Learning Analytics For The DL Courseware Factory
Analysis, Solutions, Approved Capability Requirements to Support Them, and Way-ahead

Dr. Mitchell Bonnett

Note: The views presented are those of the speaker and do not necessarily represent the views of DoD or its components
Introduction

The Analyze, Design, Develop, Implement, and Evaluate (ADDIE) model is the learning creation business process model for most of the industry.

When used to create course software (AKA courseware - CW) that is Computer Managed Instruction (CMI) at very large scale it’s a business.

A courseware business.
A CMI factory.

Today’s topic is factory measurement. Labor and tooling are future topics. Please hold questions to end. Thanks!
Focus today is CMI. Interactive courseware that is CMI is the most taken and completed DL IMI type. The discussion today is about rapid, efficient defect-free CMI production at scale.

CMI is too often difficult to develop, implement, and evaluate – and it shouldn’t be.
Scale: LARGE Scale CMI Courseware Development and Use

- 1K+ CMI courses available in FY17
- 1M+ active learners took CMI courses in FY17
- 12M+ CMI completions in FY17

The Army uses SCORM 2004 3rd Edition to autoscore its CMI.

- ??? CMI courses available in FY17
- ??? active learners took courses in FY17
- 15M CMI completions in FY17

OPM uses SCORM 1.2 to autoscore its CMI.
Analysis - Recent History of the DoD Problem Set

External analysis finds DoD CMI factories need improvement and makes recommendations

- 2017 Advanced Distributed Learning DL Gap Report
  - Use Standards/Specs
  - Incorporate Learning Metrics
- 2018 Defense Science Board - Design and Acquisition of Software For Defense Systems
  - Transition to Factory
  - Go Agile
  - Use Agile Metrics
- 2018 OSD Reform Initiative - Learning Technology (LTech) Implementation Plan
  - Go Factory (USA Learning)

Yet... Will these achieve software industry level efficiencies in our business? Perhaps...

Analysis - Review of the Industry Problem Set

Analysis finds software industry may be unprepared for use of analytics (metrics) in Agile

- 2015 Journal of Information and Software Technology “Using Metrics in Agile and Lean Software Development – A Systematic Literature Review of Industrial Studies” found:
  - Agile focus on lightweight working practices, constant deliveries, and customer collaboration conflicts with Traditional measurement (metrics) approaches
  - The overall picture is not clear on what metrics Agile teams are using in practice, for what purpose, and with what effect
  - Projects and sprints need to be planned and tracked; Quality needs to be measured; and Process problems need to be identified and fixed

Analysis: ADDIE Stages that Affect the CMI Factory

- **Analysis** and **Design** stages do not affect CMI (it's not DL yet)
- **Develop** stage is very strongly affected yet traditionally has the weakest analytics (metrics) reporting due to Develop stage span and hesitancy to make vendors brief internal practices
- **Implement** stage is strongly affected but trials and function tests can help force metrics up
- **Evaluation** stage is strongly affected but Learner Help Desk tickets can force metrics up
Analysis: High Influence Agile Industry Metrics

<table>
<thead>
<tr>
<th>Metric</th>
<th>Number of occurrences</th>
<th>importance factor</th>
<th>Sum of ranks/2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Velocity [S1,S2,S3,55,56,58,58,510,513,516,523,527,528]</td>
<td>15</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Effort estimate [S3,S7,S8,58,59,512,515,517,529]</td>
<td>12</td>
<td>3</td>
<td>1.5</td>
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<tr>
<td>Customer satisfaction [S1,S3,57,517,519,520]</td>
<td>6</td>
<td>3</td>
<td>2.5</td>
</tr>
<tr>
<td>Defect count [S1,53,55,57,57,510,525,527]</td>
<td>8</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>Technical debt [S4,S5]</td>
<td>2</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>Build status [S4,S14]</td>
<td>2</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>Progress as working code [S30]</td>
<td>1</td>
<td>3</td>
<td>6.5</td>
</tr>
<tr>
<td>Lead time [S1R,S19,S22,S24]</td>
<td>4</td>
<td>2</td>
<td>7</td>
</tr>
<tr>
<td>Story flow percentage [S13]</td>
<td>1</td>
<td>2</td>
<td>9.5</td>
</tr>
<tr>
<td>Velocity of elaborating features [S13]</td>
<td>1</td>
<td>2</td>
<td>9.5</td>
</tr>
<tr>
<td>Story percent complete [S29]</td>
<td>1</td>
<td>2</td>
<td>9.5</td>
</tr>
<tr>
<td>Number of test cases [S1]</td>
<td>1</td>
<td>2</td>
<td>9.5</td>
</tr>
<tr>
<td>Queue time [S18]</td>
<td>1</td>
<td>3</td>
<td>9.5</td>
</tr>
<tr>
<td>Processing time [S18]</td>
<td>1</td>
<td>2</td>
<td>9.5</td>
</tr>
<tr>
<td>Defect trend indicator [S25]</td>
<td>1</td>
<td>3</td>
<td>9.5</td>
</tr>
<tr>
<td>Work in progress [S17,S20,S21,S22,S23,S24]</td>
<td>6</td>
<td>1</td>
<td>10</td>
</tr>
<tr>
<td>Number of unit tests [S1,55,514,527,528]</td>
<td>5</td>
<td>1</td>
<td>14</td>
</tr>
<tr>
<td>Cost types [S21]</td>
<td>1</td>
<td>1</td>
<td>14</td>
</tr>
<tr>
<td>Variance in handovers [S21]</td>
<td>1</td>
<td>1</td>
<td>14</td>
</tr>
<tr>
<td>Defected defects [S7]</td>
<td>1</td>
<td>1</td>
<td>14</td>
</tr>
<tr>
<td>Predicted number of defects in backlog [S25]</td>
<td>1</td>
<td>1</td>
<td>14</td>
</tr>
<tr>
<td>Test coverage [S14]</td>
<td>1</td>
<td>1</td>
<td>14</td>
</tr>
<tr>
<td>Test-growth ratio [S14]</td>
<td>1</td>
<td>1</td>
<td>14</td>
</tr>
<tr>
<td>Check-ins per day [S5,S27,S28]</td>
<td>3</td>
<td>NA</td>
<td>16</td>
</tr>
<tr>
<td>Cycle time [S17,S23]</td>
<td>2</td>
<td>NA</td>
<td>16.5</td>
</tr>
</tbody>
</table>


