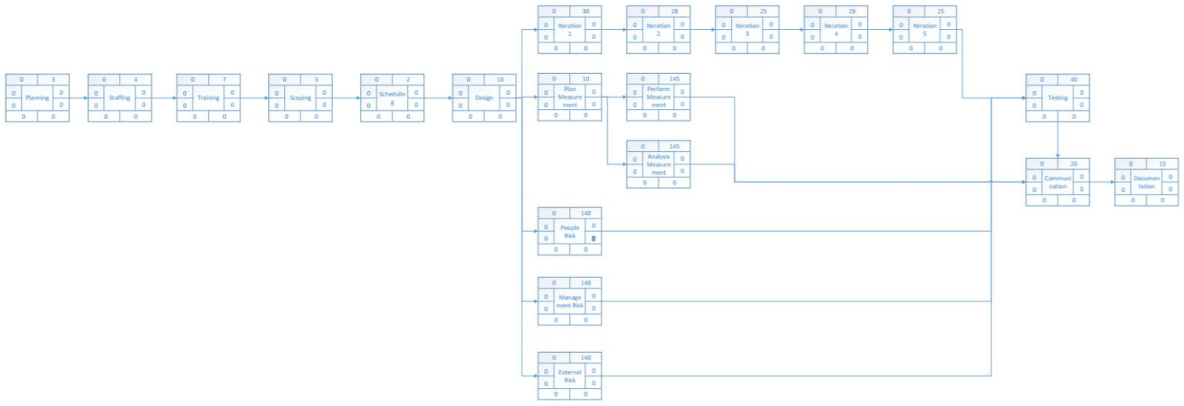


Figure 6.2.1 Critical Path Method

6.3 Work Organization

The organization graph illustrates the departments of this project. Under the guide of this organization, work is assigned to different teams and specific people.
The organization graph is as follows:

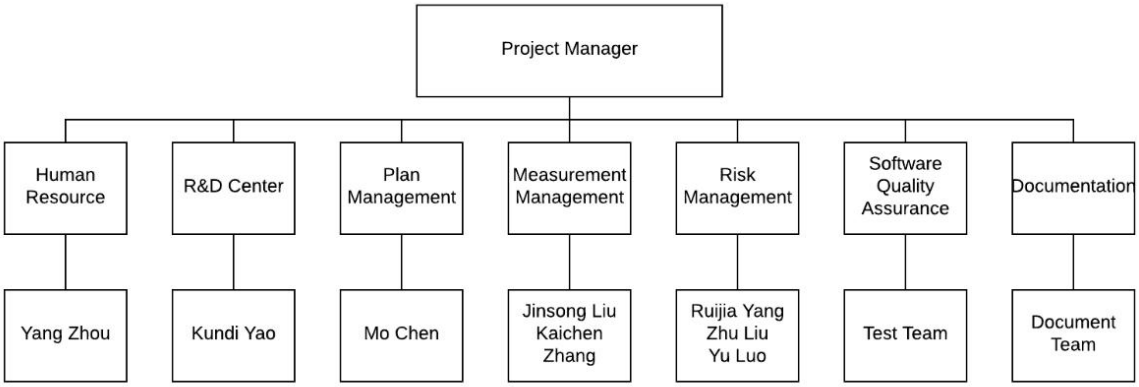


Figure 6.3.1 Work Organization

6.4 Resource Allocation

To an effective planning, every scheduled task must be assigned to specific team members.

The resource allocation chart assigns every scheduled task to specific team members and specifies skill levels of people. The chart is as follows:

（I=beginner II=intermediate-lower III=intermediate-upper IV=advanced-lower V=advanced=upper）

Task Name	Resource Names	Skill levels	Number of Staff
Planning	Project Manager	**IV**	**10**
Staffing	Project Manager	**III**	**4**
Training	Project Manager	**V**	**10**
Scoping	Project Manager	**IV**	**15**
Scheduling	Stakeholders	**III**	**10**
Design	Development Manager	**V**	**8**
Iteration 1	Develop Team	**IV**	**20**
User Story 5	Develop Team	**III**	**9**
User Story 6	Develop Team	**II**	**11**
Iteration 2	Develop Team	**IV**	**16**
User Story 8	Develop Team	**IV**	**7**
User Story 10	Develop Team	**III**	**9**
Iteration 3	Develop Team	**IV**	**22**
User Story 2	Develop Team	**IV**	**8**
User Story 3	Develop Team	**IV**	**9**
User Story 4	Develop Team	**III**	**5**
Iteration 4	Develop Team	**V**	**20**
User Story 1	Develop Team	**IV**	**10**

User Story 11	Develop Team	**IV**	**10**
Iteration 5	Develop Team	**V**	**13**
User Story 7	Develop Team	**V**	**8**
User Story 9	Develop Team	**III**	**5**
Plan Measurement	Measurement Manager	**V**	**4**
Perform Measurement	Measurement Manager	**IV**	**8**
Analysis Measurement	Measurement Manager	**III**	**8**
People Risk	Risk Manager	**V**	**3**
Management Risk	Risk Manager	**V**	**12**
External Risk	Risk Manager	**IV**	**5**
Testing	Tester	**V**	**10**
Communication	Project Manager	**III**	**4**
Documentation	Project team	**V**	**12**

Table 6.4.1 Resource Allocation Chart