

Learning Analytics For The DL Courseware Factory

Analysis, Solutions, Approved Capability Requirements to Support Them,
and Way-ahead

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

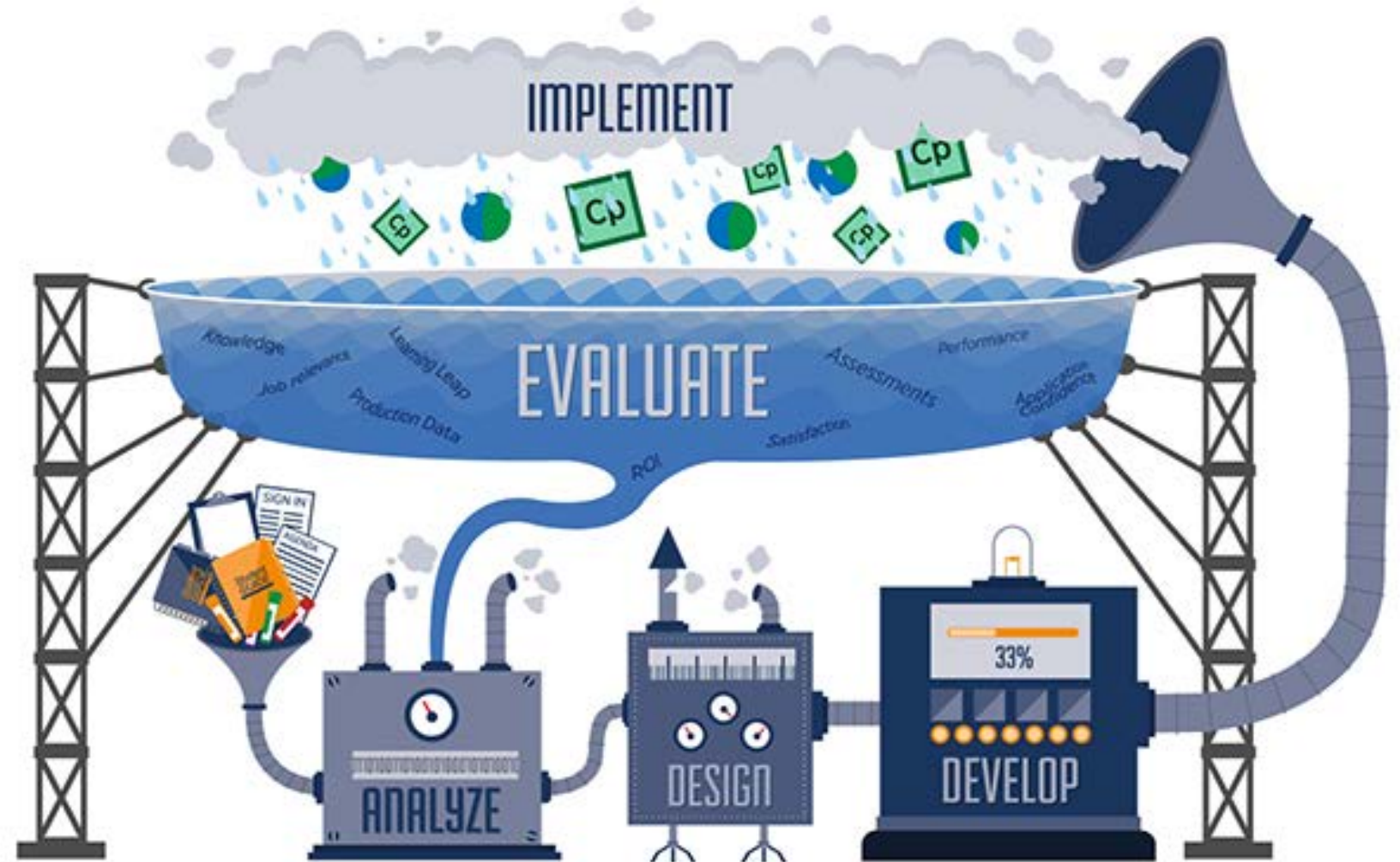
Introduction

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.

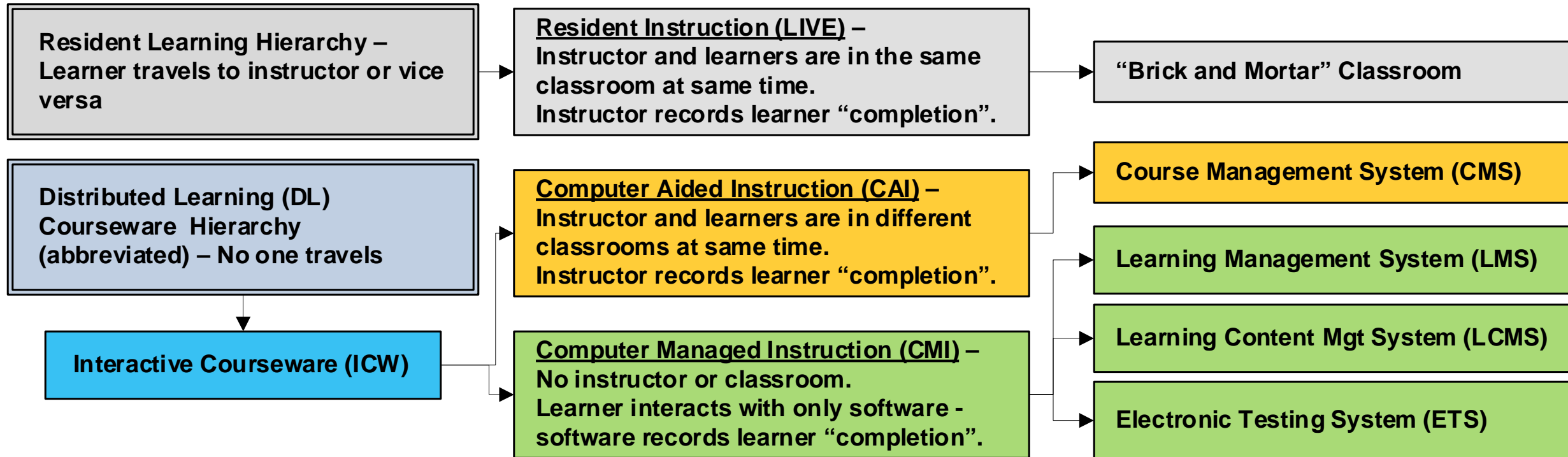
A courseware business.

