

Front-End Engineering and Design: Influence Over a Project's Outcome

June 27 - 30, 2010
at the Atlanta Marriott Marquis



TCM - Cost Engineering on My Mind

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OWN.02

Author Biography

- **Degree:**
 - **B.S. Civil and Architectural Engineering**
 - **Minor and Certificate of Business**
- **University:**
 - **University of Texas at Austin**
- **Years of Experience:**
 - **Less than 1 Year**
- **Professional Field:**
 - **Project Management & Project Controls with Journeyman Construction**
- **Something you do not know about me:**
 - **I am currently on the project team for a Courthouse Restoration in Amarillo, TX**
 - **Hobbies/Interests include:**
 - **Hiking and Mountain Biking the beautiful trails around central Texas**
 - **Playing City League Sports**
 - **Following my alumni Texas Longhorns sports teams**



Author Biography

- **Degree:**
 - **Bachelor of Science: Mechanical Engineering**
- **University:**
 - **University of Kansas**
- **Years of Experience:**
 - **32**
- **Professional Field:**
 - **Cost Engineering Consultant: Benchmarking**
- **Something you do not know about me:**
 - **Rock/Blues artist: www.youtube.com/user/deepblueharp**



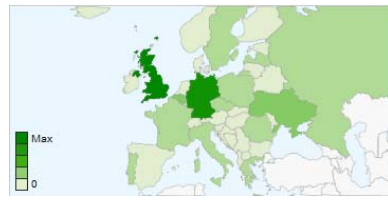
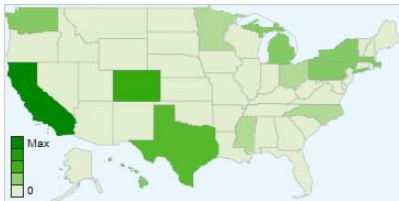
DeepBlueHarp



Walk Away



Caught Between Earth and Glory



- **Not Systems**
- **Not Checklists**
- **Not Processes**
- **Not Procedures**
- **And I am NOT going to address:**

The Holistic Characterization of Project Dynamics and the Affect on Cost and Schedule from a Statistical View after Normalization of Project Variables within the Subset of Applicable Project Management Drivers...

Schedule Gantt Chart



Total Project Cycle Duration

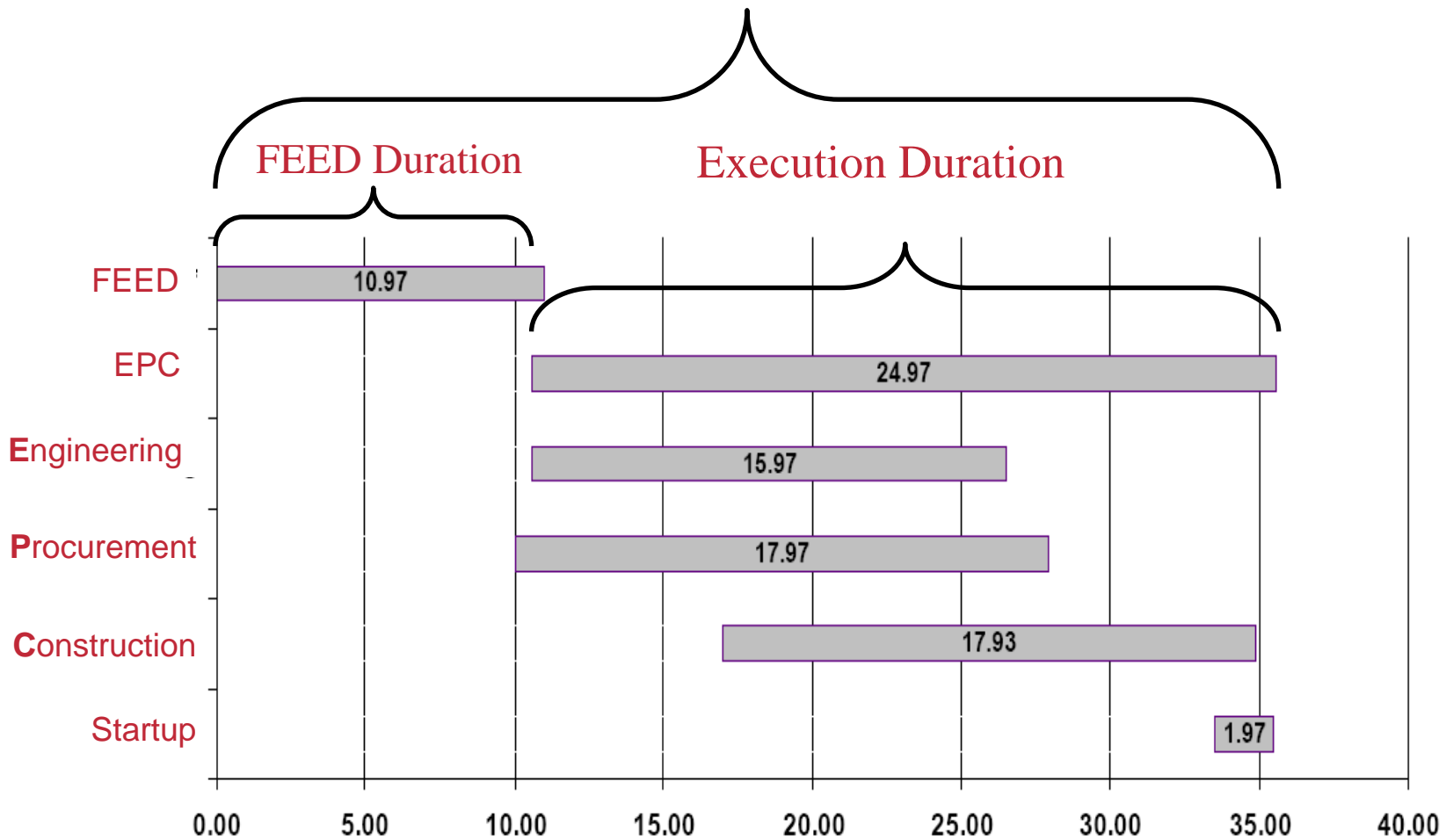


Figure 1



- **PM: Project Management: controls project scope (Owner)**
- **EM: Engineering Management: controls project scope (contractor)**
- **Engineering Discipline: develops scope into deliverables**
 - **Drawings**
 - **Specifications**
 - **Procurement**
 - **Schedules**
 - **Estimates**
 - **Engineering Discipline hours do not include EM hours**
- **Construction: builds the asset**
- **Construction Management: controls construction objective**
- **Total Office Hours: PM, EM, Engineering Discipline hours**



- **FEED Duration is where leadership is most important to set the objectives of the project**
- **FEED is inefficient by non-germane activities**
 - **Piping Isometrics before scope of project is determined**
 - **High risk of engineering items that lock down scope pre-maturely**
 - **Out-of-sequence work causing rework later in detailed engineering or construction**
- **FEED should be staffed by high-end professionals**

Is our Project Management System Optimized?

