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Pittsburgh, PA 15213-3890

First TSP Symposium 2006

Impact of Individual Performance to Organization

A Strategic Integration of PSP, TSP, and CMMI

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September 18th, 2006

Version 6.0

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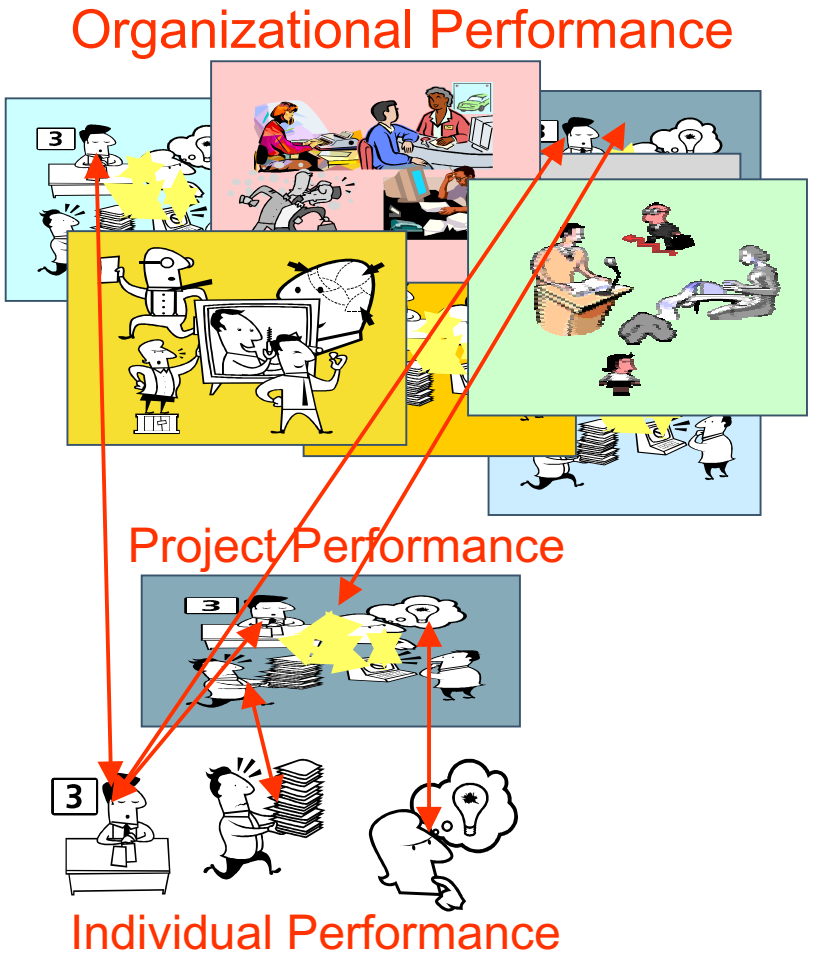
What is difficult at Organization Level



Direct measures associated with individual and project are not linked to define and control its quality and process performance objectives.

How do you ensure that organizational performance is managed?

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Purpose of this presentation

Based on the PSP and TSP process,

- Show an example of how process performance is influenced (linked) by individual to project and organization, where the strategic integration is desired,

- Find a promising approach to improve organizational performance.

NOTE: Toward CMMI

Parameters Changed: where “1” indicates the performance of one person (Person-3) half of the lower yield or rate.

Input to Simulation

Input/assumption:

- PSP and TSP processes are used,
- TSP development life cycle is followed.
- Need statements results in 15 pages of requirements,
- Team size is four engineers:
  Person 1 - 3: assigned fully for full life cycle,
  Person 4: assigned from REQ inspection phase.

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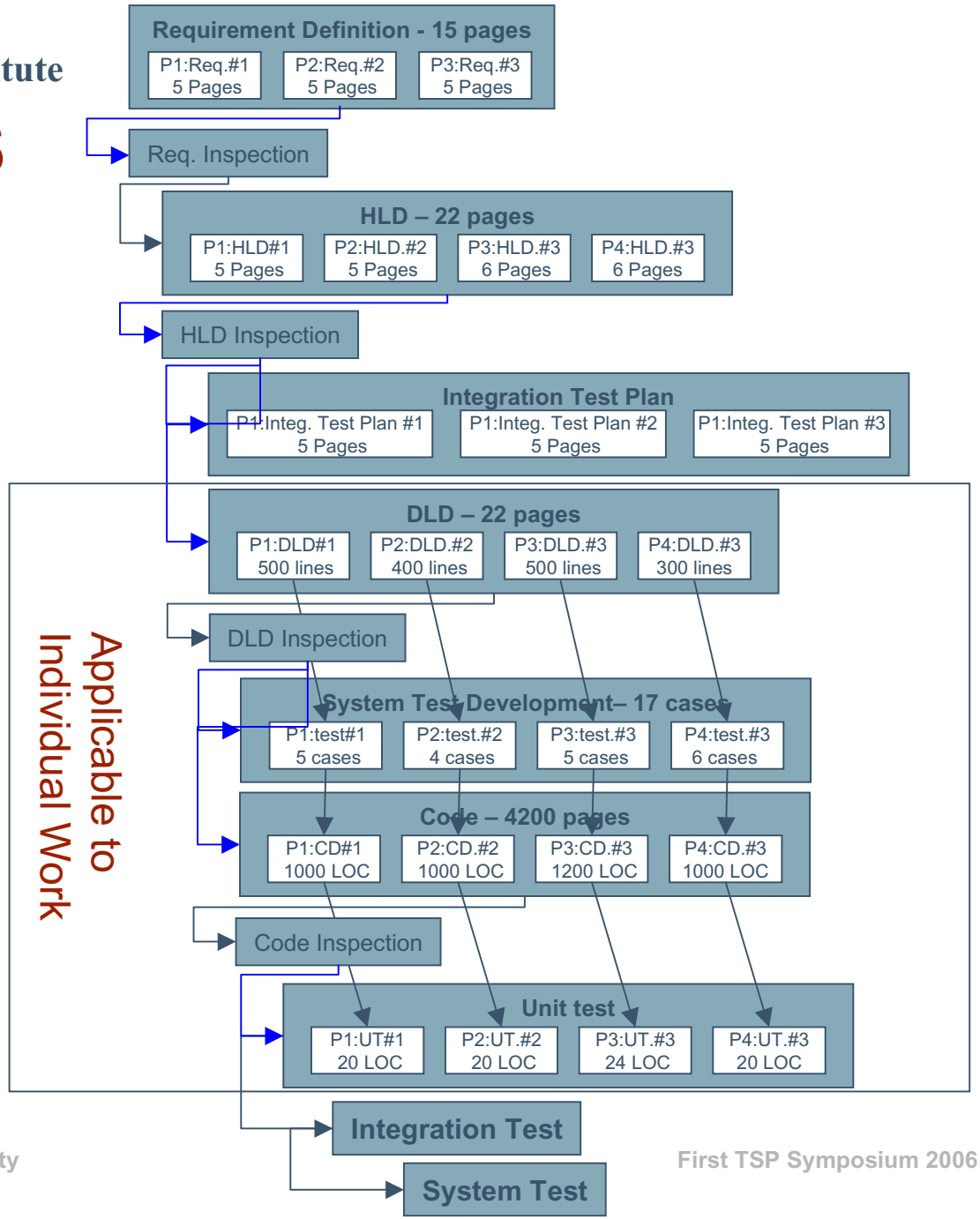
Project WBS Simplified Example

