Tutorial: If You're Living the "High Life", You're Living the Informative Material

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Contents / Agenda

Why This Presentation

The role of the informative material needs to be understood

The role of the glossary needs to be understood

The role of statistical thinking needs to be understood

Common sense is not so common. - Voltaire

Evolution of Understanding

Central themes

- Baselines
- Control Charts
- Statistical management of subprocesses

Central themes

- Process Performance Models
- Understanding and use of variation

Supporting themes

- Baselines
- Control Charts
- Statistical management of subprocesses

Common Misinterpretations

You Might Have Misunderstood OPP If…

A table showing projected defects by phase looks like a Process Performance Model to you…

The corporate average "Lines of Code Per Staff Day" by year looks like a Process Performance Baseline or a Process Performance Model to you…

A control chart used to 'manage' defects escaping into the field looks like a Process Performance Model to you…

An Earned Value Management System seems to fulfill the requirements of Maturity Level 4…

You Might Have Misunderstood QPM If…

"Tracking bugs across the lifecycle" looks like statistical management to you…

You plan to "re-baseline" the control limits used to manage critical subprocesses on a quarterly basis…

'Management judgment' is used to 'adjust' control limits used as thresholds to drive corrective actions…

Schedule variance and defect density look like perfectly good subprocesses to statistically manage…

You Might Have Misunderstood CAR If…

You always respond to “High Severity” defects by saying “Let’s run a causal analysis and see what’s going on”…

Causal analysis is used only to find and resolve the root cause of defects…

You don’t see the value of applying DAR to select when and how to apply CAR…

You don’t see the value of applying CAR to select when, what and how to apply OID…

You don’t see how Process Performance Models and Process Performance Baselines contribute to CAR…

You Might Have Misunderstood OID If…

You think 42 Six Sigma projects – all focused on the inspection process – make a company Maturity Level 5…

A 5% boost in the performance of a process that fluctuates by ±7% looks like a best practice to roll out immediately…

The strength of an improvement proposal can only be measured by the persuasiveness of the author…

You work off improvement proposals only in the order in which they were received…

You don’t see how Process Performance Models and Process Performance Baselines contribute to OID…

PART I
DEFINITIONS

Glossary Use

“The CMMI glossary of terms is not a required, expected, or informative component of CMMI models. You should interpret the terms in the glossary in the context of the model component in which they appear”.

"We developed the glossary recognizing the importance of using terminology that all model users can understand. We also recognized that words and terms can have different meanings in different contexts and environments. The glossary in CMMI models is designed to document the meanings of words and terms that should have the widest use and understanding by users of CMMI products."

Definitions -1

capable process

- A process that can satisfy its specified product quality, service quality, and process-performance objectives. (See also “stable process,” “standard process,” and “statistically managed process.”)

causal analysis

- The analysis of defects to determine their cause.

common cause of process variation

- The variation of a process that exists because of normal and expected interactions among the components of a process. (See also “special cause of process variation.”)

Definitions -2

establish and maintain

- In the CMMI Product Suite, you will encounter goals and practices that include the phrase “establish and maintain.” This phrase means more than a combination of its component terms; it includes documentation and usage. For example, “Establish and maintain an organizational policy for planning and performing the organizational process focus process” means that not only must a policy be formulated, but it also must be documented, and it must be used throughout the organization.

Definitions -3

objectives for quality and process performance

- Objectives and requirements for product quality, service quality, and process performance. Process-performance objectives include quality; however, to emphasize the importance of quality in the CMMI Product Suite, the phrase quality and process-performance objectives is used rather than just process-performance objectives.

optimizing process

- A quantitatively managed process that is improved based on an understanding of the common causes of variation inherent in the process. The focus of an optimizing process is on continually improving the range of process performance through both incremental and innovative improvements. (See also “common cause of process variation,” “defined process,” and “quantitatively managed process.”)

Definitions -4

process-performance

- A measure of actual results achieved by following a process. It is characterized by both process measures (e.g., effort, cycle time, and defect removal efficiency) and product measures (e.g., reliability, defect density, and response time).

process-performance baselines

- A documented characterization of the actual results achieved by following a process, which is used as a benchmark for comparing actual process performance against expected process performance. (See also “process performance.”)

Definitions -5

process-performance models

- A description of the relationships among attributes of a process and its work products that is developed from historical process-performance data and calibrated using collected process and product measures from the project and that is used to predict results to be achieved by following a process.

quantitatively managed process

- A defined process that is controlled using statistical and other quantitative techniques. The product quality, service quality, and process-performance attributes are measurable and controlled throughout the project. (See also “defined process,” “optimizing process,” and “statistically managed process.”)

Definitions -6

special cause of process variation

- A cause of a defect that is specific to some transient circumstance and not an inherent part of a process. (See also “common cause of process variation.”)

stable process

- The state in which all special causes of process variation have been removed and prevented from recurring so that only the common causes of process variation of the process remain. (See also “capable process,” “common cause of process variation,” “special cause of process variation,” “standard process,” and “statistically managed process.”)

Definitions -7

statistical process control

- Statistically based analysis of a process and measurements of process performance, which will identify common and special causes of variation in the process performance and maintain process performance within limits. (See also “common cause of process variation,” “special cause of process variation,” and “statistically managed process.”)

statistical techniques

- An analytic technique that employs statistical methods (e.g., statistical process control, confidence intervals, and prediction intervals).

Definitions -8

statistically managed process

- A process that is managed by a statistically based technique in which processes are analyzed, special causes of process variation are identified, and performance is contained within well-defined limits. (See also “capable process,” “special cause of process variation,” “stable process,” “standard process,” and “statistical process control.”)

PART II FUNDAMENTALS OF STATISTICAL THINKING

Fundamentals of Statistical Thinking

All product development and services are a series of interconnected processes.

All processes have variation in their results.

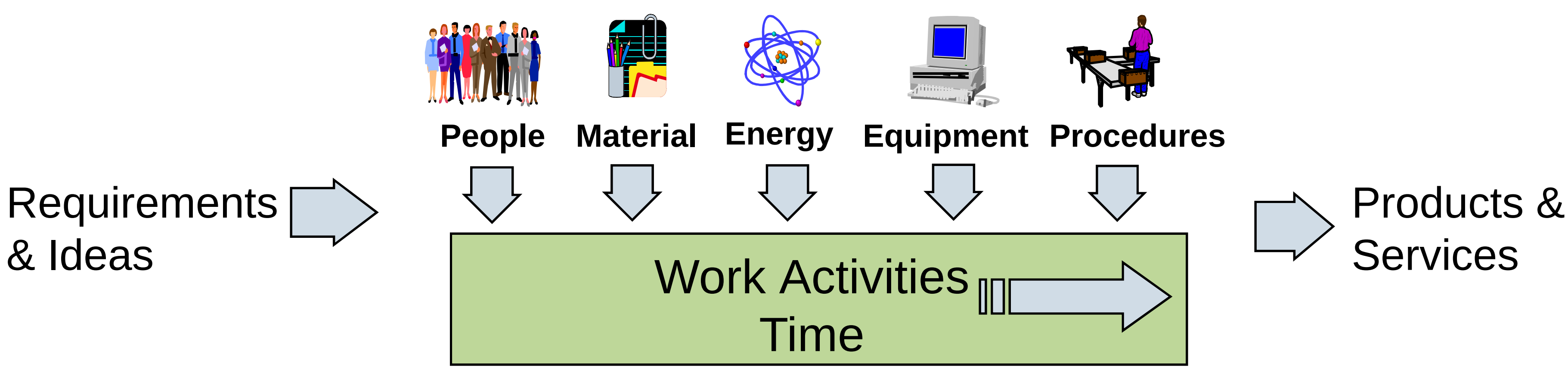
Understanding variation is the basis for management by fact and systematic improvement:

- understand the past quantitatively
- control the present quantitatively
- predict the future quantitatively

What Is a Process in Relation to Products and Services?

Processes defined in CMMI are “activities that can be recognized as implementations of practices in a CMMI model.”

They may also be thought of as a system that includes the people, materials, energy, equipment, and procedures necessary to produce a product or service.

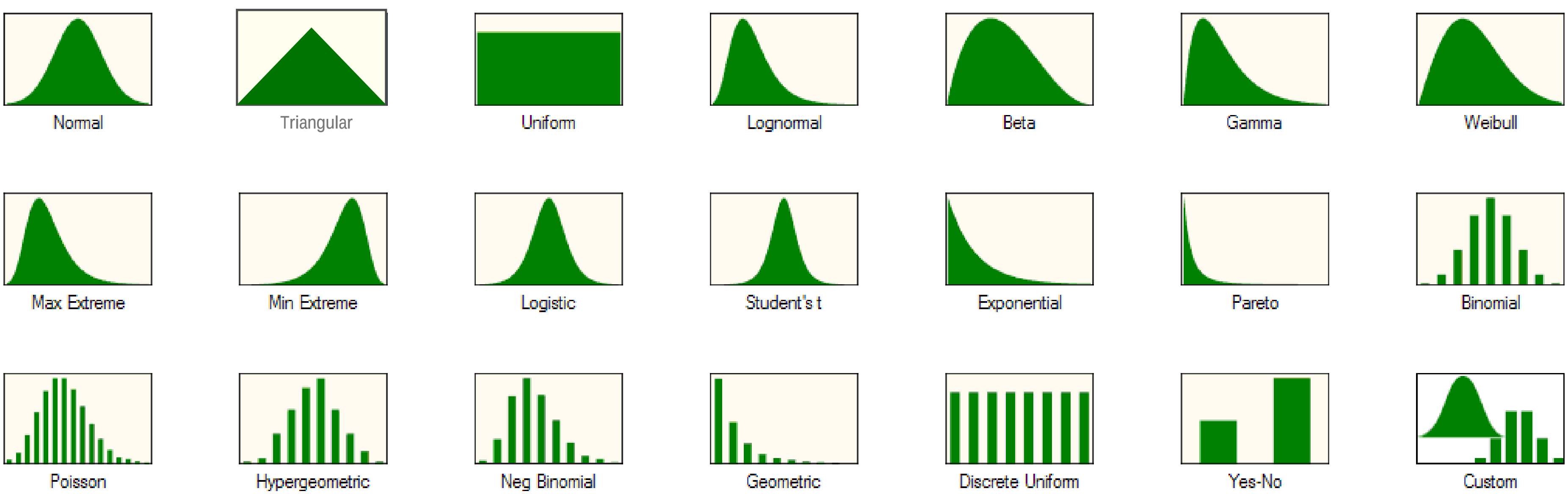


Distributions Describe Variation

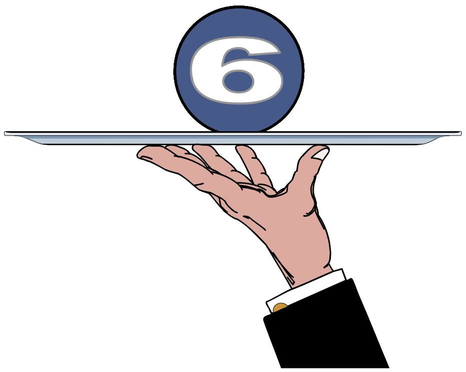
Populations of data are characterized as distributions in most statistical procedures:

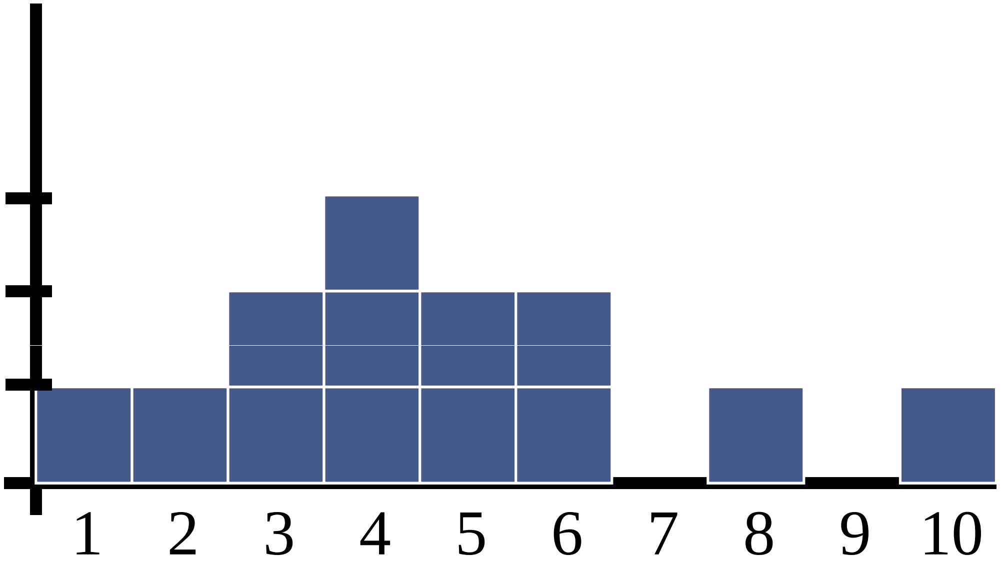
- expressed as an assumption for the procedure
- can be represented using an equation

The following are examples of distributions you may come across:



How Distributions Are Formed



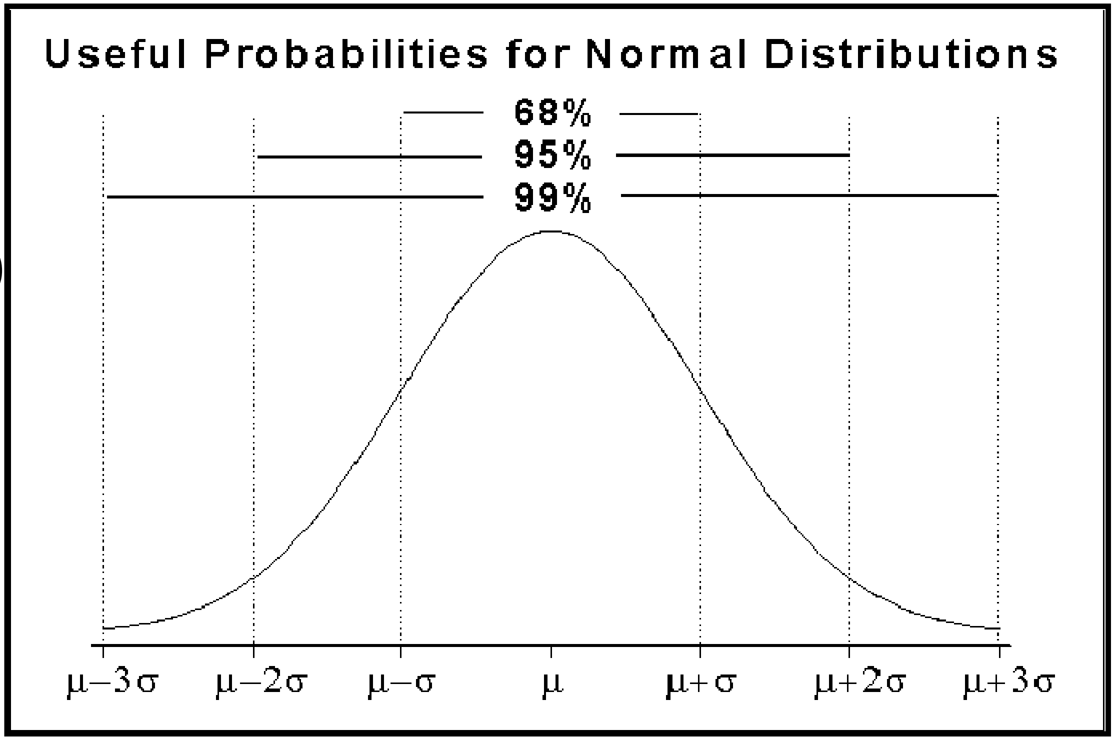


What Is a Statistic?

