Chapter 5

Estimation Techniques Case Study Analysis

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Chapter 5

Estimation Techniques Case Study Analysis

Introduction

This chapter has been developed keeping in mind the difficulties faced by me while developing and estimating live software projects. It was good experience to interact with industry personnels to get detail requirements of projects . New software developers may face similar problems in estimating the software projects.So, I have attempted to provide a good solution in the form of below live case studies based on estimation to the new software developers. There are two different case studies for evaluating size and effort of two different projects :

Project 1 : A draft version of Requirement document for Developing Catering Services Application (Windows based application)

Project 2: Clinic Management System (Web based Application)

5.1 Case Study 1: Catering Services Application

5.1.1 Introduction:

The food service industries provide catering services for various occasions such as School functions, Colleges functions, Hospital functions, Marriage Party and many other formats, including 'on-premises' and 'off-premises' catering services. Catering is a multifaceted segment of the food service industry. Also they may provide food service at a remote site or a site such as hotels, and hence there is a need of software application for maintaining master and transaction records and making system automated.

5.1.2 Existing System:

(1) The organizations used to complete their official activities such as

making menus of customers, assigning tasks to the expert team, and managing customer details in Microsoft Word by typing the respective content.

(2) There may be numerous human mistakes in the manual system while typing. So there is need to review all the menus.

(3) There is a need of high capacity storage devices such as pen drive and hard disks because organization needs to keep copies of all the menus.

5.1.3 Proposed System:-

The proposed system will support all activities related to the Menu Creation including master tables maintenance and report generation.

5.1.4 Master Maintenance:

This module consists of information about the products and services. This includes two sub-modules, **Items master**, **Team master, Sub items master, Event master, and Party master**.

- **Items master** includes the information about the particular Items. Such as items code and items name.
- **Team master** includes the information about the particular team who are expertise in making food items. Information to be stored such as team id and team name.
- **Sub items master** includes the information about the particular sub items. Information to be stored such as Sub Item code, Sub Item Name, Items Category, and also Team or Experts who is expertise in making those sub items.
- **Event master** includes the information about the particular Event. Such as event id and event name.

- **Party master** includes the information about the particular Party. Such as party code, party name, address, contact number, notes and handle by management person who is handling/creating menus for that party.

5.1.5 Requirement - Food Menu Creation:

In this module, a food menu will be created based on the requirements of the customer for various events or sub events. This module provide menu items list to the customer and customer can easily view those list and decide the food items for various events. This module should include the information about the particular **Menu Items**. Such as Menu code, Event code, Party status, Party name, Menu Date, Event name, Items and Sub Items.

5.1.6 Reporting Modules and Data Backup:

In this module all reports will be generated as below:

1. New Menu
2. Expert wise items Report
3. Party wise menu report.
4. Suggested menu reports
5. Party handled by Report

The application must provide a Data Backup and restore facility

5.1.7 List of functions:

Table 5.1: List of Functional Modules of Catering Services Project

Sr No.	Main Function	Comments
1	Maintain Party/Customer Details	Add,Modify,Delete
2.	Maintain Main Item Category	Add,Modify,Delete
3	Maintain Sub items of different item category	Add,Modify,Delete
4	Maintain Team Details	Add,Modify,Delete
5	Maintain Event Details	Add,Modify,Delete

6	Managing Events for Party/Customer	Add,Modify,Delete
7	Menu Creation	Add,Modify,Delete
8	Menu Status Report	Report
9	Creating Duplicate copy of Existing Menu	Add
10	Date wise Menus Display	Report
11	Display Menu handling Status Date Wise	Report
12	Display Team Task (Individual)	Report
13	Display Team Task (Customer/Party wise)	Report
14	Database Backup	Backup in External Storage
15	Database Restore	Restore from External Storage
Source : Organization Requirements		

5.1.8 Design or Architectural Guidelines:

5.1.8.1 Operating Environment and Features:

Development Environment:

Platform: Visual Studio.NET 2010

Framework version: 3, 3.5 and 4 or above

Database: SQL Server 2008

Reports: SAP Crystal Reports 13

Operating system: Windows 8.1 Pro (32 bit)

Hardware: 6 GB RAM, Intel(R) Core i3 processor – 2.40 GHz

Client Environment:

.Net Framework: 3, 3.5 and 4 or above

Operating system: Windows 7 or above

Reports: SAP Crystal Reports 13

Hardware: Minimum 2 GB RAM Intel(R) Core i3 processor

Database: SQL Server 2008

User friendliness:

Input and output screens should be easy to understand. Assistants should be

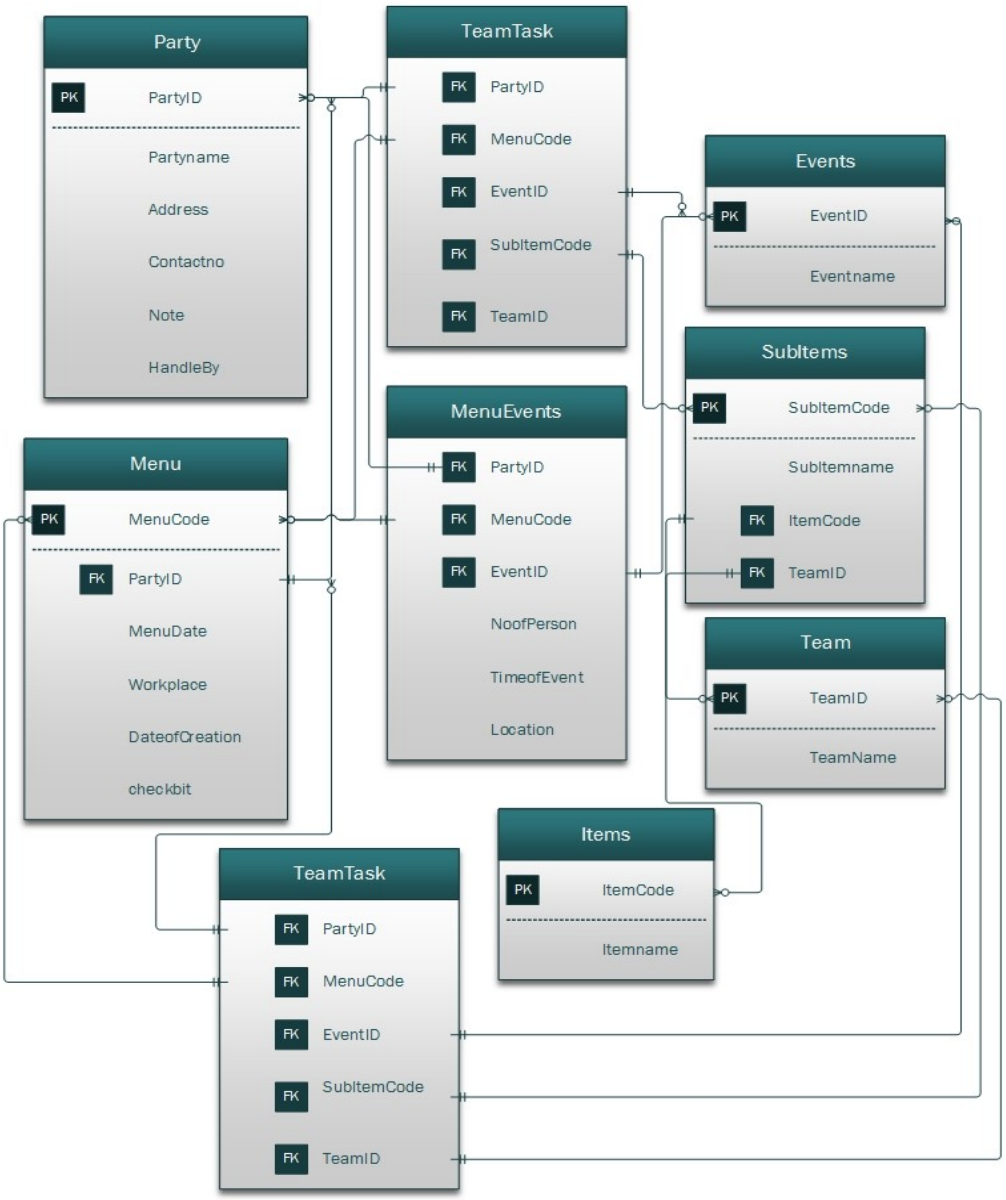
able to use the system within 2 to 3 hours of training. It must have Help document for short cut keys.

Security:

System must have Authentications for the users for login into the system. Also, system must ask key password for Backup/Restore Application.

