College of Performance Management

EVM World 2013 Conference

Do You Trust Your IMS?

Alexander Schostag & Yancy Qualls

May 30, 2013

Outline

iECD Overview

- ❑ iECD Basics
- ❑ Why iECDs?
- ❑ iECD Types
- ❑ Multiple iECDs

Estimated Schedule Duration

- ❑ A brief remark about TFCI
- ❑ EAC analysis:
  - $EAC_{CPI} = {}^{BAC}/_{CPI}$
- ❑ Schedule analogies
- ❑ Methodologies
- ❑ Data

What is an iECD?

- Independent Estimated Completion Date
- A mathematical method of calculating the completion of a project or other interim milestone
- Assumes past performance **IS** indicative of future results
- Independent of what?
  - The rose colored glasses often worn when assessing our own capacity for performance

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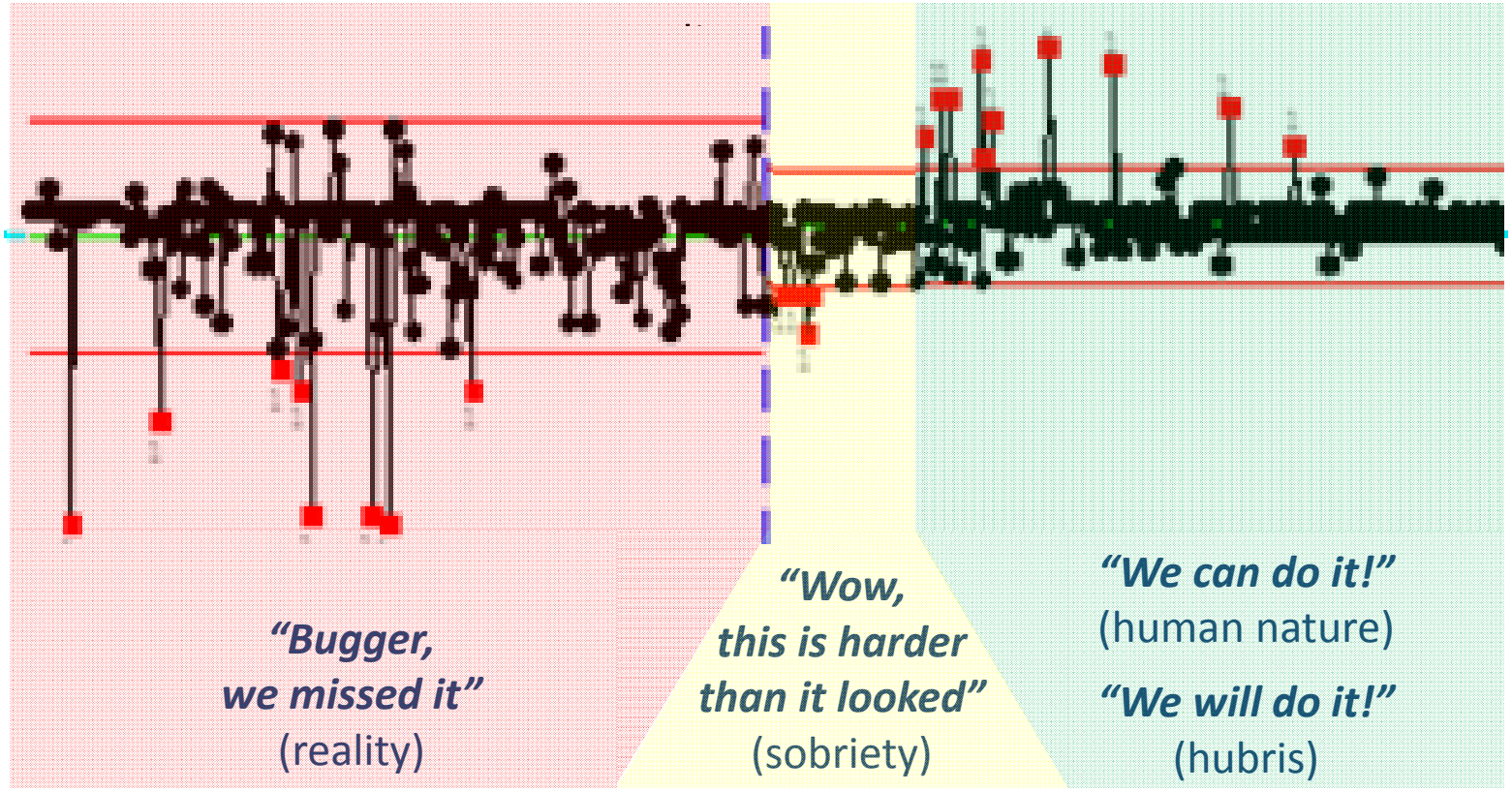
The 1st step toward recovery…

