Milestone
Planning and Research Inc.

A PRIMMS PROJECT MANAGEMENT TUTORIAL

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Quality Gates: A PRIMMS Tutorial

Tutorials 13: Quality Gates

Objectives

Understanding what Quality Gates are and why they are important to project managers

Identifying sufficiency criteria for a Quality Gate

Building a Quality Gate table

Reporting Quality Gate status

Conducting a Quality Gate Review

Data Files

Decision Problems.ppt

Project Beta.mpp

MS Word Quality Gate Paper by Aaron, Bratta and Smith 1993.

Powerpoint Phase Gate Table Example and Template

MS Project Sample Technology Project Schedule

Powerpoint Slip Chart Example and Template

Introduction

As a project manager, you must plan and control scope, schedule, cost and quality in an integrated fashion. Project managers frequently have difficulty in planning and controlling quality and its integration with the scope and schedule. Yet, quality can be the most crucial element to managing a project because quality usually affects all other dimensions of project performance. If quality is not properly planned and executed, the necessary corrective actions and preventative actions required for overall good project management cannot be performed. This tutorial helps project managers develop their skills in managing quality and its integration with scope, schedule and cost by using a tool commonly referred to as Quality Gates. Over the years Quality Gates have taken a number of different names including: stage gates, phase gates and toll gates to name a few. They all refer to basically the same concept.

Understanding Quality Gates

Of the four project management constraints (scope, time, cost and quality), the management of the quality constraint has remained the most elusive for practitioners to plan and control. In many cases, *project quality* becomes an issue only during the latter phases of a project. In those cases quality tends to focus primarily upon the functionality or acceptability of products in testing, working models, or delivered end products. Thus, the quality constraint often holds little relevance until the project manager or team has something tangible that approximates the final deliverable to be submitted to the customer.

Along these lines quality inspections and testing on projects tend to focus in the later phases of a project and primarily upon the final project deliverables or end products that are delivered to the ultimate customer or project sponsor. Check sheets and punch lists are the typical inspection-oriented tools used by the project team during the later phases to document observed defects, nonconformities of the final deliverable to contract specifications or failures to meet customer requirements on specific dimensions.

Final inspection is an important quality tool, but the reliance on a "quality by final inspection approach" holds many pitfalls when applied to projects. Its major shortcomings are that inspection usually occurs too late and seldom includes the examination of the earlier, interim deliverables. It is this lack of rigor in the earlier project phases that lead to larger issues downstream. As a result, we often hear a project manager complain that he or she had been meeting the original schedule and budget objectives early on, but the project fell apart in testing and required substantial *rework* resulting in project inefficiencies, schedule delays and cost overruns.

Experience indicates that similar problems occur when project teams fail to secure sufficient closure to milestones and allow projects to prematurely move forward into subsequent phases of their life cycles. The resulting loss of focus and efficiency can result in chaos as project team members try to do everything at once (e.g. trying to design while testing). This situation is shown diagrammatically as Tutorial decision problems.ppt.

Definition: A Quality Gate is a collection of completion criteria and sufficiency standards representing satisfactory execution of a phase of a project plan. Quality Gates enable a project manager to structure projects in a way that allows the integrated reporting and control of schedule and scope progress against both quality criteria and completion criteria through the entire life cycle. It is the use of Quality Gates that enables project managers to ground their projects in reality during the execution phases of projects and provide clear, unambiguous warnings that the project is not as far along as stakeholders may think.

Quality Gates act as "forcing functions" that protect projects by ensuring that project team members finish first things first and don't get too far ahead of themselves during the execution phases. In addition, without the use of Quality Gates project teams run the risk of performing work out of sequence and trying to complete all the work at once which causes project execution efficiency to plummet putting the project in jeopardy.