Activities included

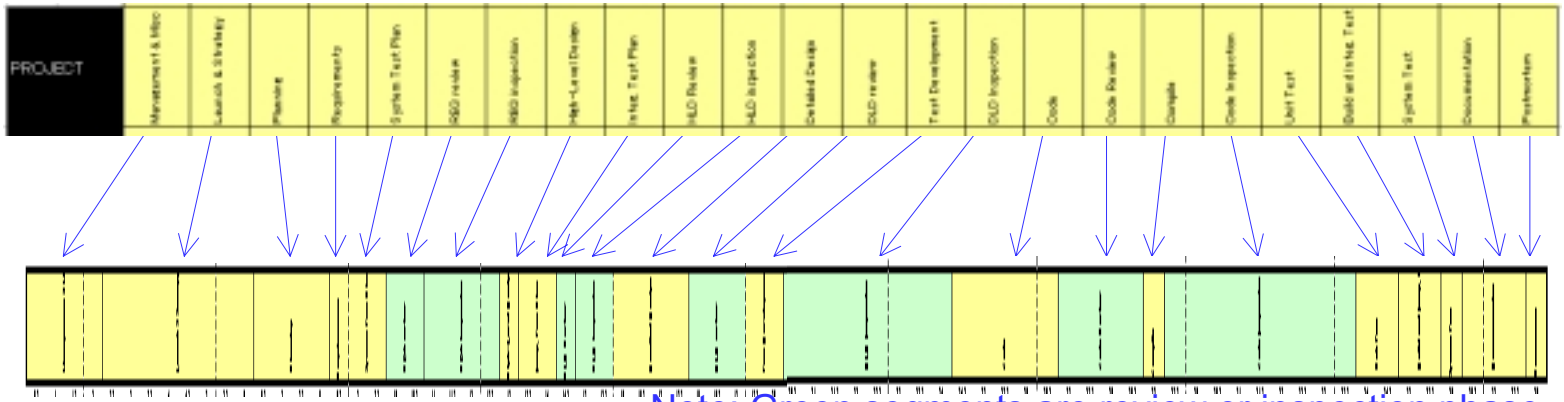
- Launch session
- Weekly meetings
- Documentation
- Postmortem



Project Life Cycle

The TSP phase definition is used for practical project life cycle.

Linear Life Cycle Definition



Note: Green segments are review or inspection phase.

Life Cycle Definition with phase time duration

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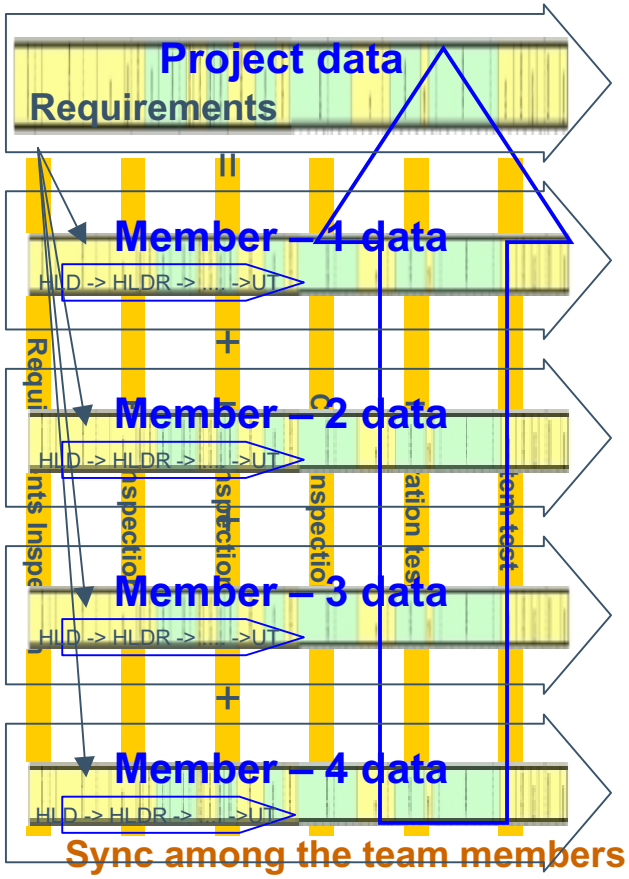
Simulation Definition: Individual to Project

Individual's process data are mostly defined by PSP and TSP workbook.

Project data is mostly defined by TSP workbook.

Project assumes four-day launch.