A CMI factory.



Today's topic is factory measurement. Labor and tooling are future topics. Please hold questions to end. Thanks!

Scope: Computer Managed Instruction (CMI) IMI Type



- 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

DEPARTMENT OF THE ARMY
Fiscal Year (FY) 2019 Budget Estimates
Operation and Maintenance, Army
Budget Activity 03: Training and Recruiting
Activity Group 32: Basic Skill and Advanced Training
Detail by Subactivity Group 324: Training Support



The Official Learning Development Site for the U.S. Federal Government

Distributed Learning (DL) Course Completed¹

FY 2017

12,530,354

FY 2017

15,000,000

- 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.

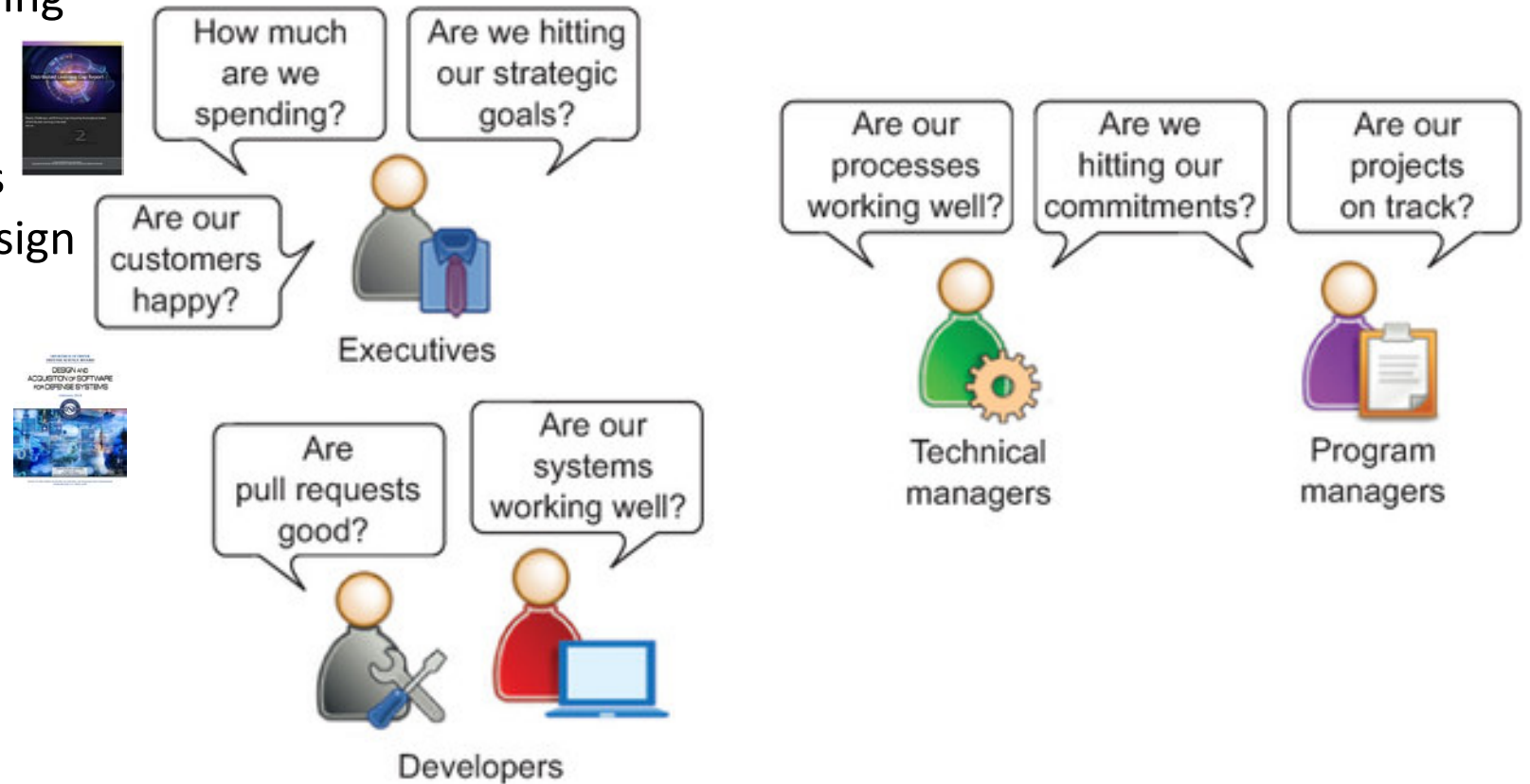
- ??? CMI courses available in FY17
- ??? active learners took courses in FY17
- 15M CMI completions in FY17

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)



Davis, C. W. H. (2015). Agile metrics in action : how to measure and improve team performance

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

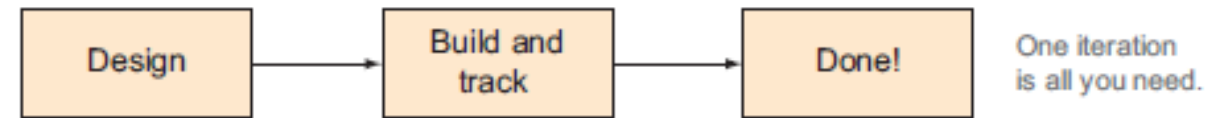
Analysis - Review of the Industry Problem Set

