Lean & Agile

Earned Value Management

How to Use Agile EVM to Manage Projects, Programs, & Portfolios

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Agile Capabilities: http://davidfrico.com/rico-capability-agile.pdf
Agile Resources: http://www.davidfrico.com/daves-agile-resources.htm
Agile Cheat Sheet: http://davidfrico.com/key-agile-theories-ideas-and-principles.pdf
Dave's NEW Business Agility Video: https://www.youtube.com/watch?v=-wTXqN-OBzA
Dave's NEWER Development Operations Security Video: https://vimeo.com/214895416
DoD Fighter Jets vs. Amazon Web Services: http://davidfrico.com/dod-agile-principles.pdf

Author BACKGROUND

- Gov't contractor with 34+ years of IT experience
- B.S. Comp. Sci., M.S. Soft. Eng., & D.M. Info. Sys.
- ☞ Large gov't projects in U.S., Far/Mid-East, & Europe
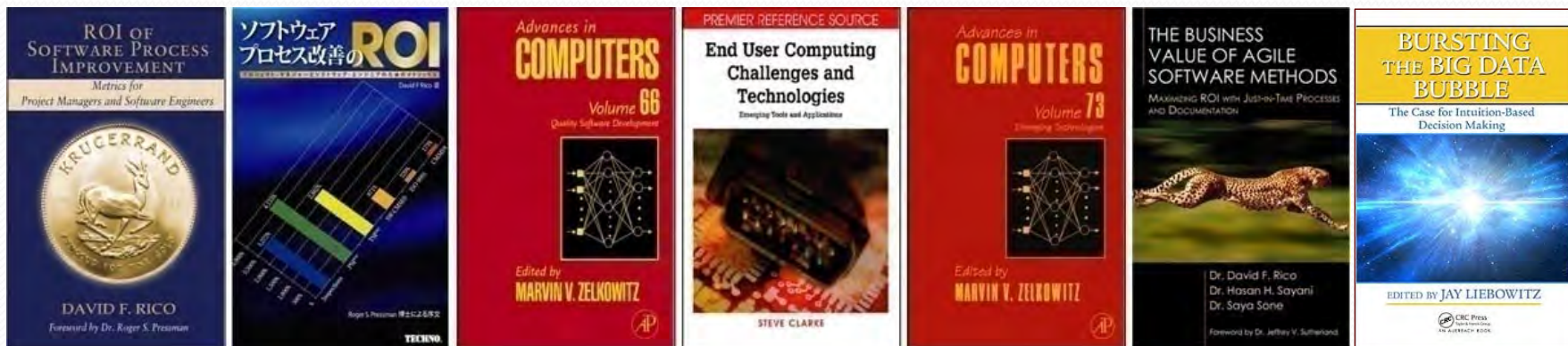
→ *Career systems & software engineering methodologist*
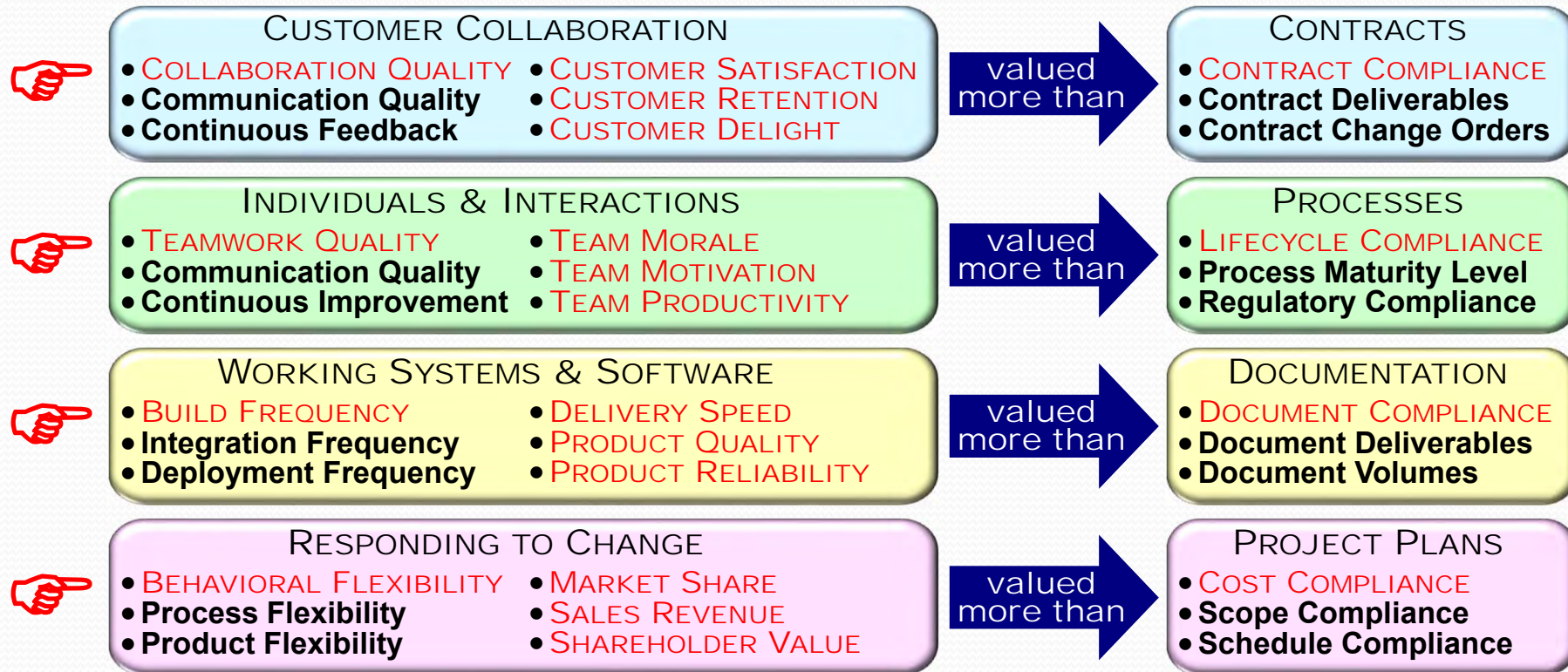→ *Lean-Agile, Six Sigma, CMMI, ISO 9001, DoD 5000*
→ *NASA, USAF, Navy, Army, DISA, & DARPA projects*
→ *Published seven books & numerous journal articles*
→ *Intn'l keynote speaker, 195+ talks to 14,300 people*
→ *Specializes in metrics, models, & cost engineering*
→ *Cloud Computing, SOA, Web Services, FOSS, etc.*
→ *Professor at 7 Washington, DC-area universities*

