Module Eight: Project Monitoring and Control

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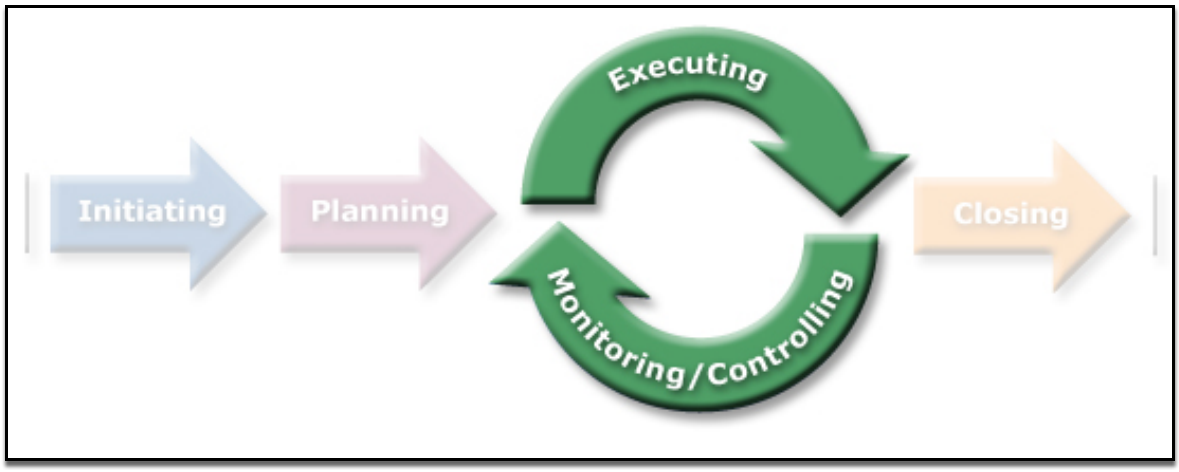
The control tower at Sydney Airport, Australia.

8.01 Learning Outcomes

Module Eight: Project Monitoring and Control



In the Monitoring and Controlling portion of a project, practitioners will watch for any changes that may affect project work or that could disrupt project plans.

As the project team finishes work in the Executing stage, information will be collected that will allow practitioners to compare project progress to the baselines and standards created in the Planning stage. Participants will apply change control, performance reporting, and quality control techniques to help them monitor and guide project work. And they'll keep an eye out for any new risks that could result from events both within the project and outside the project or organization.

Learning Objectives

After completing this module, you should be able to:

1. Assess closure activities needed to effectively close out a project
2. Analyze the role of the project manager throughout the implementation of the project

8.03 Monitoring and Controlling Project Work

Monitoring and Controlling Project Work

Monitoring and Controlling

In the monitoring and controlling stage, as a project manager you are asked to monitor project performance and to make sure there's compliance with project objectives. You and your team compare project progress to baselines and plans, making changes as needed. During the monitoring and controlling phase of a project, you also manage risks as well as overseeing contract compliance and checking vendor performance. You want to make sure that the project meets the acceptance criteria set by stakeholders, customers, or the organization, complies with regulatory, industry, or legal standards, and achieves its quality requirements. Monitoring and controlling activities happen at the same time as executing processes. This overlap of phases ensures that the project is progressing satisfactorily as work is completed.

One important aspect of the monitoring and controlling process is the reporting of project performance to appropriate stakeholders. Effective project managers convene frequent team meetings to review project status and progress. As a project manager, you should communicate regularly with stakeholders, keeping them updated about team progress. You should also give stakeholders and opportunity to provide feedback and discuss project challenges. Often during the monitoring and controlling stage of a project, you may find changes to the project are necessary. You and your project team will need to analyze and consider the impact those changes could make on the project. Project teams use the project charter, baselines, and plans to measure actual performance against planned performance. This comparison helps to ensure that the project continues to meet its objectives. Any deviations from planned performance or any requests to change the project from its initially stated goals should be analyzed for further impact before they can be included or incorporated into project work. Failure to monitor or control change requests can cause significant delays and problems for projects and may derail them entirely. By keeping close watch on these changes, effective project managers keep their projects on track.

As teams run their projects, adjustments to project activities will have to be made to keep the project on course to meet its objectives. When change enters a project, practitioners will need to act quickly to ensure that the change is handled appropriately before it can disrupt project activities. But often the only way to recognize that change has occurred is to monitor and control project work closely.

Monitoring and Controlling project work involves tracking, reviewing, and regulating project progress to ensure that it meets the objectives defined in the project plan. In monitoring and controlling a project, participants will be concerned with:

- Comparing actual project performance against what was planned for in the project plan
- Assessing performance to determine whether action needs to be taken to keep the project on course
- Monitoring changes as they are implemented
- Tracking and analyzing existing risks (and identifying new risks) to ensure that risks do not threaten the project or its deliverables
- Updating project plans and baselines
- Communicating performance reports to appropriate project participants
- Developing and maintaining an information base of project successes and challenges

Monitoring the project involves the collection, recording, and reporting of information about the project. *Controlling* the project is the use of this information to ensure that the project is achieving what it is designed to achieve.

Monitoring and controlling project activities is essential to ensuring an efficient and effective workflow throughout a project. The activities that are implemented here will give a unique and objective perspective on the results produced and the preventive or corrective actions may need to be taken to keep the project on track.

Aligning Work with Project Plans

The project plan will act as the basis for monitoring project activities and knowing when to take corrective action. By comparing the project plan to actual progress, team leaders can quickly see how well the project is moving:

- They can assess project progress by comparing the work produced, effort, cost, and schedule to the baselines that were created.
- They can use milestones, the project schedule, and the work breakdown structure (WBS) to check performance and to select times for monitoring and controlling efforts.
- They can review the responsibility assignment matrix to ensure that responsible parties are aware of and are completing their work assignments.
- They can monitor and review contractor performance to ensure that the work produced complies with the agreements signed.
- They can review and update the project's risk register to ensure that existing risks are monitored and new risks that could affect the project are detected and planned for.

If Monitoring and Controlling activities reveal that the project is not progressing as it should, practitioners will need to take action and adjust project work to ensure that the project achieves the objectives for which it was designed. These corrective actions may be necessary when any part of the project is not meeting objectives; actions may include changes to expected activity durations, changes in resource productivity and availability, and reactions to unresolved or unanticipated risks. If actions are not taken to remedy issues that rise, the project may fail to meet its goals.

Monitoring Risk

Understanding the changes that could affect a project will help participants manage any risks to the project that may occur. Risks are inherent in any project and new risks crop up regularly. Proactively monitoring risk throughout the project will ensure that risks are identified and reported as early as possible so that action can be taken as needed.

Adding a review of risk register items to regular meetings—at least to daily and/or weekly meetings—and updating this document as needed will ensure that project activities continue to support objectives and satisfy the acceptance criteria that were set for the project's deliverables.

Ensuring Project Alignment

A key benefit from the Monitoring and Controlling activities that are enacted here is that project performance will be measured regularly to ensure that it aligns with the objectives of the project plan. Any actions needed to realign work activities can be quickly implemented and problems can be resolved before they disrupt the project. The activities that are completed at this point will ultimately ensure that the project proceeds smoothly and efficiently to satisfy its intended outcome.

Video Commentary

Monitoring and Controlling

Rich Maltzman

Let's discuss Monitoring and Controlling--this portion of the project.

Time-wise, it's actually almost directly overlapped with executing a project. It's at this point where we're kind of looking at what we're doing while we're doing it. I'd like to use risk as the way to illustrate this.

Early on in Planning, we created a risk register, for example: a list of risks that could occur (both threats and opportunities), a quick description of them, the way we might respond to them, its probability, its impact. This is the kind of thing that we do in risk management. And one of the mistakes I've seen a lot of project managers make is to take that list and put it in their bookcase and forget about it. And they say, "Boy, it's great that we're done with our risk planning." Risk is continuous. Risks can come up at any time in the project, and oh, by the way, the risk treatments that you've put in place may not work or, even worse, the risk treatment or risk response you've put in place may cause new risks. There are many examples of this that you can see, some of which even in the text for this course. So keep in mind that risk is continuous, and risk is one of the ways--I like to illustrate this idea of Monitoring and Controlling. Always be on the lookout for new risks, keep that risk register handy, and understand the ways in which your risk treatments or risk responses may generate new risks or may leave residual risk 'cause they haven't treated the risks properly. Again, I use that as a way to illustrate what is happening during this Monitoring and Controlling process.

The other thing that's going on here is change. Changes are coming in, and you need to look at whether the change and control process you have put in place is serving you well. It's also at this stage where you'll be taking into account performance reporting as different vendors and your internal team is doing their work. You are looking at how things are going. In fact, two ways of looking at this are from the "quality control" perspective as well as the "scope verification" perspective. Those are formal terms that, from a pragmatic standpoint, refer to the "correctness" and the "completion" of tasks or deliverables on the project. So if something gets done, is it really done? That's scope verification. Is it done well enough? That's quality control. And as a project manager during Monitoring and Control, that's what you're looking at. You're looking at all these deliverables and kind of ticking the boxes as they come in. That's the completeness. But also having a look at whether or not these things are being produced in a way that's sustainable for the execution of the process. Again, this overlaps--Monitoring and Controlling overlaps intensely with the Execution phase.

Let me talk for a moment about internal and external contributors to the project. During this Monitoring and Controlling, you are looking at the performance reports coming in from your own project team and checking to see whether they're meeting the expectations. You're also looking at the contributions coming from externally contracted or externally provided work elements. And in that case, you may be invoking contract clauses because you may do scope verification and quality control--in other words, correctness and completeness--and finding that a vendor isn't doing what they need to do. It's at this point where you're going to do the "control" part of the Monitor and Control. You're going to take actions and perhaps switch vendors or invoke a contract penalty.

Overall, this Monitor and Control portion of the project--kind of a strange analogy--it's kind of like pulling away and having an "out-of-body experience" and looking at yourself and the project team and the project work from 30,000 feet--10,000 meters--away. Very subjectively, objectively looking at it from--you know, recognizing also that it's you looking at it--and determining whether changes need to be made based on what you are seeing happening in Execution. But again, since it's happening at the same time, no one else can do it. You have to pull away and, in parallel with the execution, look at how well the project's running.

Rich Maltzman, PMP®, is the Learning and Professional Advancement Leader at a major telecom supplier. A contributor to the *PMBOK® Guide*, 4th Edition, he has co-authored PMP® Exam study guides. He is co-founder at EarthPM, LLC, and along with co-founder David Shirley, PMP®, has authored the book, *Green Project Management: Planet, Projects, Profits, and People*. He received a BSEE from the University of Massachusetts in Amherst and has a graduate degree in industrial engineering from Purdue University.

8.03.1 Exercise: Monitoring and Controlling Fill-in-the-Blank

This assignment does not contain any printable content.

8.04 Risk Monitoring and Controlling

Risk Monitoring and Controlling

An important part of monitoring and controlling any project is managing the risks that could disrupt or derail the project.

Every project entails a certain amount of risk, and that risk must be managed appropriately. To manage risk well, practitioners will need to increase the probability that good events will happen while also decreasing the potential for bad events to occur. Furthermore, because project participants often cannot control whether an event will happen, they'll need to limit the impact of the negative events and increase the influence of positive ones. They'll also need to ensure that existing risks stay within acceptable levels and that adequate responses are detailed for each one.

Reviewing the Risk Register

It is important for project participants to review the items on the risk register frequently and to revise the register as needed. Participants may find that, as their project continues, certain risks are no longer possible or their potential impact has decreased to a negligible level. They might even consider removing these risks from the risk register altogether (although keeping them on the register may help anyone who uses these project records as a guide or template for future projects).