A summary or characterization of a distribution (i.e., a set of numbers)

A characterization of a central tendency (e.g., mean, median, and mode)

A characterization of dispersion (e.g., variance, standard deviation, interquartile range, and range)



Central Tendency and Dispersion

Central tendency implies location:

- middle of a group of values
- balance point
- examples include mean, median, and mode

Dispersion implies spread:

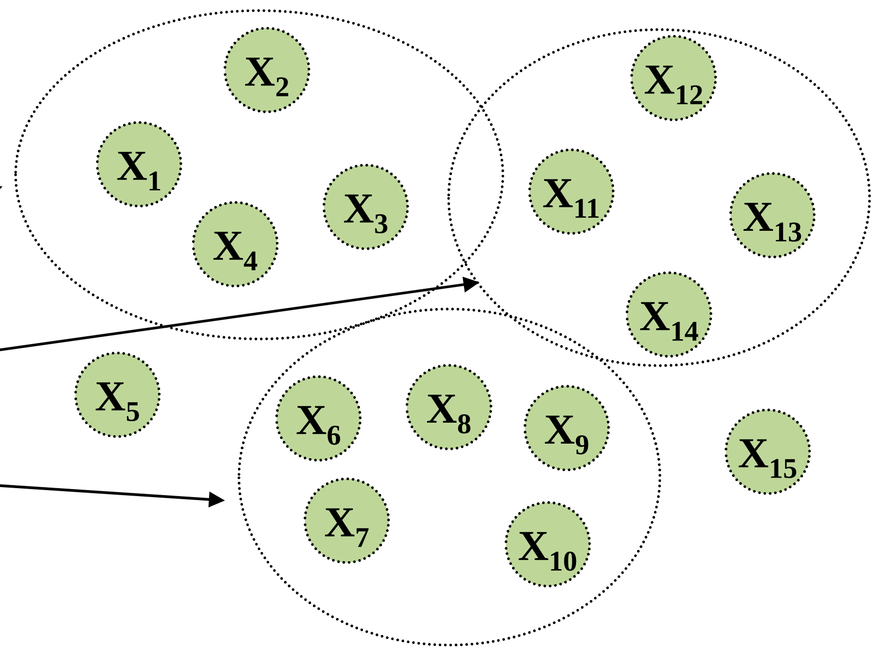
- distance between values
- how much the values tend to differ from one another
- examples include range and (sample) standard deviation

These two are used together to understand the baseline of a process-performance factor and outcome.

Other Terms and Definitions

A population consists of the total possible observations with which you are concerned but to which you do not necessarily have access (X_1 thru X_{15}).

A sample is a set of observations selected from a population that you can access.



Statistics (specifically hypothesis testing) enable you to place a confidence interval on the central tendency and variation of the population and on future samples.

Hypothesis Testing: To Understand and Compare Performance

A formal way of making a comparison and deciding whether or not the difference is significant is based on statistical analysis.

Hypothesis testing consists of a null and alternative hypothesis:

- The null hypothesis states that the members of the comparison are equal; there is no difference (a concrete, default position).
- The alternative hypothesis states that there is a difference; it is supported when the null hypothesis is rejected.

The conclusion either rejects or fails to reject the null hypothesis.

Understanding the null and alternative hypotheses is the key to understanding the results of statistical prediction models discussed in Module 5 on OPP.

Formally Stating a Hypothesis

Average productivity equals 100 source lines of code (SLOC) per person week:

- Null: Average productivity is equal to 100 SLOC per person week.
- Alternative: Average productivity is not equal to 100 SLOC per person week.

A refinement of these hypotheses are as follows:

- Null: Average productivity is equal to 100 SLOC per person week.
- Alternative: Average productivity is less than 100 SLOC per person week.

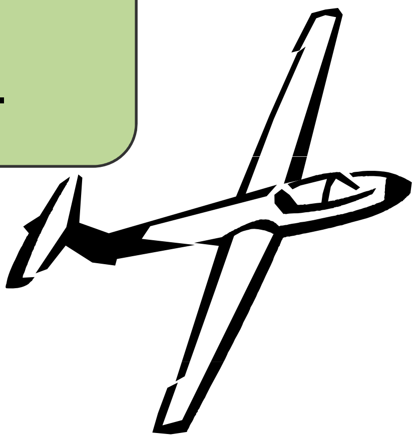
Generally, the alternative hypothesis is the difference (e.g. improvement or performance problem) that you seek to learn about.

The null hypothesis holds the conservative position that apparent differences can be explained by chance alone. The phrase "is equal to" will generally appear in the null hypothesis.

Slogan to Remember p Interpretation

When the p is low, the null must go.

When the p is high, the null must fly.



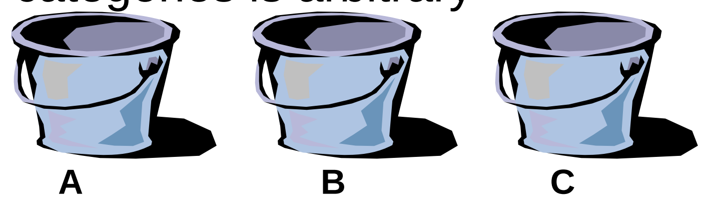
Note: The p value is the key output in statistical analysis that students are taught to identify and use to draw a conclusion regarding the hypothesis test comparison or regarding the significance of a statistical model.

Data Type Determines the Hypothesis Test

Attribute
(aka categorized discrete data)

Nominal

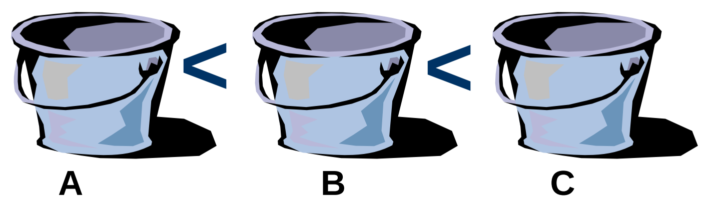
Categorical data where the order of the categories is arbitrary



Examples
- Defect types
- Labor types
- Languages

Ordinal

Nominal data with an ordering; may have unequal intervals



Examples
- Severity levels
- Survey choices 1-5
- Experience categories

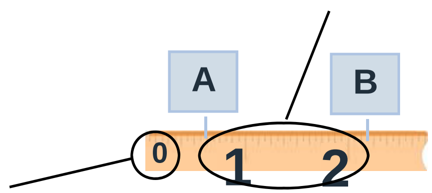
Continuous
(aka variables data)

Interval

Continuous data that has equal intervals; may have decimal values

Ratio

Interval data set that also has a true zero point; decimal values



Examples
- Defect densities
- Labor rates
- Productivity
- Variance %’s

Prediction Modeling Techniques

X \ Y	Continuous	Discrete
Discrete	ANOVA & Dummy Variable Regression	Chi-Square & Logistic Regression
Continuous	Correlation & Regression	Logistic Regression

p value Summary

Method	Null	Alternative	P < 0.05	P > 0.05
Hypothesis Tests	No difference exists; no associations	Two items are different; association exists	Accept alternative	Accept null
Tests for Normality	Data follows Normal Distribution	Data does not follow Normal Distribution	Accept alternative	Accept null
ANOVA	No difference of Y across levels of x	Difference of Y exists between 1+ levels of x	Accept alternative	Accept null
Regression	x factor does not add value to model	X factor adds value to model	Accept alternative	Accept null
Chi-Square	Two discrete variables are not associated	Two discrete variables are associated	Accept alternative	Accept null
Logistic Regression	x factor does not add value; model has no significant x's	X factor adds value to model; model has 1+ significant x's	Accept alternative	Accept null

PART III
A TALE OF TWO ORGANIZATIONS

Introduction

The tale of two organizations aspiring for CMMI High Maturity is embedded in the next section

The first organization, called "***<u>Un-Gestalt</u>***", does not view the CMMI holistically, nor use the informative material to guide practice.

The second organization, called "***<u>Gestalt</u>***", wants to use the CMMI High Maturity practices, including informative material, to gain true competitive advantage and grow their business.

Caveats

The tale demonstrates differences in practical use and benefit of CMMI High Maturity Practices

The "***Un-Gestalt***" organization thinks they are performing acceptably at the CMMI High Maturity level but in fact are not

The "***Gestalt***" organization epitomizes an exemplary interpretation and implementation of CMMI High Maturity practices.

The tale illustrates the importance of understanding variation in addition to central tendency, the benefit of having reliable knowledge of causal relationships beyond trends, and the benefit of having finer-grained insight into process performance, as contrasted with less frequent and larger-grained monitoring of process performance.

The "Gestalt" example illustrates superior methods within the mainstream of industry use; however, the "Gestalt" example is not a prescription for what is a minimal acceptable interpretation from either a maturity rating or an appraisal perspective.

References for the Gestalt Examples

- http://www.isixsigma.com

- http://www.allbusiness.com

  Query on the following terms and "Case Study":

ANOVA
Chi-Square
Regression
Logistic Regression
Dummy Variable Regression
Bayesian Belief Network
Designed Experiments
Discrete Event Simulation
Reliability Growth Modeling
Response Surface Modeling
Time Series Analysis
Hypothesis Testing
Logit
Monte Carlo Simulation
Optimization

Recent Publications

- "CMMI and Six Sigma: Partners in Process Improvement" by Jeannine M. Siviy, M. Lynn Penn, and Robert W. Stoddard. Addison-Wesley 2008.
- "Moving Up the CMMI Capability and Maturity Levels Using Simulation" by David M. Raffo, PhD and Wayne Wakeland, PhD. CMU/SEI-2008-TR-002, January 2008. (http://www.sei.cmu.edu/publications/documents/08.reports/08tr002.html)

Scenarios within the Tale

1. Establishing Process Performance Baselines (PPB)
2. Deciding on Process Performance Models (PPM)
3. Project Forecasting (PM)
4. Composing a Process (Compose)
5. Deciding What to Statistically Manage (Manage)
6. Periodic Management Reviews of Projects (Reviews)
7. Taking Corrective Action When Needed (CAR)
8. Introducing Innovative Change to Organization (OID)

PART IV
LEVELS 4 AND 5 – TO "GESTALT," NOT “UN-GESTALT”

MDD on Use of Informative Material and Subpractices -1

The MDD states on page I-20

- "Appraisal teams compare the objective evidence collected against the corresponding practices in the appraisal reference model. In making inferences about the extent to which practices are or are not implemented, appraisal teams draw on the entire model document to understand the intent of the model, and use it as the basis for their decisions. This comparison includes the required and expected model components (i.e., generic and specific goals, generic and specific practices) as well as informative material, such as model front matter, introductory text, glossary definitions, and subpractices."

MDD on Use of Informative Material and Subpractices -2

Additionally on page I-24 in discussing direct artifacts for PIIs

- "The tangible outputs resulting directly from implementation of a specific or generic practice. An integral part of verifying practice implementation. May be explicitly stated or implied by the practice statement or associated informative material."

And from page II-110

- "The use of informative material in the appraisal reference model to form a checklist is explicitly discouraged."

And from page III-50 the glossary definition for direct artifact

- “The tangible outputs resulting directly from implementation of a specific or generic practice. An integral part of verifying practice implementation. May be explicitly stated or implied by the practice statement or associated informative material. "

Interpreting this Presentation

Text in the yellow boxes is an example description of implementing the practice consistent with the glossary, using the standard English meaning of words instead of the statistical meaning, and without using the informative material. For example, interpreting variation to mean the difference between two items.

Text in the green boxes is an example description of implementing the practice consistent with the glossary, the statistical meaning of words, and accounting for the informative material. For example, interpretating variation (in the level 4 & 5 practices) to mean central tendency and dispersion.

OPP SG 1 Establish Performance Baselines and Models

Baselines and models, which characterize the expected process performance of the organization's set of standard processes, are established and maintained.

OPP SP 1.1 Select Processes

Select the processes or subprocesses in the organization's set of standard processes that are to be included in the organization's process-performance analyses.

Pick a few processes from the OSSP for which we have measures.

Select processes/subprocesses that will help us understand our ability to meet the objectives of the organization and projects, and the need to understand quality and process performance. These subprocesses will typically be the major contributors and/or their measures will be the leading indicators.

OPP SP 1.2 Establish Process-Performance Measures

Establish and maintain definitions of the measures that are to be included in the organization's process-performance analyses.

Provide definitions for the measures and update as necessary.