Are we accomplishing what we set out to do?

Are we leaders?

Definitions: Critical Success Factors



Metric	Calculation
<i>FEED Duration Percent of Total Project Cycle Duration</i>	$\frac{\text{FEED Duration}}{\text{Total Project Cycle Duration}}$
<i>Percent of Engineering Discipline hours complete at Full Funding</i>	$\frac{\text{FEED Detail Eng Hrs}}{\text{FEED Detail Eng Hrs} + \text{Execution Detail Eng Hrs}}$
<i>FEED Percent of Office Hours</i>	$\frac{\text{FEED hrs (PM + Eng Detail + EM)}}{\text{Total Hrs (PM + Eng Detail + EM)}}$
<i>PM and EM Percent of FEED Office Hours</i>	$\frac{\text{FEED Hrs (PM + EM)}}{\text{FEED Hrs (PM + Eng Detail + EM)}}$

Table 1: Critical Success Factors



- **Evaluation of cost and schedule compared to industry average (expressed as an index)**
- **This is not predictability which is growth (accuracy) from estimate to actual (expressed as a percentage)**
- **A project can have great performance and lousy predictability**
 - **The goal is to get both right on target**
- **Obviously, you have to have a LARGE DATABASE**
 - **Ours has several thousand projects to perform this type of research**
 - **We want to roll out a deepwater study at AACE**

An Indicator is NOT a guarantee of outcome.

Definitions: Key Performance Indicators



Metric	Calculation
<i>Project Cost Growth</i>	$\frac{\text{Total Project Cost} - \text{Budget at Full Project Funding}}{\text{Budget at Full Project Funding}}$
<i>Project Execution Schedule Growth</i>	$\frac{\text{Actual Exec. Duration} - \text{Predicted Exec. Duration at Full Project Funding}}{\text{Predicted Exec. Duration at Full Project Funding}}$
<i>Total Project Cycle Duration Index</i>	$\frac{\text{Total Project Cycle Duration}}{\text{Industry Average total cycle duration}}$
<i>Execution Duration Index</i>	$\frac{\text{Execution Duration (EPC Duration)}}{\text{Industry Average Total EPC Cycle Duration}}$
<i>Cost Index</i>	$\frac{\text{Project Actual \$TIC gross}}{\text{Industry average cost}}$
Rework <i>Percent Eng. Complete during Construction Phase</i>	$\frac{(\text{Actual Eng. end date} - \text{Actual Constr. start date})}{(\text{Actual eng. duration})}$
Table 2: Key Performance Indicators	

Cost vs. Schedule Driven

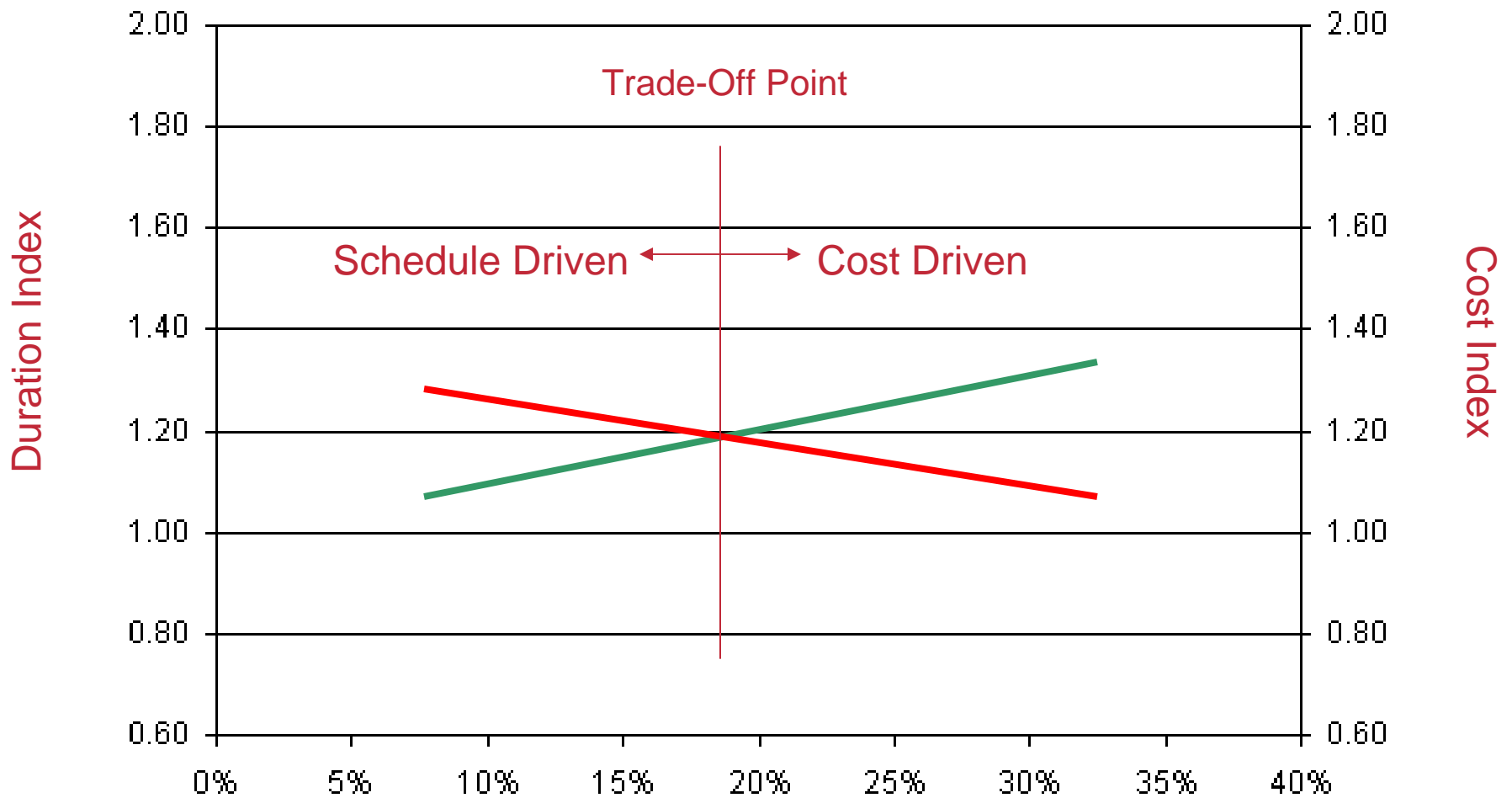


Figure 2

— Execution Duration

— Cost



FEED (or FEL)

