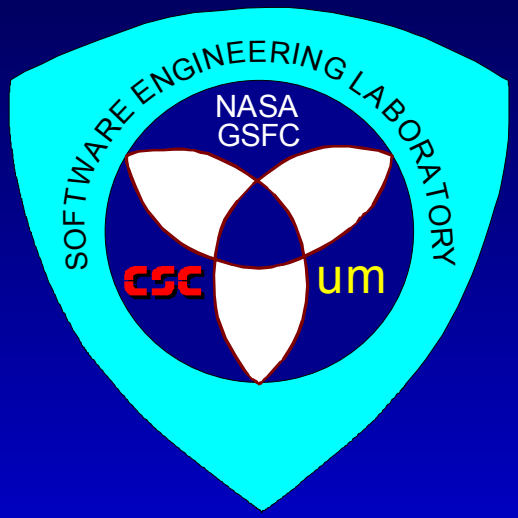
The Improvement Cycle: Analyzing Our Experience



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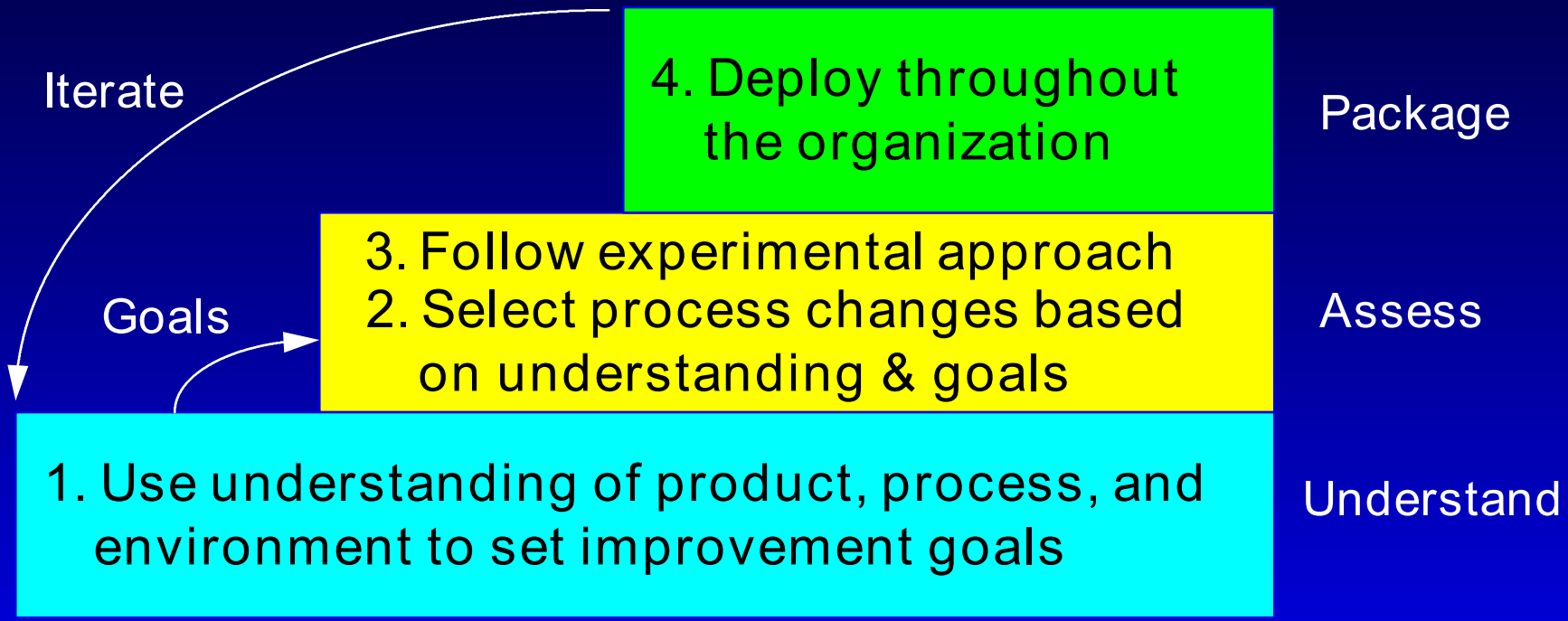
Presentation Outline

- What is an improvement cycle?
  - Relationship to SEL Improvement Approach
  - Improvement cycle steps
- Compare/contrast SEL examples
  - Reuse
  - Quality Techniques
  - Independent Testing
- Observations and Conclusions

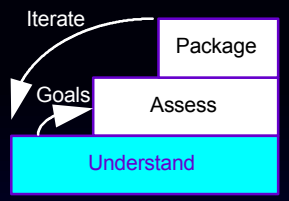
What Is an Improvement Cycle?