Team members may also discover new risks that they hadn't thought of before, or find that secondary risks occur as they implement risk responses. (A secondary risk is a risk that occurs as a result of the response implemented previously. For example, if a team member decides to modify the surface of a product because it is not aerodynamic enough, he or she may introduce a secondary risk if paint won't adhere to the modified surface.)

Any new risks and secondary risks will need to be analyzed and added to the register, and appropriate responses will have to be developed and assigned to appropriate parties.

Strategies for Addressing Risks

There are several common risk response strategies that can be used to deal with risks. Because a risk can be classified as either a positive or a negative event, the strategies that are employed may try to enhance or reduce the probability and impact of an event.

Strategies for addressing negative risks:	Strategies for addressing positive risks:
Avoid the risk: Take action to completely isolate the project from risk. Teams may choose to avoid the risk by increasing communications or clarifying requirements. They could also change the project scope, schedule, or strategy—or cancel the project entirely—but they may need authorization from a higher authority before taking drastic steps.	**Exploit the risk:** Reduce or eliminate any uncertainty surrounding a positive event, thereby increasing the chances that it will happen. For example, team leaders might allocate more resources to a project to ensure that it is completed on time and at a high quality.

Transfer the risk to another group or organization: Shift the risk to another party by buying insurance, selling bonds, or purchasing warranties and guarantees. Be aware, however, that the performing organization may have to pay the other party to take on the risk responsibility.	**Share the risk with another organization:** Share ownership of a positive event with another party to increase the chances that the event will happen (especially if there are not enough resources to ensure that the event will occur). For instance, an independent film company with budgetary constraints may turn to a larger film studio to help with production or to take on marketing responsibilities.
Mitigate the threat: Reduce the probability or impact of the risk to an acceptable threshold. For example, even if team members know that a bridge may collapse because of a category 4 hurricane, they may decide to delay renovation if they believe they can adequately mitigate the threat by reinforcing the weak parts of the bridge. They may also choose to reduce the impact of the event by closing off the bridge during hurricanes.	**Enhance the opportunity:** Increase the chances that a positive event will occur by maximizing the factors or causes behind the event. For example, if team leaders find that incentive pay improved progress on projects in the past, they may decide to offer incentive pay on a current project to increase the probability that the project will finish early.
Accept the risk: Simply accept the risk if no suitable response can be agreed upon or if the team does not want to change the project plan.	**Accept the risk:** Let the opportunity pass if it cannot actively be pursued.

To run a project effectively, practitioners must proactively manage all project risks throughout the project's life cycle. They must identify and analyze risks, but they must also implement responses and follow-up to ensure that those responses are effective and that they don't cause new risks to the project. Failing to ensure that risk responses are appropriate and implemented correctly can be as harmful to a project as not identifying risks in the first place. And failing to look for and proactively manage risks throughout a project can quickly cause projects to tumble into chaos and drastically reduce their chances for survival.

8.05 The Change Control Process

The Change Control Process

It is likely that change requests have been received as the project team executes its project work but it is important to realize that not all change requests are good for the project. They may not bring enough value to the project to merit inclusion or they may create significant disruption to existing work. It is the responsibility of the project leader or project manager to evaluate calls for change (either individually or as part of a change control team) and implement those that will add benefit to the project work.

Evaluating the Request

The first task for any change control manager (or change control team, if the project organizers decide to convene one) is to review the change request forms that they've received from project participants and evaluate their merit. It is important for all change requests to be evaluated objectively and impartially; by eliminating bias in the evaluation, change control practitioners ensure that only those requests that are good for the project will be incorporated into the project, which helps to foster an environment of trust and inclusion. Also, the change's impact on all of the project parameters must be evaluated; because the parts of a project are interdependent, a change to one part of the project will likely require adjustments in others.

If team members decide that a change is necessary, they'll then have to determine if the change is possible, given the project's existing plan. Is there enough time in the schedule to enact the change? Are resources available to implement it? Is there enough money in the budget to pay for the change? If the change is essential to the project, the team may have to find a creative way to implement it, or they may have to change the plan to accommodate it.

Informing Interested Parties

Regardless of whether the team decides to accept or reject the change, it is important to inform the people who submitted the request of the team's decision. Replying to all requests assures those involved that their requests have been heard and evaluated appropriately. If participants think that their requests are being ignored, they may take matters into their own hands and make changes without telling anyone.

Directing and Recording Changes

It is also very important to ensure that *all* change requests are funneled through the change control process.

Channeling changes through the process ensures that requests are fully analyzed and incorporated in a way that limits disruptions to the flow of the project.

Project managers must be sure to update their records to reflect any implemented changes and to communicate significant changes to the appropriate stakeholders to ensure that there are no surprises when projects are evaluated and reviewed.

An efficient change control process evaluates and implements changes that bring value to a project while also rejecting those requests that could disrupt project work. It ensures that everyone associated with the project understands the decisions made and provides a record to explain why a project's end results may differ from initial expectations. Effective change control prevents many of the project delays, cost increases, and quality problems that can plague projects and eliminates the frustration that team members may feel if change management is handled inefficiently.

Video Commentary

Managing Real World Projects

Change Control

Rich Maltzman

Earlier we talked about change management, which describes how, in general, we will manage change on the project. When it comes to change control, the actual facing of a specific change when it arrives and deciding what to do with it, I think it's really important, pragmatically, for a project manager to step back and look at a change not necessarily as something that's going to be, "Well, It's outside scope. We can't do it. I am the controller of change. I am the protector of scope." And to reject a request for change out of hand.

Here, we kind of act as an agent for the enterprise, stepping back and saying, "Okay, a new aspect of this project is going to be added. It's going to take extra time, it's going to draw on extra resources, and it's going to potentially cost significantly more." Maybe that's a good thing. Maybe that's upscoping that is a big advantage for the company--it's more sales, it's more revenue, it's more work for the company. So instead of thinking proprietarily that we must reject this change because it's out of scope, again, step back, look at the changes as it comes in, decide whether, "Huh...for an additional two weeks of time and an additional $70,000, we can accomplish this change."

I think the change control board will help you do that. I think that a kind of a viewpoint at the enterprise and a more sustainable long-term view as a project manager will help you with these kinds of unbiased decisions. And just look at the changes on their own merits, decide whether they'll add value to the project or not, and make the decision that way.

Rich Maltzman, PMP®, is the Learning and Professional Advancement Leader at a major telecom supplier. A contributor to the *PMBOK® Guide*, 4th Edition, he has co-authored PMP® Exam study guides. He is co-founder at EarthPM, LLC, and along with co-founder David Shirley, PMP®, has authored the book, *Green Project Management: Planet, Projects, Profits, and People*. He received a BSEE from the University of Massachusetts in Amherst and has a graduate degree in industrial engineering from Purdue University.

8.05.1 Minicase: Managing the Change Control Procsess

This assignment does not contain any printable content.

8.06 Reporting Performance

Reporting Performance

As a project team runs its project, project managers will be expected to report on the team's performance to interested stakeholders. To provide useful reports, team members will need to monitor their performance closely and update the project manager with timely information; the project manager will then need to summarize any important information in a style and format that will meet the needs of his or her audience. The reports presented to stakeholders should document project performance and describe any inconsistencies or problems that the team may have encountered. They'll need to discuss the impact of any discrepancies between expected performance and actual performance and explain any plans that have been made to correct these discrepancies or to mitigate their impact.

Completing Project Review Reports

To adequately report on project performance project managers will need to collect information about the ongoing work of their project and distribute it to the appropriate parties.

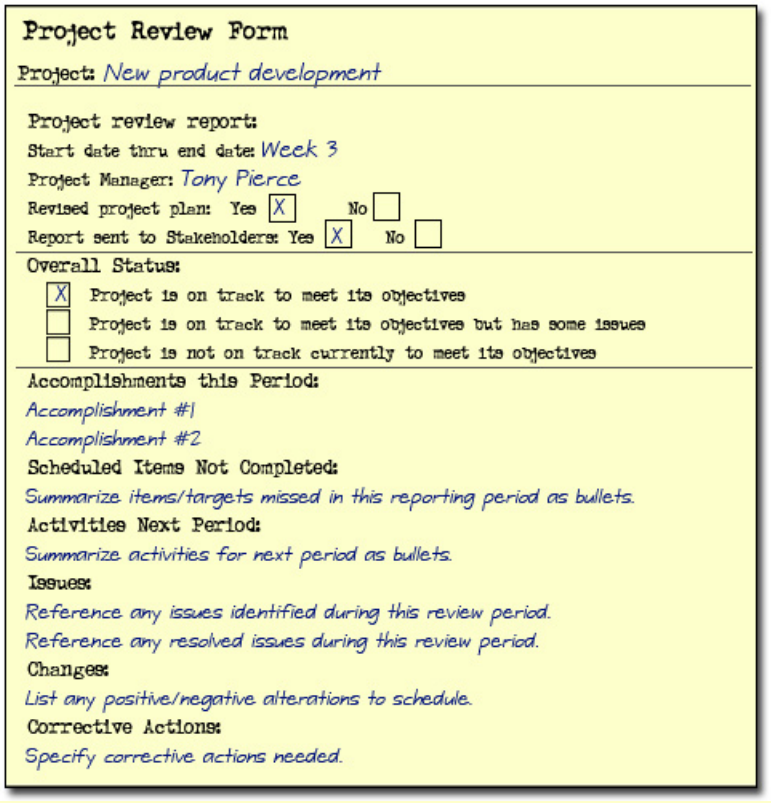
A project manager should expect team members to take responsibility for tracking their own work and reporting progress in daily, weekly, or biweekly activity status updates. Once this data has been collected, the manager will need to produce a report that highlights important performance information. This status report should include:

- Scheduling information: Which activities did not run as planned? Which tasks took shorter or longer than expected?
- Cost updates: Which tasks went over or under budget?
- Comparisons of effort: Did the effort expended to complete tasks match estimates?
- Risk updates: Which risks occurred and what new risks should be considered?

When a project manager presents this information to stakeholders, he or she should consider placing the information that is most critical to the audience at the top of the form; highlighting this information in this way will increase its visibility and reinforce its importance.

The performance reports created can be either complex, detailed documents or simple, targeted reports but they should summarize work performance to a level of detail that makes sense for each stakeholder. While some stakeholders may need to know specific details about project work, others may just need to know that the project is on track or that additional resources were needed to complete activities as planned. Whatever format is used to present information, it should compare expected performance to actual results and discuss the impact of any discrepancies. Tracking project performance against the project baselines and other documents created in the Planning stage will help expose variations in problems as they arise. A project manager can then work with the project team and key stakeholders to address these problems and realign project work with expectations.

An example of a project status report is presented below.



Project Review Form

Project: New product development

Project review report:
Start date thru end date: Week 3
Project Manager: Tony Pierce
Revised project plan: Yes [X] No [ ]
Report sent to Stakeholders: Yes [X] No [ ]

Overall Status:
[X] Project is on track to meet its objectives
[ ] Project is on track to meet its objectives but has some issues
[ ] Project is not on track currently to meet its objectives

Accomplishments this Period:
Accomplishment #1
Accomplishment #2
Scheduled Items Not Completed:
Summarize items/targets missed in this reporting period as bullets.
Activities Next Period:
Summarize activities for next period as bullets.
Issues:
Reference any issues identified during this review period.
Reference any resolved issues during this review period.
Changes:
List any positive/negative alterations to schedule.
Corrective Actions:
Specify corrective actions needed.