Project Management

Engineering



FEED Metrics

FEED Duration % of Total Project Cycle Duration vs. Predictability

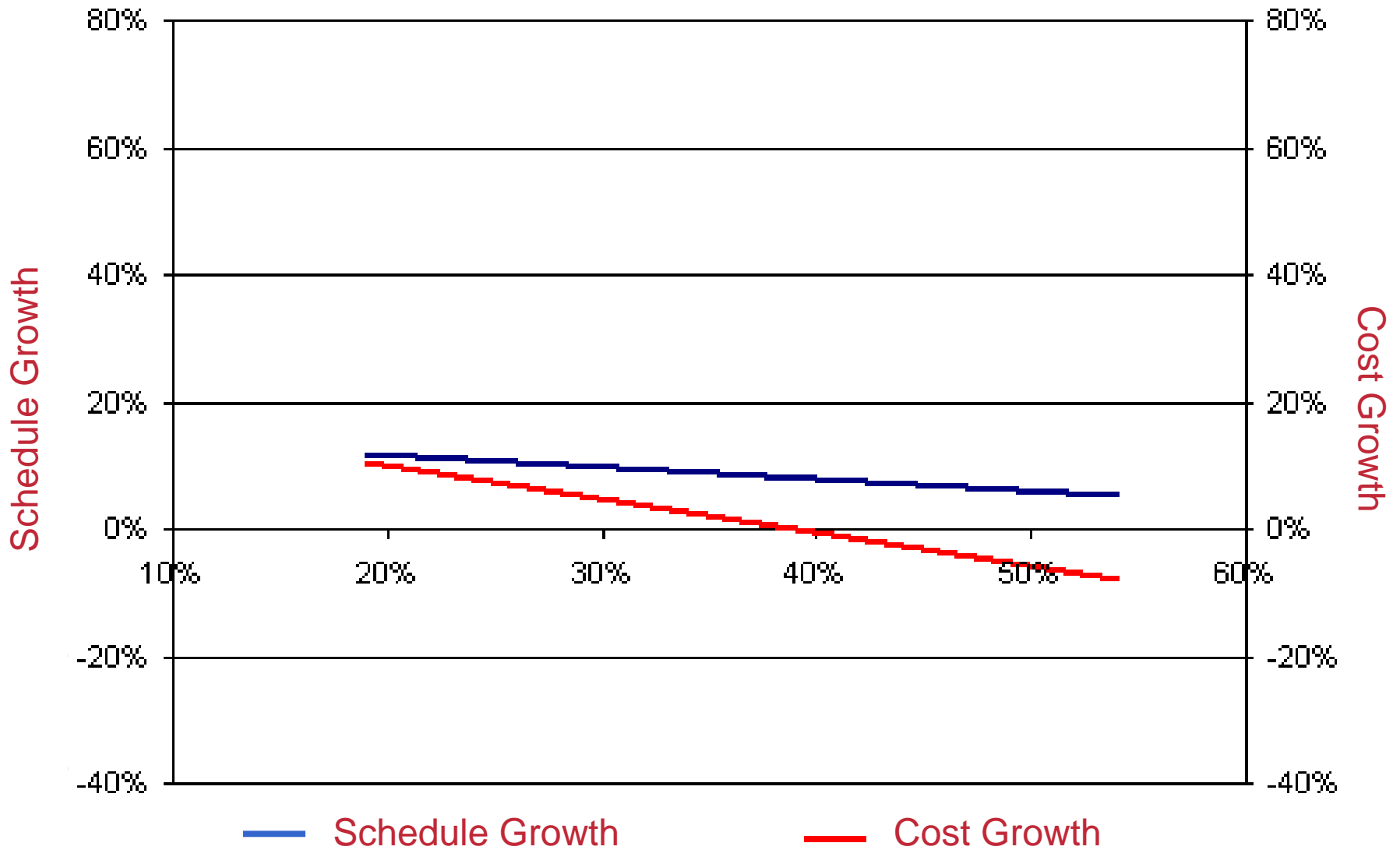


Figure 3

FEED Duration % of Total Project Cycle Duration vs. Performance

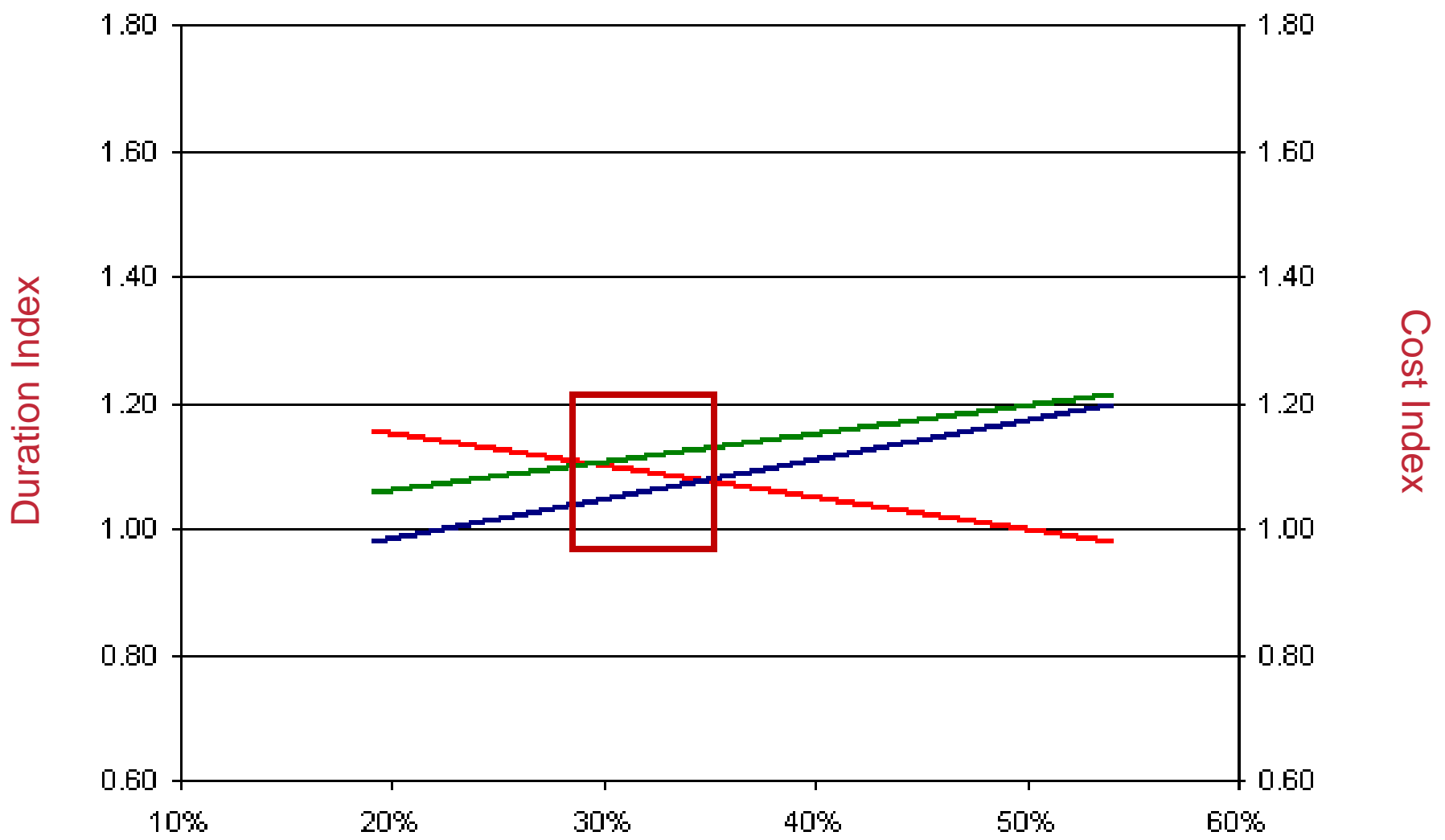