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

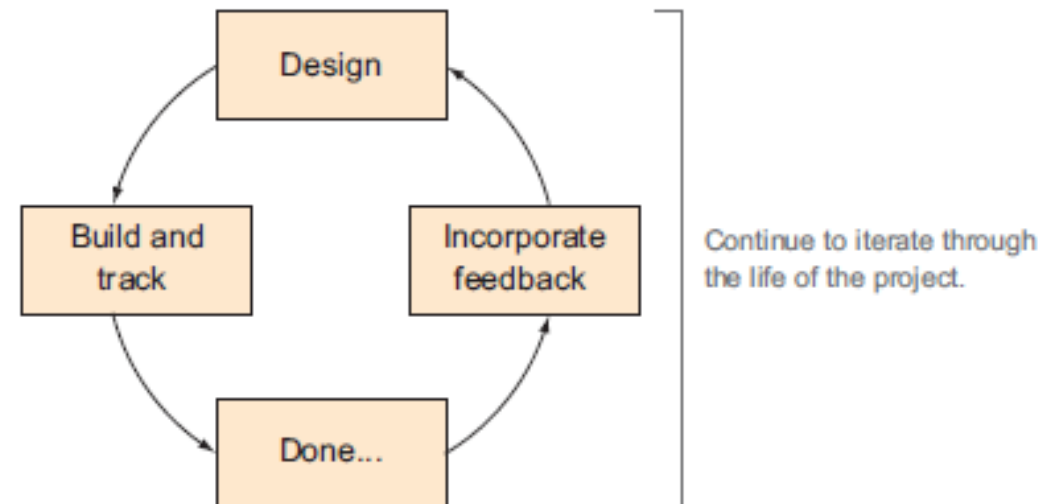
- 2015 Journal of Information and Software Technology “Using Metrics in Agile and Lean Software Development – A Systematic Literature Review of Industrial Studies” found:

- 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

Project mentality



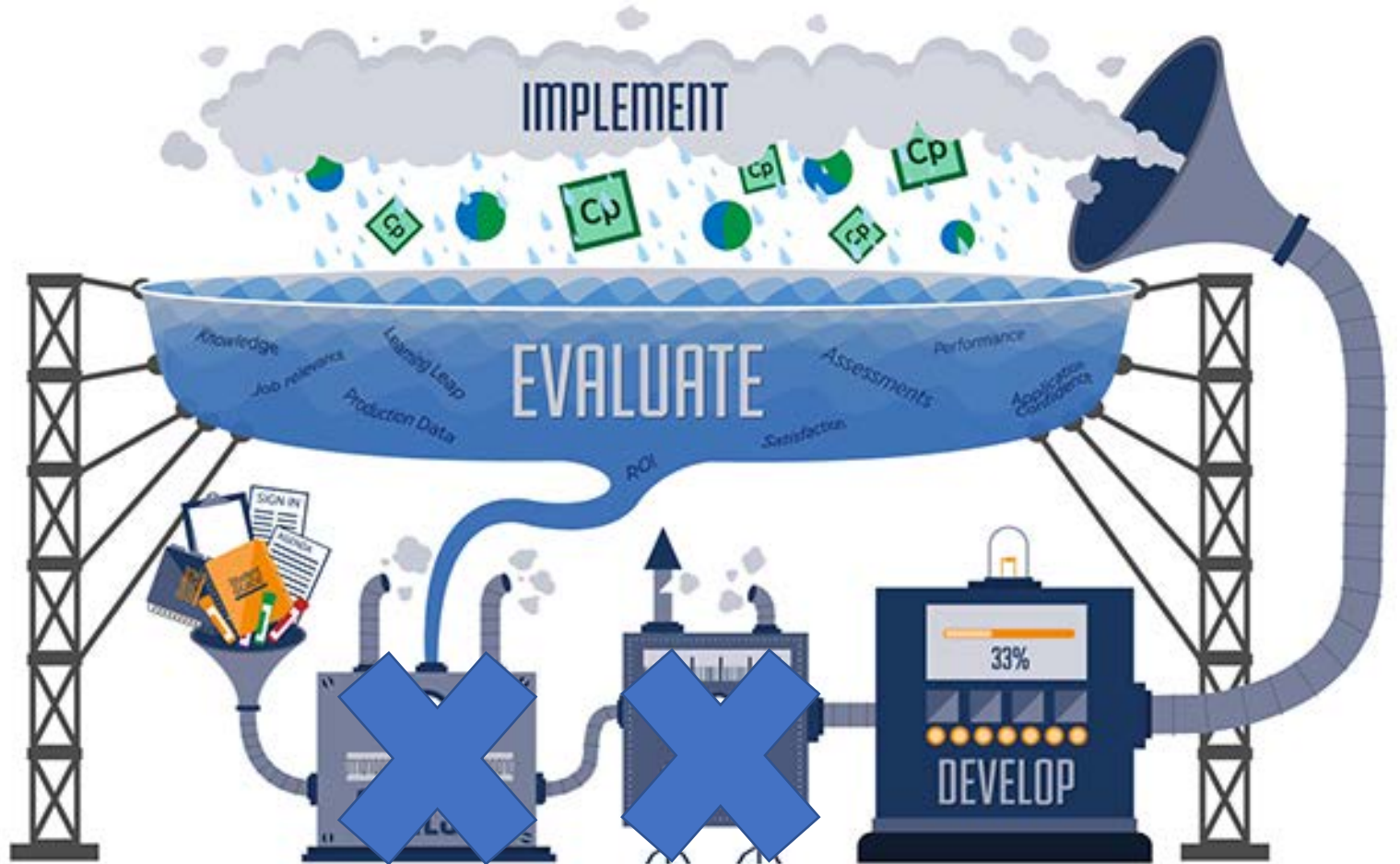
Product mentality



Davis, C. W. H. (2015). Agile metrics in action : how to measure and improve team performance

Analysis: ADDIE Stages that Affect the CMI Factory

- **Analysis** and **Design** stages do not affect CMI (its 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

High influence metrics based on number of occurrences and perceived importance factor.

Metric	Number of occurrences	Importance factor	Sum of ranks/2
Velocity [S1,S2,S3,S5,S6,S8,S8,S10,S13,S16,S23,S27,S28]	15	3	1
Effort estimate [S3,S7,S8,S8,S9,S12,S15,S17,S29]	12	3	1.5
Customer satisfaction [S1,S3,S7,S17,S19,S20]	6	3	2.5
Defect count [S1,S3,S5,S7,S7,S10,S25,S27]	8	2	5
Technical debt [S4,S4]	2	3	5
Build status [S4,S14]	2	3	5
Progress as working code [S30]	1	3	6.5
Lead time [S18,S19,S22,S24]	4	2	7
Story flow percentage [S13]	1	2	9.5
Velocity of elaborating features [S13]	1	2	9.5
Story percent complete [S29]	2	2	9.5
Number of test cases [S1]	1	2	9.5
Queue time [S18]	1	2	9.5
Processing time [S18]	1	2	9.5
Defect trend indicator [S25]	1	2	9.5
Work in progress [S17,S20,S21,S22,S23,S24]	6	1	10
Number of unit tests [S1,S5,S14,S27,S28]	5	1	11
Cost types [S21]	1	1	14
Variance in handovers [S21]	1	1	14
Deferred defects [S7]	1	1	14
Predicted number of defects in backlog [S25]	1	1	14
Test coverage [S14]	1	1	14
Test-growth ratio [S14]	1	1	14
Check-ins per day [S5,S27,S28]	3	NA	16
Cycle time [S17,S23]	2	NA	16.5

No need to strain your eyes –
they will be discussed in
upcoming slides.

