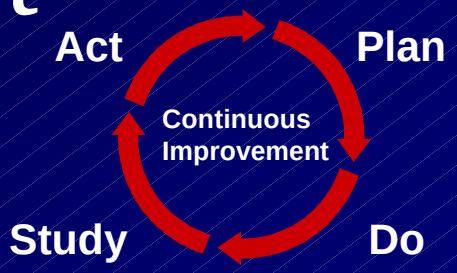
An Integrated View of Process and Measurement



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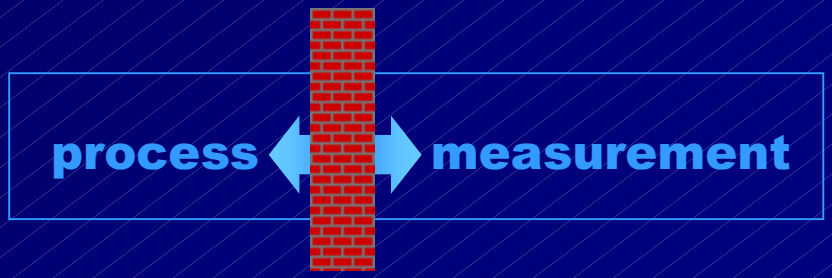
Some Common Misconceptions

Process maturity Levels 2-3 focus on process definition. Measurement is largely postponed until Levels 4 and 5.

Technical Working Groups (TWGs) should be organized by CMM/CMMI process areas – therefore there should be a separate "Measurement TWG."

There should be two plans – one that guides process change and one that guides how measurement is introduced and implemented.

Only certain specialized roles require competency in measurement skills.



Measurement Activities in Process Improvement

Measurement is an essential construct of process – measurement must be woven into the fabric of process.

Definition of measurement should be an essential part of any process definition work.

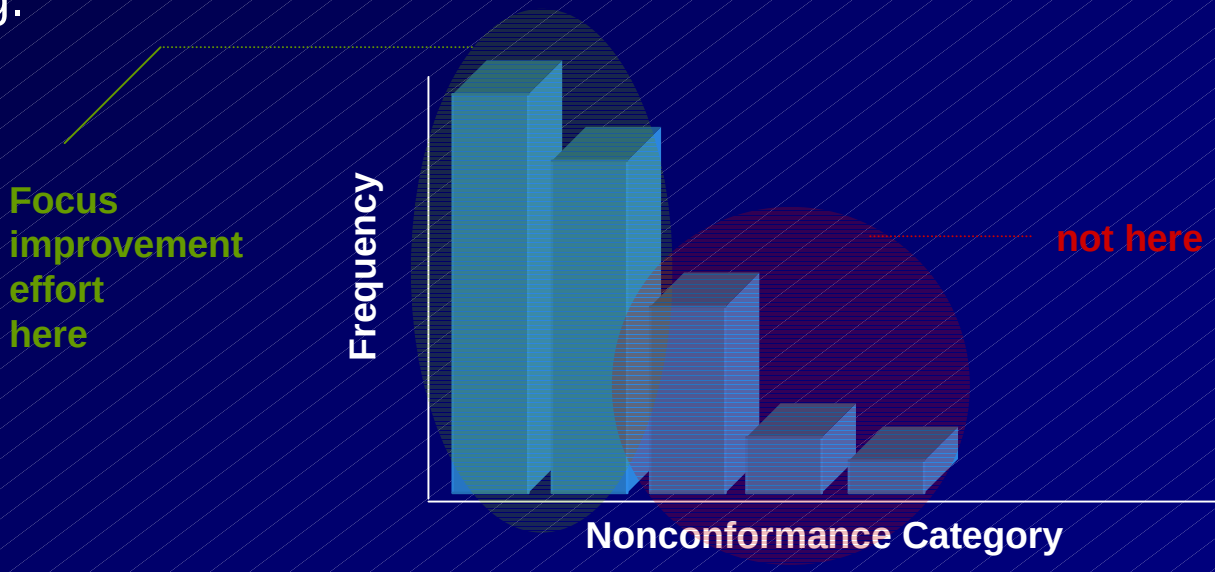
Measurement focuses continuous process improvement – it should never be postponed (although the sophistication of data collection and storage mechanisms should evolve).

Everyone needs to understand how to effectively monitor and improve their work processes – measurement is the key.

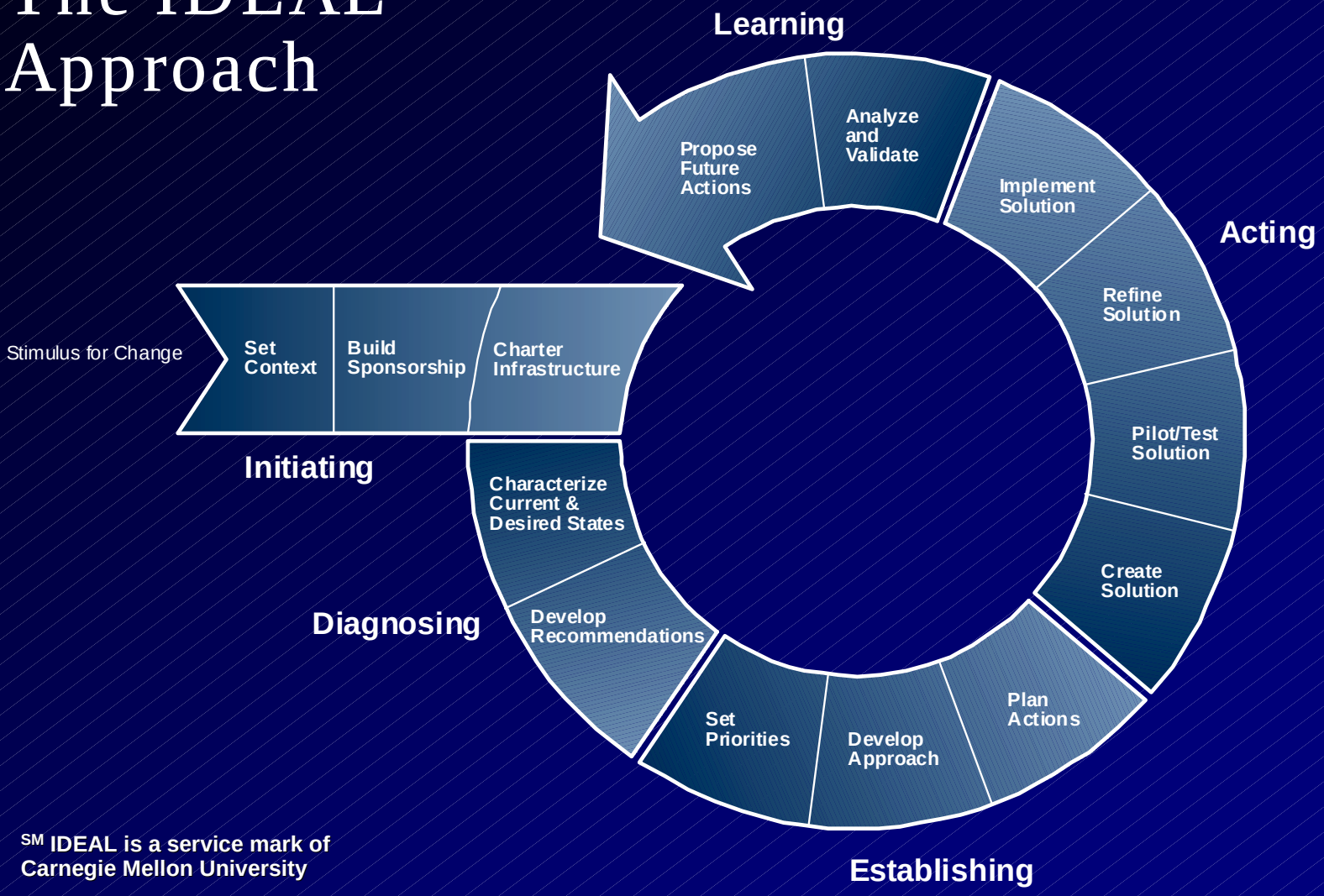
Measurement Pinpoints Future Improvement Opportunities

It has generally been found that variation in a few of the process attributes has significant impact on overall performance. These significant-few process attributes are "key" process characteristics.

These key process characteristics are the ones we should be measuring.

