

# **Maintenance/Enhancement Phase of Software Development**

## **Mile Hi PMI Chapter**

March 13, 2002

by

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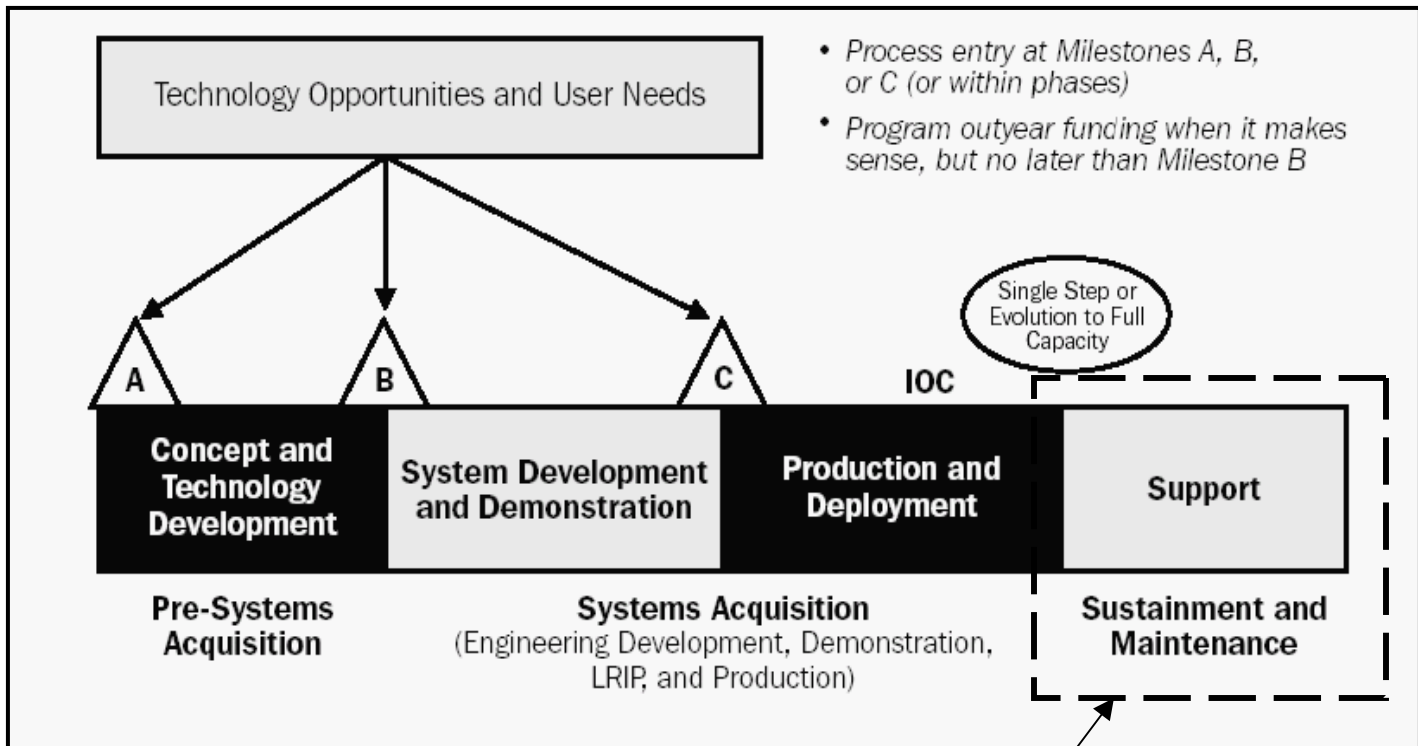
# Agenda

- Describe Maintenance/Enhancement Phase
- Describe how this fits with PMBOK disciplines
- Describe processes for Maintenance/Enhancement improvements, including Volume Based Methodology (VBM)
- Show Other Uses of VBM

## Special Thanks

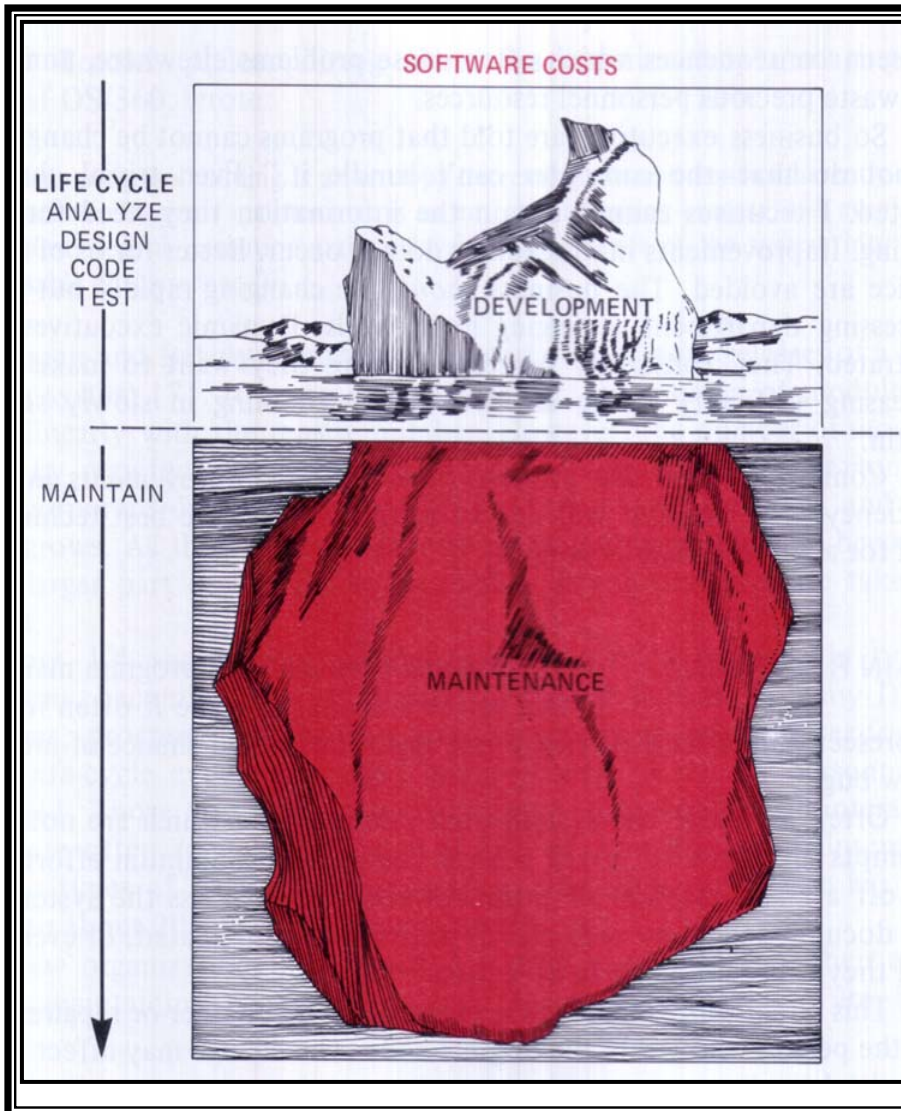
- Maintenance/Enhancement Initiation - A. Eiden
- Maintenance/Enhancement Improvements - C. Yee