Iterations of experimentation followed by deployment to satisfy an organizational goal



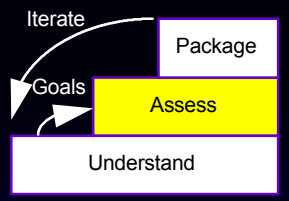
SEL Improvement Paradigm

Step 1 - Use Understanding of Process and Environment



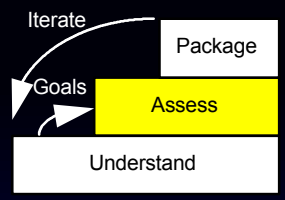
- What's inside/outside organization's control (requirements changes, deadlines)
- Current baseline measures of organizational performance (effort, schedule, errors)
- Process characteristics (work activities)
- How people spend their time

Step 2 - Select Process Change Based on Organizational Goals



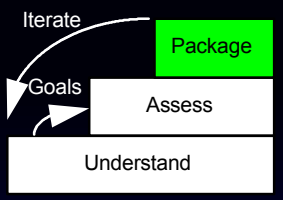
Goal	Leverage Area	Experimental Focus
Decrease Cost	Maximize reuse	Ada, object oriented techniques
	Minimize rework	CASE
	Eliminate process redundancy	Combine phases
Increase Quality	Increase personal discipline	Cleanroom, personal software process
	Detect errors earlier	Testing and review methods

Step 3 - Follow Experimental Approach



- Select measures to fulfill experimental goals
- Iterate on multiple projects, using multiple techniques
  - Established methods: Pilot/Refine
  - Conceptual methods: Create/Pilot/Refine
- Involve development organization in feedback loop

Step 4 - Deploy Throughout Organization



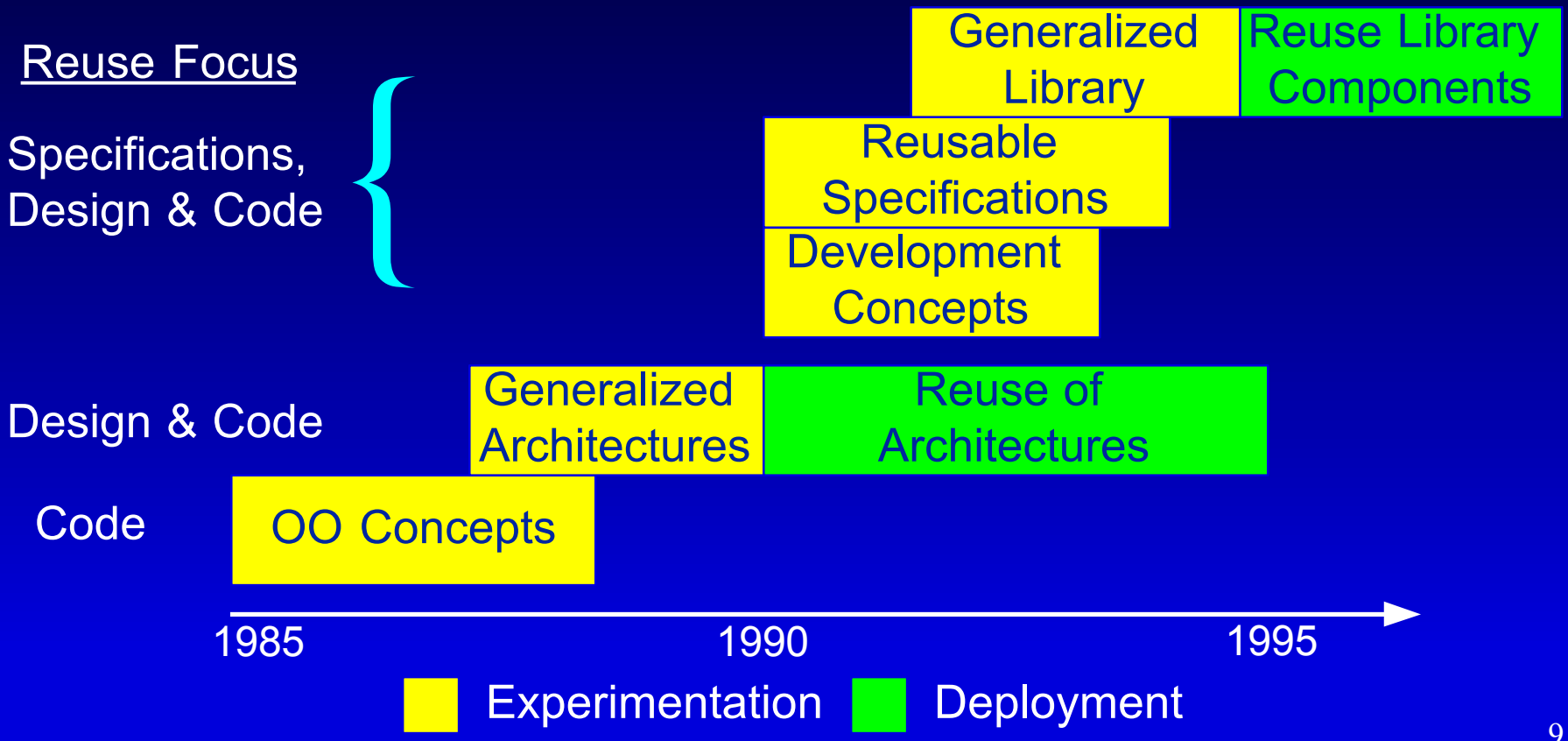
- Document process to appropriate level
- Provide training for new element in the context of the existing process
- Reinforce use by publicizing results to development organization

