Project Planning and Control When Time Matters: Focus on Process to Synchronize and Drive Results

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ABSTRACT

Operational excellence in project organizations is increasingly about time performance—delivering a portfolio of projects quickly and predictably. In some environments such as new product development, time performance has become so valuable that it essentially defines operational excellence. Firsthand experience shows that focusing on two fundamental business processes—baseline project planning and periodic updating and reporting—improves time performance. Leveraging these two processes requires commitment from all parts of the organization, not just project management. Senior leadership, functional management, and individual contributors all play important roles in synchronizing the organization around project speed and predictability. Baseline project planning and periodic updating and reporting processes are discussed in the context of the newer critical chain method, which greatly facilitates better time performance compared with more traditional critical path methods. The challenges of implementing changes to improve operational excellence are addressed in the form of implementation tips and guidelines proven to drive real results.

Keywords: project speed, project predictability, project planning and control, critical chain project management, multitasking, project updating, and reporting

INTRODUCTION

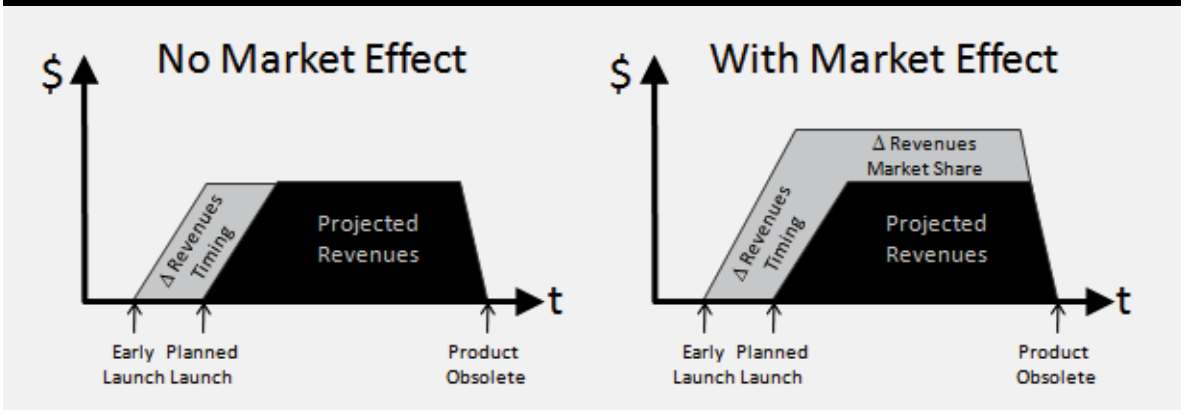
Within the broad realm of operations management, a reference to "achieving operational excellence" may likely trigger thoughts on how to better manage manufacturing, distribution, or service operations. In many industries, achieving excellence in project operations has become increasingly important in reaching business goals. Basic research, new product development, marketing, manufacturing engineering, IT, and capital expansion are all areas where important business objectives are achieved primarily through the completion of projects. The connection between operational excellence in these areas and overall strong business performance is not hard to make.

While each traditional project management objective—scope, quality, time, and cost—are relevant in today's business environment, it is hard to find a business context where time performance is not gaining importance and even becoming the dominant measure of success. The increasingly frenzied pace of business leaves little room for slow and unpredictable projects, regardless of their specific nature. Much of the experience reported in this paper comes from working extensively with organizations that develop new products. Like other project organizations, these organizations must closely coordinate effort across multiple functions to deliver a portfolio of projects in a highly uncertain environment. By and large, new product development is a project environment where time performance has become the dominant measure of operational excellence. The two most common measures of time performance tend to be predictability and cycle time. New product development predictability—completing projects on or before commitment dates—is fundamental to overall control of the business. New product development cycle times—the elapsed (calendar) times between starting and finishing projects[1]—have a significant impact on business competitiveness and market share.

Missing a new product launch date affects business credibility and frequently the size and timing of revenue streams (Smith and Reinertsen 1995, Newbold 2008). The difference between launching a new product on time and launching a few months late can easily translate into many millions of dollars of foregone revenues. The converse is also true—launching early can increase overall revenues

[1] *Project cycle time is the total elapsed time required to complete the project and is referred to as makespan in the companion paper in this journal by Herroelen and Demeulemeester (2010). It is also called project duration.*

FIGURE 1: THE VALUE OF TIME PERFORMANCE IN NEW PRODUCT DEVELOPMENT



because the product launch date is not a major factor in determining the product obsolescence date. Instead, obsolescence is more often a function of market forces, technological developments, patent expiration dates, consumer preferences, and the like. This means that an early or late launch actually extends or contracts the product revenue curve. This is conceptually illustrated in Figure 1. The left side of the figure shows the revenue bonus that can be gained if a product is launched sooner. The right side shows the added effect that comes if early launch enables the business to capture additional market share. Again, the converse is true—launching late would result in shrinking the revenue curve and falling short of projections.

One industry in which time performance has a significant financial impact is large pharmaceuticals, where forecasted annual revenues for top-priority new medicines can easily reach the hundreds of millions of dollars. In this industry, shifting launch dates cause changes in revenues because the major factor determining product obsolescence timing is the patent expiration date, which is independent of the product launch date. One project team we recently worked with had forecasted (risk-adjusted) annual revenues of $1.6 billion. Using a simple straight-line approximation[2], this means that a one-week delay in product launch would translate into $32 million or so in lost revenues. Conversely, accelerating the product launch by just one month would mean $130 million of additional revenues.

Despite the enormous stakes, experience has shown time and time again that companies often struggle to deliver new products to market quickly and reliably. I have more than 10 years of full-time project management consulting experience, not only in new product development, but also in IT and capital expansion. In addition to large pharmaceutical companies, I have worked with firms in the consumer products, medical devices, and semiconductors industries, among dozens of other organizations. In my experience, struggles with time performance are not restricted to a particular industry, size, or type of project organization. What does seem to be consistent is that struggles with time performance are connected to deficiencies in the organization's project planning and control system.

In project organizations (see sidebar "The Project Organization" on p. 28), the demand for better time performance—short project cycle times with high on-time completion rates—naturally places a premium on an organization's ability to create robust project plans and execute against those plans in an environment of great uncertainty and constant change. To improve project planning and control, organizations often respond through changes in staffing or structure (for example, hiring more or different project managers, creating a project management office, or shifting back and forth between a project and a functional focus), more extensive project manager education (often

[2] *Obviously these "what if" calculations can get sophisticated, and other factors certainly can affect the ultimate value of early or late project completion. New product development is not the only environment where time performance has a potential financial impact—IT, manufacturing engineering, construction, and facility maintenance are other examples. While the analysis may be different, the value of time performance can be significant.*

Defined: The Project Organization

The focus of this article is the multiproject organization whose ongoing charter is to define and deliver a portfolio of projects quickly and reliably. These organizations commonly employ some form of matrix management where people are organized into functional areas and then assigned to projects. The key roles in a project organization are as follows:

Senior Leaders: The senior leader is typically a vice president and has both budget authority and ultimate responsibility for project results. The senior leader's leadership team typically consists of direct reports who are in charge of functional areas.

Resource Managers: These people are in the functions and occupy the layers of management between the supervisor and functional head. Responsibilities include allocation of resources, skill development, and performance evaluation.

Project Managers: These are the people responsible for delivering projects successfully (time, cost, and scope). Project managers are sometimes located in their own function (often called a PMO) and other times dispersed in the other functions. Project managers typically manage multiple projects and do not have direct authority over the individual contributors working on projects.

Individual Contributors: These are the people that Jim Patterson (2010) in his companion paper on leadership in this journal calls the "doers"—the people who complete project tasks. They almost always work on multiple projects in addition to functional duties such as training.