Team Measures related to Individual (1)

QualGuide (TSP Support Tool)

Measure	Goal	Comments
Percent Defect Free (PDF)		
Compile	> 10%	
Unit Test	> 50%	
Integration Test	> 70%	
System Test	> 90%	
Defects/KLOC:		
Total defects injected	75 - 150	If not PSP trained, use 100 to 200.
Compile	< 10	All defects
Unit Test	< 5	All major defects (in source LOC)
Integration Test	< 0.5	All major defects (in source LOC)
System Test	< 0.2	All major defects (in source LOC)
Defect Ratios		
Detailed design review defects /unit test defects	> 2.0	All major defects (in source LOC)
Code review defects/compile defects	> 2.0	All major defects (in source LOC)
Development Time Ratios		
Requirements inspection/requirements time	> 0.25	Elicitation in requirements time
High-level design inspection/high-level design time	> 0.5	Design work only, not studies
Detailed design/coding time	> 1.00	
Detailed design review/detailed design time	> 0.5	
Code review/code time	> 0.5	
Review and Inspection Rates		
Requirements pages/hour	< 2	Single-spaced text pages
High-level design pages/hour	< 5	Formatted design logic
Detailed design text lines/hour	< 100	Pseudocode ~ equal to 3 LOC
Code LOC/hour	< 200	Logical LOC
Defect Injection and Removal Rates		
Requirements defects injected/hour	0.25	Only major defects
Requirements inspection defects removed/hour	0.5	Only major defects
High-level design defects injected/hour	0.25	Only major defects
High-level design inspection defects removed/hour	0.5	Only major defects
Detailed design defects injected/hour	0.75	Only design defects
Detailed design review defects removed/hour	1.5	Only design defects
Detailed design inspection defects removed/hour	0.5	Only design defects
Code defects injected/hour	2	All defects
Code review defects removed/hour	4	All defects in source LOC
Compile defects injected/hour	0.3	Any defects
Code inspection defects removed/hour	1	All defects in source LOC
Unit test defects injected/hour	0.067	Any defects
Phase Yields		
Team requirements inspections	~ 70%	Not counting editorial comments
Design reviews and inspections	~ 70%	Using state analysis, trace tables
Code reviews and inspections	~ 70%	Using personal checklists
Compiling	~ 50%	90+ % of syntax defects
Unit test - at 5 or less defects/KLOC	~ 90%	For high defects/KLOC - 50-75%
Integration and system test - at < 1.0 defects/KLOC	~ 80%	For high defects/KLOC - 30-65%
Acceptance test - at < 1.0 defects/KLOC	~ 65%	For high defects/KLOC - 30%
Before compile	>75%	Assuming sound design methods
Before unit test	> 85%	Assuming logic checks in reviews
Before integration test	> 97.5%	For small products, 1 defect max
Before system test	> 99%	For small products, 1 defect max

TSP Instructions / PlanGuide / QualGuide / Project / Team / Roles / Goals / SUMP / SUMQ / SUMS /

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Project Characterization - Measures (1)

Ref. TSP QualGuide

Constraints on allocated times

Measure Analysi	Min	Max	Min	Max	
Defects/KLOC					
Defect Ratio					
Development Time Ratios					
Review and Inspection Ratios					
Req. pages/Hour	2				
HLD pages/Hour	5				
DLD review text lines/Hr	100		110		
Code Review LOC/Hour	200		220		
Defect injection and Removal Rates					
Req. defects injected/Hour	0.25		0.33	1.3	Rate 30% high
Req. defects insp. remvd/Hour	0.5		0.35	0.7	Rate 30% low
HLD defects injected/Hour	0.25		0.33	1.3	Inject defects more
HLD defects insp. remvd/Hour	0.5		0.35	0.7	Remove defects less
DLD defects injected/Hour	0.75		0.98	1.3	Inject defects more
DLD review defects remvd/Hour	1.5		1.05	0.7	Remove defects less
DLD defects insp. remvd/Hour	0.5		0.35	0.7	Inject defects more
Code defects injected/Hour	2		2.60	1.3	Inject defects more
Code review defects remvd/Hour	4		1.60	0.4	Remove defects less
Compile defect injected/Hour	0.3		0.39	1.3	Inject defects more
Compile defect removed/Hour	10		7.00	0.7	Inject defects more
Code Inspection defects rmvd/Hour	1		0.70	0.7	Remove defects less
Unit Test defects injected/Hour	0.07		0.09	1.3	Inject defects more
Unit Test defects removed/Hour	2		2.00	1	Inject defects less
Phase Yields					
Team req. inspection	0.7				
Design Reviews and inspections	0.7		0.35	0.5	20% lower yield
Code review and inspections	0.7		0.35	0.5	20% lower yield
Compiling	0.5		0.35	0.5	50% lower yield
UT - at 5 or less defects/KLOC	0.9		0.25	0.5	50% lower yield
IT and ST - at <1.0 defects/KLOC	0.8		0.45	0.5	60% lower yield
Acceptance test - at 1.0 def./KLOC	[illegible]				
Before compilation					
Before unit test					
Before IT	0.98				
Before ST	0.99				

SR

LR

SY

LY

Rates of process activities

Low performance Rates (LR)

Phase yield

Lower Yield (LR)

TSP parameter values

Process management activities

Quality management activities

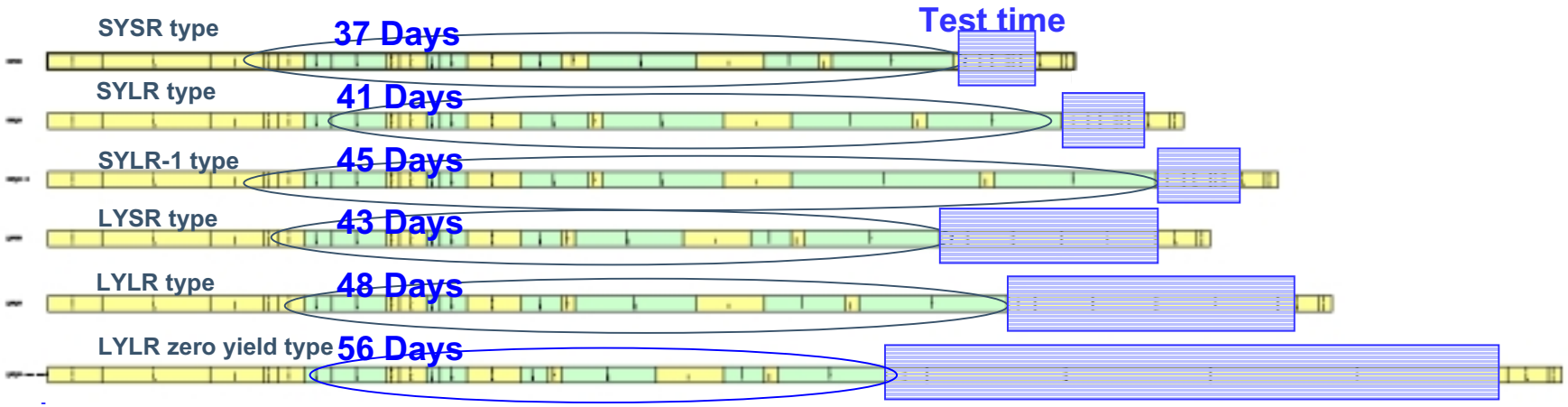
Project Type

- Characterized by process disciplines, where we use TSP and PSP process disciplines.