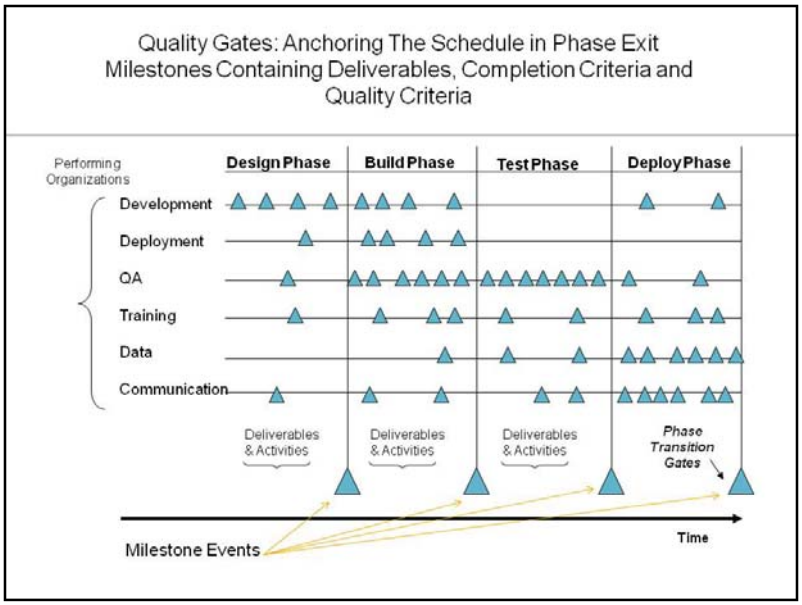
Reference: Read the PMI Quality Gate PMI Whitepaper by Aaron, Bratta and Smith 1993.

Identifying Sufficiency Criteria

The essence of Quality Gates is to anchor milestones in sufficiency criteria. Shown below (Figure 1-1) is a conceptual view of super-milestones and sub-milestones on a project across the time dimension. It is assumed that the life cycle for this example project follows a Waterfall approach containing multiple phases and various organizational functions (tracks of work) that thread through the life cycle simultaneously. The triangles shown reflect milestones. The phase exit points are super-milestones (large triangles) that slice vertically through the diagram and function as Quality Gates. These points represent criterion-based, cross functional events that are deemed complete only when the sub-milestones (smaller triangles) are completed by the various teams (functions) performing the work.

Upon attainment of sufficiency, each sub-milestone contributes to the readiness for exiting a phase. In this regard the sub-milestones (i.e. the criteria) within the figure can be considered "phase exit criteria". The phases are super-milestones (the Quality Gates) reflecting the summation of the individual criteria across the sub-milestones. In practice, the whole is equal to the sum of its parts. Project managers cannot claim credit for a super-milestone (i.e. a Phase exit Quality gate) until sufficiency across all sub-milestones has been reached.

Figure 1-1



Now we advance our discussion from the abstract to a specific example. Shown in Figure 1-2 is an example of a Quality Gate table containing the names of the sub-milestones and their sufficiency criteria needed for exiting a project phase (a super-milestone QR7) on a development project (Alpha Project) in the telecommunications industry.

Figure 1-2

ALPHA PROJECT
QUALITY GATE QR7 STATUS REPORT

Milestones for Implementation Phase	Dept. Head	Total Sufficiency Criteria	Criteria	Total Criteria Met	Baselined Schedule	Forecasted Complete
Capital Expense Authorization Approved - OPS	VAC	1	Yes	1	1/03/93	1/05/93
Development Lab Facilities Available	TG	3	Yes	2	1/15/93	3/25/93
Prototype Hardware Available	TG	2	100%	0	2/01/93	3/20/93
SIT Test Plans Approved	DPS	20	95%	13	2/15/93	4/01/93
95% Pass Rate on Hardware Tests	TG	1	100%	1	3/01/93	3/01/93
Customer Letter of Intent Received	SS	1	Yes	1	3/15/93	1/02/93
Drawings and BOM's Released to Operations	TG	40	95%	38	3/15/93	2/16/93
Controlled Introduction Plan Reviewed & Issued	KC	2	Yes	2	4/01/93	1/02/93
Draft Source Materials to Technical Writing	JAM TG	8	100%	2	4/15/93	4/15/93
Code Inspections Complete	JAM	60	95%	30	5/30/93	5/30/93
	Total	138		90		

Notice in the naming of the sub-milestones in this table the presence of both completion criteria and quality criteria. For instance, the sub-milestone *"Prototype Hardware Available"* references a completion criterion. Sufficiency is reached for this milestone once the corresponding activities on the project plan have been completed. On the other hand, the sub-milestone *"95% Pass rate on Hardware Tests"* references a quality criterion. It is only reached once a sufficient quality level has been met. This requires the meeting of a qualitative standard by the project team and requires more than just checking off a box on a project schedule.