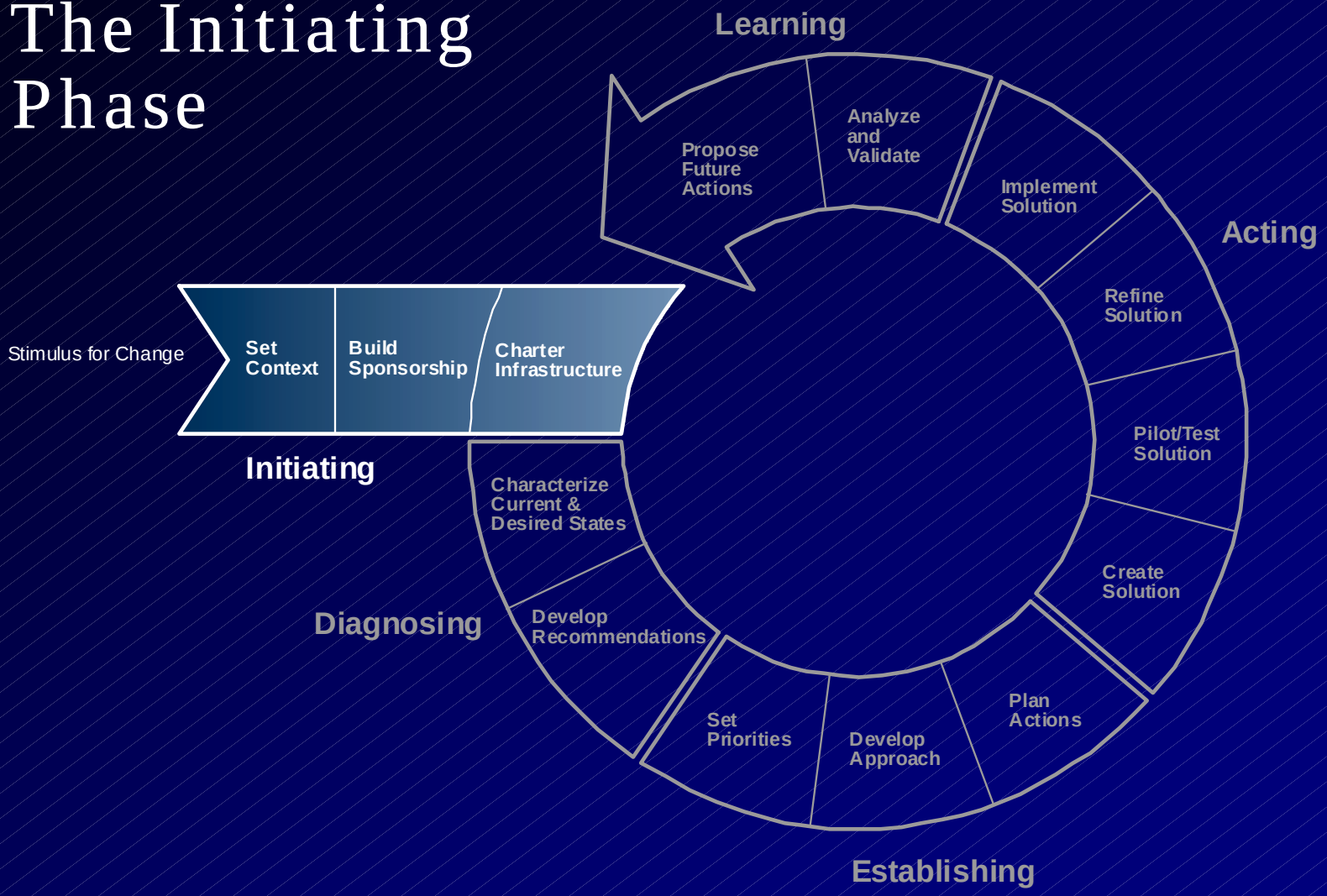


The IDEAL℠ Approach



℠ IDEAL is a service mark of Carnegie Mellon University

The Initiating Phase



Key Success Factors for Effective Launch

The Must Haves:

1. A compelling reason for change
2. Leadership of the change effort by the top executive in the organization — responsibility cannot be delegated
3. Informed commitment of the top management team
4. Designation of a primary change agent (the EPG Leader) and an adequate mandate for change
5. Sound performance measures that drive change

Performance Measures that Drive Change

Measures are integral to effective change. A goal-focused measurement system is the best vehicle for galvanizing management action and institutionalizing the targeted changes.

If you deploy a poor set of measures (or none at all), any positive accomplishment will be undermined by inefficiencies as managers chase an inconsistent and/or conflicting set of targets.

Performance measures must be:

- Relevant. Does the measure have a significant, demonstrable relation to strategy and business goals?
- Reliable. Will the measure identify strengths or weaknesses of one or more business processes?

Performance Measures: Reestablishing Your Business Goals

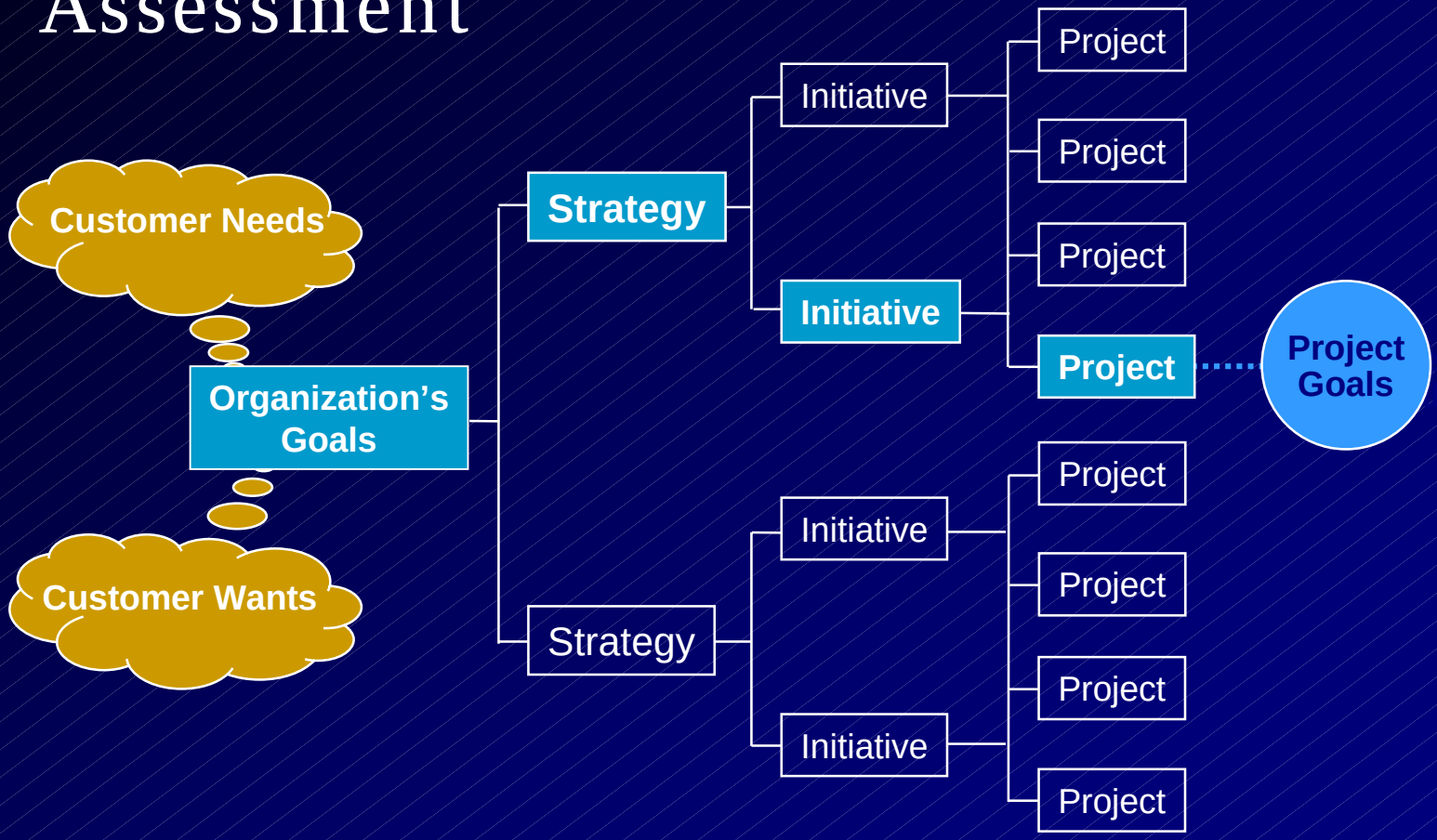
Performance measures must be tied to and reflect the new vision that is driving the change. And the right measures must be forged on business goals that are both real and inspirational.

For most organizations, development of performance measures must be preceded by reestablishing or refreshing the organization's values, vision, mission and goals.

When these are undefined, are not communicated, or are not inspiring to people, it can undermine any effort to improve.

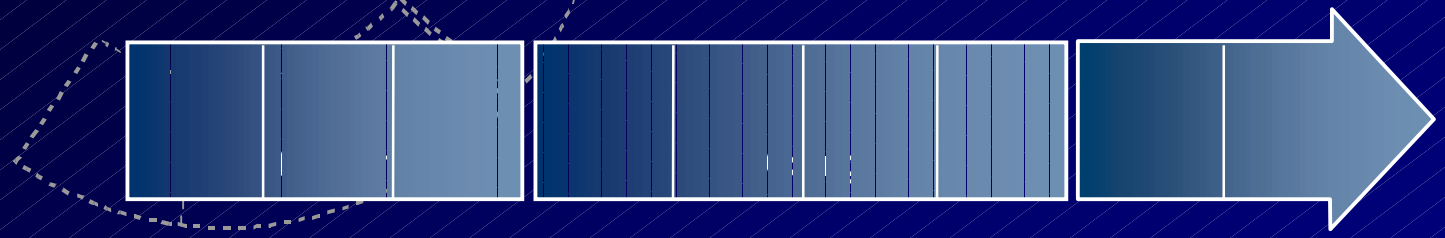
If the values, vision, mission and goals are poorly defined, then work will be needed before performance measures can be considered—or before other positive changes can be achieved.

Project Measures Should Ultimately Tie to Customer Satisfaction Assessment



Assessing Your Process Maturity

Process Change Methodology



1. Organize and Prepare
2. Conduct Organizational Scan
3. Establish Technical Working Groups
4. Understand Project's Current State
5. Redesign the Process
6. Develop Solution
7. Conduct Pilot(s) and Evaluate
8. Facilitate Organizational Learning

The Process Change Method

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PCM 1: Organize and Prepare

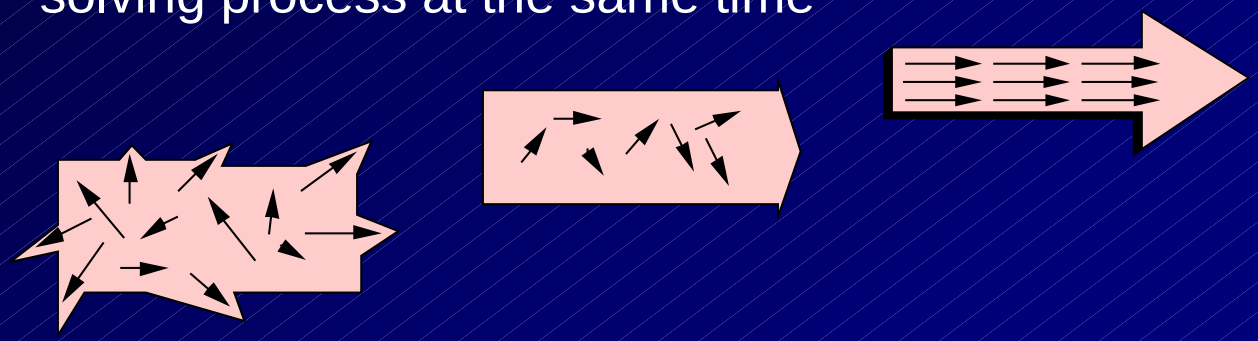
When Discussion Turns to Problem-Solving

Problem solving is at the core of the SEPG's activities.