# Life Cycle Description - PMBOK



• P. 14, PMBOK

# Life Cycle Description



## Programmer population (Projected 2000)

New Projects – 4M (40%)  
Enhancements – 4.5M (45%)  
Repairs – 1.5M (15%)

p. 319, *Applied Software  
Measurement*, C. Jones (1997)

Graphic from p. 7, *Software  
Maintenance*, J. Martin &  
C. McClure

# How Big is Maintenance/Enhancement?

## Maintenance/Enhancement Cost during Software Life-cycle

- 50% to 75% of overall costs – p. 533, *Software Engineering Economics*, B. Boehm.
- 67% - p. 24, *Software Maintenance*, Martin/McClure

# Maintenance/Enhancement – Why?

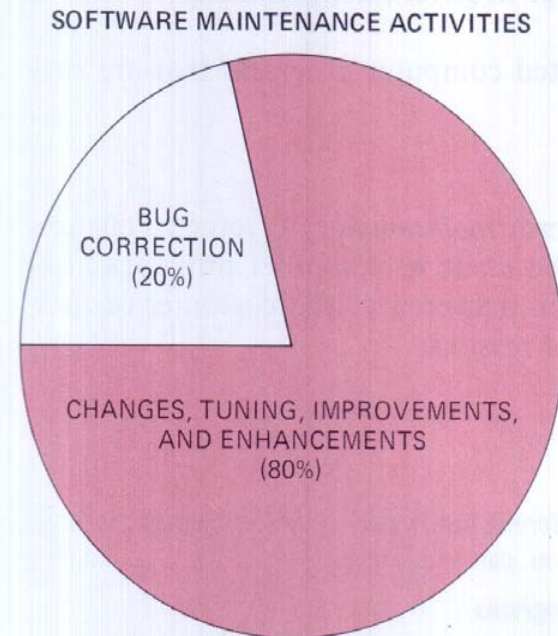
- U.S. averages, defect-removal efficiency prior to release of software ~ 85 percent, p. 604, *Estimating Software Costs*, C Jones