What is AGILITY?

- **A-gil-i-ty** (ə-'ji-lə-tē) Property consisting of quickness, lightness, and ease of movement; To be very nimble

  - *The ability to create and* **respond to change** *in order to profit in a turbulent global business environment*

  - *The ability to* **quickly reprioritize** *use of resources when requirements, technology, and knowledge shift*

  - *A very* **fast response** *to sudden market changes and emerging threats by intensive* **customer interaction**

  - *Use of* **evolutionary**, **incremental**, *and* **iterative** *delivery to converge on an optimal customer solution*

  - *Maximizing* **BUSINESS VALUE** *with right sized, just-enough, and just-in-time processes and documentation*

Highsmith, J. A. (2002). *Agile software development ecosystems*. Boston, MA: Addison-Wesley.

What are AGILE METHODS?

- Collaboration maximizes customer satisfaction
- Iteration maximizes speed, quality, and feedback
- Adaptability maximizes continuous improvements

CUSTOMER COLLABORATION			CONTRACTS
• COLLABORATION QUALITY • Communication Quality • Continuous Feedback	• CUSTOMER SATISFACTION • CUSTOMER RETENTION • CUSTOMER DELIGHT	valued more than	• CONTRACT COMPLIANCE • Contract Deliverables • Contract Change Orders
INDIVIDUALS & INTERACTIONS			PROCESSES
• TEAMWORK QUALITY • Communication Quality • Continuous Improvement	• TEAM MORALE • TEAM MOTIVATION • TEAM PRODUCTIVITY	valued more than	• LIFECYCLE COMPLIANCE • Process Maturity Level • Regulatory Compliance
WORKING SYSTEMS & SOFTWARE			DOCUMENTATION
• BUILD FREQUENCY • Integration Frequency • Deployment Frequency	• DELIVERY SPEED • PRODUCT QUALITY • PRODUCT RELIABILITY	valued more than	• DOCUMENT COMPLIANCE • Document Deliverables • Document Volumes
RESPONDING TO CHANGE			PROJECT PLANS
• BEHAVIORAL FLEXIBILITY • Process Flexibility • Product Flexibility	• MARKET SHARE • SALES REVENUE • SHAREHOLDER VALUE	valued more than	• COST COMPLIANCE • Scope Compliance • Schedule Compliance

Rico, D. F., Sayani, H. H., & Sone, S. (2009). *The business value of agile software methods*. Ft. Lauderdale, FL: J. Ross Publishing.

How does AGILE WORK?

