Leading Indicators for Project Management

Project Headlights

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Agenda

- Motivation
- “Headlights”
- Strategies for Leading Indicators
- Common Leading Indicators
- “Back-up Lights”
- Summary
Motivation

- The outcome of a project always involves uncertainty, especially if more than one dimension of performance is considered.
- Measurement results often viewed as “snapshot in time”, implications of current conditions not understood.
- Systematic view of measurement needed to anticipate and understand project performance, enables definition of “leading indicators” or “headlights.”
No “measure” is intrinsically a leading indicator

Leading Indicator = f (measure, time, interpretation)

Not leading indicators:
- Customer Satisfaction
- Earned Value
Types of Indicators

- Leading Indicators
- Current Indicators
- Trailing Indicators
“Headlights” (Leading Indicators)

- Under specific conditions, an individual measure or collection of measures may be predictive of future performance.
- “Headlights” should be planned into the project – can be expensive to mount as an option.
- No *generic* answer as to exactly what to measure for a *specific* project.
- Many common measurement practices obscure the actual situation, providing “back-up lights” instead.
Requirements for Leading Indicators

- Timely data collection and analysis
- Knowledge of what is important to success
- Measures with leading indicator properties (strategies)
- Interpretation and use of the measures as leading indicators
Projects are Systems

- Many interacting internal and external factors
- Influence of any individual factor varies over time
- Measure factors likely to affect the performance factor of interest, not just the performance factor directly
- Common tendency to avoid recognition of problems as opposed to searching for potential problems
Interactions Among Factors

Functional Size

Product Size

Effort

Likely Causes

Likely Effects

Customer Satisfaction

Schedule

Process Performance

Product Quality

Adapted from J. McGarry, D.Card, et al., Practical Software Measurement, Addison Wesley, 2002
Strategies for Leading Indicators

- One measure predicts future values of another measure
- Values of a measure predict future values of the same measure
- A measure tracks a basic constraint or limit to performance
- A measure captures risk or uncertainty
Three Common Leading Indicators

- Process Compliance – failure to follow the defined plan and process usually results in failure to meet budget, schedule, and quality objectives.

- Requirements Volatility – uncertainty about the project objectives usually results in delays, rework, and inadequate testing.

- Risk Exposure – project activities must reduce risk in order to reach a successful conclusion.
Unusual results in one dimension may predict problems in others!
Quantification of Risk and Uncertainty

- Risk of undesirable events
- Lack of information
- Variability in performance
Risk Exposure

![Graph showing Risk Exposure over time]

- **Risk Referent (Planned Exposure)**
- **Current Estimated Exposure**
Planning Uncertainty into a Project

- On-Time
- Late
- Don't Know

Frequency (# Milestones)

- 02/28/97
- 03/30/97
- 04/30/97
- 05/30/97
- 06/30/97
- 07/30/97
- 08/30/97
- 09/30/97
- 10/30/97
- 11/30/97
- 12/30/97
- More

project End
Variation in Performance

Common Causes Determine Overall Level of Performance

Unmanaged Variation = Unmanaged Risk

Special Causes Produce Unusual Differences
Process Variability

From D.Card, Controlling the Object-Oriented Design Process, CNRC Conference on Quality Assurance of Object-Oriented Software, February 2000
Longitudinal Predictions

- Involves chains of activities (e.g., inspections) or continuing activities (e.g., requirements changes) that span the product life-cycle
- Values of performance factor in one activity relate to subsequent activities
- May be described analytically, empirically, or simulated
Example Defect Profile

Post delivery defects are those reported within 6 months following release of the software to the field.

Potential Constraints

- Staff Availability
- Annual Budget
- Specialized Facilities
Common “Back-up Lights”

- Cumulative measures
- Percentages
- Focus on a single factor
- Ambiguous and inconsistent measurement definitions
Cumulative View

Typical View of Cost

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<th>Month</th>
<th>Cost Performance Index</th>
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<tr>
<td>1</td>
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<td>0.75</td>
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</tbody>
</table>

Cost Performance Index = \[
\frac{\text{Sum to date of Budgeted Cost of Work Performed}}{\text{Sum to date of Actual Cost of Work Performed}}
\]

Series 1
Individual View

Changes can be detected as they occur

Individuals chart with Shewhart Control Limits

- **Series 1**: Center = 0.97, UCL = 1.2466, LCL = 0.6934
- **Zone A Above**: Change can be detected as they occur
- **Zone B Above**: Change can be detected as they occur
- **Zone A Below**: Change can be detected as they occur
- **Zone B Below**: Change can be detected as they occur

Month
Process Performance Models

- All effective PPMs are leading indicators
- Not all leading indicators are valid PPMs
Summary

- Consider the project as a system
- Plan “Headlight” measures into the project
- Avoid measurement practices that obscure the situation
- Ensure that measures are well-defined
- Remember “leading” is relative
- Don’t forget about constraints and risks
- Get managers to think in terms of leading indicators