Performance of Deliverables to Baseline

Past



Future

…is to "forecast" we have a problem

IMS Death Spiral

"I must break you"

Ivan Drago

iECD Target

~~***Inaccurate***~~

No iECD should consistently provide more reliable delivery forecasts than sound critical path analysis with thorough schedule risk assessments

Neglected

The process of determining ***WHY*** an iECD is forecasted where it is and understanding ***HOW*** your forecast differs, requires attention to the IMS

~~***Unused***~~

Calculating an iECD does not directly require the use of an IMS by the project team

Regularly defending forecasts that significantly differ from calculated iECD, spur healthy discussions about the IMS

Desired iECD Usage Domino Effect

As more attention is given to understanding the IMS, its accuracy will improve

~~***Inaccurate***~~
Reliable

As the IMS becomes more reliable, it becomes a more necessary management tool

~~***Unused***~~
Dependent

As management becomes more dependent on the IMS, it will be maintained more consistently

~~***Neglected***~~
~~***Interest***~~
Maintained

iECD's

- Strive to reduce the human bias inherent in forecasts from an IMS
  - Many CP elements tend to be highly subjective
    - Remaining durations
    - Likelihood of occurrence
    - Lags/leads
    - Constraints
  - iECD's tend to rely more on measurable statistics, demonstrated performance and historical trends
    - BEI
    - SPI
    - Earned Schedule
    - Float trends
    - Variance trends
    - BCWR

Caution

Q: Why not solely rely on iECDs, if they are forecasts that strive to be independent of human biases?

*A: Because they are also independent of:

- Logic
- Sanity

* Stolen from Gary Humphreys

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iECD Categories

- Based on
  - Trend data
  - Demonstrated schedule performance
  - Spend (earning) rate

Trend iECDs

If a target has been continually moving, what makes us think it has now stopped?

Should Mom expect him to be on time?

Examples of trends to track:

- Total Float
- Baseline Variance
- Critical Path Duration

Trend window:

Total Project to Date

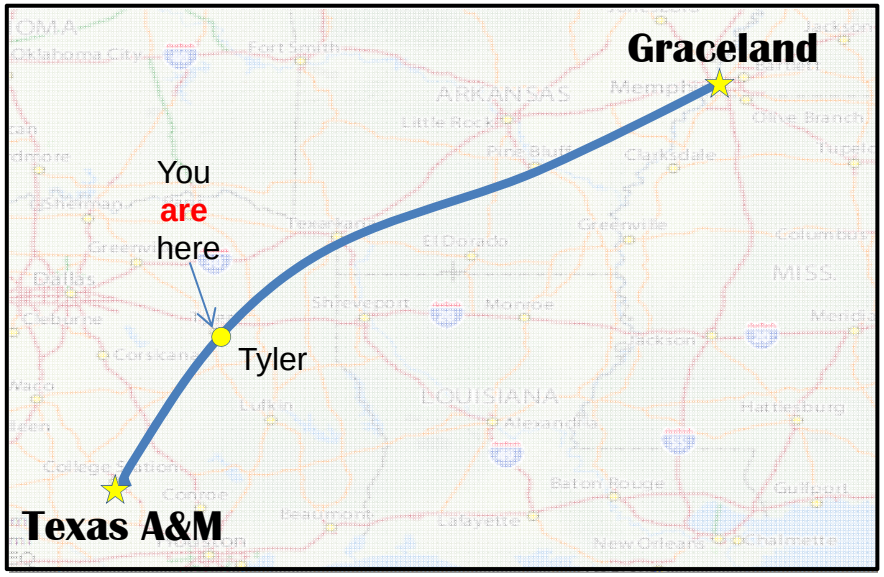
vs

Recent Period

Formula example:

$$\text{Planned Finish} + \frac{\text{Baseline Variance}}{\text{\% Complete}}$$

Past Schedule Performance iECDs



- Remaining Distance: 400 miles
- Average Speed: 50 mph
- **Estimated Time: 8 hrs**

So if it is currently noon, based on demonstrated performance you will get to Graceland at 8 PM tonight.

