What Agile Learns from Waterfall…
And What Waterfall Learns from Agile

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QSM Corporate Profile

- Founded by Larry Putnam, international expert in software estimation.
- QSM Software Lifecycle Management Tools (SLIM Suite) used worldwide by Fortune 500 Clients, Federal, and State Agencies to measure, estimate, and control software development.
- QSM research findings and the methodology within SLIM are published in 5+ books, over 100+ published papers.
Industry Data from the QSM SLIM-Metrics Database

- Spans 20+ years
- Large, worldwide heterogeneous database contains over 7,400+ projects
- Represents over 685+ million SLOC, 7+ million function points, over 600 languages, from 500+ organizations in 18 countries
- Adding 200 – 400 projects/year
Partial List of Clients

- British Telecom
- SAP
- Microsoft
- DirecTV
- AT&T/BellSouth
- BMC Software
- Motorola
- Verizon Wireless
- Computer Sciences Corp
- Checkfree Corp
- IBM Global
- Misys Healthcare
- JPMorganChase
- Boeing
- Bank of New York Mellon
- Lockheed Martin
- Siemens Medical
- The Vanguard Group
Project Interviews
Whiteboard Sketch – Network Management Project

Release 2.3

CONSTRUCT/TEST
TIME = 5.25
EFFORT = 488 PM

57 QA
11 MGT SUPPRT
33 DEV
111 Mg/

1.2B

443

INFRASTRUCTURE
SOLUTIONS
139

STORY CARDS
443

INF

45

SOL

918

834,540
2,835

JAVA
XML

4MOS
32PMs

TIME = 4mos
EFFORT = 32PMs

JAVA
XML

PORTAL
BPS
SDK
INSTAΛΛGE
PADM
DATABASE
CLUSTER
SERVERS
Whiteboard Sketch – e-Commerce Application
Two Categories of Work Types

- Expert Thinking: Requiring creativity and expert problem solving, design of new products.
- Complex Communication: High paying jobs in design, innovation, and management of others with face-to-face interaction.
- Routine Cognitive Tasks: Work that follows well-defined logical rules, such as call center and data processing. Some routing software coding.
- Routine manual tasks: Physical labor jobs such as blue-collar assembly line work.
- Nonroutine manual tasks: Physical labor jobs difficult to automate requiring optical recognition, fine motor control, including a range of factory jobs.
Software Design and Code LifeCycle

Feasibility
Requirements
Low Level Design
HL Design
Code/Unit Test
Integration
System Test
Field Trials
Post-Delivery Corrections

People

Elapsed Calendar Time

Critical Domain Knowledge and Complex Communication Occurs Here
Software Design and Code LifeCycle

Elapsed Calendar Time

Lack of Domain Knowledge, Communication Breakdowns Show Up Here
Release Retrospectives

1 - COLLECT AND VALIDATE PROJECT DATA

2 - ANALYZE PROJECTS USING QSM REFERENCE DATABASE

3 - DETERMINE PROCESS METRICS & PROJECT POSITIONING

4 - DOCUMENT RESULTS
Co-Located XP - Follett Software

- **Team size**
  - 24 Developers
  - 7 Testers
  - 3 Customers
  - 3 Project Leaders

- **Code Base**
  - 1,000,000 lines of code
  - 7,000 automated unit test
  - 10,000 automated acceptance test
People Management

- XP Says “XP works in small to medium sized teams”
- How we evolved or extended this rule
  - Subteams
  - 1 large room is mandatory
- Trade-offs
  - Communication between subteams
  - 1 room noise level (distractions)
  - Lack of personal space
### Input to SLIM

#### Project ID 1: Destiny Release 5.0 (Record 1 of 3)

<table>
<thead>
<tr>
<th>Basic Information</th>
<th>Application</th>
<th>Sizing</th>
<th>Accounting</th>
<th>Custom Fields</th>
<th>Environment</th>
<th>Quality</th>
<th>Review</th>
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<td><strong>Project Information</strong></td>
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<tr>
<td>Project Name</td>
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<td>Preparer Name</td>
<td>Kim Wheeler</td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>Date Last Modified</td>
<td>6/26/2006</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Predominant Application Type
- Payroll
- Trading
- Funds Transfer
- Inventory Control
- Facility Mgmt
- Financial Mgmt
- Materials Mgmt

#### Description
Destiny resource management solution centrally manages library materials, textbooks, instructional media and fixed and portable assets. Districts using all Destiny solutions simultaneously benefit from consolidated reporting and seamless sharing of patron data across all modules. It provides robust, flexible reporting with...