A problem is simply a gap between what is desired and what exists.

A group with an effective problem-solving process meets two conditions:

1. members use a systematic process for solving problems
2. all members focus on the same step of the problem-solving process at the same time



Adapted from [Senge 90, pp. 234-235]

Generic Problem-Solving Process

1. Define the problem
2. Establish criteria for evaluating solutions
3. Identify root causes
4. Generate alternative solutions
5. Evaluate alternative solutions
6. Select the best solution
7. Develop an action plan
8. Implement the action plan
9. **Evaluate outcomes and the process**

Adapted from [Schwarz 94, p. 159]

9 Evaluate Outcomes of the Process

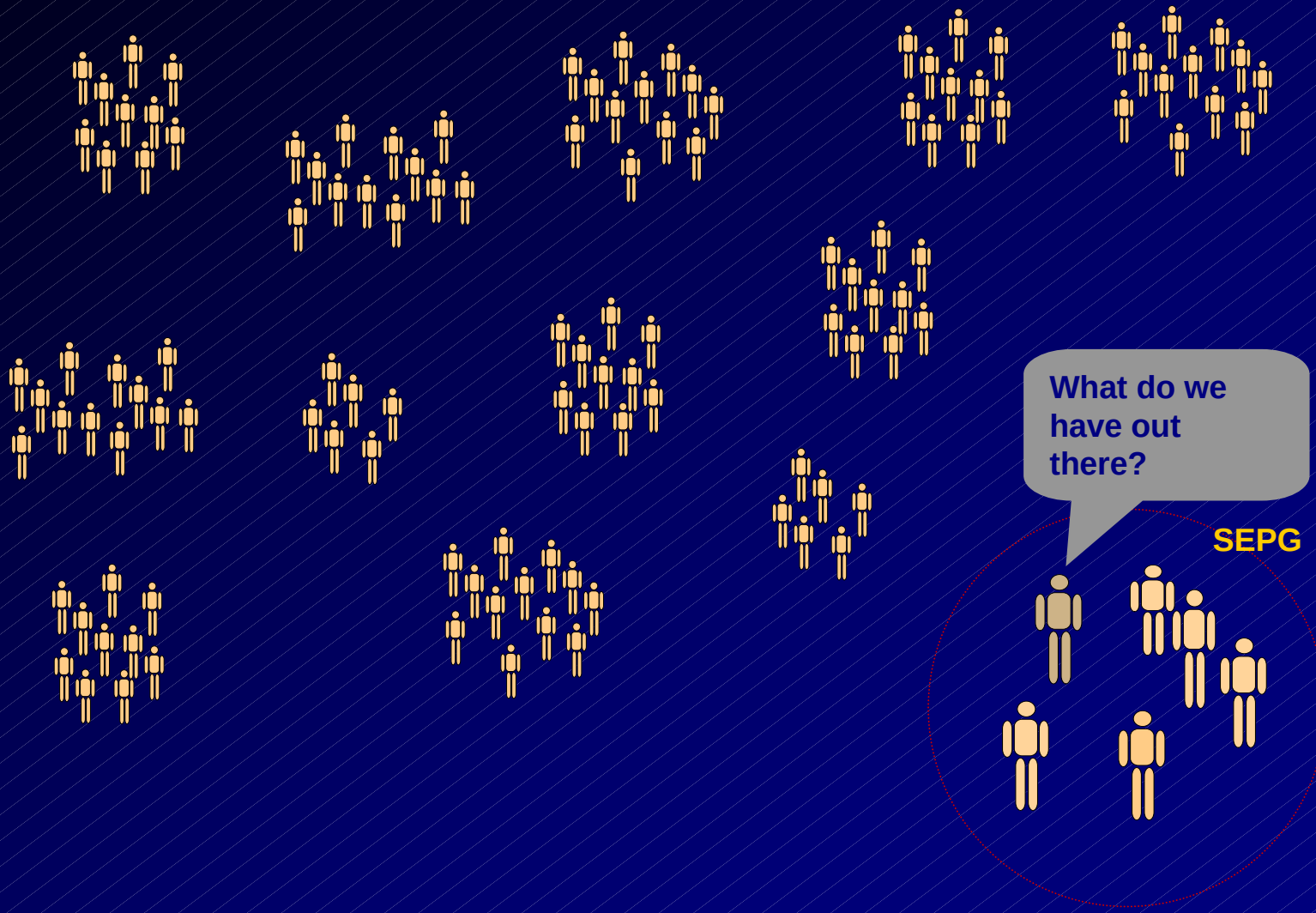
Evaluation through measurement is the step most often underemphasized.

However, evaluation is essential for a group that values valid information.

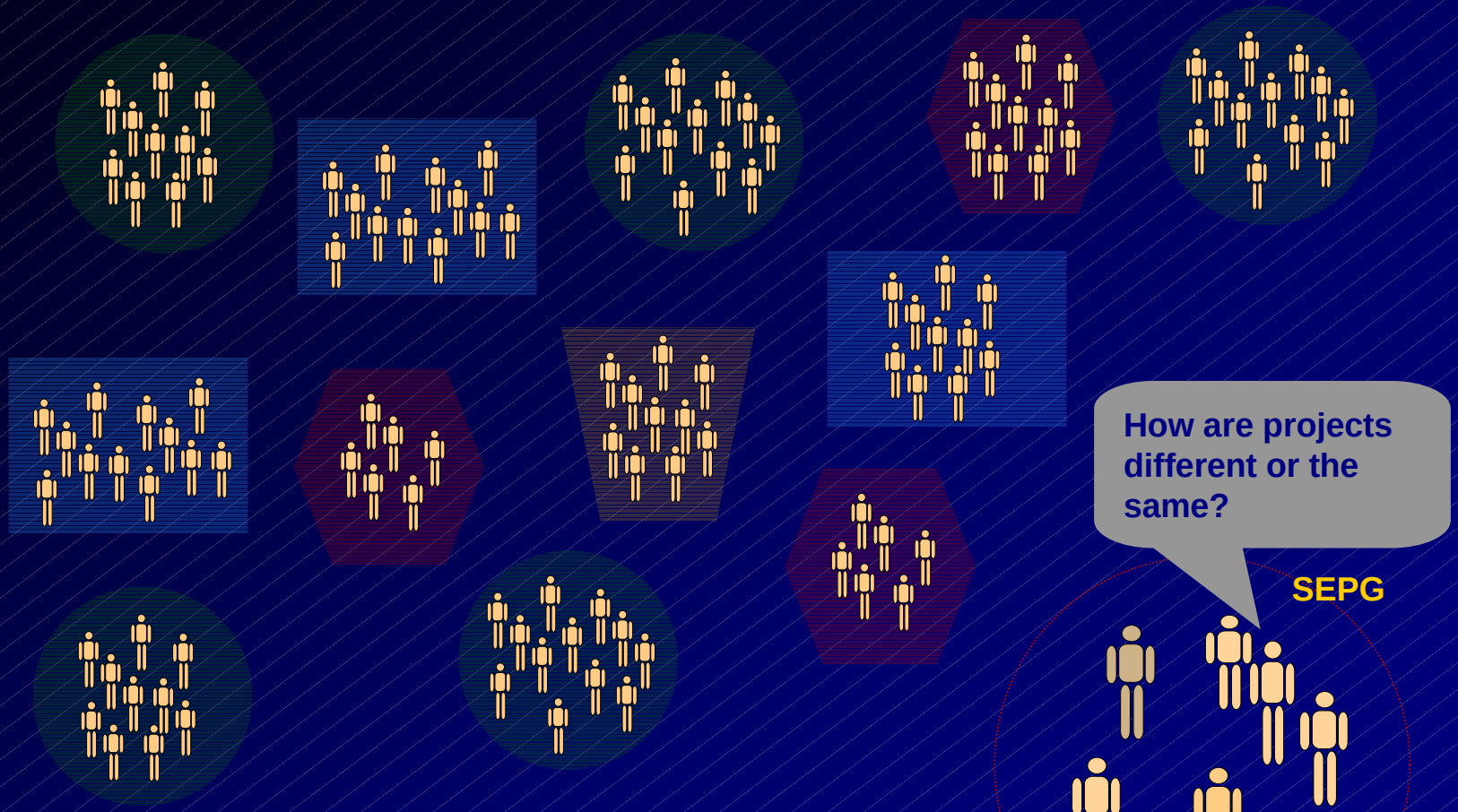
When groups resist evaluation, several interventions are possible:

- help the group explore its reluctance to evaluate
- once barriers are identified, help group reframe the meaning of evaluation from threat to one in which members seek continuous improvement of their work
- help the group consider how comprehensive their evaluation needs to be