Figure 4 — Total Project Cycle Duration — Execution Duration — Cost

% Total Office Hours in FEED vs. Predictability

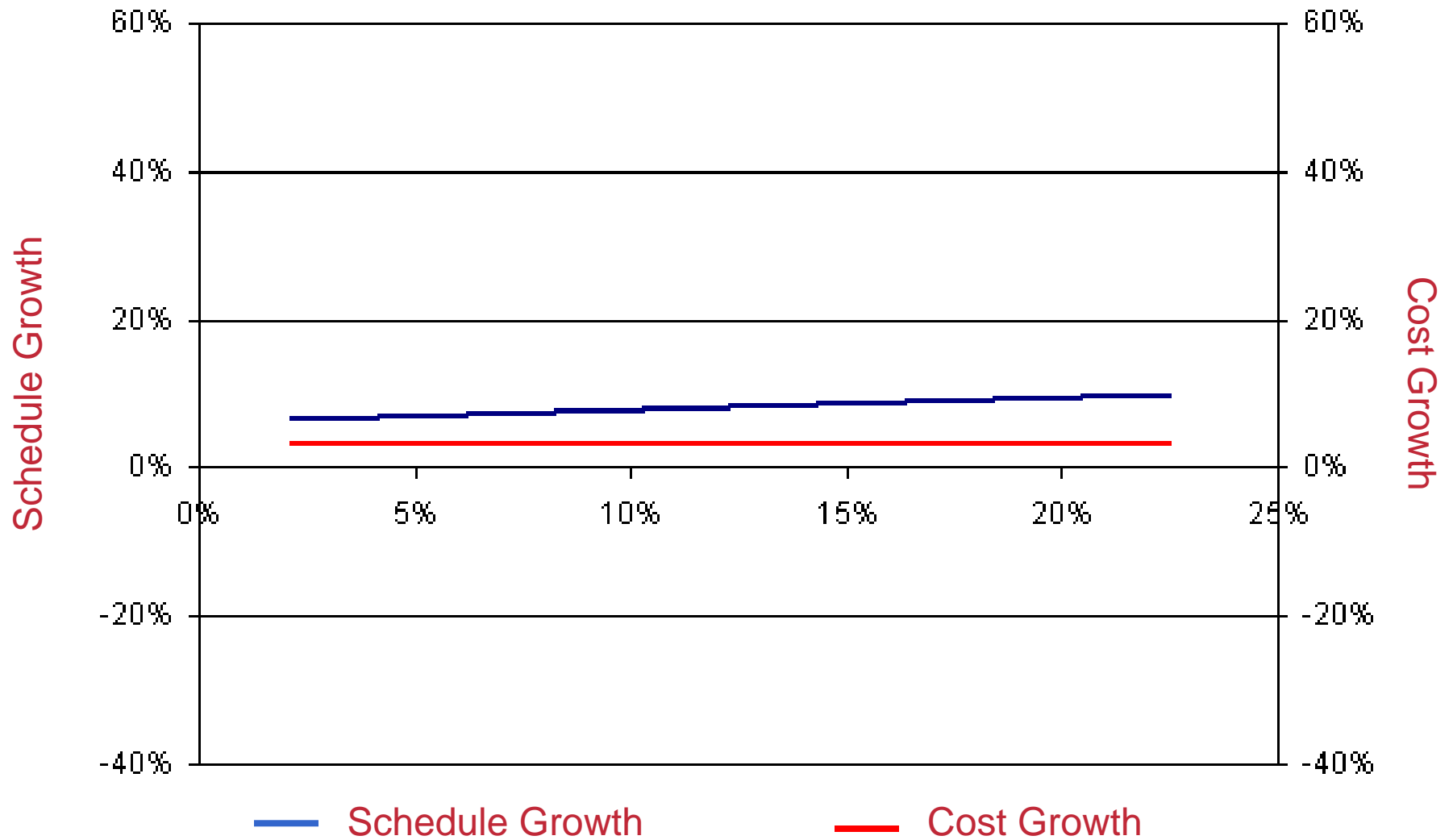


Figure 9

% Total Office Hours in FEED vs. Performance

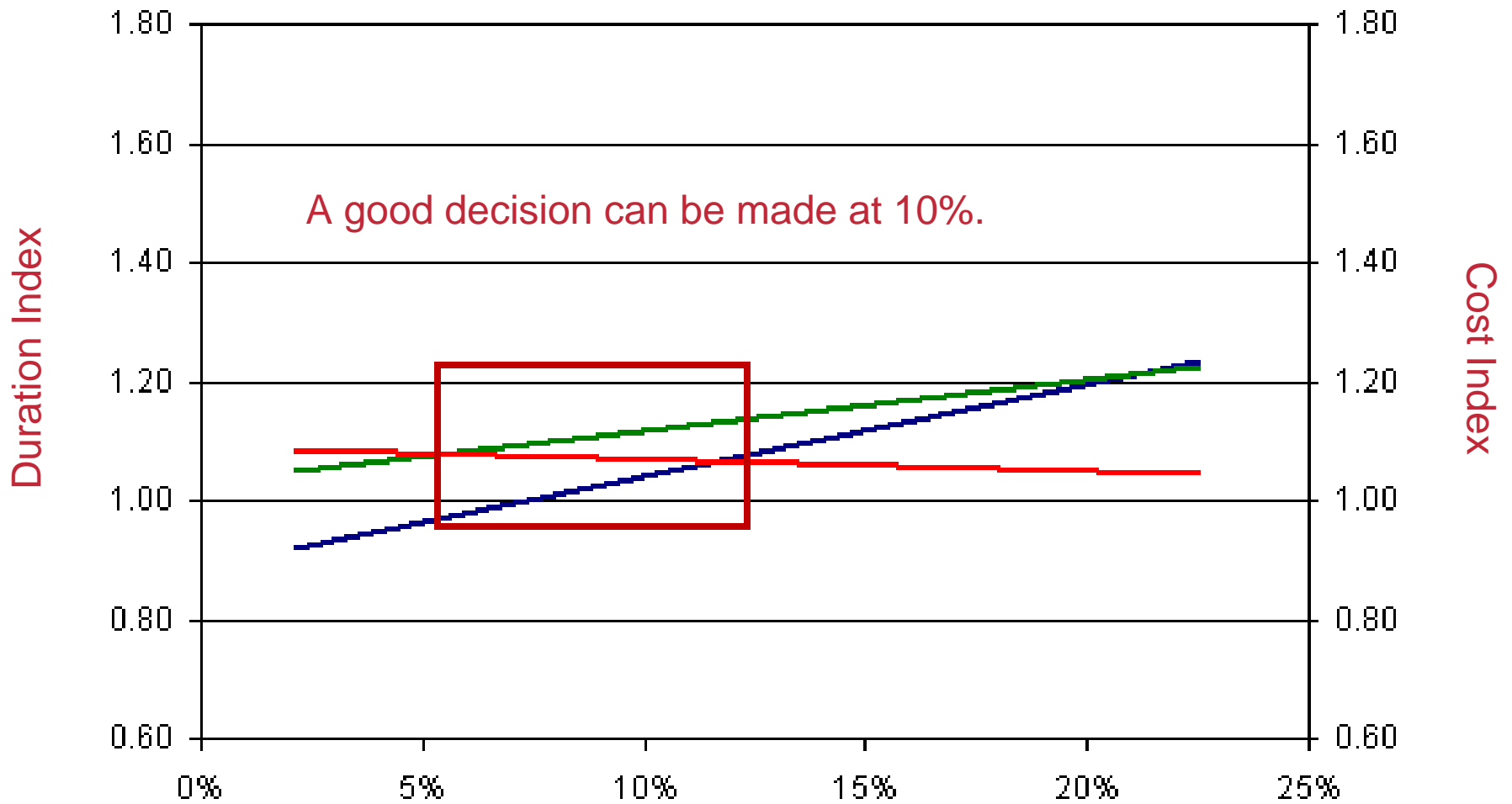


Figure 10 — Total Project Cycle Duration — Execution Duration — Cost

- **A good decision can be made with**
 - **30% of the Total Project Duration devoted to FEED**
 - **10% of the Total Office hours devoted to FEED HOURS**
- **This is a “leading indicator”**