- ☐ Agile requirements implemented in slices vs. layers
- ☐ User needs with higher business value are done first
- ☞ ☐ Reduces cost & risk while increasing business success

Agile

- Faster
- Early ROI
- Lower Costs
- Fewer Defects
- Manageable Risk
- Better Performance
- Smaller Attack Surface

Traditional

- Late
- No Value
- Cost Overruns
- Very Poor Quality
- Uncontrollable Risk
- Slowest Performance
- More Security Incidents

1   **2 3**

| GUI |
| APIs |
| Applications |
| Middleware |
| Operating System |
| Computer |
| Network |

Seven Wastes

1. Rework
2. Motion
3. Waiting
4. Inventory
5. Transportation
6. Overprocessing
7. Overproduction

- JIT, Just-enough architecture
- Early, in-process system V&V
- Fast continuous improvement
- Scalable to systems of systems
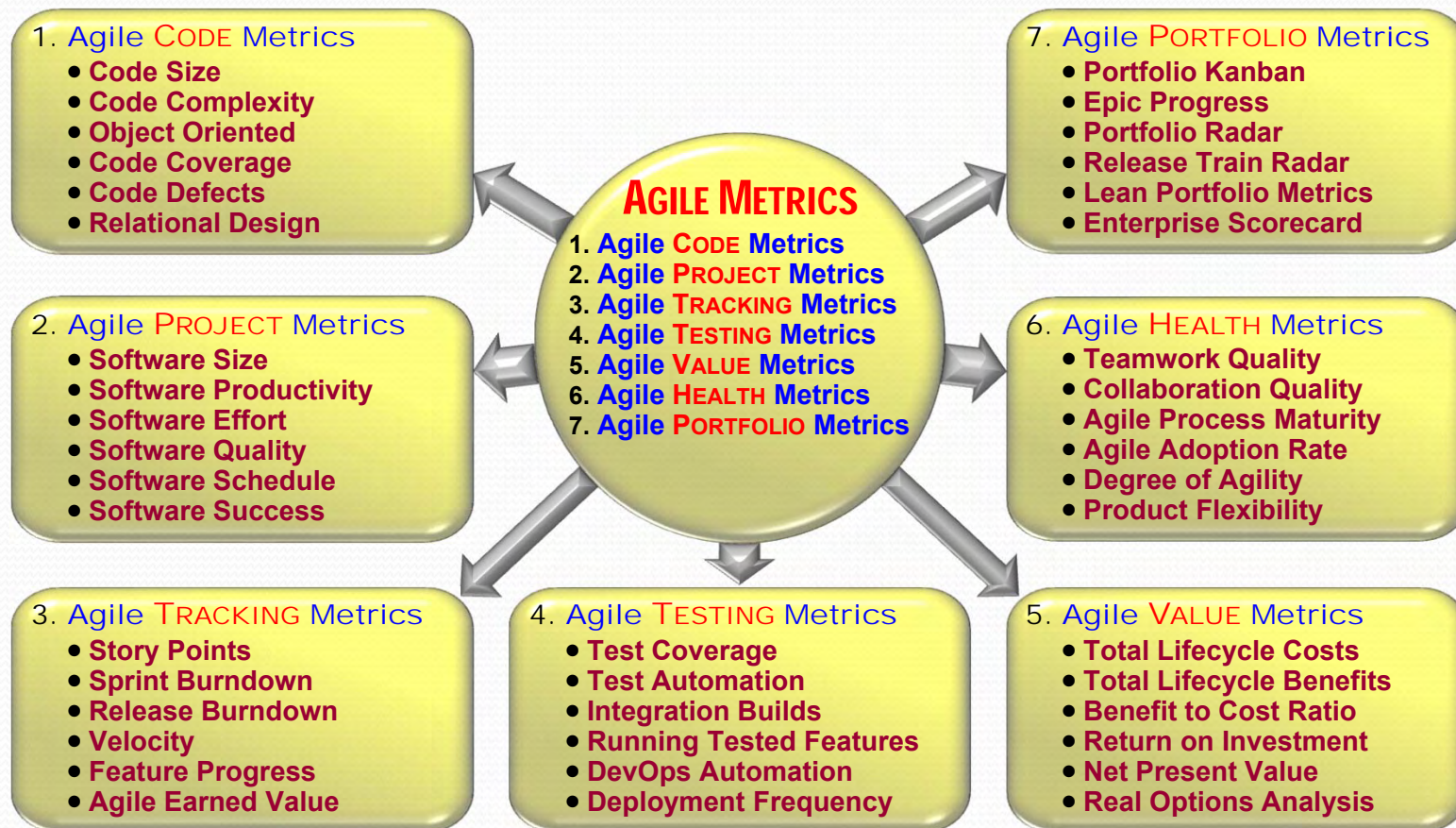- Maximizes successful outcomes

