Types of SW Maintenance: modification of SW product after delivery

- Corrective Maintenance: reactive modification to correct discovered problems.
- Adaptive Maintenance: to keep SW product usable in changed or changing environment.
- Perfective Maintenance: to improve performance or maintainability.
- Preventive Maintenance: to detect & correct latent faults in the SW before they become effective faults.

Chapter 3
Earned Value Analysis.

BCW, Budget Cost of Work. : 각 작업에 대해 예상된 노력.
BCWS, Budget Cost of Work Scheduled : 특정시점까지 완료 예정된 작업에 대한 예상 노력 총합.
BAC, Budget At Completion : 프로젝트 전체 예상 노력 총합. (BCWS 총합)
PV, planned value: 전체 예상 노력 중 특정 작업에 할당된 비율. BCW/BAC
BCWP, Budget Cost of Work Performed : 특정시점까지 실제 완료된 예상 노력 총합.
ACWP, Actual Cost of Work Performed : 완료된 작업의 실제 노력 총합.

EV, Earned Value : BCWP/BAC. 프로젝트 완료율. 완료된 작업의 PV 합계
SPI, Schedule Performance Index : BCWP/BCWS > 1 ⇒ 계획보다 앞섬.
SV, Schedule Variance : BCWP - BCWS > 0 ⇒ 예정보다 n일 앞섬.
CPI, Cost Performance Index : BCWP/ACWP > 1 ⇒ 예산보다 효율적 비용사용
CV, Cost Variance : BCWP - ACWP > 0 ⇒ 예산보다 적은 비용 사용.

Work Task	Estimated Effort (programmer-days)	Actual Effort So Far (programmer-days)	Estimated Completion Date	Actual Date Completed
1	5	10	1/25/01	2/1/01
2	25	20	2/15/01	2/15/01
3	120	80	5/15/01	
4	40	50	4/15/01	4/1/01
5	60	50	7/1/01	
6	80	70	9/01/01	

BAC = 5+25+120+40+60+80 = 330 days.

3/1/01 기준. ⇒ 실제 완료 : 1, 2, 4, 계획된 완료 작업 : 1, 2
BCWP = ① + ② + ④ = 5+25+40 = 70.
BCWS = ① + ② = 30
ACWP = ① + ② + ④ = 10+20+50 = 80

EV = BCWP/BAC = 70/330
SPI = BCWP/BCWS = 70/30 > 1
SV = BCWP - BCWS = 70 - 30 = 40 } 예정보다 40일 앞섬
CPI = BCWP/ACWP = 70/80 > 1
CV = BCWP - ACWP = 70 - 80 = -10 } 예상보다 10일치 비용 더 투입.

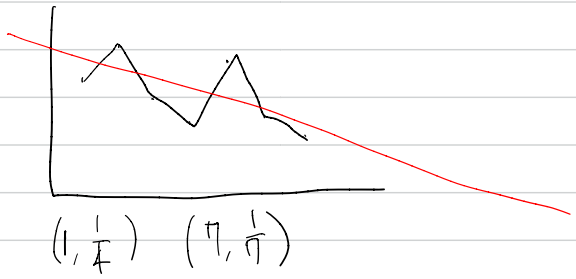
Chapter 3 Error Tracking

Error rate = 1 / 오류 발생 간 시간

fault 수정 ⇒ Error rate 감소 오류 발생 간 시간 증가

오류 횟수 (error number)

경과시간 (elapsed time of testing)



$(1, \frac{1}{t})$ $(n, \frac{1}{n})$

Chapter 4.

(작업시간 [완료시간]) * critical path.

Table 4-1 Subtasks

Subtask ID	Time to Complete Task	Dependencies
a	8	
b	10	
c	8	a,b
d	9	a
e	5	b
f	3	c,d
g	2	d
h	4	f,g
i	3	e,f

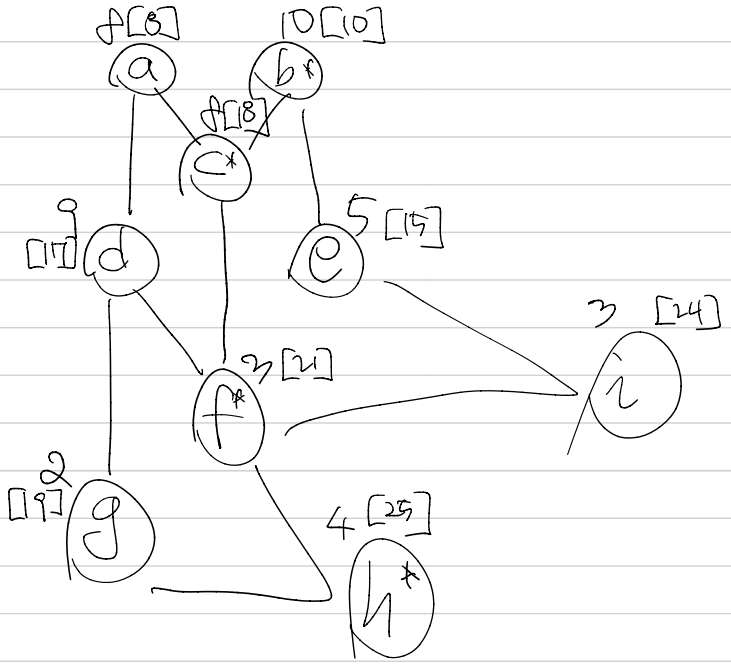


Table 4-2

Subtask ID	Start Time	Completion Time	Critical Path
a	0	8	
b	0	10	*
c	10	18	*
d	8	17	
e	10	15	
f	18	21	*
g	17	19	
h	21	25	*
i	21	24	

비주요 작업 가장 늦게 종료 : i 25일까지 종료가능.
⇒ 21~22일차에 시작 가능.