Example 1 - Reuse

1	Improvement Goal	• Reduce cost
	Baseline Measures	• 20% code reuse per system • 564 staffmonths per mission
2	Leverage Area	• Increase software reuse
	Process or Technology	• Use Ada language • Apply object-oriented concepts
3	Expectations	• 40% code reuse per system • Reduced cost per mission
	Experiment Approach	• Iterative learning • Multiple small projects
4	Deployment	• Full use in highest payback applications • Just-in-time training by local experts

Reuse Improvement Cycles

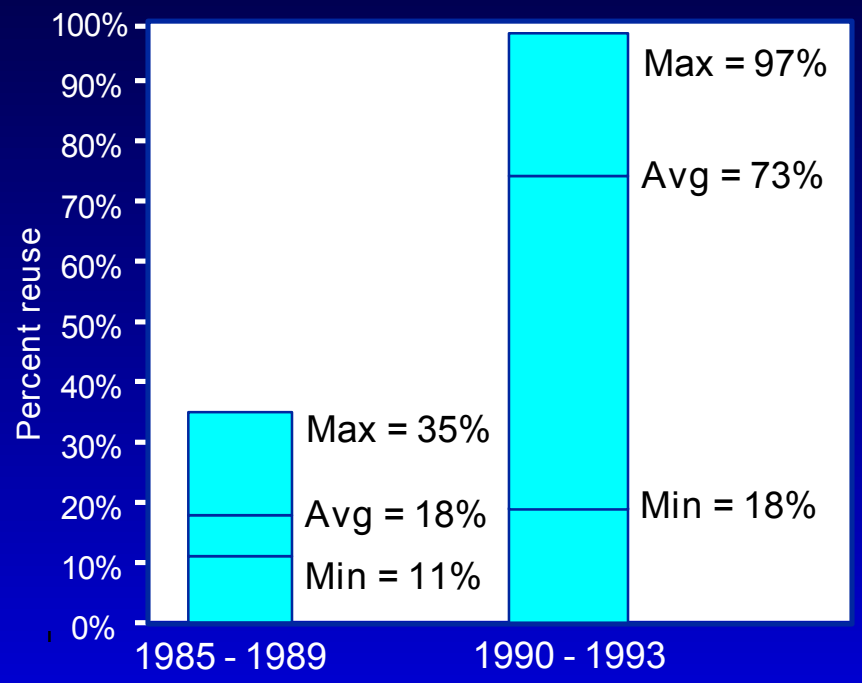
2 major improvement cycles
Iterative learning of how to apply OO concepts
Scope: Increased from code to specifications reuse



Reuse - Results of First Improvement Cycle

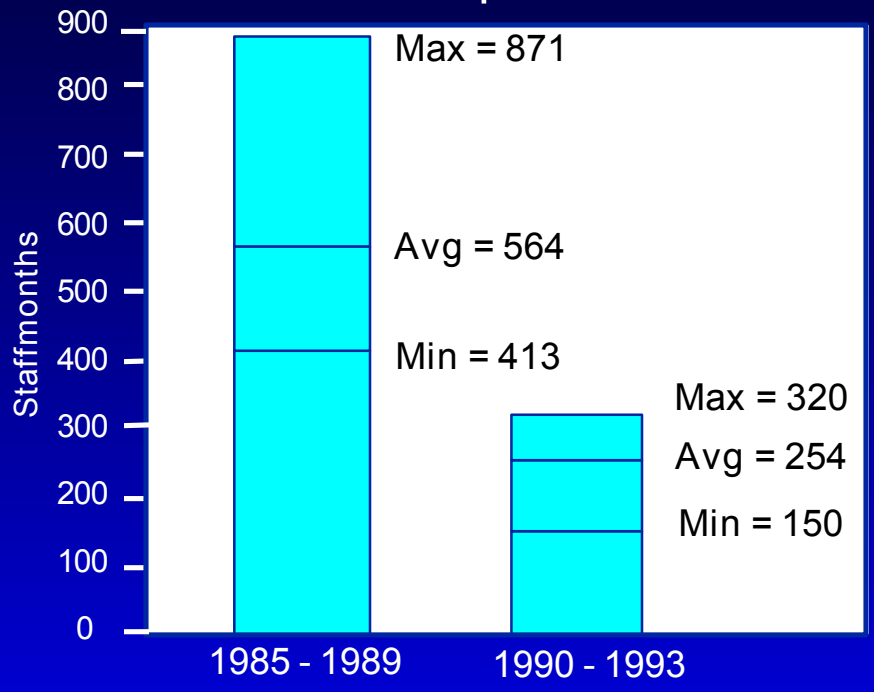
Improvement exceeded expectations.