Project Team Members: These are usually crossfunctional teams headed by the project manager and consisting of individual contributors and/or resource managers assigned to represent their function. Because reporting lines are functional, project managers tend to have far less influence than resource managers on individual contributor behavior.

Note that these roles are sometimes assumed by the same individual. For example, a person can be both a supervisor (resource manager) and an individual contributor.

taking the form of a certification program), procurement of new project scheduling software, or standardization of project tracking and reporting (as provided, for example, by enterprise project management systems). Meanwhile, the "how-to" of truly effective project planning and control —the business processes that serve to define the project planning and control system—often evade close scrutiny. Individual project managers are commonly given wide latitude in how they apply their training and new tools; they are expected to figure out for themselves how best to create project plans and keep their teams on track. Given that effective planning and control is not a trivial undertaking and is often beyond the span of project managers' control, it should not be surprising that only a tiny fraction of an organization's project managers successfully parlay their tools and training into fast, reliable project performance. Furthermore, given that project organizations are "looking in all the wrong places" for improved organizational performance, it makes sense that many organizations find it daunting to improve time performance.

Two business processes are critical to ensuring that a project planning and control system delivers satisfactory levels of time performance across the project portfolio: baseline project planning and periodic updating and reporting. To influence project execution decisions—who does what and when—there must first exist a baseline plan that is relevant, useful, and credible to all stakeholders in the project organization. The next section of this paper outlines a four-step baseline planning process that has proven effective at accomplishing this. That section is followed by one that shifts the focus to ongoing project execution. The four-step periodic updating and reporting process described outlines how a plan can be kept current and useful in driving fast, predictable completion. Both processes are the result of more than a decade of experience with literally hundreds of project teams across a wide variety of industries that highly value fast projects delivered on time or early. While new product development has been the primary environment for my application of these two important processes, they have also been applied in other time-sensitive project environments with great success.

Processes are not terribly useful unless and until they are effectively implemented, as another section of this paper discusses. As one reads through this paper, it would be easy to create a long list of things to do that would improve time performance in your project organization. As with most things, the Pareto principle also applies to improvement efforts. That is, a small handful of changes would make a big difference in overall performance. The final section of this paper provides one perspective on what those few leveraged changes should be.

A PROCESS FOR BASELINE PROJECT PLANNING

Project planning advocates frequently make the point that planning is much more than scheduling. While this is certainly true, I would suggest that project scheduling is the sine qua non of project planning. In many ways, the project schedule is the project plan in that it embodies the key outcomes of the planning process—objectives, scope, technical approach, risk mitigation, resource requirements. These are all reflected in a well-developed project schedule.

The baseline project planning process is depicted in Figure 2. Each step is described in detail in the paragraphs that follow. The baseline schedule establishes the timing commitment used to evaluate project progress and judge performance[3]. The central tenet underlying the steps in this process is the firmly held belief that schedule credibility is the single most important outcome of the planning process and a necessary condition for deliv-

Case in Point: 'Incredible' Schedules

Before beginning a pilot critical chain implementation for a major consumer products company, I separately interviewed the senior leader and several experienced project managers. I asked each if they believed their current project schedules.

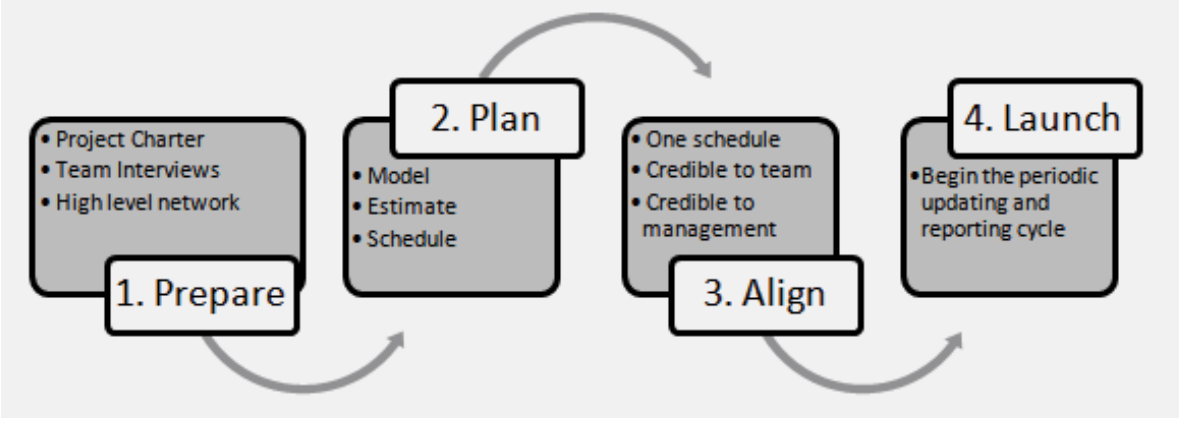
The senior leader told me that in his head, he added six months to any schedule because they were usually late. At the same time, he was completely frustrated because he came up through the ranks and knew for a fact that they could develop new products in half the time of the current schedules.

The project managers told me they didn't really use the schedule. They were always given unrealistic deadlines by management that they had to agree to. They agreed those times were possible, but there were always so many unknowns and they were in a constant battle with the functions to get things done.

The bottom line is that no one believed the schedule, which meant the schedule was useless for synchronizing the organization. The truly remarkable thing was that leadership kept demanding schedules and project teams kept supplying them.

[3] *This presumes that project control will be exercised by the traditional approach of comparing current status to planned status. A conceptually interesting alternative to this traditional approach can be found in Reinertsen (2009). He proposes a project control system founded on the flow principles applied in Just-in-Time or demand flow manufacturing control systems.*

FIGURE 2: PROCESS FOR BASELINE PROJECT SCHEDULING



Case in Point: Training and Enabling Project Planning and Control Experts

A large pharmaceutical company that rolled out critical chain designated six individuals to serve as full-time facilitators. These individuals knew the business and had demonstrated substantial potential for growth. All were skilled communicators, good with software, and had strong people skills.

The six went through a rigorous "hands on" certification program in the tools and implementation processes of critical chain. Within two years of beginning their program, the group had trained many others and had brought almost all project teams through the two processes described here. The organization increased on-time delivery to 100 percent and reduced cycle times—in some cases by as much as 50 percent.

ering high levels of time performance. Establishing schedule credibility at both leadership and team levels is extraordinarily difficult. The schedule is the place where two often-conflicting realities meet.

Leadership sees clearly the reality of what the business needs—the revenues, costs, competition, regulatory requirements, and consumer preferences that determine needed project outcomes. Those working directly on the projects—project managers, lower-level resource managers, and especially individual contributors—all see the reality of what the organization is able to deliver: the resource constraints, conflicting priorities, personnel issues, and budget shortfalls that determine what is feasible. When these two realities conflict (and they almost always do), schedule credibility is tremendously strained. Realistic schedules don't complete fast enough to meet the external demands, so there is tremendous pressure to arbitrarily cut the schedule. Too often, schedule credibility is thrown overboard to avoid conflicts and give management what it wants to see. If this is occurring in your organization, it is important to acknowledge and address this conflict as an essential part of the effort to improve project planning and control (see sidebar "Case in Point: 'Incredible' Schedules" on p. 29).

