

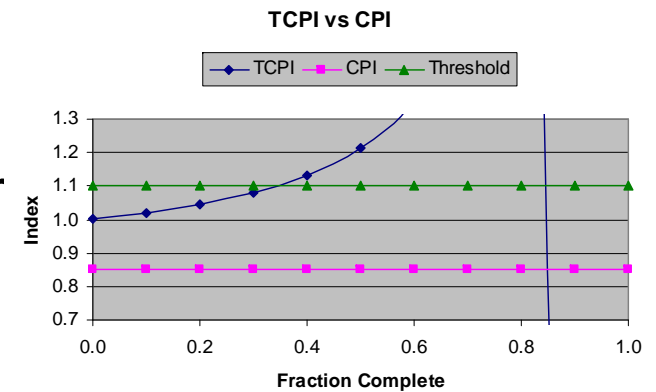


The To Complete Performance Index

...transforming project performance



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Abstract



- The To Complete Performance Index (TCPI) from Earned Value Management describes the performance efficiency required to achieve a cost objective.
- Beyond its usual application, the TCPI indicator has a significant role in transforming project performance to effect a project recovery. This virtually unknown aspect is the focus of this presentation.



Overview



- Introduction
- Evaluation of EAC
- Further Examination
- Application to Project Recovery
- Evaluating the Recovery Strategy
- Schedule Analysis
- Summary & Conclusions



Introduction



- EVM provides a method of describing project performance numerically ...a significant improvement for assessing & reporting project status
- The most often used and best understood indicator from EVM is the Cost Performance Index, $CPI = EV / AC$
- CPI is a description of the efficiency of achieving the accomplishment with respect to the cost investment made



Introduction



- Whereas CPI describes the past, TCPI provides information about the future
- TCPI is defined as the work remaining to be accomplished divided by the amount of unspent funding
- $TCPI = (BAC - EV) / (TC - AC)$
where TC = Target Cost or Desired Cost Outcome
- *What does TCPI tell us?*
The index value describes the cost performance efficiency required for the remainder of the project to achieve the desired final cost



Evaluation of EAC



- Traditionally, TCPI is used by customers or oversight organizations to assess the reasonableness of an estimated final cost or Estimate at Completion (EAC)
- For this application,
$$TCPI = (BAC - EV) / (EAC - AC)$$

The customer evaluates the EAC provided by the PM from the value of the TCPI computed