Percent Reuse



300% Increase in Reuse

Total Cost per Mission



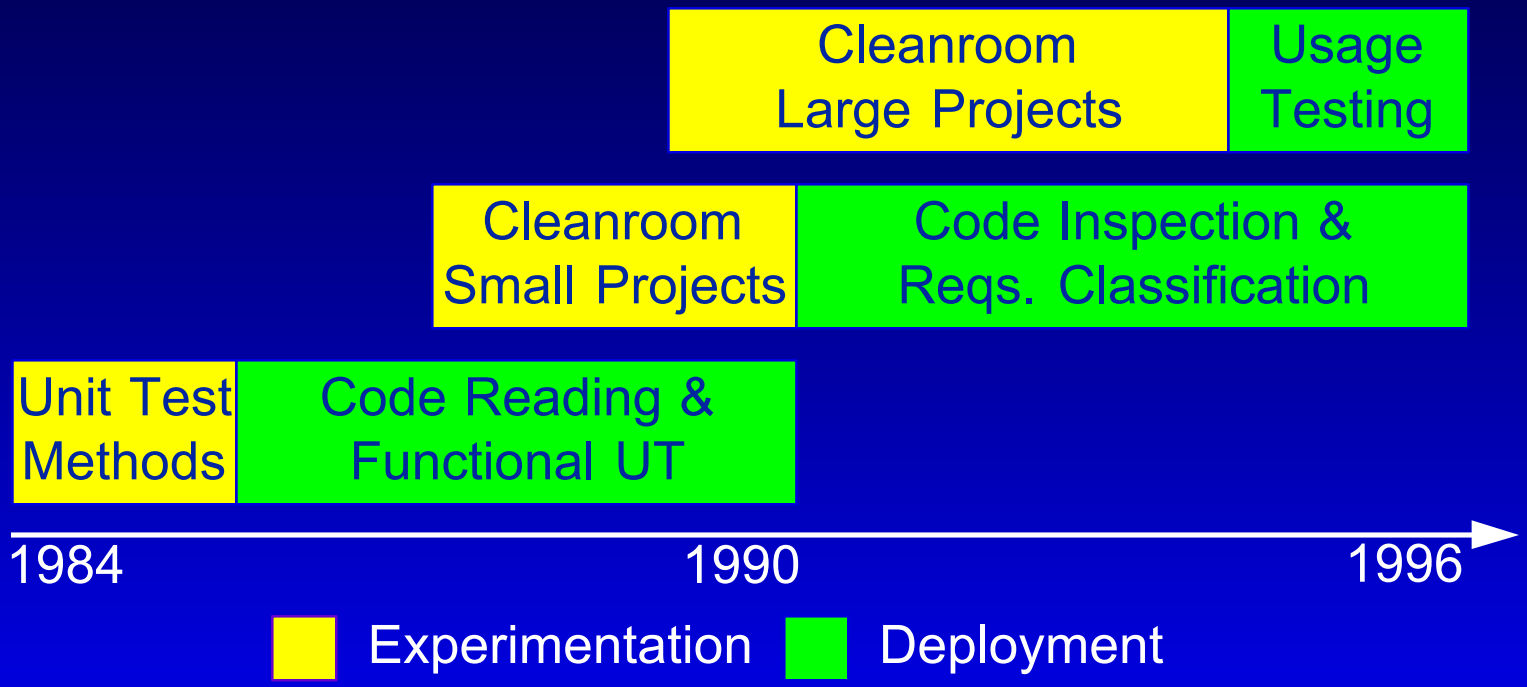
55% Cost Reduction

Example 2 - Quality Techniques

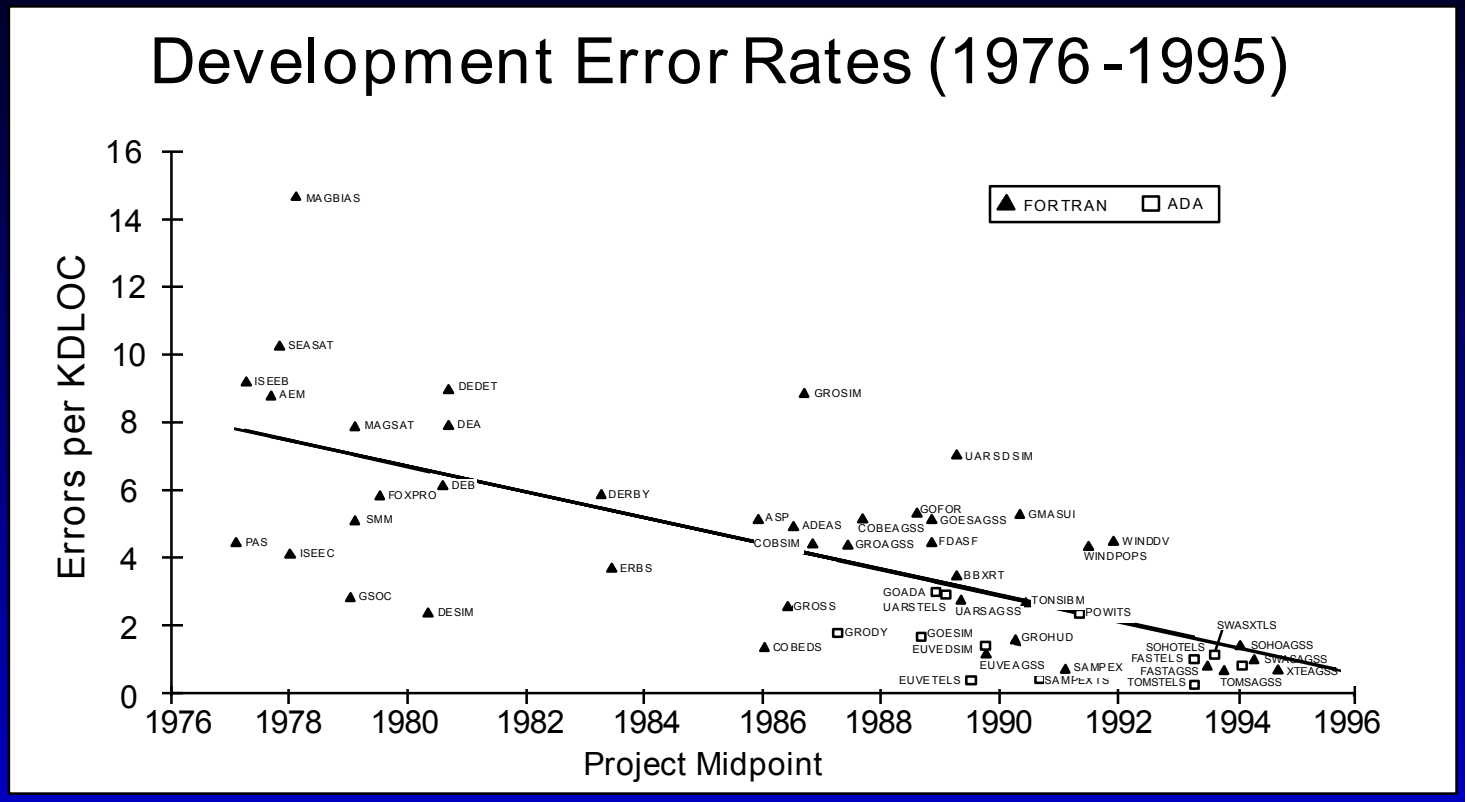
1	Improvement Goal	• Increase quality
	Baseline Measures	• 6.5 errors per KSLOC
2	Leverage Area	• Human discipline
	Process or Technology	• Various testing and review techniques • Cleanroom Methodology
3	Expectations	• Fewer errors during development and use • No additional cost