Select measures, analyses, and procedures that provide insight into the organization's ability to meet its objectives and into the organization's quality and process performance. Create/update clear unambiguous operational definitions for the selected measures. Revise and update the set of measures, analyses, and procedures as warranted. In usage, be sensitive to measurement error. The set of measures may provide coverage of the entire lifecycle and be controllable.

OPP SP 1.3 Establish Quality and Process-Performance Objectives

Establish and maintain quantitative objectives for quality and process performance for the organization.

Write down quality and process performance objectives such as improve cycle time, quality, and the percent of improvement we want.

These objectives will be derived from the organization's business objectives and will typically be specific to the organization, group, or function. These objectives will take into account what is realistically achievable based upon a quantitative understanding (knowledge of variation) of the organization's historic quality and process performance. Typically they will be SMART and revised as needed.

OPP SP 1.4 Establish Process-Performance Baselines

Establish and maintain the organization's process-performance baselines.

Store measures in our spreadsheet repository on a periodic basis indicating the end date of the period they represent and baseline them in our CM system.

Baselines will be established by analyzing the distribution of the data to establish the central tendency and dispersion that characterize the expected performance and variation for the selected process/subprocess. These baselines may be established for single processes, for a sequence of processes, etc. When baselines are created based on data from unstable processes, it should be clearly documented so the consumers of the data will have insight into the risk of using the baseline. Tailoring may affect comparability between baselines.

Scenario 1: Establishing Process Performance Baselines

Scenario 1 (PPB): "Un-Gestalt"

We have performance baselines on a variety of factors. For example, we know that we have the following average defect density (defects per 10 KSLOC) entering System Test:

- 14.35 algorithm defects
- 13.20 stack overflow defects

We focused most of our effort on the algorithm defects using pareto analysis, not realizing …

Scenario 1 (PPB): "Un-Gestalt" - continued

```
Two-sample T for Algorithm vs StackOverFlow

                 N   Mean  StDev  SE Mean
Algorithm      100  14.35   6.07     0.61
StackOverFlow  100  13.20   4.53     0.45


Difference = mu (Algorithm) - mu (StackOverFlow)
Estimate for difference:  1.154
95% CI for difference:  (-0.340, 2.649)
T-Test of difference = 0 (vs not =): T-Value = 1.52  P-Value = 0.129
```

The P-Value greater than 0.05 shows that we cannot reject the Null Hypothesis (that these two defect types occur at similar rates)!

Thus, we should be focusing on both types of defects equally!

Scenario 1 (PPB): “Gestalt”

We have performance baselines on a variety of factors. For example, we know from last year that we have the following baselines which follow the normal distribution:

Defect Type Entering Test		Mean	Std Dev
Algorithm		15	2.5
Stack Overflow		10	3.3
Global Variables		7	1.98
Processing Logic		5	0.76
Data Type Mismatch		5	0.23
Invalid Pointers		3	0.12
Cosmetic		9	1.98

Scenario 1 (PPB): "Gestalt" - continued

Knowing the distribution of each performance baseline, we are able to confidently assess whether we have real "differences" to act upon or not.

We use ANOVA to assess true differences!

Scenario 1 (PPB): “Gestalt” - continued

One-way ANOVA: Algorithm, StackOverFlow, GlobalVariables, ProcessingLogic, DataTypeMismatch, InvalidPointers, Cosmetic

```
Source   DF        SS       MS       F      P
Factor    6  11189.30  1864.88  198.56  0.000
Error   693   6508.68     9.39
Total   699  17697.98

S = 3.065   R-Sq = 63.22%   R-Sq(adj) = 62.91%


                                      Individual 95% CIs For Mean Based on
                                      Pooled StDev
Level               N    Mean  StDev  ---+---------+---------+---------+------
Algorithm         100  14.354  6.067                                  (-*-)
StackOverFlow     100  13.200  4.534                               (-*)
GlobalVariables   100   6.927  1.969             (-*-)
ProcessingLogic   100   5.158  0.767        (-*)
DataTypeMismatch  100   4.971  0.230       (-*-)
InvalidPointers   100   2.994  0.122  (-*)
Cosmetic          100   9.037  1.960                   (-*-)
                                      ---+---------+---------+---------+------
                                       3.5       7.0      10.5      14.0
```

OPP SP 1.5 Establish Process-Performance Models

Establish and maintain the process-performance models for the organization's set of standard processes.

We have historical productivity and defect injection/detection rates by phase which we update periodically and include in reports.

Rather than just a point estimate, PPMs will address variation in the prediction. PPMs will model the interrelationships between subprocesses including controllable/uncontrollable factors. They enable predicting the effects on downstream processes based on current results. They enable modeling of a PDP to predict if the project can meet its objectives and evaluate various alternative PDP compositions. They can predict the effects of corrective actions and process changes. They can also be used to evaluate the effects of new processes and technologies/innovations in the OSSP.

Scenario 2: Deciding on Process Performance Models

Scenario 2 (PPM): "Un-Gestalt"

We are using both COCOMO and SLIM for our initial project forecasting. These models have predictive value and may be used by answering a list of questions.

We do our very best with these models to give them the best starting point as possible.

We also have an escaped defect model that uses the historical average defects inherited, injected and removed by phase.

Even with these models, we still seem to have plenty of surprises in cost, schedule and quality!

Scenario 2 (PPM): "Gestalt"

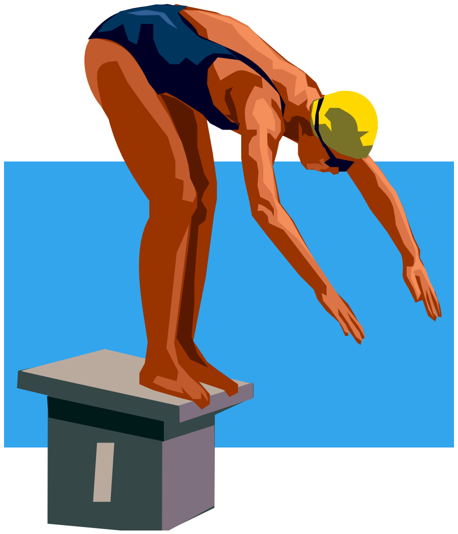
We have enriched our detailed process maps from CMMI ML3 to include executable process models that possess information on cycle times, processing times, available resources, sub-process costs and quality.

We have also identified the key process handoffs during the project execution in which exit and entrance criteria are important!

At these handoffs, we have process performance models predicting the interim outcomes. They will form a pact governing the process handoff and provide leading indicators of problems with outcomes.

Scenario 2 (PPM): “Gestalt”

An illustration of an appropriate number of PPMs. In Swimming, the three primary subprocesses are 1) entering the water, 2) straightline swim, and 3) making the turn.



Scenario 2 (PPM): “Gestalt” - continued

Next, we identify controllable factors tied to earlier sub-processes that may be predictive of one or more of the outcomes (interim and final) we need to predict.

We then decide what type of data our outcome (Y) is and what type of data our factors (x’s) are.

Using the data types, we can then begin to identify the statistical methods to help with our modeling. (See next slide)

Scenario 2 (PPM): "Gestalt" - continued

X \ Y	Continuous	Discrete
Discrete	ANOVA & MANOVA & Dummy Variable Regression	Chi-Square & Logit
Continuous	Correlation & Regression	Logistic Regression

Scenario 2 (PPM): "Gestalt" - continued

ANOVA, Dummy Variable Regression

Using these controllable factors…	To predict this outcome!
Type of Reviews Conducted; Type of Design Method; Language Chosen; Types of Testing	Delivered Defect Density
High-Medium-Low Domain Experience; Architecture Layer; Feature; Team; Lifecycle model; Primary communication method	Productivity
Estimation method employed; Estimator; Type of Project; High-Medium-Low Staff Turnover; High-Medium-Low Complexity; Customer; Product	Cost and Schedule Variance
Team; Product; High-Medium-Low Maturity of Platform; Maturity or Capability Level of Process; Decision-making level in organization; Release	Cycle Time or Time-to-Market
Iterations on Req'ts; Yes/No Prototype; Method of Req'ts Elicitation; Yes/No Beta Test; Yes/No On-Time; High-Medium-Low Customer Relationship	Customer Satisfaction (as a percentile result)

Scenario 2 (PPM): "Gestalt" - continued

Regression

Using these controllable factors…	To predict this outcome!
Req'ts Volatility; Design and Code Complexity; Test Coverage; Escaped Defect Rates	Delivered Defect Density
Staff Turnover %; Years of Domain Experience; Employee Morale Survey %; Volume of Interruptions or Task Switching	Productivity
Availability of Test Equipment %; Req'ts Volatility; Complexity; Staff Turnover Rates	Cost and Schedule Variance
Individual task durations in hrs; Staff availability %; Percentage of specs undefined; Defect arrival rates during inspections or testing	Cycle Time or Time-to-Market
Resolution time of customer inquiries; Resolution time of customer fixes; Percent of features delivered on-time; Face time per week	Customer Satisfaction (as a percentile result)

Scenario 2 (PPM): "Gestalt" - continued

Chi-Square, Logistic Regression

Using these controllable factors…	To predict this outcome!
Programming Language; High-Medium-Low Schedule compression; Req'ts method; Design method; Coding method; Peer Review method	Types of Defects
Predicted Types of Defects; High-Medium-Low Schedule compression; Types of Features Implemented; Parts of Architecture Modified	Types of Testing Most Needed
Architecture Layers or components to be modified; Type of Product; Development Environment chosen; Types of Features	Types of Skills Needed
Types of Customer engagements; Type of Customer; Product involved; Culture; Region	Results of Multiple Choice Customer Surveys
Product; Lifecycle Model Chosen; High-Medium-Low Schedule compression; Previous High Risk Categories	Risk Categories of Highest Concern

Scenario 2 (PPM): "Gestalt" - continued

Logistic Regression

Using these controllable factors…	To predict this outcome!
Inspection Preparation Rates; Inspection Review Rates; Test Case Coverage %; Staff Turnover Rates; Previous Escape Defect Rates	Types of Defects
Escape Defect Rates; Predicted Defect Density entering test; Available Test Staff Hours; Test Equipment or Test Software Availability	Types of Testing Most Needed
Defect Rates in the Field; Defect rates in previous release or product; Turnover Rates; Complexity of Issues Expected or Actual	Types of Skills Needed
Time (in Hours) spent with Customers; Defect rates of products or releases; Response times	Results of Multiple Choice Customer Surveys
Defect densities during inspections and test; Time to execute tasks normalized to work product size	Risk Categories of Highest Concern

Scenario 2 (PPM): "Gestalt" - continued

Recently, we conducted a regression analysis to develop our statistically-based process performance model **predicting Defect Density**.

As will be seen on the next slide, the regression model provides rich information about the role of the **controllable x factors (Req'ts Volatility and Experience)** in predicting the **Y outcome (Defect Density).**

In turn, this will provide management with rich information on how to be **pro-active** in changing predicted high levels of Defect Density to acceptable lower levels!

Scenario 2 (PPM): “Gestalt” - continued

Regression Analysis: Defect Densi versus ReqtsVolatil, YearsDomainE

```
The regression equation is
Defect Density = 0.484 + 0.480 ReqtsVolatility - 0.0242 YearsDomainExperience


Predictor                  Coef    SE Coef       T      P
Constant                0.48367    0.03957   12.22  0.000
ReqtsVolatility         0.47963    0.09511    5.04  0.000
YearsDomainExperience -0.024215   0.001941  -12.48  0.000


S = 0.00893207   R-Sq = 85.9%   R-Sq(adj) = 84.8%


Analysis of Variance

Source          DF        SS        MS      F      P
Regression                                       0.000
Residual Erro
Total
```

Prediction equation of defect density

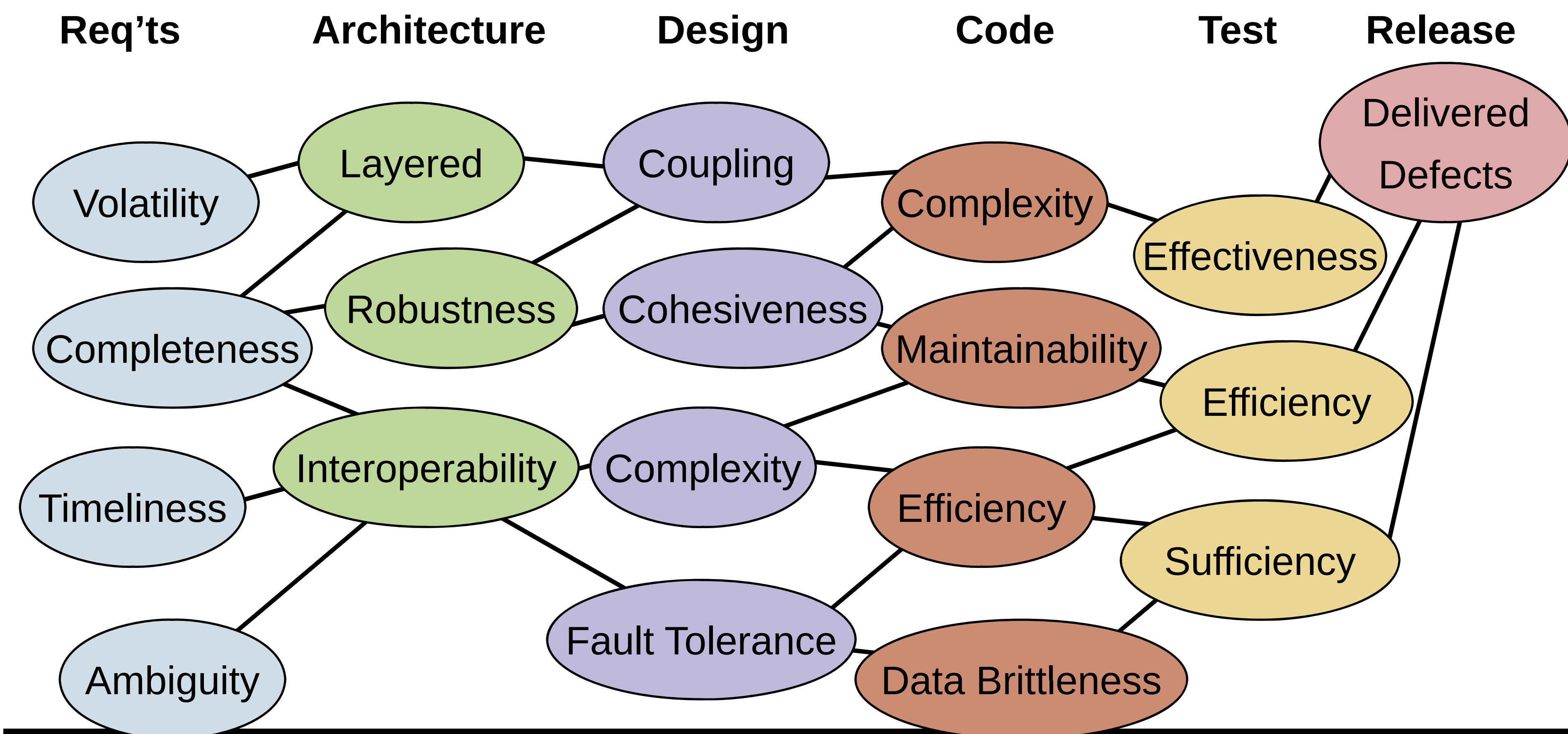
p values below 0.05 indicate the predictors to keep in the model

Percentage of total variation in defect density explained by the model

p value below 0.05 indicates the model is significant

Scenario 2 (PPM): “Gestalt” - continued

A probabilistic model can represent a collection of process performance models in that each child node below may be statistically predicted by it’s parents to the left.