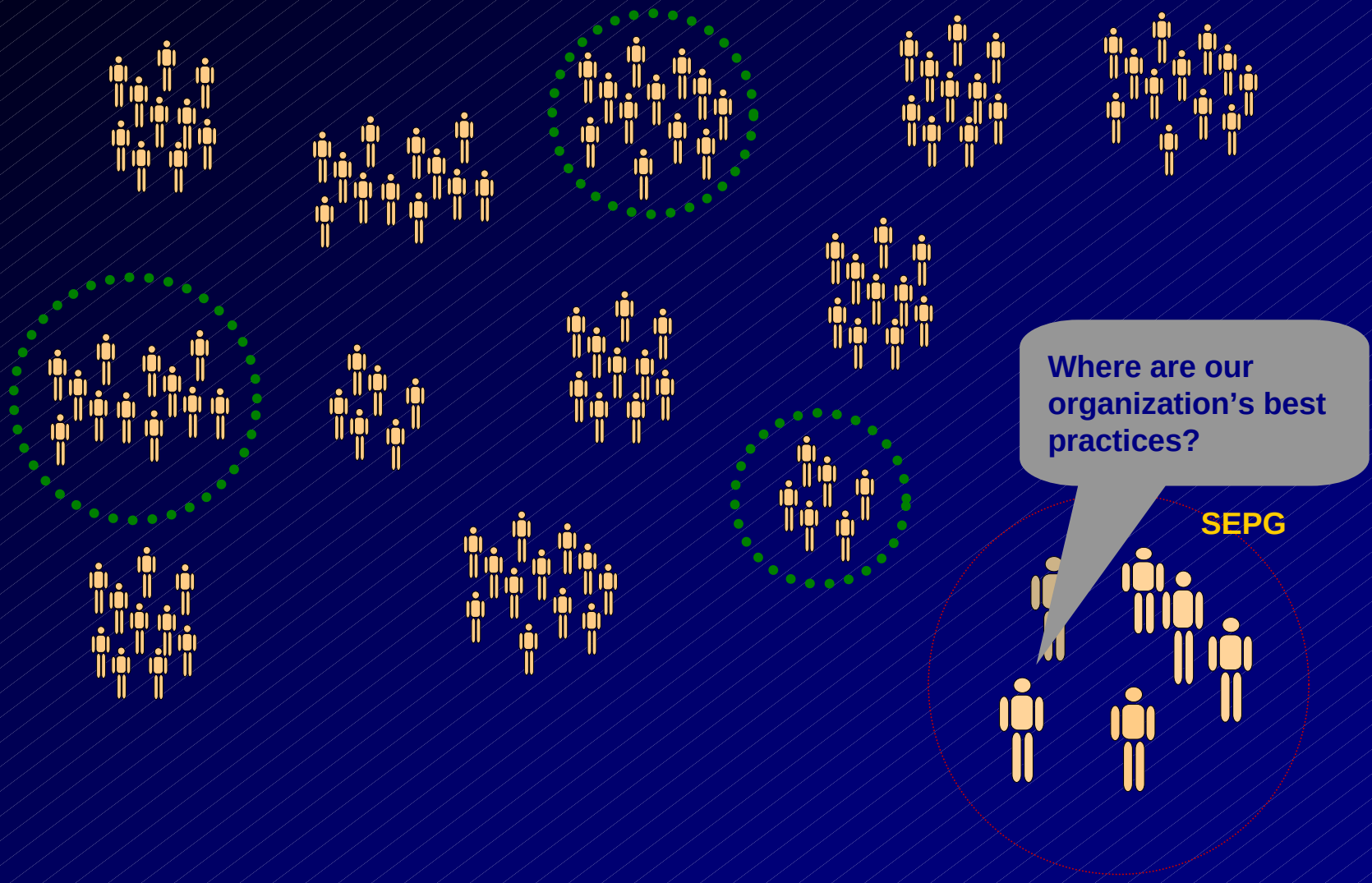
PCM 2: Conduct Organizational Scan



PCM 2: Conduct Organizational Scan

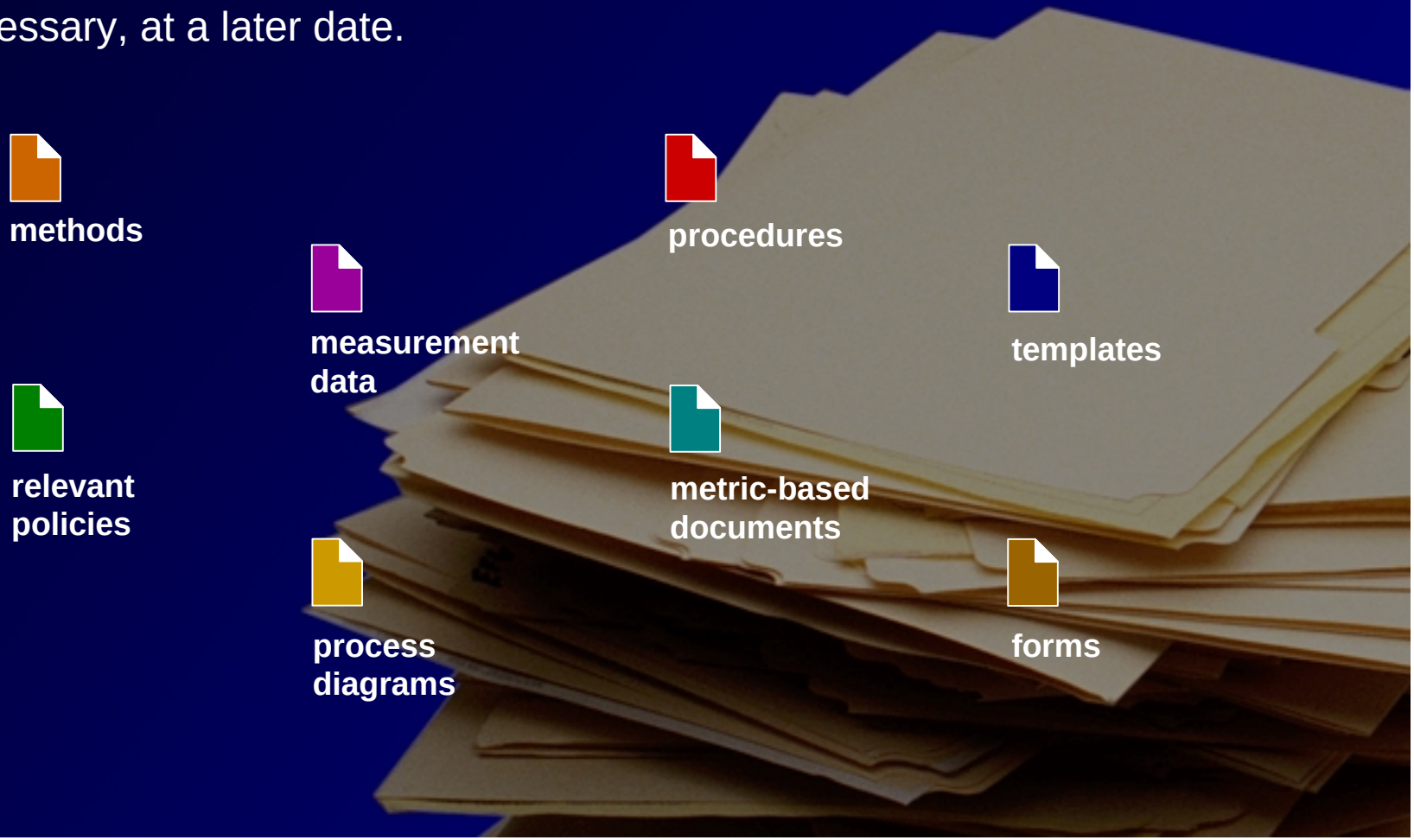


PCM 2: Conduct Organizational Scan

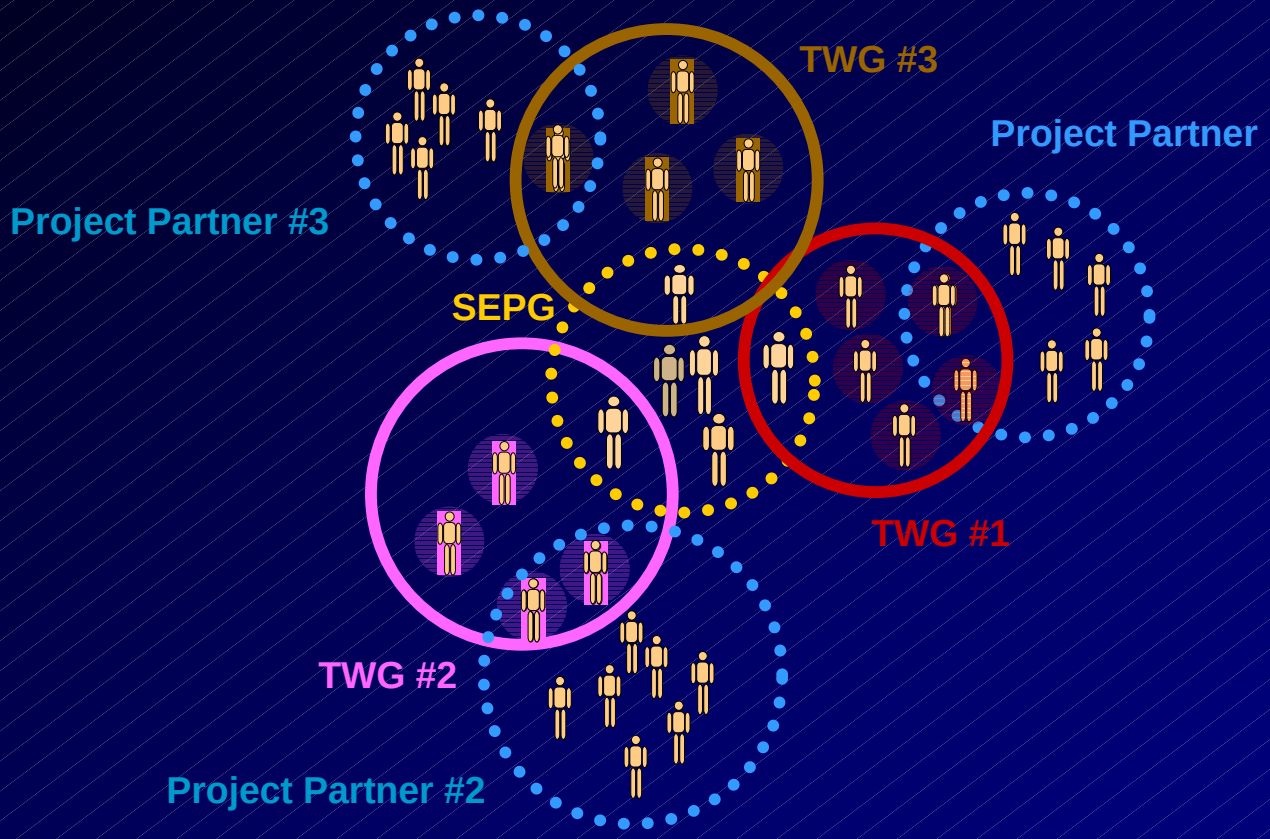


Gather Data

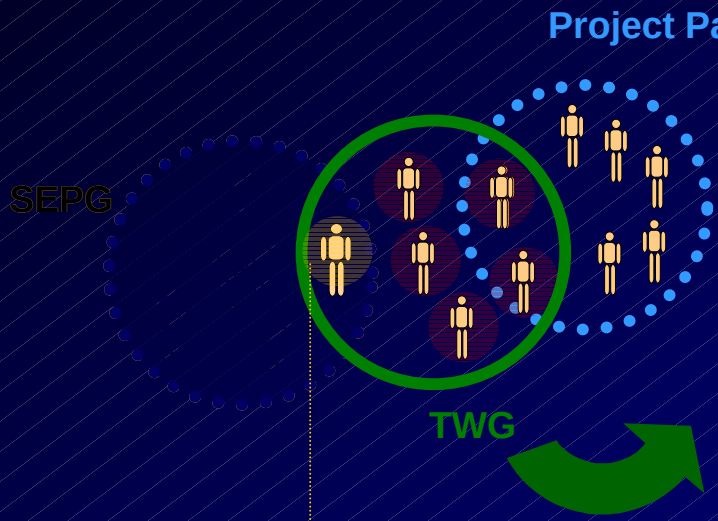
Obtain artifacts. Process documentation is identified during the interviews. This documentation is collected immediately or, if necessary, at a later date.