Project Type	Description
SYSR	PSP/TSP disciples followed. Project focuses the yield (quality) and the activity rates are appropriate, e.g., not too fast and not too slow, according to the TSP process parameters
SYLR	The quality is focused but the activity rates are not appropriate. Consistent engineering activity is recognized but not much on the work rates.
SYLR-1	Same as SYLR but the third member spends two times longer to remove one defect, compared to the other members.
LYSR	Less focus on the quality but the activity rates are focused.
LYLR	Less focus on the quality and also the activity rates are not appropriate.
LYLR-zero yield until CI	Zero yield is assigned from HLD review through code inspection to LY-LR

Findings – Project Management Tradeoff

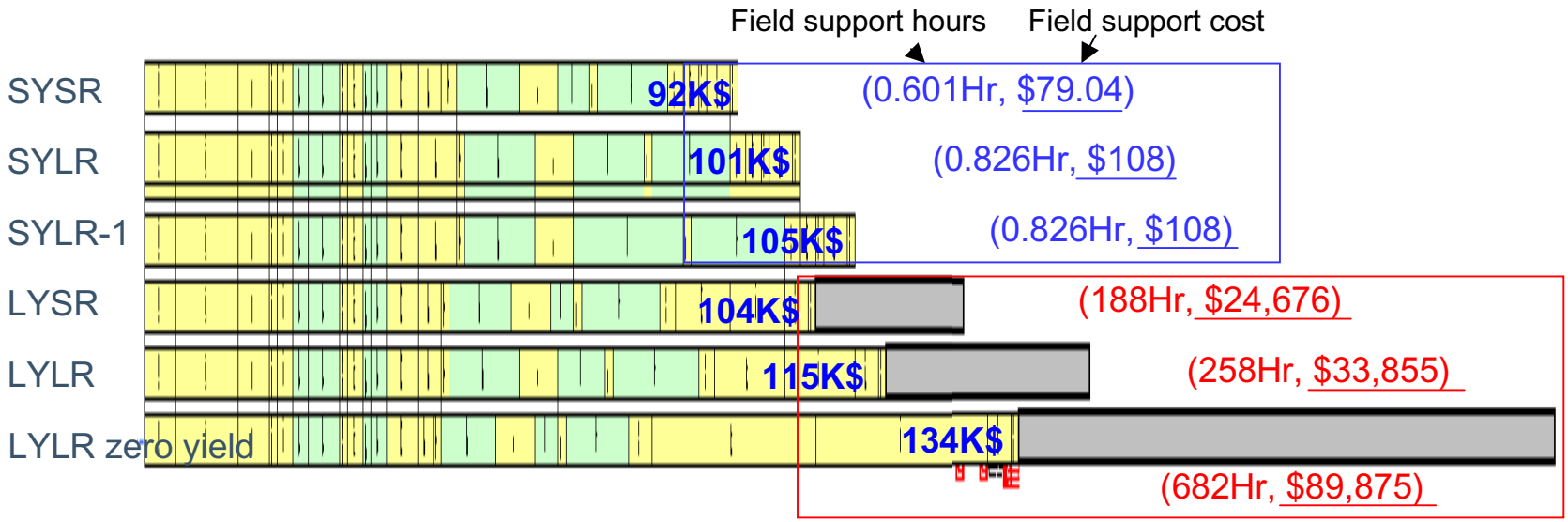
Green segments show review and inspection.
Blue box show the time duration from the unit test through the system test.



- If the review & inspection time is longer, the test time becomes shorter.
- The lifecycle time of a SYLR type project is longer than that of a LYSR type project.

