

Phase Containment Effectivity

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Background: Mid-1990s
Motorola Transmission Products Business Unit

Revenues \$220 million / year
Cash cow for the division
About 100 software engineers; multi-sited
Two major telecommunications product lines
 Box products for enterprise interconnect
 Embedded software, multi - 68xxx processors
 Custom digital signal processor technologies
>90% of value in software
Release projects lasted 9 ±2 months

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Business Unit Development Maturity

Previously achieved CMM Level 2 assessment
Code reviews were a standard practice
QA was embedded within design team, but reported
to another organization
Testing was owned by engineering

Mgmt. searching for ways to continuously improve

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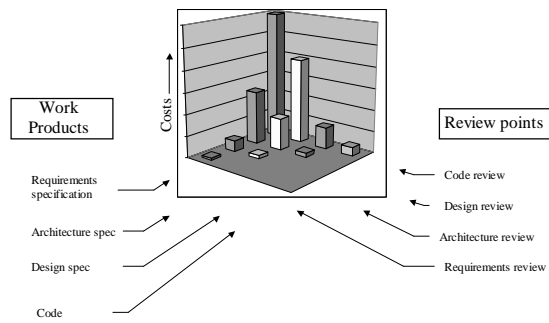
How phase containment initiative was "sold"

Expected benefits of initiative
 More diligence on design work products
 Avoiding mistakes (vs. containment)
 Smoother system test phase
Unexpected benefits of initiative
 Early visibility into project's outcome
 Better precision on release criteria
 (test coverage, outstanding defects, code stability)

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Cost to fix problems

(Based on when the defect is created versus when its discovered)



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Standard of Performance Requirements Specifications

Complete
Unambiguous
Testable ←
Traceable
Concise
Independent of implementation
Conformant to internal and external standards

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Phase Containment Metric and Process

November 21, 2001

Project Reliant Release 4.0

Work Products	Phase Review Points							Total Errors	Total Defects	Total Faults	Phase Containment Effectivity
	Requirements Review	Architecture Review	Design Review	Code Review	Module Test	Integration Test	Alpha Test				
Requirements Specification	6	9	8	1	1	2	1	6	22	28	0.24
Architecture Spec		130	9	14	12	16		130	81	211	0.62
Design Spec			156	40	25	23	12	156	100	296	0.81
Code				117	63	13	6	117	62	179	0.65
Test Spec					24	5	2	24	7	31	0.77
Faults by Phase	6	139	194	167	107	55	37				

	Measured	Historical
In process Defects	272	
In process Faults	705	

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Reviews

Metrics per review

Number of people	Elapsed time
Work product size	Defect volume
Defect severity, location	Defect root cause

Interpretation of results

Review thoroughness and quality
Project state
Project compared to similar projects
Project management responses

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Another value of CMM activity
General Dynamics Decisions Systems
(360 software engineers)

CMM Level	Percent rework	Phase containment effectivity	CRUD density per KSLOC	Productivity X factor (relative)
2	23.2%	25.5%	3.2	1 x
3	14.3%	41.5%	.9	2x
4	9.5%	62.3%	.22	1.9 x
5	6.8%	87.3%	.19	2.9 x

Source: King, Diaz, *Crosstalk: The Journal of Defense Software Engineering* March 2002

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Smoother entry into final testing

- Concise requirements (testability)
- Review-able final test planning
- Agreement on test sequencing vs. build
- Agreement on regression sampling
- Agreement on coverage objectives

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Better final test planning

The plan is nothing, planning is everything

Dwight David Eisenhower

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System Test Coverage Template