A way to help interpret the sufficiency table for QR7 shown in Figure 1-1 is to keep in mind that in order for the project manager to claim achievement of this entire Phase, the project team must sufficiently complete all of the associated sub-milestones in the phase by reaching a level of readiness as specified by the criteria.

Let's go through the table in Figure 1-2. It contains a total of 10 sub-milestones that have been identified as being necessary for exiting Phase QR7. Each criterion has an identified owner (shown by the initials of a department head); and has an associated number of sufficiency criteria (standards) required for its completion. Collectively the sub-milestones and their completion standards indicate the minimal state of readiness necessary for the project manager to claim completion of the cross-functional, super-milestone QR7. The table also contains space to insert the planned and forecasted dates of sufficiency completion for each sub-milestone.

Building a Quality Gate Table

Building upon the concepts discussed thus far we will construct a Quality Gate table containing the sufficiency criteria needed for successfully exiting a project phase. In real life the project manager, in collaboration with the project team, constructs a separate Quality Gate table for each execution phase of the project. Each table contains the criteria that must be met for successfully exiting a phase of the project. Typically, the team constructs all of these tables (one for each phase) during the Planning phase of the project. Then, the team refines the criteria as the project progresses during the Execution phases. As a phase in a project nears its target completion date, the use of exit criteria becomes all the more important for objective evaluation during a phase exit review meeting with all project stakeholders present.

The steps necessary for building a Quality Gate table are summarized on the next page. In brief these steps are:

- Creating the table template—this will be a blank table that will be used to construct the Quality Gate tables for each phase exit milestone.
- Identifying the phases of the project and preparing to populate the Quality Gate tables with sufficiency criteria for each phase exit milestone.
- Identifying the critical benchmarks for each phase—this refers to capturing the key sub-milestones in each track of work that must be accomplished for claiming completion of the phase —a super-milestone on the project.
- Refining the benchmarks (part 1) by identifying the key deliverables and their required states of completion that point in the project.
- Refining benchmarks (part 2): identifying quality criteria other qualitative criteria that suggests the required state of readiness across the various tracks of work on the project.
- Counting the total benchmark criteria
- Identifying planned dates for reaching sufficiency on each benchmark.
- Documenting forecasted and actual dates of achieving sufficiency on each criterion in the table .

Let’s go through these steps using sample projects on the following pages.

FIGURE 1-3: Building the Quality Gate Table]

Steps	Project Manager Actions
Creating the Table Template	Using a tool such as Excel or Powerpoint, construct the table template that can be used to structure Quality Gate sufficiency criteria for each phase of the project. Each table (one for each phase) will be populated with the appropriate sufficiency criteria necessary for exiting that phase. Each phase will have its own unique criteria. Each table will contain the specific sub-milestones and their readiness criteria needed for phase exit. There will be seven total columns in each table as shown in Figure 1-2.
Identifying the Phases of the Project and preparing to Populate Quality Gate tables phase by phase	There will be a Quality Gate table constructed for each execution phase in your project schedule. The default phase names for many projects follows the *waterfall* which includes Requirements, Design, Build, Test and Deploy phases (in that order). If the project WBS is phase oriented the project manager can identify any phase by rolling up the plan to the highest level of the WBS. See Figure 1-5
Identifying the critical Benchmarks of each phase	Start with the earliest phase and progress to the latest phase of the project. Break out the WBS and the schedule for the first phase in question. Try to identify the key activity completion events that constitute the essence of that phase. List those events in the far left-hand column of the Quality Gate table. These activities become the benchmarks upon completion.
Refining the benchmarks (part 1): Identifying the key deliverables and completion criteria for key sub-milestones.	For the phase in question, identify tangible deliverables (e.g. documents, decisions, and walkthroughs) that result when the activities identified in the plan are completed and validated. The completion of important, tangible deliverables marks progress unambiguously and often makes excellent sufficiency criteria).
Refining the benchmarks (part 2): Identifying Quality Criteria	For the phase in question go back through the list of important deliverables for the phase and determine quality criteria (such as test pass rates) that signify appropriate states of targeted readiness for the project at that point in the project life cycle. Then populate the criteria column of the table with attributes of sufficiency using such terms as percentages, yes's and no's.
Counting the total benchmark criteria	For the phase in question count the total number of completion criteria and quality criteria that are needed for each sub-milestone. Enter this count into the column total. Then review the updated project schedule (i.e. updated with actual completion dates) and count the number of criteria that have already been met to date. Enter these counts into the "Total Criteria Met" column of the table.
Identifying planned dates for reaching sufficiency for each benchmark	Go through the project baseline schedule and identify the target completion dates for each milestone listed in the Quality Gate table. Populate the Quality Gate table with these planned baseline dates. Note: the latest planned milestone date identified becomes the target phase exit date.
Identifying forecasted dates for reaching sufficiency for each benchmark	Perform a critical path analysis of the updated project plan. Identify new early finish dates that are calculated for each of the milestones in the Quality Gate table. Evaluate these new dates good judgment and enter forecast dates into the "Forecast" column. Take note of any forecasted schedule slippage.
Repeat the above process for each phase of the project.	There should be one Quality Gate table completed for each phase of the project.