OPP SG 1 Establish Performance Baselines and Models

Baselines and models, which characterize the expected process performance of the organization's set of standard processes, are established and maintained.

The aforementioned data and models characterize OSSP performance.

Central tendency and variation are the cornerstones of our implementation. Our baselines and models incorporate our understanding of these, allow us to understand risks in our organizations and its projects, and allow us to create and execute effective strategies to mitigate and manage risks.

QPM SG 1 Quantitatively Manage the Project

The project is quantitatively managed using quality and process-performance objectives.

QPM SP 1.1 Establish the Project’s Objectives

Establish and maintain the project’s quality and process-performance objectives.

Project Manager documents project objectives such as “Produce the system better, cheaper, faster” in the project plan.

These objectives will be based on the organization’s quality and process performance objectives and any additional customer and relevant stakeholder needs and objectives. These objectives will be realistic (based upon analysis of historical quality and process performance) and will cover interim, supplier, and end-state objectives. Conflicts between objectives (i.e., trade-offs between cost, quality, and time-to-market) will be resolved with relevant stakeholders. Typically they will be SMART, traceable to their source, and revised as needed.

QPM SP 1.2 Compose the Defined Process

Select the subprocesses that compose the project's defined process based on historical stability and capability data.

Look at our data spreadsheets to select the subprocesses that have the highest performance, best quality, and most stability -- the ones that have changed the least.

The PDP is composed by:

- selecting subprocesses
- adjusting/trading-off the level and depth of intensity of application of the subprocess(es) and/or resources

to best meet the quality and process performance objectives. This can be accomplished by modeling/simulating the candidate PDP(s) to predict if they will achieve the objectives, and the confidence level of (or risk of not) achieving the objective.

Scenario 3: Project Forecasting

Scenario 3 (PM): "Un-Gestalt"

We collect data on historical projects and use it to compare our projects being planned to similar historical projects.

We also ask each sub-process owner for their assessment of task duration and we compute our critical path.

Regretfully, our schedule variances are not improving over the past 4 years. It seems that we may have hit a ceiling of performance in our schedule variance!

Scenario 3 (PM): "Gestalt"

We collect data on historical projects and develop distributions of task durations for key sub-processes.

When we don't have solid historical data, **we query the process owners for task durations by asking them for [Best Case, Worst Case, Most Likely]** so that we can model the uncertainty.

We have much fewer surprises in our schedules with this approach! Instead of reporting single values that management wants to hear, process owners are honest! Everyone now has buy-in to the schedule!

Scenario 3 (PM): “Gestalt” - continued

Process	Durations		
Step		Expected	
1		30	
2		50	
3		80	
4		50	
5		90	
6		25	
7		35	
8		45	
9		70	
10		25	
		500	

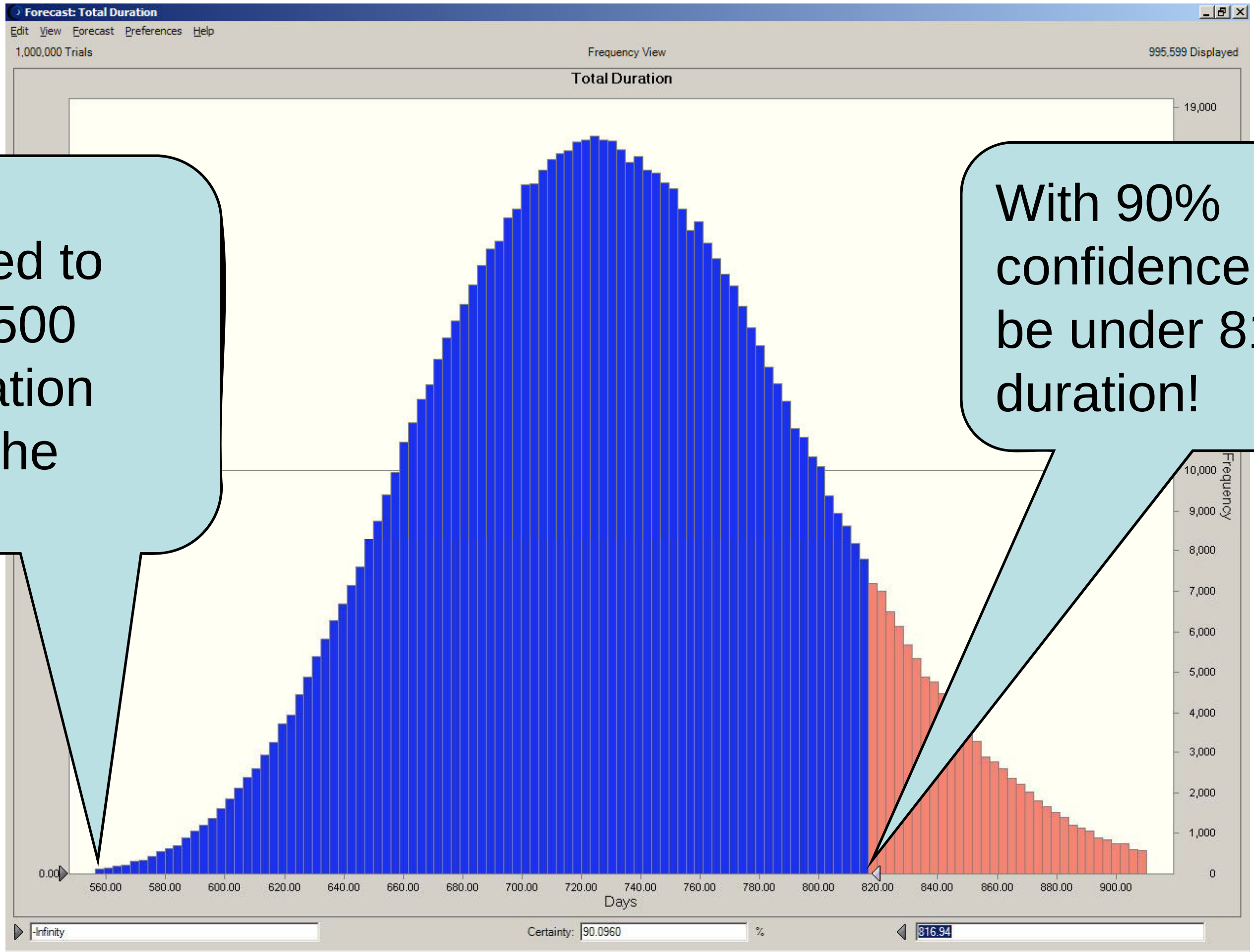
What would you forecast the schedule duration to be?

Scenario 3 (PM): “Gestalt” - continued

Process	Durations		
Step	Best	Expected	Worst
1	27	30	75
2	45	50	125
3	72	80	200
4	45	50	125
5	81	90	225
6	23	25	63
7	32	35	88
8	41	45	113
9	63	70	175
10	23	25	63
		500	

Would you change your mind in the face of unbalanced risk?

Scenario 3 (PM): “Gestalt” - continued



Almost guaranteed to miss the 500 days duration 100% of the time!

With 90% confidence, we will be under 817 days duration!

Scenario 4: Composing a Process

Scenario 4 (Compose): "Un-Gestalt"

We know how our processes work. We don't have a lot of choices but our experts are confident that we do make the correct few choices during our tailoring session.

If our experts believe that there were problems during the last project with some of our sub-processes, we may choose alternative sub-processes to avoid problems.

We believe we are informed, but we aren't always confident in our choices - as we continue to have surprises in process performance!

Scenario 4 (Compose): “Gestalt”

We have collected plenty of distributional data for performance baselines of our key sub-processes.

By analyzing our organizational goals and customer reqts, we can model our subprocess’ capabilities to see if they provide desirable outcomes in cost, schedule and quality.

We also reach into our process performance models to see if they are predicting successful outcomes based our composition decisions.

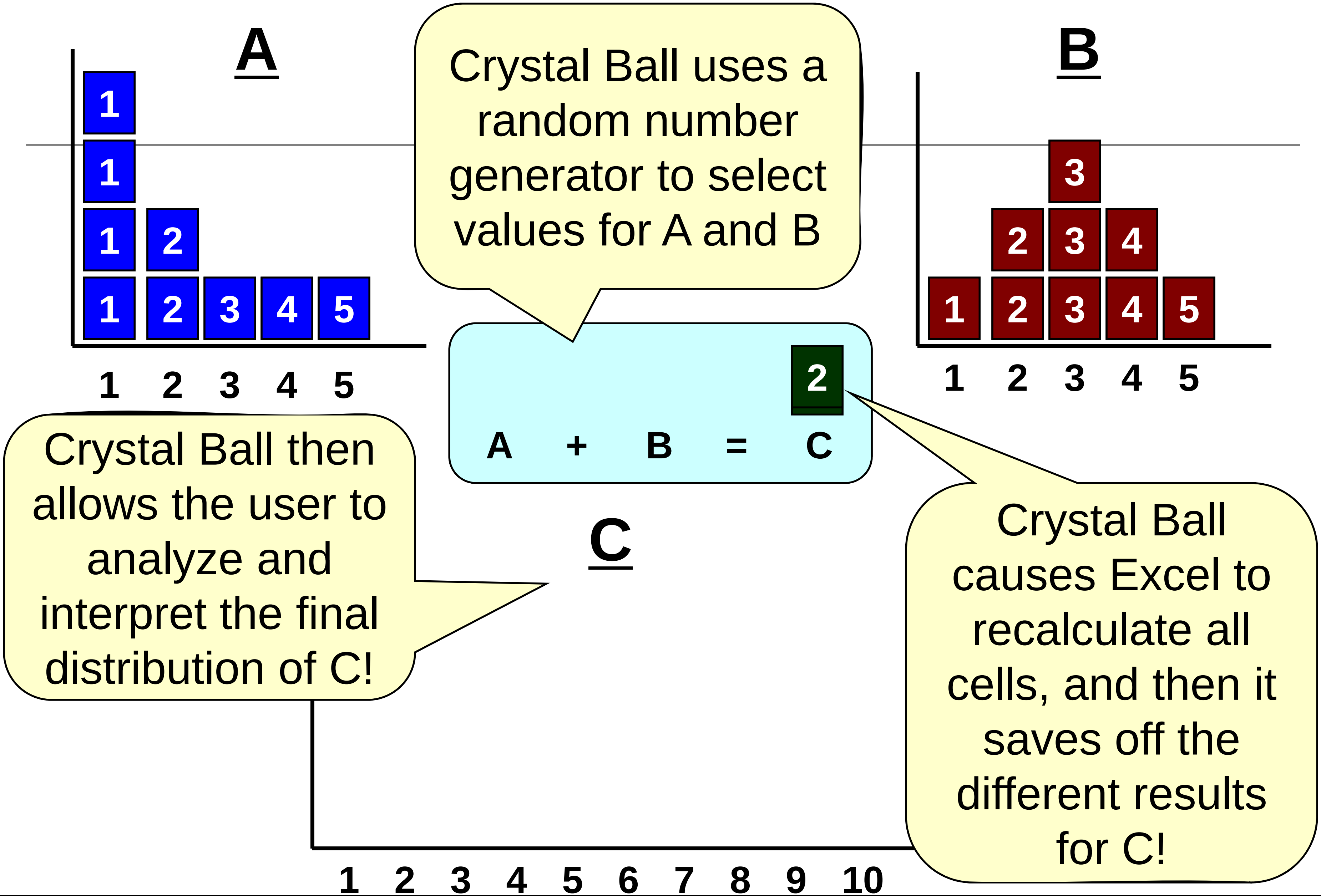
Scenario 4 (Compose): "Gestalt" - continued

Our modeling for process composition is based on Monte Carlo simulation and optimization.

Essentially, we can model the inter-connected subprocesses and include decisions of which alternative subprocesses to choose.

The simulation and optimization help to confirm which choices we should make.

We are thankful that this modeling is available because we have many complicated processes involving many tradeoffs!