Presenting Information in Status Meetings

When presenting performance reports, project managers should begin by focusing on good news that publicly acknowledges the team's hard work. Visual tools and graphics should be used to show progress and to display accomplishments. By providing an open acknowledgment of achievements, project managers can recognize team success and enhance motivation by helping team members feel connected to the project and its goals.

If an issue requires further investigation, project team leaders should be sure to track any necessary action items on a spreadsheet and assign them to team members for follow-through. Leaders should allow assigned team members to discuss progress on the action items during team meetings and to request help in completing assignments if needed.

Performance reports allow project leaders to distribute information as needed to interested participants but these leaders may want to be selective in the types or amount of information that they broadcast. If there is any performance information that needs immediate attention, leaders and managers might want to consider using a form of push communication to present this information to stakeholders; pushing information directly to stakeholders may increase the likelihood that information will be read quickly and acted on with more urgency.

8.06.1 Best Practices: Performance Reporting

Best Practices: Performance Reporting

As mentioned previously, project status reports should present project information at a level of detail that makes sense for its intended audience. Often, this means that these documents should include detailed or in-depth material for well-informed participants and team members.

Examples of this type of more-extensive material may include:

For those stakeholders with an advanced knowledge of earned value management, status reports may include details such as cost variance/cost performance index numbers, schedule variance/schedule performance index data, critical ratios, and project forecasting data (e.g., estimate at completion, estimate to complete, and to-complete performance index information). This will help those knowledgeable stakeholders better understand the project and its progress.

Status reports may include details about project risk, including changes in the levels of risk on the project, trends that may

suggest upcoming risks, a discussion of new risks that have been uncovered, the results of any implemented risk responses that have been put into effect, and risks that have "passed" and are unlikely to occur. The project's risk register (and any supporting documentation) should be updated to reflect any new information that is discussed or included in status report meetings.

Practitioners may want to spell out any specific project changes that have occurred since the last status report was presented. These may include changes to deliverables, changes to team makeup, and/or any other changes that are deemed important. This may also include any changes authorized and/or rejected by the change control board.

Status reports may also include a discussion of work completed since the last status presentation. This discussion may be detailed or kept at a high level, depending on the audience and their level of interest and understanding.

8.07 Performing Quality Control and Quality Assurance

Performing Quality Control

One of the important parameters that project practitioners will have to track and report on is the project's quality.

To track and control quality proficiently, participants need to assess project results and make any necessary changes to improve performance. They'll have to monitor quality issues for both products *and* processes throughout the life of the project and find actions that they can take to correct any issues they uncover.

Measuring quality is really about measuring the extent to which results (which can include project management outcomes like how well the project adhered to the scope or cost baseline) conform to the quality standards that were set. Product quality and work performance will have to be compared to expectations for the project, and root cause analysis will have to be employed to identify the reasons behind the problems encountered. Once these underlying reason(s) have been uncovered, solutions can be proposed that will eliminate the issues on the project.

Video Commentary

Quality: The Customer Perspective

Gina Abudi

Think of quality... Quality in management applies to all projects. It doesn't matter what the project is, but quality management should be looked at from the perspective of the customer satisfaction. So what is quality to the customer, to your stakeholder? What is satisfaction to them? What do they want to see in the project? And that's the quality that you're striving for. That's the quality you're looking at.

When you look at quality from that perspective, you're looking at it from the perspective of prevention, rather than having to rework, so if I know what my stakeholders want in quality from their perspective, because everybody has a different perspective of quality, I understand what to strive towards, and I understand how to work with my team members to make sure that they're keeping quality of that project in mind.

The more complex and strategic a project is, the more likely there's a very rigorous quality control process in place. Smaller projects may not have as rigorous a quality control process, but don't assume quality's not important. Again, think of what is quality from the perspective of your stakeholder, your sponsor, your customers, and then that is the quality you're measuring against.

Gina Abudi is President of Abudi Consulting Group, LLC. Gina presents at various conferences, forums, and corporate events—including the PMI® Global Congress—on developing a project management best practice. She was honored as one of the Power 50 from PMI®. She has served on the PM Summit/BA World Advisory Board and

has served as Chair of the PMI® Global Corporate Council Leadership Team. Gina received her MBA from Simmons Graduate School of Management and is President of the PMI® Mass Bay Chapter Board of Directors.

Quality Control Tools

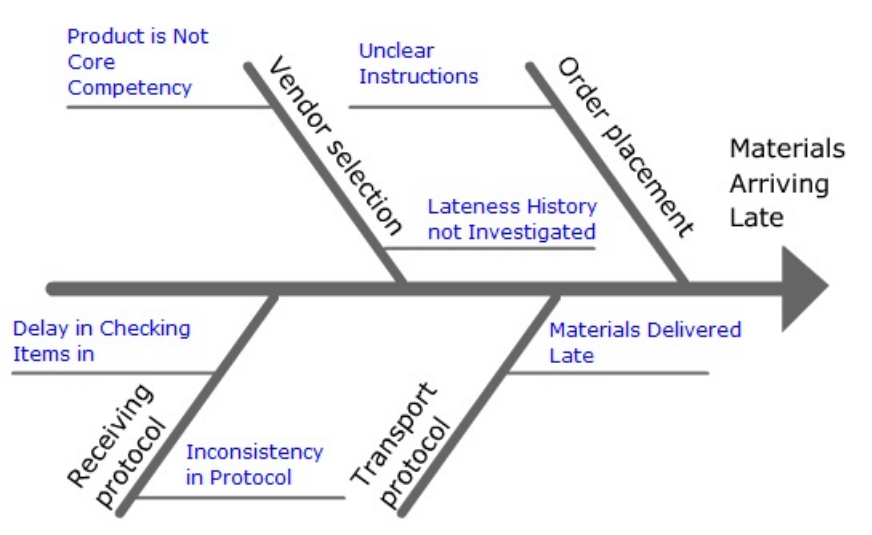
There are several tools and techniques that can help project teams see how well their project conforms to its objectives.

Cause-and-effect diagrams

A cause-and-effect diagram (also called an Ishikawa diagram or a fishbone diagram) helps team members identify the root causes for the problems on their project. Once all of the contributing causes are mapped, *why* or *how* something happened should become apparent.

To create a cause-and-effect diagram, participants will first have to identify the correct problem to study and place it as a problem statement at the end of the diagram. They'll then fill out the "nodes" or "branches" on the diagram, arranging the causes of that problem according to their level of importance or detail. By moving from the problem statement back through each line of causality, they'll develop a hierarchy of events that leads from the problem to the underlying root causes of that problem.

An example of a cause-and-effect diagram is below.



In some instances, practitioners may be able to combine some relatively empty branches on the diagram or move causes to other places on the diagram. By contrast, they might have to break overcrowded clusters into separate lines of causality.

Once the diagram is complete, team members should be able to visualize root causes that warrant further investigation and agree on how to address them immediately.

Checksheets

A checksheet is a structured form or table that practitioners use to count how many times an event or problem happened, or to record when or where something happened.

Checksheets are easily adapted to any need and can be as simple or as complex as necessary. Some teams create simplistic tables to track data in clear-cut categories, while others create more complex matrices or draw pictures of a part or process and keep count of the defects or occurrences directly on the image they created.

CUSTOMER SERVICE CALLS

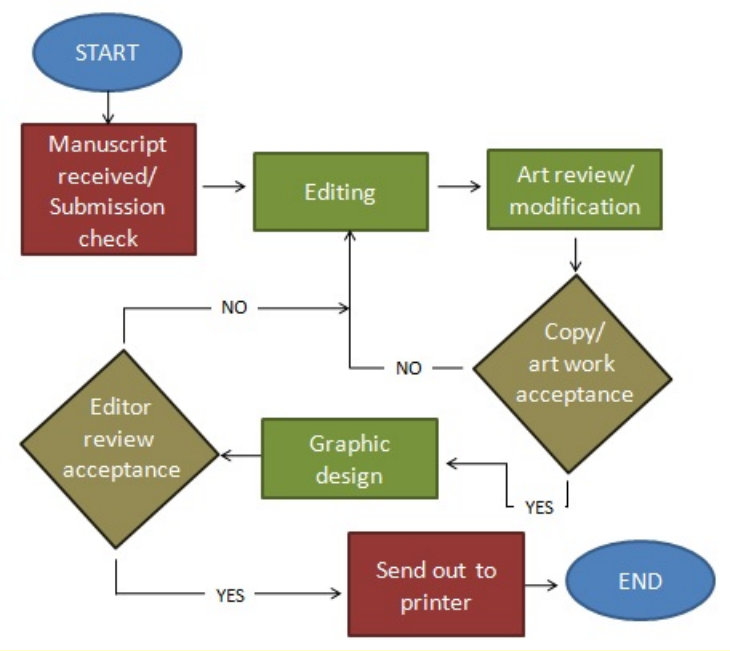
	DATE					
Category	5-Mar	6-Mar	7-Mar	8-Mar	9-Mar	TOTAL
Product Features	𝍸 III	𝍸	𝍸 II	IIII	𝍸 III	32
Product Availability	𝍸 I	𝍸 I	𝍸	𝍸 II	𝍸 I	30
Product Problems	III	IIII	III	𝍸	III	18
Cost	𝍸	IIII	𝍸 II	𝍸	𝍸	26
Billing	𝍸 𝍸	𝍸 III	𝍸 𝍸	𝍸 III	𝍸 𝍸 I	47
Other	𝍸 II	𝍸 I	𝍸 II	𝍸	𝍸 IIII	34
TOTAL	39	33	39	35	42	

Flowcharts

Flowcharts show the relationships and interfaces between project activities. To create a flowchart, participants will first define the process boundaries by picking the beginning and end points, then clearly define the relationships of all of the steps within those boundaries.

Flowcharts can be either high-level or very detailed. Reviewing an existing flowchart might show what steps are allowing poor quality to enter a project, or it might show where quality monitoring and control activities can be placed to ensure that issues are resolved before work progresses.

The image below is a portion of a flowchart, using standard rectangles for operational steps and diamonds for decision points. Ovals serve as the process' start and end points, and arrows show the process sequence.

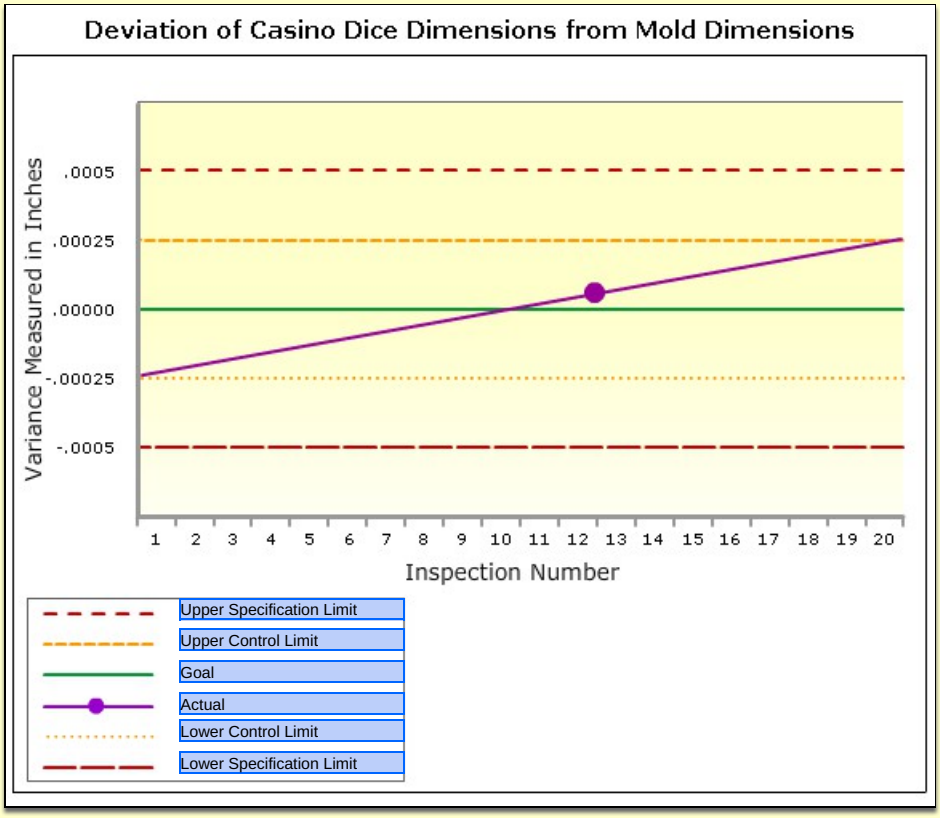


Other flowchart symbols that can be used include a circle with a letter inside to indicate that the flow continues elsewhere at a matching letter or symbol, and a rhombus to indicate material entering or leaving the system. Whatever symbols are used, it is important to ensure that the flowcharts developed match the level of complexity needed for the project and are clearly understood by everyone involved.