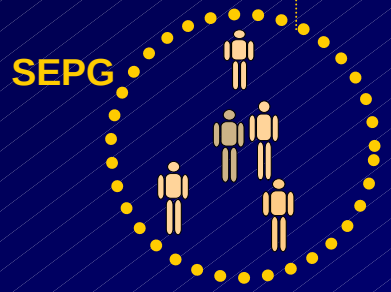


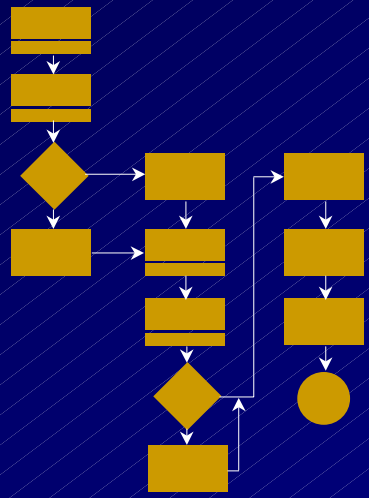
PCM 3: Establish TWG(s)



PCM 4: Understand Project's Current State

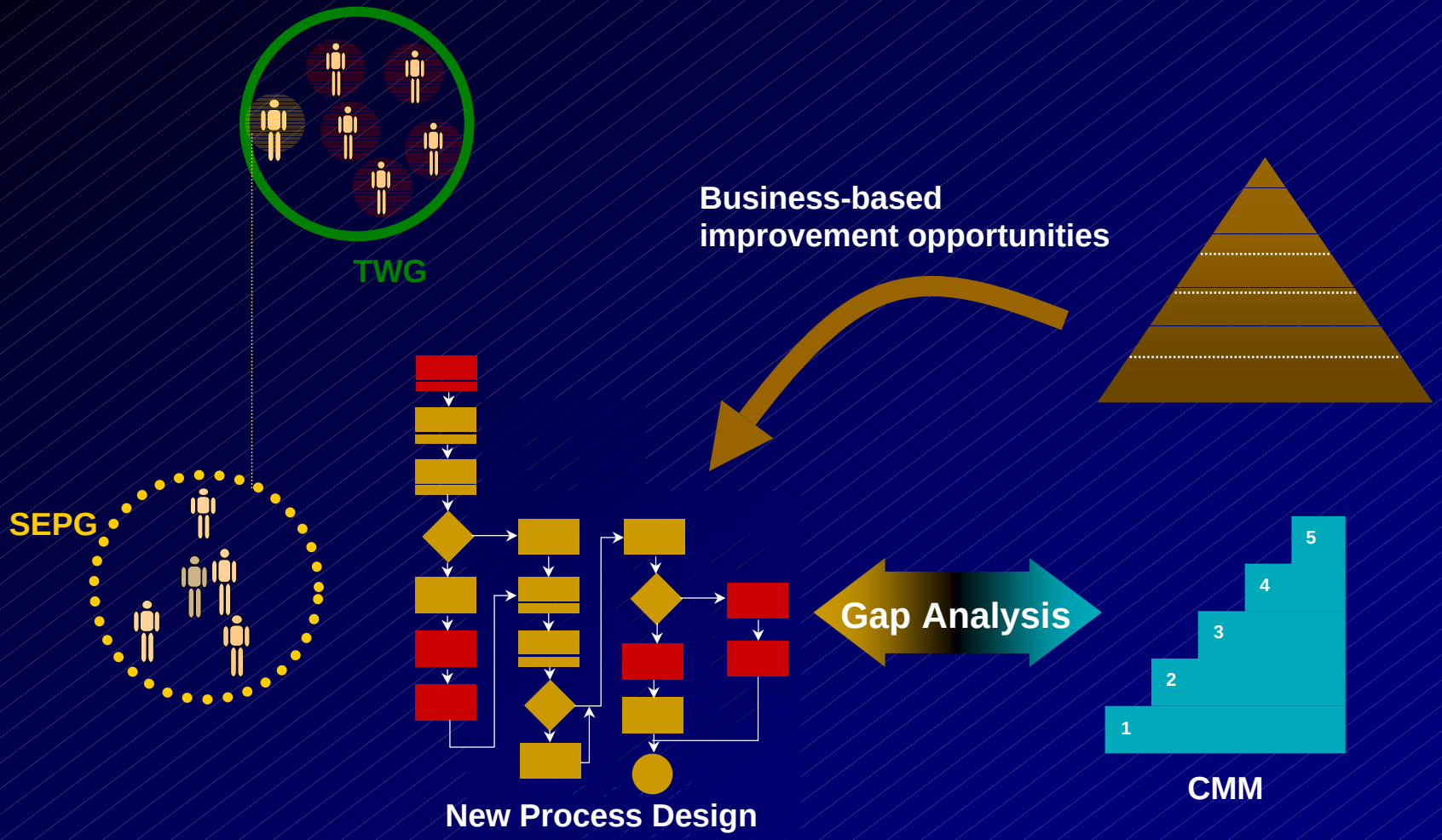


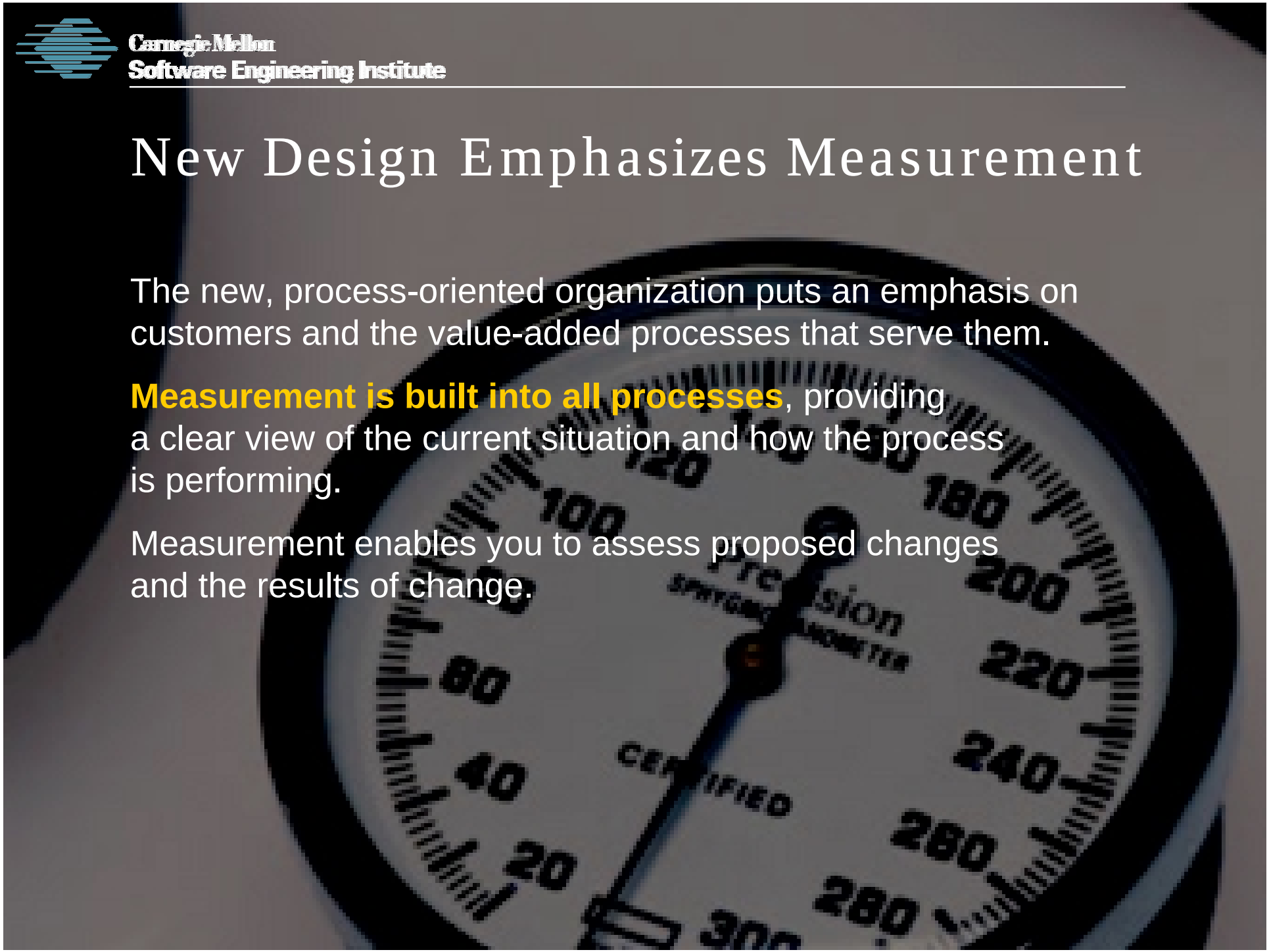




Defining the existing process

PCM 5: Redesign the Process





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New Design Emphasizes Measurement

The new, process-oriented organization puts an emphasis on customers and the value-added processes that serve them.

Measurement is built into all processes, providing a clear view of the current situation and how the process is performing.

Measurement enables you to assess proposed changes and the results of change.

Why the Emphasis on Metrics?

"Software Engineering" is the term used to describe the collection of techniques concerned with applying an **engineering** approach to the construction of software products. By *engineering* approach we mean

- planning
- costing
- managing
- modeling
- analyzing
- designing
- implementing
- testing
- maintaining

It would be difficult to imagine how the disciplines of electrical, mechanical and civil engineering could have evolved without a central role for measurement.

