

Lean Construction Institute

Building Knowledge in Design and Construction

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John J. Kirlin & NCSU

**Variation of Construction
Related Tasks – A Case Study**

17 AUG 2010

Presented by:

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NC STATE UNIVERSITY

Agenda

- **Introduction**

- Variation Research
- Case Study Design

- **Case Study Observations**

- Weekly work planning
- Percentage Planned Complete
- Variation
- Productivity

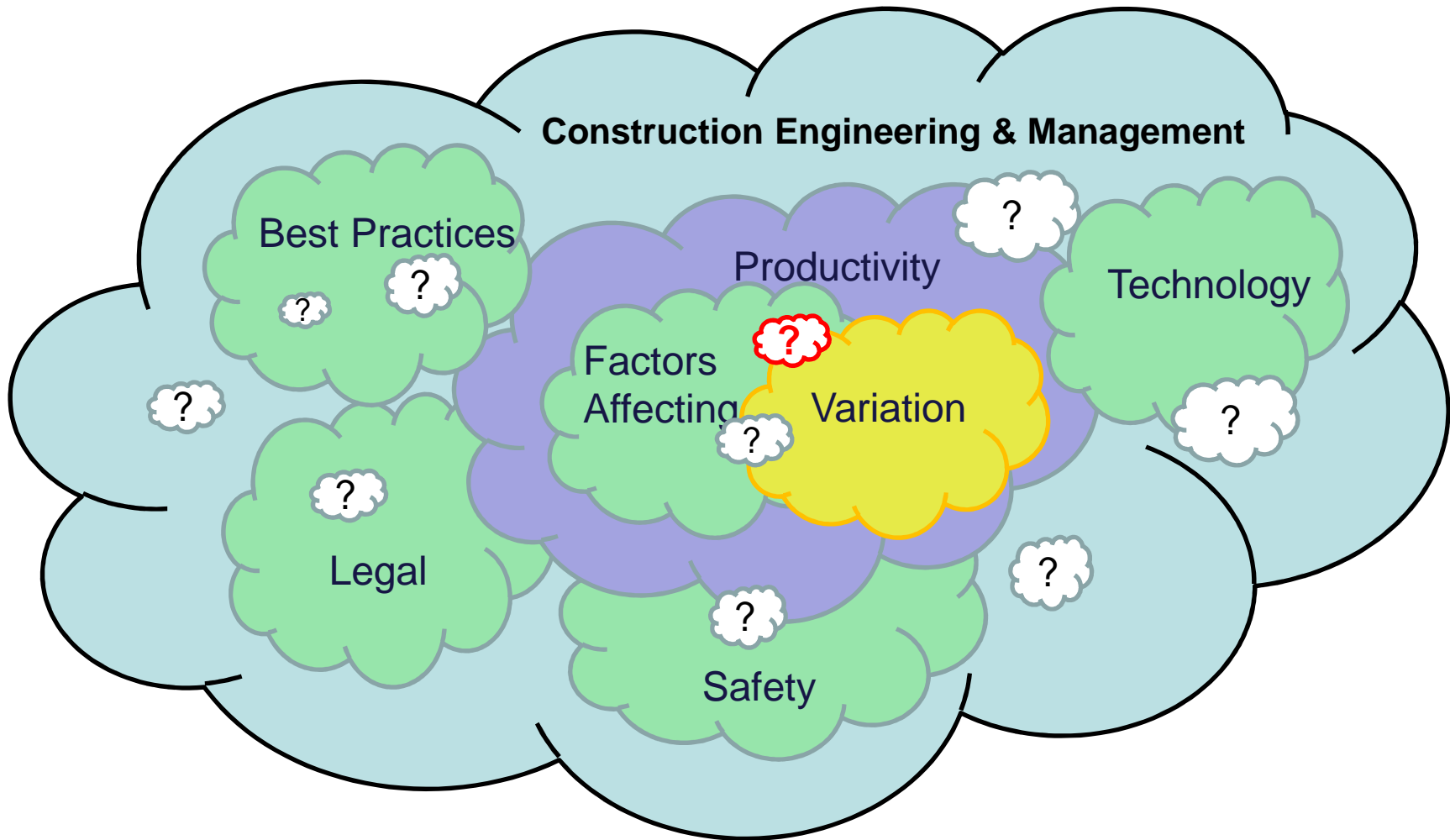
- **The Way Ahead**

- What we've observed
- Decision / Action Plan

- **Questions / Comments**



Research Background



Variation = The difference between what was planned and what actually happened

Variation Literature Review Summary

➤ Previous research

'94	'98	'99	'02	'04	'05	'08	'10		
Howell et al.	Rilett	Tommelein et al.	Thomas et al.	Radosaljevic and Horner	Koskela	Horman and Thomas	Kaplan et al.	Kim et al.	Hallowell and Gambatese