비주요 g : 최대 19 ~ 최대 21 에 종료.
⇒ 17~19일차 시작가능.

비주요 d : 최대 17 ~ 최대 18 에 종료.
⇒ 8~9일차 시작가능.

비주요 e : i 최대시작 22
⇒ e완료 시간 15~22
시작 시간 10~17

비주요 a : 8~9 에 종료.
⇒ 완료 8~9
시작 0~1

Chapter 4: Functional Point Analysis

EI. External Input. : items of app data supplied to program.
logical input ⇒ 1 item. no individual fields.

EO. External Output : displays of app data. (report, screen, error message)
no individual fields.

EQ, External Inquiries. : (req-res) pairs ⇒ not change internal data.
[name ⇒ address req ⇒ address res] = 1 inquiry

ILF, Internal Logical files : logical files must be maintained by system that customer understand.
1 file ? diff domain ⇒ counted as ? files in terms of counting functional points.

EIF, External Interface files : data that is shared with other programs.
1 file 2 diff system ⇒ considered as an interface in both system

Chapter 4. Counting Unadjusted Function Points (UFP)

Step 1: individual function point items identified & counted as EO IO EQ ILF EIF
Step 2: individual function point items are classified as simple, average, complex.
Step 3: Weighted point for each function point item is calculated by multiplying its counted point and its weight.
Step 4: UFP is calculated by summing the weighted points.

Chapter 5. McCabe's Cyclomatic Number

$C = e - n + 2p$ e: # edge / n: # node / p: # Strongly connected components = 1 (usual)
$= e - n + 2$

$C = r$ (r: # regions) region: 내부 영역 (edge로 완전히 둘러싸여 경계 구성) + 외부 영역 (graph 가장 바깥쪽 영역)
⇒ only for planer graph (edge 교차 X)

$C = \pi + 1$ (π: # decisions) ⇒ if / for / while

$C > 10$ = Threshold. ⇒ diff maintenance ⇒ reduce value or split module

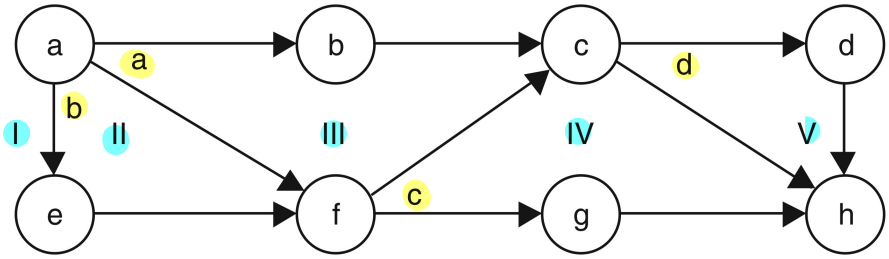


Fig. 5-3. Control flow graph with lowercase letters.

$n = 8$
$e = 11$

$C = 11 - 8 + 2 = 5$
$r = 5$ (I, II, III, IV, V)
$C = r$ (∵ planer graph)
$\pi = 4$

Chapter 7: Software Product Quality (ISO 9126-1)

Functionality	Efficiency
Reliability	Maintainability
Usability	Portability

PERFUM

Functionality: set of attributes that bear on the existence of set of functions & their specified properties.
SAIS — functions are those that satisfy stated or implied needs.
⇒ sustainability / accuracy / interoperatability / Security / Functionality Compliance.

Reliability: set of attributes that bear on the capability of SW to maintain its level of performance under stated conditions for stated period of time
RMF ⇒ maturity / fault tolerance / recoverability / reliability compliance

Usability: set of att. that bear on effort needed for use, and on the individual assessment of such use, by a stated or implied set of users.
U-LOA ⇒ understandability / learnability / operatability / attractiveness / Usability compliance

Efficiency: set of att that bear on the relationship between the level of performance of SW and amount of resources used, under stated conditions.
TR ⇒ time behavior / resource utilization / Efficiency compliance.

Maintainability: " effort needed to make specified modification.
TACS ⇒ analyzability / Changeability / Stability / Testability / Maintainability compliance

Portability: " ability of SW to be transferred from one env to another.
AIR-C ⇒ adaptability / installability / replaceability / coexistence / portability compliance.

P E R F U M

A T R S U T

I R M A L A

R I O C

F S A

C J

Chapter 7: SW Reliability Prob Theory.

F(1) : 다음 실행에서 실패할 확률. = 실패 횟수 / 총 테스트 수.
R(1) : 실패 확률의 보수(complement) = 1-F(1)

$R(10) = R(1)^{10}$ / $F(10) = F(1)^{10}$.