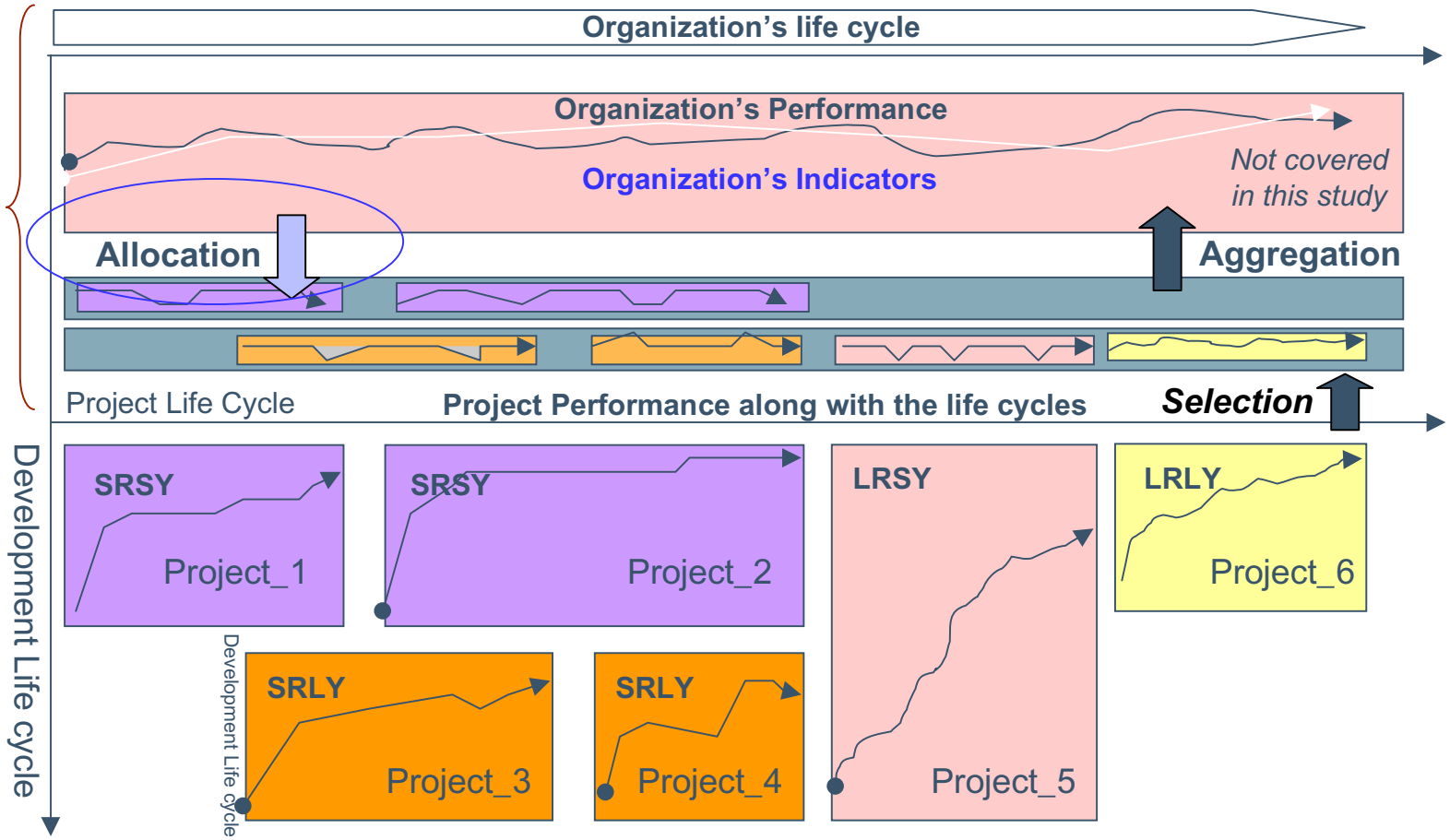
Findings – Project TCO including Field Support

Grey boxes show the cost needed to fix field defects.



1) Field support cost of the SY* type project is negligible, i.e., very small.
2) Field support cost of the LY* type project is not negligible, i.e., not small.

Simulation Definition: Project to Organization



Spectrum of Organization Type

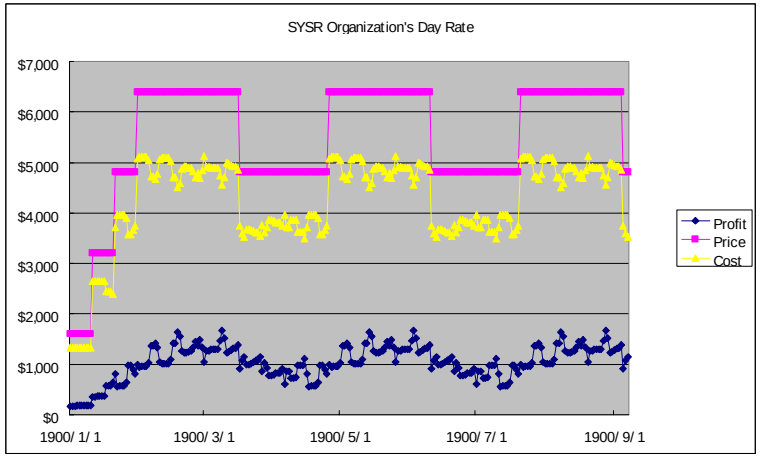
Organization Type	Description	Amplification of (Yield, activity rates) to the SY-SR data
SY-SR	Organization with projects of fully TSP/PSP trained teams	(1.0, 1.0)
SY-LR	Organization of projects with the same yield level but 30% lower or higher activity rates to SY-SR (e.g., higher defect injection rates or lower defect removal rates)	(1, 1.3 or 0.7)
LY-SR	Organization of projects with lower yield level but the same activity rates	(0.5, 1.0)
LY-LR	Lower yields and lower rates (e.g., amplified 30% higher or lower to the TSP parameters)	(0.5, 1.3 0r 0.7)
SY-LR-1	Same yield level and lower rates (e.g., higher injection rates or lower removal rates) + one person has one half of the yields for code review, unit test, integ. test and system test	(1.0/one half for one person, 0.5)
LY-LR zero yield up to code insp.	Zero yield is assigned from HLD review through code inspection to LY-LR	(0.5/0.0 for HLD review - code inspection, 0.5)

Findings – Organization's Performance

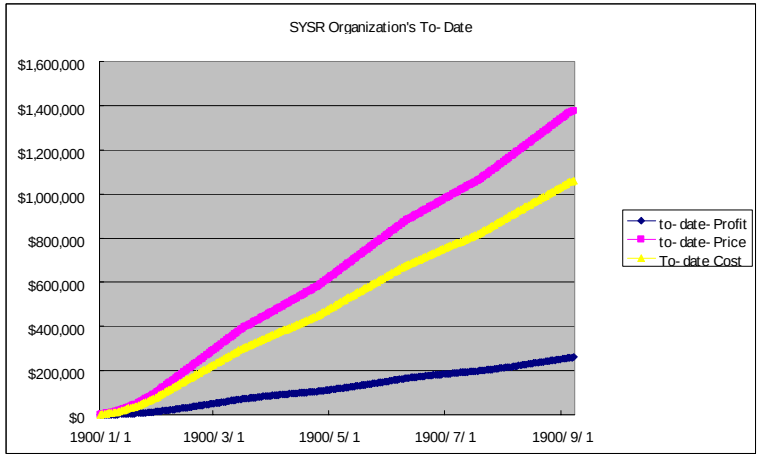
Assumptions:

- The work product sizes are same across projects examined.
- The project price is same to all projects and given such that the LYSR type project has the profit of about 9% of the price.
- The project price does not include the field support.
- The cost rate of the project members are equally given.
- The project price is spread over the project life cycle.
- The organization's performance is calculated for nine month long.