The centerpiece of the planning process illustrated in Figure 2 is Step 2, which is accomplished in a multiple-day, team-based planning event led by an external facilitator. Multiple-day planning meetings—referred to here as network builds—are far less common today than they were 10 or 15 years ago. When we reintroduce network builds to organizations, we almost always meet strong initial resistance. Cost and efficiency pressures, headcount reductions, and an enveloping sense of urgency are so pervasive in today's project organizations that time-consuming, deliberate processes such as the one described below come under great pressure and are frequently truncated or eliminated. The initial resistance we experience, however, almost always evaporates once the organization gains experience with network builds. The value that all stakeholders derive from the process greatly outweighs the costs. Teams find value in the understanding of their project and the ownership of the plan they have created together. Leadership finds value in the clarity of thought, rigor, and team commitment associated with the schedule.

Another feature of the baseline project scheduling process is the use of an external facilitator. This is also frequently regarded as a stumbling block to adopting the process. The facilitator does not have to be external to the organization, but should be external to the project team (see sidebar "Training and Enabling Project Planning Control Experts" on p. 30). There are tangible, substantial benefits to using an external facilitator, who is able to stay focused on the planning process itself. This helps establish accountability for planning process excellence while simultaneously setting the stage for longer-term improvement. If the process ownership is centralized, and there is a channel back to it from the project teams, then ongoing process improvement can occur.

Step 1: Prepare

The preparation step begins with the facilitator working with the project manager to create a project charter. If the project already has a charter, it should be reviewed to verify that the essential elements are addressed. At a minimum, the project charter should clearly describe project scope and objectives, deliverables, a definition of when the

project is "done," resources allocated, and risks. In addition, the charter should clearly articulate the key planning assumptions. Examples include "the project budget will be approved," "the regulatory agency will not require major changes to the protocol," and "there will be no significant test failures." The plan's credibility is influenced by how realistic these assumptions are. The assumption list will be amended throughout the planning process. Charters can grow to be fairly comprehensive documents, but for the basic purposes here, a one- or two-page document is sufficient[4].

The next preparation step is to decide the membership of the core planning team. This crossfunctional team should be familiar with the project, experienced with the business, knowledgeable on the requisite technologies and underlying business processes, and tuned in to any organizational issues that would affect the project's success. Core team members should be empowered and willing to speak for their functions when it comes to resourcing and estimating. The ideal core team size is six to eight individuals. Avoid the temptation to work with a much larger team—the process will slow down appreciably. Not all functions need to be represented—only those that complete substantial pieces of work or have the potential to limit project speed. Once the team is identified, the facilitator should conduct short interviews with each core team member. The interviews can help identify potential issues that would affect the project plan, and can help begin building the relationship between the facilitator and the project team.

Also as a part of preparation, the facilitator should work with the project manager to create a high-level project plan to serve as a framework for the network build session[5]. This plan is a small (10-20) activity dependency network[6] that clearly models the relationships between the major elements of work required in the project. The process of developing the high-level plan is enlightening in that it reveals how well the project strategy is defined and how well the project manager understands his or her project.

The "prepare" step closes with an alignment meeting. The facilitator, project manager, and representatives from senior management meet to review the charter and high-level plan. Gaining alignment prior to conducting the network build session ensures that everyone has the same expectations going into the session and reduces the possibility that team plans are based on the wrong objectives or assumptions.

Step 2: Plan

In this step, the core planning team attends a multiple-day workshop to do the hard work of creating the project plan and generating the baseline schedule. Scheduling a multiple-day session is no small task in today's hectic project organization. Teams will often ask if they can split the network build session into a series of half- or one-day sessions spread out over weeks. This should be strongly discouraged, as it drags the process out and decreases efficiency and quality.

The first morning of the network build is devoted to training, charter review, and presentation of the high-level network. Training is important if some or all the team members are unfamiliar with the scheduling method being used. Because we use the relatively new project management critical chain schedule approach, up-front training is always necessary. (see the Appendix for an overview of Critical Chain). The charter review is led by the project manager and almost always takes longer than team members expect. Often, team members are not aligned on one or more items in the charter. The facilitator should

[4] For a more complete description of project charters, see the PMBOK Guide, 4th Edition.

[5] Depending on the situation and the uniqueness of the project, it may be helpful to develop a high-level work breakdown structure (WBS) after drafting the charter, but prior to building the high level network. De Reyck (2010) provides insightful guidance on how to create a WBS to further clarify project scope. In many NPD applications (as well as elsewhere), the underlying development processes tend to be standardized to the point that the high level WBS is essentially the same for all projects (for example, in pharmaceutical development, while each clinical trial is a unique project, all involve protocol development, database programming, material preparation, site start-up, etc., are major elements of the WBS). Regulations can further dictate what must be done and how it should be completed. Network build participants knowledgeable about these processes are usually able to move from charter development to high level network build without a problem. This of course may not be the case where processes and work are yet to be defined at this stage of development.

[6] Most project management books include a section on project modeling. For those unfamiliar with modeling conventions, see Wiest and Levy (1977) or Kerzner (2009).

ask probing questions when alignment seems lacking, and should not rush ensuing discussions. The charter should be modified real-time in front of the group to reflect agreed-upon positions. Many project managers tell me that the charter discussion alone was worth the time spent in the network build session.

The rest of the network build can be divided into three sections: (1) modeling, (2) estimating durations and resources, and (3) scheduling.

■ **Modeling**: The review of the high-level network begins the modeling portion of the network build. The project manager goes through the model one section at a time, stopping to take questions and ensure alignment along the way. The model should be modified in real time as appropriate to reflect the team's consensus. If significant changes were made to the project charter, it is not unusual for the high-level network to be changed as it is reviewed.

Once the team is aligned on the high-level network, detailed planning begins. The team and facilitator should build from the high-level network by adding detail until the plan is complete. As De Reyck (2010) indicates, "The model should be created using the software's network-based view (not the Gantt view) projected on a screen so that the team can clearly see the tasks and dependencies as they are added." It helps to periodically plot hard copies of the network so that the team can scrutinize the entire model and easily annotate model changes. The network is complete when all high-level tasks have been expanded to a sufficient level of detail[7].

Teams sometimes have an existing schedule and would prefer to start with it rather than starting over by building out the high-level network. While this seems like a smart move that would save time, it almost always results in a longer process and a lower-quality plan. My experience is the same as related by De Reyck (2010)—it is highly likely that the existing schedule will contain extensive modeling errors. In the rare instance when the schedule is technically satisfactory, starting with an existing schedule almost never works well. I learned this lesson the hard way nearly 10 years ago while facilitating one of my first network build sessions. The project manager had invested so much time in her 600-task schedule that I relented and agreed to use it as the starting point instead of beginning fresh. Although the team had claimed to be familiar with the schedule, it turned out that its members did not really understand how everything fit together. They would make changes only to discover later that they hadn't modeled the change correctly. After a full day of trying to work with the existing schedule, they were so frustrated that they all voted to scrap it and start over. As a result, our standard practice is to build a new schedule starting with the high level network. This does not preclude the team from referencing the old schedule.

■ **Estimating durations and resources:** If there is a key step in planning, it is this one. What seems

Defined: Multitasking versus Focused Work

Multitasking does not simply mean having multiple tasks to complete; instead, it refers specifically to how those tasks are worked. Multitasking occurs when an individual contributor switches between assigned tasks before completing any of them. For example, a scientist might spend one day each week writing a report. In this case, an (elapsed) duration of five weeks might be the estimate.

The opposite of multitasking—referred to as focused work—occurs when individual contributors work one task at a time (in priority order) to completion. Tasks are handed off as soon as they are completed. In the example, a focused time estimate would be five days (less, if productivity effects are factored in).

While the negative productivity and quality impacts of multitasking are well documented (Crenshaw 2008), it unfortunately remains the dominant work ethic in project organizations. Change is necessary when achieving operational excellence and achieving strategic goals requires timely and reliable project performance.