Kupiainen, E., Mäntylä, M. V., & Itkonen, J. (2015). Using metrics in Agile and Lean Software Development – A systematic literature review of industrial studies. *Information and Software Technology*, 62, 143-163. doi: <https://doi.org/10.1016/j.infsof.2015.02.005>

Analysis: Where We Need to Be in Agile Metrics

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

Where we are (some of us?)

ADDIE
Develop

ADDIE
Develop

ADDIE
Develop

ADDIE
Implement

ADDIE
Evaluate

Manage
tasks and
bugs

Manage
code and
collaboration

Generate
builds and
run tests

Move code
across
environments

Ensure
everything
is working

Project
tracking

Source
control

Continuous
integration

Deployment
tools

Application
monitoring

- Good designs
- Architecture
- Technical excellence
- Simplicity
- Changing requirements
- Working together
- Motivated individuals
- Face to face conversation

- Good designs
- Architecture
- Technical excellence
- Continuous delivery
- Become more effective

- Good designs
- Architecture
- Technical excellence
- Deliver frequently
- Continuous delivery
- Become more effective

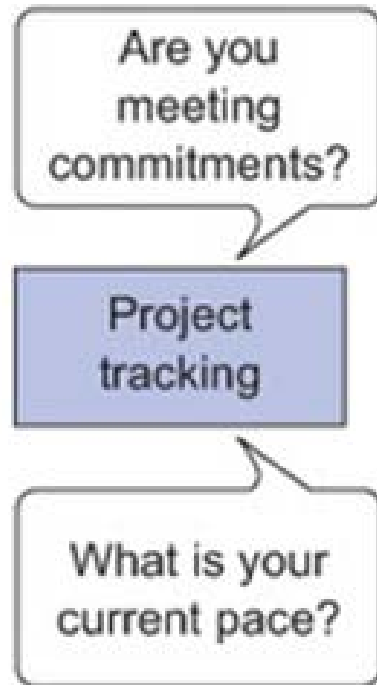
- Good designs
- Architecture
- Technical excellence
- Deliver frequently
- Continuous delivery
- Become more effective

- Good designs
- Architecture
- Technical excellence
- Working software
- Satisfy the customer

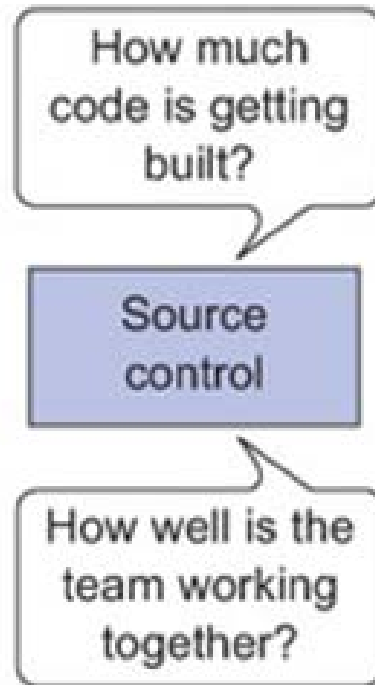
Davis, C. W. H. (2015). Agile metrics in action : how to measure and improve team performance