*This is regarding maintenance only.*

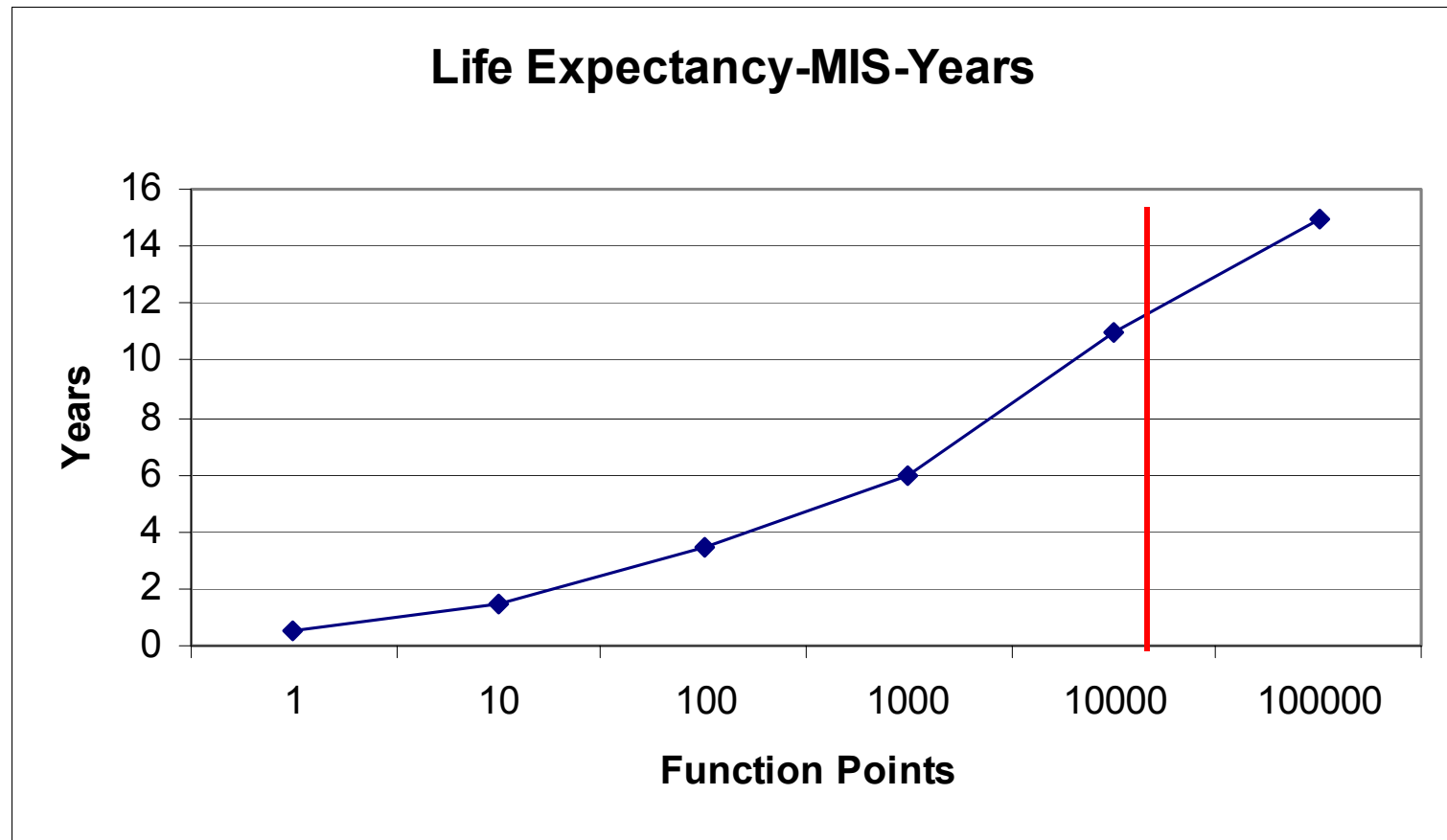
Enhancement effort may be  
much larger than bug correction

p. 4, *Software Maintenance*,

Martin/McClure



# Application Life Expectancy



p. 224, *Applied Software Measurement*, C. Jones

# 9 PM Knowledge Areas from PMBOK

• Cost Mgt

\$

• HR Mgt

• Procurement Mgt

• Scope Mgt

S

• Quality Mgt

Q

• Time Mgt

T

• Integration Mgt

• Risk Mgt

• Communication Mgt

C

\$

S

Q

T

C

# Problems Seen – Maintenance/Enhancement

## Before Structured Process

- Had no Release Methodology (ad hoc)
- Code not delivered on schedule
- Could not reliably advise customers which Problem Reports (PRs) or Change Requests (CRs) they would be receiving
- Customers did not understand why more PRs/CRs were not being completed
- Had significant quality problems during
  - Requirements
  - Testing
  - Production

Processes not in Place - 

\$	S	Q	T	C
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\$	S	Q	T	C
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# Start-up

Processes focused on have been

- Implement Release Methodology (group PRsCRs)
- Scope Management – work to do, requirements
- Time Management –
  - Capacity
  - Tracking
- Quality Management
- Communication Management

# Define a “Release”

SW Development Life Cycle (SDLC) used for Each Release Cycle

- Requirements

\$

- Analysis

S

- Design

Q

- Code

- Tests

C

~~T~~

- Deployment

**•Structure of 3 month Release Cycle Implemented**

\$

S

Q

C

# Time Management – Capacity & Load

## Determine Capacity

- Interviewed Programmers to develop categories
- Developed estimates of Work Capacity per category

## Define Load

- Define PRs (bugs) and CRs (Enhancements) for Upcoming Release Cycle
- Estimate PRs/CRs
- Match Load with Capacity when Defining Release Content

# Capacity – Categories used

- Categories used to measure work avail effort.
  - Vacation/holiday/sick - any time that the resource is not working on the project
  - Production Support - put-out-the-fire fixes to keep the current system function, helping run non-automated processes, system upgrades
  - System Test support - supporting the prior release currently in system test
  - Current Release - work in the current release content
  - Concurrent Items - emergency items that cannot wait until the next schedule release
  - Other - administrative tasks, training, meeting, etc

# Time Management - Tracking

Comparison – typical Software Development Life Cycle (SDLC) and Maintenance/Enhancement (M/E)

<b>SDLC</b>	<b>M/E</b>
<ul style="list-style-type: none"><li>• Sequential paths</li><li>• Multiple “critical” paths</li><li>• Phase development (waterfall, RAD, etc.)</li></ul>	<ul style="list-style-type: none"><li>• Multiple non-sequential items</li><li>• Significance of parallel efforts is &gt; than sequential development</li></ul>

# **Example of Tracking Progress- Capacity vs Work Load on a Release Schedule**

## **Example Used**

- 8/13 Release Start**
- 9/17 Status of Release**
- 10/15 Due Date for Release to SyTst**