[7] *Judging the right level of detail is challenging. The detail should be sufficient to gain credibility and set priorities; anything beyond that can be put into checklists and notes. For large projects, modeling tasks at this level of detail can result in a very large network which can be problematic because they are more difficult to analyze and maintain. Experience shows that the most useful plans tend to be no larger than 350 tasks. If the project is so large that the team cannot create a network this size at the recommended level of detail, the options are to live with the challenges posed by a large network or to apply hierarchical scheduling (a program level schedule with linked subprojects).*

like a simple exercise is almost always complicated by organizational dynamics and human behavior. It is important to understand these dynamics because they can greatly affect the outcome of the whole planning process.

Judgment will be applied in the estimating process, so it is important for the team to agree on estimating ground rules. Clear ground rules ensure estimate consistency across team members. Two ground rules are especially important to clarify. First, an assumption is needed regarding how tasks will be worked—multitasking or focused work (see sidebar "Multitasking vs. Focused Work" on p. 32). If the assumption is multitasking, then the team would estimate the elapsed task durations (elapsed duration = focused time + time allowance for working other tasks). Second, an assumption on probability is needed—how likely is it that the task can be completed within the estimated duration? The higher the probability, the longer the task duration estimates. The most aggressive time estimates, then, are low probability estimates (for example, 50 percent) assuming focused work. The most conservative are high probability estimates assuming multitasking. I have experienced task durations that change from four weeks down to one day as a result of changing the estimating ground rules.

Once the ground rules are specified, estimating begins. If the critical path method scheduling technique is being used, then the task duration estimate is a single number. Given the uncertainty and multitasking inherent in most project organizations, team members asked to give only one number are typically uncomfortable with anything other than conservative estimates. This is especially true if team members are held accountable in their functions for hitting those durations. When excellent time performance is important, conservative estimating leads to a big problem: the team's schedule is (sometimes much) longer than leadership feels the business must have[8]. This conflict almost always results in pressure on the team to reduce the schedule by trimming their task duration estimates. The estimating process can quickly break down and become a negotiating process where final task durations depend on who has more leverage and better negotiating skills. When this happens, schedule credibility is the real loser because there is no way to objectively evaluate the resulting schedule. Task durations are an uneven mix of work and padding, and reflect the results of playing a game instead of more objective estimates of the work required to deliver the project.

If the critical chain scheduling method is being used, then two task duration estimates are specified for each task—a 50 percent probable and a 90 percent probable estimate (see Appendix). Being allowed to estimate a range of possible task durations provides team members with a mechanism to account for the uncertainty inherent in the project environment and reduces the team's anxiety level associated with the process[9]. The two estimates are used to calculate the project buffer that shows the range of possible completion dates for the project. This indicates to leadership both what is possible (the beginning of the project buffer) and what is highly likely (the end of the project buffer). Experience shows that this greatly reduces the potential for conflict between the team and leadership, maintains the integrity of the estimating process, and improves the credibility (believability) of the schedules.

All rate-limiting resource limitations should be accounted for in the final schedule. A rate-limiting resource is one that has the potential to be a bottleneck, meaning more of that resource would speed the entire project. Resource leveling is the traditional approach used in scheduling and is nicely illustrated by Herroelen and Demeulemeester (2010) in this issue. Resource leveling should not, however, always be applied. Instead, the decisions about whether and how to apply resource leveling should take into account the estimating ground rules. If multitasking is assumed in the duration estimates, one should be cautious about applying resource leveling to the schedule. In a very real sense, the padding incorporated in task duration

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[8] This problem is magnified in detailed schedules. The more detail, the more safety time (De Reyck [2010] refers to this as "padding" in his paper) is embedded in tasks and the longer the resulting schedule.

[9] Significantly faster schedules result when teams assume focused work in their estimates. These estimates are only credible if the functions agree to modify the work environment so that focused work is possible in reality. This means that a full critical chain implementation should include a plan to decrease multitasking and increase focused work in the functional areas.

Case in Point: Schedule Reduction

The very first network-build session I led was for a small plastics manufacturer that needed to get a new manufacturing line installed and operating in time to take the new material to an important annual trade show. Missing the trade show would mean the loss of significant potential sales and substantial revenue for the coming year.

A crossfunctional team was created and a three-day network-build session conducted. Going into the session, the team did not believe it would be possible to get all the required work done prior to the trade show. Despite this, team members engaged in the network-build process, built a detailed network, and estimated and scheduled it. The schedule confirmed what they believed: there was little chance of getting final production line up and running prior to the trade show. There were intense discussions as the team tried to find ways to accelerate the schedule, but nothing seemed to work.

As the team was about to concede defeat, there was a long pause in the discussions. The silence was broken when the sales rep assigned to the team asked, "Do we have to get the pilot line running before the production line? Why can't we just start with the production line?" The team laughed at first, but before dismissing this "crazy" idea, it asked me to model this option. I removed one link in the model—the one that made the production line a successor to the pilot line—and the schedule came in by three months. Making the trade show was now possible. The team dove in and came up with a way to mitigate the risks associated with the plan. It was approved by management and the project ended up being a tremendous success.

estimates already accounts for the time required to do other work. Applying resource leveling to padded task times can significantly overstate the impact of resource limitations and result in very long schedules. This is likely one reason why resource leveling is so rarely applied in practice—the resulting schedules overstate the time and resources required, and strain credibility.

Because critical chain task duration estimates typically assume focused work, resource leveling on critical resources is a necessary part of creating a credible schedule. This means that task estimation expands to include more than duration estimating; the task-level resource requirements must also be estimated. Not all resources need be estimated, but rather only those suspected as bottlenecks in the projects.

- **Scheduling:** The project schedule is essentially a feasible timetable for all project tasks considering task durations, resources, and precedence relationships for a given set of estimating ground rules and a selected scheduling approach. The first time the project is scheduled, it is almost certain that the end date will be much later than the team expects or management would accept. This is fondly referred to as the "cardiac moment" by experienced facilitators. The schedule reduction process now begins. This is an iterative process by which the schedule is compressed by challenging the modeling assumptions, making model adjustments, and recalculating the schedule. The first few iterations will address simple modeling errors, but soon the model will be seen by the team as valid, and only substantive changes to the plan itself will further shorten the schedule. These changes typically involve reducing task durations (that is, crashing), breaking links to eliminate dependencies, or increasing the capacity of constrained resources. Sometimes these discussions surface questions about scope and can lead to eliminating work that isn't necessary to achieve the defined project objective. Any time a change is made, the facilitator should ensure the team understands the implications and believes the changes are realistic. The crossfunctional discussions that occur during schedule reduction are incredibly valuable (see sidebar "Schedule Reduction" on p. 34). Eventually, the team will reach a point of diminishing returns in its effort to shorten the schedule. This occurs when there are multiple network paths of near-equal duration. Team efforts to further reduce the schedule result in the critical path/chain bouncing back and forth between these paths, such that many paths have to be simultaneously reduced to shorten the project further.

The network build session is successful if by the end of the session the team has a completed schedule

that it feels is credible (challenging yet reliable). There is tension between these two (challenging and reliable) that is greatly reduced when the critical chain scheduling method is being used. The team can evaluate the beginning of the project buffer for aggressiveness and the end of the project buffer for reliability. Because critical path method scheduling results in a single completion date, it is practically impossible to resolve this tension. Instead, the most common resolution is to seek some sort of compromise—a date that feels like a stretch for the team but might still be acceptable to leadership. As teams start cutting task durations that it believes are credible, overall schedule credibility at the team level is stretched in an attempt to increase credibility at the leadership level. Too often, nobody wins in this process. *Remember: A single date schedule when uncertainty is inherent is bound to be incredible to someone, and compromise schedules are bound to be incredible to everyone.*

Step 3: Align

Step 1 concluded with an alignment meeting to ensure all stakeholders were on the same page going into the scheduling session. The objective of Step 3 is to align team and management expectations coming out of the network build session around the completed schedule. This starts with a post-network build team session to address any outstanding issues and make final changes to the schedule. Once the team feels the schedule is final, a meeting is scheduled with the management group responsible for portfolio outcomes (usually a subgroup of senior leadership). This meeting can be challenging, especially if the team was unable to reduce its schedule sufficiently to meet senior leader expectations.