	Experiment Approach	• Iterative refinement • Controlled experiments; sequential projects
4	Deployment	• Broad use of most beneficial subset of techniques • Subset included in standard process

Quality Improvement Cycles

3 improvement cycles
Iterative refinement of existing technologies
Scope: Small to larger projects; unit to full system testing



Quality Techniques - Results



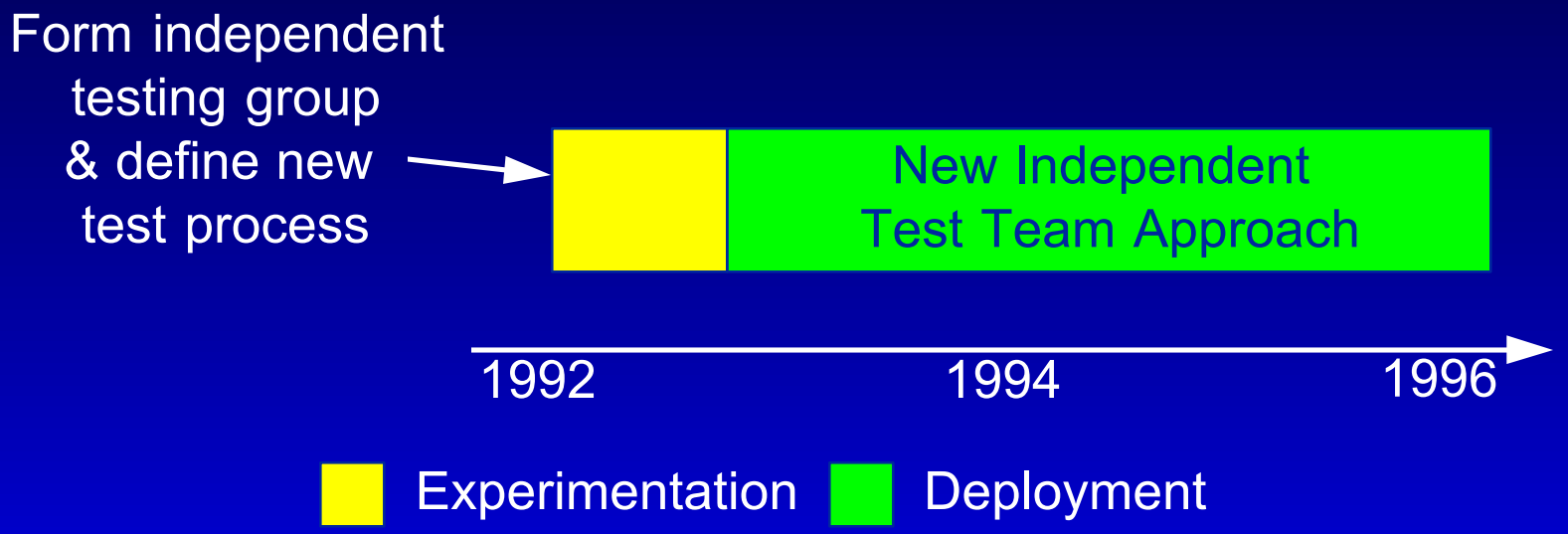
Intermediate deployment drove steady decrease in error rates. 85% improvement over 15 years.