Control charts

A control chart is a graphic display that shows whether the data for a repeated process stays within preset limits over a period of time. Upper and lower limits on the chart show measurements or values that the data cannot exceed; if its data points fall outside of these limits, the project is not meeting expectations and corrections must be made.

Once changes are made, the chart can be used to determine whether the changes eliminated inconsistencies and corrected the problem.



The **upper specification limit** shows the maximum positive variation from the goal allowable before the project will be rejected by the customer. It is usually based on stipulated limits imposed by the contract.

The **upper control limit** shows the maximum positive variation from the goal allowable before the project manager should take action. It is usually set by the project manager or the organization.

The **goal** or mean line shows the planned or ideal value. Ideally, all datapoints would be on this line.

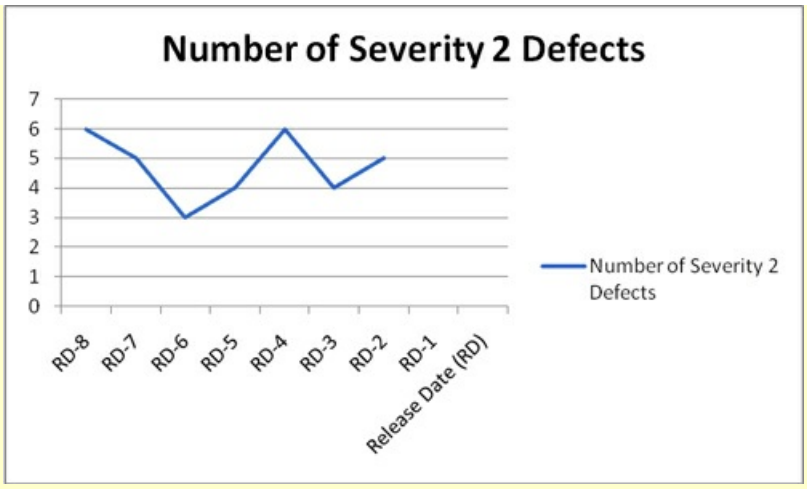
The **actual** value is the actual value of the characteristic being measured.

The **lower control limit** shows the maximum negative variation from the goal value allowable before the project manager should take action. It is usually set by the project manager or the organization.

The **lower specification limit** shows the maximum negative variation from the goal allowable before the project will be rejected by the customer. It is usually based on stipulated limits imposed by the contract.

Run charts

Run charts are similar to control charts, but they are more focused on observing process performance over the long term than controlling or correcting processes in the short run. Run charts are particularly helpful to show how many products have errors or how much variation a process is encountering over a period of time. Run charts also help team members see how quickly any corrections made in response to variations have resulted in improvements in quality.



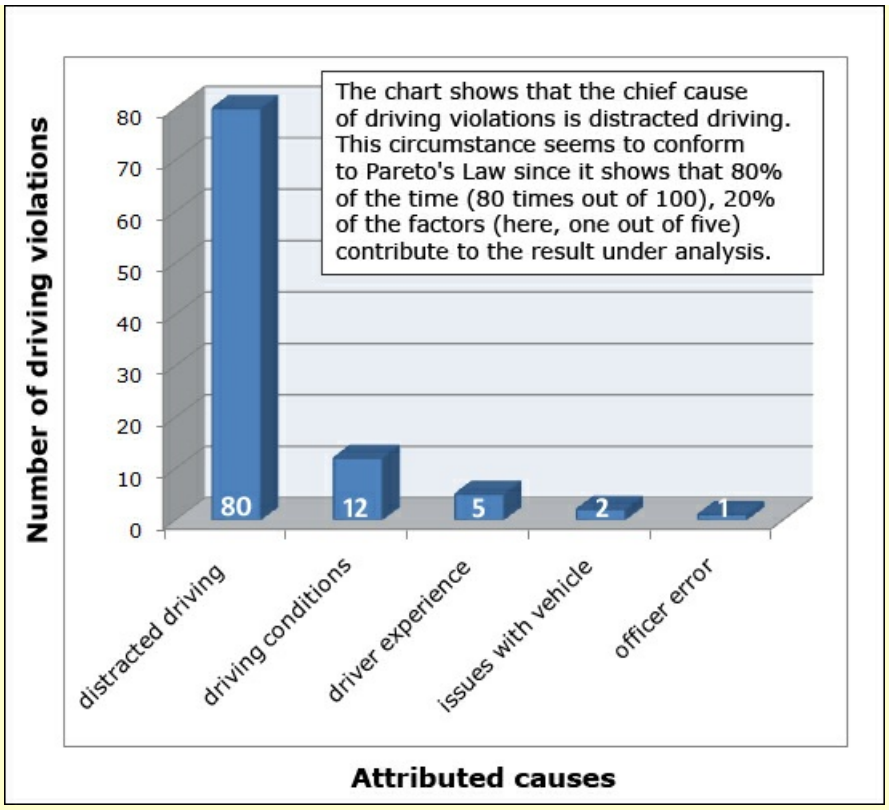
Run charts can also be used to chart performance; by comparing target performance rates with actual rates, the team can quickly see if performance aligns or deviates from plans. If the chart shows that performance has deviated from what was planned, analysis of the problem will be required to find the cause of the variance.

Histograms

A histogram is a basic bar chart that shows how often things occur and if there are categories that these occurrences can be sorted into. Each bar in the histogram represents a product quality or a contributing cause of variation in a process; a review of the histogram will show how often a variation (or category) occurred and how often it was attributed to each of the several identified causes.

Pareto diagrams

A Pareto diagram is a type of histogram that sorts variables (or the reasons for those variables) from most frequently occurring to least frequently occurring. Pareto's Law (also known as the 80/20 principle) suggests that 80% of the problems with a product or process can be attributed to 20% of the causes. By correcting the top 20% of causes, teams should be able to eliminate 80% of the problems and make significant progress resolving project issues and improving quality.



Scatter diagrams

Scatter diagrams illustrate possible correlations between a dependent variable and an independent variable. If a dependent variable (the variable that practitioners hope to find a cause for) goes up or down as an independent variable is plotted on the chart, a correlation between the variables may have been uncovered.

Be aware, however, that just because the team has discovered a correlation, that doesn't mean that they've discovered the cause behind it—there may be a "hidden" root cause that is actually causing the correlation between the two observed variables.

There are several correlations that can emerge as shown in the image below.

Slide 1

Strong Positive Correlation

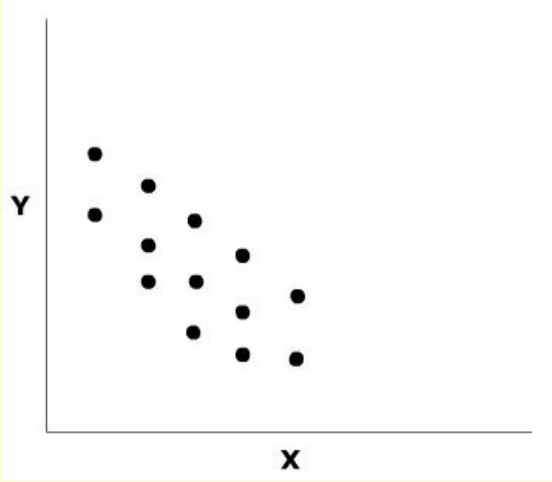
The value of Y **clearly increases** as the value of X **increases**.

Slide 2

Weak Positive Correlation

The value of Y **subtly increases** as the value of X **increases**.

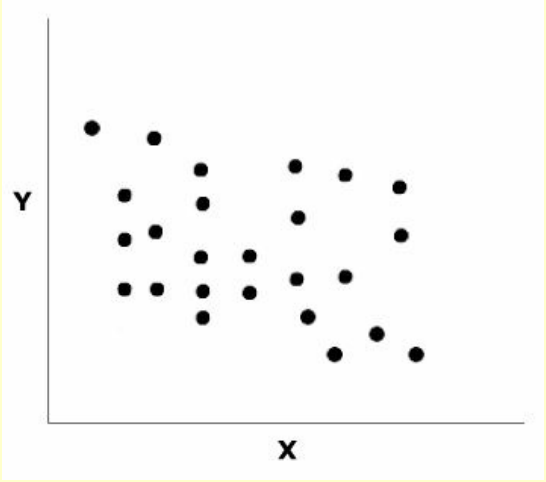
Slide 3



Strong Negative Correlation

The value of Y **clearly decreases** as the value of X **increases**.

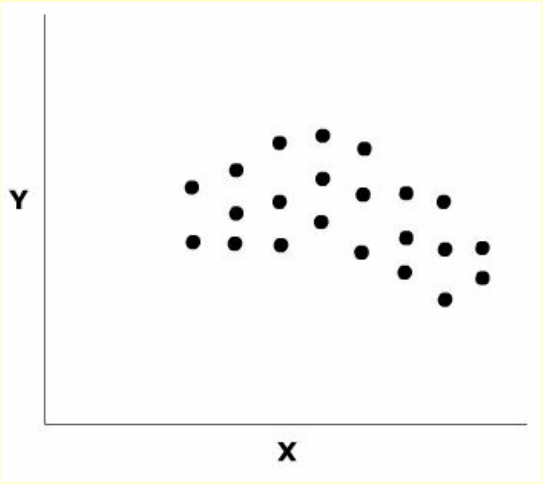
Slide 4



Weak Negative Correlation

The value of Y **subtly decreases** as the value of X **increases**.

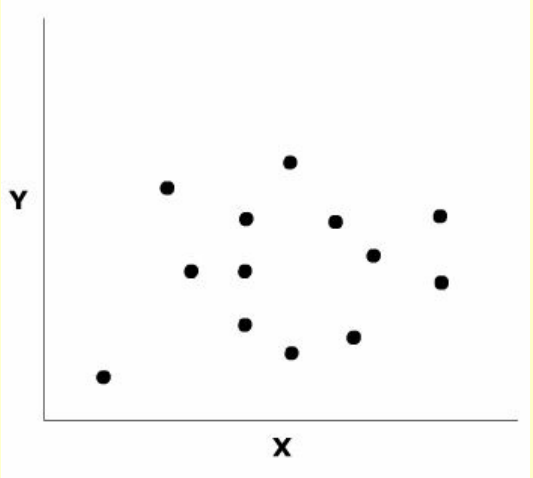
Slide 5



Complex Correlation

The value of Y clearly **seems to be related** to the value of X, but the **relationship is not easily determined**.