Findings – SYSR Organization



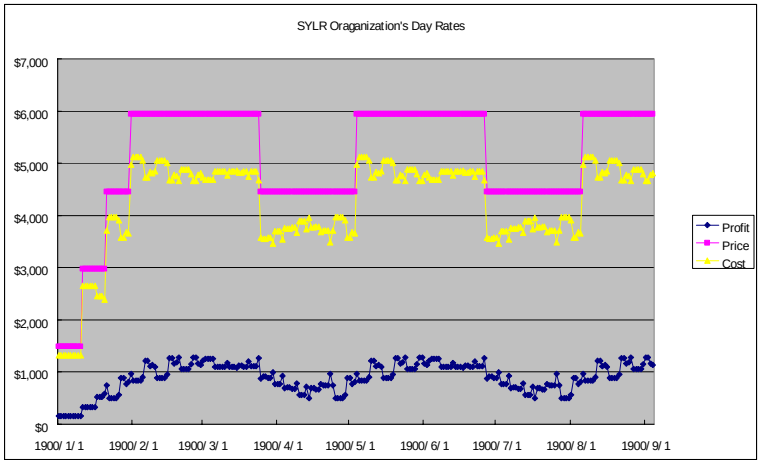
Day Rates



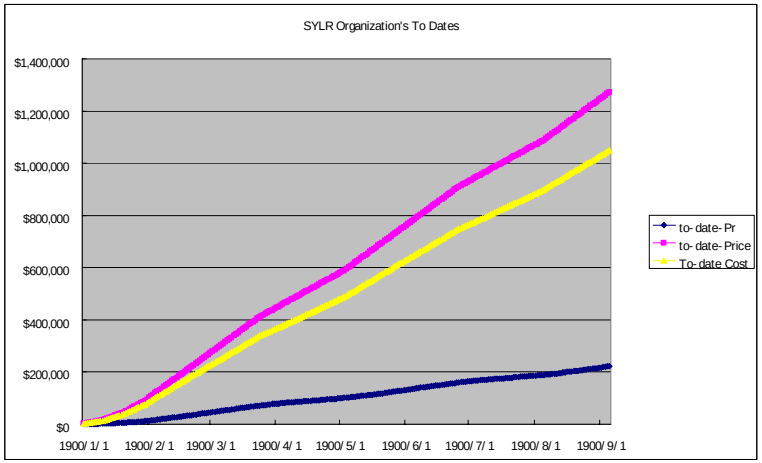
To Dates

- The profit is steadily increasing
- Day rate of profit shows stable and large smooth variations on when projects start or phase out.
- About 23% of profit is expected steadily

Findings – SYLR Organization



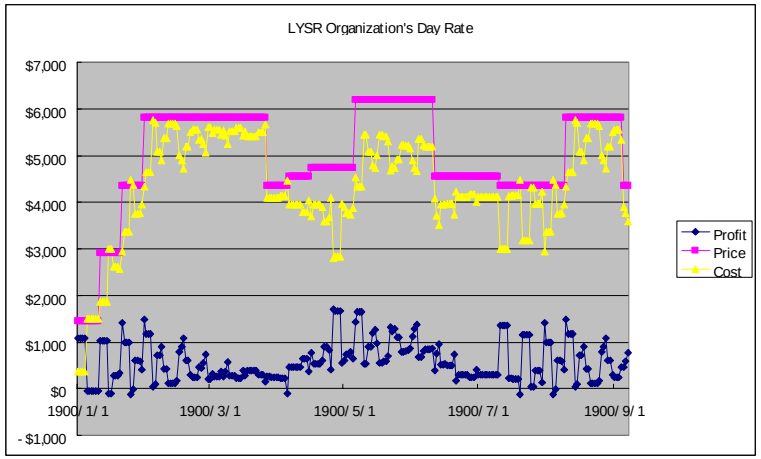
Day Rates



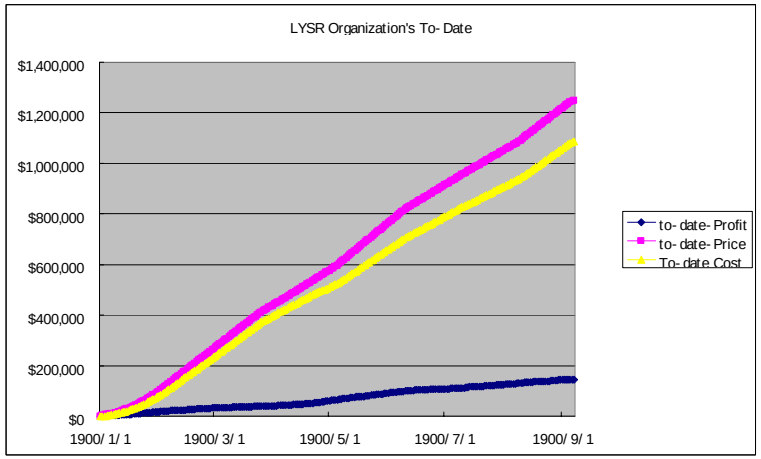
To Dates

- The patterns of the day rates and to-dates are similar to SYSR.
- About 17% profit is expected steadily.