No need to strain your eyes – they will be discussed in upcoming slides.
Analysis: Where We Need to Be in Agile Metrics

Where we need to improve for Agile (all of us?)

ADDIE
Develop

- Manage tasks and bugs
  - Project tracking
    - Good designs
    - Architecture
    - Technical excellence
    - Simplicity
    - Changing requirements
    - Working together
    - Motivated individuals
    - Face to face conversation
- Manage code and collaboration
  - Source control
    - Good designs
    - Architecture
    - Technical excellence
    - Continuous delivery
    - Become more effective

ADDIE
Develop

- Generate builds and run tests
  - Continuous integration
    - Good designs
    - Architecture
    - Technical excellence
    - Deliver frequently
    - Continuous delivery
    - Become more effective

ADDIE
Implement

- Move code across environments
  - Deployment tools
    - Good designs
    - Architecture
    - Technical excellence
    - Deliver frequently
    - Continuous delivery
    - Become more effective

ADDIE
Evaluate

- Ensure everything is working
  - Application monitoring
    - Good designs
    - Architecture
    - Technical excellence
    - Working software
    - Satisfy the customer

Where we are (some of us?)

ADDIE
Develop

- Manage tasks and bugs
  - Project tracking
- Manage code and collaboration
  - Source control
- Generate builds and run tests
  - Continuous integration
- Move code across environments
  - Deployment tools
- Ensure everything is working
  - Application monitoring

Solutions: How We Get There in Agile Metrics

ADDIE Develop

- Are you meeting commitments?
- How much code is getting built?
- How long does it take you to get things right?
- How fast can you get changes to your consumers?
- How well is your system performing?

ADDIE Develop

- Project tracking
- Source control
- Continuous integration
- Deployment tools
- Application monitoring

ADDIE Implement

- What is your current pace?
- How well is the team working together?

ADDIE Evaluate

Bottom left corner of each slide that follows indicates an approved capability requirements package passed to the DoD ADL that can fully or substantially mitigate those gaps.

Solutions: Agile Metrics for Develop (Project Tracking 2 of 2)


BL – 5 of 6 of the “most influential” factory metrics are project tracking metrics.
Solutions: Agile Metrics for Develop (Source Control)


Pull Requests

Commits, Reviews, Comments, CLOCs

Source control

How much code is getting built?

How well is the team working together?

DL Source File Repository (DLSFR) - 41 requirements approved 2015
Solutions: Agile Metrics for Develop (Continuous Integration)

ADDIE
Develop

How long does it take you to get things right?

Continuous integration

*DLICR also auto detects and stores learner computing environment data. DL Issue Collection Repository (DLICR) - 93 requirements approved 2015*

Progress as working code (7)

- Developer
- Tester
- Manager
- Shipper

From:

Test individual changes
Test multiple changes
Verify what customer gets
Ship to the customer

To:

Local development
Integration
QA
Production

Manual Content (Doctrine) Validation
Section 508 Testing
Presentation Code Testing
Scoring Language Code Testing
Individual Trials (Iterative)
Group Trials (Iterative)

Because Individual and Group Trials require human learners take them for ISD purposes of establishing course length and item analysis difficulty measurement IT and GT may never be fully automated...

Solutions: Agile Metrics for Implement (Deployment Tools)


*DLICR also auto detects and stores learner computing environment data.

DL Delivery Systems (ETS, LMS, LCMS for CMI; CMS for CAI; Etc.) All are deployed now.
Solutions: Agile Metrics for Evaluate (Application Monitoring)

Customer Satisfaction (3)

Not in the study ... but...

Way-Ahead: Require ADDIE Develop Stage Metrics

ADDIE Develop

- Are you meeting commitments?
- How much code is getting built?
- How long does it take you to get things right?
- How fast can you get changes to your consumers?
- How well is your system performing?

Project tracking
Source control
Continuous integration
Deployment tools
Application monitoring

*DLICR requirement set has a sub req set for automatically detecting and storing learner’s computing environment metrics.

DL Registry (DLR)
- 105 requirements approved 2013

DL Source File Repository (DLSFR)
- 41 requirements approved 2015

DL Issue Collection Repository (DLICR)
- 93 requirements approved 2015 *

DL Delivery Systems
(ETS, LMS, LCMS for CMI; CMS for CAI; Etc.)
All are deployed now.

DLICR (help desk);
ETS, LMS, LCMS must support item analysis
CMI Interaction data


9/11/2018 Learning Analytics For The DL Courseware Factory
Conclusion

BL - Much progress in DL metrics analytics has been but more is needed.
Q & A

• Contact mitchell.l.bonnett.civ@mail.mil or mitch_bonett@hotmail.com