# Time Mgmt, Scope Mgmt –WBS

Define Release Scope into MS Project in WBS format as shown

	Task Name	Done	Work	Actual Work	Rem Work	% Comp
1	<input type="checkbox"/> <b>Non-ACES Time Collection</b>		1,253.5 h	1,253.5 h	0 h	100%
2	Non-ACES Tasks		136.5 h	136.5 h	0 h	100%
3	Vacation/Sick Leave/Holiday		1,117 h	1,117 h	0 h	100%
4	<input type="checkbox"/> <b>Production Support</b>		1,541 h	1,535 h	6 h	99%
5	<input checked="" type="checkbox"/> <b>Data Correction</b>		299.5 h	299.5 h	0 h	100%
47	<input checked="" type="checkbox"/> <b>PR Investigation</b>		387.5 h	387.5 h	0 h	100%
77	<input checked="" type="checkbox"/> <b>Batch/Operation Support</b>		854 h	848 h	6 h	99%
108	<input type="checkbox"/> <b>Non-Release Work</b>		10,753.3 h	10,665.3 h	88 h	99%
109	<input checked="" type="checkbox"/> <b>Concurrent PRs/CRs</b>		2,102.2 h	2,014.2 h	88 h	96%
346	<input checked="" type="checkbox"/> <b>Other Non-Release Tasks</b>		5,108.6 h	5,108.6 h	0 h	100%
421	<input checked="" type="checkbox"/> <b>Development Initiatives</b>		1,669.5 h	1,669.5 h	0 h	100%
427	<input checked="" type="checkbox"/> <b>Team Lead Activities</b>		1,873 h	1,873 h	0 h	100%
429	<b>ODS Development</b>		0 h	0 h	0 h	0%
430	<input type="checkbox"/> <b>Data Warehouse - Enhancements at</b>		6,765.5 h	6,753.5 h	12 h	99%
431	<input checked="" type="checkbox"/> <b>Monthly Load Process</b>		2,669.5 h	2,669.5 h	0 h	100%
500	<input checked="" type="checkbox"/> <b>Monthly Data Load</b>		279.5 h	279.5 h	0 h	100%
504	<input checked="" type="checkbox"/> <b>CR/PR Development</b>		3,816.5 h	3,804.5 h	12 h	99%
580	<input type="checkbox"/> <b>Release X</b>		10,667.5 h	10,442 h	225.5 h	98%
581	<input checked="" type="checkbox"/> <b>CC - Committed Items in X</b>		113.5 h	103.5 h	10 h	91%
596	<input checked="" type="checkbox"/> <b>ELIG - Committed Items in X</b>		449 h	426 h	23 h	95%
647	<input checked="" type="checkbox"/> <b>FICS - Committed Items in X</b>		1,276 h	1,262 h	14 h	99%
844	<input checked="" type="checkbox"/> <b>Web - Committed Items in X</b>		164.3 h	164.3 h	0 h	100%
939	<input checked="" type="checkbox"/> <b>XTEAM - Committed Items in X</b>		8,664.7 h	8,486.2 h	178.5 h	98%
1112	<b>Release Y</b>		0 h	0 h	0 h	0%

## Columns

ID

Task Name

Done

Work

Actual Work

Remaining Work

% Complete

*Some content is collapsed in view*

# Time/Scope-Resources Assigned, Estimates Provided, Hours Collected

	Task Name	Done	This Week	Estimate	Actual	Rem. Wk	Comments
1166	<input type="checkbox"/> CR # 218022 - Medicare Buy-In Changes			229.5 h	229.5 h	0 h	
1167	>> A&D Approved	Y		0 h	0 h	0 h	
1168	<input type="checkbox"/> Coding	Y		63 h	63 h	0 h	
1169	<input type="checkbox"/> DMJ 4160A - SDX Leads Processor	Y		1 h	1 h	0 h	
	Sam	Y		1 h	1 h	0 h	
1170	<input type="checkbox"/> DMJ 4170A - Report	Y		20 h	20 h	0 h	
	Mike	Y		20 h	20 h	0 h	
1171	<input type="checkbox"/> DMJ 4141A - Report	Y		15 h	15 h	0 h	
	Mike	Y		15 h	15 h	0 h	
1172	<input type="checkbox"/> DMA 0802A - OMEN	Y		27 h	27 h	0 h	
	Mike	Y		27 h	27 h	0 h	
1173	<input type="checkbox"/> Create Unit Test Plan	Y		9 h	9 h	0 h	
	Mike	Y		3 h	3 h	0 h	
	Sam	Y		6 h	6 h	0 h	
1174	<input type="checkbox"/> Code Review	Y		2 h	2 h	0 h	
	Sam	Y		2 h	2 h	0 h	
1175	<input type="checkbox"/> Unit Test Plan Review	Y		0 h	0 h	0 h	
	Sam	Y		0 h	0 h	0 h	
1176	<input type="checkbox"/> Unit Testing	Y		40 h	40 h	0 h	
	Mike	Y		4 h	4 h	0 h	
	Sam	Y		36 h	36 h	0 h	

Task Usage View – MS Project

# Inputting Work into MS Project

Task ID	Task Name	Done?	Estimate	Act Wrk	Rem Wrk	Details	9/9		
							9/9	9/16	9/23
2171	<input type="checkbox"/> PR # 220275 - INTFACE-SEG SENT TO MMIS ON INE		60 h	10 h	50 h	Act. W	0h	2h	2h
2172	<input type="checkbox"/> Design Solution		10 h	10 h	0 h	Act. W	0h	2h	2h
	<i>Sam</i>		10 h	10 h	0 h	Act. W	0h	2h	2h
2174	<input type="checkbox"/> Coding		27 h	0 h	27 h	Act. W			
	<i>Sam</i>		27 h	0 h	27 h	Act. W			
2175	<input type="checkbox"/> Create Unit Test Plan		2 h	0 h	2 h	Act. W			
	<i>Sam</i>		2 h	0 h	2 h	Act. W			
2178	<input type="checkbox"/> Unit Testing		8 h	0 h	8 h	Act. W			
	<i>Sam</i>		8 h	0 h	8 h	Act. W			
2179	<input type="checkbox"/> Create Integration Test Plan		2 h	0 h	2 h	Act. W			
	<i>Sam</i>		2 h	0 h	2 h	Act. W			
2181	<input type="checkbox"/> Integration Testing		6 h	0 h	6 h	Act. W			
	<i>Sam</i>		6 h	0 h	6 h	Act. W			
2182	<input type="checkbox"/> Documentation		1 h	0 h	1 h	Act. W			
	<i>Sam</i>		1 h	0 h	1 h	Act. W			
2183	<input type="checkbox"/> PR # 222189 - TICS Not Inc. When Supp Reissuc		1 h	1 h	0 h	Act. W	1h		
2184	<input type="checkbox"/> Design Solution, Coding, Unit Testing		1 h	1 h	0 h	Act. W	1h		
	<i>Sam</i>		1 h	1 h	0 h	Act. W	1h		
2185	<input type="checkbox"/> PR # 224669 - INTFACE-MMIS ELIGIBILITY UPDATE		20 h	11 h	9 h	Act. W	0h	2h	5h