% Engineering Detail Hours Complete at Funding vs. Predictability

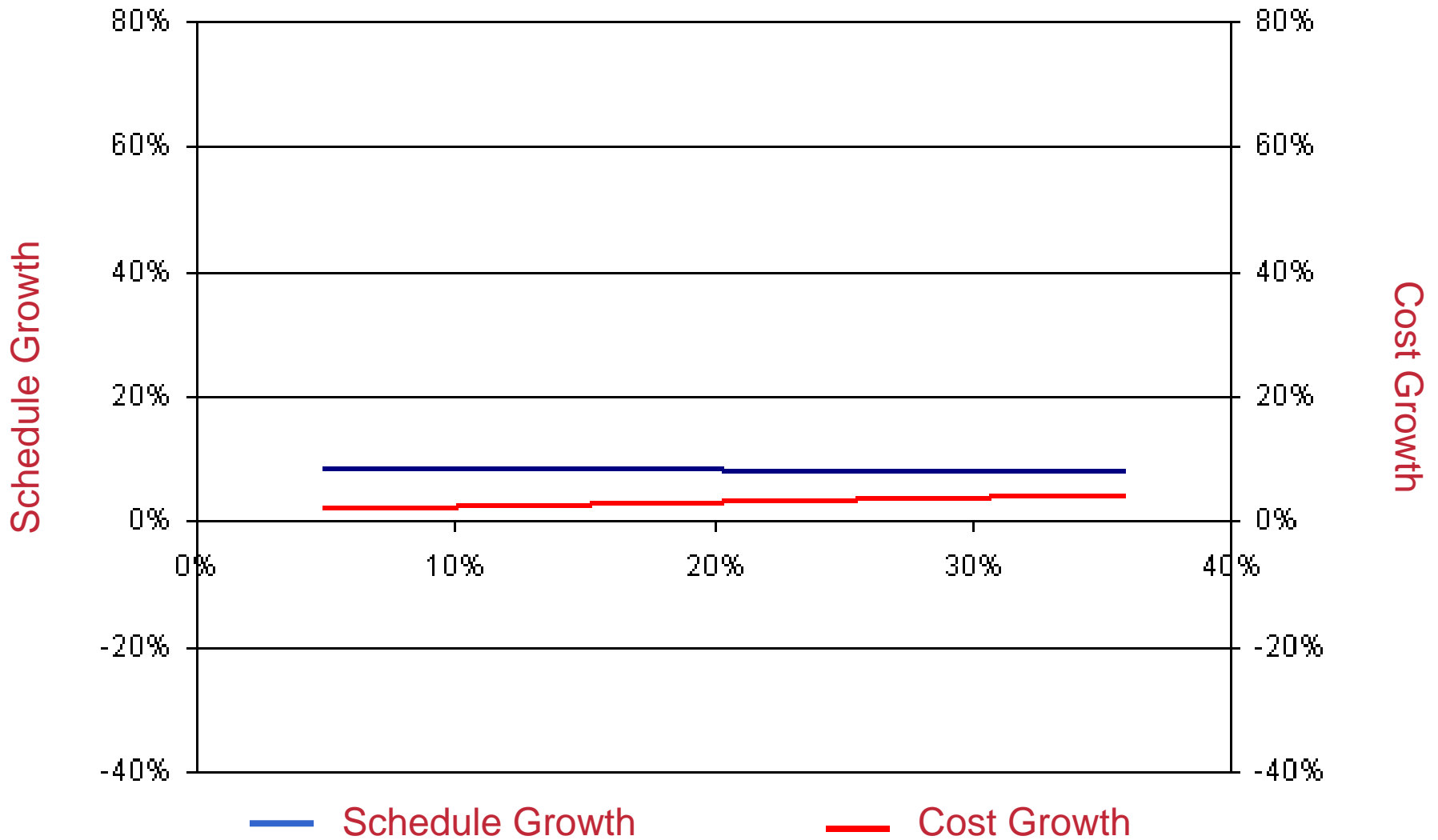


Figure 5

% Engineering Detail Hours complete at Funding vs. Performance

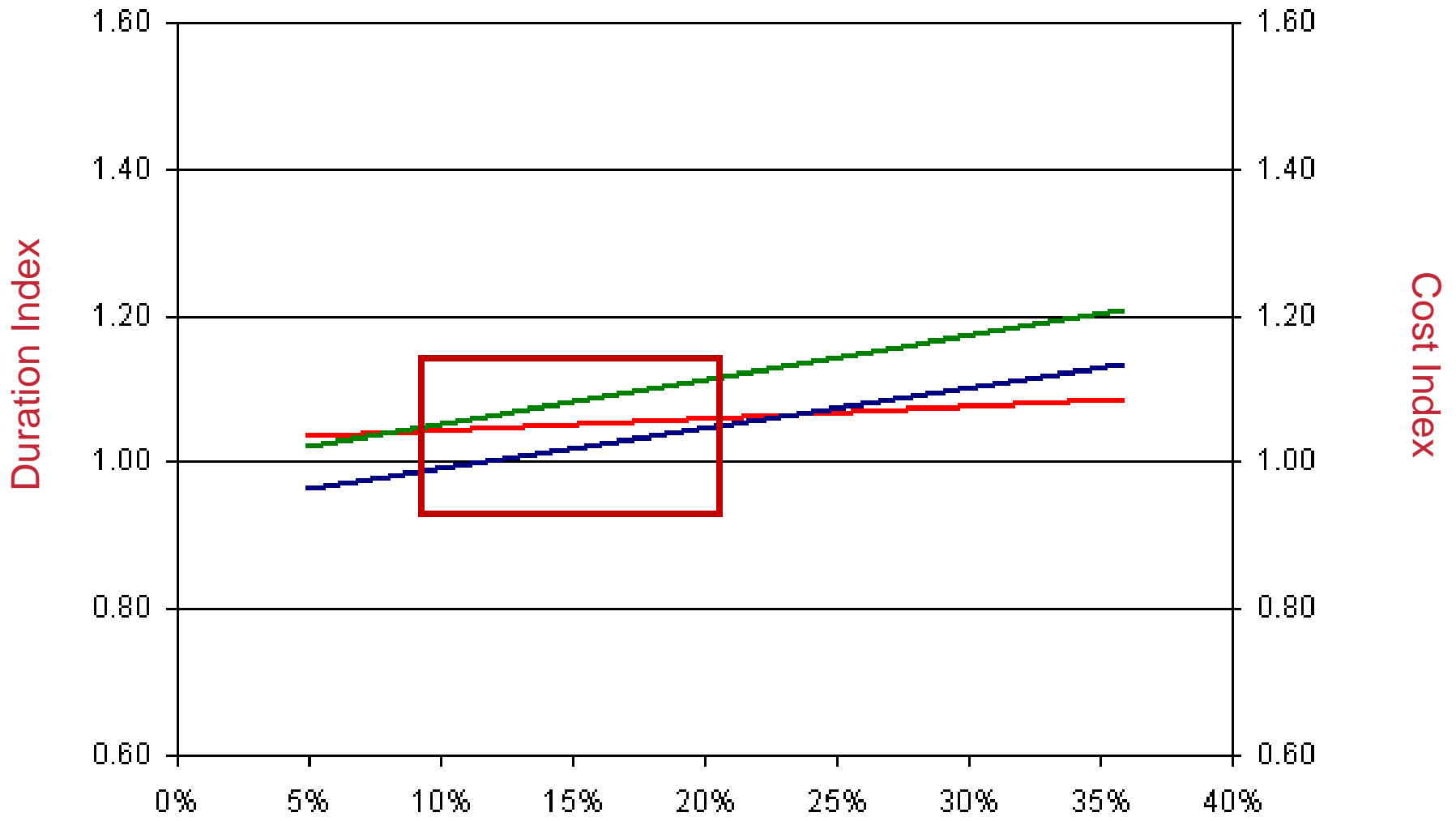


Figure 6 — Total Project Cycle Duration — Execution Duration — Cost



- **FEED**
 - Longer FEED = Improved Performance & Lower Eng Hr Growth
 - More FEED Management = Improved Performance
 - More FEED Discipline Engineering = Less Competitive Performance
 - Better to have more Subject Matter Expert engineers
- **A good decision can be made with**
 - **30% of the Total Project Duration devoted to FEED**
 - **10% of the Total Office hours devoted to FEED HOURS**
- **This is a “leading indicator”**