➤ Different perspectives

- **Flexibility** is the best option (Thomas)
- **Eliminate** variation where you can (LCI philosophy)

Percentage Planned Complete (PPC) Previous Research

Ballard's PhD research (2000)
Approx 450 weeks' worth of data

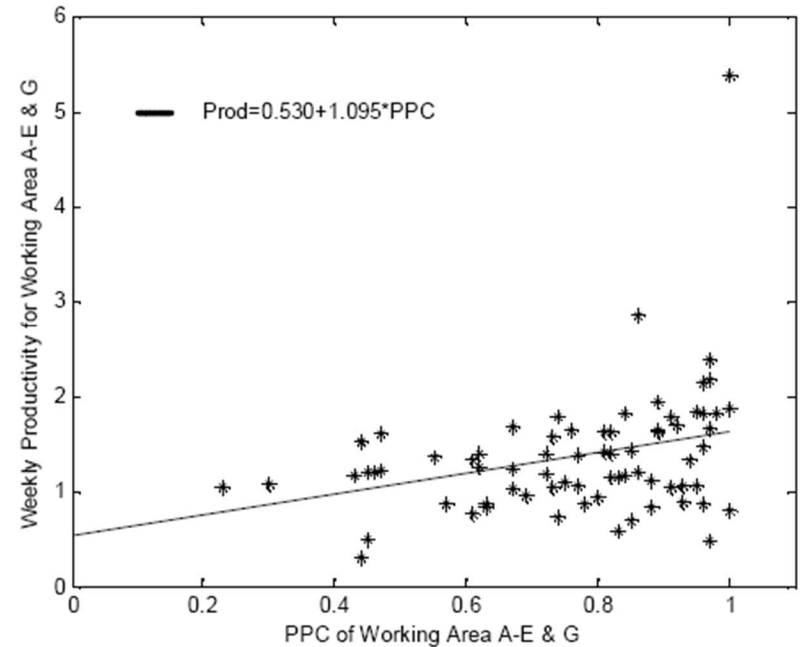
Weekly PPC	
Contractor 1	33%
Contractor 2	52%
Contractor 3	61%
Contractor 4	70%
Contractor 5	64%
Contractor 6	57%
Contractor 7	45%
Average	54%

Developed Last Planner System (LPS)™



LPS™ shown to increase PPC

Productivity positively
correlated with PPC



[Liu and Ballard, 2008]

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Why Study Variation?