Slide 6



No Correlation

There is **no correlation** between the two variables.

A team's quality control processes will help to verify that the project's deliverables are capable of satisfying the project's needs. If the project deliverables do not meet the quality requirements that have been set, the team will have to make changes to the deliverables, to the processes that are creating those deliverables, or to both, to correct discrepancies. Team members will have to document any changes that they make in their project records and include them in their lessons learned reviews throughout their project. The quality control activities that they complete will ensure not only that their *products* meet the project objectives but also that their *processes* are aligned and robust enough to deliver value.

Quality Assurance Tools

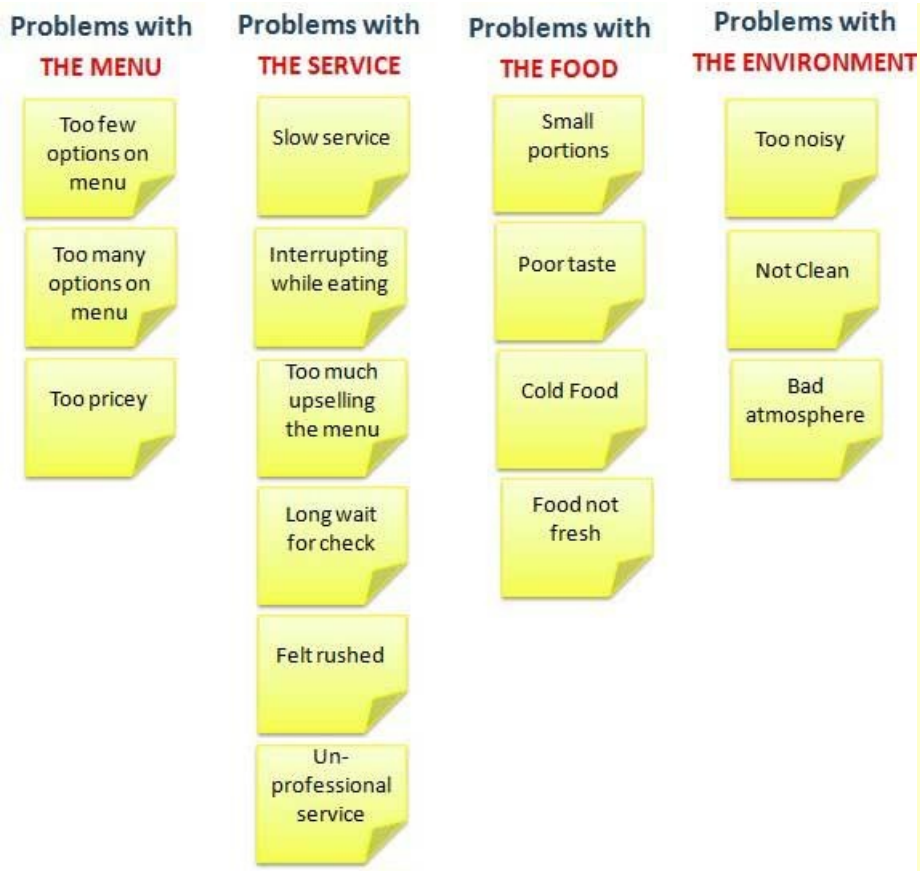
In addition to the tools discussed above, there are several tools and techniques that practitioners can use to address quality assurance in projects. These seven tools—the affinity diagram, the process decision program chart, the interrelationship digraph, the tree diagram, the prioritization matrix, the network diagram, and the matrix diagram—are interactive, team-based tools that help groups analyze verbal data and make better decisions on projects.

Affinity diagrams

An affinity diagram helps a team make sense of a large amount of data by grouping ideas into categories that can then be analyzed or evaluated. By sorting data into groups or categories, common themes or patterns emerge that can be used to break through bottlenecks or allow the team to clarify its thinking about issues or problems.

By collecting ideas into groups, affinity diagrams allow practitioners to uncover hidden relationships that may not have been noticed before. The sorting process helps to filter and sift through ideas, tying concepts together and creating consensus about issues before additional work is begun. The collaborative way that affinity diagrams are developed helps to ensure that all viewpoints are considered and prevents dominant personalities from taking over the process.

Common Complaints from Restaurant Customers

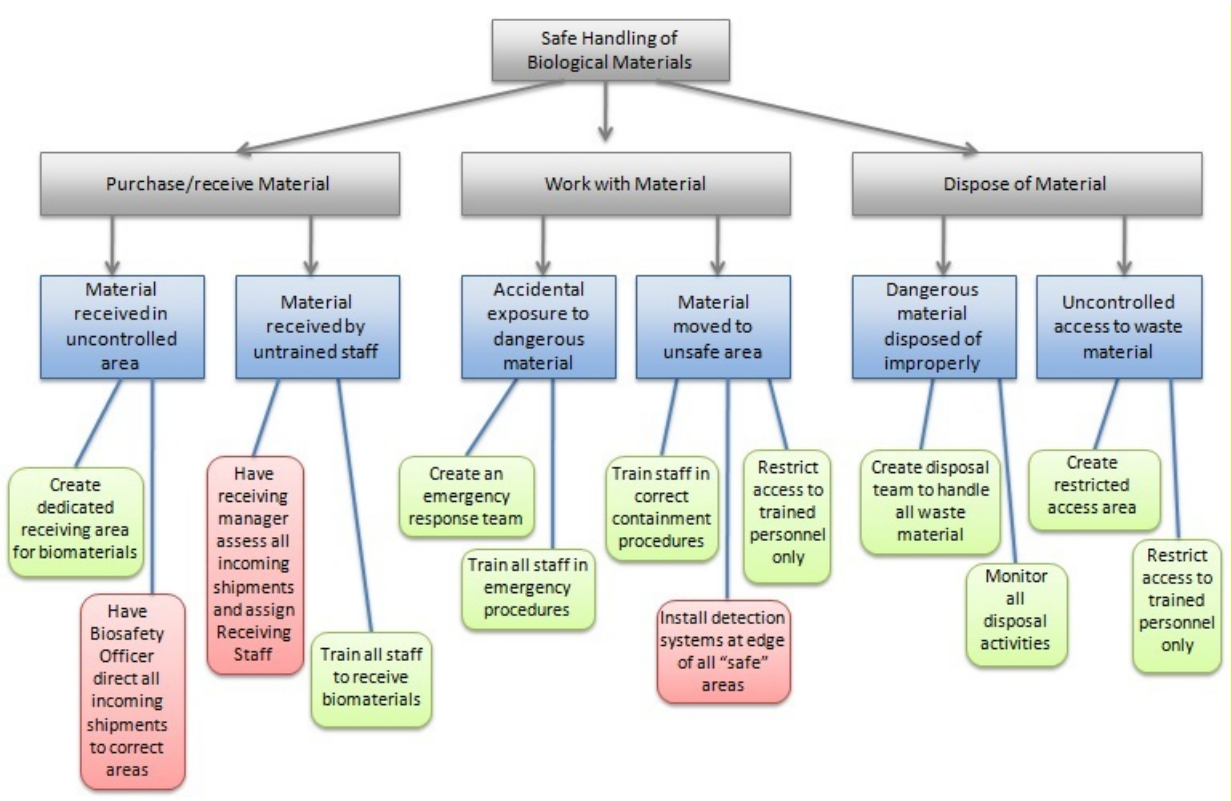


Affinity diagrams are useful for gathering and organizing ideas so they can be acted on or further developed. These diagrams allow teams to analyze a lot of verbal or qualitative information so it can be used as an input to subsequent work. Affinity diagrams show common threads among ideas and allow patterns to emerge, preventing teams from the paralysis that may ensue from trying to work with such large amounts of data. And although these diagrams may take some time to develop, the time spent here organizing information will be balanced by the amount of time saved later trying to make sense of unsorted data.

Process decision program charts

A process decision program chart (PDPC) is a tree diagram that is specifically designed to help teams mitigate risks and solve potential problems. The team breaks a goal or objective down into major steps or activities, then devises countermeasures or preventive actions to solve any potential problems that could happen during those activities. By anticipating problems and eliminating barriers to project success, teams can lower project costs, prevent rework, limit delays that could derail the schedule, and increase the safety and stability of project processes.

Like a tree diagram, the PDPC shows a hierarchy of events or ideas but the intent of the PDPC is more defined—the lowest tier of the PDPC illustrates the corrective and preventive actions that can be taken to mitigate risks or overcome process problems. The hierarchical nature of the diagram helps practitioners gain insight into problems that may occur so more-complete and better-informed solutions can be developed.



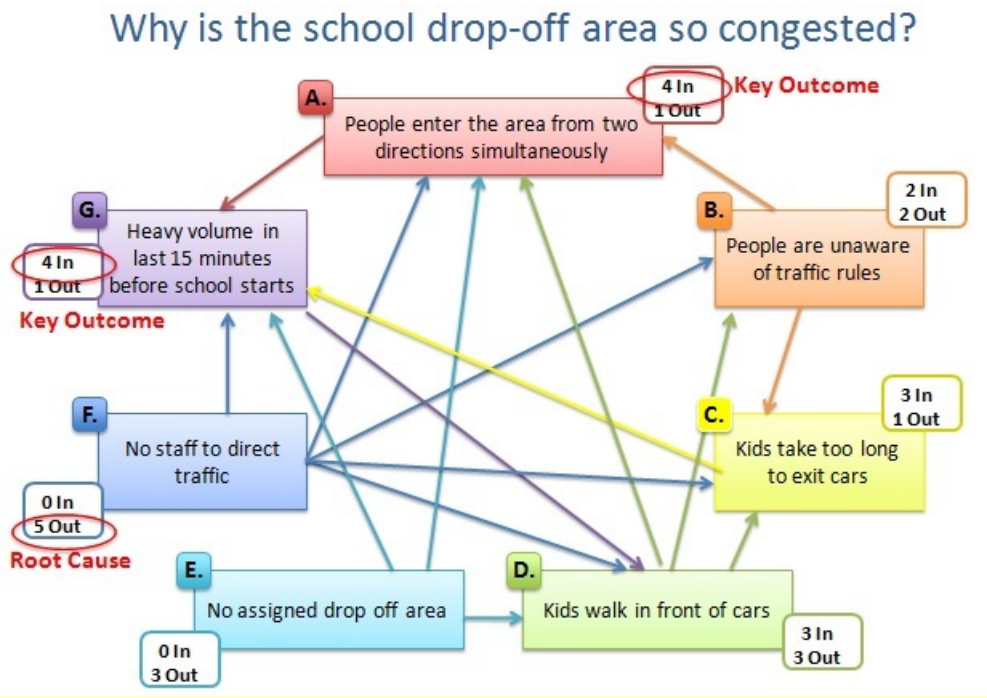
Interrelationship digraphs

An interrelationship digraph shows the cause-and-effect relationships among the many factors or contributors to a problem. These factors or contributors are placed in a circle and arrows are drawn to show how each factor relates to every other factor for the issue under investigation. By visualizing all of these relationships at the same time, practitioners can identify root causes and develop effective strategies for addressing multiple factors simultaneously.

Interrelationship digraphs help teams visualize relationships as a network of factors rather than as a linear cause-and-effect concept. A single factor is often affected by many drivers and may itself be the driver of many subsequent factors; seeing these contributors as both inputs and outputs of other factors helps project teams identify the links among ideas and plan solutions that address the key drivers that have the greatest impact on work.