MINIMIZES ➤

◄ **MAXIMIZES**

- Myth of perfect architecture
- Late big-bang integration tests
- Year long improvement cycles
- Breaks down on large projects
- Undermines business success

Shore, J. (2011). Evolutionary design illustrated. *Norwegian Developers Conference, Oslo, Norway.*

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What are **AGILE METRICS?**

- **Met-ric** (mĕt′rĭk) A standard of measurement; system of related measures; quantification of a characteristic
  - Quantitative measure *of a degree to which agile project* processes *or resulting* systems *possess some property*
  - Numerical ratings *to measure the* size, cost, complexity, *or* quality *of software produced using agile methods*
  - Measurement *of a particular characteristic of an agile project's* scope, time, cost, progress, *or* technical perf.
  - *Measure of the degree of* customer collaboration, *team-work, iterative development, or* adaptability *to change*
  - *Ensuring* **BUSINESS VALUE** *by measuring operational and team performance, customer satisfaction, and ROI*

Rico, D. F., Sayani, H. H., & Sone, S. (2009). *The business value of agile software methods*. Ft. Lauderdale, FL: J. Ross Publishing.

Agile METRICS Taxonomy

- Agile methods are based on traditional measures
- Story points, velocity, and burndown basic metrics
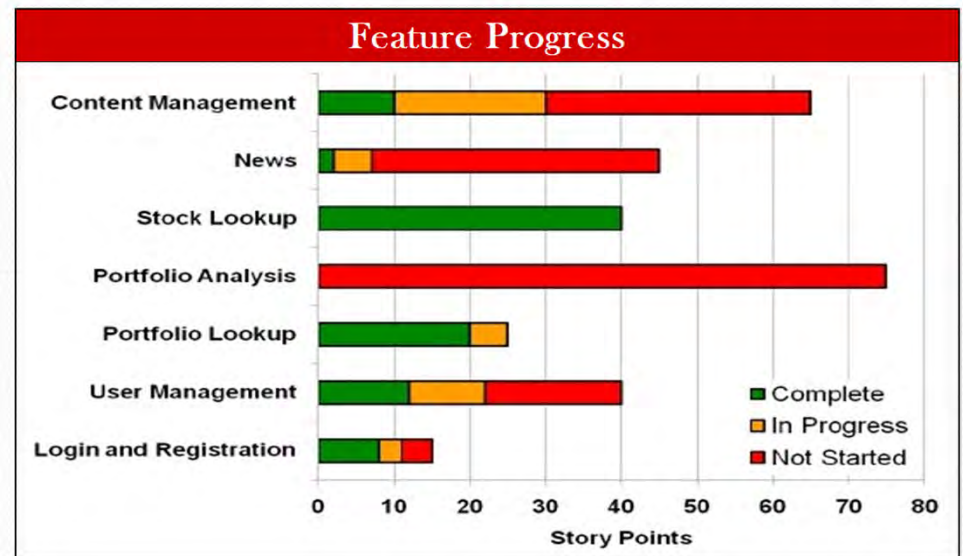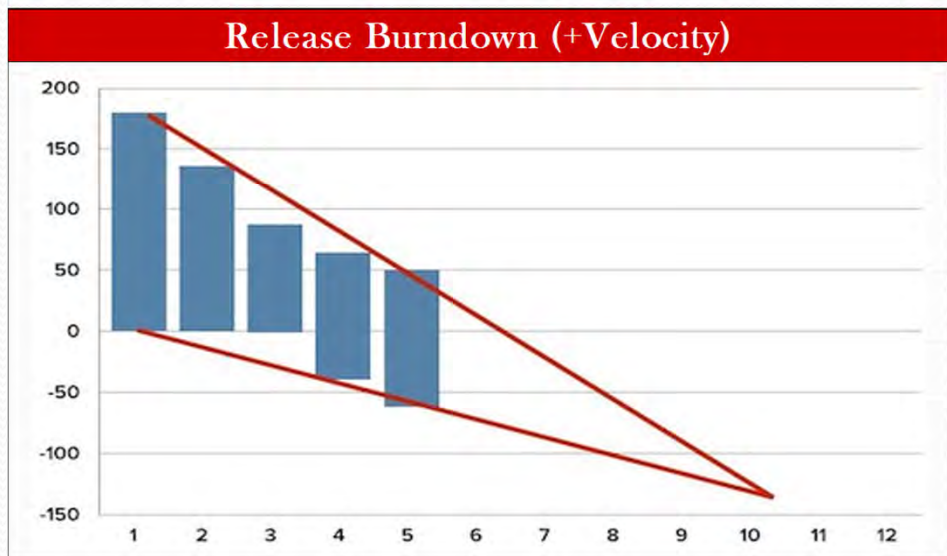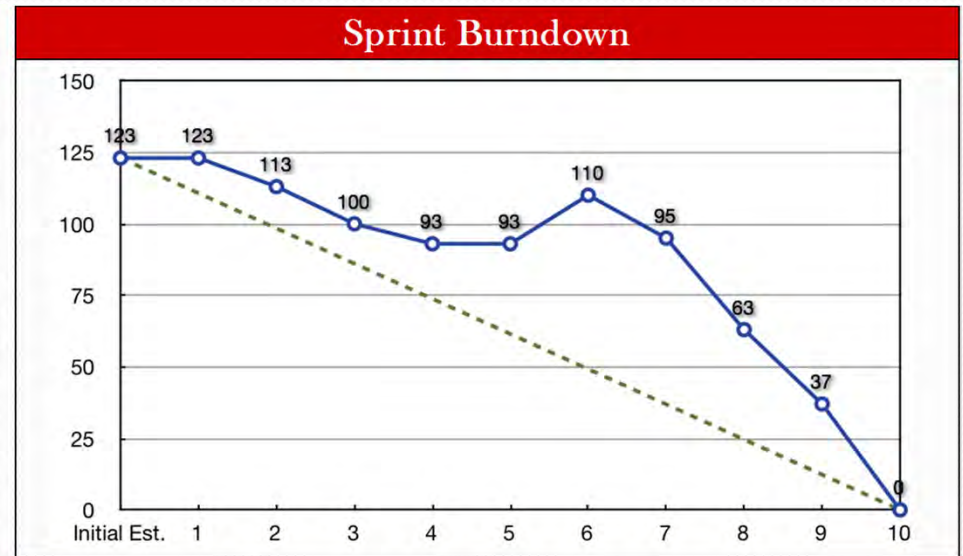- ☞ Experts use Agile EVM, test, ROI & portfolio metrics