A
B
1
1
1 2
1 2 3 4 5
1 2 3 4 5
3
2 3 4
1 2 3 4 5
1 2 3 4 5
Crystal Ball uses a random number generator to select values for A and B
2
A + B = C
Crystal Ball then allows the user to analyze and interpret the final distribution of C!
C
Crystal Ball causes Excel to recalculate all cells, and then it saves off the different results for C!
1 2 3 4 5 6 7 8 9 10

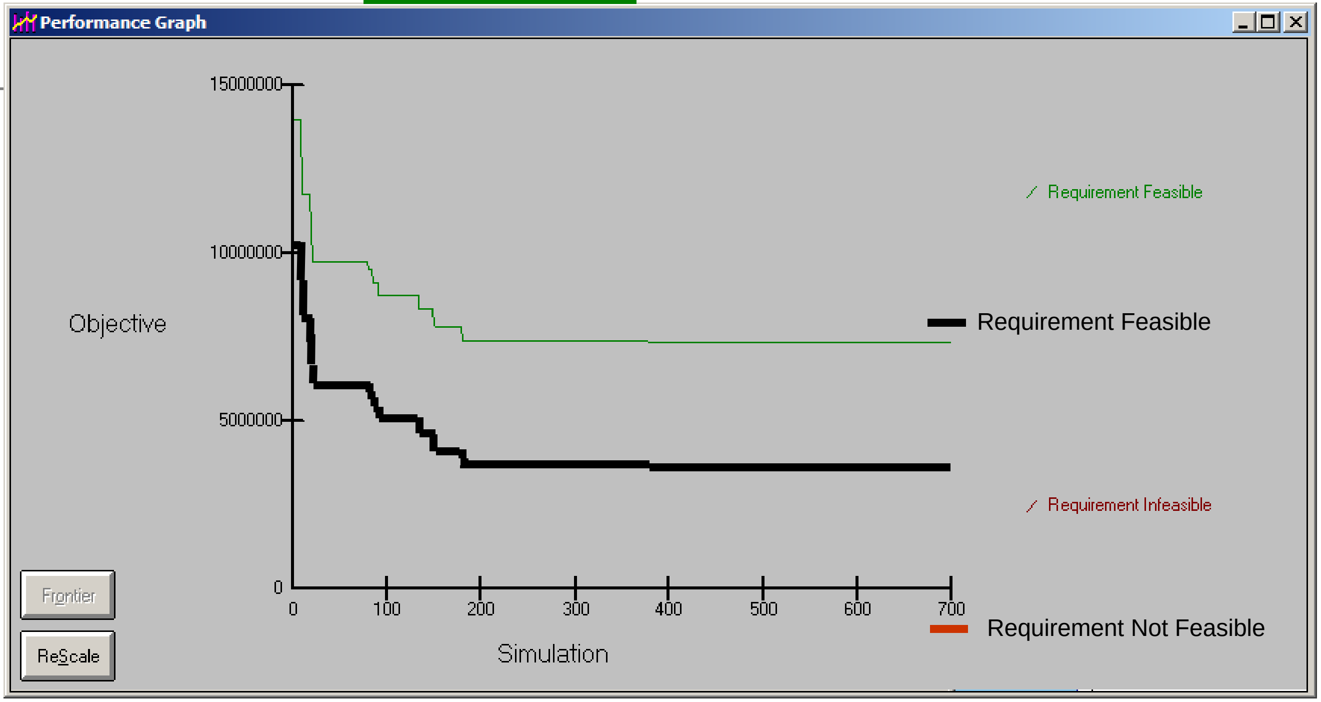
Scenario 4 (Compose): "Gestalt" - continued

		Option 1			Option 2			Option 3			Option 4		
Requirements Development		Traditional			KJ Analysis & QFD			Prototyping					
		LL	Avg	UL	LL	Avg	UL	LL	Avg	UL			
	Effort	25	35	45	35	45	55	65	80	95			
	Cycle Time	15	20	25	30	35	40	50	60	70			
	Quality	35	45	55	27	30	33	22	25	28			
Reqts Review		Email Routing			Walkthrough			Inspections			Sampling Inspections		
		LL	Avg	UL	LL	Avg	UL	LL	Avg	UL	LL	Avg	UL
	Effort	1	4	7	7	10	13	18	20	22	8	10	12
	Cycle Time	1	2	3	1	4	7	1	5	9	2	3	4
	Quality	25.00%	40.00%	55.00%	50.00%	55.00%	60.00%	80.00%	85.00%	90.00%	65.00%	70.00%	75.00%
Design		SA/SD			OOD								
		LL	Avg	UL	LL	Avg	UL						
	Effort	50	60	70	65	75	85						
	Cycle Time	40	45	50	50	55	60						
	Quality	35	45	55	16	20	24						
Design Review		Email Routing			Walkthrough			Inspections			Sampling Inspections		
		LL	Avg	UL	LL	Avg	UL	LL	Avg	UL	LL	Avg	UL
	Effort	5	12	19	15	20	25	25	35	45	5	7	9
	Cycle Time	1	2	3	1	4	7	1	5	9	2	3	4
	Quality	25.00%	40.00%	55.00%	50.00%	55.00%	60.00%	80.00%	85.00%	90.00%	65.00%	70.00%	75.00%
Code		Manual w/No Reuse			Manual w/Reuse			Code Generation w/No Reuse			Code Generation w/Reuse		
		LL	Avg	UL	LL	Avg	UL	LL	Avg	UL	LL	Avg	UL
	Effort	150	300	450	220	250	280	100	125	150	90	100	110
	Cycle Time	50	65	80	45	55	65	35	40	45	25	30	35
	Quality	200	250	300	100	200	220	90	110	130	85	90	95

Scenario 4 (Compose): “Gestalt” - continued

		Option 1			Option 2			Option 3			Option 4		
Code Review		Email Routing			Walkthrough			Inspections			Sampling Inspections		
		LL	Avg	UL	LL	Avg	UL	LL	Avg	UL	LL	Avg	UL
	Effort	5	12	19	15	20	25	25	35	45	5	7	9
	Cycle Time	1	2	3	1	4	7	1	5	9	2	3	4
	Quality	25.00%	40.00%	55.00%	50.00%	55.00%	60.00%	80.00%	85.00%	90.00%	65.00%	70.00%	75.00%
Unit Test		Ad Hoc			Path Testing Only			Data Flow Testing Only			Both Path and Data Flow		
		LL	Avg	UL	LL	Avg	UL	LL	Avg	UL	LL	Avg	UL
	Effort	90	100	110	120	150	180	200	250	300	300	350	400
	Cycle Time	9	12	15	12	16	20	13	20	27	25	30	35
	Quality	40.00%	50.00%	60.00%	55.00%	60.00%	65.00%	65.00%	70.00%	75.00%	75.00%	80.00%	85.00%
Integration Test		Bottom-Up			Top-Down			Hybrid					
		LL	Avg	UL	LL	Avg	UL	LL	Avg	UL			
	Effort	55	60	65	40	50	60	35	40	45			
	Cycle Time	20	25	30	20	25	30	20	25	30			
	Quality	55.00%	60.00%	65.00%	55.00%	60.00%	65.00%	70.00%	75.00%	80.00%			
System Test		On Breadboard			On Brassboard			Production Hardware					
		LL	Avg	UL	LL	Avg	UL	LL	Avg	UL			
	Effort	80	100	120	75	80	85	65	70	75			
	Cycle Time	30	35	40	27	30	33	19	22	25			
	Quality	65.00%	70.00%	75.00%	75.00%	80.00%	85.00%	85.00%	90.00%	95.00%			
Acceptance Test		Low Intensity			Medium Intensity			High Intensity					
		LL	Avg	UL	LL	Avg	UL	LL	Avg	UL			
	Effort	15	20	25	25	30	35	50	60	75			
	Cycle Time	3	5	7	8	10	12	15	25	35			
	Quality	70.00%	75.00%	80.00%	80.00%	85.00%	90.00%	90.00%	95.00%	99.00%			

Scenario 4 (Compose): "Gestalt" - continued

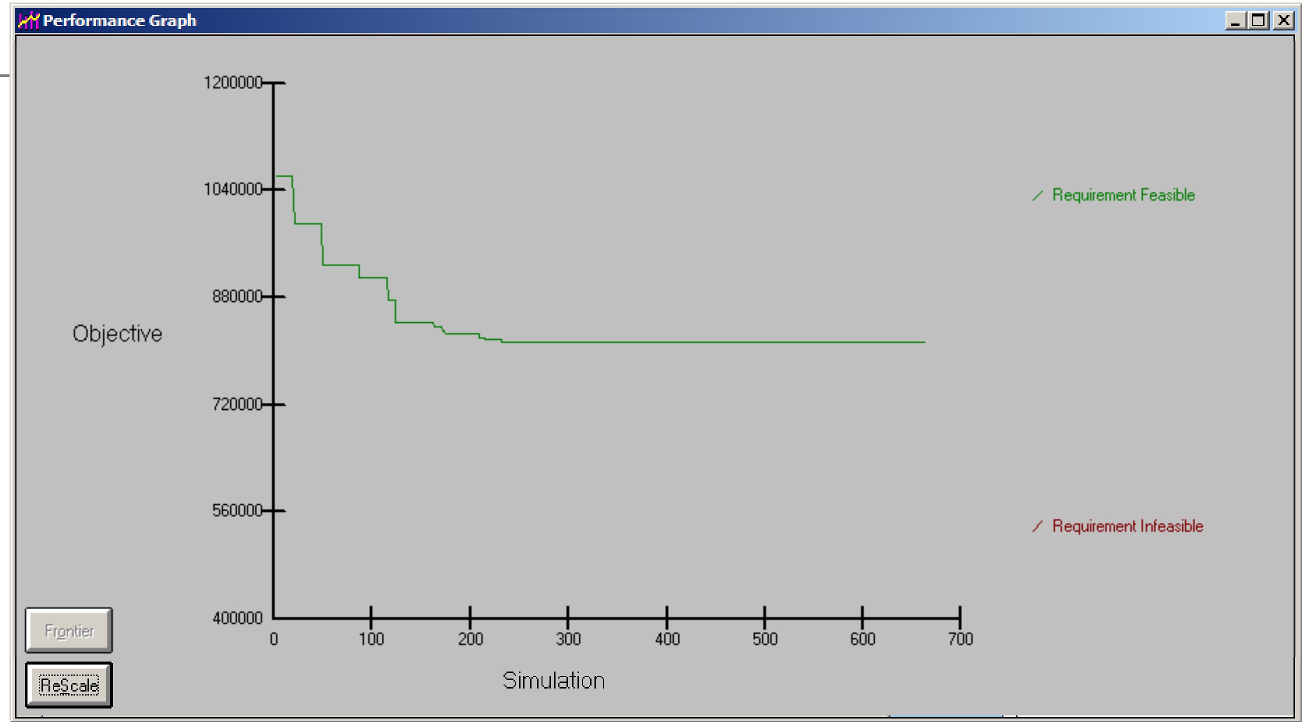


****BEST SOLUTION****

Values of Variables:
RD Decision: 1
RR Decision: 1
Design Decision: 1
DR Decision: 1
Code Decision: 4
CR Decision: 1
UT Decision: 1
IT Decision: 3
ST Decision: 3
AT Decision: 1
Objective: Overall Goal: Mean: 7336198.74811609
Requirement Feasible
Requirement: TEST01: 0
Requirement: TEST02: 0
Requirement: TEST03: 0
Additional details may be found below...

This solution of process composition is optimized with **first priority of cycle time** and secondary priority of quality.

Scenario 4 (Compose): “Gestalt” - continued



****BEST SOLUTION****

Values of Variables:
RD Decision: 1
RR Decision: 4
Design Decision: 2
DR Decision: 4
Code Decision: 4
CR Decision: 2
UT Decision: 1
IT Decision: 3
ST Decision: 3
AT Decision: 1
Objective: Overall Goal: Mean: 012254.401407005
Requirement Feasible
Requirement: TEST01: 0
Requirement: TEST02: 0
Requirement: TEST03: 0
Additional details may be found below...

This solution of process composition is optimized with **first priority of quality** and secondary priority on cycle time.

Scenario 4 (Compose): "Gestalt" - continued

Subprocesses	Optimize for	
	Cycle Time	Quality
Requirements Development	Traditional	Traditional
Requirements Review	Email Routing	Sampling Inspections
Design	SA/SD	OOD
Design Review	Email Routing	Sampling Inspections
Code	Code Generation with Reuse	Code Generation with Reuse
Code Review	Email Routing	Walkthrough
Unit Test	Ad Hoc	Ad Hoc
Integration Test	Hybrid	Hybrid
System Test	Production Hardware	Production Hardware
Acceptance Test	Low Intensity	Low Intensity
Results (95% confidence results will not exceed)		
Cycle Time	171	185
Quality Rework Costs	$487,000	$354,000
Overall Costs	$7,935,000	$841,000

QPM SP 1.3 Select the Subprocesses that Will Be Statistically Managed

Select the subprocesses of the project's defined process that will be statistically managed.

Select the subprocesses that we must already measure.

Subprocesses that are the major contributors to or predictors of the accomplishment of the project’s interim or end-state objectives will be selected. Additionally, these need to be suitable for statistical management. Statistically managing the selected subprocesses provides valuable insight into performance by helping the project identify when corrective action is needed to achieve its objectives. Select the attributes that will measured and controlled.

Scenario 5: Deciding What to Statistically Manage

Scenario 5 (Manage): “Un-Gestalt”

We first looked around to see what data was already being collected.

Then we discussed what additional data might be easy to collect.

We wanted to ensure that the final outcomes of cost, schedule and quality are measured so that we can statistically manage these for finished projects.

We have mixed feelings! We are collecting a lot of data but not sure if we are using it properly. Sure hope it is helping as it costs a lot to collect all of this data!

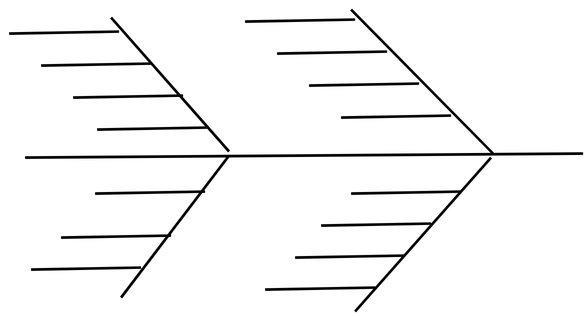
Scenario 5 (Manage): "Gestalt"

We began with our leaders forming vision statements of our organization over the next 2-5 years.

Then, we asked our leaders to perform a "fishbone diagram" exercise for each vision statement providing rich information on barriers to each vision statement.