Common performance indicators:

- SPI
- SPI(t)
- BEI

Common duration measures:

- Planned Duration
- Remaining Duration
- Unearned Schedule

Trend window:

Total Project to Date

vs

Recent Period

Formula example:

$$\text{Time Now} + \frac{\text{Unearned Schedule}}{\text{SPI(t)}}$$

Spend Rate iECDs

Common rate indicators:

- BCWP(cur)
- BCWP(avg cum)
- BCWS(cur)
- BCWS(avg cum)

To-go budget measures:

- BCWR, or
- BAC - BCWP

Trend window:

Total Project to Date

vs

Recent Period

Formula example:*

$$\text{Time Now} + \frac{\text{BCWR}}{\text{BCWS}_{(cur)}}$$

* From Humphreys & Associates

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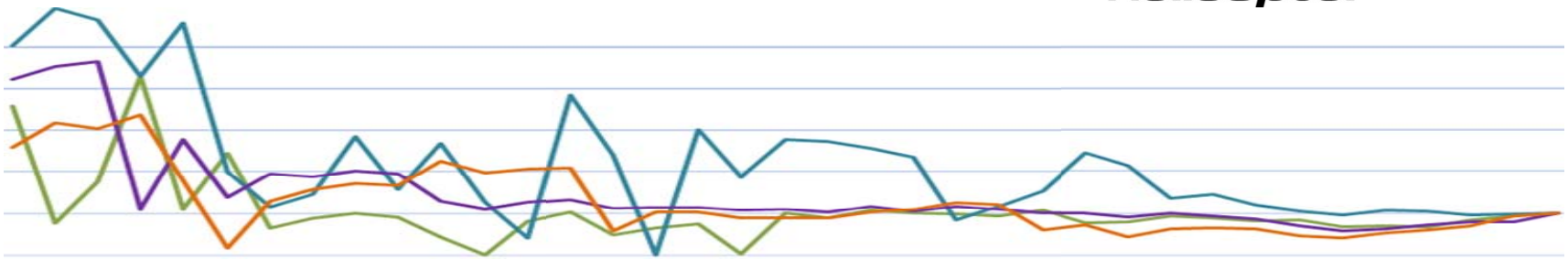
Historical iECD Accuracy @ Bell Helicopter



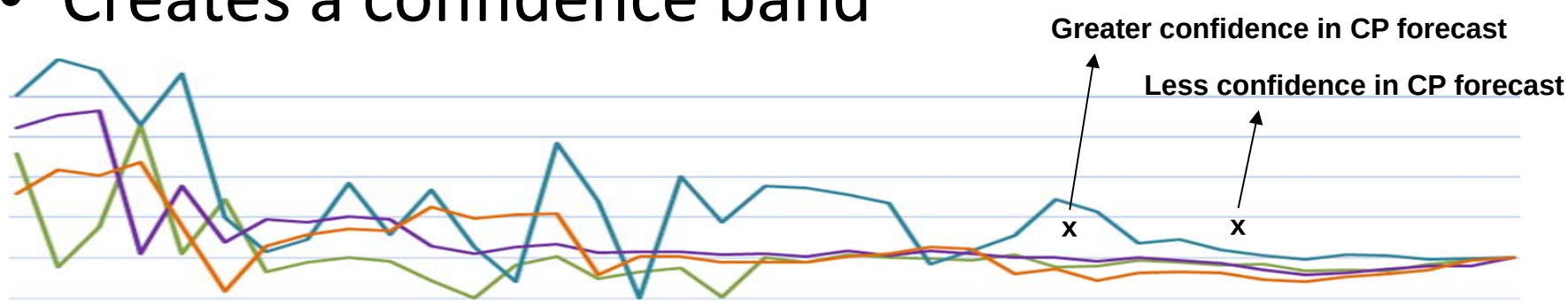
	3rd Year Away												2nd Year Away												1st Year Away											
Month's Prior to Completion	-36	-35	-34	-33	-32	-31	-30	-29	-28	-27	-26	-25	-24	-23	-22	-21	-20	-19	-18	-17	-16	-15	-14	-13	-12	-11	-10	-9	-8	-7	-6	-5	-4	-3	-2	-1
Best Indicator	BEI	BEI	BEI	BEI	US	ES	US	FT	BEI	BEI	US	US	US	US	US	US	US	US	US	US	US	US	US	US	US	US	US	US	US	FT	FT	FT	FT	FT	FT	FT
2nd Best Indicator	ES	ES	ES	FT	BEI	US	BEI	US	US	FT	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	BEI	ES	ES	ES	US	US	US	ES	US	ES	US