Project Management Metrics

PM and EM % of Total FEED Hours vs. Predictability

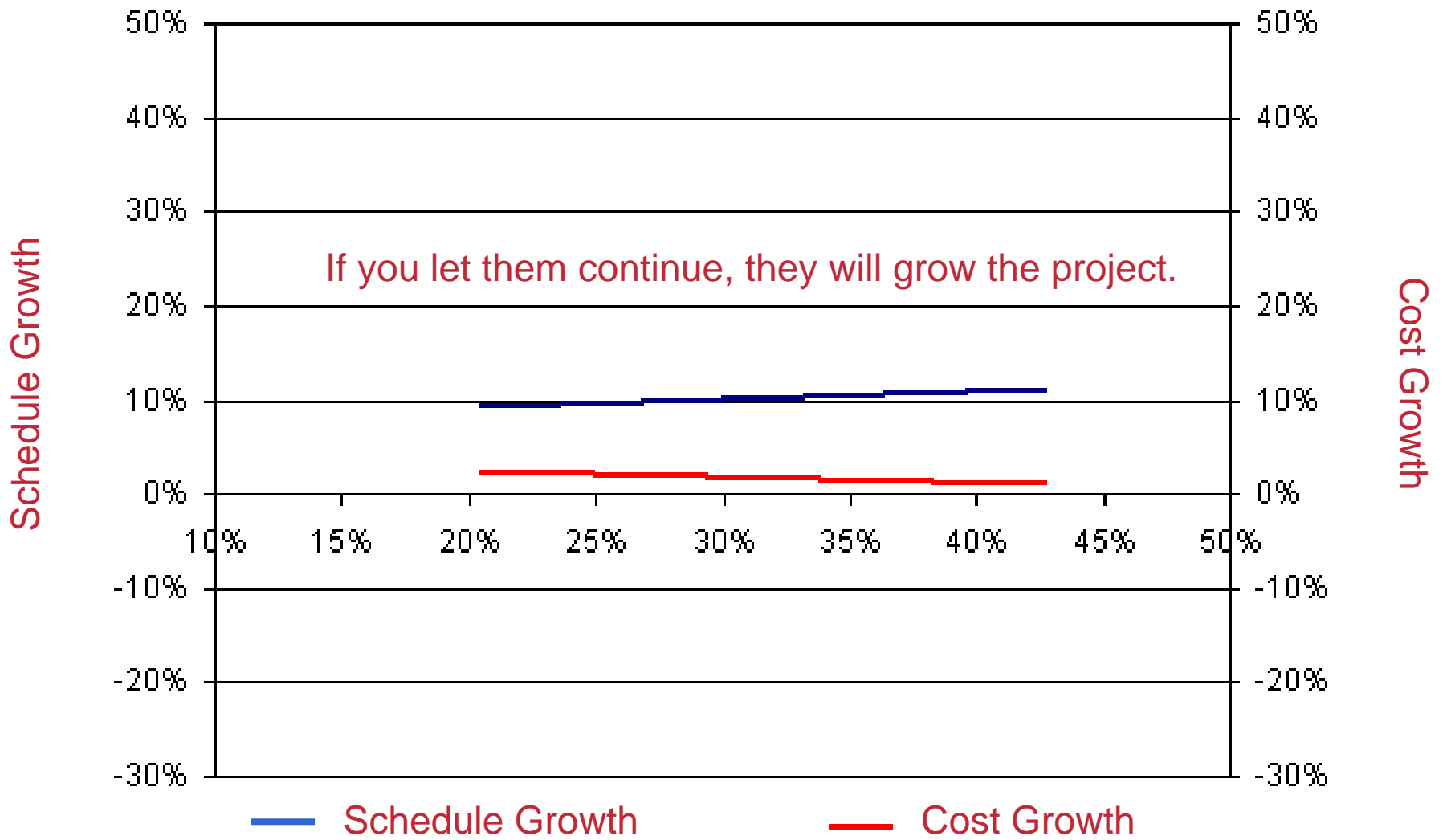


Figure 11

PM and EM % of Total FEED Hours vs. Performance

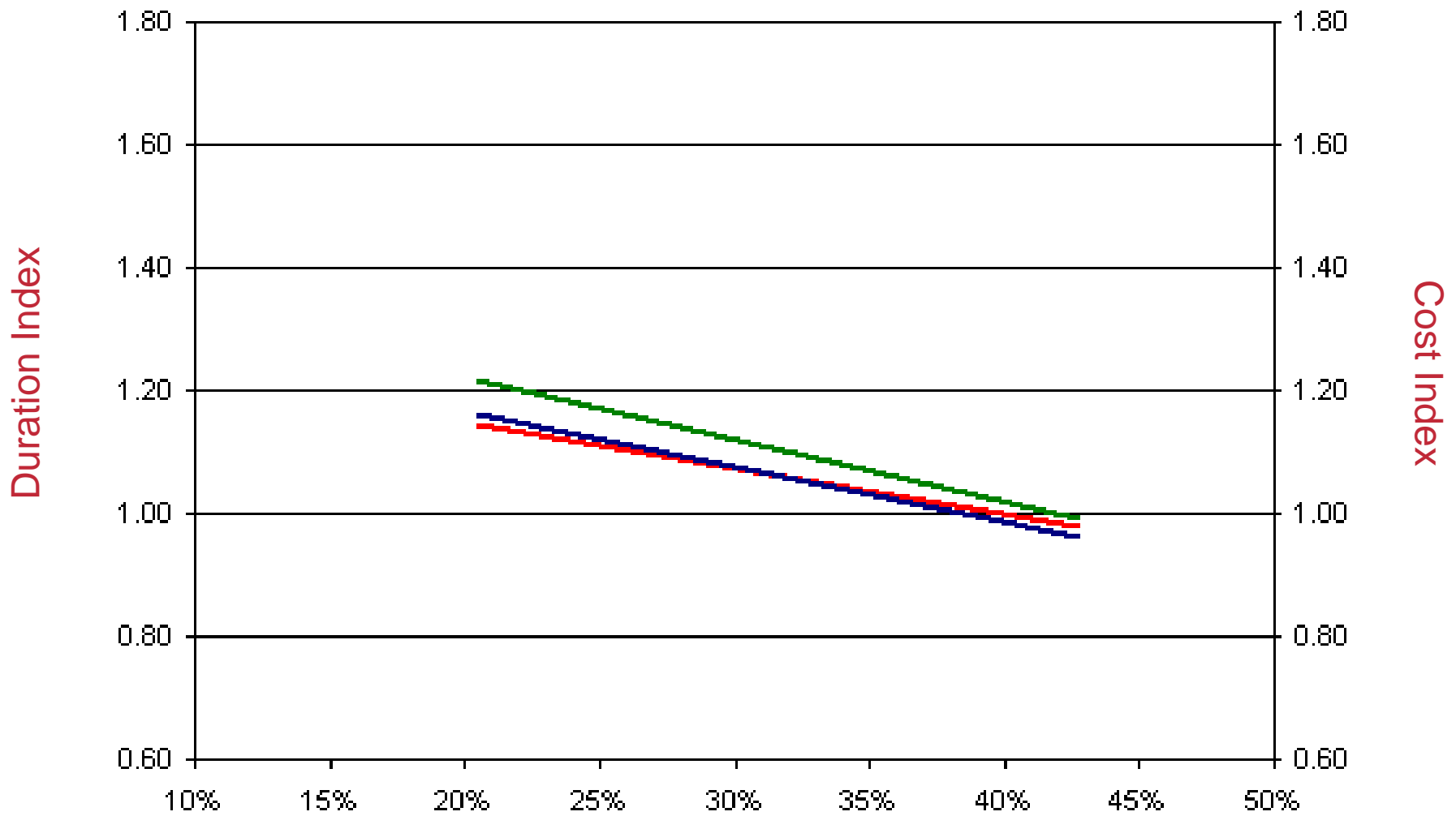


Figure 12 — Total Project Cycle Duration — Execution Duration — Cost

• **Project Management**

- **Figure 11 indicates that there may be little benefit of having more than 20% of the PM and EM total hours expended during FEED**
- **However, Figure 12 indicates that more effective use of high-end professional hours (not hours only) may be driving cost and schedule to better performance**