5.1.8.2 Schema Diagram

Figure 5.1 : Schema Diagram for Catering Management System



5.1.8.3 Database Design

Table 5.2 : Database Table for Storing Client Records

Table Name	Party
Table Description	This table will store records of party who are customers for the organization.

Column Name	**Data Type**	**Is NULL?**	**Is PK?**	**Is FK?**	**Description**
PartyID	NUMERIC(18,0)	NO	YES	YES	Identity field of Party.
Partyname	NVARCHAR(200)	NO	NO	NO	The name of party
Address	NVARCHAR(300)	YES	NO	NO	Customer location field
Contactno	NUMERIC(10,0)	NO	NO	NO	The party contact field
Note	NVARCHAR(200)	YES	NO	NO	Customers suggested field
HandleBy	NVARCHAR(50)	NO	NO	NO	The person or manager who can handle by those party.

Table 5.3 : Database Table for Storing Food Items Master Record

Table Name	Item
Table Description	This table will store records of various items

Column Name	**Data Type**	**Is NULL?**	**Is PK?**	**Is FK?**	**Description**
ItemCode	NUMERIC(18,0)	NO	YES	YES	Identity field of item.
Itemname	NVARCHAR(100)	NO	NO	NO	The name of item.

Table 5.4 : Database Table for Storing records of Subitem for specific category of Items

Table Name	Subitem
Table Description	This table will store records of Subitem for specific category of Items

Column Name	**Data Type**	**Is NULL?**	**Is PK?**	**Is FK?**	**Description**
SubItemCode	NUMERIC(18,0)	NO	YES	YES	Identity field of Sub item.
SubItemname	NVARCHAR(200)	NO	NO	NO	The name of Sub item
ItemCode	NUMERIC(18,0)	NO	NO	YES	Reference to Item table
TeamID	NUMERIC(18,0)	NO	NO	YES	Reference to Team

Table 5.5 : Database Table for Storing records Master Records of Team

Table Name	Team
Table Description	This table will store records of Team who are specialized in making various types of items

Column Name	**Data Type**	**Is NULL?**	**Is PK?**	**Is FK?**	**Description**
TeamID	NUMERIC(18,0)	NO	YES	YES	Identity field of Team
Teamname	NVARCHAR(50)	NO	NO	NO	The name of Team

Table 5.6 : Database Table for Storing records Master Records of Events

Table Name	Events
Table Description	This table will store records of Events for specific function or marriage party or any type of occasion.

Column Name	**Data Type**	**Is NULL?**	**Is PK?**	**Is FK?**	**Description**
EventID	NUMERIC(18,0)	NO	YES	YES	Identity field of Event.
Eventname	NVARCHAR(200)	NO	NO	NO	The name of event

Table 5.7

Database Table for Storing records Event Details for Specific Menu

Table Name	MenuEvents
Table Description	This table will store records of MenuEvents which contains the date of event and users add, update and delete number of event on it.

Column Name	**Data Type**	**Is NULL?**	**Is PK?**	**Is FK?**	**Description**
PartyID	NUMERIC(18,0)	NO	NO	YES	Identity field of Party
MenuCode	BIGINT	NO	NO	YES	Reference to Menu
EventID	NUMERIC(18,0)	NO	NO	YES	Reference to Event
NoofPerson	NVARCHAR(50)	NO	NO	NO	Number of persons of that specific event field.
TimeofEvent	TIME(7)	YES	NO	NO	This field will show the time of event.
Location	NVARCHAR(50)	YES	NO	NO	This field will show the location of event.

Table 5.8 : Database Table for Storing Team Assignment/Task details

Table Name	Team Task
Table Description	This table will store records of team task which contains the information about the task assign to Specific Team.

Column Name	Data Type	Is NULL?	Is PK?	Is FK?	Description
PartyID	NUMERIC(18,0)	NO	NO	YES	Reference to Party
MenuCode	BIGINT	NO	NO	YES	Reference to Menu
EventID	NUMERIC(18,0)	NO	NO	YES	Reference to Event
SubItemCode	NUMERIC(18,0)	NO	NO	YES	Reference to Subitem
TeamID	NUMERIC(18,0)	NO	NO	YES	Reference to Team

Table 5.9 : Database Table for Storing Food Menu Details

Table Name	Menu
Table Description	This table will store records of Menu it contains the basic information about the menu such as: Menu date, Work place, creating date, etc.