Solutions: How We Get There in Agile Metrics

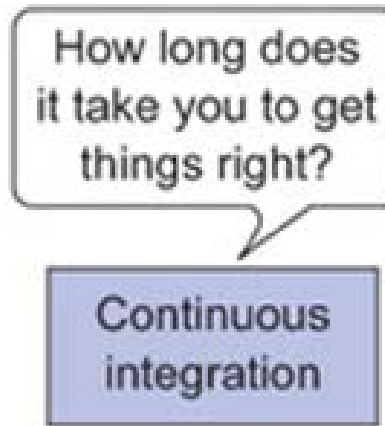
ADDIE
Develop



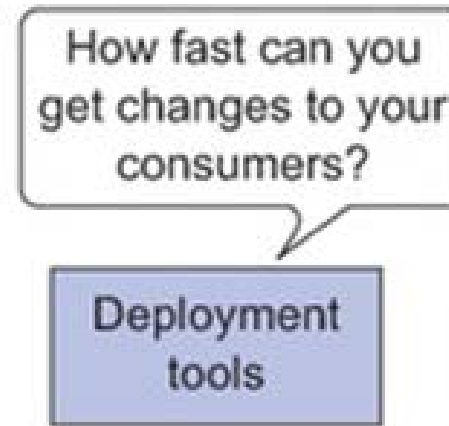
ADDIE
Develop



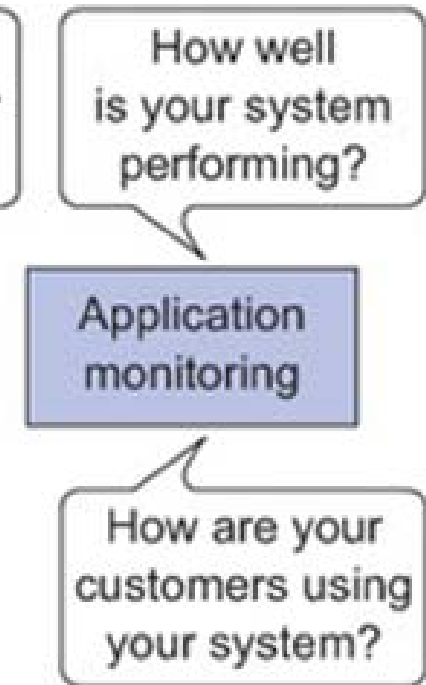
ADDIE
Develop



ADDIE
Implement



ADDIE
Evaluate



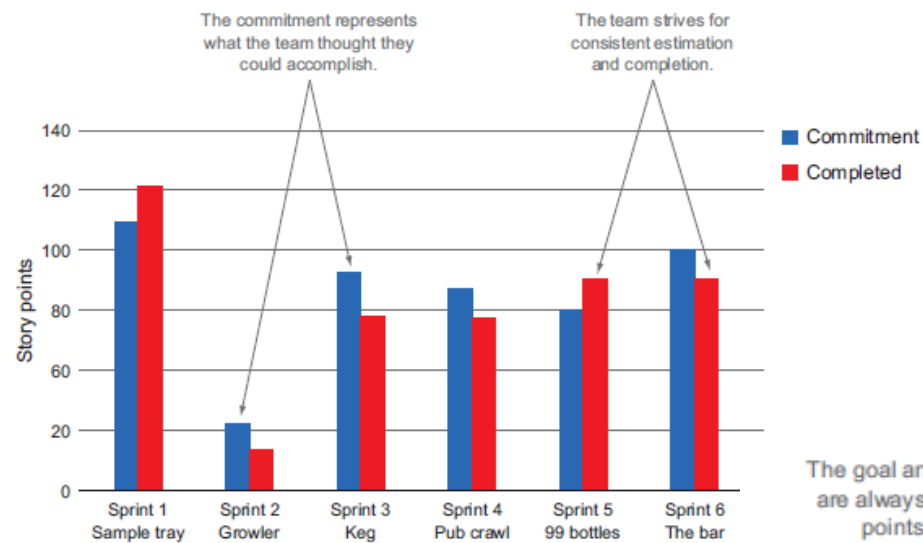
Bottom left corner of each slide that follows indicates an approved capability requirements package passed to the DoD ADL that can fully or substantially mitigate those gaps.

Davis, C. W. H. (2015). Agile metrics in action : how to measure and improve team performance

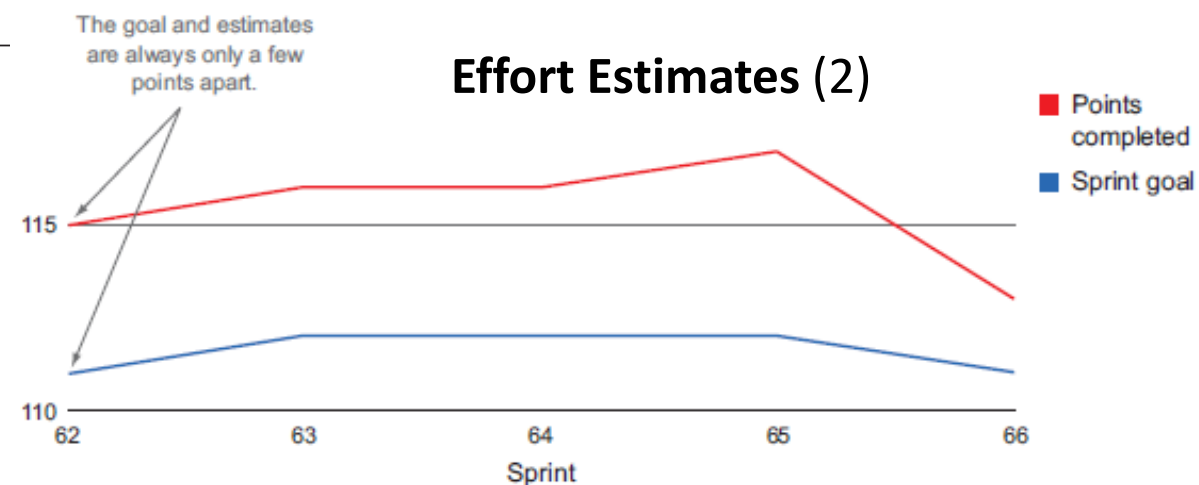
Solutions: Agile Metrics for Develop (Project Tracking 1 of 2)



- 105 requirements approved 2013



Velocity (1)



BL –The two “most influential” factory metrics” are project tracking metrics.

Davis, C. W. H. (2015). Agile metrics in action : how to measure and improve team performance

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

ADDIE

Develop

Are you meeting commitments?

Project tracking

What is your current pace?

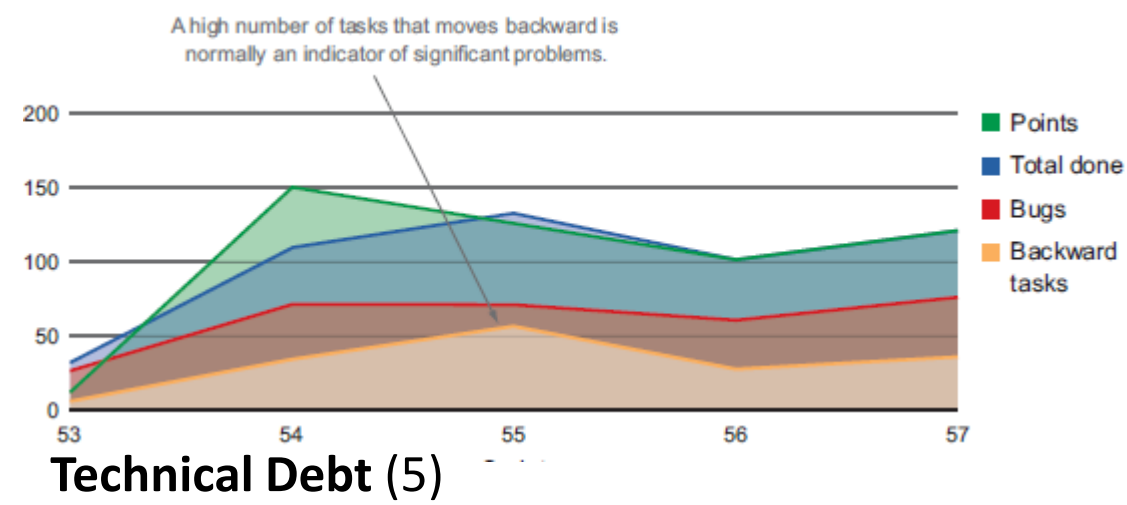
DL Registry (DLR)

- 105 requirements approved 2013



Build Status (6)

Defect (Bug) Count (4)



BL – 5 of 6 of the “most influential” factory metrics” are project tracking metrics.