#### Sizing
- **Source Lines of Code**
  - New: 126748
  - Modified: 91783

#### Requirements
- **Defects**
  - System Integration to Delivery: 121

#### Time
- **Phase**
  - 1.
  - 3. BUILD | 1/1/2004 | 7/16/2004 |
  - Months: 7.06 | 5.58 | 6.52 | 151 |

#### Effort
- **PM**
  - 11
  - 151
- **1000 $**
  - 1104.5
  - 1434.5
- **Peak Staff**
  - 2
  - 26
- **Staffing Shape**
  - Level load

#### Additional Information
- **Delete**, **First**, **Prior**, **Next**, **Last**, **Add**, **OK**, **Cancel**, **Help**
SLIM Replica – Destiny 5.0

**Staffing & Probability Analysis**

**SOLUTION PANEL - Destiny Release 5.0**

- **Duration**: 6.5
- **Effort**: 151
- **Cost**: 1283.5
- **Peak Staff**: 23.2
- **MTTD**: 0.675
- **Start Date**: 1/5/2004

**CONTROL PANEL - Destiny Release 5.0**

- **PI**: 23.1
- **MBI**: 5.6
- **Eff SLOC**: 218,531

**PI**

- **Peak Staff**: 18.5
- **Eff SLOC (K)**: 262

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Trendline Assessment – Build Phase Staffing

Main Build Peak Staff vs. Size

Effective SLOC (thousands)

Peak Staff (FTEs)

Normal Staffing

Business Systems
Avionic Systems
Command & Control
Microcode Systems
Process Control
QSM 2005 Business

Avg. Line Style
1 Sigma Line Style

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Trendline Assessment – Build Phase Schedule

Main Build Phase Duration vs Size

Schedules are Half Industry
Trendline Assessment – Defects/Quality

Far Fewer Defects: 50% - 66% Below Industry
## Follett vs. Industry Average

<table>
<thead>
<tr>
<th></th>
<th>Industry Average</th>
<th>Current Performance</th>
<th>Delta</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project Cost</td>
<td>$3.5 Million</td>
<td>$2.2 Million</td>
<td>-$1.3M</td>
</tr>
<tr>
<td>Schedule</td>
<td>12.6 months</td>
<td>7.8 months</td>
<td>-4.8 mos</td>
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<tr>
<td>Defects During QA</td>
<td>242</td>
<td>121</td>
<td>-50%</td>
</tr>
<tr>
<td>Staffing</td>
<td>35</td>
<td>35</td>
<td>n/a</td>
</tr>
</tbody>
</table>

* Using average project size of 500,000 lines of new and modified code
Follett and XP: It has worked incredibly well...

- Destiny Library Manager:
  - Award of Excellence 2004, presented by Technology and Learning magazine (December 2004).
  - Technology & Learning Award of Excellence 2006, 2007

- Destiny Textbook Manager
  - Technology & Learning Award of Excellence 2007

- Destiny Enriched Services
  - Technology & Learning Award of Excellence 2007

Follett Software provides Library Automation Solutions to 52% of the K12 market. Destiny Library Manager: Single largest product market share in K12 with 19% of the total market and continues to outpace the competition in market growth.
Benchmark Comparison of Five Agile Companies

Highlighted: BMC Software
Distributed SCRUM
Project Interviews
Whiteboard Sketch – Performance Mgr R2.3

Release 2.3

- Construct/Test
  - Time = 5.25
  - Effort = 488 PM

- Other (2%)
  - 100
  - 90
  - 80
  - 70
  - Staff 60
  - FTEs 50

- Scrum
  - Dev & QA (70)

- Scrum
  - MGT Support
  - 33 Dev
  - 37 QA
  - Integration
  - Perf/Scale/Rel (PSR)

- ILM
  - Build Team

- Java - 834,540
- XML - 2,835

- Size
  - 11 Iterations @ 12k EA.