1. Agile CODE Metrics
- Code Size
- Code Complexity
- Object Oriented
- Code Coverage
- Code Defects
- Relational Design

2. Agile PROJECT Metrics
- Software Size
- Software Productivity
- Software Effort
- Software Quality
- Software Schedule
- Software Success

3. Agile TRACKING Metrics
- Story Points
- Sprint Burndown
- Release Burndown
- Velocity
- Feature Progress
- Agile Earned Value

AGILE METRICS
1. Agile CODE Metrics
2. Agile PROJECT Metrics
3. Agile TRACKING Metrics
4. Agile TESTING Metrics
5. Agile VALUE Metrics
6. Agile HEALTH Metrics
7. Agile PORTFOLIO Metrics

4. Agile TESTING Metrics
- Test Coverage
- Test Automation
- Integration Builds
- Running Tested Features
- DevOps Automation
- Deployment Frequency

5. Agile VALUE Metrics
- Total Lifecycle Costs
- Total Lifecycle Benefits
- Benefit to Cost Ratio
- Return on Investment
- Net Present Value
- Real Options Analysis

6. Agile HEALTH Metrics
- Teamwork Quality
- Collaboration Quality
- Agile Process Maturity
- Agile Adoption Rate
- Degree of Agility
- Product Flexibility

7. Agile PORTFOLIO Metrics
- Portfolio Kanban
- Epic Progress
- Portfolio Radar
- Release Train Radar
- Lean Portfolio Metrics
- Enterprise Scorecard

Rico, D. F., Sayani, H. H., & Sone, S. (2009). *The business value of agile software methods*. Ft. Lauderdale, FL: J. Ross Publishing.

Agile TRACKING Metrics

- Basic agile metrics confluence of XP-Scrum practices
- XP release planning formed basis of Scrum planning
- Today's basic agile metrics were tailored for Scrum

METRIC	DESCRIPTION
STORY POINTS	Degree of size, difficulty, or complexity of a user story
SPRINT BURNDOWN	Estimated hours completed on a daily basis each iteration
RELEASE BURNDOWN	Estimated story points completed each iteration on a project
VELOCITY	Software productivity expressed in story points per iteration
FEATURE PROGRESS	Number, degree, or percent of planned features completed
AGILE EARNED VALUE	Simplified set of earned value measures for agile projects

Cohn, M. (2006). *Agile estimating and planning*. Upper Saddle River, NJ: Pearson Education.