Column Name	Data Type	Is NULL?	Is PK?	Is FK?	Description
MenuCode	BIGINT	NO	YES	YES	Identity field of Menu
PartyID	NUMERIC(18,0)	NO	NO	YES	Ref. to Party
Workplace	NVARCHAR(200)	YES	NO	NO	information about event work place
Date Of Creation	DATETIME	NO	NO	NO	Date of menu creation.
checkbit	NVARCHAR(50)	YES	NO	NO	Check bit field.

Table 5.10 : Database Table for Storing Food Menu with Suggestive Items

Table Name	EventMenuFinal
Table Description	This table will store records of menu which contains the information about item and sub item and it will be suggested by a Clients/Party.

Column Name	**Data Type**	**Is NULL?**	**Is PK?**	**Is FK?**	**Descriptio n**
PartyID	NUMERIC(18,0)	NO	NO	YES	Ref. to Party
MenuCode	BIGINT	NO	NO	YES	Ref. to Menu.
EventID	NUMERIC(18,0)	NO	NO	YES	Ref. to Event
ItemCode	NUMERIC(18,0)	NO	NO	YES	Ref. to Item
SubItemsforevent	NVARCHAR(1000)	NO	NO	NO	Sub item list separated by comma
Dateofadding	DATETIME	NO	NO	NO	Menu items adding date
Priority	NUMERIC(18,0)	NO	NO	NO	To set the priority of specific menu event.

5.1.9 Case Study 1: Size Estimation

This section contains the calculation of the size of Catering Services Software detailed in the Appendix-A using Function Point Analysis (FPA) Method.

FP Count=UFP × TCF

= 228 × 0.87

=198

Following steps can be followed to obtain values of UFP and TCF.

1. Calculate Unadjusted Function Point (UFP)

Table 5.11 : Case Study 1 -- Setting Factors for UFP

Type of components	Complexity of Component			
	Low	*Average*	*High*	*Total*
External Inputs (EI)	6×3=18	1×4=4	15×6=90	112
External Outputs (EO)	1×4=4	1×5=5	3×7=21	30
External Inquiries(EQ)	1×3=3	2× 4=8	2×6=12	23
Internal logical Files(ILF)	9×7=63	0×10=0	0×15=0	63
External Interface Files(EIF)	0×5=0	0×7=0	0×10=0	0
Total Number of Unadjusted Function Points				228

Source: Compiled by Researcher

1.1 External Inputs (EI):

Table 5.12 : Setting Complexity Factors for External Inputs

Sr. No.	EI name	Complexity	UFP
1	Party/Customer Details Add	HIGH	6
2	Party/Customer Details Modify	HIGH	6
3	Party/Customer Details Delete	LOW	3
4	Main Item Category Add	HIGH	6
6	Main Item Category Modify	HIGH	6
7	Main Item Category Delete	LOW	3
8	Sub items Add	HIGH	6
9	Sub items Modify	HIGH	6
10	Sub items Delete	LOW	3
11	Team Details Add	HIGH	6
12	Team Details Modify	HIGH	6
13	Team Details Delete	LOW	3
14	Event Details Add	HIGH	6

Sr. No.	EI name	Complexity	UFP
15	Event Details Modify	HIGH	6
16	Event Details Delete	LOW	3
17	Managing Events for Party/Customer	HIGH	6
18	Menu Creation Add	HIGH	6
19	Menu Creation Modify	HIGH	6
20	Menu Creation Delete	LOW	3
21	Creating Duplicate copy of Existing Menu	AVERAGE	4
23	Database Backup	HIGH	6
24	Database Restore	HIGH	6

Source: Compiled by Researcher

1.1.1 External Output(EO):

Table 5.13 : Setting Complexity Factors for External Output

Sr. No.	EO name	Complexity	UFP
1	Menu Status Report	AVERAGE	5
2	Date wise Menus Display	HIGH	7
3	Display Menu handling Status Date Wise	HIGH	7
4	Display Team Task (Individual)	LOW	4
5	Display Team Task (Customer/Party wise)	HIGH	7

Source: Compiled by Researcher

1.2 External Inquiries (EQ):

Table 5.14 : Setting Complexity Factors for External Inquiries

Sr. No	EQ name	Complexity	UFP
1	Search Party	AVERAGE	4
2	Search Team	AVERAGE	4
3	Search Items	HIGH	6
4	Search Subitems	HIGH	6
5	Search Events	LOW	3