**Better scope definition leads to
Better the project performance**

Invest in PEOPLE



Engineering Metrics



Of Course the Predictability is OK, the estimate is still in revision

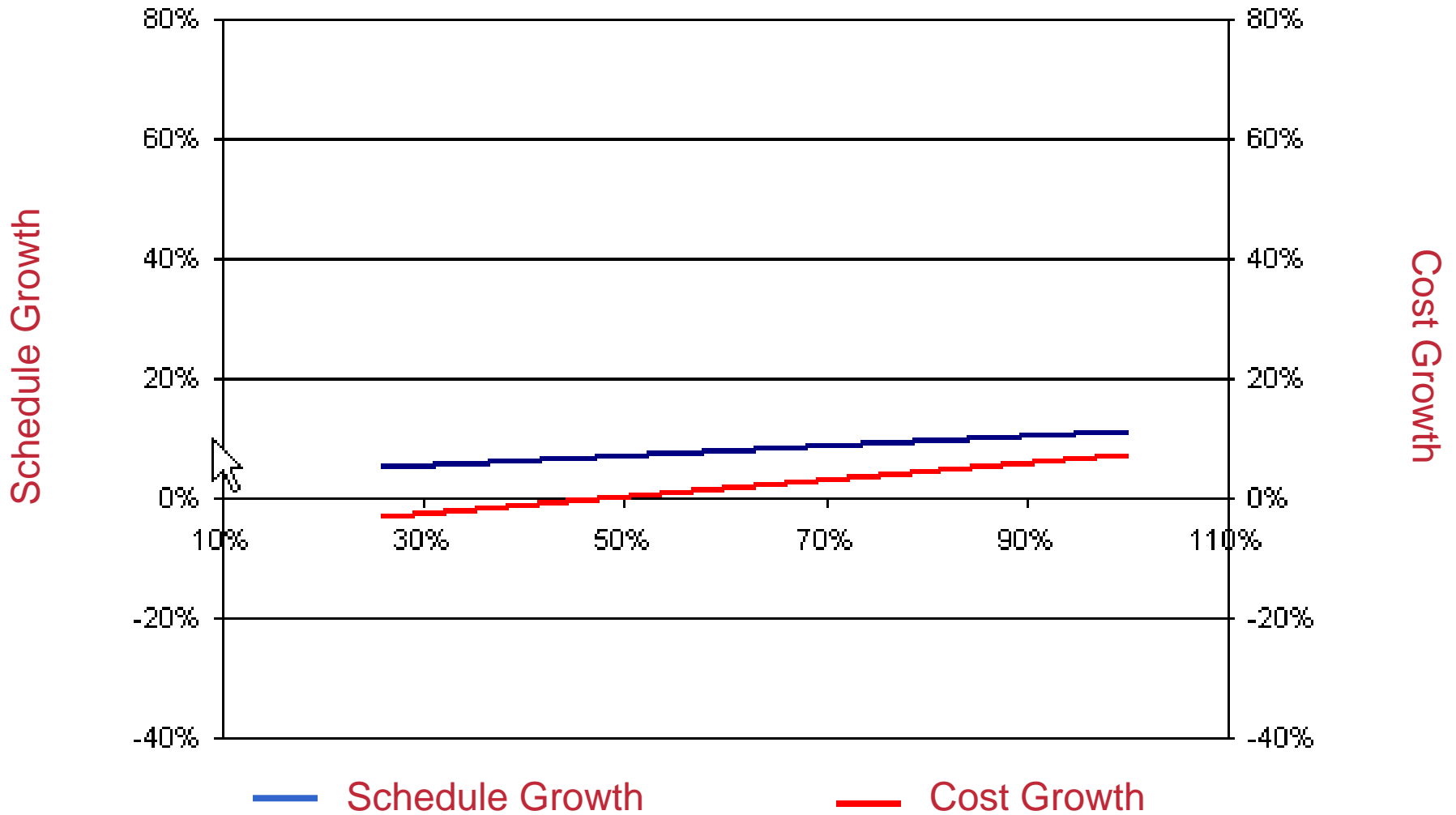


Figure 7



Figure 8 — Total Project Cycle Duration — Execution Duration — Cost

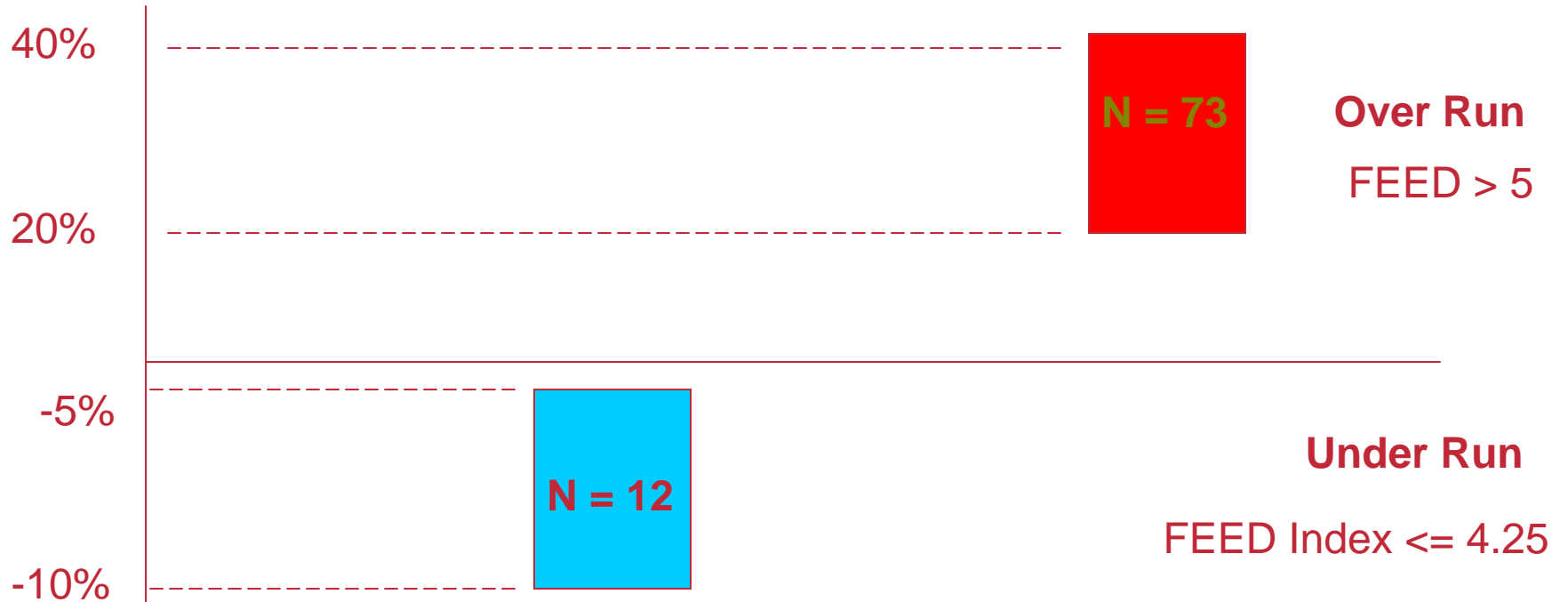


- **Engineering**

- More Engineering during construction is a large indicator of **REWORK**
- Rushing engineering, shortening FEED work, and pushing engineering to the field (fast track projects) makes the project duration significantly **LONGER**
- **PLAN MORE!**

- **FEED**
 - Is where leadership is most important to set the objectives of the project
 - Is inefficient by non-germane activities
 - Should be staffed by high-end professionals
- **A good decision can be made with**
 - 30% of the Total Project Duration devoted to FEED
 - 10% of the Total Office hours devoted to FEED HOURS
- **Project Management**
 - More effective use of high-end professional hours (not hours only) may be driving cost and schedule to better performance
- **Engineering**
 - More Engineering during construction is a large indicator of REWORK
 - Rushing engineering, shortening FEED work, and pushing engineering to the field (fast-track projects) makes the project duration significantly **LONGER**
 - Freeze the Scope before starting detailed engineering

Final Word and We're done...



- Up to 7% longer FEED 2/3 Cycle
- 1 to 5% longer FEED 3 Cycle

- 2 months prior to end of FEED 3
- 15% shorter FEED 2/3 Cycle