When a gap exists between the timing the team feels is achievable and the timing management wants, schedule credibility is usually put under enormous pressure. The simplest ways to escape this situation are either skip this step entirely or acquiesce by arbitrarily cutting the schedule until it meets management expectations. Both are common practices, but both fail to synchronize the organization around a single schedule. Schedule credibility can be maintained only through healthy dialogue in which both sides work together first to validate that the schedule is credible, then to exhaust all possible options for reducing the schedule further. During this dialogue, it is usual for management to expand the boundaries of what is possible and suggest alternatives that the team had not previously considered (for example, modified requirements, nonstandard processes, or additional resources). I recall an alignment meeting where a drug development team was given permission to double the number of research physicians working on a new drug submission. This was an "out of the box" option the team had never considered possible because it was well known that the supply of research physicians was critically short across the company. As it turned out, the change resulted in a three-month reduction in the planned submission date and was approved by leadership.

Step 4: Launch

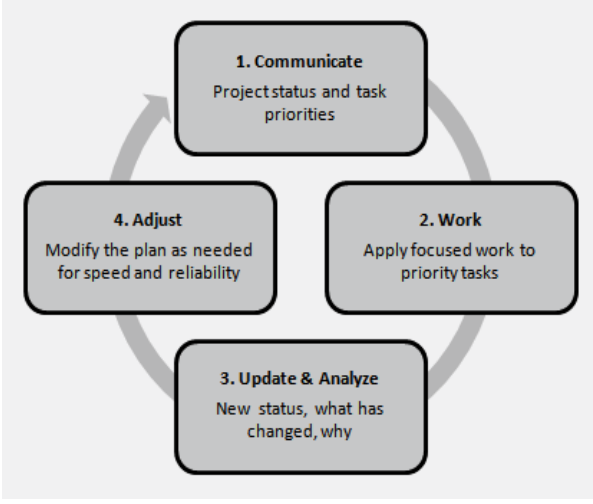
The plan is "launched" when the team begins using the schedule in the updating and reporting process described in the next section of this paper. The schedule now serves as the baseline from which progress is tracked and projections are made. The project team starts the updating and reporting process by meeting regularly (usually weekly) to review progress, compare actual status against planned status, adjust the plan as necessary, and determine priorities and task assignments for the coming week. In most cases, the launch step can and should be done in parallel with finalization, meaning the team continues to operate and make progress while team and management gain alignment.

The planning process described above has been applied hundreds of times not only in new product development, but also within IT, engineering design, manufacturing engineering, marketing, scientific research, and construction organizations. Regardless of industry, maintaining the schedule credibility throughout all steps is critical to the success of this process.

A PROCESS FOR PERIODIC PROJECT UPDATING AND REPORTING

While rigorous project planning is necessary for improving time performance, planning alone does not result in fast, on-time projects. The updating and reporting process is applied to that end and has two objectives: to ensure that the plan is followed,

FIGURE 3: PROJECT UPDATING AND REPORTING PROCESS



and to ensure the plan remains credible. Figure 3 depicts the simple four-step process that achieves these objectives. The first two steps are directed at synchronizing work according to the plan, while steps three and four are directed at keeping the plan current and credible.

The frequency with which the updating and reporting cycle repeats can vary from monthly to daily depending on the importance of the project, the amount of uncertainty being experienced, and the need for excellent time performance. In my experience, a weekly cycle is satisfactory for most projects.

Step 1: Communicate

Most project teams have a regular project meeting. Whether virtual or face to face, these meetings enable teams to regular communicate on project progress, discoveries, and issues. To achieve solid time performance, two agenda items should be considered key in every project team meeting: schedule status and task priorities.

Schedule status should be current and presented in a way that is meaningful to the team. Too often, schedule status is presented as a binary condition—on-time or late. Instead, the number of days/weeks late or early should be the regular metric. Being late is rarely seen as a good thing, so it is typical for schedule problems to be downplayed or concealed outright in hopes that either the situation will improve or some other team member will have a worse problem. Where this situation has become common practice, senior leadership needs to step in and change the tone so that actual status is valued.

To achieve speed and predictability, probably the most important weekly conversation a project team can have is clarifying the relative priority of upcoming work. Instead, I almost always hear a

Case in Point: The Updating and Reporting Process in Action

A couple of years ago, a clinical study team assigned a Phase II trial for a promising new drug compound applied the updating and reporting process using a critical chain schedule. The team had already responded to management's challenge by committing to an eight-month schedule. Everyone agreed this was an aggressive schedule.

The team built a critical chain schedule assuming focused work in their task estimates. The schedule indicated the project team could complete the trial somewhere between four and six months.

The team fully committed to applying the focused work approach. It "ran the relay race" by ensuring that everyone knew each week which tasks were time-critical. By the end of the first two months, team members were tracking to complete the trial in the aggressive time of four months.

About this time, they discovered that the trial material had been contaminated and therefore had to be remanufactured. This was an extremely rare event that would have been accepted as a legitimate reason to re-baseline and push out the completion date. Instead, the project manager added the remanufacturing tasks to the plan and calculated the new critical chain. The team reconvened and found some ways to shorten the chain by working things differently with a key vendor.

The team completed the study in just under six months despite having a catastrophic material failure midway through their project. Weekly visibility into project status and task priority, running the relay race, and the ability to re-plan in real time all helped this already excellent team deliver both quickly and reliably.

discussion of task due dates and whether or not tasks are "on time." The time-critical tasks—those on the critical path or critical chain—should receive top priority regardless of when they are due. Non-time-critical paths should receive lower priority, again regardless of when they are due. If task due dates get in the way of prioritizing tasks on the longest path, change the task due dates.

Step 2: Work

From a time performance perspective, the ideal situation for a project organization would be for individual contributors to focus on one task at a time, working their tasks in priority order to completion with as few interruptions as possible. This mode of working—called focused work—is ideal, primarily because it results in high-priority tasks moving quickly through the organization and thereby improving project speed. In focused work, time-critical tasks are treated as if they were legs in a relay race—each leg (task) is finished as quickly as possible with the baton (task deliverable) being handed off to the next runner (individual contributor) as soon as the task is completed. It is important to note that the focused work ethic need not be restricted to the most time-critical tasks. Individual contributors who don't have critical tasks still apply focused work to their tasks in order of relative priority—the closer a task is to being on the longest path, the higher the priority.

My experience indicates that focused work is countercultural relative to the multitasking work ethic found in project organizations. Individual contributors in a multitasking organization are expected to switch frequently between tasks before completing any one of them[10]. As a result, project managers must routinely intervene to get time-critical tasks prioritized. Over time, this can result in serious friction between project managers and functional area supervisors.