Source: Compiled by Researcher

1.3 Internal Logical Files(ILF):

Table 5.15 : Setting Complexity Factors for Internal Logical Files

Sr. No	ILF name	Complexity	UFP
1	Party Master	LOW	7
2	Item Master	LOW	7
3	Sub Item master	LOW	7
4	Event Master	LOW	7
5	Menu Events	LOW	7
6	EventMenuFinal	LOW	7
7	Team Master	LOW	7
8	Team Task	LOW	7
9	Menu	LOW	7

Source: Compiled by Researcher

1.4 External Interface Files(EIF):

NO EIF in the System

2. Calculate Technical Complexity Factor (TCF) :

Table 5.16 : Case Study 1 - Setting Degree of Influence to Obtain TCF

Factors	Components	Degree of Influence (0-5)	Description
F1	Data communications	0	Single user System
F2	Distributed data processing	0	Application does not require data
F3	Performance	3	
F4	Heavily used configuration	0	
F5	Transaction rate	1	
F6	On-Line data entry	5	More than 50%
F7	End-user efficiency	3	
F8	On-Line update	0	
F9	Complex processing	2	Yes for priority setting

Factors	Components	Degree of Influence (0-5)	Description
F10	Reusability	2	
F11	Installation ease	3	
F12	Operational ease	3	
F13	Multiple sites	0	
F14	Facilitate change	0	
Total		**22**	
TCF=(0.65+0.01 × 22)		**0.87**	

Source: Compiled by Researcher

5.1.10 Case Study 1: Effort Estimation

This Section contains the Effort and Duration for Catering Services Software using COCOMO Model.

Equation of COCOMO:

$$\textbf{Effort} = A \times EAF \times (Size)^{B}$$

Assuming:

A=2.94, B= (0.91+0.01(Sum of Weight of Scale Factors))

Computing B:

Table 5.17 : Case Study 1 - Setting weights for Scale Drivers

Scale Driver	Scale Driver Description	Scale Factor
PREC	Largely Familiar	1.24
FLEX	Some Relaxation	3.04
RESL	Generally (75%)	2.83
TEAM	Basically Cooperative	3.29
PMAT	SEI CMM Level 2	4.68
Sum of Weights of Scale Factors		15.08
B=(0.91+0.01 (15.08))		**1.0608**

Source: Compiled by Researcher

Size= 198 FP (from Appendix B)

[Assuming: Multiplier i.e. Lines per function point to be 27 for VB Programming Language from SystemStar tool]

Size = 198 × 27 = 5346 SLOC (~ 5.3 KSLOC)

Computing EAF:

EAF is obtained by multiplying all the cost driver ratings. Values are taken as the standard values for Cost Drivers as shown in following:

Table 5.18: Case Study 1 - Setting Cost Drivers to Obtain EAF

Cost Drivers		EH	VH	H	N	L	VL	Project Cost Drivers	
ACAP	Analyst Capability	NA	0.71	0.85	1	1.19	1.42	**H**	**0.85**
APEX	Application Experience	NA	0.81	0.88	1	1.1	1.22	**L**	**1.1**
PCAP	Programmer Capability	NA	0.76	0.88	1	1.15	1.34	**VH**	**0.76**
PLEX	Platform Experience	NA	0.85	0.91	1	1.09	1.19	**VH**	**0.85**
LTEX	Language and tool experience	NA	0.84	0.91	1	1.09	1.2	**H**	**0.91**
PCON	Personal Continuity	NA	0.81	0.9	1	1.12	1.29	**N**	**1**
TOOL	Use of software tools	NA	0.78	0.9	1	1.09	1.17	**VH**	**0.78**
SITE	Multisite Development	0.8	0.86	0.93	1	1.09	1.22	**VL**	**1.22**
SCED	Development Schedule	NA	1	1	1	1.14	1.43	**N**	**1**
TIME	Execution Time Constraints	1.63	1.29	1.11	1	NA	NA	**N**	**1**
STOR	Main Storage Constraint	1.46	1.17	1.05	1	NA	NA	**H**	**1.05**
PVOL	Platform Volatility	NA	1.3	1.15	1	0.87	NA	**N**	**1**
RELY	Required Reliability	NA	1.26	1.1	1	0.92	0.82	**N**	**1**
DATA	Database Size	NA	1.28	1.14	1	0.9	NA	**N**	**1**
CPLX	Product Complexity	1.74	1.34	1.17	1	0.87	0.73	**H**	**1.17**
RUSE	Required Reusability	1.24	1.15	1.07	1	0.95	NA	**L**	**0.95**
DOCU	Documentation match to life cycle needs	NA	1.23	1.11	1	0.91	0.81	**VL**	**0.81**