Davis, C. W. H. (2015). Agile metrics in action : how to measure and improve team performance

Solutions: Agile Metrics for Develop (Source Control)

ADDIE
Develop

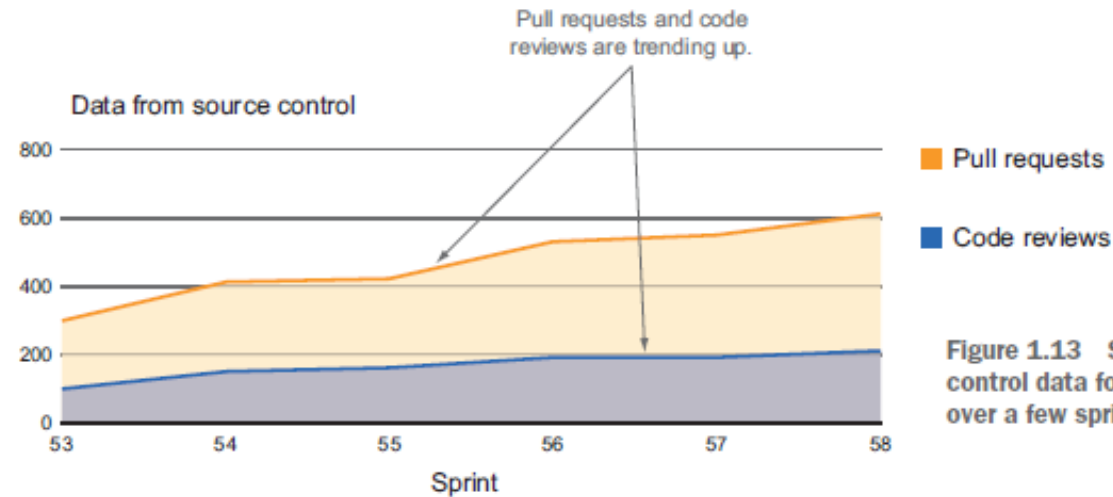
How much
code is getting
built?

Source
control

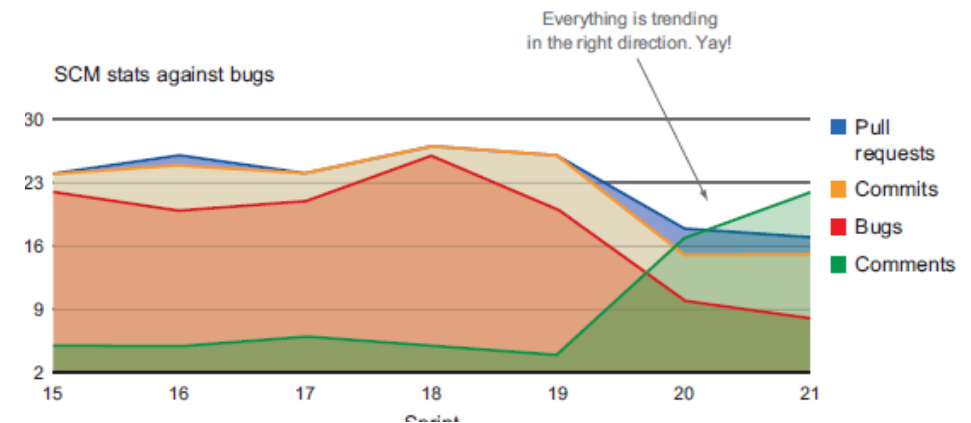
How well is the
team working
together?

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

Pull Requests



**Commits, Reviews,
Comments, CLOCs**



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Solutions: Agile Metrics for Develop (Continuous Integration)

ADDIE Develop

Progress as working code (7)

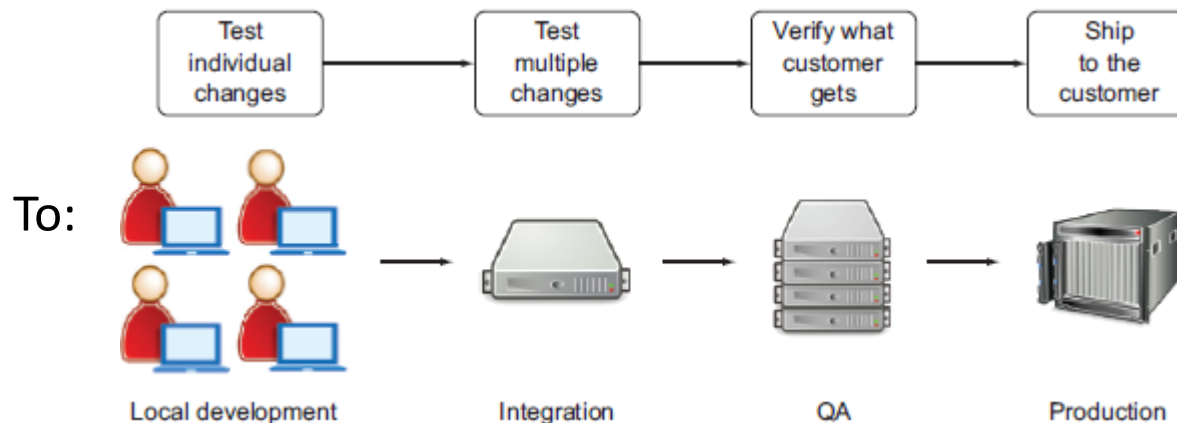
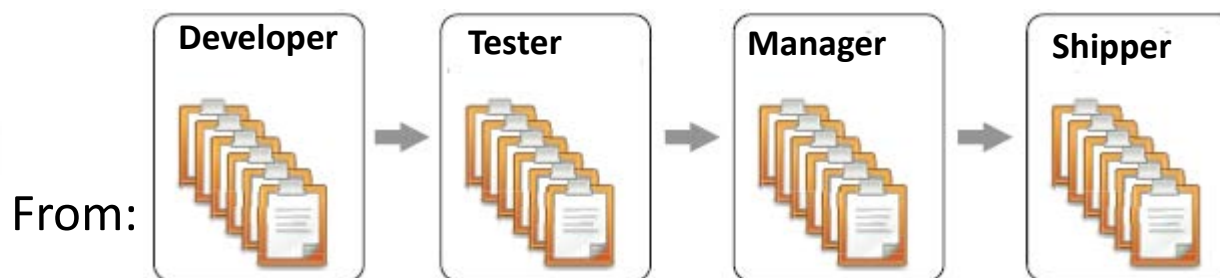
Manual

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



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

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

[illegible]

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...