We next asked our leaders to formulate a prioritized list of high level business goals attacking the barriers to the vision statements.

Vision Stmts



Business Goal Stmts

"Future State"

"Barriers to Future State"

"Business Goals tackling the Barriers"

Scenario 5 (Manage): “Gestalt” - continued

Once we had our high level business goals, we commenced on an exercise called the “Goal-Decomposition Matrix”. (See next slide)

This matrix is used to produce a set of SMART Goal Statements **at the project level** to drive QPM for critical subprocesses.

Essentially, each project goal statement will be a statement of what can be controlled at the subprocess level to maximize accomplishment of the goal.

Scenario 5 (Manage): “Gestalt” - continued

Goal Decomposition Matrix

Process Step	Goal 1	Goal 2	Goal 3	Goal 4	Goal 5	Goal 6	Goal 7
Req’ts Elicitation	X			X			
Prototype		X					
Architecture Modification							
High level Design			X				
Low level Design			X				
Coding							
Unit Test							
Integration Test							
System Test	X			X			
Alpha Test							
Beta Test		X					

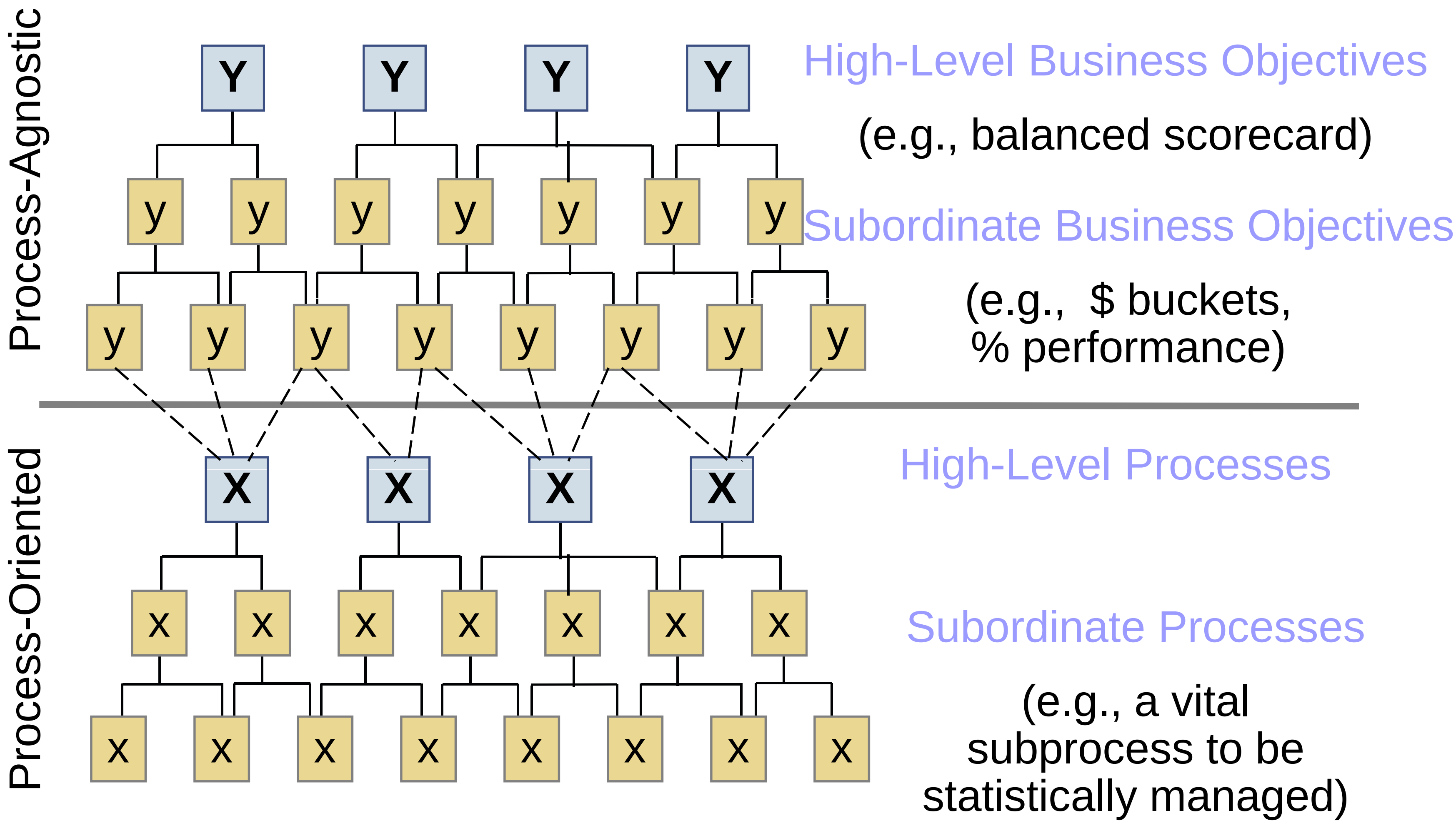
Each **X** receives a S.M.A.R.T. objective statement and is a candidate for statistical management. Each Goal will potentially have a process performance model with some of these controllable x factors.

Scenario 5 (Manage): "Gestalt" - continued

Next year, we will fully implement a Big Y – to – small x tree that is connected with a series of regression equations. With this connected tree, we will have a solid basis to determine what to statistically manage as well.

Next year, we will implement a tolerance analysis on our sub-processes to determine which ones need to be tightly vs loosely controlled.

Scenario 5 (Manage): “Gestalt” - continued



QPM SP 1.4 Manage Project Performance

Monitor the project to determine whether the project's objectives for quality and process performance will be satisfied, and identify corrective action as appropriate.

Compare the actual versus estimated and corresponding actual trend versus estimated trend. If we're not meeting our objectives or based on the actual trend it looks like we won't achieve our objectives in the future, document what we might do to fix the shortcoming/potential shortcoming.

Monitor the project

- Manage stability and capability of selected subprocesses.
- Track quality and process performance data including suppliers'
- Update/calibrate PPMs and predictions based on results to date.
- Identify deficiencies/risks to achieving objectives (e.g., where current performance is outside tolerance intervals, or prediction/confidence intervals are not contained within specification limits).

Scenario 6: Periodic Management Reviews of Projects

Scenario 6 (Review): "Un-Gestalt"

We hold many management reviews of our software measures.

Sometimes we have management look at the control charts and sometimes they look at dashboards that have red-yellow-green status codes.

Our management knows immediately when any of our outcomes are unacceptable or go "out of control".

However, our management aren't sure if they are looking at the correct things and getting the value that they should be!

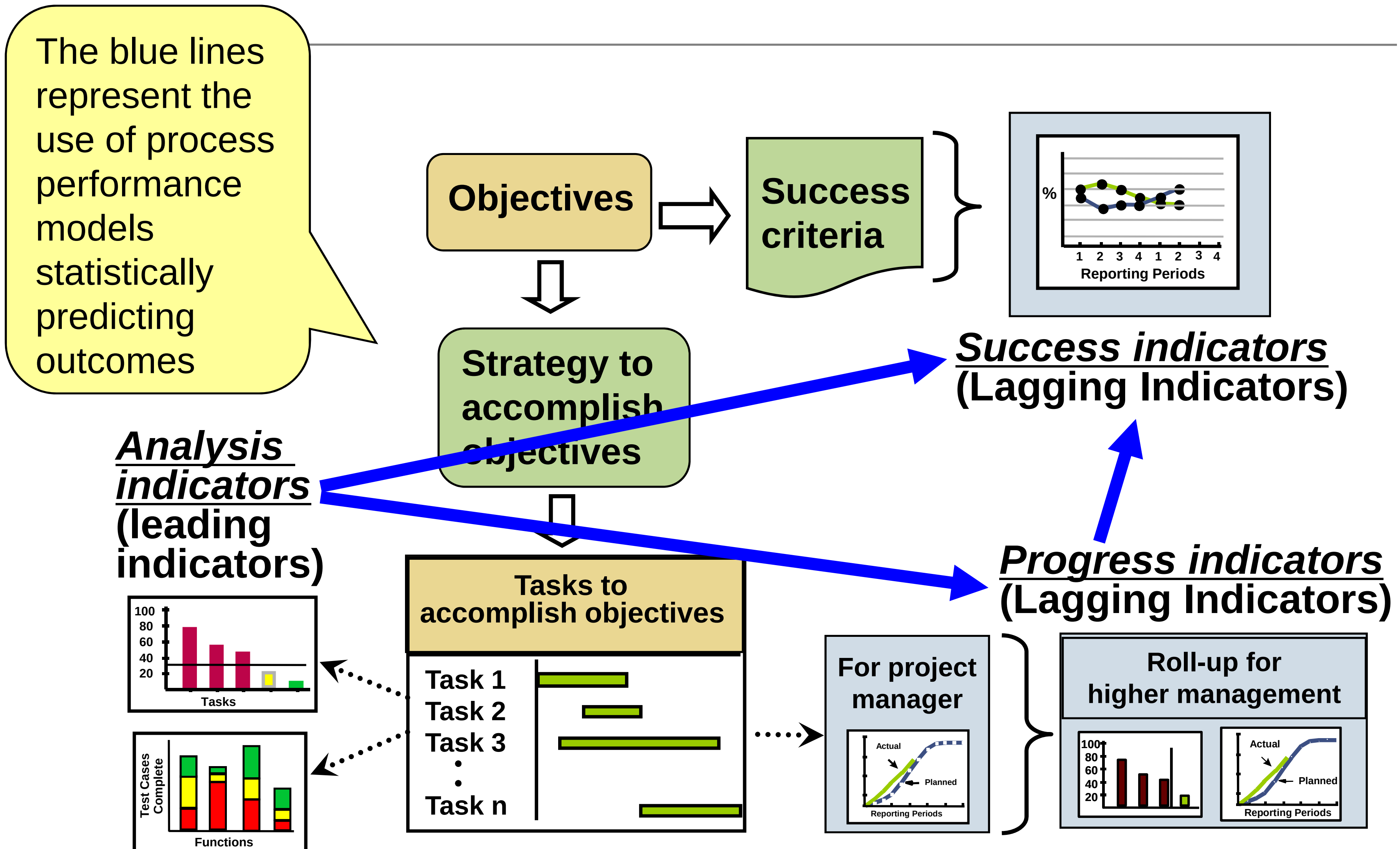
Scenario 6 (Review): "Gestalt"

Our management mostly reviews dashboards that include not only outcomes but leading indicators such as the controllable x factors used in our QPM and performance models.

We know that just looking at the outcomes is like driving a car using the rear-view mirror.

We have also developed 3-5 leading indicators for each outcome (or lagging indicator) that may be used in a process performance model.

Scenario 6 (Review): “Gestalt” - continued



Scenario 6 (Review): “Gestalt” - continued

Our management now only spends **20% of each management review looking at the lagging indictors** (e.g. the outcomes of cost, schedule and quality)

They now spend **80% of their time reviewing the statistical management of controllable x factors and the predicted outcomes** based on the x factors.

Inherently, the discussion focuses on management **pro-actively taking action based on performance models and control charts of controllable x factors.**

QPM SG 1 Quantitatively Manage the Project

The project is quantitatively managed using quality and process-performance objectives.

Project processes are managed against objectives using the standard data and statistical management spreadsheets*.

* Explained in QPM goal 2

Projects are managed through the use of:

- measuring and controlling quality and process performance attributes.
- statistical techniques to ensure stable and capable subprocesses
- PPMs to predict if objectives will be met based on current performance
- spec limits to indicate when the performance of current processes will adversely affect the project’s ability to meet its objectives

QPM SG 2 Statistically Manage Subprocess Performance

The performance of selected subprocesses within the project's defined process is statistically managed.

QPM SP 2.1 Select Measures and Analytic Techniques

Select the measures and analytic techniques to be used in statistically managing the selected subprocesses.

Select effort, size, and defects (estimated and actual for each) and use trend charts to analyze them and investigate spikes that appear to be unusually large as special causes.

Identify the measures that will provide insight into the performance of the subprocesses selected for statistical management and the statistical techniques that will be used for analysis. These measures can be for both controllable and uncontrollable factors. Operational definitions will be created/updated for these measures. Where appropriate (i.e., they are critical to meeting downstream objectives), spec limits will be established for the measures.

QPM SP 2.2 Apply Statistical Methods to Understand Variation

Establish and maintain an understanding of the variation of the selected subprocesses using the selected measures and analytic techniques.

For each subprocess measure, compare the actual to the estimated (using trends) to understand how much variation there is between what we expected and what we are actually getting.

Selected measures for the subprocesses will be statistically controlled to identify, remove, and prevent reoccurrence of special causes of variation, or in other words, stabilize the process. When control limits are too wide, sources of variation are easily masked and further investigation is warranted.

QPM SP 2.3 Monitor Performance of the Selected Subprocesses

Monitor the performance of the selected subprocesses to determine their capability to satisfy their quality and process-performance objectives, and identify corrective action as necessary.

Compare the actual versus estimated and corresponding actual trend versus estimated trend. If we're not meeting our objectives or based on the actual trend it looks like we won't achieve our objectives in the future, document what we might do to fix the shortcoming/potential shortcoming.

For a stable subprocess, determine if the control limits (natural bounds) are within the specification limits which indicates a capable subprocess. If it is not, document corrective actions that address the capability deficiencies.

QPM SP 2.4 Record Statistical Management Data

Record statistical and quality management data in the organization's measurement repository.

Put the data in our statistical management spreadsheet.

Record the data along with sufficient information to understand the context for the data and thus make the data usable by the organization and other projects.

QPM SG 2 Statistically Manage Subprocess Performance

The performance of selected subprocesses within the project's defined process is statistically managed.

Systemization of our process is achieved through planning and execution of the plans.

Selected subprocesses are statistically managed to ensure stability and capability (i.e., special causes of variation are identified, removed, and prevented from recurring and the control limits of the subprocess are kept within the specification limits).

CAR SG 1 Determine Causes of Defects

Root causes of defects and other problems are systematically determined.

CAR SP 1.1 Select Defect Data for Analysis

Select the defects and other problems for analysis.