Evaluation of EAC



TCPI Value	Predicted Outcome
≤ 1.00	Achievable
> 1.10	Not Achievable



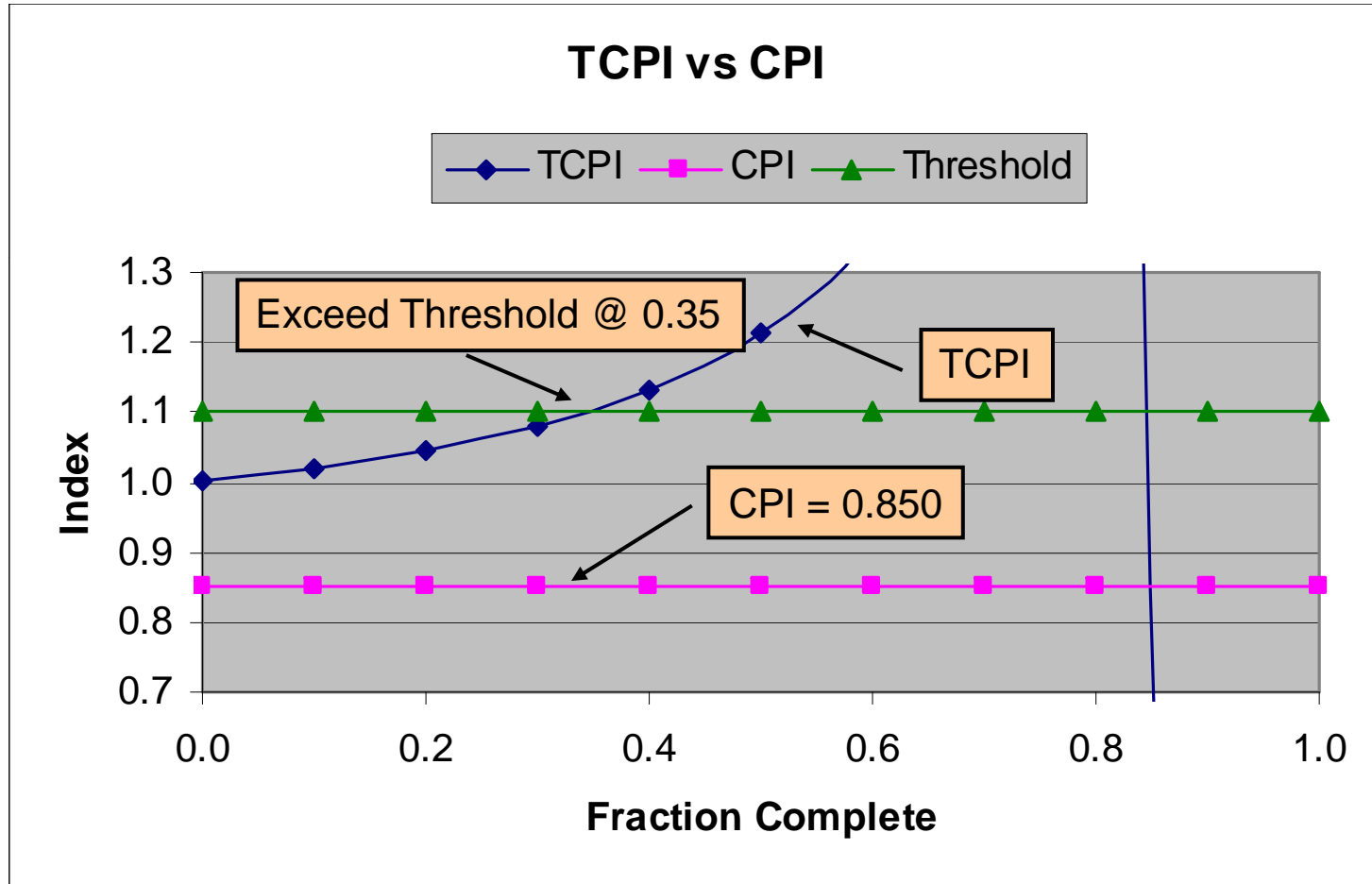
Evaluation of EAC



- When TCPI is equal to or less than 1.00, there is confidence that the EAC can be achieved
- Conversely, when TCPI is equal to or greater than 1.10 the project is considered to be “out of control;” the EAC is very likely unachievable
- Between the two declarative values, 1.00 and 1.10, the PM’s actions become ever more critical to project success. Management intervention to improve cost performance very probably will be required to achieve the EAC



Evaluation of EAC





Evaluation of EAC



- The planned final cost (BAC) will not be achieved if this performance, $CPI = 0.850$, continues
- TCPI continually increases as the project progresses, exceeding the threshold value of 1.10 at fraction complete of approximately 0.35
- The rate of TCPI increase becomes ever larger as fraction complete increases.



Further Examination



- *What is the evidence that when $TCPI > 1.10$, the project is irrecoverable?*
- As far as I know, there have not been any empirical or theoretical studies to validate the claim.
- In the next few slides, we'll look at the behavior of TCPI in more detail ...and state my opinion



Further Examination



- A revealing view can be obtained using calculus ...from TCPI in a different form:

$$TCPI = (1 - EV\%)/(CR - CPI^{-1} * EV\%)$$

where CR (Cost Ratio) = TC / BAC

$$EV\% = EV / BAC$$

- For notation simplicity:
 $y = TCPI$, $x = EV\%$, $a = CR$, $b = CPI^{-1}$
- The equation to examine becomes:
 $y = (1 - x)/(a - bx)$



Further Examination



- As an example, let us analyze a project having cost performance which will not achieve the cost objective: $CPI^{-1} = 1.20$, $CR = 1.10$
- The point of interest is when TCPI equals the threshold value (1.10)

$$\begin{aligned}x &= (y_a - 1)/(y_b - 1) \\ &= ((1.1 * 1.1) - 1)/((1.1 * 1.2) - 1) \\ &= 0.656\end{aligned}$$



Further Examination



- *What is the rate of increase of TCPI at the threshold value (1.10)?*
- TCPI rate of increase with respect to fraction complete can be examined using the first calculus derivative: $dy/dx = (b - a)/(a - bx)^2$
- At the point of interest (TCPI = 1.10), the derivative can be evaluated:

$$\begin{aligned} dy/dx &= (1.2 - 1.1)/(1.1 - (1.2 * 0.656))^2 \\ &= (0.1)/(1.1 - 0.7875)^2 \\ &= 1.024 \end{aligned}$$