Creating the Table Template

Figure 1-4 is a suitable format for a Quality Gate Quality Gate table. This table can be created using common tools such as Excel or Powerpoint.

[FIGURE 1-4: Constructing the Table Template]

Benchmark	Resp.	Total	Done	Criteria	Value	Baseline Schedule	Forecast Schedule	Actual Schedule

Let's review the columns of our template. Notice that the far left column contains the title "Benchmark" instead of "Milestone". We have changed the title merely to add clarity. That said, the definitions of our columns are as follows:

Benchmark-This column contains the Work Products and Activities for the Phase (gate) to be considered complete.

Responsible-The organization responsible for leading and bringing the activity to closure

Total -The total number of work products to be delivered for completion of the task

Done -A measure of the work products completed at a given point in time

Criteria- The completion criteria to close out the work product. This can be stated in numbers, percentages or Yes (all)

Value- A measure of the work activity completed against the criteria at a given point in time

Baseline Schedule- Initial scheduled date for completing the benchmark (Note: the latest scheduled benchmark date is the scheduled phase exit date).

Forecasted Schedule- Current estimated completion date for the work product

Actual Schedule - Actual completion date for the work product.

Identifying the Phases of the Project and Preparing to Populate the Quality Gate Tables Phase by Phase

Figure 1-5

	Task Name	Duration	Start	Finish	% Complete	Predecessors
1	Project Beta --------Application Development Project	209.88 days	1/1/2009	10/21/2009	0%	
2	Requirements Phase	20 days	1/1/2009	1/28/2009	0%	
4	Design Phase and Prototype Phase	61.88 days	1/29/2009	4/24/2009	0%	3
57	Final Construction Phase	20 days	4/24/2009	5/22/2009	0%	54
59	Test Phase	40 days	5/22/2009	7/17/2009	0%	57
61	Preparation Phase	6.88 days	7/20/2009	7/28/2009	0%	59
64	Go Live	1 day	7/28/2009	7/29/2009	0%	61
66	Support and Maintenance	60 days	7/29/2009	10/21/2009	0%	64

Figure 1-5 shows the high level WBS of Project Beta, an application development project, using a combination waterfall and iterative development methodology. The view shown in the figure is a roll up of the complete schedule. Each line item reflects a phase of the project requiring a Quality Gate table. In practice we would build a Quality Gate table for the Requirements phase first, and then proceed to the Design and Prototype phase, etc. until all phase tables were completed.

Identifying the Critical Benchmarks for Each Phase

Here we examine the Design phase of Beta project to illustrate how the project manager identifies benchmarks for a Quality Gate table in a project phase. Refer to Figure 1-6 below.

This figure breaks out the project schedule to a lower level for the Design and Prototyping Phase. We look for those critical activities and deliverables that signify the “essence” of the phase. By this we mean those items that must be completed in order for the project to legitimately move into the next phase.

We notice that five *design* elements exist. These are:

Establish Product Design

Design Application Logic

Design Database

Design user Interface

Select Infrastructure components

We also observe that *Unit Test Plans* and *Product Initial Prototype* are important. Collectively the designs, unit test plans and prototype become the critical benchmarks that should be entered into our Quality Gate table for this phase.