An interrelationship digraph helps teams understand where to focus their efforts to get the greatest benefits; by ranking the key drivers and outcomes for a problem, the digraph helps teams prioritize corrective actions and anticipate where effects from these actions will be felt.

The digraphs are especially helpful in instances where the symptoms of a problem are more visible than the underlying causes. By seeing that a relatively "minor" problem radiates out to many areas and is actually a driver for many other contributors to a problem, the diagram shows relationships that may not have been evident or that would not normally be addressed with much vigor.



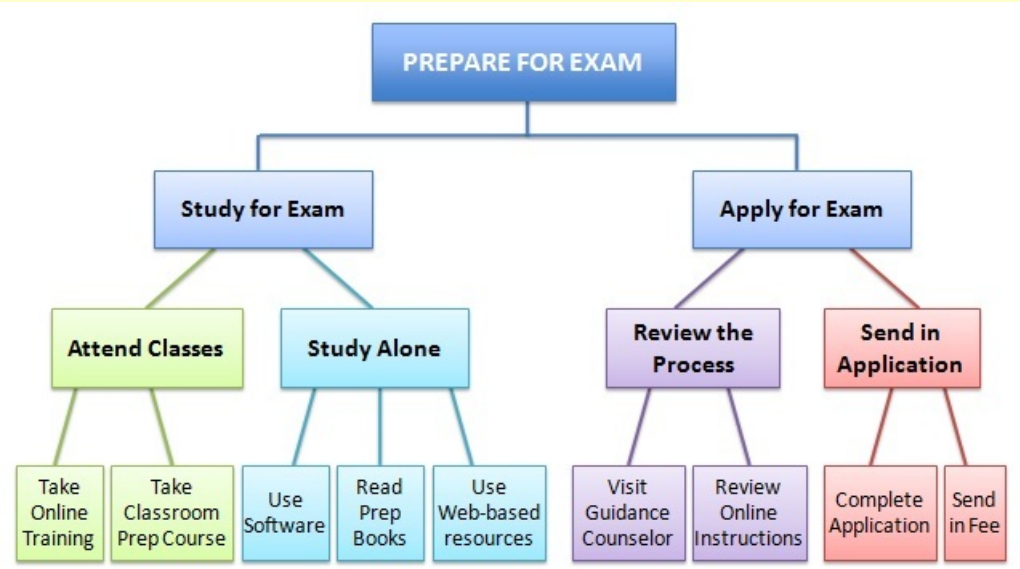
Tree diagrams

A tree diagram shows a hierarchy of items in a graphic format. The tool uses successive steps to break things down into greater detail, helping project teams map out their path toward a goal or showing them a logical way to work toward a result. By separating topics into components in logical steps, teams gain deeper insight into goals or targets by seeing *all* of the work needed to complete their objective.

Tree diagrams can be used to uncover alternatives or to divide tasks into smaller increments for assignment. The diagram is usually built from the top down, with each successive layer showing more components or options. The branching and "nesting" of components shows progressively more detail as teams move through the diagram, with the lowest level showing the greatest detail or finest granularity for the topic.

An effective diagram should include *all* of the possible outcomes or components that make up each level of the chart. Components in each level should break down into the pieces of the lower levels and also roll up into the components at higher levels. Each chart level should be composed of *all* of the components *but only* the components of the next-lower level; a level should not include "extra" pieces or components that do not belong there.

Getting Ready for a College Entrance Exam



Prioritization matrices

A prioritization matrix helps a team prioritize options when there are multiple criteria to satisfy at one time. By agreeing

on the criteria that are most important to the project and then comparing options based on that information, teams can focus on implementing the best actions to quickly make an impact.

Every project has criteria that it must satisfy to be considered successful but satisfying all criteria at once may not be possible, especially if resources are limited. There may also be several competing criteria that must be considered simultaneously, and each criterion may be more or less important to project success than other competing criteria. A prioritization matrix will help a team compare these criteria to determine which ones are most important, then choose the options that are best for the project.

Criteria are assessed weights to show their importance to project success and to ensure that decisions are based on information about the project rather than on emotions or feelings. When decisions are made objectively, teams begin to trust project leaders to a greater extent and buy-in to project plans and activities more completely.

Prioritization Matrix: Project Selection

Criteria

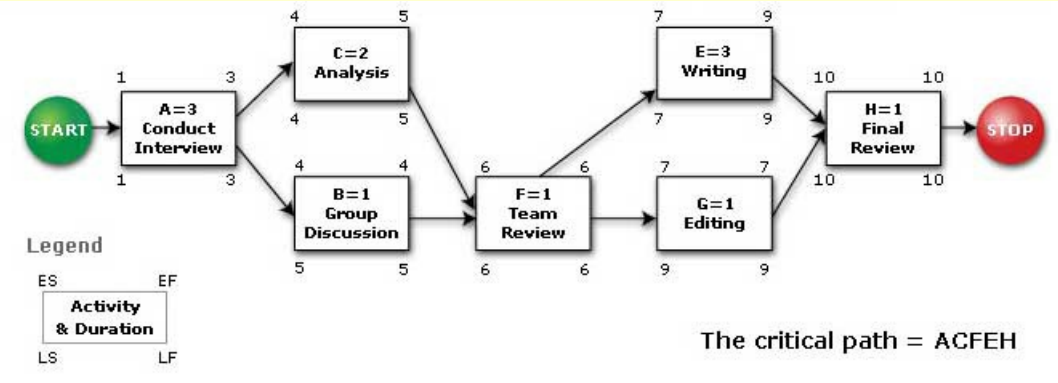
Projects	Increase Revenue (Weight = .35)	Lower Costs (Weight = .24)	Introduce New Product (Weight = .15)	Enter New Market Segment (Weight = .12)	Increase Organizational Learning (Weight = .08)	Enhance Public Image (Weight = .06)	Row Total	Final Priority of Projects
Hurricane II	19 x .35 = 6.65	13 x .24 = 3.12	28 x .15 = 4.2	38 x .12 = 4.56	13 x .08 = 1.04	31 x .06 = 1.86	21.43	4
DeltaSynch 7	41 x .35 = 14.35	16 x .24 = 3.84	21 x .15 = 3.15	29 x .12 = 3.48	12 x .08 = 0.96	19 x .06 = 1.14	26.92	2
Labyrinth 2.0	29 x .35 = 10.15	19 x .24 = 4.56	28 x .15 = 4.2	10 x .12 = 1.2	62 x .08 = 4.96	35 x .06 = 2.1	27.17	1
Newfoundland Plus	11 x .35 = 3.85	52 x .24 = 12.48	23 x .15 = 3.45	23 x .12 = 2.76	13 x .08 = 1.04	15 x .06 = 0.9	24.48	3

Ranking of options in each column = blue

Weighting factor for each criterion = green

Network diagrams

A network diagram is a simple graphic that shows the relationships among project activities and guides a team in executing project work. The diagram shows the predecessors (any activities that must be completed before) as well as the successors (those activities that follow) for all of the activities in the project. (Note: This course discussed network diagrams in the development of the project schedule.)



A network diagram helps the team:

- Ensure that the project will continue to meet its expected schedule
- Compare actual results to plans and see when corrections to the schedule are needed
- Keep stakeholders informed about changes to the project's time line

As such, it must be reviewed regularly and kept up to date to ensure that it reflects the team's most recent work and

latest progress.

Matrix diagrams

A matrix diagram shows how strong the relationships between items or sets of items are. Items from one group are compared to items in another group; the comparisons are then compiled in a table for analysis and easy reference. The results from these comparisons help to expose gaps that should be addressed and focus the team's attention on high priority areas that should be tackled immediately.

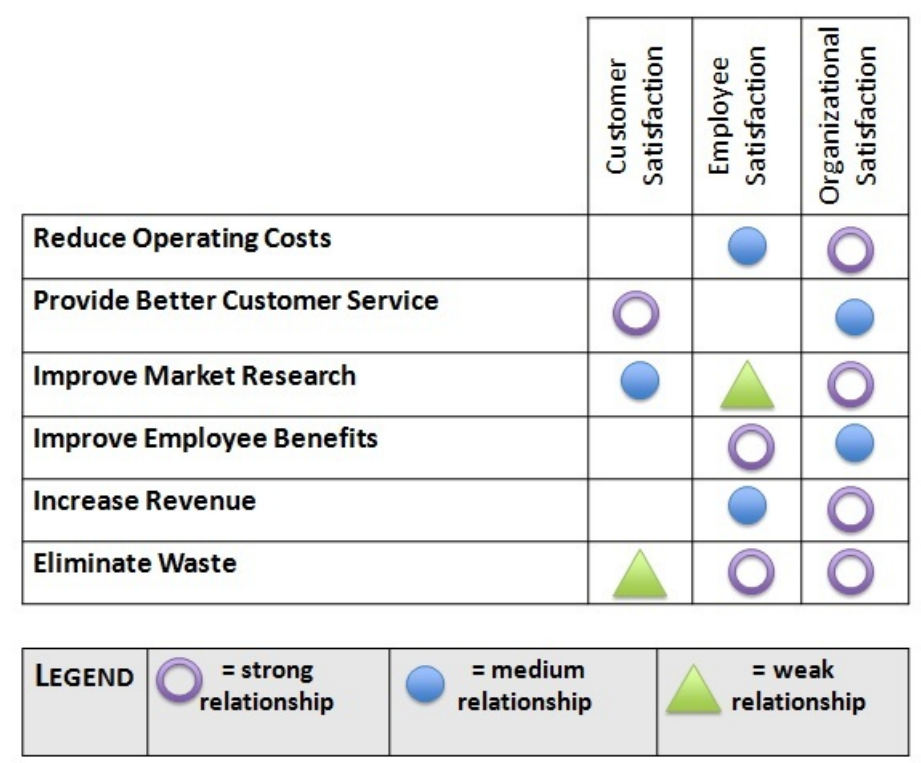
The cells of a matrix diagram can be populated using a variety of designations or "markers" such as letters, numbers, symbols, or colors to show how strongly items are related. Some common markers are included in the table below:

Relationship	Numbers	Letters	Symbols	Colors
Strong	9	H (High)		
Medium	3	M (Medium)		
Weak	1	L (Low)		

The choice of which markers to use is up to the team developing the matrix diagram but care should be taken to ensure that anyone looking at the matrix will understand the information it contains. To prevent confusion, it is often helpful to include a legend with the diagram to explain what each marker means, to help interested parties read the chart with a minimum of problems.

It is also important to leave a significant gap between the marker for strong relationships and the marker for medium relationships, to dramatically separate these items from each other as they are ranked. If this gap is not large enough, it may be difficult to spot the differences in the data, especially if numbers are used and the columns or rows are averaged or totaled. (This explains why there is such a large numerical gap between the "9" assigned for strong relationships and the "3" assigned for medium relationships; if a "5" was used instead of a "9," the totals or averages calculated for each row or column may not be separated enough to be noticed.)

L-shaped Diagram Comparing Satisfaction Levels



8.07.1 Exercise: Basic Quality Tools Seven Strikes Game

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8.08 Utilizing Project Management Software

Utilizing Project Management Software

Many project practitioners use project management software programs to track, monitor, and control their project tasks and activities. These programs (or groups of programs) help make project progress readily apparent and quickly expose any problems or potential issues that may arise.