Further Examination

- *What happens to the rate of increase of TCPI when performance continues and fraction complete increases?*



<u>EV%</u>	<u>dy/dx</u>
0.656	1.024
0.700	1.479
0.750	2.500



Further Examination



- For modest increases in EV%, it is seen from the numbers in the table that dy/dx (i.e. the TCPI rate) has larger and larger rates of change
- Once the threshold is exceeded, there is little hope that management intervention can have positive impact ...the project is very rapidly becoming “out of control”
- Thus, the threshold value of 1.10 for TCPI appears to be a reasonable criterion for making the assertion that the EAC put forth by the PM in the project status report is unachievable



Application to Project Recovery



- PMs applying EVM possess early warning tools
 - Forecast of final cost, $IEAC = BAC / CPI$
- As an example, let's examine a project using the following data: $CPI = 0.850$, $BAC = \$1000$, $MR = \$100$
- *What is projected for the future?*
 - If CPI does not improve, BAC will be exceeded
 - $IEAC = 1000 / 0.850 = \$1176$
 - MR will be consumed, $IEAC > TAB$
 - The project is headed for a budget overrun



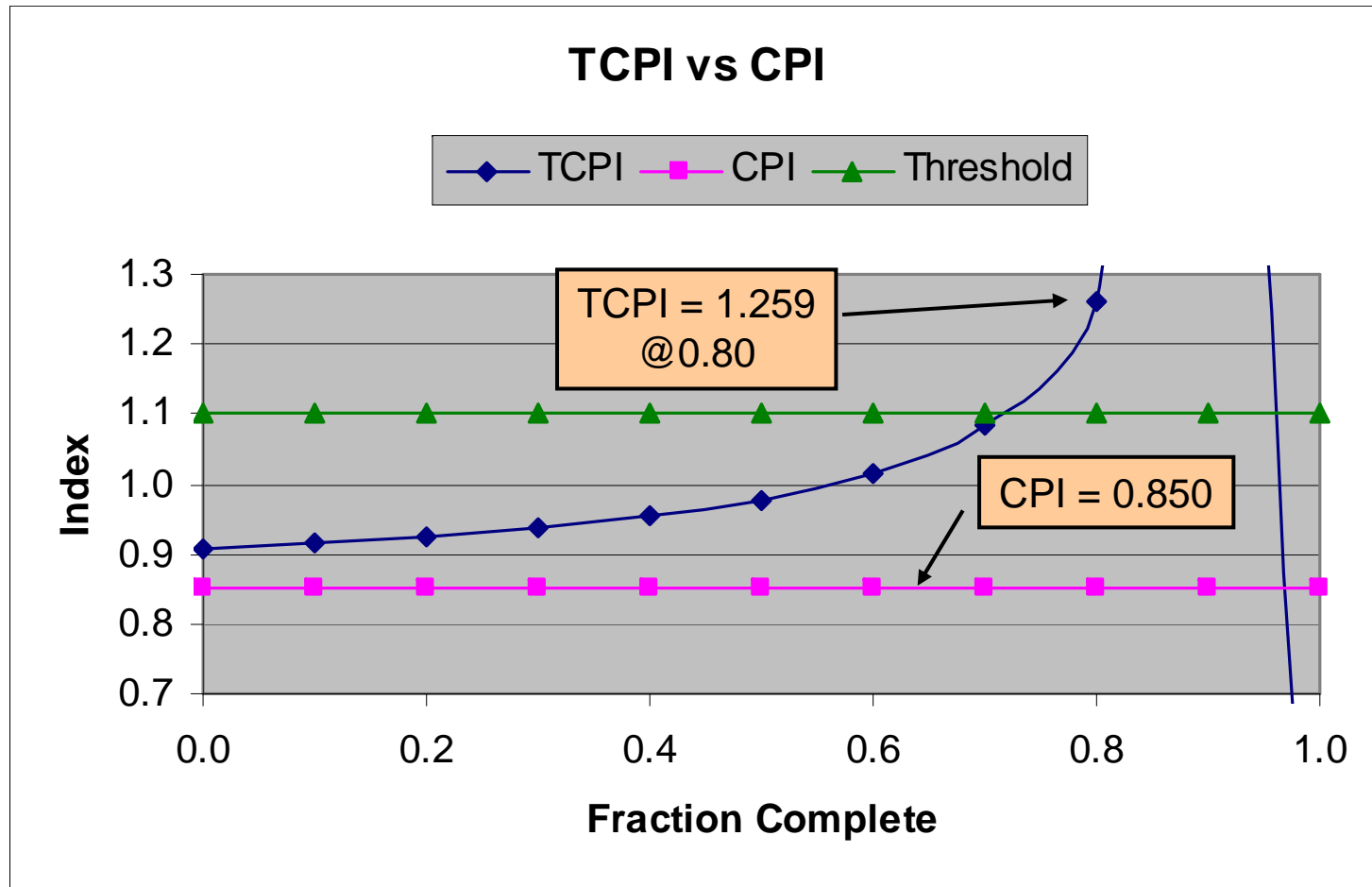
Application to Project Recovery



- *What is the PM's prerogative when the project is 80 percent complete?*
- By calculating TCPI using TAB as the desired final cost and graphing it as shown previously, the answer is readily seen
- As observed in the next slide, the value of TCPI is so large it is nearly off the chart; the computed value is 1.259



Application to Project Recovery





Application to Project Recovery



- From our previous discussion, the PM knows that when $TCPI \geq 1.10$ the project is regarded as irrecoverable and that additional funding is very likely needed
- In this instance, as uncomfortable as it may be, negotiation with the customer cannot be avoided
- *Does the PM make the same decision when the project is 30 percent complete?*

Application to Project Recovery

- The simple answer is “No”
- At 30 percent complete, TCPI = 0.937, a good number, yet the PM knows from IEAC that if the current performance does not improve the project will overrun the funding available (TAB)
- However, with this value for TCPI, the PM has an opportunity to take action thereby avoiding the overrun ...*and the embarrassment of the impending negotiation if the present cost performance continues*