Select first ten defects/problems on the list

Defects and other problems are selected for further analysis based on factors such as clustering and analysis of the clusters of similar defects or problems including impact to the project's objectives, predicted ROI, etc. PPMs may be used in the prediction of impact, calculation of cost and benefits, ROI, etc.

CAR SP 1.2 Analyze Causes

Perform causal analysis of selected defects and other problems and propose actions to address them.

Perform causal analyses on the selected defects and problems using Fishbone diagrams. The analysis is qualitatively driven. Propose actions to address the identified causes.

The causal analysis can include:

- analysis of PPBs and PPMs to help identify potential sources of defects and problems
- causal analysis meetings with the involved parties
- formal root cause analysis.

The analysis is both quantitative and qualitative.

Actions are proposed to not only address the defect/problem but also to correct the root cause and prevent reoccurrence.

CAR SG 1 Determine Causes of Defects

Root causes of defects and other problems are systematically determined.

Systemization of our process is achieved through planning and execution of the plans.

Processes, plans and methods are used to identify the root cause(s) of defects and other problems and identify the actions necessary to fix and prevent future occurrences.

CAR SG 2 Address Causes of Defects

Root causes of defects and other problems are systematically addressed to prevent their future occurrence.

CAR SP 2.1 Implement the Action Proposals

Implement the selected action proposals that were developed in causal analysis.

Execute proposed actions.

Prioritize the actions based on factors such as impact, ROI, availability of resources/budget, interdependencies, etc. Implement the actions. Additionally, identify and remove similar defects and other problems that may exist in other processes and work products. Where appropriate, submit proposals to improve the OSSP.

CAR SP 2.2 Evaluate the Effect of Changes

Evaluate the effect of changes on process performance.

Did process performance go up/down (e.g., more/less productivity, less/more defects).

Measure and analyze the change to determine if process performance has been positively affected and there are no harmful side-effects. This may involve hypothesis testing using a before and after PPBs to determine if the change is statistically significant. May also involve comparing the change to the PPM predicted change to see if the predicted performance benefits were achieved. Further analysis may use a PPM to determine if the change will positively contribute to meeting downstream quality and process performance objectives.

CAR SP 2.3 Record Data

Record causal analysis and resolution data for use across the project and organization.

Put the data in our spreadsheet.

Record the data along with sufficient information to understand the context for the data. Data related to project adoption experience and other data that will assist deployment in other parts of the organization should be collected.

CAR SG 2 Address Causes of Defects

Root causes of defects and other problems are systematically addressed to prevent their future occurrence.

Systemization of our process is achieved through planning and execution of the plans.

The changes are made and measures taken and analyzed to determine if the changes are positive and statistically significant. Similar processes and work products are also modified and sufficient data is recorded to understand the context and assist other projects. When appropriate, proposals are submitted to the organization to improve the OSSP.

Scenario 7: Taking Corrective Action When Needed

Scenario 7 (CAR): “Un-Gestalt”

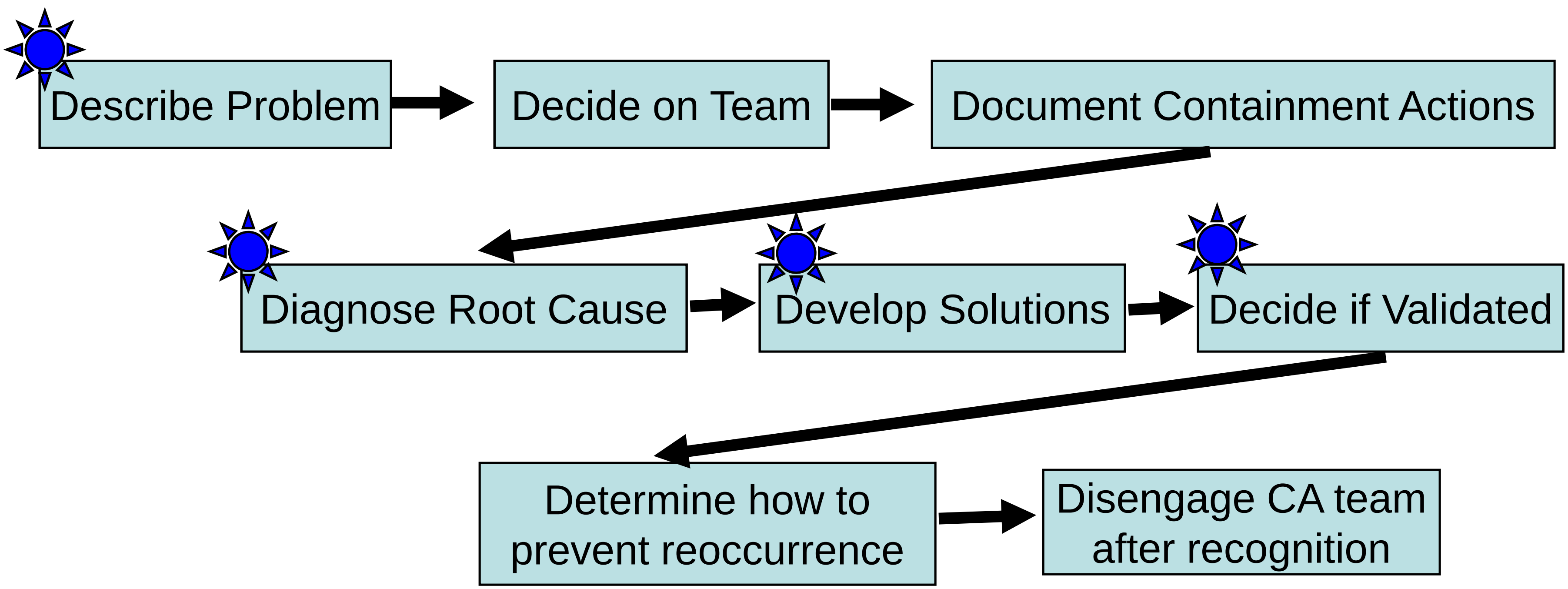
Our projects use pareto analysis and fishbone diagrams to decide which problems are the greatest importance to tackle.

We work very hard to resolve all defects and process issues. There are so many of them, that we seem to be expending all of our time resolving defects and issues.

With the volume that we have, we have now decided to staff more engineers throughout the project’s lifecycle to handle the workload.

Scenario 7 (CAR): "Gestalt"

Our project uses a closed-loop corrective action process similar to the Ford Global 8D process. We have modified the process to make specific uses of process performance baselines and models at the points indicated:



Scenario 7 (CAR): "Gestalt"

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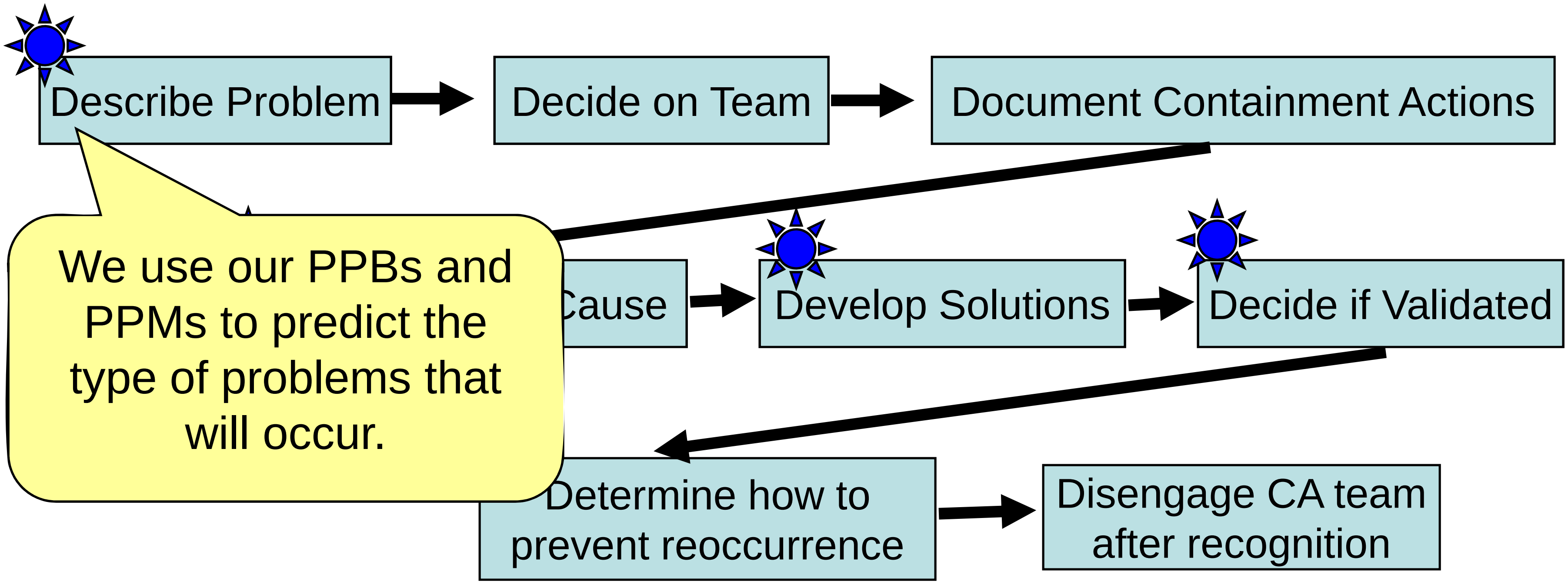

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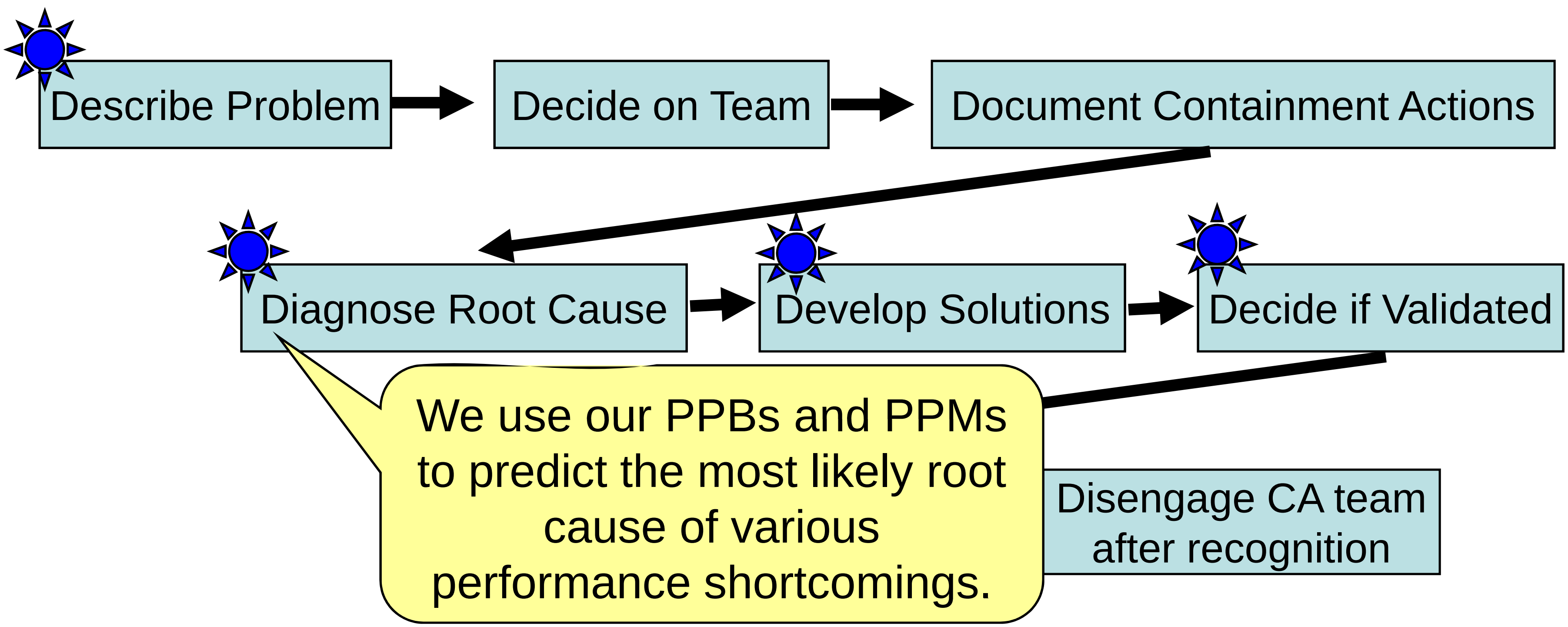

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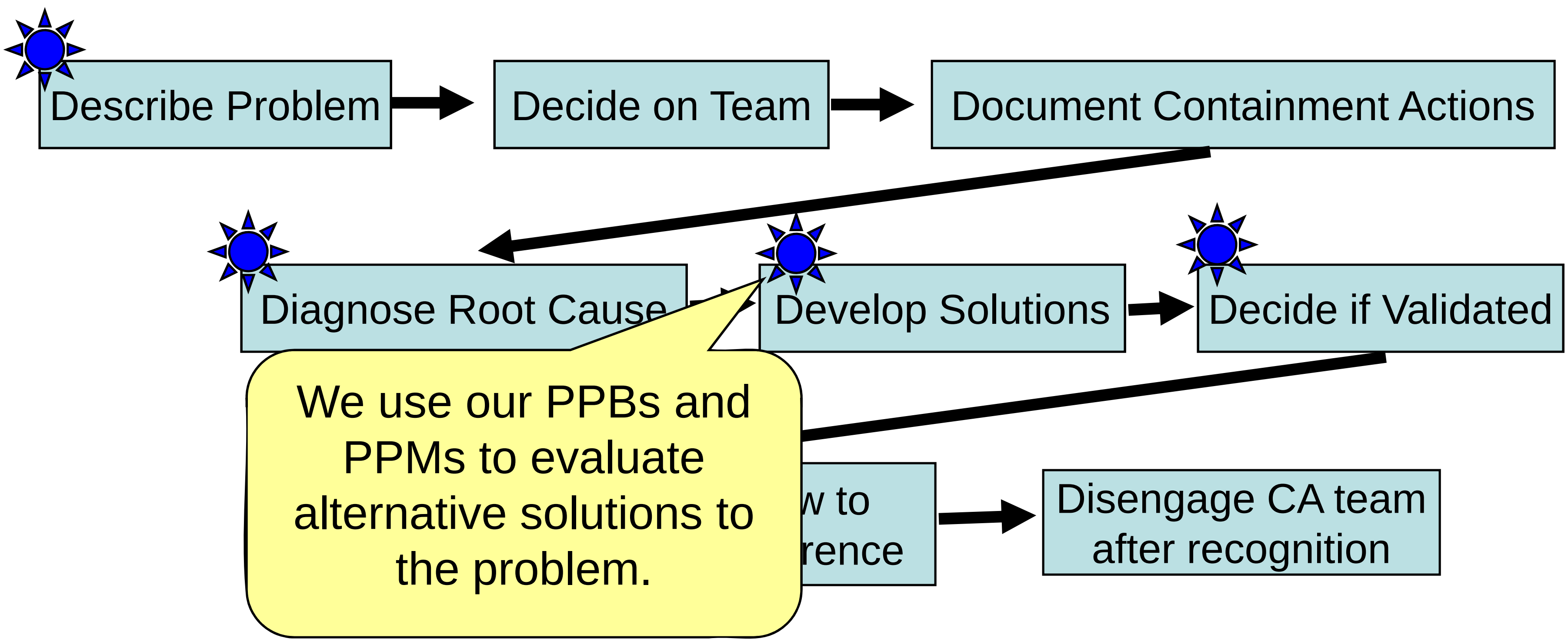