- 3 years out
  - No tests dominated
- 2 years out
  - US & ES tests were most accurate
- 1 year out
  - Float Trend was best as projects neared completion

	iECD Basis
BEI	Baseline Execution Index
FT	Float Trend
ES	Earned Schedule
US	Unearned Schedule

Why multiple tests?

- Different tests may be more accurate at various stages of a project
- Some tests may be better suited to specific project types
  - e.g. Design vs. Production
- Creates a confidence band



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IMS based schedule analogy to EAC

- The following slides will establish a foundation for the translation of a cost based Estimate At Complete (EAC) to an IMS based Estimated Schedule Duration (ESD) including methodologies for application and results from actual data.

A brief remark about TFCI

Carissa Carter, a program integrator for DCMA, created a Total Float Consumption Index and methodology for application to answer the following questions.

1. **If total float consumption continues at the current rate, then where will the project be (in scope of scheduled days) when the project baseline finish date arrives?**

2. **What is the total float of the critical path when the project baseline finish date arrives?**

A brief remark about TFCI

TFCI is a duration-based performance index calculating total float consumption used as an efficiency factor. The TFCI is used for predicting project completion status in a network schedule.

In a delinquent schedule, the TFCI is less than 1.0

$$\text{TFCI} = \frac{\text{Project Actual Duration + Critical Path Total Float}}{\text{Project Actual Duration}}$$

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EAC analysis: $EAC_{CPI} = {}^{BAC}/_{CPI}$

Starting with

$$\boldsymbol{EAC_{CPI} = ACWP + \left[\frac{BAC - BCWP}{CPI}\right]}$$

and factoring out CPI

$$EAC_{CPI} = ACWP + \frac{1}{CPI}[BAC - BCWP].$$

Then by substituting for ${}^{1}/_{CPI}$

$$EAC_{CPI} = ACWP + \frac{ACWP}{BCWP}[BAC - BCWP]$$

and multiplying back in ${}^{1}/_{BCWP}$

$$EAC_{CPI} = ACWP + ACWP\left[\frac{BAC - BCWP}{BCWP}\right].$$

EAC analysis: $EAC_{CPI} = {}^{BAC}/_{CPI}$

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From the previous slide

$$\boldsymbol{EAC_{CPI} = ACWP + ACWP\left[\frac{BAC - BCWP}{BCWP}\right].}$$

Separating inside the brackets

$$EAC_{CPI} = ACWP + ACWP\left[\frac{BAC}{BCWP} - \frac{BCWP}{BCWP}\right]$$

and reducing ${}^{BCWP}/_{BCWP}$

$$EAC_{CPI} = ACWP + ACWP\left[\frac{BAC}{BCWP} - 1\right].$$

Now factoring out ACWP

$$EAC_{CPI} = ACWP\left(1 + \left[\frac{BAC}{BCWP} - 1\right]\right).$$

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Now cancel the 1s

$$EAC_{CPI} = ACWP\left[\frac{BAC}{BCWP}\right]$$

and factor out ${}^{ACWP}/_{BCWP}$

$$EAC_{CPI} = \frac{ACWP}{BCWP} * BAC.$$

Finally replace ${}^{ACWP}/_{BCWP}$

$$EAC_{CPI} = \frac{BAC}{CPI}.$$

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Schedule analogies

$$EAC_{CPI} = ACWP + \left[\frac{BAC - BCWP}{CPI}\right] = \frac{BAC}{CPI}$$

Proposed Analogies:

$EAC \approx ESD = Estimated\ Schedule\ Duration$

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$BCWP \approx BDWP = Baseline\ Days\ of\ Work\ Performed$

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Schedule analogies

BCWS and the analogical BDWS

In scheduling, we plan one day's worth of work to be completed each and every working day.