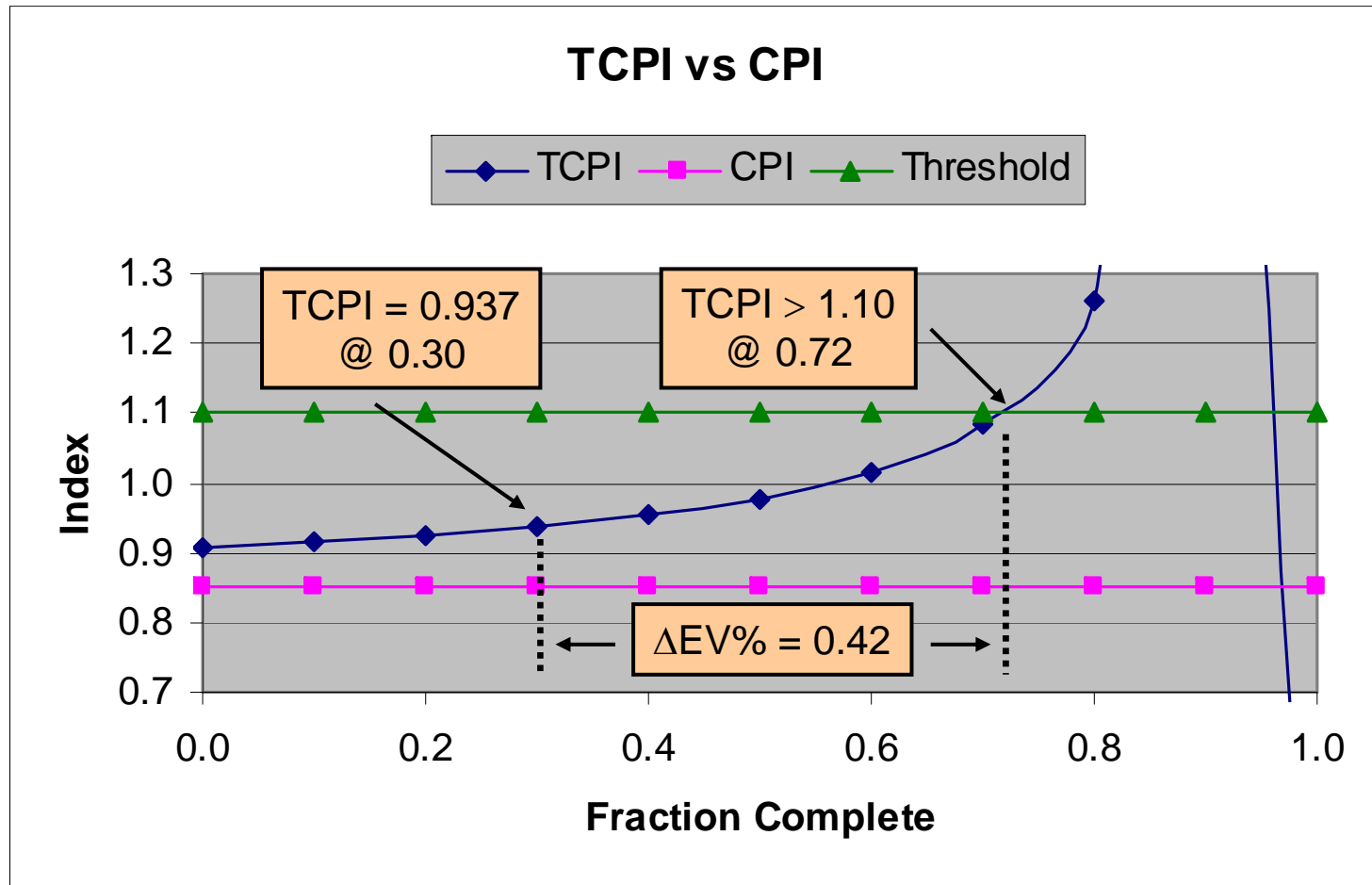
Application to Project Recovery



- *What is the period of opportunity for the PM to make a positive performance change?*
- The PM has from the present status point until TCPI exceeds 1.10 to recover the project
- *Is the period of opportunity sufficient for recovery to be successful?*
- For our example, let's look at the graph ...



Application to Project Recovery





Application to Project Recovery

- For a project of reasonable size, having more than 40 percent of the period of performance to create and make an effective change, the PM has a very good chance for being successful with the recovery action





Evaluating the Recovery Strategy



- The TCPI has application, as well, in creating a viable recovery strategy ...a trade-off between cost and schedule performance to achieve the commitments to the customer (TAB & negotiated product delivery date)
- To resolve the condition of unsatisfactory cost performance, the PM creates a plan for transforming the cost performance from the present value of CPIa (actual value) to an improved efficiency, CPIs (strategy value)

Evaluating the Recovery Strategy



- TCPI plays a role in evaluating whether the change desired can realistically be achieved. For this purpose, the following formula for TCPI is used:

$$TCPI = (1 - EV\%) / (CPIs^{-1} - CPIa^{-1} * EV\%)$$

- As a rule of thumb, the envisioned performance change has a good likelihood of being achievable when the calculated value for TCPI is less than or equal to 1.00 ...*indicating whether there is sufficient opportunity for the improvement to succeed*



Schedule Analysis



- The To Complete Schedule Performance Index (TSPI) facilitates analysis similar to the TCPI
