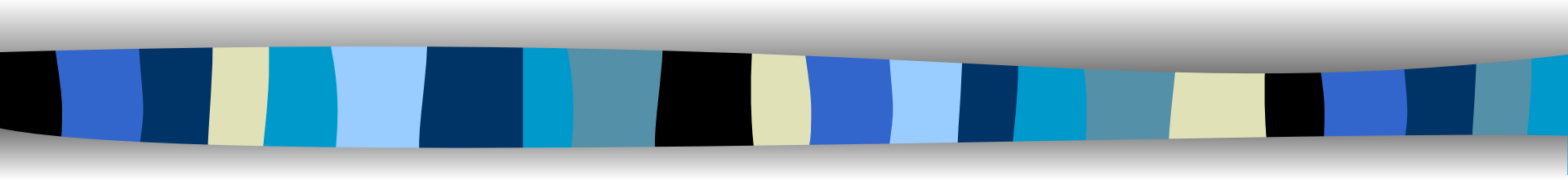
Chapter 23



Estimation

Software Engineering: A Practitioner's Approach
6th Edition
Roger S. Pressman

Software Project Estimation (1)

- S/W is the most expensive element of virtually all computer based systems
- S/W cost and effort estimation will never be an exact science
  - Too many variables
    - Human
    - Technical
    - Environmental
    - Political

Software Project Estimation (2)

- Options for estimation
  1. Delay estimation until late in the project
     - Attractive, but not practical
  2. Base estimates on similar projects that have already been completed
     - Unfortunately, past experience has not always been a good indicator of future results
  3. Use relatively simple decomposition techniques to generate project cost and effort estimates
     - "Divide and conquer" approach
  4. Use one or more empirical models for software cost and effort estimation
     - Can used as a complement of 3
- 3 & 4 are viable options and Can be used as a cross-check for one another

Decomposition Techniques

- Two different points of view for the decomposition approach
  - Decomposition of the problem
  - Decomposition of the process
- But first, the project planner must
  - Understand the scope of the s/w to be built
  - Generate an estimate of its “size”
  - quantifiable measure of s/w project
  - e.g. Line of Code (LOC)

Problem-Based Estimation (1)

- Example of baseline productivity metrics are LOC/pm or FP/pm
  - pm=person-month of effort
- Making the use of single baseline productivity metric is discouraged
  - Any estimation technique must always be cross-checked with another approach.
- In general, LOC/pm or FP/pm averages should be computed by project domain

An Example of LOC-Based Estimation (1)

Function	Estimated LOC
User interface and control facilities (UICF)	2,300
Two-dimensional geometric analysis (2DGA)	5,300
Three-dimensional geometric analysis (3DGA)	6,800
Database management (DBM)	3,350
Computer graphics display facilities (CGDF)	4,950
Peripheral control function (PCF)	2,100
Design analysis modules (DAM)	8,400
Estimated lines of code	*33,200*

An Example of LOC-Based Estimation (2)

- Estimated lines of code = W = 33,200
- Let,
  - Average productivity = 620 LOC/pm = X
  - Labor rate = $8,000 per month = Y
- So,
  - Cost per line of code = Z = Y/X = $13 (approx.)
  - Total estimated project cost = W*Z = $431,000 (approx.)
  - Estimated effort = W/X = 54 person-months (approx)

Function Point Analysis

How is Function Point Analysis done?

Working from the project design specifications, the following system functions are measured (counted):

- Inputs
- Outputs
- Files
- Inquires
- Interfaces

Function Point Analysis

These function-point counts are then weighed (multiplied) by their degree of complexity:

	Simple	Average	Complex
Inputs	2	4	6
Outputs	3	5	7
Files	5	10	15
Inquires	2	4	6
Interfaces	4	7	10

Function Point Analysis

A simple example:

inputs

3 simple X 2 = 6
4 average X 4 = 16
1 complex X 6 = 6

outputs

6 average X 5 = 30
2 complex X 7 = 14

files

5 complex X 15 = 75

inquiries

8 average X 4 = 32

interfaces

3 average X 7 = 21
4 complex X 10 = 40

Unadjusted function points 240

Function Point Analysis

Factor		Value
1.	Backup and recovery	4
2.	Data communications	2
3.	Distributed processing	0
4.	Performance critical	4
5.	Existing operating environment	3
6.	On-line data entry	4
7.	Input transaction over multiple screens	5
8.	ILFs updated online	3
9.	Information domain values complex	5
10.	Internal processing complex	5
11.	Code designed for reuse	4
12.	Conversion/installation in design	3
13.	Multiple installations	5
14.	Application designed for change	5

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Function Point Analysis

Continuing our example . . .

Complex internal processing	= 3
Code to be reusable	= 2
High performance	= 4
Multiple sites	= 3
Distributed processing	= 5
Project adjustment factor	= 17

Adjustment calculation:

Adjusted FP = Unadjusted FP X [0.65 + (adjustment factor X 0.01)]

= 240 X [0.65 + (17 X 0.01)]

= 240 X [0.82]

= 197 Adjusted function points

Function Point Analysis

But how long will the project take and how much will it cost?

- Assume, programmers in the organization average 18 function points per month. Thus . . .

  197 FP divided by 18 = 11 man-months

- If the average programmer is paid $5,200 per month (including benefits), then the [labor] cost of the project will be . . .

  11 man-months X $5,200 = $57,200

An Example of FP-Based Estimation (1)

Information Domain Value	Count		Weighting factor				
			Simple	Average	Complex		
External Inputs (EIS)	3	X	3	4	6	=	9
External Outputs (EOs)	2	X	4	5	7	=	8
External Inquiries (EQs)	2	X	3	4	6	=	6
Internal Logical Files (ILFs)	1	X	7	10	15	=	7
External Interface Files (EIFs)	4	X	5	7	10	=	20
Count Total							50

Figure 15.4: Computing function points

An Example of FP-Based Estimation (2)

Information domain value	Opt.	Likely	Pess.	Est. count	Weight	FP count
Number of external inputs	20	24	30	24	4	97
Number of external outputs	12	15	22	16	5	78
Number of external inquiries	16	22	28	22	5	88
Number of internal logical files	4	4	5	4	10	42
Number of external interface files	2	2	3	2	7	15
Count total						*320*

An Example of FP-Based Estimation (3)

Factor	Value
1. Backup and recovery	4
2. Data communications	2
3. Distributed processing	0
4. Performance critical	4
5. Existing operating environment	3
6. On-line data entry	4
7. Input transaction over multiple screens	5
8. ILFs updated online	3
9. Information domain values complex	5
10. Internal processing complex	5
11. Code designed for reuse	4
12. Conversion/installation in design	3
13. Multiple installations	5
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Value Adjustment Factors

An Example of FP-Based Estimation (4)

- Now,
  - $FP_{estimated}$ = count-total × [0.65 + 0.01 × Σ (F_i)]
    - F_i (i = 1 to 14 are value adjustment factors)
- So,
  - $FP_{estimated}$ = W = 320 × [0.65 + 0.01 × 52] = 375 (approx.)
- Let,
  - Average Productivity = X = 6.5 FP/pm
  - Labor rate = Y = $8,000 per month
- So,
  - Cost per FP = Z = Y/X = $1,230 (approx.)
  - Total estimated project cost = W*Z = $461,000 (approx.)
  - Estimated effort = W/X = 58 person-months (approx)