## MS Project – Task Usage view

Generates information of Work, Actual Work, and Remaining Work, and % Complete (see p. 20). Also re-adjusts Work as tasks are completed

# Time Management – Developing Projected Finish

Why Isn't Using MS Project Good Enough?

- ~ 100 items are in a release, each w/ 5 steps
- Many parallel activities by multiple people
- Projected Finish of Release is not possible from Critical Path Methodology (CPM) in this case

Therefore – Volume Based Methodology (VBM)

- Projected Finish based on Volume – each week
  - Remaining Work
  - Remaining Capacity

# Projected Capacity– Resource Profile Defined for Weeks of Release

Into MS Excel, from historical information (by categories)

*Total Time Avail for Release Work, by week*

TABLE 3.2: Individual Work Profile

Mike	8/13	8/20	8/27	9/3	9/10	9/17	9/24	10/1	10/8	10/15	TOTAL
Vacation/Holiday/Leaves				40.0					40.0		80.0
Production Support	1.3	1.3	1.3		1.3	1.3	1.3	1.3		1.3	10.2
System Test Support	10.8	10.8	10.8		10.8						43.1
Current Release	10.4	10.4	10.4		10.4	21.2	21.2	21.2		21.2	126.3
Concurrent Items	2.3	2.3	2.3		2.3	2.3	2.3	2.3		2.3	18.0
Other	15.3	15.3	15.3		15.3	15.3	15.3	15.3		15.3	122.4

Sam	8/13	8/20	8/27	9/3	9/10	9/17	9/24	10/1	10/8	10/15	TOTAL
Vacation/Holiday/Leaves											0
Production Support	0	0	0	0	0	0	0	0	0	0	0
System Test Support	6.0	6.0	6.0	6.0	6.0						29.8
Current Release	29.1	29.1	29.1	29.1	29.1	35.0	35.0	35.0	35.0	35.0	320.5
Concurrent Items	0	0	0	0	0	0	0	0	0	0	0
Other	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	49.7

Adjustments for System Test Support (1<sup>st</sup> 5 weeks), vacation, etc.

# Actual Work Tracked-Weekly

Actual Work also put into MS Excel

Actual Work

is entered by  
release

Categories  
for each resource

Cumulative Actual Work is then  
determined for the entire release  
(by resource)

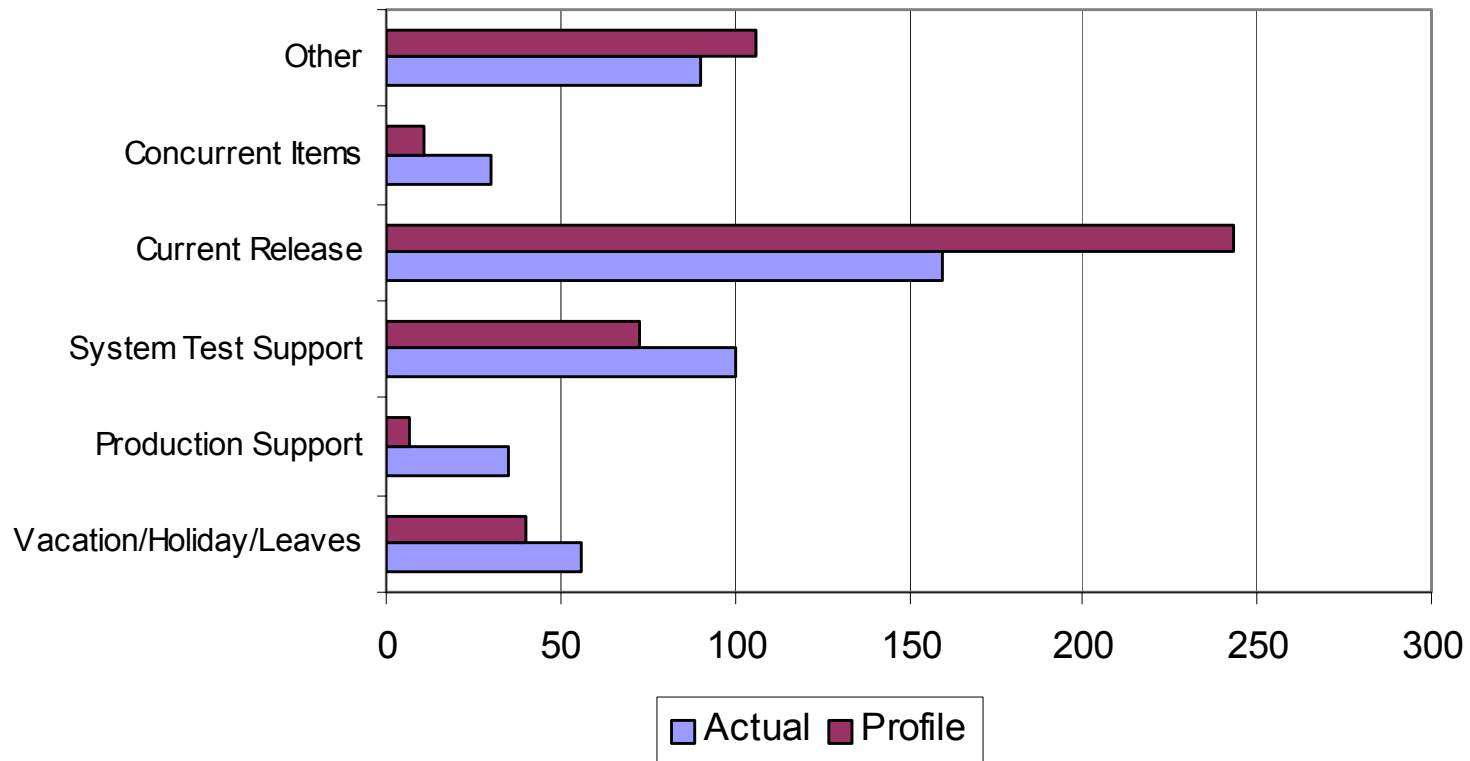
**TABLE 3.4: Timesheet from the Week of 9/17**