So as each actual working day passes, we would expect to have completed one day's worth of work.

$$ADWP = BDWS$$

Schedule analogies

But what about BCWS and the analogical BDWS?

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$$\boldsymbol{ADWP = BDWS}$$

Schedule analogies

Now let's take a closer look at the cost side and use CV and SV to help define BDWP.

$$BCWP - ACWP = CV \quad so, \quad BCWP = CV + ACWP$$

$$BCWP - BCWS = CV \quad so, \quad BCWP = SV + BCWS$$

On the program critical path, what is the difference between where you expected to be and where you are?

Since a single day of variance on a critical path task affects total float by a single day.

Therefore,

$$BDWP - ADWP = Float \quad so, \quad BDWP = Float + ADWP$$

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Schedule analogies

Now returning to our analogies,

And applying what we just showed,

$EAC \approx ESD = Estimated\ Schedule\ Duration$

$ACWP \approx ADWP = Actual\ Days\ of\ Work\ Performed$

$BCWP \approx BDWP = Budgeted\ Days\ of\ Work\ Performed = ADWP + Float$

$BAC \approx BDC = Budgeted\ Duration\ at\ Complete$

$CPI \approx TFCI = Total\ Float\ Consumption\ Index = \frac{ADWP+Float}{ADWP} = \frac{BDWP}{ADWP}$

Schedule analogies

$$EAC_{CPI} = ACWP + \left[\frac{BAC - BCWP}{CPI}\right] = \frac{BAC}{CPI}$$

$EAC \approx ESD = Estimated\ Schedule\ Duration$

$ACWP \approx ADWP = Actual\ Days\ of\ Work\ Performed$

$BCWP \approx BDWP = Baseline\ Days\ of\ Work\ Performed = ADWP + Float$

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$CPI \approx TFCI = Total\ Float\ Consumption\ Index = \frac{ADWP + Float}{ADWP} = \frac{BDWP}{ADWP}$

$$ESD = ADWP + \left[\frac{BDC - BDWP}{TFCI}\right] = \frac{BDC}{TFCI}$$

Outline

iECD Overview

- ✓ iECD Basics
- ✓ Why iECDs?
- ✓ iECD Types
- ✓ Multiple iECDs

Estimated Schedule Duration

- ✓ A brief remark about TFCI
- ✓ EAC analysis:
  - $EAC_{CPI} = {}^{BAC}/_{CPI}$
- ✓ Schedule analogies
- ❑ Methodologies
- ❑ Data

Methodologies

We have established a basic schedule analogy to a formulaic EAC.

However,

We only looked at how TFCI can be used as CPI.

So,

Are there other indices that can be used as performance factors?

$$ESD = ADWP + \left[\frac{BDC - BDWP}{Performance\ Factor}\right]$$

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First let's consider TFCI.

$$\boldsymbol{TFCI = \frac{ADWP + Float}{ADWP}}$$

TFCI is an index of the current critical path total float compared to the number of days we are into the program.

Thus, we would expect that early in a program, when ADWP is small, float will have a greater impact on our index.

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Let us now consider a complimentary index using the Budgeted Duration of Work Remaining,

$$\boldsymbol{BDWRI = \frac{BDWR + Float}{BDWR}}$$

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Methodologies

TFCI, as a performance factor, considers critical path total float as a factor of actual duration working on the program while BDWRI considers critical path total float as a factor baseline duration remaining.

Now consider a composite index of TFCI and BDWRI using percent complete as the apportionment. We use the percent complete for TFCI and percent remaining for BDWRI since those are the areas relative to the indexes.

The result is

$$EDC = ADWP + \left[\frac{BDC - BDWP}{\%complete * TFCI + \%remaining * BDWRI}\right]$$