Source: Compiled by Researcher

Effort Adjustment Factor found out to be:

EAF= 0.85 × 1.1 × 0.76 × 0.85 × 0.91 × 1 × 0.78 × 1.22 × 1 × 1 × 1.05 × 1 × 1 × 1 × 1.17 × 0.95 × 0.81

EAF= **0.4944**

Therefore,

$$\text{Effort}_{(\text{nominal})} = 2.94 \times (5.3)^{1.0608}$$
$$= 17 \text{ Person-Months}$$

$$\text{Effort}_{(\text{Maintenance})} = 2.94 \times 0.4944 \times (5.3)^{1.0608}$$
$$= 8.4 \text{ Person-Months}$$

SE=0.28 + 0.2 (B-0.91) = 0.3101

$$\text{Duration} = 3.67 \times [\text{Effort}_{(\text{Maintenance})}]^{SE}$$
$$= 3.67 \times (8.4)^{0.3101}$$
$$= 7 \text{ Months}$$

$$\text{Actual Staff} = (\text{Effort/Duration})$$
$$= 8.4/7$$
$$= 1 \text{ Person}$$

5.2 Case Study 2: Clinic Management System

5.2.1 Introduction

The Clinic Management System is expected to be a web based application to convert the existing manual process to automated or online process. The application must include following functionalities:

1) There are multiple clinic locations and each clinic must have unique list of staff and therapists. Also, multiple clinics cannot share the same patient record.

2) When patient will enter into clinic, he/she must fill the manual form given to them. Then patient can schedule the appointment based on therapist's specialization and availability. Here status will be ACTIVE.

3) After entering patient details into system, status of patient must be maintained. Status could be ACTIVE, INACTIVE, WAITING etc.

4) There must be common Billing section for all the clinics. Billing team can review all the clinics and all the patients. Billing team can also verify the patient's insurance details. After successful verification of insurance details, billing team notifies the clinic for processing the benefits to the patient.

5) Therapist can add the notes and fill the evaluation form after the treatment. Also, he will provide the next visit details into the system.

6) If patient will not report till 75 days, his/her status must be changes to INACTIVE.

7) The system should be multi-user system and must have user authentications which are to be maintained under the user management module.

5.2.2 Case Study 2: Size Estimation

This section contains the calculation of the size of Catering Services Software detailed in the Appendix-A using Function Point Analysis (FPA) Method.

$$\text{FP Count} = \text{UFP} \times \text{TCF}$$

$$= 1932 \times 0.96$$

$$= 1855$$

Following steps can be followed to obtain values of UFP and TCF.

1. **Calculate Unadjusted Function Point (UFP)**

Table 5.19 : Case Study 2 - Setting Factors for UFP

Type of components	Complexity of Component			
	Low	*Average*	*High*	*Total*
External Inputs (EI)	8×3=24	17×4=68	37×6=222	314
External Outputs (EO)	0×4=0	1×5=5	5×7=35	40
External Inquiries(EQ)	4×3=12	3× 4=12	4×6=24	48
Internal logical Files(ILF)	40×7=280	80×10=800	30×15=450	1530
External Interface Files(EIF)	0×5=0	0×7=0	0×10=0	0
Total Number of Unadjusted Function Points				1932

Source: Compiled by Researcher

2. **Calculate Technical Complexity Factor (TCF) :**

Table 5.20 : Case Study 2 - Setting Degree of Influence to Obtain TCF

Factors	**Components**	**Degree of influence (0-5)**	**Description**
F1	Data communications	2	Multi user System
F2	Distributed data processing	1	
F3	Performance	3	
F4	Heavily used configuration	0	
F5	Transaction rate	3	
F6	On-Line data entry	5	More than 50%
F7	End-user efficiency	3	
F8	On-Line update	2	
F9	Complex processing	3	Yes
F10	Reusability	1	
F11	Installation ease	2	
F12	Operational ease	1	
F13	Multiple sites	1	
F14	Facilitate change	4	
Total		**31**	
TCF=(0.65+0.01 × 31)		**0.96**	

Source: Compiled by Researcher

5.2.3 Case Study 2: Effort Estimation

This Section contains the Effort and Duration for Catering Services Software using COCOMO Model.