- Requirements
  - Infrastructure 139
  - Solutions 304
  - Storycards 443
  - Infr 450/565
  - Sol 410
  - Total 918

- ELAB
  - Time = 4 mos
  - Effort = 32 PMs
Release 2.3 Defect Rate
Input to SLIM-DataManager

Project ID 2: Performance Manager Rel 2.3 (Record 2 of 3)

Basic Information | Application | Sizing | Accounting | Custom Fields | Environment | Quality | Review

- **Project Information**
  - Project Name: Performance Manager Rel 2.3
  - Status: Completed
  - Confidence: High
  - Preparer Name: Mike Lunt
  - Record Creation Date: 6/19/2007
  - Date Last Modified: 7/19/2007

- **Predominant Application Type**
  - System
    - Operating System
    - Environments
    - Middle Ware
    - Tools (DBMS, etc.)
    - Compilers
    - Network Mgmt
    - LAN/WAN OS
    - Other

- **Description**
  - BMC Performance Manager allows clients to manage the availability, performance, and business impact of a distributed systems environment, including network, applications, databases, and operating systems via a common presentation interface. R2.3 focuses on Atrium integration (CMDB), and a focus on large systems.

- **Sizing**
  - Source Lines of Code:
    - New: 211178
    - Modified: 633533
  - Requirements: 443

- **Defects**
  - System Integration to Delivery:
    - First Month after Delivery: 635

- **Time**
  - Months: 4.03, 5.26, 5.77
  - PM: 32, 488
  - 1000 $: 320, 4880
  - Peak Staff: 10, 93
  - Staffing Shape: Rayleigh Front Load, Level load
  - PI: 28.3, MBI: 8.3

- **Effort**
  - Start Date: 6/1/2006
  - End Date: 12/31/2006
  - Duration: 7 months
  - Add: 550, 5,500

- **Delete** | **First** | **Prior** | **Next** | **Last** | **Add** | **OK** | **Cancel** | **Help**
Staffing & Probability Analysis

Avg Staff (people)
<Performance Manager Rel 2.3>

<table>
<thead>
<tr>
<th>Month</th>
<th>Avg Staff</th>
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<tbody>
<tr>
<td>Apr</td>
<td>100</td>
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<tr>
<td>May</td>
<td>80</td>
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<tr>
<td>Jun</td>
<td>70</td>
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<td>Jul</td>
<td>60</td>
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<td>Aug</td>
<td>50</td>
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<tr>
<td>Sep</td>
<td>40</td>
</tr>
<tr>
<td>Oct</td>
<td>30</td>
</tr>
<tr>
<td>Nov</td>
<td>20</td>
</tr>
<tr>
<td>Dec</td>
<td>10</td>
</tr>
</tbody>
</table>

Milestones
- CSR
- SRR
- HLDR
- LLDR
- CUT
- IC
- STC
- UAT
- FCR
- 99R
- 99.9R

SOLUTION PANEL - <Performance Manager Rel 2.3>

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
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<tbody>
<tr>
<td>Duration</td>
<td>5.3</td>
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<tr>
<td>Effort</td>
<td>488</td>
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<tr>
<td>Cost</td>
<td>4800.0</td>
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<tr>
<td>Peak Staff</td>
<td>92.8</td>
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<tr>
<td>MTTD</td>
<td>0.104</td>
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<tr>
<td>Start Date</td>
<td>7/2/2006</td>
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CONTROL PANEL - <Performance Manager Rel 2.3>

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<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
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<tbody>
<tr>
<td>PI</td>
<td>28.3</td>
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<tr>
<td>MBI</td>
<td>8.3</td>
</tr>
<tr>
<td>Eff SLOC (K)</td>
<td>844,710</td>
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<tr>
<td>PI</td>
<td>22.6</td>
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<tr>
<td>MBI</td>
<td>33.9</td>
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<tr>
<td>Peak Staff</td>
<td>74.2</td>
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<td>Eff SLOC (K)</td>
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<tr>
<td>PI</td>
<td>92.8</td>
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<tr>
<td>MBI</td>
<td>111.3</td>
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<tr>
<td>Peak Staff</td>
<td>1014</td>
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PI=28.3 MBI=8.3 Eff SLOC=844,710
Agile projects are faster as a whole. (BMC (and also Follett) are highlighted)
Agile Assessment — Staffing

Agile Projects’ team sizes are fairly typical. BMC elects to run with large teams.
Follett and BMC bug rates are significantly lower.
Agile projects as a whole achieve faster speed

Low Defects for BMC & Follett
Four Core Metrics: Project History

Produced Software (Size)

Duration
Effort
Discovered Defects

How long?
How much?
How good?