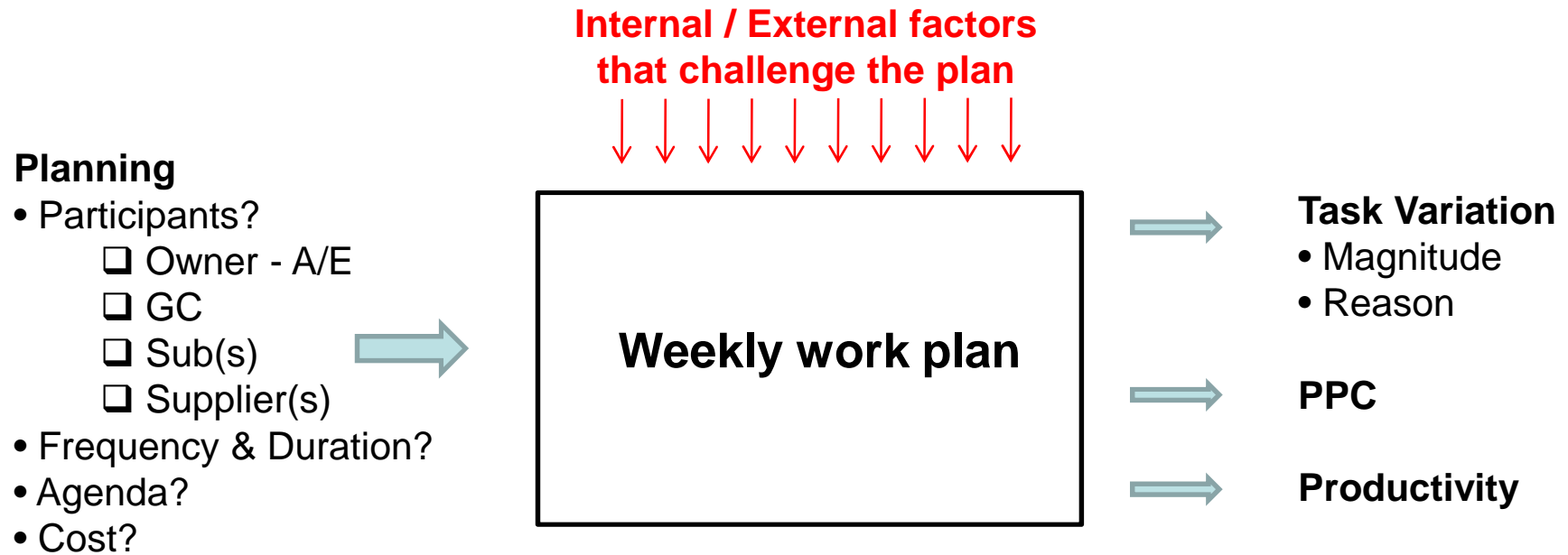
		Frequency or Likelihood				
		Rare	Unlikely	Possible	Likely	Certain
Severity	Catastrophic	M	H	E	E	E
	Major	M	H	H	E	E
	Moderate	L	M	H	H	E
	Minor	L	L	M	H	H
	Low	L	L	L	M	M

Key: L = Low M = Moderate H = High E = Extreme

PPC – related to frequency (likelihood the plan is unreliable)

Variation – incorporate magnitude (severity) as well as frequency to assess impact on construction activities

John J Kirlin Case Study Framework



Cisco – Lean

\$5.2M

16 months (Dec '09 – Mar '11)

47% Complete

Renovation of existing building

Install:

- 28 Cooling units
- 3 Chillers
- 3 Cooling towers
- 2 Rooftop AC units

SAS – Traditional

\$2.9M

12 months (Oct '09 – Sep '10)

76% Complete

New building

Install:

- 14 Cooling units
- 2 Chillers
- 2 Cooling towers
- 2 Outside AC units

John J. Kirlin, LLC

Job: 3217

Cisco Building #1

LEAN NCSU CASE STUDY

Weekly Report

DESCRIPTION		JJK	HOURS	ACTUAL	+/-	Week of: June 7 th thru June 11 th										
Area	Activity	CODE	ESTIMATED	SPENT		M	T	W	T	F	WHO	Completed?	Reason Codes			
2 nd Floor - Data Bldg #1	CHWS & R Weld Pipe	620	100	96	-4		24	24	24	24	Israel, Jorge, Antonio	YES	63			
1 st Floor - Data Bldg #1	Dom. Water Rough-in	505	80	34	-46	10	8	8	8		Ervi	NO	31	35	51	75
1 st Floor – Data Bldg	Install Ductwork		200	240	40	48	48	48	48	48	SCAS*	YES	63b			
Data Bldg #1	Supervision	81000	80	64	-16	9	8	7	8	8	Don, Brent, Will	YES				
2 nd floor - Data Bldg #1	Install Transfer		30	24	-6					24	SCAS*	YES	63b			
Data Bldg #1	Jobsite Safety Meetings	400	1	1				1			Will	YES				
Data Bldg #1	Subcontractor's Meetings	600	1	1		1					Will	YES				
Data Bldg #1	Daily Team Jobsite	300	8	6.5	1.5	0.5	1.5	1.5	1.5	1.5	Israel, Jorge, Antonio, Ervi,	YES	34			
Data Bldg #1	QCM Meetings	200														
Data Bldg #1	Weekly Jobsite Meetings	500	1	1			1				Cory	YES				