Equation of COCOMO:

$$\text{Effort} = A \times EAF \times (\text{Size})^{B}$$

Assuming:

A=2.94, B= (0.91+0.01(Sum of Weight of Scale Factors))

Computing B:

Table 5.21 : Case Study 2 - Setting weights for Scale Drivers

Scale Driver	Scale Driver Description	Scale Factor
PREC	Largely Familiar	1.24
FLEX	Some Relaxation	3.04
RESL	Generally (75%)	2.83
TEAM	Basically Cooperative	3.29
PMAT	SEI CMM Level 2	4.68
Sum of Weights of Scale Factors		15.08
B=(0.91+0.01 (15.08))		**1.0608**

Source: Compiled by Researcher

Size= 2145 FP

[Assuming: Multiplier i.e. Lines per function point to be 27 for VB Programming Language from SystemStar tool]

Size = 1855 × 27 = 50077 SLOC (~ 50 KSLOC)

Computing EAF:

EAF is obtained by multiplying all the cost driver ratings. Values are taken as the standard values for Cost Drivers as shown in following:

Table 5.22: Case Study 2 - Setting Cost Drivers to Obtain EAF

Cost Drivers		EH	VH	H	N	L	VL	Project Cost Drivers	
ACAP	Analyst Capability	NA	0.71	0.85	1	1.19	1.42	H	0.85
APEX	Application Experience	NA	0.81	0.88	1	1.1	1.22	L	1.1
PCAP	Programmer Capability	NA	0.76	0.88	1	1.15	1.34	VH	0.76
PLEX	Platform Experience	NA	0.85	0.91	1	1.09	1.19	VH	0.85
LTEX	Language and tool experience	NA	0.84	0.91	1	1.09	1.2	H	0.91
PCON	Personal Continuity	NA	0.81	0.9	1	1.12	1.29	N	1
TOOL	Use of software tools	NA	0.78	0.9	1	1.09	1.17	VH	0.78
SITE	Multisite Development	0.8	0.86	0.93	1	1.09	1.22	N	1
SCED	Development Schedule	NA	1	1	1	1.14	1.43	N	1
TIME	Execution Time Constraints	1.63	1.29	1.11	1	NA	NA	N	1
STOR	Main Storage Constraint	1.46	1.17	1.05	1	NA	NA	H	1.05
PVOL	Platform Volatility	NA	1.3	1.15	1	0.87	NA	N	1
RELY	Required Reliability	NA	1.26	1.1	1	0.92	0.82	N	1
DATA	Database Size	NA	1.28	1.14	1	0.9	NA	H	1.14
CPLX	Product Complexity	1.74	1.34	1.17	1	0.87	0.73	H	1.17
RUSE	Required Reusability	1.24	1.15	1.07	1	0.95	NA	L	0.95
DOCU	Documentation match to life cycle needs	NA	1.23	1.11	1	0.91	0.81	VL	0.81

Source: Compiled by Researcher

Effort Adjustment Factor found out to be:

EAF= 0.85 × 1.1 × 0.76 × 0.85 × 0.91 × 1 × 0.78 × 1 × 1 × 1 × 1.05 × 1 × 1 × 1.14 × 1.17 × 0.95 × 0.81

EAF= **0.4620**

Therefore,

$$\text{Effort}_{(\text{nominal})} = 2.94 \times (50)^{1.0608}$$
$$= 186 \text{ Person-Months}$$

$$\text{Effort}_{(\text{Maintenance})} = 2.94 \times 0.4620 \times (50)^{1.0608}$$
$$= 86 \text{ Person-Months}$$

SE=0.28 + 0.2 (B-0.91) = 0.3101

$$\text{Duration} = 3.67 \times [\text{Effort}_{(\text{Maintenance})}]^{SE}$$
$$= 3.67 \times (86)^{0.3101}$$
$$= 14.60 \text{ Months}$$

$$\text{Actual Staff} = (\text{Effort/Duration})$$
$$= 86/14.60$$
$$= 6 \text{ Person}$$

5.3 Results:

As per the data analysis and interpretation, I have calculated the size of project using function point analysis as most of the IT companies are following the same technique to calculate size of any project. FPA gives accurate result for small projects and as complexity increases it gives you less accurate results. But as per research study, FPA is good for complex projects as well for small IT companies with small or complex projects.