Productivity - "The Fifth Metric"
Example PI Calculation

\[
\text{PI} = \frac{\text{SIZE}}{\text{TIME} \times \text{EFFORT}} = 28.3
\]

Size = 918 Stories/837k LOC
Effort = 488 Person-Months
Time = 5.25 Months (Build)
Productivity Index (PI)
(industry values by application type)

Information
- Business
- Scientific
- System
- Process Control
- Telecommunications
- Command and Control
- Real Time

Engineering
- Avionics
- Microcode

Real Time

Productivity Index (PI) w/ ±1 Standard Deviation

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Productivity Index: Five Companies Using Agile

BMC and Follett lead the pack.
Productivity Index Assessment

Follett and BMC Indexes are exemplary

- Agile Companies
- Company B SCRUM
- Company A - Agile XP
- QSM 2005 Business
- Avg. Line Style

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Agile Assessment – Quality

But blue dots (other 3 companies) had higher than average defects
## BMC vs. Industry Average

<table>
<thead>
<tr>
<th></th>
<th>Industry Average</th>
<th>Current Performance</th>
<th>Delta</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project Cost</td>
<td>$5.5 Million</td>
<td>$5.2 Million</td>
<td>-$0.3M</td>
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<tr>
<td>Schedule</td>
<td>15 months</td>
<td>6.3 months</td>
<td>-8.7 mos</td>
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<tr>
<td>Defects During QA</td>
<td>713</td>
<td>635</td>
<td>-11%</td>
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<tr>
<td>Staffing</td>
<td>40</td>
<td>92</td>
<td>+52</td>
</tr>
</tbody>
</table>

* Using average project size of 150,000 lines of new and modified code
BMC “Secret Sauce”
BMC “Secret Sauce” (con’t)

- **Buy-In**
  - VP-Level (or higher) Senior Executive Sponsorship
  - Scrum Master Training
  - Core Group Energized and Passionate

- **Staying “Releasable”**
  - Nightly Builds/Test
  - 2-week Iteration Demos
  - Frequent, Rigorous Peer Code Review

- **Dusk-to-Dawn Teamwork**
  - Communication Techniques for Information Flow
  - Wikis, Video-conferencing, Periodic On-Site Meetings
  - Co-Located Release Planning
  - Scrum of Scrum Meetings (US Time)
BMC “Secret Sauce” (con’t)

- **Backlogs**
  - One Master Backlog AND Multiple Backlog Management
  - One Setup for User Stories Across Teams
  - Added “Requirements Architect” to Interface Product Mgt with R&D

- **“Holding Back the Waterfall”**
  - Test Driven Development
  - Retrospective Meetings to Not Regress into old Waterfall Habits
  - Outside Source to Audit the Process
Benchmark Comparison of Offshore Waterfall Development
A CXO Comment…

“Chunk it, routinize it, digitize it, …and then send it offshore

_for an army of people offshore to code it_…”
Staffing View – Outsourced Project

Avg Staff (people)
<Overall September Baseline>

- INCEP
- ELAB
- CONST
- TRANS

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Defects vs. Industry Average

Defects Found

Current Plan
Actuals
Green Control Bound
Yellow Control Bound

Project: CEP

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10/22/2008
## Industry Average vs. Offshore

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<th>Offshore Average</th>
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<td>9.6 months</td>
<td>-2.7 mos</td>
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<td><strong>Cumulative Defects</strong></td>
<td>2,702</td>
<td>7,565</td>
<td>+280%</td>
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<tr>
<td><strong>Staffing</strong></td>
<td>33</td>
<td>50</td>
<td>+17</td>
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*Using average project size of 150,000 lines of new and modified code*
It’s Not Easy to “Blend Minds” Across the Planet
Models Used for this Analysis

SLIM-Metrics

Metrics Repository & Analysis

SLIM-Estimate

Size, Schedule, Cost & Quality Estimating

“In-Flight” Forecasting

SLIM-Control
We have better tools for predicting the future...

Precision software tools backed by industry leading consulting

Find out how QSM can help your organization control costs and create better software >>

INDUSTRY CONNECTION

Optimal Friction

NEW!
Michael's Blog exploring the world of dynamic software development.

Join the conversation >>

Other Musings from Michael >>

TOOL NEWS

Featured Customer

MISYS
MISYS HEALTHCARE SYSTEMS

Read the Computerworld article...
"Haste Makes Waste" in software development

SD Times Special Feature...
SLIM shows the Best and Worst in Class Software Projects!

TRAINING ALERT

Training Overview
Learn About Training, Dates and Times

Sep 27 - 29...Sign Up Here...
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RESOURCES

Click Here to Learn More!
The NEW QSM 2006 Software Almanac IT Metrics Edition

Cutter Consortium on Agile Metrics
Download the Webinar...

Cutter Report Abstract "The Agile IT Executive and Outsourcing"
Recommended Reading


For Additional Information

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Blog: www.optimalfriction.com