Planning Process

Cisco – Lean

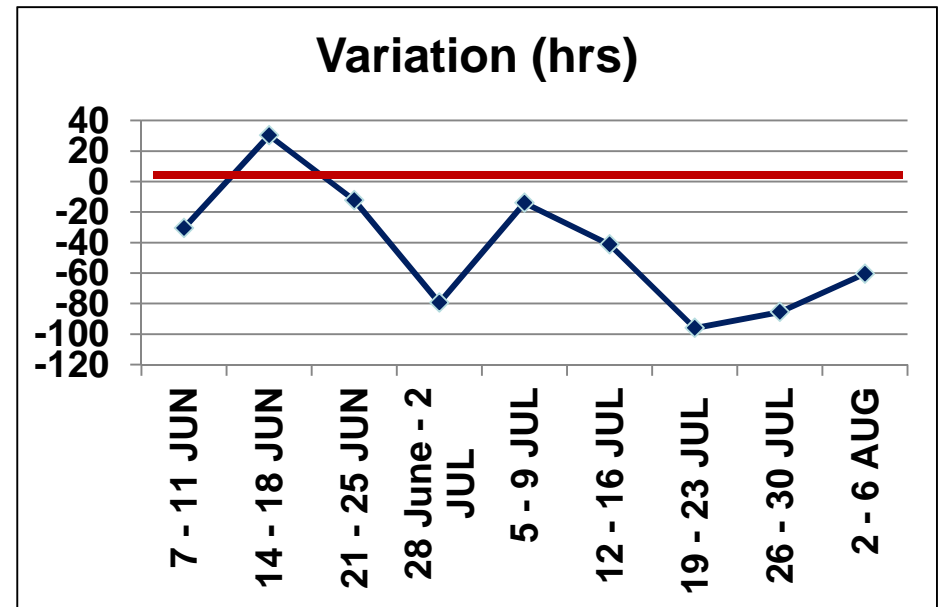
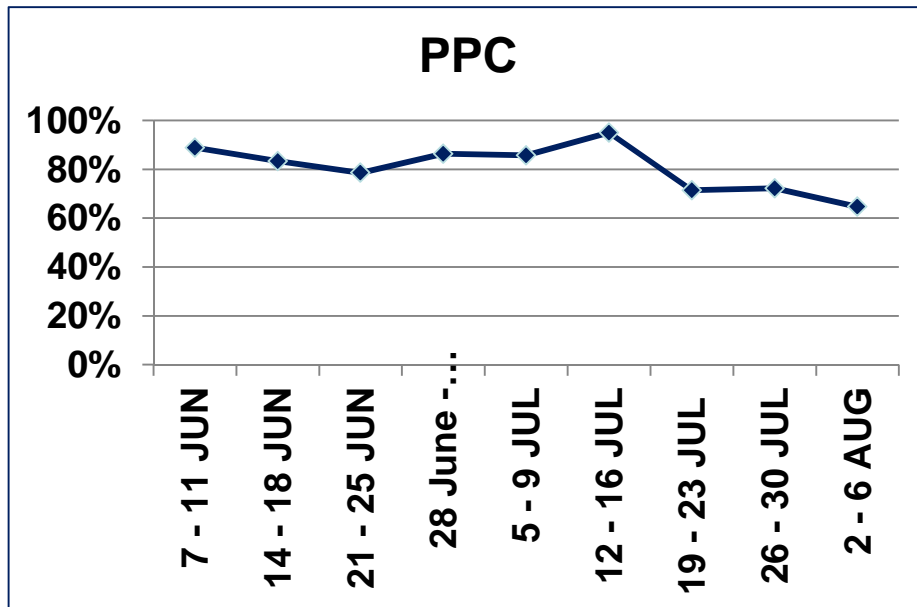
- Meet weekly
- Project Manager, Superintendent, Foreman
- Basic Agenda:
 - Review completed week
 - Develop weekly work plan
 - ID / address constraints
 - 3 week look ahead
- Daily field reviews

SAS – Traditional

- Every other week
- Project Manager, Superintendent, Foreman
- Basic Agenda:
 - Review completed week
 - 3 week look ahead



Observations – PPC & Variation (Lean Project)