Findings – LYSR Organization



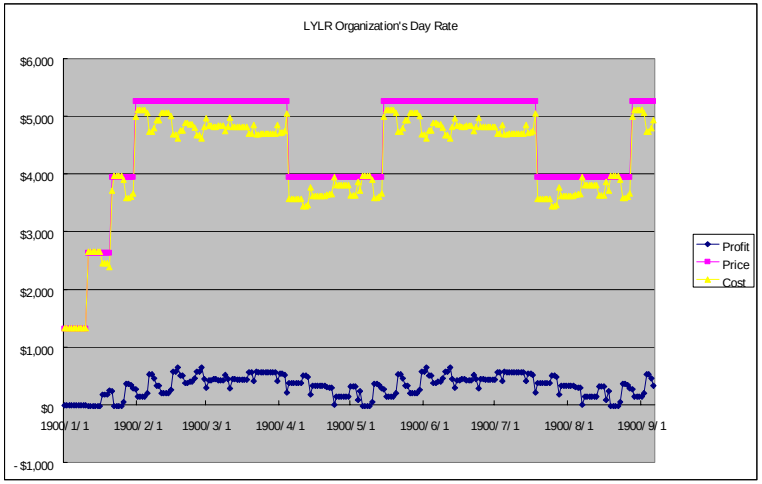
Day Rates



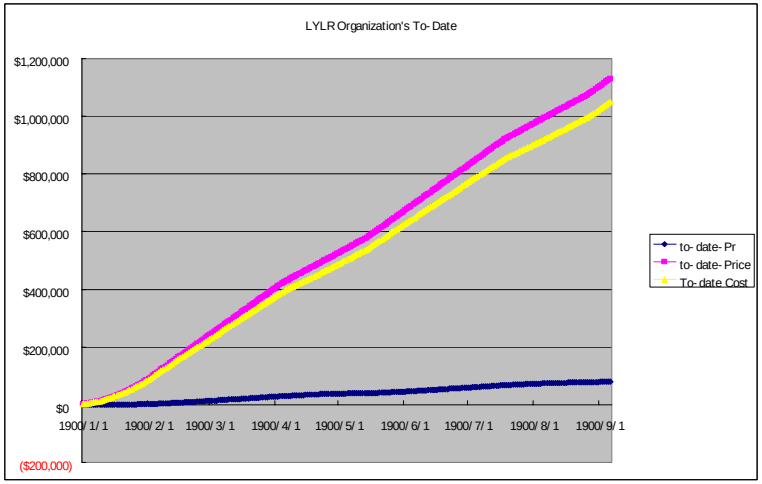
To Dates

- Variation on the rates of the cost, therefore, the profit is larger.
- About 9% profit is achieved but the variation is significant.
- The organization has risk on making profit (9%.)
- The TCO becomes negative.

Findings – LYLR Organization



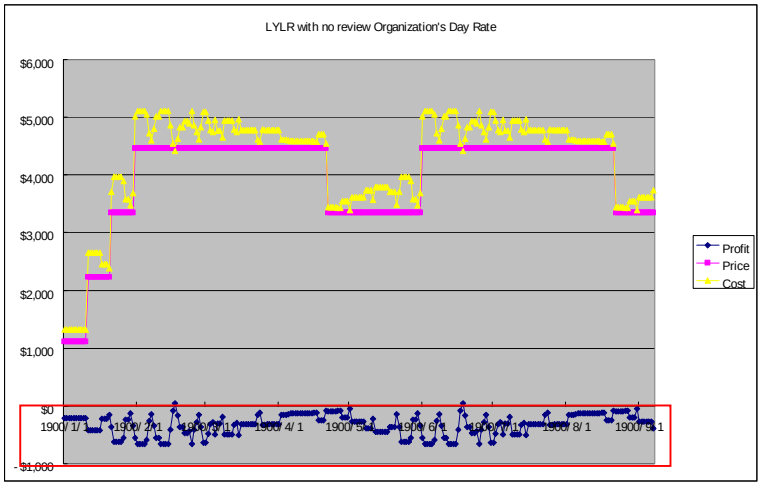
Day Rates



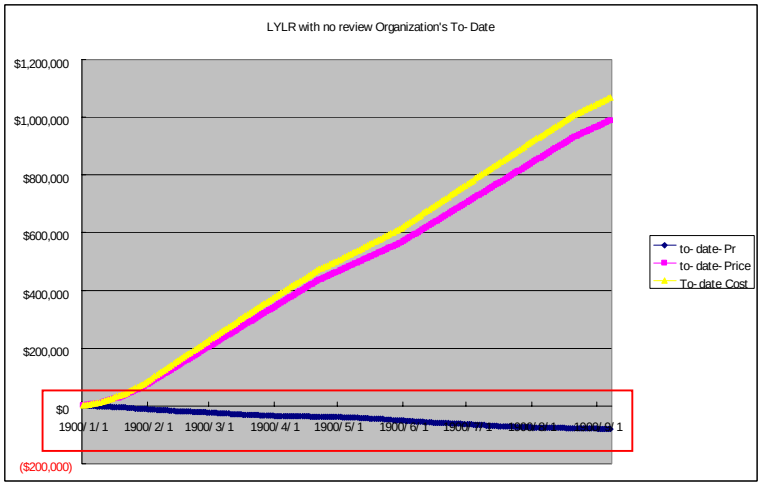
To Dates

- The day rate of the profit is lower than the profit of SYSR projects.
- About 7.6% profit of project is achieved.
- The TCO becomes negative.

Findings – LYLR zero yield Organization



Day Rates



To Dates

- The Day Rate Profit is *negative value*, e.g., the cost is higher than the price.
- To Date profit increases negatively larger but not visible because of no review or inspection activities are missing.

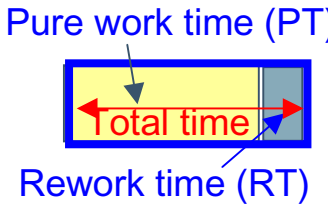
Findings – Total Cost of Ownership

Below is the table showing the TCO information of the organization:

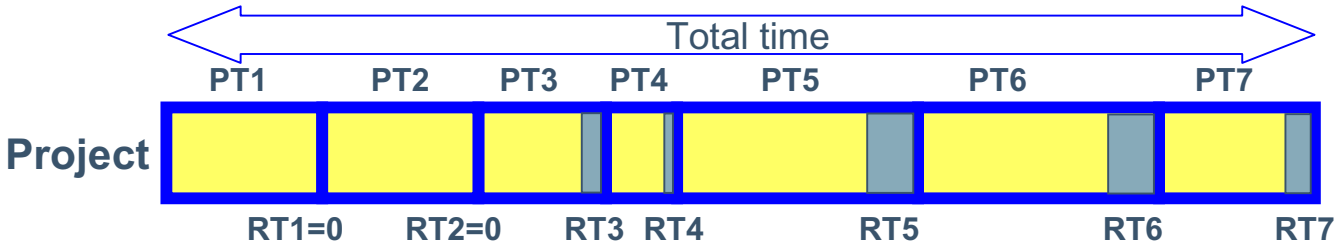
	Price	Cost	Profit	Field Support	TCO	Net Results
SYSR	$124,842	$93,613	$31,228	$79	$93,691	$31,149
SYLR	$124,842	$102,700	$22,141	$108	$102,808	$22,033
LYSR	$124,842	$113,492	$11,349	$113,492	$138,168	-$13,327
LYLR	$124,842	$115,386	$9,455	$115,386	$149,241	-$24,400
LY-LR zero yield up to code insp.	$124,842	$134,871	-$10,030	$89,875	$224,746	-$99,905

- SYSR and SYLR organization can only make TCO **profit**.
- LYSR and LYLR organization may make profit at the project completion, however, the TCO will eventually be in **red**.
- If you don't identify and fix defects before compile, such a project might be classified as the "LYLR – zero yield up to code inspection" type.