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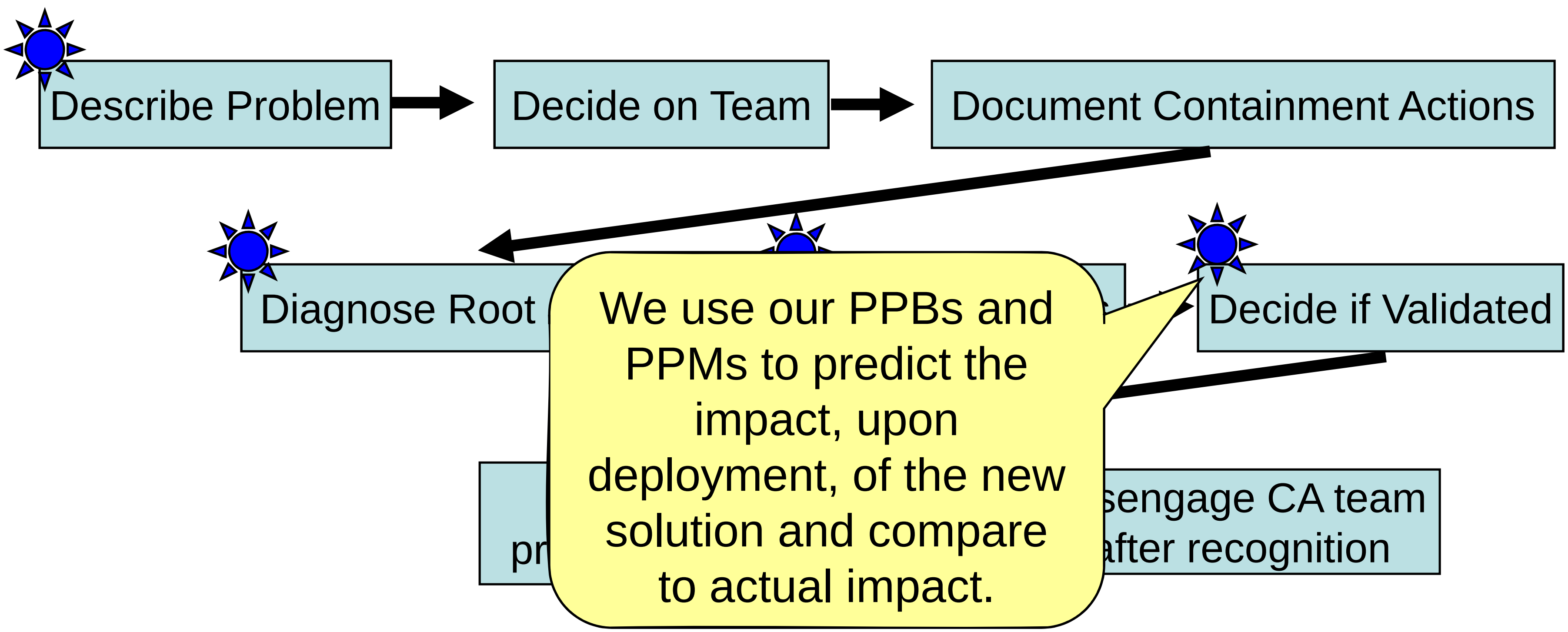


OID SG 1 Select Improvements

Process and technology improvements, which contribute to meeting quality and process-performance objectives, are selected.

OID SP 1.1 Collect and Analyze Improvement Proposals

Collect and analyze process- and technology-improvement proposals

Put the process and technology improvement proposals in a spreadsheet, think about each one, and tag with a plus if you think it will improve or a minus if you think it will decrease quality and process performance.

Collect improvement proposals and analyze for costs, benefits, and risks. Select those that will be piloted. Document the results of analyses and selection. PPMs may be used to predict effects of the change to the process, the potential benefits, evaluate side effects, and evaluate the effects of multiple interrelated improvement proposals.

OID SP 1.2 Identify and Analyze Innovations

Identify and analyze innovative improvements that could increase the organization’s quality and process performance.

Identify improvements that seem to be “out of the box” and look like they will increase quality and process performance.

Actively seek, both inside and outside the organization, innovations to improve processes and product technologies and analyze them for possible inclusion, predicting cost on benefits (using PPMs). Use PPMs and PPBs to analyze the OSSP and identify areas or targets of opportunity for change. Submit improvement proposals for changes that are predicted to be beneficial. Select those to be piloted.

OID SP 1.3 Pilot Improvements

Pilot process and technology improvements to select which ones to implement.

Try the improvements or use someone else’s results and see which ones might be selected.

Plan the pilot including documenting the criteria for evaluating the success or failure of the pilot. Select pilot environments that are representative of the typical use of the improved process and/or technology. Evaluate the results using the documented criteria. This will typically involve the use of PPMs to see if the processes behaved as predicted and PPBs to see it the change is statistically significant (through the use of hypothesis testing).

OID SP 1.4 Select Improvements for Deployment

Select process and technology improvements for deployment across the organization.

Pick the improvements to be deployed across the organization.

Prioritize the improvements for deployment (typically involves evaluating the predicted ROI from PPMs and other factors such as availability of resources, impact, etc.) and begin to determine a deployment strategy.

OID SG 1 Select Improvements

Process and technology improvements, which contribute to meeting quality and process-performance objectives, are selected.

Improvements that appear to help us meet our goals are selected.

The improvements which will contribute most to achieving the organizations objectives, provide the best ROI and most desirable impact, and can be accomplished with available resources will be chosen.

OID SG 2 Deploy Improvements

Measurable improvements to the organization's processes and technologies are continually and systematically deployed.

OID SP 2.1 Plan the Deployment

Establish and maintain the plans for deploying the selected process and technology improvements.

Schedule the deployment of the improvements and update the schedule as necessary.

Determine modifications necessary for deploying the new/revised process to the projects' environments. Define how the value of the deployed process/technology improvements will be measured. Determine the deployment risks. Devise a plan for the deployment, get commitment from stakeholders, and revise as necessary.

OID SP 2.2 Manage the Deployment

Manage the deployment of the selected process and technology improvements.

Track against the schedule and reschedule as necessary.

Monitor the deployment against the plan and determine that the deployed processes have not adversely affected the ability to meet quality and process performance objectives. Update the appropriate PPMs and PPBs.

OID SP 2.3 Measure Improvement Effects

Measure the effects of the deployed process and technology improvements.

Measure whether people like the change.

Measure the cost and value of the improvement in the deployed process. Through the use of PPMs determine if the predicted performance is being achieved. Use hypothesis testing or other statistical/probablistic techniques of the before and after PPBs to determine if the improvement is statistically significant.

OID SG 2 Deploy Improvements

Measurable improvements to the organization's processes and technologies are continually and systematically deployed.

Measured improvements that help are adopted according to our approved plans.

We have ensured through measurements and analyses that the deployed processes have indeed been systematically and continually improved the process in a statistically significant way.

Scenario 8: Introducing Innovative Change to Organization

Scenario 8 (OID): “Un-Gestalt”

Our organization benchmarks with other companies to stay informed of the leading-edge, innovative concepts

Based on word of mouth and expert opinion, we identify the low hanging fruit new concepts to try out each year.

We pilot all of the new concepts each year that we can afford to.

Hopefully, this will pay off.   It does represent a lot of time and resources.

Scenario 8 (OID): "Gestalt"

Our organization possesses a healthy collection of process performance baselines and models developed over a multi-year period.

With such an arsenal, we are able to use them to first look inward and identify the ripe opportunities for radical improvement and innovation.

1

Once we identify the areas ripe for improvement, we benchmark with external organizations for the types of innovation we need.

Scenario 8 (OID): “Gestalt” - continued

2

As we identify external innovation ideas, we use our baselines and models to evaluate the potential of the ideas. In this manner, we will use our baselines and models to “screen” the ideas to pilot.

Once we identify the ideas to pilot, we use the baselines and models to predict the outcomes we should see.

3

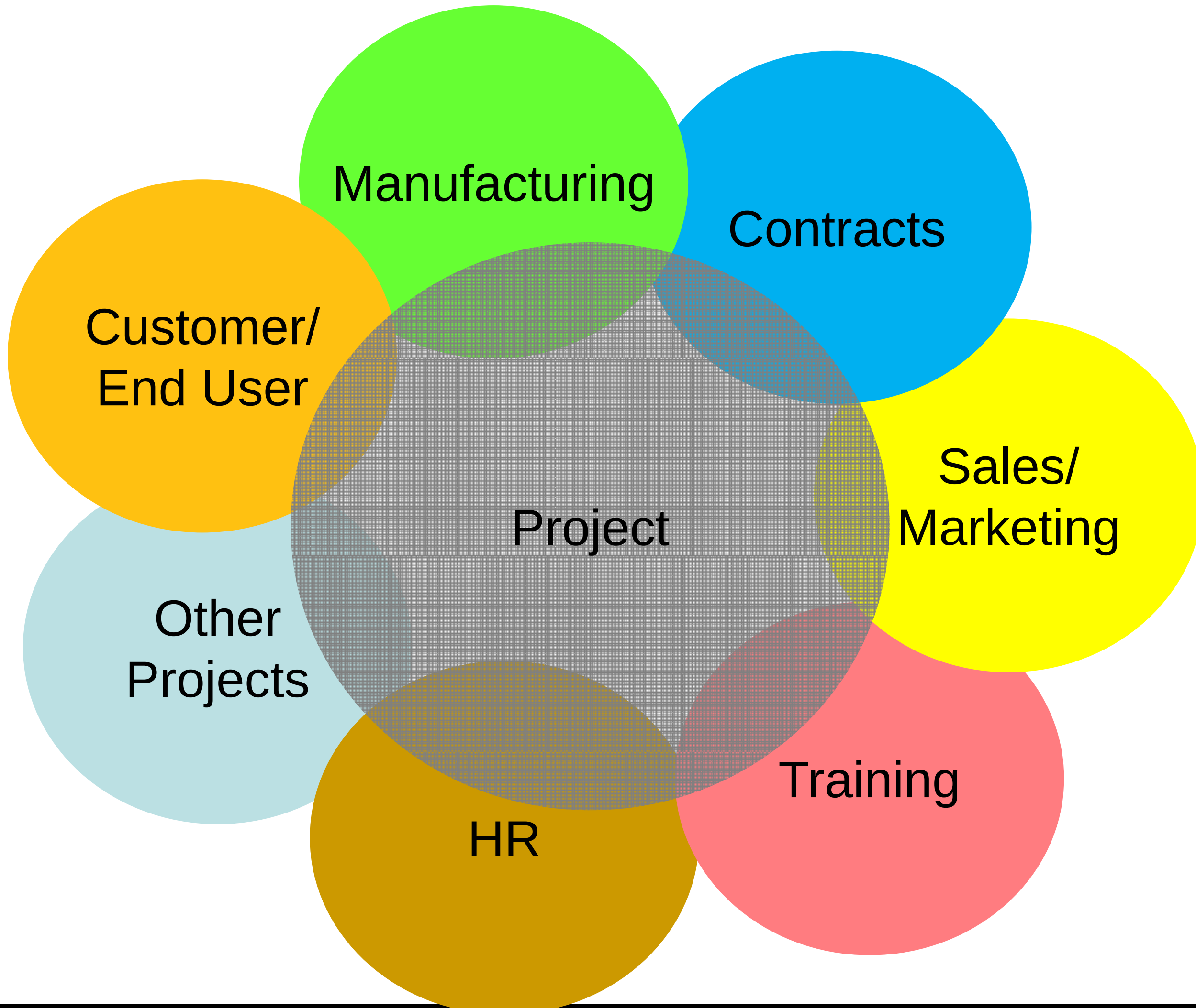
We then pilot and compare the results to our prediction.   We make adjustments as necessary before rollout.

Then we rollout and use baselines and models to track the new subprocess changes during adoption to steady state running.

4

SOME FINAL THOUGHTS

HM Involves and Impacts the Entire Organization



Are you just in it for the number?

That can be a valid business objective

But, it is in all of our best interest to ensure that the number means something

- That means paying attention to the informative
- The richness of the model is in the informative
- The ideas/concepts that add value are in the informative

Without the informative material Levels 4 and 5 add little of even the minimum we all believe they are

If it is not value added, change it

Lack of Data is No Excuse

In fact, it is quite common

And the answer is

Sampling

Can Level 5 be Stagnant?

Can performance and quality improvement be characterized as asymptotic?

Since every one loves “how many” questions

- How many “improvements” must be made to get to and remain at level 5?

Software Engineering Institute | Carnegie Mellon