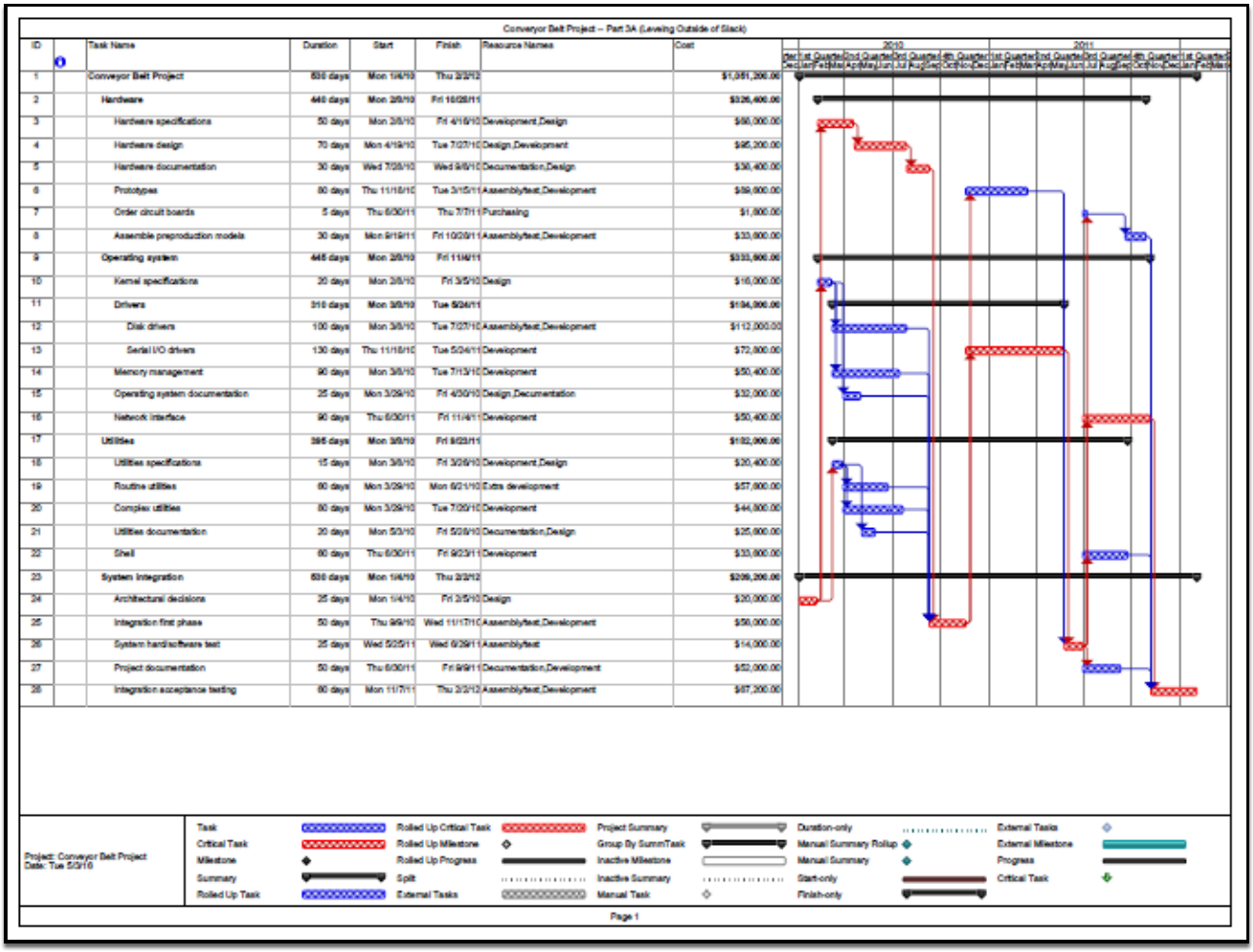
Most of these software applications are spreadsheet-based systems, but many have other graphic or charting capabilities that allow project teams to present the most important information in easy-to-read formats for ease of use.

Several popular programs are described briefly below. (*Note:* These descriptions do not represent a comprehensive list nor do they imply advocacy or endorsement by this course.)

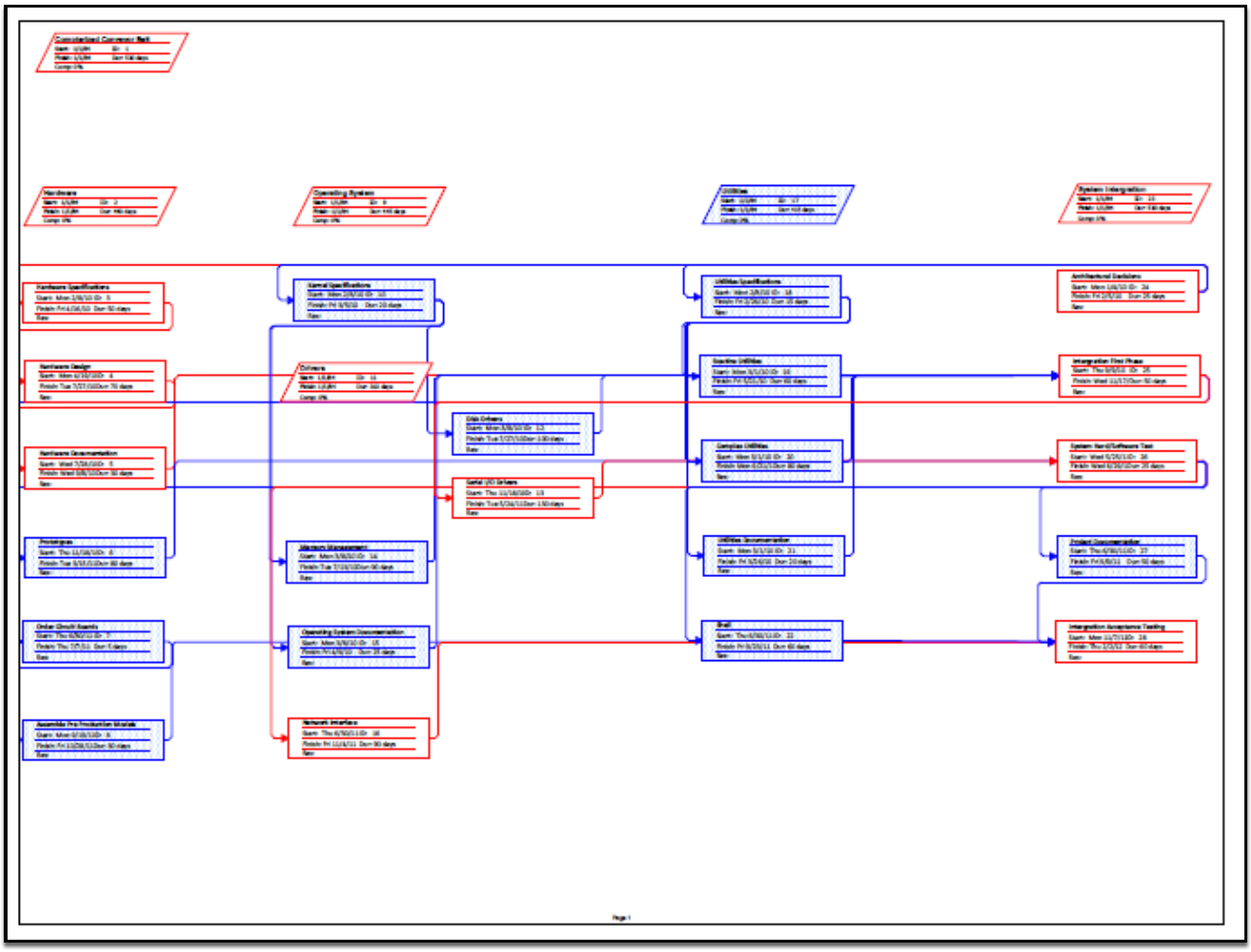
Microsoft MS Project®

MS Project is a popular project management software application for linking tasks to project objectives and results. The multiple layers and screens allow for integration and synchronization of project parameters (e.g., scheduling, reporting, resource allocation, progress, etc.) to enhance collaboration and communication among project participants and stakeholders.