Example 3 - Independent Testing

1	Improvement Goal	• Reduce cost and schedule
	Baseline Measures	• 254 staffmonths per mission • 106 weeks per mission
2	Leverage Area	• Eliminate process redundancy
	Process or Technology	• Form independent test teams from system and acceptance test groups • Overlap testing and development of builds
3	Expectations	• Reduced cost and schedule per mission • No loss of quality
	Experiment Approach	• Define process • Reorganize and pilot
4	Deployment	• Full use on all applications • Test teams fine-tune process

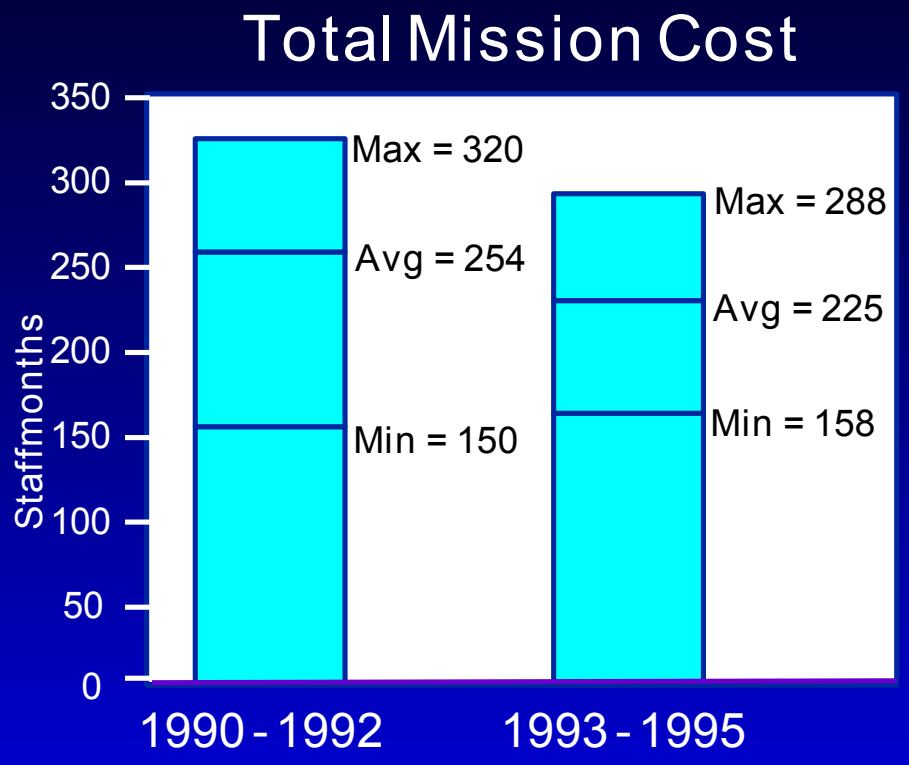
Testing Improvement Cycle

1 improvement cycle
Refinement of existing process and organization change
Scope: Piloted on all projects immediately