Figure 1-6

Task Name	Duration
Project Beta -------Application Development Project	**209.88 days**
Requirements Phase	**20 days**
Design Phase and Prototype Phase	**61.88 days**
Initiate design	**6 days**
Establish business requirement	1 day
Identify stakeholders	0.5 days
Identify key resources and skills	0.5 days
Assess business risks and feasibility	1 day
Establish the business case	5 days
Approval to proceed	0 days
Establish product design	**13 days**
Design application logic	**6 days**
Design database	**8 days**
Design User Interface	**4 days**
Select infrastructure components	**5 days**
Architecture Design Review	0 days
Prepare test plan	**11 days**
Develop unit test plan	**5 days**
Develop integration test plan	**5 days**
Completed product design	0 days
Product initial prototype	12 days
Increment prototype function	10 days
Final Construction Phase	**20 days**
Test Phase	**40 days**
Preparation Phase	**6.88 days**
Go Live	**1 day**
Support and Maintenance	**60 days**

Refining the Benchmarks (part 1): Identifying the Key Deliverables and Completion Criteria for Activities

Having identified the three critical deliverables required for the Design phase exit, we populate these items as Benchmarks into our Quality Gate Table as shown in Figure 1-7. Notice how the wording of the terms imply closure of these deliverables by including terms such as “signed off” and “complete”. As stated these Benchmarks constitute the completion criteria in the Total and Criteria columns of the table.

Figure 1-7

Quality Gate Table for Project Beta-Design and Prototyping Phase
04/25/09

Benchmark	Resp.	Total	Done	Criteria	Value	Baseline Schedule	Forecast Schedule	Actual Schedule
Prototype Demonstration Signed off	Dev	1	1	Yes	Yes	4/24/2009		4/24/2009
Design documentation complete	Dev	5	5	100%	100%	4/2/2009		4/15/2009
Unit Test Plans Complete	SIT	25	23	100%	92%	4/15/2009	5/1/2009	
Total Benchmarks = 3		31	29	--	--	--	--	--

Refining the Benchmarks (part 2): Identifying Quality Criteria

Next, we review our Benchmarks and add needed quality criteria. Refer to Figure 1-8. During his analysis the project manager realizes that all major design issues should be closed before the Design phase should be considered complete. So, accordingly, the project manager adds the quality Benchmark *Severity 1 and 2 Design Issues Closed* to the table as shown below. In this case 36 of the total 47 design issues are closed (77%). However, all 47 design issues need to be closed for phase exit.

Figure 1-8

Quality Gate Table for Project Beta-Design and Prototyping Phase
04/25/09

Benchmark	Resp.	Total	Done	Criteria	Value	Baseline Schedule	Forecast Schedule	Actual Schedule
Prototype Demonstration Signed off	Dev	1	1	Yes	Yes	4/24/2009		4/24/2009
Design documentation complete	Dev	5	5	100%	100%	4/2/2009		4/15/2009
Unit Test Plans Complete	SIT	25	23	100%	92%	4/15/2009	5/1/2009	
Severity 1 and 2 design Issues Closed	Dev	47	36	100%	77%	4/24/2009	5/5/2009	
Total Benchmarks = 4		78	65	--	--	--	--	--

Counting the total Benchmark Criteria

As a next step we sum up the criteria totals and develop an exit criteria status metric for each benchmark within the project phase by counting the total number of benchmarks required for phase completion and comparing that number with the actual number achieved to date.

Identifying Planned Dates of reaching Sufficiency for each Benchmark each phase

By examining Figure 1-8 above closely we see that the latest planned finish date for our benchmarks in the table is 4/24/09. This date then becomes the official Baseline phase target phase exit date on our project plan. Refer to Milestone #2 on the chart shown on the following page (Figure 1-9). You will notice that this date becomes the official target completion date for the milestone. This date takes on significance because it is anchored in sufficiency criteria suggesting that its completion will indicate achievement for the project unambiguously.