Process and Product Metrics

Software metrics are often classified as either *process metrics* or *product* metrics.

Process metrics quantify attributes of the development process and of the development environment. For example:

- **resources (such as level of effort)**
- **duration of the design phase**

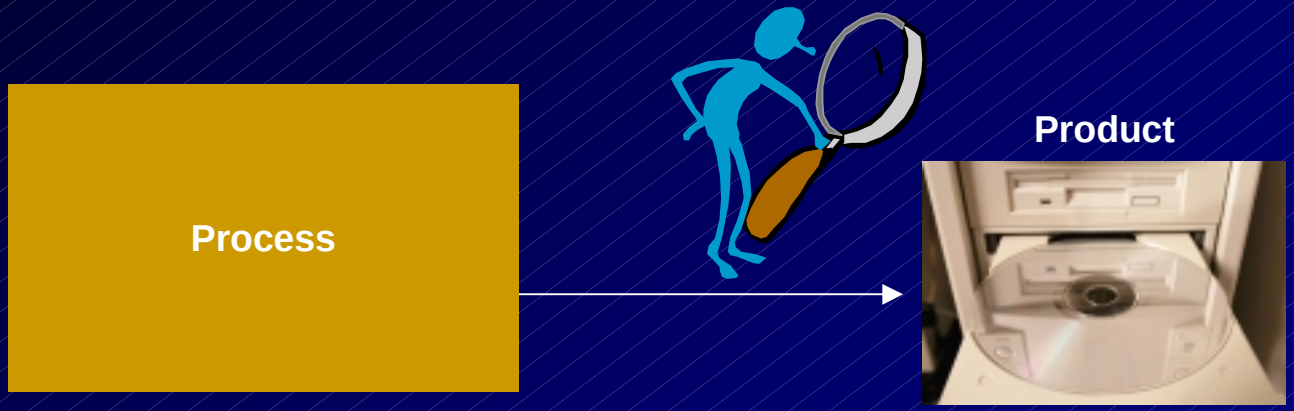
Product metrics are measures of the software product. For example:

- **size of the product (such as lines of code, number of modules)**
- **complexity (such as flow of control, depth of nesting, or recursion)**
- **number of defects**

In general, it is likely that a product metric is influenced by the process used and vice versa.

Ineffective Approach to Quality

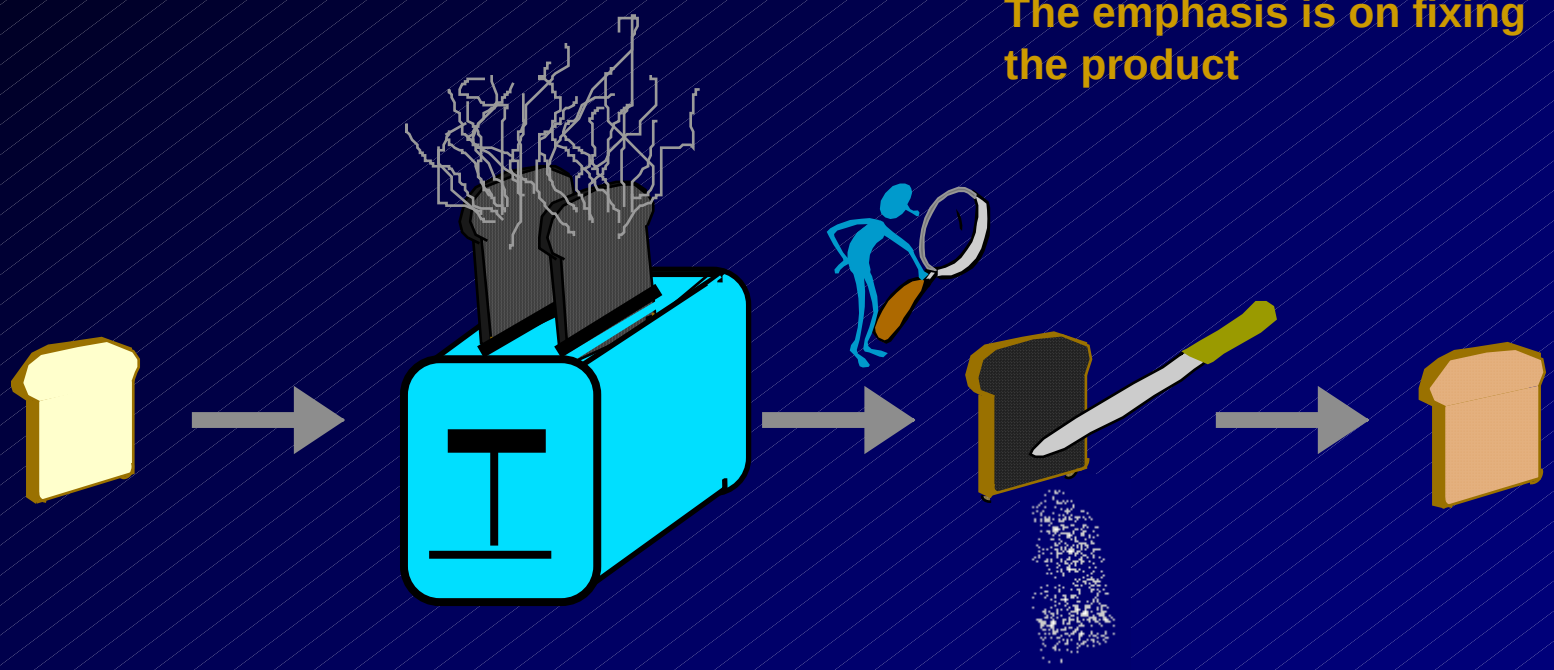
Historically, many organizations have approached quality by performing *product measurement* only. But, this approach does not improve quality nor guarantee quality. It's a strategy of defect *detection,* not defect *prevention*.



Measurement of final product attributes is too late...the quality, good or bad, is already in the product.

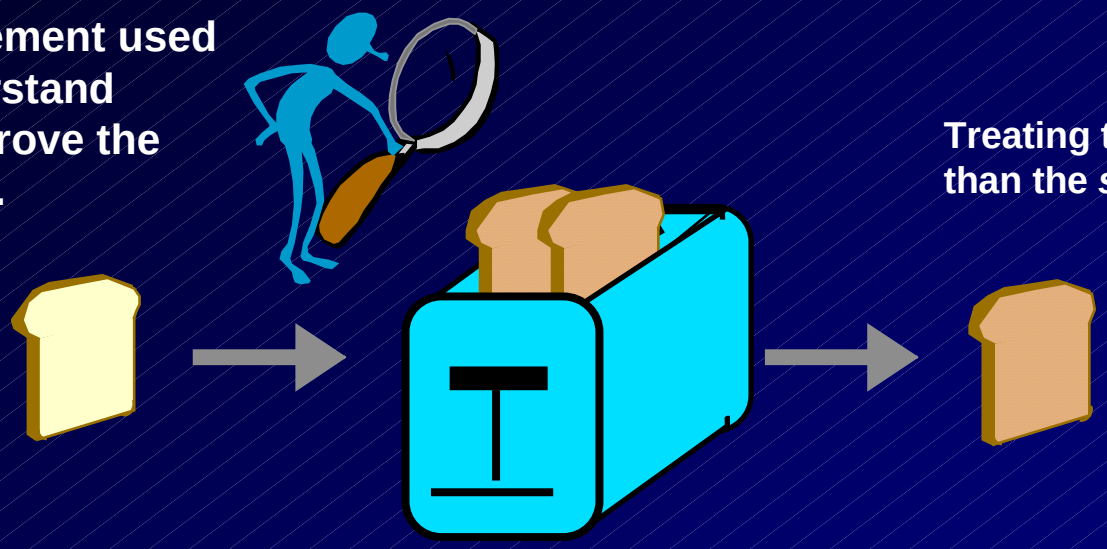
100% inspection is only 80% effective
— Dr. Joseph Juran

Traditional Approach is Wasteful



Focus on the Process

Measurement used to understand and improve the process.