- TSPI is equal to the planned duration for the work remaining divided by the duration available:

$$\text{TSPI} = (\text{PD} - \text{ES}) / (\text{TD} - \text{AT})$$

where PD is the planned duration

ES is the Earned Schedule

TD is the total duration desired

...generally: PD, the negotiated duration (ND), or estimated duration (ED)

AT is the actual time or duration at the time of computation



Schedule Analysis



- The use of TSPI is available for schedule management and control in a parallel manner to cost and TCPI
- *Is the project schedule recoverable?*
- *What is the period of opportunity for the PM to make a positive schedule performance change?*
- *Is the period of opportunity sufficient for schedule recovery to be successful?*
- Both TCPI & TSPI are needed to have complete capability for the cost–schedule performance trade-off necessary for project recovery



Summary



- TCPI is definitely more than the simple calculation for determining the performance rate needed for the remaining work
- TCPI has application in evaluating the realism of the bottom up derived EAC ...it was shown that the value of 1.10 is a reasonable criterion for determining when a project is not recoverable and is “out of control”



Summary



- Use of TCPI was extended to the evaluation of the opportunity and the performance transformation envisioned for project recovery
 - TCPI may also be used in creating the tactical changes of personnel and overtime adjustments
- Through Earned Schedule the methods described for TCPI are made applicable to schedule analysis, as well
- TCPI & TSPI have much to offer to the PM in his/her efforts for controlling and managing the project



References



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