	Mike	Sam
Vacation/Holiday/Leaves	8	
Production Support	5	8
System Test Support	15	
Current Release	12	28
Concurrent Items		5
Other		2
<b>TOTAL</b>	<b>40</b>	<b>43</b>

**TABLE 3.5: Total hours for the current release up to 9/17**

	Mike	Sam
Vacation/Holiday/Leaves	48	8
Production Support	5	30
System Test Support	70	30
Current Release	20	140
Concurrent Items	10	20
Other	80	10
<b>TOTAL</b>	<b>233.0</b>	<b>238.0</b>

# Capacity Analysis – Profile vs Actual



•Shown for the two combined resources (Sam and Mike)

# Capacity Left for Release

From Resource Profile – Projected Hours Available for Release on 9/17

	Mike	Sam
Vacation/Holiday/Leaves	40.0	-
Production Support	3.8	-
System Test Support	-	-
Current Release	63.5	140.1
Concurrent Items	6.8	-
Other	45.9	19.9

# Calculating Release Finish

Remaining Work from (MS Project) compared to

Remaining Hours Avail from Resource Profile (MS Excel)

## Slack Analysis for the Current Release

Week Ending 9/17 with Development Ending on 10/15

Resources	Rem. Wrk	Total Avail. Hrs	Utilz Profile	Avail. Rls Hours	Variance (hours)	Slack (days)	Utilization Needed		
							w/e 9/17	w/e 9/10	w/e 9/3
Unassigned	10				-10				
Mike	80	120	53%	63.5	-16.5	-4	67%		
Sam	86	160	88%	140.1	54.1	8			
<b>Team Total</b>	<b>176</b>	<b>280</b>	<b>73%</b>	<b>203.6</b>	<b>27.6</b>	<b>2</b>			

Work Variance

Calculating Days ahead or behind on schedule

# Overview - Tracking Processes

## From MS Project

- Well defined scope
- Defined Resource assignments
- Capture of Est Work, Act Work
- Calculation- Remaining Work
- \*Resource Actuals reported in MS Project

Task Name	Done?	Estimate	Act Wk	Rem Wk	Details	9/9	9/16	9/23
2171 <input type="checkbox"/> PR # 220275 - INTERFACE-SEG SENT TO MMIS ON INE		60 h	10 h	50 h	Act, W	0h	2h	2h
2172 <input type="checkbox"/> Design Solution		10 h	10 h	0 h	Act, W	0h	2h	2h
<i>Sam</i>		10 h	10 h	0 h	Act, W	0h	2h	2h
2174 <input type="checkbox"/> Coding		27 h	0 h	27 h	Act, W			
<i>Sam</i>		27 h	0 h	27 h	Act, W			
2175 <input type="checkbox"/> Create Unit Test Plan		2 h	0 h	2 h	Act, W			
<i>Sam</i>		2 h	0 h	2 h	Act, W			
2178 <input type="checkbox"/> Unit Testing		8 h	0 h	8 h	Act, W			
<i>Sam</i>		8 h	0 h	8 h	Act, W			
2179 <input type="checkbox"/> Create Integration Test Plan		2 h	0 h	2 h	Act, W			
<i>Sam</i>		2 h	0 h	2 h	Act, W			
2181 <input type="checkbox"/> Integration Testing		6 h	0 h	6 h	Act, W			
<i>Sam</i>		6 h	0 h	6 h	Act, W			
2182 <input type="checkbox"/> Documentation		1 h	0 h	1 h	Act, W			
<i>Sam</i>		1 h	0 h	1 h	Act, W			
2183 <input type="checkbox"/> PR # 222189 - TICS Not Inc. When Supp Reissuc		1 h	1 h	0 h	Act, W	1h		
<i>Sam</i>		1 h	1 h	0 h	Act, W	1h		
2184 <input type="checkbox"/> Design Solution, Coding, Unit Testing		1 h	1 h	0 h	Act, W	1h		
<i>Sam</i>		1 h	1 h	0 h	Act, W	1h		
2185 <input type="checkbox"/> PR # 224669 - INTERFACE-MMIS ELIGIBILITY UPDAT		20 h	11 h	9 h	Act, W	0h	2h	5h