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Solutions: Agile Metrics for Implement (Deployment Tools)

ADDIE
Implement

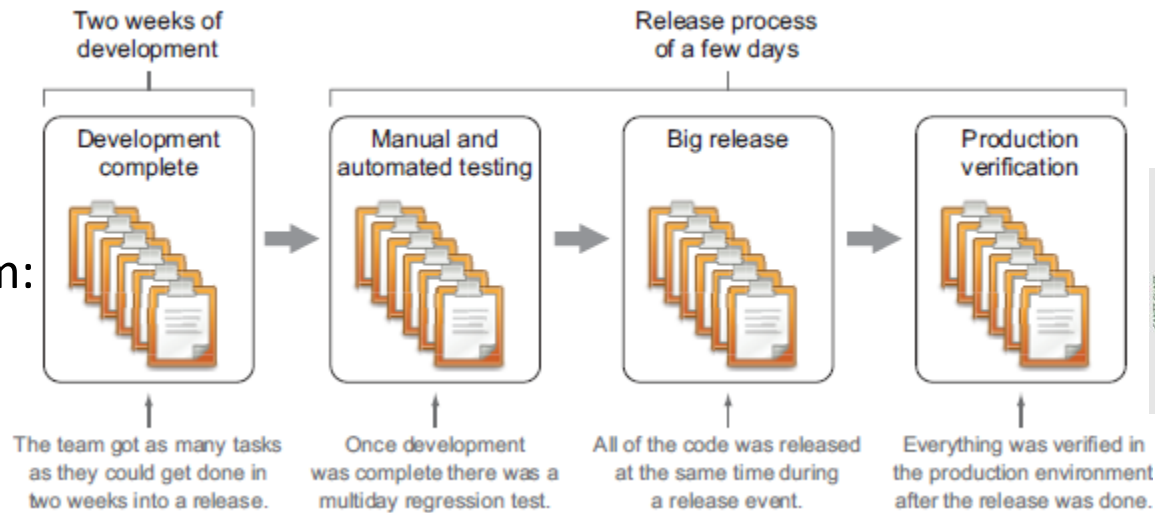
Progress as working code (7)

Manual

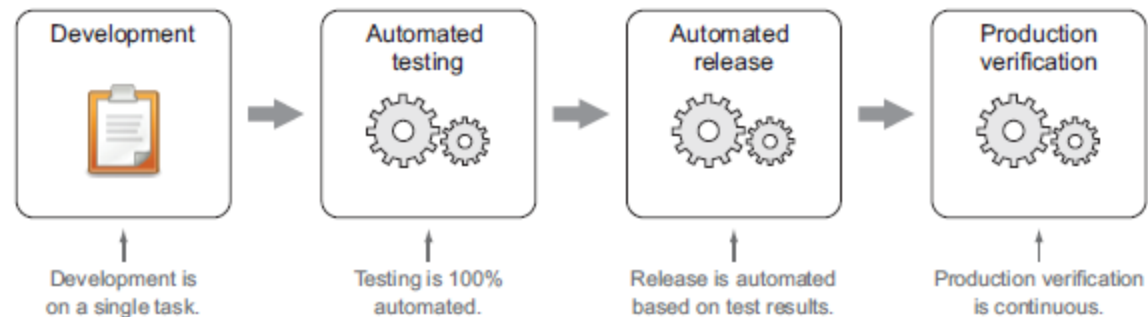
Documents/Test Logs Review
Function Testing
Fielding



From:



To:

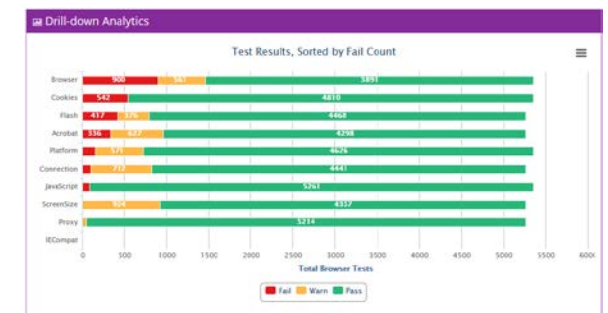


*DLICR also auto detects and stores learner computing environment data.

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

26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																															

Automated



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Solutions: Agile Metrics for Evaluate (Application Monitoring)