[10] *Individual contributors tend to value multitasking because it gives the perception of being very busy, plus it enables them to keep their task owners somewhat pacified by reporting at least partial progress on their tasks. Supervisors tend to like individual contributors who multitask because it reduces their work in resolving conflicts. Individual contributors are often rewarded for this behavior despite a body of evidence that shows multitasking results in not only a significant decrease in personal productivity, but also reduced quality.*

Step 3: Update and Analyze

Frequent updating prevents the plan from becoming irrelevant to all stakeholders. When first meeting with project managers, I always ask to see their project schedule. All too often, they shuffle around their office looking for it, finally spot a notebook sitting on a shelf somewhere, blow the dust off of it, and hand it to me. This indicates that significant work is ahead!

Three elements of the project schedule should be updated regularly: First, task duration estimates should be zeroed for completed tasks and updated for tasks in progress. Second, tasks should be added or deleted to reflect changes to the planned work. Finally, if discoveries or unexpected issues change the precedence structure in the project model, those linkages should be modified. Linkages are especially important to update because they can have a dramatic effect on which tasks are time-critical and when the project will be completed.

When the updates are entered, the schedule can be recalculated and analyzed. The extent of the analysis depends on the extent to which the updates changed the project completion date and the relative task priorities. Big changes need to be understood so they can be explained to the project team and sometimes even senior leadership. If the project model is large and/or significantly complex, analysis can be time consuming. Scheduling software varies widely in the tools provided to accomplish this analysis—strong tools can make a big difference in how effective the project manager can be in scheduling analysis.

Step 4: Adjust

When adjustments are necessary, they generally happen at one of two levels. The first level is adjusting the project plan without changing the baseline project completion date. Project completion date adjustments are made when the project completion date is judged to be in danger of being missed, or the business situation has changed such that additional acceleration is needed. The project manager is responsible for deciding on the adjustments, but often this involves convening some part of the project team to work through alternatives. The schedule plays a major role in evaluating the time impact of the various recovery alternatives

(see sidebar "Updating and Reporting Process in Action" on p. 36).

The second level of adjustment is re-baselining. This occurs when the schedule impact is so serious that no feasible plan can be found that would meet the baseline commitment date. Because frequent re-baselining erodes schedule credibility, it should be a rare event and only exercised as a last resort.

KEYS TO IMPROVING TIME PERFORMANCE

Experience has proven that organizations that are rigorous in their efforts to create credible baseline plans, disciplined in keeping plans current and informative, and committed to synchronizing focused work around those plans will experience significant advantages in time performance. An honest evaluation of your organization might reveal gaps in one or all of these areas, and crafting an effective change plan may seem daunting. As with most undertakings, the principle of leverage also applies to conducting a change implementation. If the organization focuses on a small handful of opportunities, it will gain significant improvement. I outline four tips that will improve the chances of achieving real benefits from an improvement undertaking:

Tip 1: Commit to Process Excellence

Many organizations leave decisions on how to plan and control projects to the discretion of the project managers, and each does it his or her own way (if they do it at all!). Improvement cannot begin without a commitment to standardizing and consistently practicing project planning and control processes. This commitment must come from the most senior levels of the project organization because the processes don't work without meaningful participation of individual contributors and midlevel managers in the functional areas. It takes the whole organization to improve time performance, and the fastest way to get this started is for leadership to get serious about quality project planning and control business processes.

Tip 2: Standardize on One Scheduling Method

Along with standardizing the two key project planning and control processes, the organization should standardize on one scheduling method, and ensure that method is being effectively applied on all projects. Allowing one project manager to apply critical path, another to use a spreadsheet, and a third to pick some dates out of thin air (which happens more often than you might expect or would like to believe) only serves to confuse teams and thwart efforts to establish portfolio-wide schedule credibility.

In theory, either the critical path method or the critical chain method could serve as a basis for improving project time performance[11]. They both support project modeling, task-level scheduling, and project updating and reporting. Both are also capable of providing updated project status information and relative task priorities. In practice, however, driving better time performance with the critical path method is difficult due to its deterministic approach to scheduling—single-task duration estimates yielding single-task and project completion dates. This causes difficulty in establishing schedule credibility with both the team and leadership. Without schedule credibility, the updating and reporting process—the very place where speed and predictability are created—never gets started. Deterministic critical path method schedules also enable and fortify the practice of setting task due dates, which confounds project managers' efforts to set priorities based on time criticality.

Tip 3: Develop Effective Project Managers

This is an essential element of any effort to improve time performance. It should be obvious how important the project manager is to the success of a project planning and control system. The good news is that much has already been written in support of equipping project managers, and training and certification programs abound. Given the important role the project schedule plays, it is essential that project managers be technically proficient in whatever scheduling method is chosen. The foundation for these skills can be gained in

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[11] An alternative receiving some attention now is Monte Carlo simulation. De Reyck (2010) and Herroelen and Demeulemeester (2010) discuss Monte Carlo approaches for quantitative risk assessment. As a scheduling approach, Monte Carlo has some of the same advantages as critical chain by considering the probabilities associated with ranges of times. Having personal experience implementing Monte Carlo, there are some challenges that come with the approach including difficulty gaining buy-in if the approach is not well explained or delivered to the user. To quote De Reyck (2010), "No one wants to use an approach they do not understand". I have found that unless used properly, there can be a tendency of the approach to underestimate variability in project completion times.

software training courses, but project planning and control skills are usually not fully developed until they are applied repeatedly in real-world situations. Training or certification programs that include on-the-job instruction and guidance are good ways to develop these necessary skills. In addition to technical skills, softer skills like leadership, team building, and time management can help develop the project managers' ability to be excellent in the project planning and control processes like those described in this paper.

Tip 4: Institutionalize Focused Work

Every project organization I have worked with discovered at some point how to apply focused work. They all have a story where an important project faced challenges and the organization responded with focus and resolve. Extra effort was invested in planning, updating, and reporting. The organizations had a vision and clear priorities, and applied focus to complete their projects in record time.

But the problem is that consistent, focused work is the exception rather than the norm. The norm is multitasking, which means nothing is completed particularly fast. What tends to be most important for individual contributors and their supervisors is keeping customers happy on a daily basis. Multitasking meets this need by enabling people to switch frequently (be responsive) and show at least some progress to all customers. Being able to juggle many tasks tends to be rewarded and is often much more valued than the ability to focus and complete tasks.

Meaningful progress in driving improved time performance is not possible unless the multitasking mindset is agressively attacked. Buying new tools, training project managers, or even institutionalizing new processes are of little help unless there is some change made in how project work is accomplished. The campaign against multitasking must begin at the very top of the organization and needs to be supported by a well-thought-out culture change plan.

SUMMARY AND CONCLUSION

For many project organizations, operational excellence is determined by the ability to deliver a portfolio of projects quickly and reliably. Scope, cost, and quality are important necessary conditions that cannot be sacrificed to achieve time performance, but the reality is that time performance is becoming a dominant measure of organizational success. As one example of the desirability of time performance, a pharmaceutical organization (Borfitz 2009) recently adopted a critical chain-based methodology to improve its project planning and control, with "stupendous" results; the company has yet to miss a major milestone date. The value of time performance in this industry is huge: When patents expire, generic drug manufacturers move in and undercut markets, driving revenue streams to near zero almost instantly. Therefore, the importance of excellent project planning and control in this industry (as well as elsewhere) is hard to overstate.

These kinds of improvements are not simple, due both to the complexity of projects and to the organizational issues that arise when time performance is made a priority. Organizations embark on expensive, multifaceted improvement programs hoping to cover all bases, only to find project speed and reliability remain relatively unchanged. That is why it is so important to recognize that project planning and control excellence can be achieved by focusing on two core processes—baseline planning, and updating and reporting. These two processes are crucial to synchronizing the entire organization around the fast, reliable completion of projects.