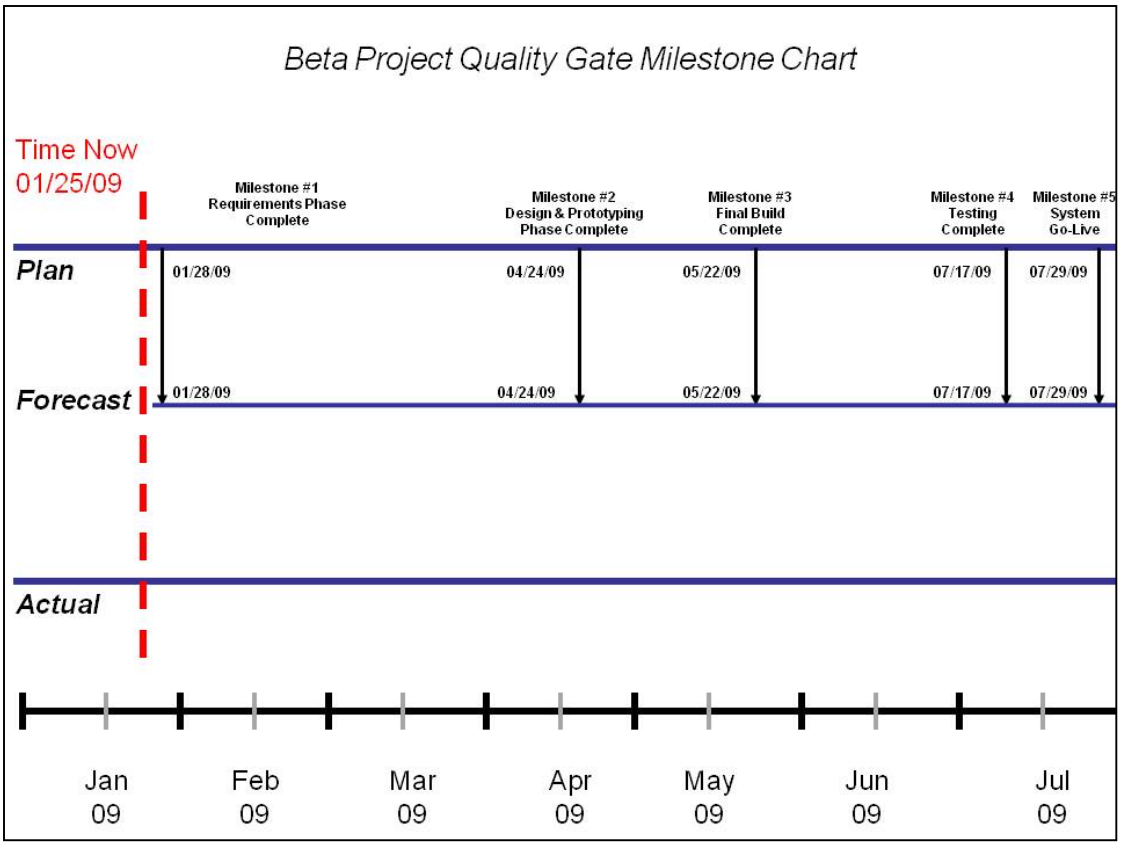
Repeating the process for each phase of the project.

This same series of steps must be performed for each phase exit milestone on the project . The phase exit dates are then summarized on the Milestone Chart (slip chart) as shown in Figure 1-9 shown on the following page.

Reporting Quality Gate Status

Figure 1-9

This is a tool called a Milestone Chart or a "slip chart" that provides a visual status for completion of criteria for Quality Gates (i.e. phase exit milestones) as well as a forecast (i.e. a current plan). In our example project there are five milestones (M1 through M5) that must reach sufficiency. Milestone M1, Requirements Phase Complete, is scheduled to meet sufficiency on 01/28/09. As shown in the figure below based upon



performance to date milestone M1 is forecasted to meet sufficiency on schedule, hence the vertical line from plan to forecast. In addition the remaining milestones are also forecasted to meet sufficiency on their planned target dates. From this status report management should conclude that as of time now (01/25/09) this project is on schedule.

In Tutorial 19 we will use the slip chart as a tool to control the project by giving early slippage warnings that the project is in jeopardy of meeting milestone sufficiency on the planned dates.