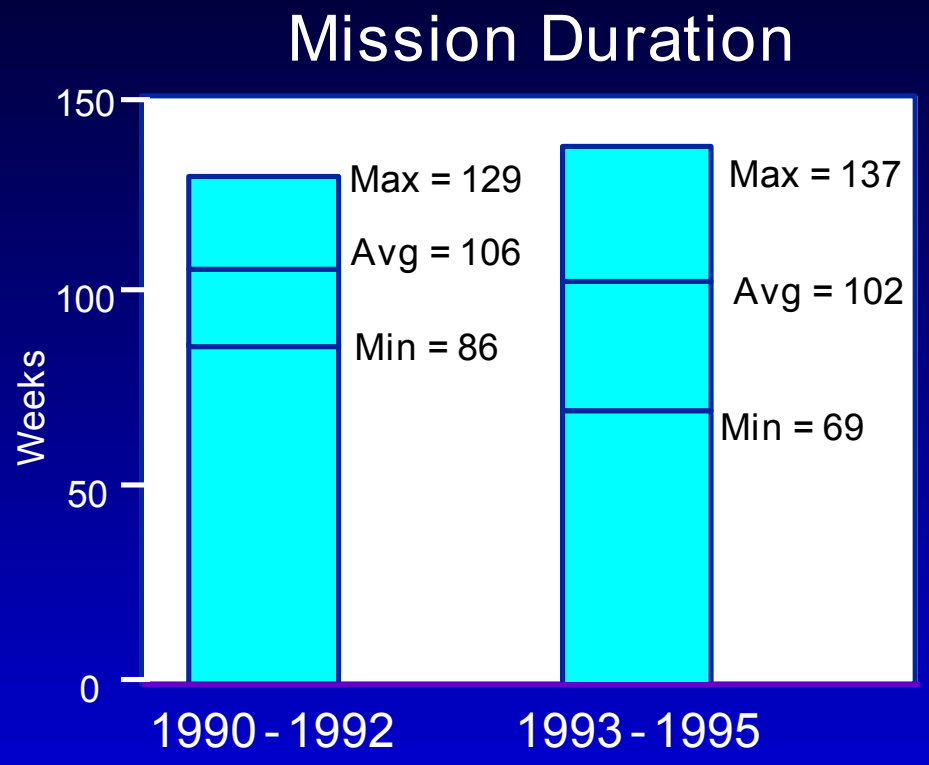


Independent Test Teams - Results

Measurements show modest improvements



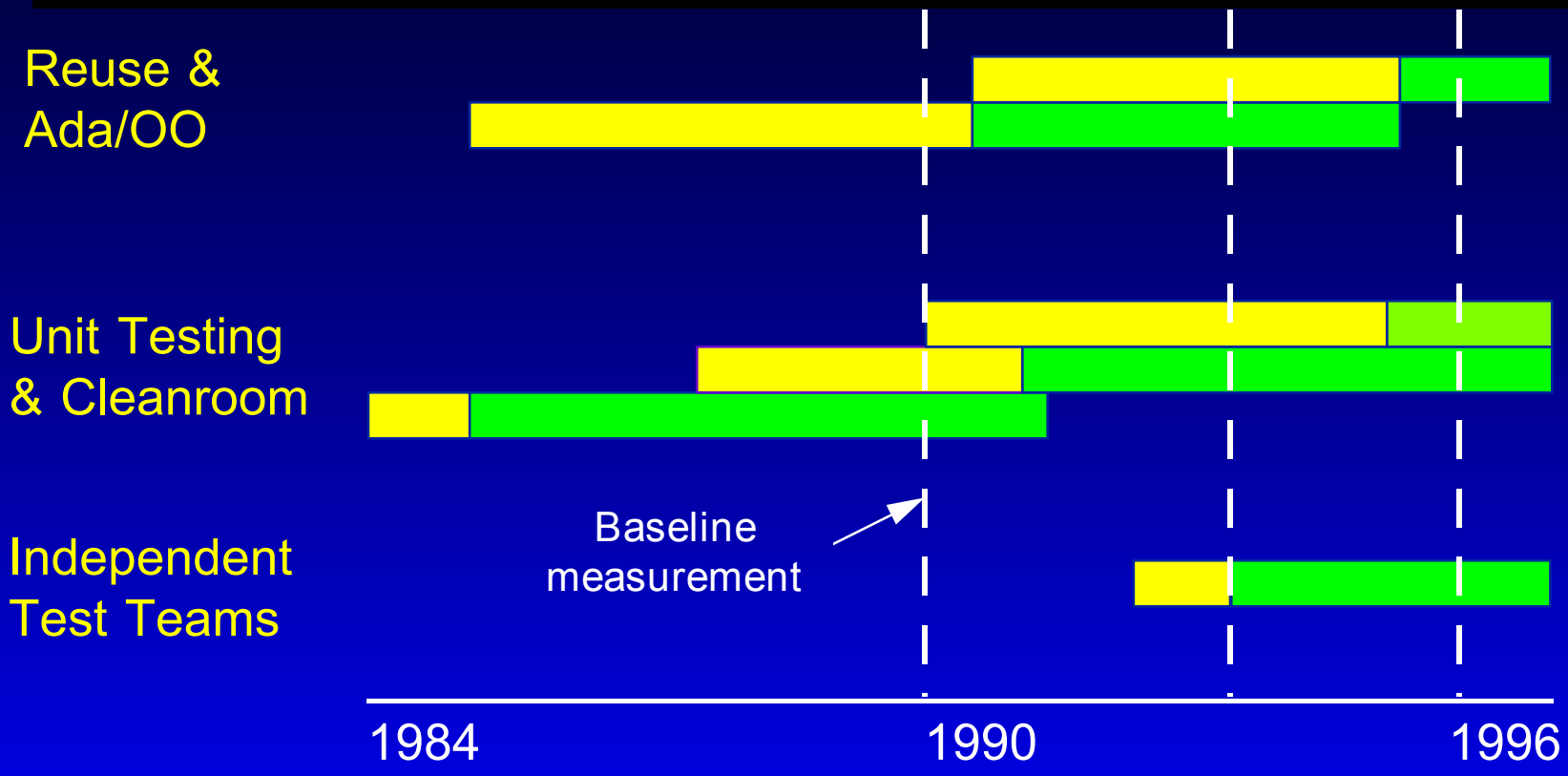
10% Cost Reduction



5% - 20% Improvement

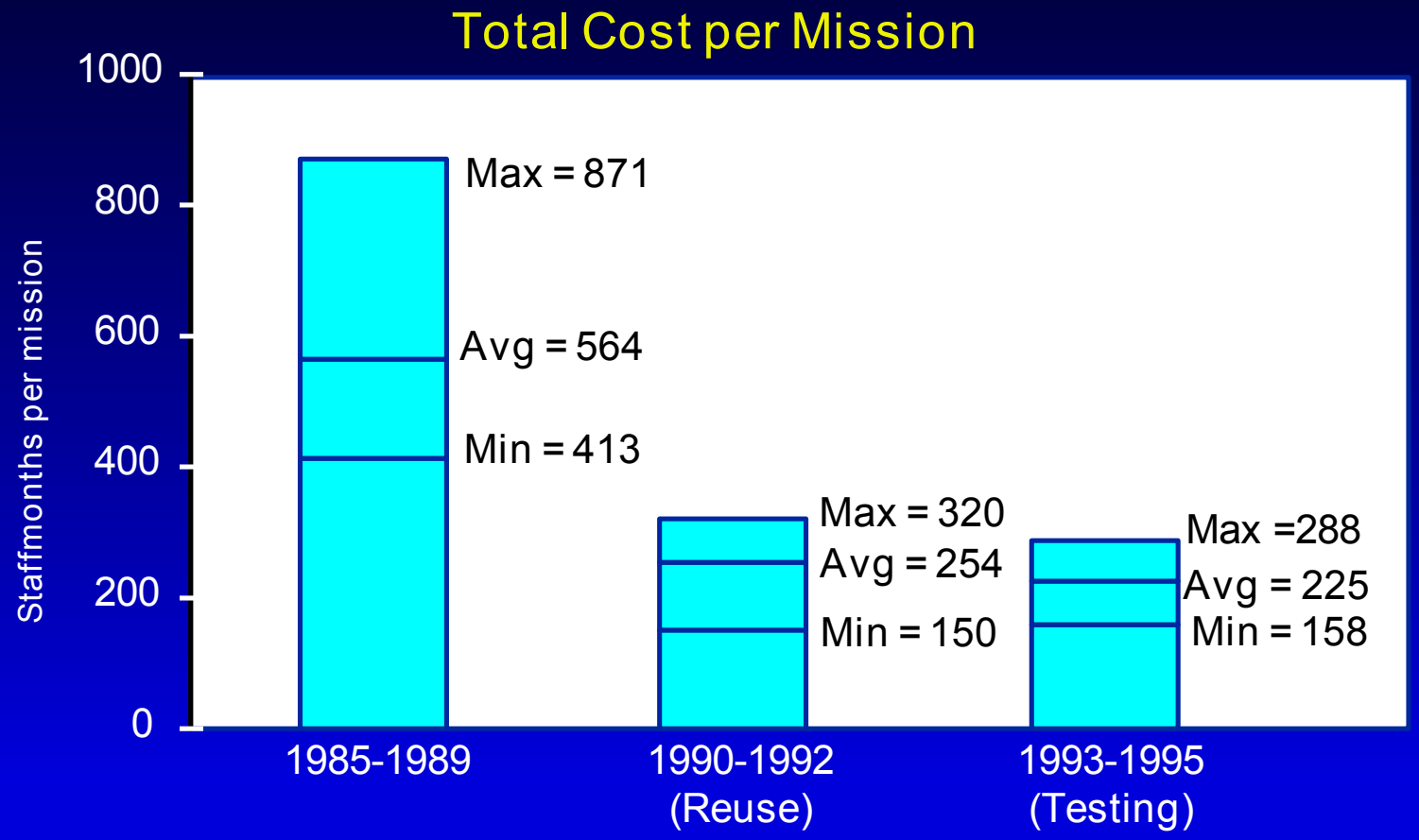
Simultaneous Experimentation

Multiple improvements were piloted simultaneously, but on separate project sets.



Overall Improvement

Improvements combine to make 60% cost reduction



Keys to Success

- Focus on one primary organizational goal
- Select process changes that leverage people (use technology to replace routine tasks)
- Allocate more time (iterations) when creating process from concepts
- Actively seek developer feedback

Conclusions

- More localized process changes lead to more rapid rate of improvement ....

  . . . but, broader conceptual changes result in larger improvements.

- Experimentation allows for intermediate deployment of new process or technology with minimal risk