Including a discussion of scheduling approaches in a paper about PPC process risked taking the spotlight off of the most important factors in creating real improvement—those being process discipline and the improved interactions among all stakeholders. Synchronizing the roles and actions of the project managers, functional managers, senior leadership, and individual contributors leads to true subordination of the organization to the project portfolio. The discussion, however, was necessary because of the central role scheduling plays in both processes and the underappreciated influence the scheduling approach has on stakeholder attitudes and behaviors. Because CPM makes no allowance for the uncertainty inherent in all project organizations, stakeholders develop coping mechanisms that lead to conflicts that, in turn, confound efforts to synchronize the organization.

By acknowledging uncertainty, Critical Chain greatly facilitates the elimination of these conflicts and enables the organization to replace a conservative "don't be late" with the more aggressive "how can we (safely) go faster" mentality that is essential to true performance improvement.

Perhaps the most important difference between the process recommendations offered here and those advocated elsewhere is recognizing the key role individual contributors—the project "doers"—play in achieving operational excellence. So many attempts to improve project operational excellence are confined to the project management function, and then fall short because of this limited vision. Improving operations requires the active commitment of all parts of the organization, especially the resource managers and individual contributors in the functional areas. Grassroots support for these processes is important, which is why these groups are discussed in some depth. Real improvement, however, happens when the leadership of the project organization establishes a clear vision of improved time performance for the business and communicates a real sense of urgency to change the status quo.

The implementation tips offered here come from extensive experience and have proven extremely valuable in achieving meaningful change. An underlying theme of this paper has been the power of focus, and this is just as true when implementing a change effort as it is when executing project tasks. Perhaps the most leveraged of the four tips is the last one—create an environment where focused work is valued and possible. There are so many good results that come from the elimination of multitasking, an organization would derive substantial benefits if it did nothing other than wage a campaign to replace multitasking with focused work.

APPENDIX: CRITICAL CHAIN PROJECT SCHEDULING—HOW IT WORKS

The experience that forms the basis for this paper's recommendations comes from implementing the critical chain approach to project management. Critical chain is directed at achieving project speed and predictability improvements by leveraging the principle of focused work and synchronizing the project organization around credible project schedules (Newbold 2008). While many helpful books have been written on Critical Chain, the essence of leveraging the methodology for time performance can be captured in the following four steps:

1. Credibly represent the work needed to get a project team to their objectives, using a dependency network that includes tasks with aggressive durations, links, and needed resources.

2. Determine the longest chain of tasks – the "Critical Chain"– through that network, taking into account resource limitations.

3. Add time – a "Project Buffer" – to each endpoint to protect the customer or delivery from fluctuations along that chain.

4. Decouple the Critical Chain (CC) from non-Critical Chain tasks by inserting protection at each point where the non-Critical Chain joins the Critical Chain.

The scheduling method at the center of critical chain project management is an extension of traditional network-based project scheduling methods, and is designed to support the behaviors and decision making embodied in the methodology. The following simple example illustrates the basics of critical chain scheduling.

Consider the simple product development effort shown in Figure A1. Pictured is an activity-on-node network diagram where boxes represent tasks and arrows represent precedence. There are two parallel work streams (paths) in the project. Tasks 1 and 2 are on the first path and are done in sequence to complete subassembly A, while on the second path tasks 3, 4, and 5 are accomplished in sequence to complete subassembly B. The two paths join at task 6, where the final product is assembled and tested. Box 7 is not a task but rather a zero-duration event (milestone) indicating the project's completion. The duration and resources required to complete each task are noted at the bottom of each box. Note that when creating critical chain schedules, the task duration estimates assume that no multitasking is occurring and that focused work is being applied. This means that the duration estimates are substantially shorter than typically found in most project organizations[12]. All tasks in this example require one unit of the speci-

FIGURE A1: NETWORK DIAGRAM FOR EXAMPLE PROJECT

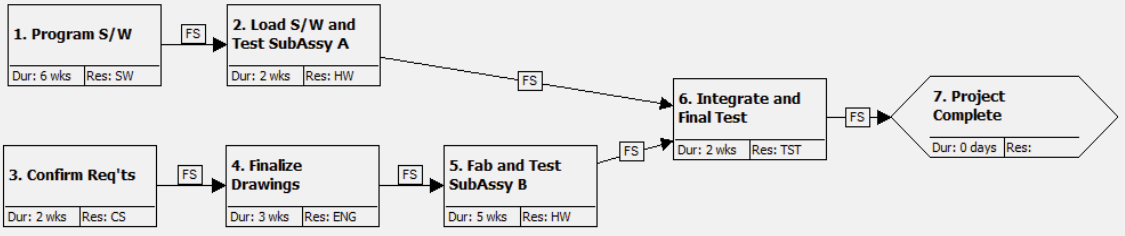
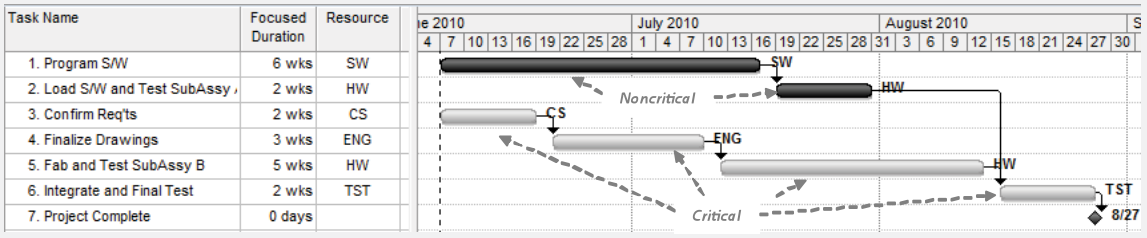


FIGURE A2: GANTT CHART FOR EXAMPLE PROJECT



fied resource[13]. The only resource that is needed on more than one task is the hardware resource, which is required for both tasks 2 and 5.

The Gantt chart shown in Figure A2 shows the timetable that would result from a simple critical path calculation. In this case, the critical path is the task sequence 3-4-5-6 with a total duration of 12 weeks[14]. Tasks 1 and 2 are noncritical (from a timing perspective) in that there are two weeks of extra time (slack) that could be used to absorb delays or issues without making the project longer than 12 weeks. The schedule shows tasks 1 and 2 starting as early as possible, which is traditional in critical path method scheduling. One drawback of critical path method scheduling as typically practiced—the absence of resource leveling—is discussed by De Reyck (2010) and Herroelen and Demeulemeester (2010). If, for example, only one unit of each resource type is available, then the schedule in Figure A2 is infeasible in that two units are required in the time between the start and finish of task 2. Note that this is only an issue if the task duration estimates are based on the assumption of focused work. If duration estimates include an allowance for multitasking, applying any sort of leveling algorithm would likely over-adjust for resource limitations.