As far as Efforts is concerned, after research survey, it was found that most of the IT companies are using COCOMO for finding out the effort

required for the project. As the procedure is too lengthy for evaluating effort using COCOMO, I conclude that Modularized based mechanism is good for small projects. For small projects, we need to consider various factors or cost drivers and equations to get the result in COCOMO. So, Modularized based methods are good and give accurate results for small projects. But for complex projects COCOMO is preferable.

For Case Study 1: Effort Evaluation using Modularized Estimation Method

1) Application Size= 198 FP
2) Productivity for the IT organization (Average Assumed) = 15 Function Point/Person Month
3) Other Productivity factors :

   Due to Technology: 0.80 (for Microsoft .NET)

   Due to Project Execution Type: 0.90 (New Development)

   Due to Project Size: 0.70 (< 350 FP)
4) Total Project Effort = (198/15) × 0.80 × 0.90 × 0.70 = ~ 7 Person Months

For Case Study 2: Effort Evaluation using Modularized Estimation Method

5) Application Size= 1855 FP
6) Productivity for the IT organization (Average Assumed) = 15 Function Point/Person Month
7) Other Productivity factors :

   Due to Technology: 0.80 (for Microsoft .NET)

   Due to Project Execution Type: 0.90 (New Development)

   Due to Project Size: 1.50 (> 1500 FP)

8) Total Project Effort = (1855 /15) × 0.80 × 0.90 × 1.50= ~ 134 Person Months

Following is the summary of all size and effort calculations:

Table 5.23: Summary of Calculations

	Case Study 1 (Small Project)	**Case Study 2 (Complex Project)**
Estimated Size using FPA	198	1855
Estimated Effort using COCOMO (in Person Month)	8.4	86
Estimated Effort using Modularized Method (in Person Month)	7	134
Duration (in Months)	7	14.6
Total Staff	1	6

Source: Compiled by Researcher

Figure 5.2 : Comparison of Modularized and COCOMO Effort Values

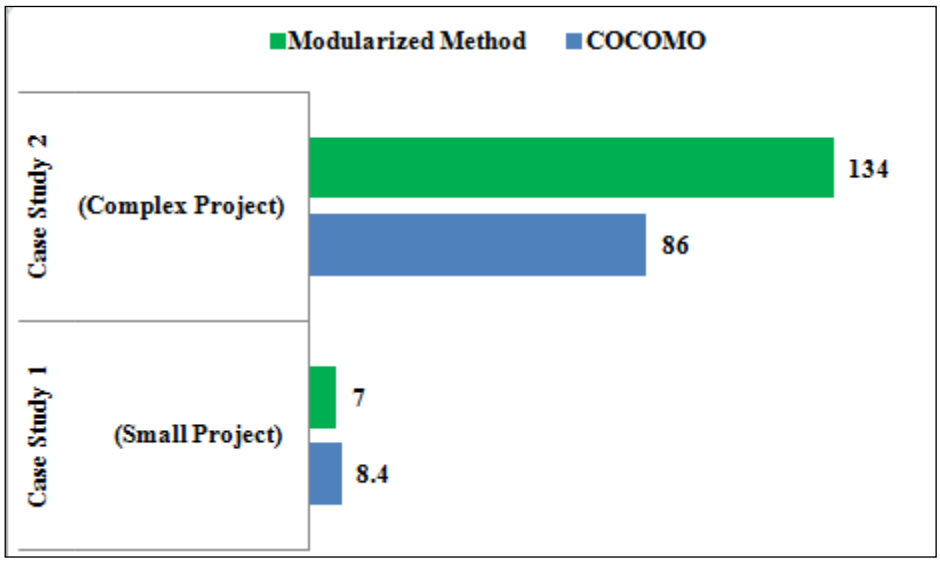


Figure 5.2 shows the estimated effort of 7 person months and 134 person months for small project. It seems a realistic approach to say that the estimation of a project is 7 person months using Modularized Method and due to set up of various parameters and equations (essentially not required for small projects) in COCOMO, its value rise up to 8.4 person month and which is found to be inaccurate.

However, for complex projects, there is a huge gap between the values. We require essential parameters values for large complex applications to get accurate estimated values. So, effort value obtained from COCOMO is considered more accurate than modularized method i.e. 86 person months.

5.4 Conclusions

For small projects Modularized method is good for effort evaluation but for complex projects COCOMO is considered to be more accurate. FPA is considered to be good for both types of projects.