Treating the *cause* rather than the *symptoms.*

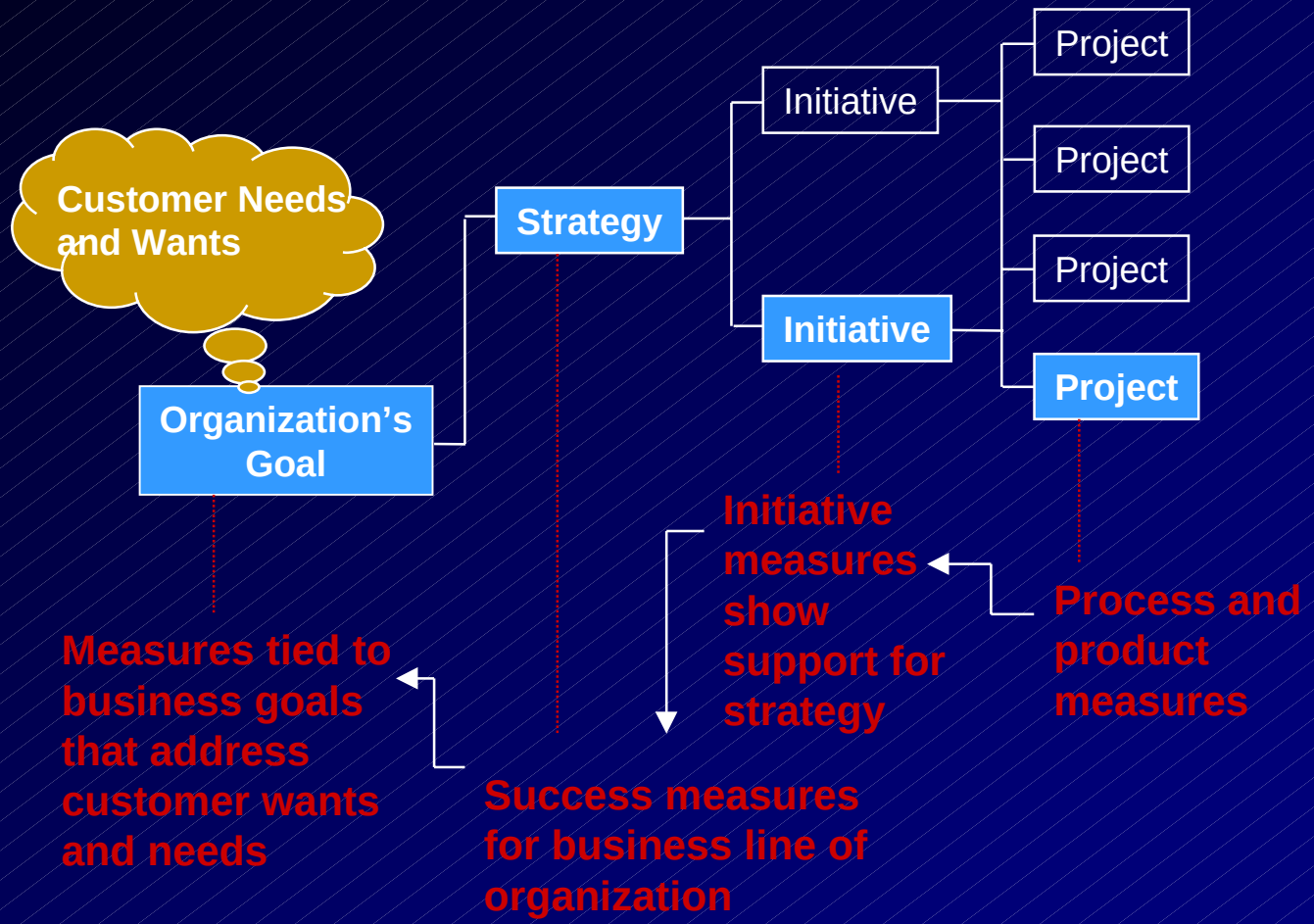
Input

Process

Acceptable product

Rework

Business Goals and Measures Drive Project Performance Measures



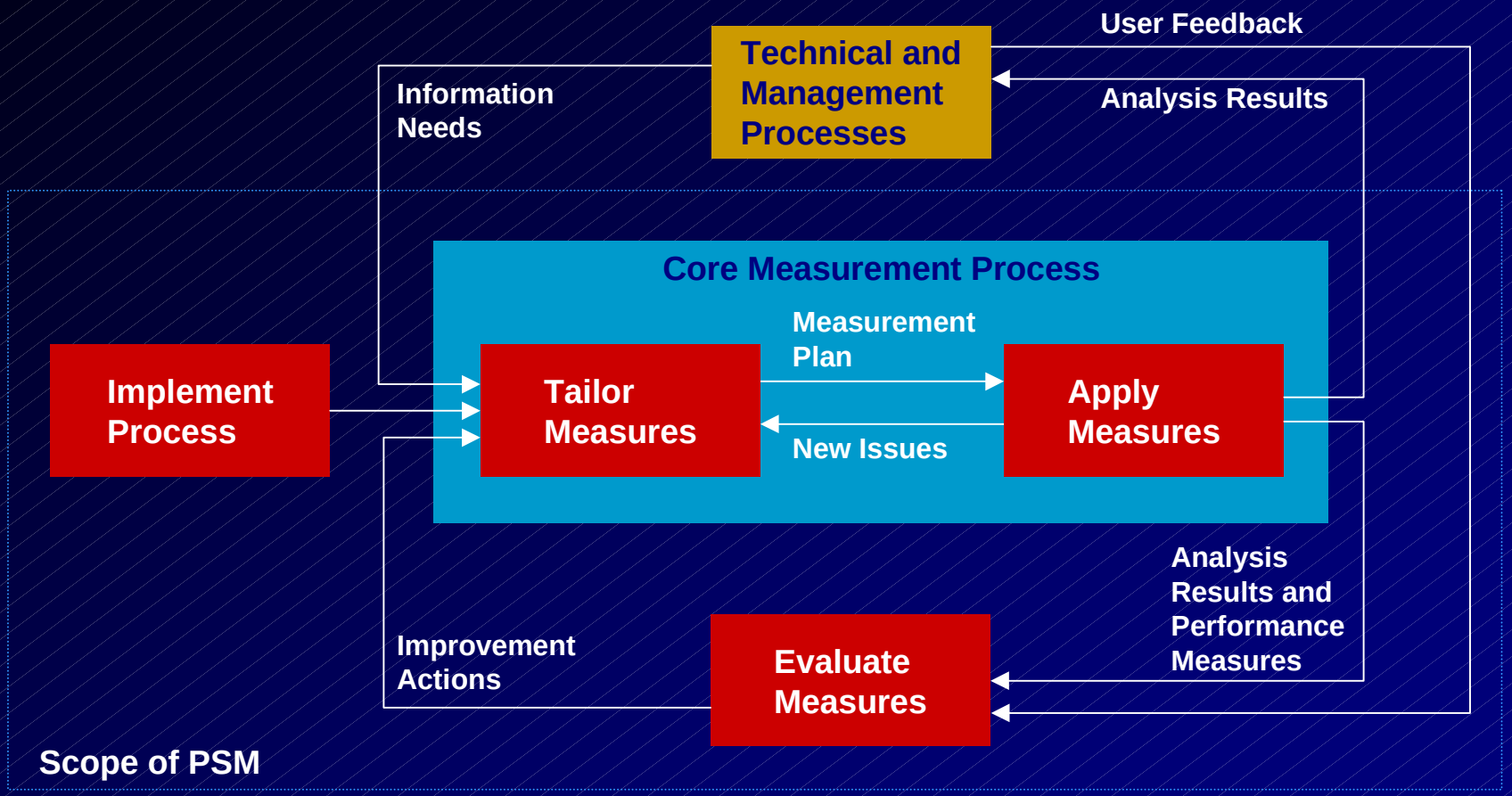
Goal-Driven Measurement

The Goal/Question/Metric (GQM) paradigm provides a framework involving three steps.

1. **List a major goal of the process**
2. **For each goal, derive questions that must be answered to determine if the goals are being met.**
3. **Decide what must be measured in order to be able to answer the questions adequately**

[Basili 88]

Practical Software Measurement



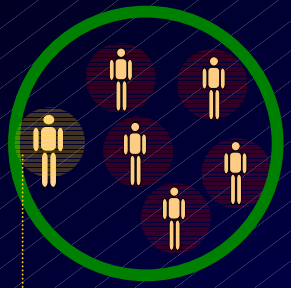
See http://www.psmsc.com/

Software Metrics: Ten Traps to Avoid

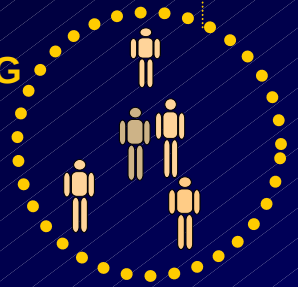
1. Lack of management commitment
2. Measuring too much, too soon
3. Measuring too little, too late
4. Measuring the wrong things
5. Imprecise metrics definitions
6. Using metrics data to evaluate individuals
7. Using metrics to motivate, rather than to understand
8. Collecting data that is not used
9. Lack of communication and training
10. Misinterpreting metrics data

[Wiegers 00]