The critical chain schedule for the example project depicted in Figure A3 was generated with the ProChain® Project Scheduling (v9.4) software add-in to Microsoft® Project. Since critical chain schedules are built from focused time estimates, resource leveling is an integral part of creating a critical chain schedule. This is illustrated by the offsetting of tasks 2 and 5 in the schedule. Because these two tasks are offset, the longest path now includes task 2 and the sequence is now 3-4-5-2-6. This resource-leveled critical path is called the criti-

[12] *Focused task duration estimates are assumed to be 50 percent probable. Focused duration estimates are used to level and identify the critical chain. The user is allowed to specify the 90 percent probable duration for each task. If none is specified, a default value of two times the focused duration is assumed.*

[13] *While the example shows only a single unit of one resource type assigned to each resource, the ProChain software allows for the assignment of multiple units of multiple resource types to any tasks. An assignment of multiple units of different types would be represented in MS Project something like "Res: HW[2], SW, ENG[3]."*

[14] *Note that few if any experienced project managers would ever apply the critical path method to this network and commit to a project schedule of 12 weeks. Task duration estimates that assume focused work and make no allowance for the realities of uncertainty, risk, non-instant resource availability, etc. would result in a schedule with a very low probability of completion on-time. When the critical path method is used, the task duration estimates are increased (sometimes dramatically) to make allowances for project realities.*

FIGURE A3: CRITICAL CHAIN SCHEDULE FOR EXAMPLE PROJECT

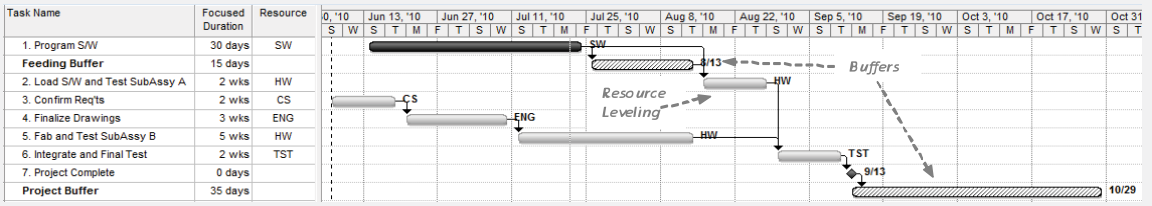
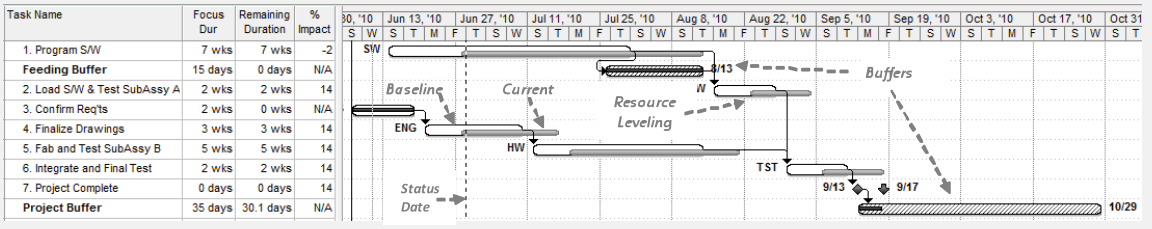


FIGURE A4: UPDATED CRITICAL CHAIN SCHEDULE FOR EXAMPLE PROJECT



cal chain. The other addition to the schedule is a series of explicit time buffers added to allow for the uncertainty inherent in the project environment. A project buffer is added at the end of the critical chain, and the project due date is established at the end of this buffer[15]. Feeding buffers are inserted wherever noncritical tasks link to critical tasks—in this case, only one is needed and it is placed between tasks 1 and 2. Task 1 is no longer started as soon as possible; instead the insertion of the feeding buffer determines when this task should be started. The size of a buffer depends on the cumulative amount of risk in the tasks leading into that buffer—the more risk, the larger the buffer. A user-determined percentage of this risk is applied to establish the final buffer sizes. In the example below, default values are assumed, resulting in a feeding buffer of 15 days (three work weeks) and a project buffer of 35 days (seven work weeks[16].

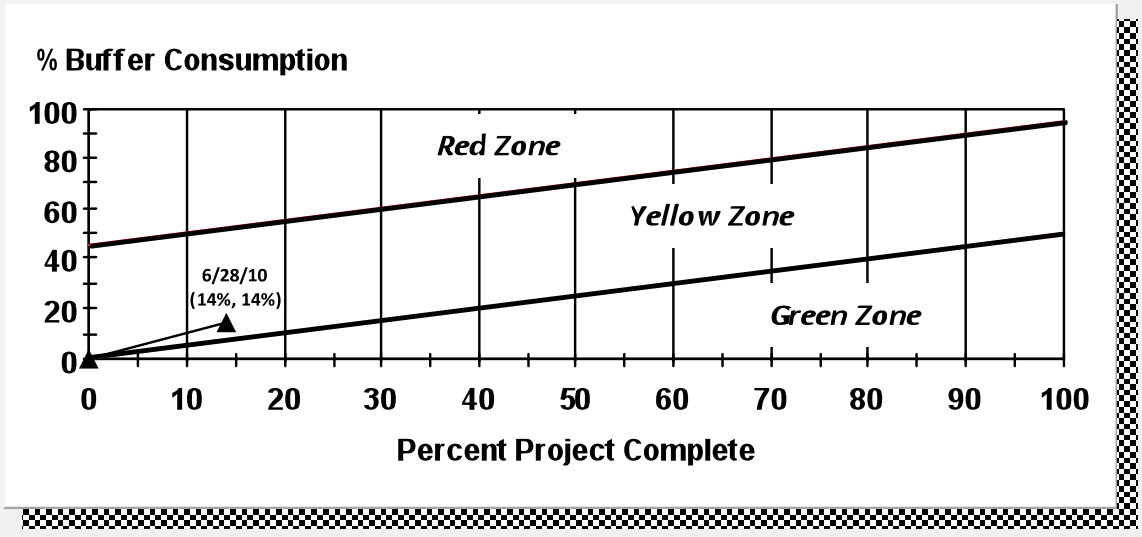
The critical chain schedule is specifically designed to support the relay race behaviors required for quick project completion. Figure A4 shows how this is accomplished by depicting the schedule status after three weeks of updating (vertical dashed line indicates the update date). In the scenario depicted, the only real progress made was to complete task 3. The handoff was made to engineering, but it has yet to start task 4. The software group was supposed to work task 1, but not only did it not make progress, but it also increased its task duration estimate from six weeks to seven weeks. The baseline schedule in Figure A4 is depicted by black-outlined task bars, while the current (updated) schedule is shown by gray half-height bars. The delays have resulted in the feeding buffer being entirely "consumed," while 14 percent of the project buffer has been used. The projected finish date has moved from 9/13 to 9/17 but still is ahead of the 10/29 due date.

Overall project status can be effectively communicated by plotting project buffer consumption against progress made in finishing the critical chain. Converting these to percentages enables the simple "fever chart" shown in Figure A5. With each successive update, a new plot point is added to the chart. If the relay race behaviors are applied and technical surprises are all manageable, little project buffer will be needed and the plot line will travel in the lower part of the graph. If problems and delays are experienced and project buffer is used faster than progress is made on the critical chain, the plot will move vertically. When it travels into the yellow zone, project teams

[15] Schedules can have multiple end points—for example, product launch in the US and product launch in Asia. The final schedule will identify the critical chain for each end point and there will be a project buffer created to protect the finish time of each end point.

[16] The buffer is sized by summing the difference between 50 percent and 90 percent durations along the longest path feeding the buffer. A user-determined factor (0 percent to 100 percent; default value is 50 percent) is applied to compute buffer size.

FIGURE A5: STATUS CHART FOR EXAMPLE PROJECT



Project Buffer "Fever Chart"

should determine their contingency and recovery actions. When it crosses into red zone, those actions should be implemented.

Perhaps the most important function for the critical chain schedule is to determine relative task priorities. It would seem that task 1 is in the most trouble having been delayed several weeks and extended in duration. The reality, however, is that task 3 is the most important task and should receive the most attention. This is because task 1 was originally noncritical and protected by a feeding buffer, and while the feeding buffer has been entirely consumed, the delay in critical chain task 3 has provided task 1 with some additional slack time. While it is easy to see the situation in this simple network, real-life projects are much more complex. ProChain software calculates a task parameter called "percent impact" to help sort out relative task priority—the higher the percent impact, the more important it is to focus on that task. Figure A4 shows that task 4 has a higher percent impact (14 percent) than does task 1 (-2 percent).

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