Finding -
Why high quality project finishes earlier (1)



(Schedule) Elasticity = Total time/PT=1+RT/PT



Total pure time = PT1 + PT2 + ... + PT7
Total rework time = RT1 + RT2 + ... + RT7

Max elasticity = 1+Max { RT3/PT3, RT4/PT4, RT5/PT5, RT6/PT6, RT7/PT7 }

Average elasticity =Total time/ Total pure time

Finding -
Why high quality project finishes earlier (2)

The yield management is the key for SY type organization.

High yield (70% or higher) is achieved if
- the max elasticity is in the range 1.0 – 1.5, and,
- the average elasticity is in the range 1.0 – 1.2

Respectively.

We call this as the ***yield-elasticity rule*** and the next slide supports the rule:

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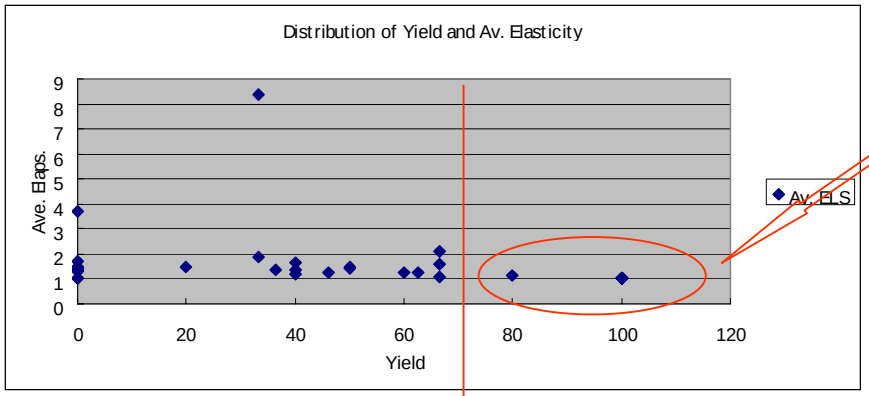
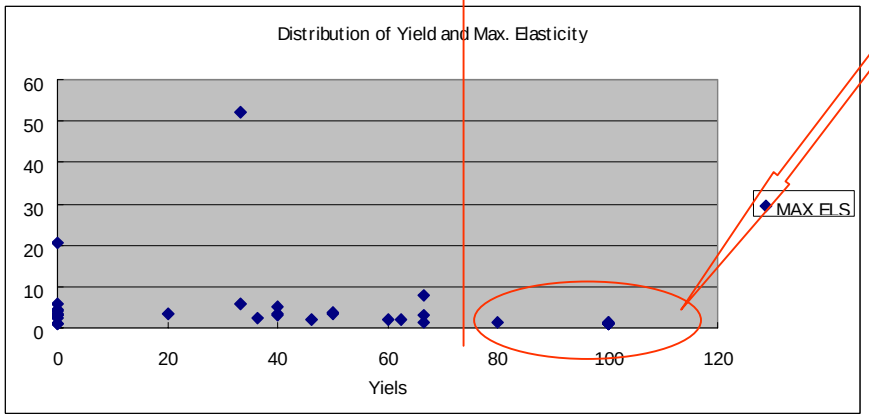
Observation of the Elasticity -– PSP Data





PGM	Yield	MAX ELS	AV ELS
1	100	1	1
2	100	1	1
3	100	1	1
4	0	1.13333	1.01905
5	0	1.14286	1.02793
6	100	1.15385	1.02198
7	100	1.2	1.02857
8	100	1.21739	1.03106
9	100	1.22222	1.04015
10	66.6667	1.5	1.09048
11	80	1.5	1.16753
12	60	1.9	1.27143
13	62.5	2	1.25283
14	46.1538	2	1.26967
15	0	2.25	1.30556
16	36.3636	2.5	1.36786
17	66.6667	3	1.60484
18	0	3.14286	1.30612
19	0	3.17391	1.43888
20	40	3.21951	1.35279
21	40	3.28571	1.17294
22	50	3.33333	1.48889
23	0	3.5	1.35714
24	20	3.5	1.49433
25	50	3.66667	1.40136
26	0	4.28571	1.46939
27	0	4.47619	1.50534
28	40	5	1.65714
29	0	6	1.71429
30	33.3333	6	1.8617
31	66.6667	8	2.10431
32	0	20.6667	3.68637
33	33.3333	52	8.37415

Max elasticity <1.5 and Average elasticity <1.2 should give high yield performance to be credited.

What is the promising improvement approach for organization

From the study so far:

- The project cost is not much different across the SY and LY type organizations.
- The TCO measure must be picked up regardless the field cost is paid by project organization or customer.
- The key parameter for low TCO is the yield that can be applied to project and project members (individuals.)

A promising approach for organizational improvement is to establish the SY nature of every project it manages and therefore of every individuals to be capable to produce work product at high quality. Neither SR nor LR nature is critical.

Overall Picture: Individual, Project, and Organization

Unit	Activities	Character.	Process or Process Model	Measurement	Measures
Organization	Profit, Managing Cost / Resources etc	Manage Cost, Resource, and Profit	CMMI	Goal Driven SW Measurement	Profit Summed Cost Resource
Project Team	Managing Cust./Sponsor and team Team Building	Team Level PQM and Communication	TSP	TSP Measurement Framework	Summed Sizes Workloads Ranges Cost Quality
Individual	Activity Manage. Small tasks And PQM	Individual Level PQM	PSP	PSP Measurement Framework	Size Workload Range Cost Quality

Process Performance Model

PQM = Productivity and Quality Management.

Process Performance Model Applies.....

Summary

Direct measures of individual process such as the pure work time and rework time or defects injected and removed, are essentially linked to the quality performance of the project and organization.

Organizational performance is consistently improved by the SY nature, where every individual of the organization manages high yields or the adequate elasticity.

TCO problem will be resolved to result in the win-win situation for project and its customer.