Agile TRACKING Metrics—*Example*

Story Points

Relative Size	Story Points	Staff Hours	Staff Days	Staff Month	Staff Years	2-Week Sprints	3-Sprint Releases
User Story	1	22	3	0.1	0.0	0.1	0.0
	2	44	6	0.3	0.0	0.1	0.0
	3	67	8	0.4	0.0	0.2	0.1
	5	111	14	0.6	0.1	0.3	0.1
Feature	8	178	22	1.0	0.1	0.4	0.1
	13	289	36	1.7	0.1	0.7	0.2
	21	467	58	2.7	0.2	1.2	0.4
	34	755	94	4.4	0.4	1.9	0.6
Epic	55	1,222	153	7.0	0.6	3.1	1.0
	89	1,977	247	11.4	1.0	4.9	1.6
	144	3,199	400	18.5	1.5	8.0	2.7
	233	5,177	647	29.9	2.5	12.9	4.3

Sprint Burndown

Release Burndown (+Velocity)

Feature Progress

Content Management, News, Stock Lookup, Portfolio Analysis, Portfolio Lookup, User Management, Login and Registration

Legend: Complete (green), In Progress (orange), Not Started (red)

Cohn, M. (2006). *Agile estimating and planning*. Upper Saddle River, NJ: Pearson Education.

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What is AGILE EVM?

- **E-V-M** (ē′vē′ĕm) A standard of measurement; system of interrelated measures; quantification of performance

  - Quantitative *family of* metrics, measures, *and models to determine* project, program, *or portfolio performance*

  - Numerical ratings *to measure* technical, cost, *and time or schedule performance of IT programs and projects*

  - Early warning system *to help indicate when a program, project, or portfolio has* technical *or* financial *difficulties*

  - *A* systematic collection *of measures to objectively track performance of IT-intensive* public sector acquisitions

  - *Helps ensure* **BUSINESS VALUE** *is achieved by measuring technical, cost, and schedule performance early and often*

Sulaiman, T. (2010). *AgileEVM: Information for good decision making*. San Francisco, CA: CollabNet, Inc.
Sulaiman, T., & Smits, H. (2007). Measuring integrated progress on agile software development projects. *Methods & Tools, 5*(3), 2-9.
Sulaiman, T., Barton, B., & Blackburn, T. (2006). Agile EVM: Earned value management in scrum projects. *Agile 2006 Conference, Minneapolis, Minnesota, USA*, 7-16.

Why use AGILE EVM?

- Earned value management created in early 1960s
- EVM adapted to lean & agile methods around 2004
- Enables cost/schedule tracking for gov't & PM sector

Method	Advantages
Traditional EVM	Integrates technical performance, schedule, and cost
	Cost efficiency indicators of program performance
	Very early warnings of program performance problems
	Enables early corrective actions to be implemented
	Project management method in-use for over 40 years
Agile EVM	Adds a missing cost component to agile metrics
	Balances the needs of all project stakeholders
	Optimizes the value of releases and iterations
	Enables better business decisions to be made

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Agile RELEASE Metrics

- ☐ Challenge was to map EVM metrics to agile artifacts
- ☐ Does NOT require any new or additional metrics data
- ☞ ☐ Basic input data are iterations, story points, & budget

Metric	Description
NPI	**Number of planned iterations** in a release
NPS	**Number of planned story points** in a release
TPB	**Total planned budget** for a release
NCS	**Number of completed story points** in a release
NCI	**Number of completed iterations** in a release
TAC	**Total actual cost** for a release
TSC	**Total story points changed** for a release plan

Release Baseline — NPI, NPS, TPB

Release Measures — NCS, NCI, TAC, TSC

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Agile EVM Metrics

- Next issue was to map EVM ratios to agile inputs
- Another challenge was to interpret & validate ratios
- ☞ Based on planned vs. actual iterations & story points

Metric	Description
Base Values	
EPC	Expected percent complete (*NCI divided by NPI*)
PV	Planned value (*EPC multiplied by TPB*)
APC	Actual percent complete (*NCS divided NPS*)
EV	Earned value (*APC multiplied by TPB*)
Agile EV Metrics	
CPI	Cost performance index (*EV divided by TAC*)
EAC	Estimate at complete (*TPB divided by CPI*)
SPI	Schedule performance index (*EV divided by PV*)

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Sulaiman, T., & Smits, H. (2007). Measuring integrated progress on agile software development projects. *Methods & Tools, 5*(3), 2-9.
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Agile PROJECT Metrics—*Example*

- Input data & information is simple & already exists
- Use planned vs. actual story points, iterations & cost
- Assumes agile release planning & estimating are used