PCM 6: Develop Solution

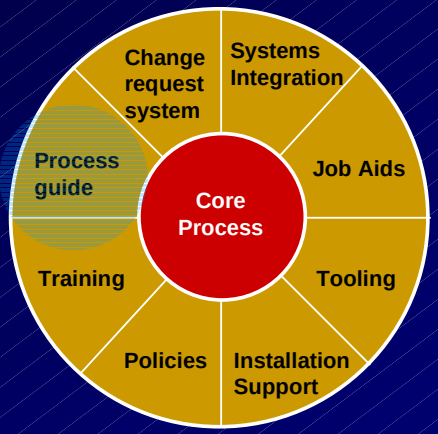


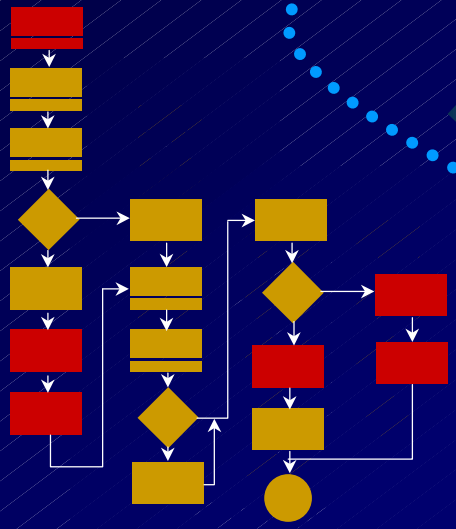
TWG



SEPG

Whole product solution

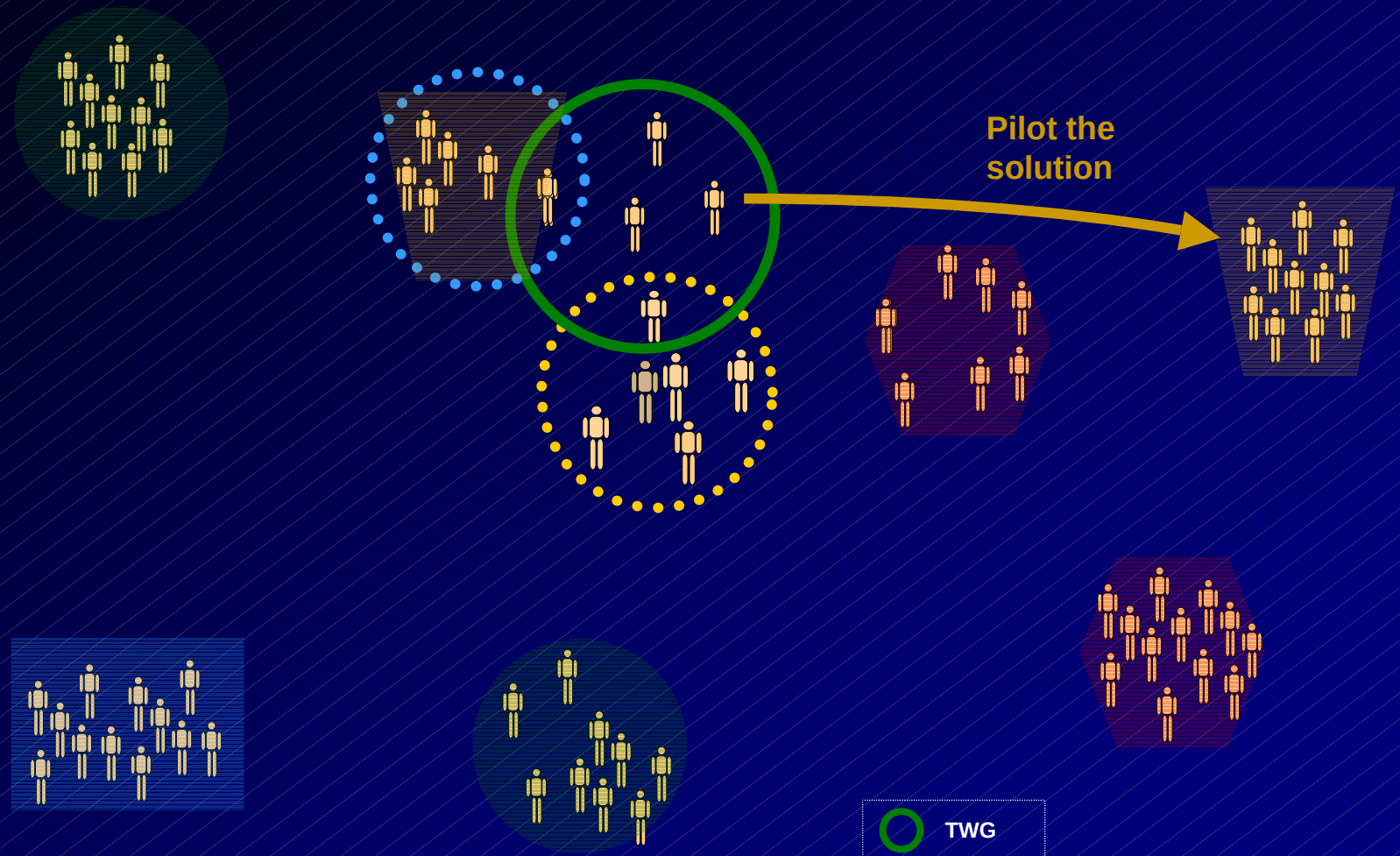




New Process Design from PCM 5

Guidebook for users of the process

PCM 7: Conduct Pilots and Evaluate



How Will You Know if the Change Worked?

Quite often, pilot studies are conducted without measurement either before or after the change was introduced.

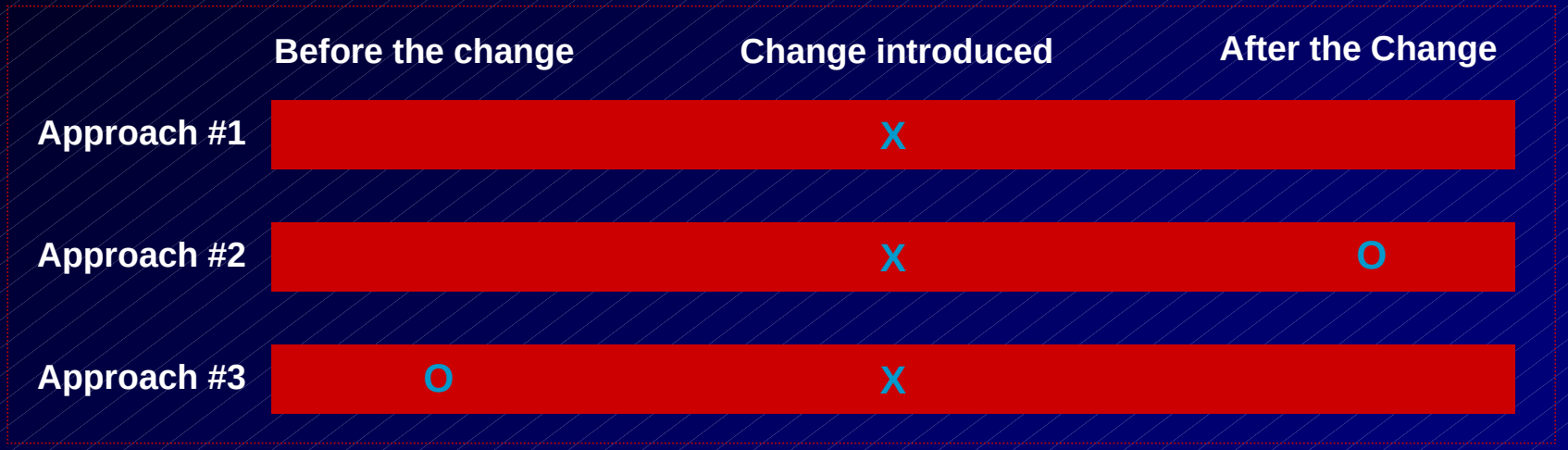
Therefore, how do we know if the outcome was better or worse than the original situation?

In these cases, interpretation is based on opinion and impressions – but there is a lack of data to back it up!

Therefore, there is less confidence in the results of the pilot – interpretation is problematic and there's a risk that consensus about the results are not achieved.

Typical Approaches to Pilot Study Evaluation

Typical approaches that fail



"Engineering" Implies a Scientific Approach

Typical approaches that fail

	Before the change	Change introduced	After the Change
Approach #1		X	
Approach #2		X	O
Approach #3	O	X	

In all three approaches, there is no way to tell if the outcome from the change was better or worse than the original situation.

Approaches to Validation

In the scientific and manufacturing world, improvements or innovations are validated using a rigorous statistical approach known as design of experiments (DOE)

- Extraneous variables that might impact the result you're looking at can be held steadied or controlled
- The experimental design can employ techniques such as randomization and replication to add clarity and confidence to the assertions that are made about the change

Run Number	Variable A	Variable B	Variable C	Result
1	-	-	-	7
2	+	-	+	15
3	-	+	-	21
4	+	+	+	11

Scientific Methods Do Exist

Research designs called quasi-experimentation do exist for proper interpretation of results from pilot studies … but they are rarely applied!

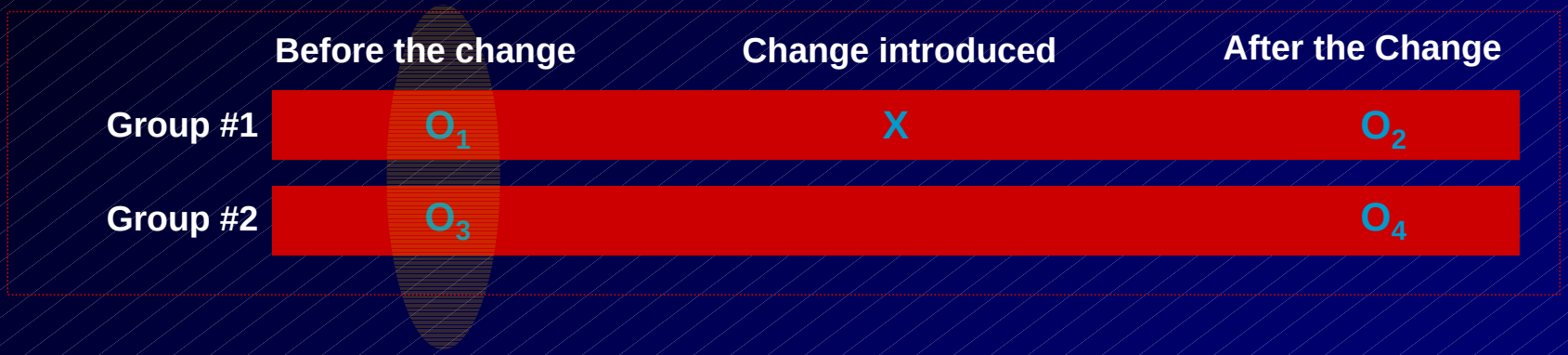
Good approach #1

Before the change	Change introduced	After the Change
O_1	X	O_2

Better approach #2

	Before the change	Change introduced	After the Change
Group #1	O_1	X	O_2
Group #2	O_3		O_4

Consider Better Approach #2



Do two different groups obtain the same results to begin with?

If yes, then O_2 and O_4 data may be compared using a *t* test.

If no, then O_2 and O_4 data may be compared using analysis of covariance.

Note: A *t* test and the analysis of covariance method are statistical methods that provide a scientific basis for making assertions about the results of your pilot study.

Facilitate Organizational Learning

Select target project(s) and plan

Tailor process assets

Support and monitor project(s)

Conduct ongoing evaluations and identify new improvement opportunities

Conduct improvement activities

Communicate results and update the process asset library

Conduct "Lessons Learned" Events

The SEPG should conduct regular lessons learned events after each major milestone of the PCM.

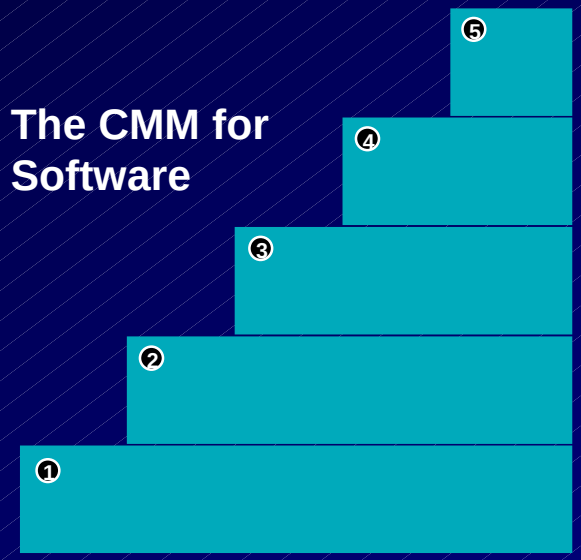
Many organizations conducting PI also implement yearly "lessons learned" events to "check the pulse" of the organization.

- What are people's attitudes about the changes now that they've been *changed*?
- Now that some are experienced with the new way of doing things, what ideas are there for improving what's there?

Assessing PI Progress

The SEPG evaluates the progress of CMM based PI.

The **Interim Profile** method is a way to rapidly measure an organization's SPI maturity between assessments, such as a CMM-Based Appraisal for Internal Process Improvement (CBA IPI).



[Whitney 96]

The Process Change Method

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MEASUREMENT

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The following citations were made in this presentation:

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Thanks for your time and attention

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