ADDIE
Evaluate

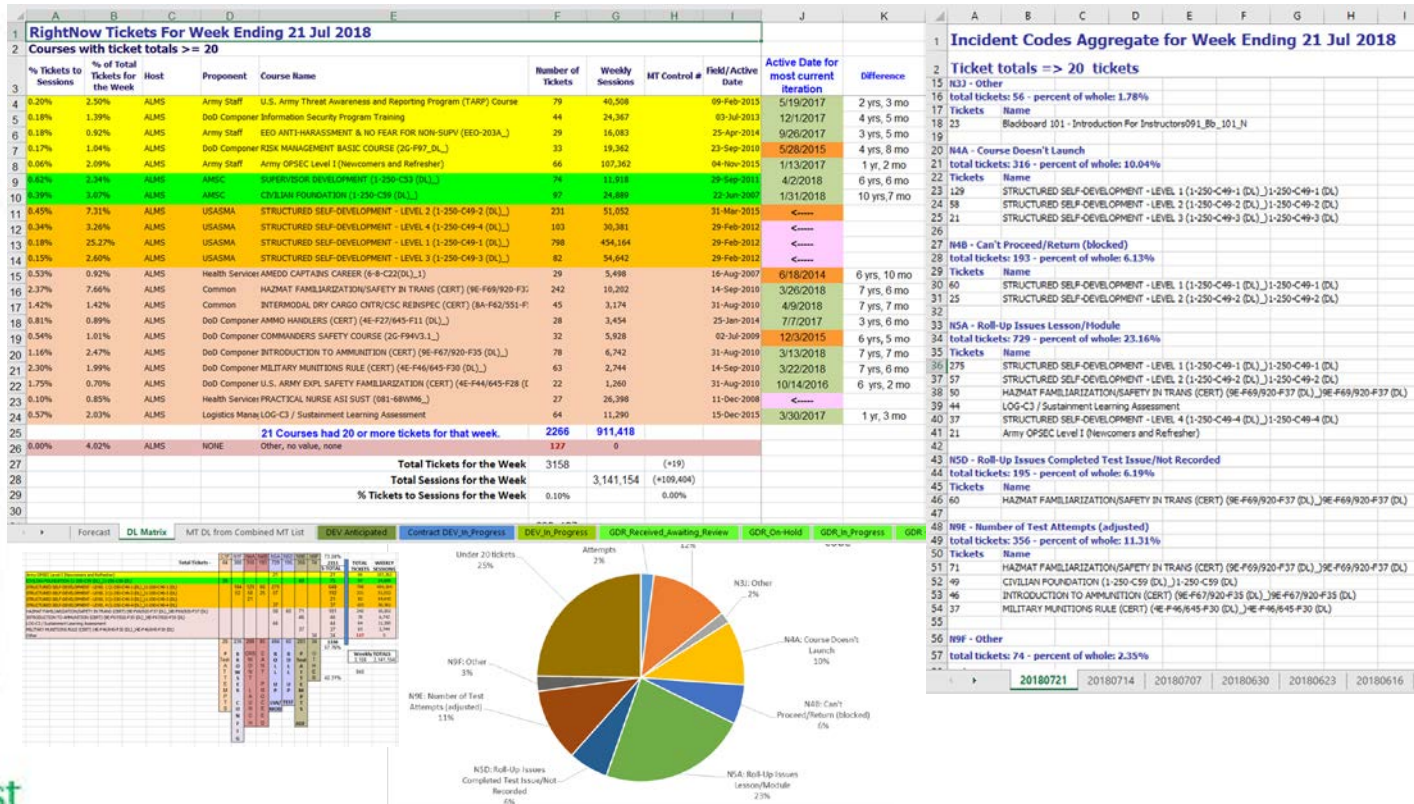
Customer Satisfaction (3)

How well
is your system
performing?

Application
monitoring

How are your
customers using
your system?

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

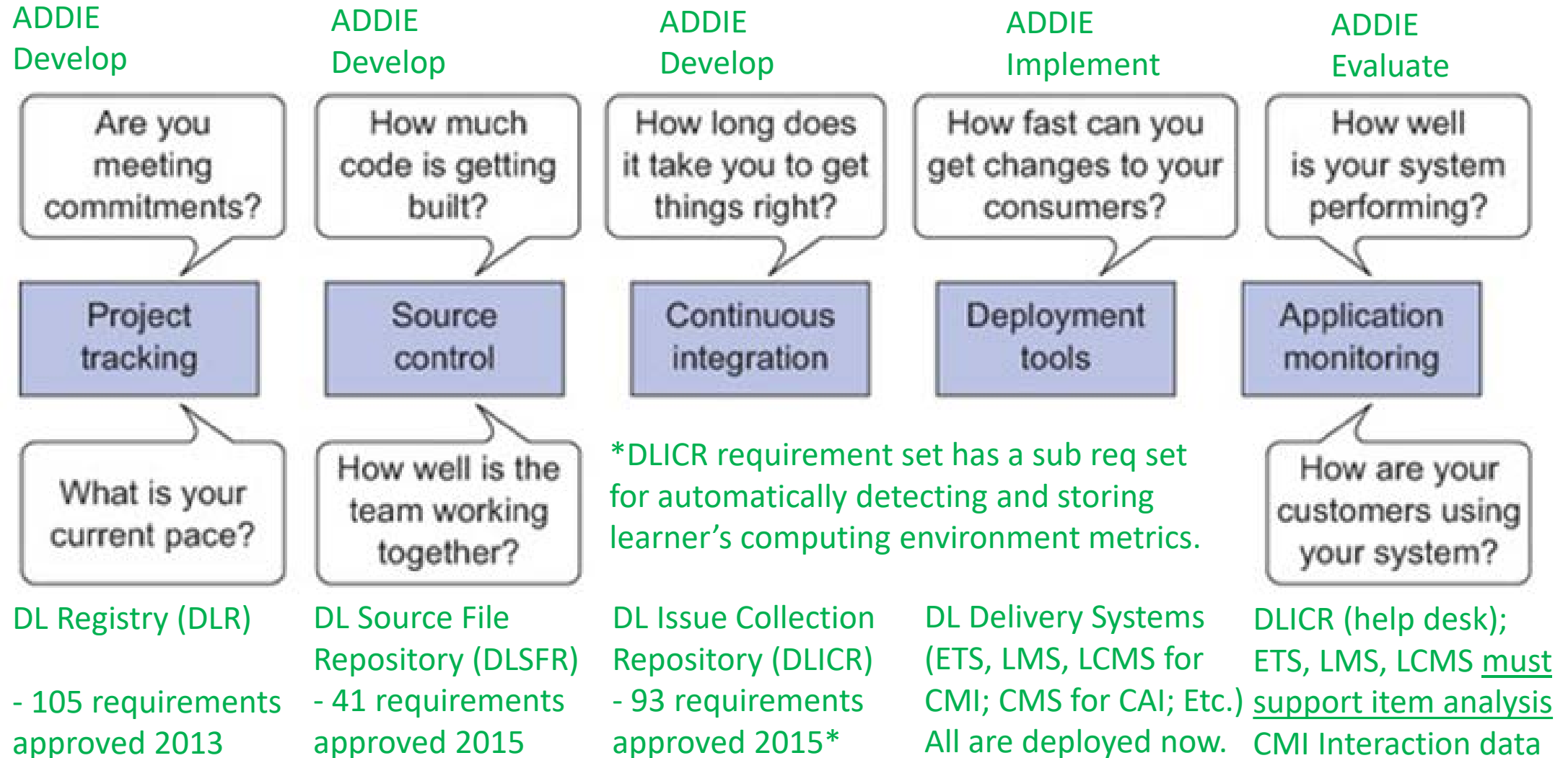


← Not in the study ... but...

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Learning Analytics For The DL Courseware Factory

Way-Ahead: Require ADDIE Develop Stage Metrics



Davis, C. W. H. (2015). Agile metrics in action : how to measure and improve team performance

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