FEATURE	ESTIMATED STORY POINTS	COMPLETED STORY POINTS	ACTUAL COST
Welcome Screen	10	10	15
Splash Screen	20	20	30
Login Screen	10	10	20
Google Ads	20		
Catalog Browser	20		
Catalog Editor	10		
Shopping Basket	5		
Shopping Basket Editor	25		
Checkout Process	20		
Invoice Calculation	10		
Credit Card Verification	10		
PayPal Payment Handling	20		
Order Confirmation Email	20		
TOTALS	200	40	$65,000

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Agile **RELEASE** Metrics—*Example*

□ Start with planned iterations, story points, & budget
□ Then re-sample same inputs after iteration complete
☞ □ Important to use new, added, & changed story points

Metric	Description
NPI	4 planned iterations in the release
NPS	200 planned story points in the release
TPB	$175,000 total planned budget in the release
NCS	40 completed story points in the release
NCI	1 iteration completed in the release
TAC	$65,000 total actual cost in the release
TSC	0 total story points changed in the release

Release Baseline → (NPI, NPS, TPB)

Release Measures → (NCS, NCI, TAC, TSC)

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Agile **EVM** Metrics—*Example*

- ☐ Basic planned vs. actual data input into EVM ratios
- ☐ Planned & earned values are derived from input data
- ☞ ☐ Finally CPI & SPI indices are calculated & interpreted

Metric	Description
EPC	$1 \div 4 = 25\%$ (*one of four iterations complete*)
PV	$25\% \times \$175,000 = \$43,750$
APC	$40 \div 200 = 20\%$ (*one-fifth of story points complete*)
EV	$20\% \times \$175,000 = \$35,000$
CPI	$\$35,000 \div \$65,000 = 54\%$ (*CPI < 1 is over budget*)
EAC	$\$75,000 \div 54\% = \$325,000$ (*46% over budget*)
SPI	$\$35,000 \div \$43,500 = 80\%$ (*SPI < 1 is behind schedule*)

Base Values → (EPC, PV, APC, EV)

Agile EV Metrics → (CPI, EAC, SPI)

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Sulaiman, T., & Smits, H. (2007). Measuring integrated progress on agile software development projects. *Methods & Tools, 5*(3), 2-9.
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Agile PROGRAM Metrics—*Example*

- ☐ EVM is especially useful for programs & portfolios
- ☐ Work of multiple teams & projects can be monitored
- ☞ ☐ Scales agile methods to big public sector acquisitions

Team	TPB	PV	EV	TAC	CPI	SPI	EAC
A	$300K	$150K	$150K	$150K	1.00	1.00	$300K
B	$1,000K	$575K	$500K	$625K	0.80	0.86	$1,250K
C	$800K	$175K	$200K	$180K	1.11	1.14	$720K
Total	$2,100K	$900K	$850K	$955K	0.89	0.94	$2,360K

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Sulaiman, T., & Smits, H. (2007). Measuring integrated progress on agile software development projects. *Methods & Tools, 5*(3), 2-9.
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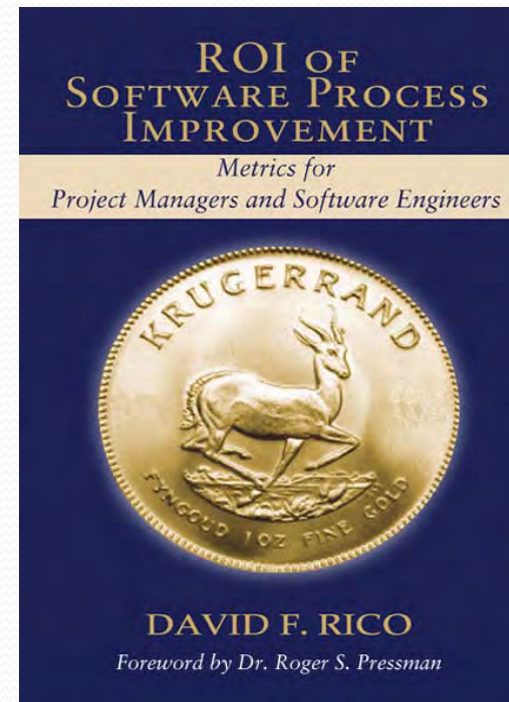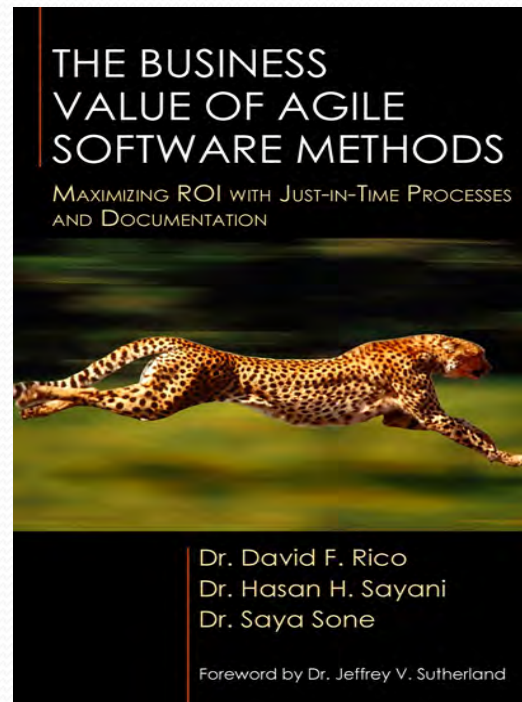
Agile **EVM** Summary

