Parametric Project Monitoring and Control: Performance-Based Progress Assessment and Prediction

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Software projects fail more often than not
Project success ⇐ Good management
Measurement objectifies management
Software projects are governed by dynamic properties
  • Properties currently accounted for in the Project Planning process
  • Properties should also be accounted for in the Project Monitoring and Control process
Project Monitoring ⇐ Performance Measurement
4-D Earned Value objectifies progress
Project Control ⇐ Control Limits
Re-Baselining ⇐ Performance-Based Forecasting
Communication is essential to successful project management
Things are Getting Better; however, There’s Still Room For Improvement

**Success:** The project is completed on time and on budget, with all features and functions

**Challenge:** Over budget, over time, offers fewer features than originally specified

**Failure:** Project is cancelled prior to completion

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How does ineffective management of resources (people, time, $) contribute to this problem?


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**Mnemonic Aid for Software Project Management**

- **Planning** – estimating, scheduling
- **Resourcing** – interviewing, hiring, motivating
- **Organizing** – establishing interpersonal communication paths and rules, mapping resources to tasks
- **Training** – teaching, mentoring
- **Equipping** – acquiring and allocating equipment, tools, materials, supplies, products etc.
- **Controlling** – directing, measuring, correcting and/or replanning
- **Transitioning** – delivering, reviewing, analyzing, archiving
Project Management Context

- Estimate & Plan
- Monitor & Control
- Measure & Analyze

Knowledge & Experience

Baseline(s) & Final Actuals

Baseline

To-date Actuals
Process Focus (CMMI™)

- **Project Planning**
  - Establish Estimates
  - Develop a Project Plan
  - Obtain Commitment to the Plan

- **Project Monitoring and Control**
  - Monitor Project Against Plan
  - Manage Corrective Action to Closure

- **Measurement and Analysis**
  - Align Measurement and Analysis Activities
  - Provide Measurement Results
Software Development and Measurement

Staffing (people, time)
Effort (person-months)
Cost (currency)
Desire

Effective Technology (coefficient)
Technology
Friction
Defects (count)

Software Development Process
Start
Finish

Time (calendar months)
Size (work units)
Size (work units)

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Fundamental Measures

Size
Effective Technology
Time
Effort ➔ Cost, Staffing
Defects
es·ti·mate (es'ti mit), n.
an approximate judgment or calculation, as of the value or amount of something

a prediction that is equally likely to be above or below the actual result (Tom DeMarco)

**A WELL FORMED ESTIMATE IS A DISTRIBUTION**
Brooks’ Law (Software Equation)

- Adding people to a late project makes it later.
- Development time (duration) and development effort (labor) are not linearly interchangeable.

Paul Masson’s Law Applied to Software Development (Minimum Time Equation)

- No [software] before its time.
- Each and every project, by its nature (technical difficulty), can effectively handle only so much staffing acceleration; therefore, there exists, for each and every project, some minimum achievable development time.

Parkinson’s Law (Optimal Effort Equation)

- Work expands so as to fill the time available for its completion.
- There exists, for each and every project, some point of maximum productivity; i.e., some point that represents the most efficient use of labor on the project.
For a given Size and Technology

Paul Masson’s Law

Parkinson’s Law

Minimum Time

Optimal Effort

Brooks’ Law

Elapsed Calendar Time (months)

Effort (person-months)

Impossible

Reasonable

Inefficient
Software Project Management
Ad Hoc Process

Desire → Estimating → Scheduling → Directing → Measuring → Software Development Process
Desire → Estimating → Scheduling → Directing → Software Development Process

Measuring

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Software Project Management
Fully Managed Project

Desire → Estimating → Scheduling → Directing → Software Development Process

Measuring
Performance Measurement: Measures and Metrics

Fundamental Cost of Work Measures
- **Baseline Budget** – Budget at Completion (BAC)
- **Planned** – Budgeted Cost of the Work Scheduled (BCWS)
- **Earned** – Budgeted Cost of the Work Performed (BCWP)
- **Spent** – Actual Cost of the Work Performed (ACWP)