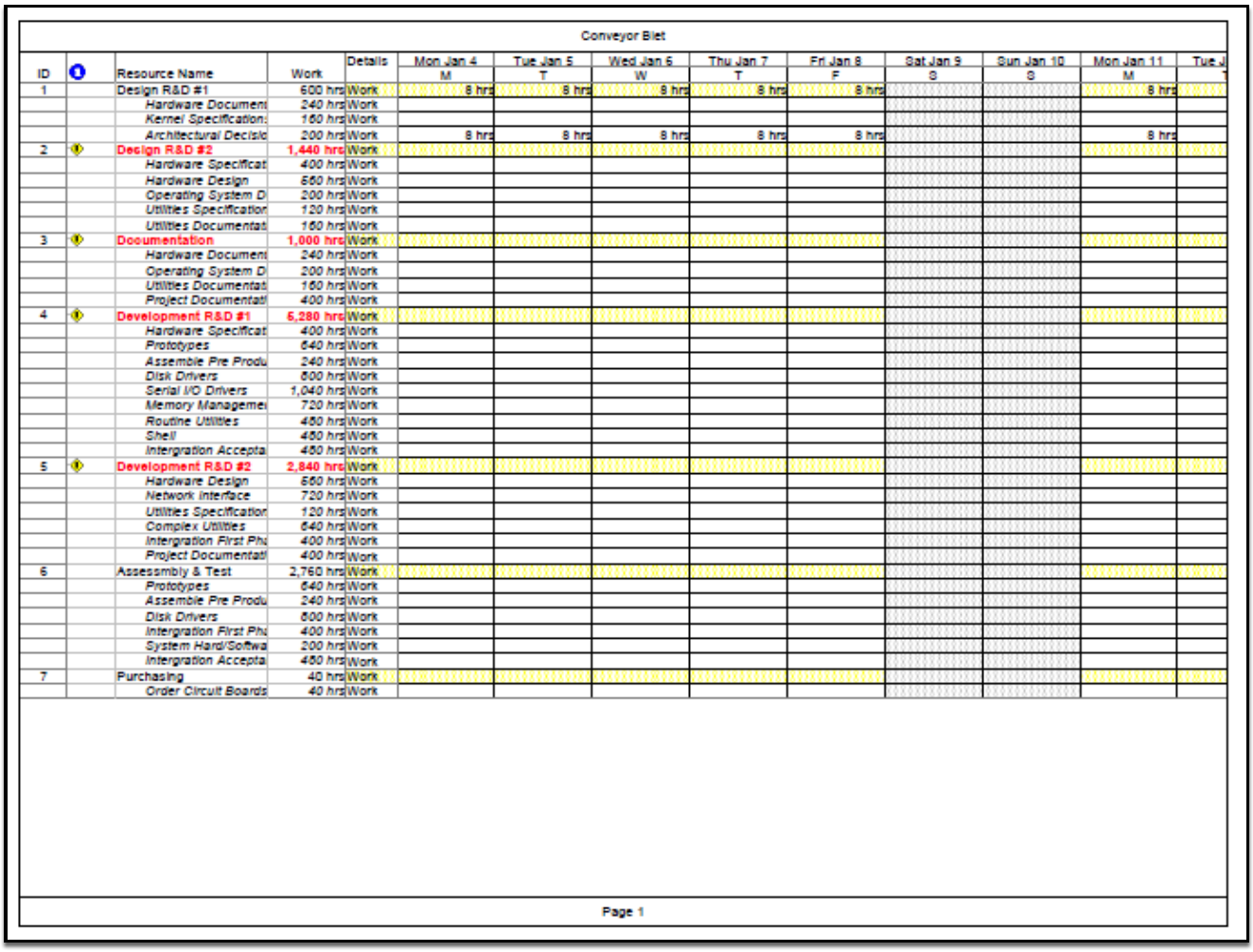
An MS Project Gantt Chart



An MS Project Network Diagram



An MS Project Resource Usage Table



Conveyor Blet

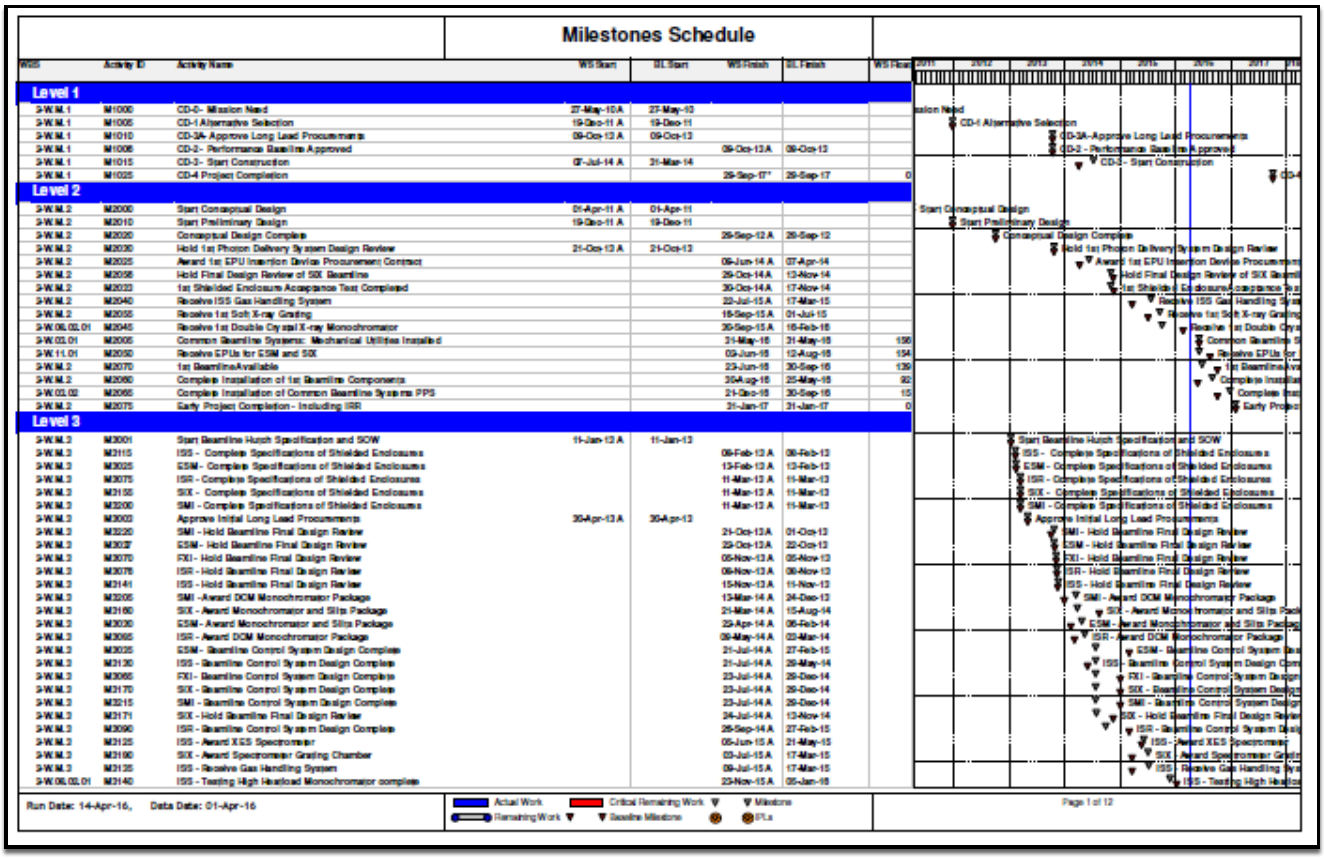
ID	Resource Name	Work	Details	Mon Jan 4 M	Tue Jan 5 T	Wed Jan 6 W	Thu Jan 7 T	Fri Jan 8 F	Sat Jan 9 S	Sun Jan 10 S	Mon Jan 11 M	Tue J T
1	Design R&D #1	600 hrs	Work	8 hrs	8 hrs	8 hrs	8 hrs	8 hrs			8 hrs	
	Hardware Document	240 hrs	Work									
	Kernel Specification	160 hrs	Work									
	Architectural Decisio	200 hrs	Work	8 hrs	8 hrs	8 hrs	8 hrs	8 hrs			8 hrs	
2	Design R&D #2	1,440 hrs	Work									
	Hardware Specificat	400 hrs	Work									
	Hardware Design	560 hrs	Work									
	Operating System D	200 hrs	Work									
	Utilities Specification	120 hrs	Work									
	Utilities Documentat	160 hrs	Work									
3	Documentation	1,000 hrs	Work									
	Hardware Document	240 hrs	Work									
	Operating System D	200 hrs	Work									
	Utilities Documentat	160 hrs	Work									
	Project Documentati	400 hrs	Work									
4	Development R&D #1	6,280 hrs	Work									
	Hardware Specificat	400 hrs	Work									
	Prototypes	640 hrs	Work									
	Assemble Pre Produ	240 hrs	Work									
	Disk Drivers	600 hrs	Work									
	Serial I/O Drivers	1,040 hrs	Work									
	Memory Manageme	720 hrs	Work									
	Routine Utilities	480 hrs	Work									
	Shell	480 hrs	Work									
	Intergration Accepta	480 hrs	Work									
5	Development R&D #2	2,840 hrs	Work									
	Hardware Design	560 hrs	Work									
	Network Interface	720 hrs	Work									
	Utilities Specification	120 hrs	Work									
	Complex Utilities	640 hrs	Work									
	Intergration First Phi	400 hrs	Work									
	Project Documentati	400 hrs	Work									
6	Assessmbly & Test	2,760 hrs	Work									
	Prototypes	640 hrs	Work									
	Assemble Pre Produ	240 hrs	Work									
	Disk Drivers	600 hrs	Work									
	Intergration First Phi	400 hrs	Work									
	System Hard/Softwa	200 hrs	Work									
	Intergration Accepta	480 hrs	Work									
7	Purchasing	40 hrs	Work									
	Order Circuit Boards	40 hrs	Work									

Page 1

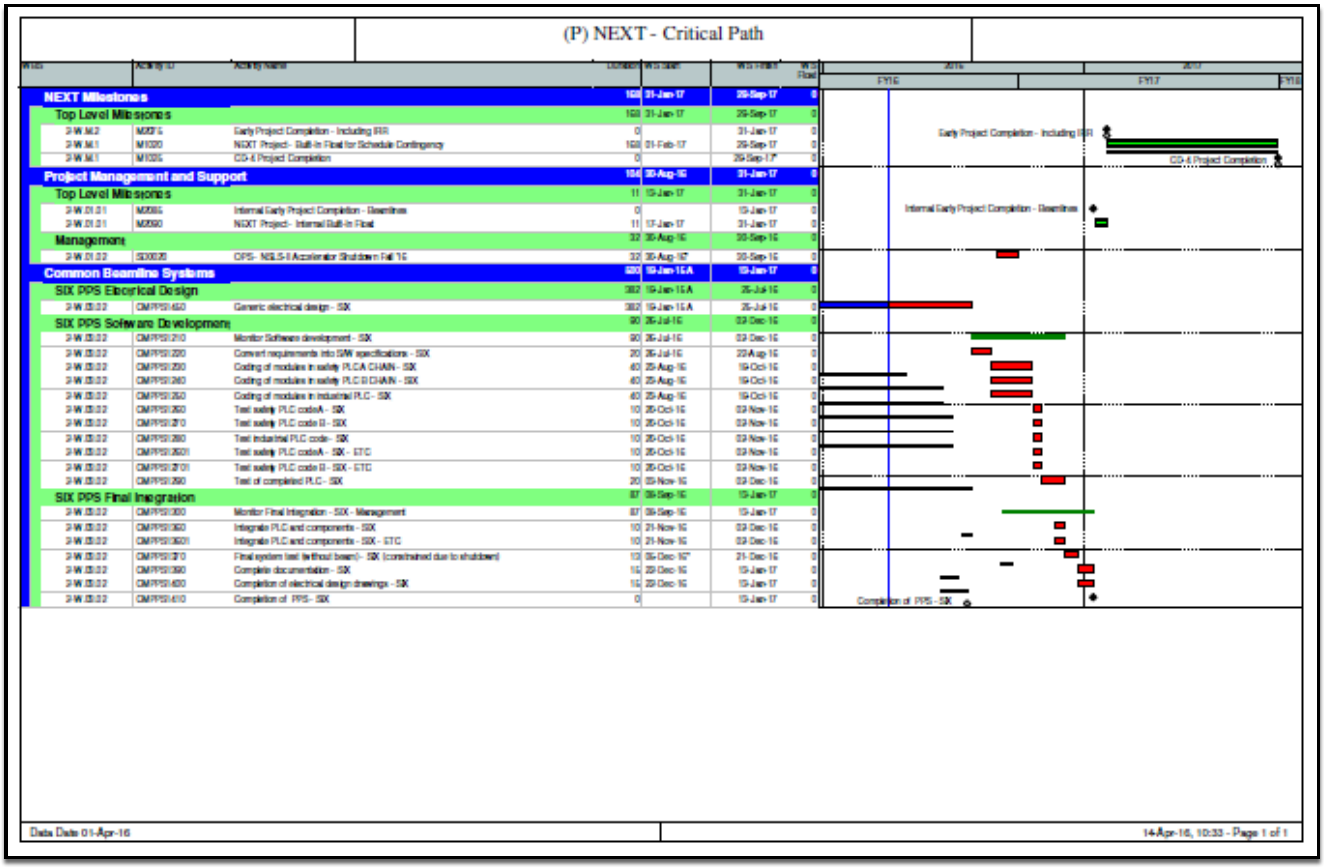
Oracle® Primavera Project Management Solutions

Practitioners working on larger or more-complex projects tend to gravitate toward Oracle Primavera applications, to balance their need to assess and track multiple layers of complexity with an ability to access and communicate data clearly and succinctly. The software's numerous displays and templates provide clear entry to multifaceted projects and sophisticated information analysis, while allocation, tracking, forecasting, and risk management features ensure that project monitoring and control occur in real time to enhance operations and completion.

A Primavera Milestone Schedule



A Primavera Critical Path Designation



Additional Project Management Software Programs

A number of alternate software applications can be used if either of the above-mentioned systems is a poor fit for a specific project; these programs can be applied separately or in conjunction to provide comprehensive coverage of project needs.

For example, WorkZone® and Smartsheet® can be used (as stand-alone products or in collaboration with other applications) to track and monitor projects of any size, making it easier to control work without necessitating in-depth training or added costs. Project supervision can also be achieved by customizing or adapting common applications (such as Microsoft® Office or Apache OpenOffice®) to cover any and all aspects of project management; however, care should be taken (as with any software program or application) to ensure that proper guidance and oversight are employed, to prevent mishaps or mistaken analyses from damaging project progress and success.

8.09 Capstone Case Study: Execution and Monitoring & Controlling

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8.09.1 Capstone Case Study I: Distributing Information

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8.09.2 Capstone Case Study II: Resolving Conflict

This assignment does not contain any printable content.

8.09.3 Capstone Case Study III: Monitoring Risks, Controlling Change, and Evaluating Quality

This assignment does not contain any printable content.

8.10 Discussion Board

This assignment does not contain any printable content.

8.11 Short Paper

This assignment does not contain any printable content.

Module Feedback

This assignment does not contain any printable content.