Conducting a Quality Gate Review

Once the project enters the execution phases, the project manager attempts to focus the team on completing near term milestones. On a daily to weekly basis the project manager monitors performance by the team and enters performance information on the project scheduling tool (refer to figure 1-10 below). As the project approaches an upcoming phase exit date, the project manager schedules a meeting with all stakeholders to attend a Phase exit review meeting where the Quality Gate table is discussed and populated and the Milestone Slip Chart is modified to provide official schedule status of the project.

In order for this process to work there must be correspondence between the project schedule, the Quality Gate Table and the Slip Chart.

Milestone Slip Chart that is posted publicly after each Phase exit Readiness Review.

The chart shows that the forecast is either anticipating on time completion of future milestones or anticipated slippage.

It is the process of collecting this information from stakeholders that causes corrective action and preventative actions to occur.

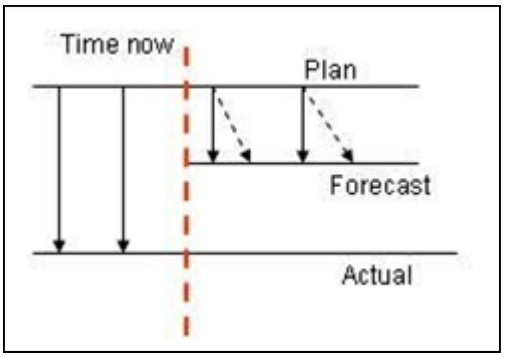


Figure 1-10

Quality Gate Table that is updated at Phase Exit Readiness Reviews

Quality Gate Table for Project Beta-Design and Prototyping Phase
04/25/09

Benchmark	Resp.	Total	Done	Criteria	Value	Baseline Schedule	Forecast Schedule	Actual Schedule
Prototype Demonstration Signed off	Dev	1	1	Yes	Yes	4/24/2009		4/24/2009
Design documentation complete	Dev	5	5	100%	100%	4/2/2009		4/15/2009
Unit Test Plans Complete	SIT	25	23	100%	92%	4/15/2009	5/1/2009	
Severity 1 and 2 design Issues Closed	Dev	47	36	100%	77%	4/24/2009	5/3/2009	
Total Benchmarks = 4		78	65	--	--	--	--	--

	Task Name	Duration	Baseline Start	Baseline Finish	% Complete	Actual Start	Actual Finish
1	Project Beta ------Application Development Project	209.88 days	1/1/2009	10/21/2009	0%	NA	NA
2	+ Requirements Phase	20 days	1/1/2009	1/28/2009	0%	NA	NA
4	Design Phase and Prototype Phase	61.88 days	1/29/2009	4/24/2009	0%	NA	NA
5	+ Initiate design	6 days	1/29/2009	2/5/2009	0%	NA	NA
12	+ Establish product design	13 days	2/5/2009	2/24/2009	0%	NA	NA
20	+ Design application logic	6 days	1/29/2009	2/5/2009	0%	NA	NA
25	+ Design database	8 days	1/29/2009	2/9/2009	0%	NA	NA
29	+ Design User Interface	4 days	1/29/2009	2/3/2009	0%	NA	NA
33	+ Select infrastructure components	5 days	2/25/2009	3/3/2009	0%	NA	NA
38	Architecture Design Review	0 days	3/25/2009	3/25/2009	0%	NA	NA
39	+ Prepare test plan	11 days	2/25/2009	3/11/2009	0%	NA	NA
45	+ Develop unit test plan	5 days	3/12/2009	3/18/2009	0%	NA	NA
50	+ Develop integration test plan	5 days	3/19/2009	3/25/2009	0%	NA	NA
54	Completed product design	0 days	4/24/2009	4/24/2009	0%	NA	NA
55	Product initial prototype	12 days	3/26/2009	4/10/2009	0%	NA	NA
56	Increment prototype function	10 days	4/13/2009	4/24/2009	0%	NA	NA
57	+ Final Construction Phase	20 days	4/24/2009	5/22/2009	0%	NA	NA
59	+ Test Phase	40 days	5/22/2009	7/17/2009	0%	NA	NA
61	+ Preparation Phase	6.88 days	7/20/2009	7/28/2009	0%	NA	NA
64	+ Go Live	1 day	7/28/2009	7/29/2009	0%	NA	NA
66	+ Support and Maintenance	60 days	7/29/2009	10/21/2009	0%	NA	NA

Project Schedule that is updated with actuals daily and weekly.