☞ □ Visionaries adapted EVM to agile methods circa 2004
□ Saw need to address government & PM stakeholders
☞ □ Tracks cost & schedule performance for acquisitions

- **MAINSTREAM** - *Lean & agile methods have entered the mainstream*.
- **PUBLIC SECTOR** - *Lean & agile methods preferred in public sector*.
☞ - **ACQUISITION** - *Lean & agile acquisition metrics desperately needed*.
- **METRICS** - *Lean & agile technical, cost, & schedule metrics needed*.
- **TRADITIONAL EVM** - *Traditional EVM is preferred acquisition metric*.
- **AGILE EVM** - *Agile EVM is a needed adaptation of traditional EVM*.
- **COSTS** - *Agile EVM is a method to track lean & agile project costs*.
- **MONITOR** - *Agile EVM is a method to monitor project performance*.
- **WARNING** - *Agile EVM indicates when a project may be in-trouble*.
- **PROGRAM** - *Agile EVM scales lean & agile methods to programs*.
- **PORTFOLIO** - *Agile EVM good for measuring portfolio performance*.
- **TIME** - *Now is the time for lean & agile metrics such as Agile EVM*.

Traditional & AGILE ROI Books

- Guides to software methods for business leaders
- Communicates the business value of IT approaches
- ☞ Rosetta stones to unlocking ROI of software methods

THE BUSINESS VALUE OF AGILE SOFTWARE METHODS

MAXIMIZING ROI WITH JUST-IN-TIME PROCESSES AND DOCUMENTATION

Dr. David F. Rico
Dr. Hasan H. Sayani
Dr. Saya Sone

Foreword by Dr. Jeffrey V. Sutherland

ROI OF SOFTWARE PROCESS IMPROVEMENT

Metrics for Project Managers and Software Engineers

DAVID F. RICO

Foreword by Dr. Roger S. Pressman

- http://davidfrico.com/agile-book.htm (*Description*)
- http://davidfrico.com/roi-book.htm (*Description*)

Dave's PROFESSIONAL CAPABILITIES

Leadership & Org. Change	Strategy & Roadmapping	Acquisition & Contracting	Cost Estimates & Scheduling	Systems Engineering

BPR, IDEF0, & DoDAF		Innovation Management

Valuation — Cost-Benefit Analysis, B/CR, ROI, NPV, BEP, Real Options, etc.

CMMI & ISO 9001		Evolutionary Design

Technical Project Mgt. **Software Development Methods** **Software Quality Mgt.**

PSP, TSP, & Code Reviews		Research Methods

Lean-Agile — Scrum, SAFe, Continuous Integration & Delivery, DevOpsSec, etc.

DoD 5000, TRA, & SRA		Statistics, CFA, EFA, & SEM

Lean, Kanban, & Six Sigma	Metrics, Models, & SPC	Workflow Automation	Big Data, Cloud, NoSQL	Modeling & Simulations

STRENGTHS – Data Mining • Gathering & Reporting Performance Data • Strategic Planning • Executive & Management Briefs • Brownbags & Webinars • White Papers • Tiger-Teams • Short-Fuse Tasking • Audits & Reviews • Etc.

34+ YEARS IN IT INDUSTRY

- **Data mining**. Metrics, benchmarks, & performance.
- **Simplification**. Refactoring, refinement, & streamlining.
- **Assessments**. Audits, reviews, appraisals, & risk analysis.
- **Coaching**. Diagnosing, debugging, & restarting stalled projects.
- **Business cases**. Cost, benefit, & return-on-investment (ROI) analysis.
- **Communications**. Executive summaries, white papers, & lightning talks.
- **Strategy & tactics**. Program, project, task, & activity scoping, charters, & plans.

PMP, CSEP, FCP, FCT, ACP, CSM, SAFE, & DEVOPS

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