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Data

	Project Actual Duration	Project Duration	% baseline duration complete	CP Total Float	BDWR	BDWRI	ESD_BDWRI	Alternate TFCI method	%Complete Composite TFCI BDWRI	TFCI	Applied Project Status	Predicted CP Total Float	Baseline Finish	Schedule Forecast Finish	TFCI Forecast Finish Date
Dec-08	11.92	585	2%	-48	621.1	1.08	588.44	-193.27	636.96	-3.03	-1770.70	-2355.70	11/8/2010	1/26/2011	3/11/2020
Jan-09	64.44	579	11%	-42	556.6	1.08	581.95	1662.69	624.06	0.35	201.63	-377.37	11/8/2010	11/18/2011	5/18/2012
Feb-09	91.07	591	15%	-54	553.9	1.10	595.80	1451.91	649.98	0.41	240.57	-350.43	11/8/2010	2/3/2011	4/11/2012
Mar-09	121.78	559	22%	-19	456.2	1.04	559.76	662.34	578.65	0.84	471.79	-87.21	11/8/2010	12/7/2010	3/23/2011
Apr-09	162.7	559	29%	-9	405.3	1.02	559.20	591.73	568.14	0.94	528.08	-30.92	11/8/2010	11/19/2010	12/23/2010
May-09	190.96	559	34%	-11	379	1.03	559.31	593.17	570.22	0.94	526.80	-32.20	11/8/2010	11/23/2010	1/5/2011
Jun-09	220.95	559	40%	-8	346.1	1.02	559.18	580.00	567.11	0.96	538.76	-20.24	11/8/2010	11/18/2010	12/9/2010
Jul-09	256.63	559	46%	1	301.4	1.00	559.00	556.83	558.00	1.00	561.18	2.18	11/8/2010	11/5/2010	11/4/2010
Aug-09	268.73	559	48%	1	289.3	1.00	559.00	556.93	558.00	1.00	561.08	2.08	11/8/2010	11/5/2010	11/4/2010
Sep-09	292.04	559	52%	1	266	1.00	559.00	557.09	558.00	1.00	560.91	1.91	11/8/2010	11/5/2010	11/3/2010
Oct-09	315.34	559	56%	4	239.7	0.98	559.07	552.00	555.03	1.01	566.09	7.09	11/8/2010	11/2/2010	10/28/2010
Nov-09	339.21	559	61%	8	211.8	0.96	559.31	546.12	551.11	1.02	572.18	13.18	11/8/2010	10/27/2010	10/22/2010
Dec-09	365.76	559	65%	8	185.2	0.96	559.36	547.04	551.11	1.02	571.23	12.23	11/8/2010	10/27/2010	10/20/2010
Jan-10	392.91	559	70%	8	158.1	0.95	559.43	547.85	551.11	1.02	570.38	11.38	11/8/2010	10/27/2010	10/23/2010
Feb-10	410.41	559	73%	8	140.6	0.94	559.48	548.31	551.11	1.02	569.90	10.90	11/8/2010	10/27/2010	10/24/2010
Mar-10	439.1	559	79%	8	111.9	0.93	559.62	549.00	551.11	1.02	569.18	10.18	11/8/2010	10/27/2010	10/24/2010
Apr-10	466.69	559	83%	8	84.31	0.91	559.84	549.58	551.11	1.02	568.58	9.58	11/8/2010	10/27/2010	10/25/2010
May-10	486.44	559	87%	-7	79.56	1.09	559.57	567.16	566.09	0.99	550.96	-8.04	11/8/2010	11/17/2010	11/19/2010
Jun-10	514.26	575	89%	-7	67.74	1.10	575.66	582.93	582.09	0.99	567.17	-7.83	11/8/2010	11/17/2010	11/18/2010
Jul-10	515.14	559	92%	-2	45.86	1.04	559.08	561.18	561.01	1.00	556.83	-2.17	11/8/2010	11/10/2010	11/11/2010
Aug-10	522.49	559	93%	20	16.51	-0.21	444.39	538.39	539.75	1.04	580.40	21.40	11/8/2010	10/12/2010	10/10/2010
Sep-10	534.7	559	96%	19	5.3	-2.58	532.65	539.82	540.74	1.04	578.86	19.86	11/8/2010	10/12/2010	10/11/2010
Oct-10	542.97	559	97%	-18	34.03	1.53	565.23	578.17	577.59	0.97	540.47	-18.53	11/8/2010	12/6/2010	12/7/2010
Nov-10	550.16	559	98%	-4	12.84	1.31	559.95	563.09	563.03	0.99	554.94	-4.06	11/8/2010	11/12/2010	11/15/2010
Dec-10	556.23	559	100%	-19	21.77	1.87	567.85	578.77	578.67	0.97	539.91	-19.09	11/8/2010	12/7/2010	12/8/2010

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Questions and comments