## From MS Excel

- Resource Profile hrs. by week
- Resource actual hrs. by week
- Calculation of Proj Fin based on comparing Remaining Work (MS Project vs MS Excel)

**TABLE 3.2: Individual Work Profile**

Mike	8/13	8/20	8/27	9/3	9/10	9/17	9/24	10/1	10/8	10/15	TOTAL
Vacation/Holiday/Leaves				40.0					40.0		80.0
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Concurrent Items	2.3	2.3	2.3		2.3	2.3	2.3	2.3		2.3	18.0
Other	15.3	15.3	15.3		15.3	15.3	15.3	15.3		15.3	122.4

**Slack Analysis for the Current Release**  
Week Ending 9/17 with Development Ending on 10/15

Resources	Rem. Wrk	Total Avail. Hrs	Utilz Profile	Avail. Rls Hours	Variance (hours)	Slack (days)
Unassigned	10				-10	
Mike	80	120	53%	63.5	-16.5	-4
Sam	86	160	88%	140.1	54.1	8
<b>Team Total</b>	<b>176</b>	<b>280</b>	<b>73%</b>	<b>203.6</b>	<b>27.6</b>	<b>2</b>

# Impact of Improvements - PMBOK Processes

Scope of Release is well defined. **S**cope

Early Warning System if provided – data driven **T**ime

Information if available for

- Variance in Work (+/-) (*what to add or remove if needed*) **S**

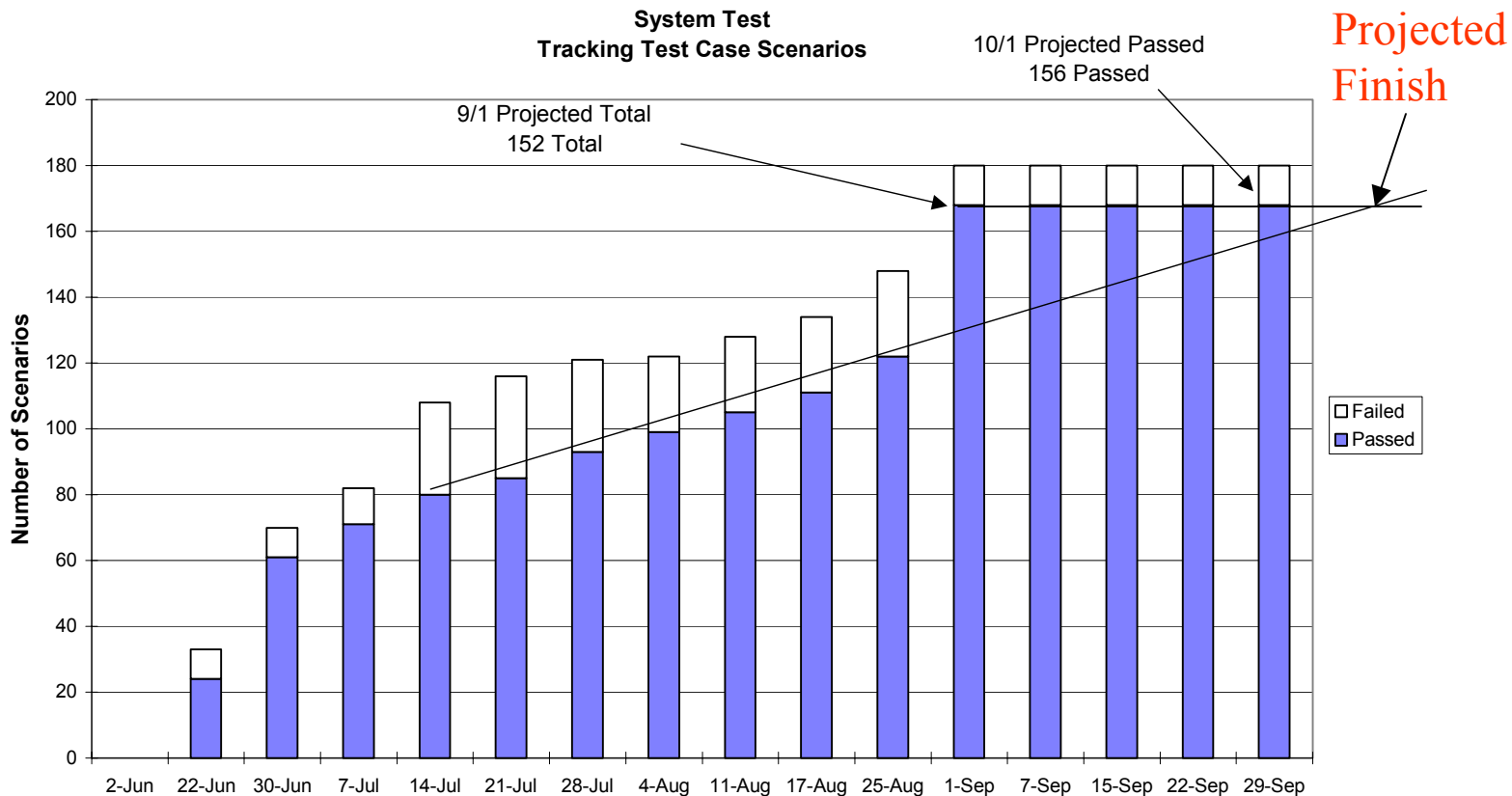
- Days ahead or behind on Completion of Release **T**