Product Validation Test Department		Build 1	Build 2	Build 3	Build 4	Build 5	Build 6	Build 7	Build 8																																								
Start	1/15/03	3/20/03	4/10/03	4/25/03	4/25/03	5/15/03	5/15/03	6/10/03	6/10/03																																								
End	2/15/03	3/15/03	4/30/03	4/25/03	5/5/03	5/20/03	5/20/03	6/10/03	6/10/03																																								
Aug-03	SDK Release 3.1	0.10	0.14	0.32	0.54	0.65	0.67	0.77	0.78																																								
Plan revision 2.1	Summary for all Tests	<table border="1"> <thead> <tr> <th>Total test cases</th> <th>Pass</th> <th>Fail</th> <th>Not Exec</th> <th>Not Exec</th> <th>Not Exec</th> <th>Not Exec</th> <th>Not Exec</th> <th>Not Exec</th> <th>Not Exec</th> </tr> </thead> <tbody> <tr> <td>125</td> <td>6</td> <td>3</td> <td>9</td> <td>21</td> <td>11</td> <td>5</td> <td>10</td> <td>2</td> <td>1</td> </tr> <tr> <th>Total test days</th> <td>1953</td> <td>3</td> <td>1</td> <td>1</td> <td>6</td> <td>0</td> <td>0</td> <td>0</td> <td>0</td> </tr> <tr> <th># Test cases this build</th> <td>12</td> <td>9</td> <td>27</td> <td>40</td> <td>19</td> <td>5</td> <td>12</td> <td>3</td> <td>3</td> </tr> </tbody> </table>								Total test cases	Pass	Fail	Not Exec	Not Exec	Not Exec	Not Exec	Not Exec	Not Exec	Not Exec	125	6	3	9	21	11	5	10	2	1	Total test days	1953	3	1	1	6	0	0	0	0	# Test cases this build	12	9	27	40	19	5	12	3	3
Total test cases	Pass	Fail	Not Exec	Not Exec	Not Exec	Not Exec	Not Exec	Not Exec	Not Exec																																								
125	6	3	9	21	11	5	10	2	1																																								
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# Test cases this build	12	9	27	40	19	5	12	3	3																																								
Test plan section	Test description	Estimated days	Planned coverage	Planned coverage	Planned coverage	Planned coverage	Planned coverage	Planned coverage	Planned coverage																																								
Section 1 Totals	Coverage in this build	20	0.44	0.67	0.78	0.78	0.89	0.94	1.00																																								
Core	Cumulative coverage to date		0.20	0.20	0.10	0.35	0.30	0.15	0.10																																								
Section 2 Totals	Coverage in this build	40	0.20	0.30	0.40	0.55	0.65	0.80	0.85																																								
Comm	Cumulative coverage to date		0.00	0.00	0.60	0.53	0.07	0.00	0.00																																								
Section 3 Totals	Coverage in this build	58	0.00	0.00	0.60	0.93	1.00	1.00	1.00																																								
Backend	Cumulative coverage to date		0.00	0.00	0.00	0.30	0.25	0.00	0.00																																								
Section 4 Totals	Coverage in this build	24	0.00	0.00	0.00	0.30	0.55	0.55	0.55																																								
Frontend	Cumulative coverage to date		0.00	0.00	0.50	0.44	0.22	0.06	0.00																																								
Section 5 Totals	Coverage in this build	27	0.00	0.00	0.50	0.78	1.00	1.00	1.00																																								
Backup	Cumulative coverage to date		0.00	0.00	0.42	0.00	0.00	0.47	0.00																																								
Section 6 Totals	Coverage in this build	27.5	0.00	0.00	0.00	0.42	0.42	0.42	0.89																																								
Redundancy	Cumulative coverage to date		0.00	0.00	0.00	0.42	0.42	0.42	0.89																																								

System Test Coverage Tool (Build 4 exploded)”

Current status

Section 2: Core test suites

Section 3: Backend test suites

Product Mission Test Department	Build 1	Build 2	Build 3	Build 4	Build 5	Build 6	Build 7	Build 8	Build 9	Build 10	Build 11	Build 12	Build 13	Build 14	Build 15	Build 16	Build 17	Build 18	Build 19	Build 20	
Page 1
System Test Coverage Tool
Section 2: Core test suites
Section 3: Backend test suites

Test Coverage Decision Support

SDK 3.1 Test Coverage by Build

Build 4 vs. Build 5 Coverage Analysis

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Did it matter ?

“Innovation is creativity that ships ” Steve Jobs

- Higher quality and more predictable releases
- Early visibility into project s likely outcome (after the first few iterations)
- Consistency was important
- Postmortems found engineers were more effective and happier

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One solid measurement is worth a thousand expert opinions ”

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