Variances (Differences between Cost of Work Measures)
- Schedule Variance (SV)
- Cost Variance (CV)
- Budget Variance (BV)
- Time Variance (TV)
Performance Measurement: Measures and Metrics

Performance Indices – (Ratios Between Cost of Work Measures)
- Schedule Performance Index (SPI)
- Cost Performance Index (CPI)
- Budget Performance Index (BPI)
- Time Performance Index (TPI)
- Composite Performance Index (XPI)
- To-Complete Performance Index (TCPI)

Status and Forecasting Metrics
- Estimate at Completion (EAC)
- Estimate to Complete (ETC)
Three Unit Systems for Performance Measurement Values

- **Monitory Value** – units of currency; e.g.:
  - $  
  - £  
  - €

- **Effort Value** – units of labor; e.g.:
  - person-hours, staff-hours, effort-hours, labor-hours  
  - person-months, staff-months, effort-months, labor-months

- **Normalized Value** – unitless
  - % of full scale
4-D Earned Value

- SDLC Primary Activity Completion
- Artifact Completion
- Milestone Completion
- Defect Discovery / Removal
Example Project: Metrics Charts at Project Start (Initial Plan)
Example Project: Metrics Charts at System Design Review

Status Dashboard - Program: CPU 1

Defects Tracking

CPU 1

Performance Indices

CPU 1 (Cumulative)

Health Status Indicator

CPU 1

Schedule Variance | Time Variance | Cost Variance | Size Growth | Defects
WORSE | WORSE | WORSE | NO CHANGE | WORSE
N/A | N/A | N/A | N/A | N/A
N/A | N/A | N/A | N/A | N/A
N/A | N/A | N/A | N/A | N/A

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Example Project: Metrics Charts at Software Requirements Review

Status Dashboard - Program: CPU 1

CPU 1 (Cumulative)

Defects Tracking

Health Status Indicator

CPU 1

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Example Project: Metrics Charts at Critical Design Review

Status Dashboard - Program: CPU 1

CPU 1

% of Baseline Plan

Baseline Plan

Defects Tracking

CPU 1

Defects

Defects

Estimated Defects Reported

Estimated Defects Removed

Actual Defects Reported

Actual Defects Removed

CPU 1 (Cumulative)

Performance Indices

Index

Date

CPI

SPI

TPM

Defects

Schedule

Variance

Time

Variance

Cost

Variance

Size

Variance

Defects

Better

Worse

Better

No Change

Worse

N/A

N/A

N/A

N/A

N/A
Performance-Based Forecasting and Re-Baselining

1. Start a new estimate
2. Update size estimate
3. Update technology assumptions
4. Update schedule assumptions
5. Update staffing assumptions
6. Update labor rate and FTE assumptions
7. Time now calibration
8. Communicate the results
9. Re-Baseline the project
Example Project: Metrics Charts
Update Size Estimate
Example Project: Metrics Charts
Update Technology Assumptions

Status Dashboard - Program: CPU 1

- PFMS Schedule Accomplishments
- Performance Indices

CPU 1 (Cumulative)

Defects Tracking

Health Status Indicator

CPU 1

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Example Project: Metrics Charts
Update Staffing Assumptions
Example Project: Metrics Charts

Re-Baseline the Project

Status Dashboard - Program: CPU 1

PFM0 Schedule Accomplishments

Performance Indices

CPU 1 (Cumulative)

Defects Tracking

Health Status Indicator

CPU 1

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Example Project: Metrics Charts

Update Staffing Assumptions
Example Project: Metrics Charts
Re-Baseline the Project
Example Project: Metrics Charts at Component Int. & Test Complete
Example Project: Metrics Charts

at Program Test Complete
Example Project: Metrics Charts at Project Finish (Initial Delivery)
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