Quality Improved – more predictable Testing **Q**uality

Metrics are available for future improved estimating. **\$**

Excellent communication to stakeholders **C**ommunication

# Example – VBM, System Test

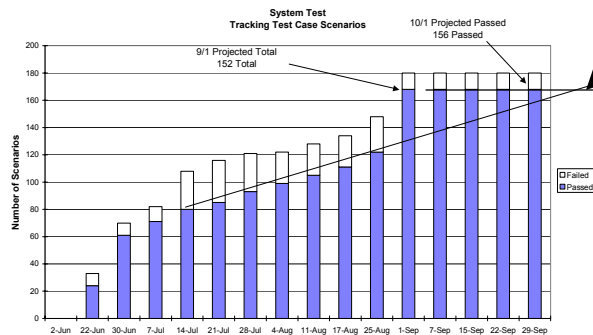


*Use weekly information to develop historical trend*

Blue – # of passed scenarios, white – # of failed scenarios

# Using VBM with CPM, System Test

Use Results of VBM to determine Projected Finish



Projected Finish

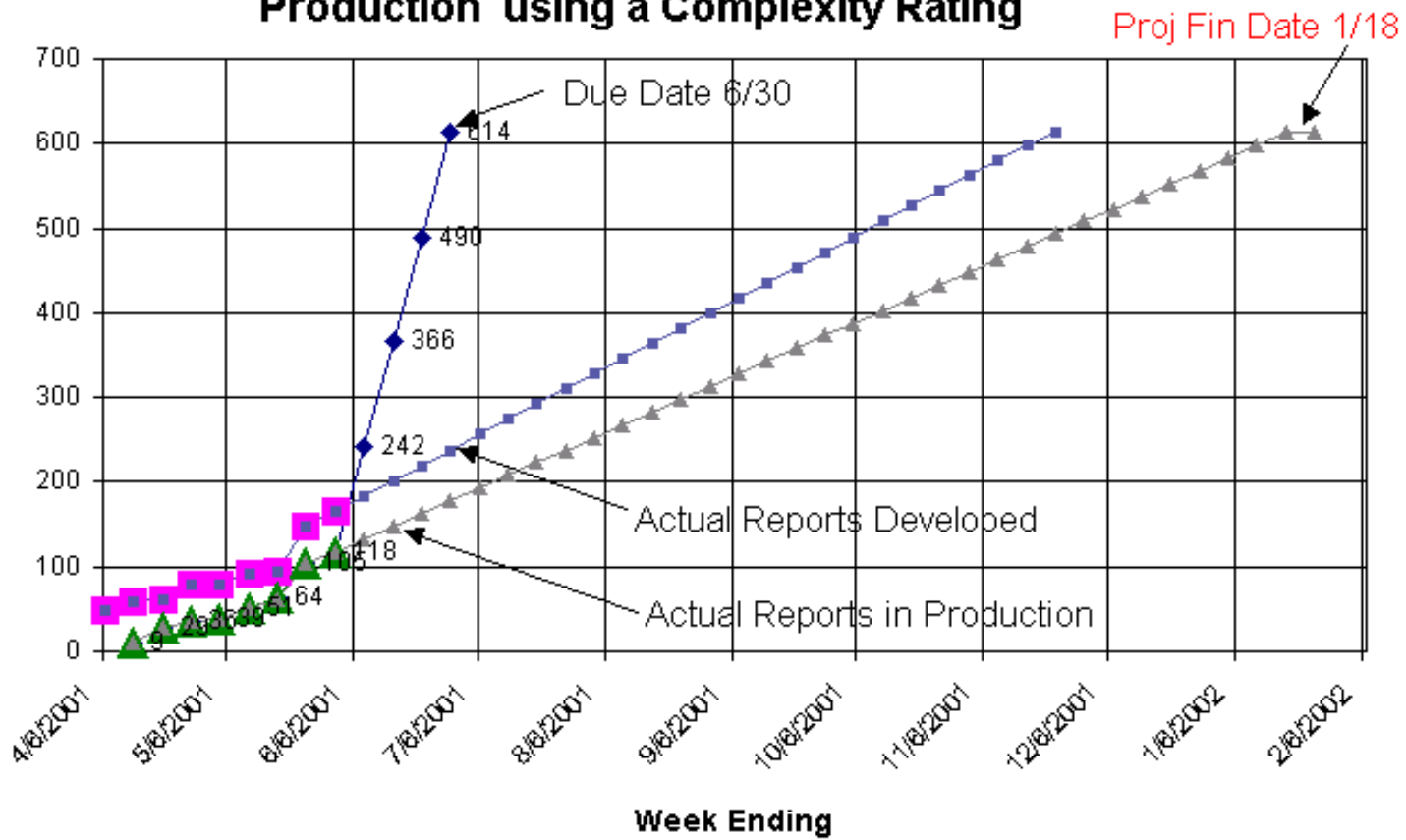
Graph of System Test using VBM

To modify the Finish Date of a task in MS Project

	Task Name	Duration	August					September				October			
			29	5	12	19	26	2	9	16	23	30	7	14	21
1	Conduct Analysis	10d						8/17				8/30			
2	Code/Unit Test	10d						8/24				9/6			
3	Promote Code to System Test	1d								9/7		9/7			
4	Conduct System Test	25d								9/10					10/12

# VBM, Report Development

**Progress & Projection of Reports Development & Reports Ready for Production using a Complexity Rating**



# Possible Changes in Future Maintenance

- Shorter life expectancy of applications/systems
- More off the shelf applications
- Changes to be accomplished w/ less effort and shorter schedules
- However, % maintenance may remain same due to increased user demands
- Rapid Development w/ releasing portions of function to maintain followed by more development

# Conclusion

## Give Maintenance a Little Respect

For Maintenance

- Define Release methodology
- Implement PMBOK/CMM processes
- VBM for planning and tracking

*Note*

Look for other opportunities for VBM for early warning system during development.



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