Approx 15 tasks per week

PPC average about 80%

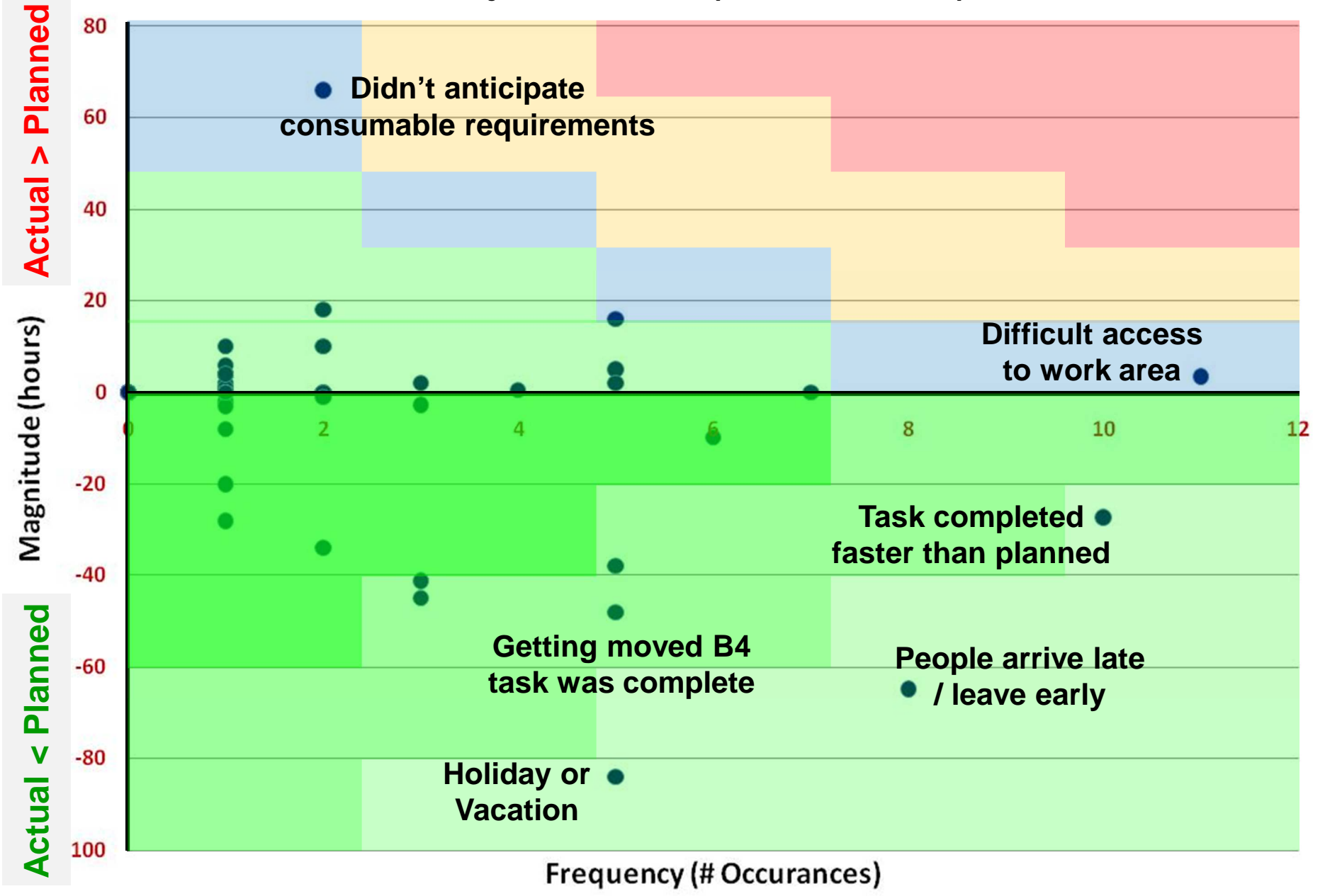
135 instances of variation (~ 15/wk)

Negative Variation:

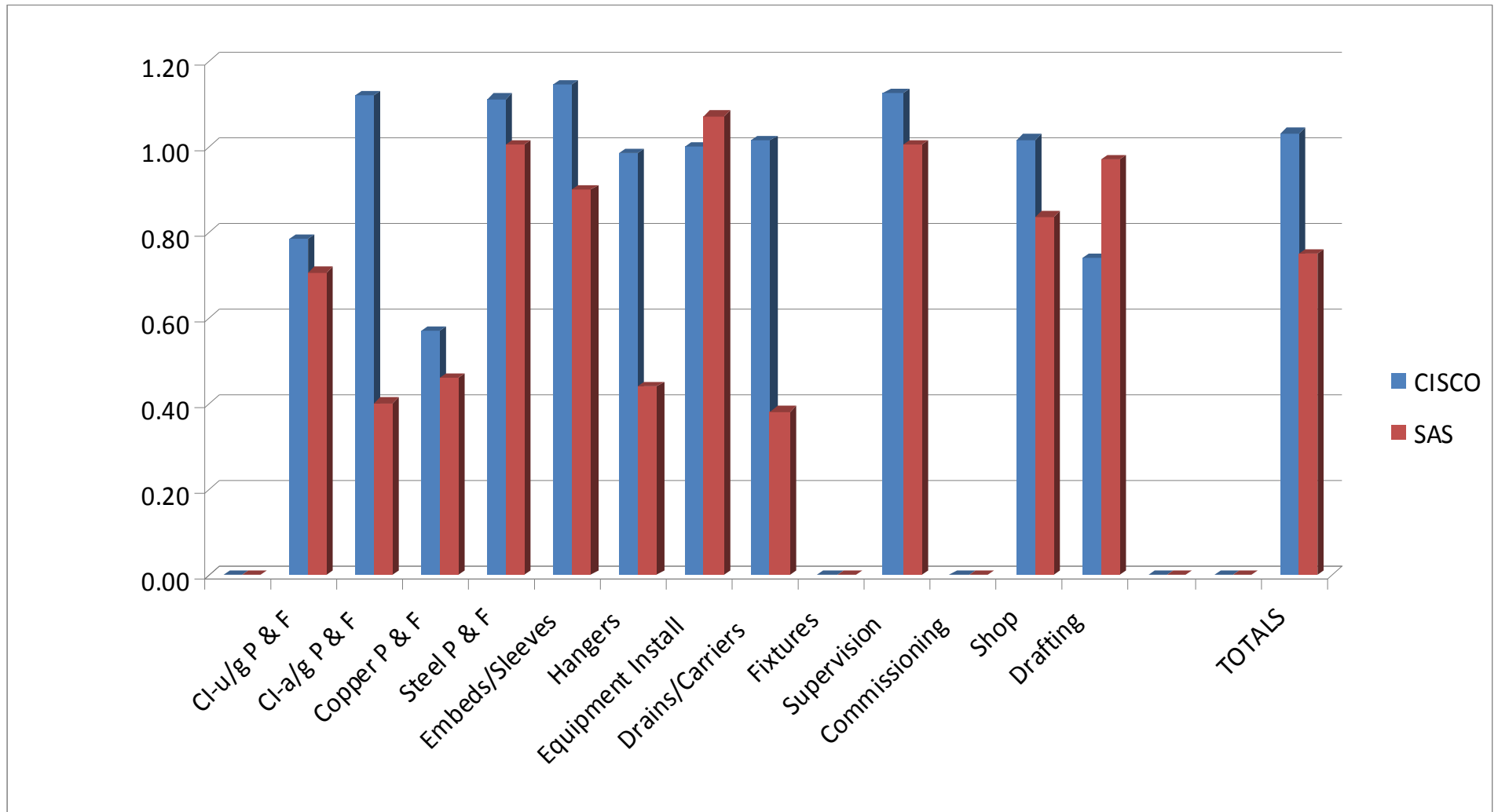
- Actual hours spent on task < Planned

Aggregate Variation approx -300 hrs

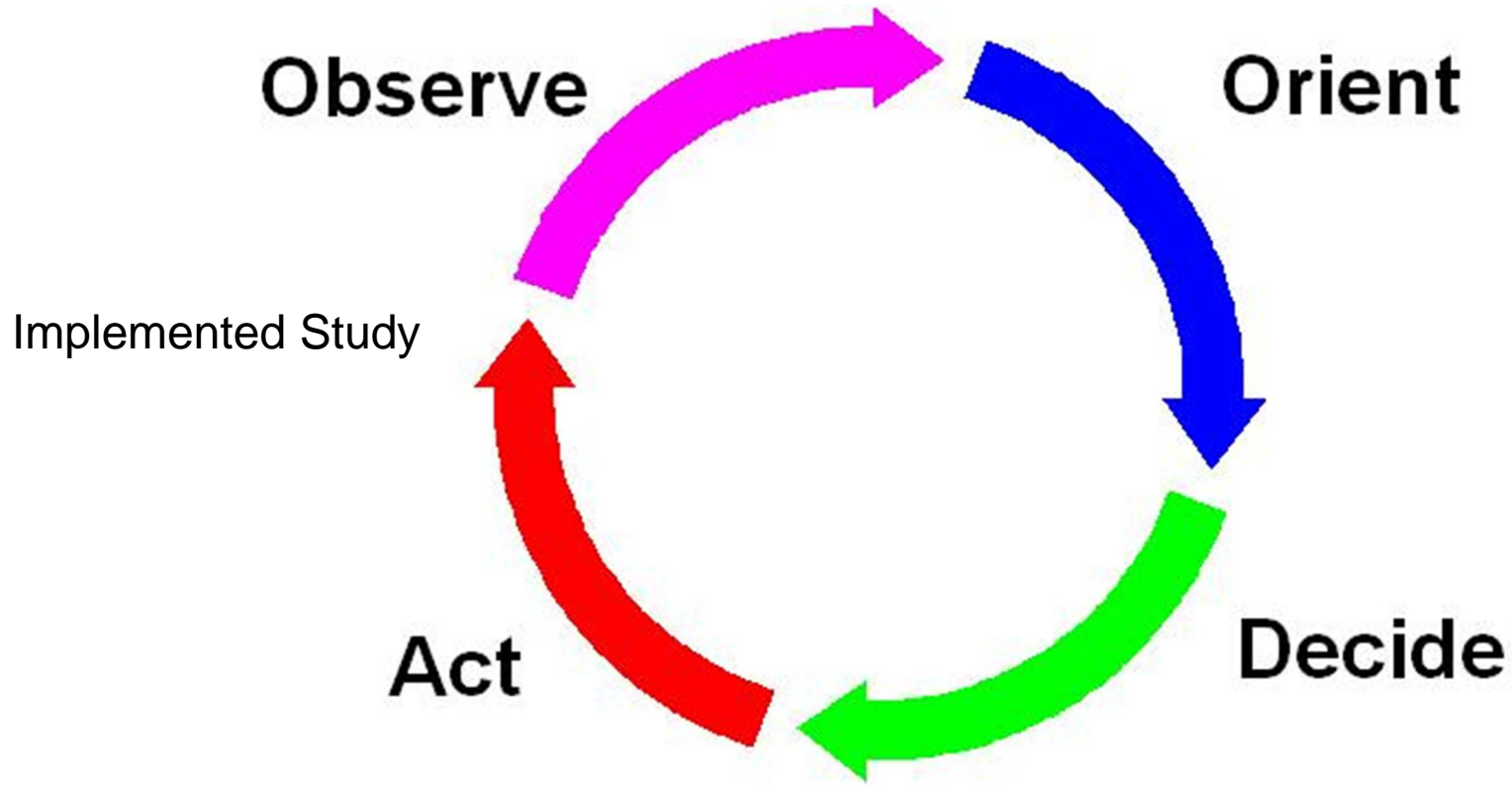
Cisco Project Variation (7 JUN – 6 AUG)



Productivity Rate Comparison



The Way Ahead



Observations

- Considerable number of deviations have been recorded weekly. Averaging 2.7 deviations per day
- We currently have spent approximately \$4,000 in additional planning from our standard practices and expect to spend \$12,000 total on the project
- Our planning sessions have helped the workers become better planners to schedule their work.
- We are currently meeting our planned productivity and exceeding it in certain areas, while continuing to educate our labor force in a system that will help to eliminate deviations.
- If this additional planning continues to track the current trend versus the other comparison project. This additional planning cost could prevent an additional cost estimated at \$52,000.

Comments or Questions

