A White Paper on

Maximizing the Project Throughput
of an Organization

Using Total Matrix Management

Faster Projects – Agility

More Successful Projects – Speed

Over 90% On-Time Completions - Accuracy

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Executive Summary

Projects are the life blood of all organizations. The successful completion of projects provides the oxygen to all of a business' operations, both internal and external in nature. To be without projects is to be stagnant and unchanging – a precarious status in our current global business climate.

Projects often require expensive expertise or equipment. Once these individual expensive resources are acquired, it immediately becomes evident that a strategy needs to be created where these resources can be shared throughout the organization. This is the underlying motivation for the creation of the organizational structure we call the Project/Resource Matrix which is so common in business today.

In almost all mid- to large-size companies, the completion of projects occurs in a matrix organization. Anyone who has spent any time in this type of environment realizes that there are always some resources which are in limited supply, and the projects are in competition to gain access to these resources.

The problem with matrix-based operations is that historically, there has been a complete lack of a strategy to manage the matrix as a unit. Instead the management process which has been pushed and emphasized is classic Project Management. This white paper discusses a management technology which manages the matrix as a whole. The result is that hidden capacity in the system allows the number of successfully completed projects to at least double while the average duration of projects is halved or more – all with the existing staff.

This increase in capability – more projects completed in less time – can have several major positive impacts on an organization. The most obvious occurs for organizations which constantly release new or upgraded products to the market. In this case the improvement in speed to market along with more new and improved products, results in an increase in the bottom line of about 10% to 80% of current sales.

Increasing the capacity to complete projects can be very beneficial if it is done before organizations invest in new major management processes – e.g. SAP, Six Sigma. Without the increase in the capacity the additional projects required to bring the new management processes on board often overloads the system causing a huge increase in implementation costs beyond the original estimate

The primary differentiator of this management technology approach is that it emphasizes increasing revenue for the bottom line rather than a self-limiting strategy of cost savings.

This paper takes an in-depth look at today's business systems and discusses the concepts and straightforward tactics which allow them to be optimized for maximum revenue generation using the existing staff. We refer to the management technology as Total Matrix Management (TM^2).

The Fundamental Business Models

Introduction

Total Matrix Management (TM^2) is a management technology which directly optimizes the number and quality of projects completed by a business with its existing staff. The importance of this capability is directly correlated to the effect projects have on the bottom line. The tool is generic – it works with any industry that does projects. The industry may be high tech, chemicals, software, food technology, pharmaceuticals… The largest improvements in the bottom line occur when there is a direct tie between project activity and revenues.

To senior management, the project-level issues are often details that are below their radar unless a particular large corporate project is experiencing delay. Although they have a responsibility to ensure that the organization is producing as much output as possible, the current project management processes do not include effective senior management roles. This makes senior management a customer of the project outputs with very little opportunity for constructive input or support.

How did we get here? Although it is not overtly apparent, most businesses run with an Additive Model of their business. The common belief is that when the workforce is optimized to spend the maximum amount of time to task rather than overhead, the output of the organization is also maximized.

The Additive Model is the source of the common fundamental belief that a well balanced operation is optimized when everyone spends 100% of their time on task. Unfortunately the Additive Business Model is fundamentally flawed, and outrageously violates the Interaction-Centric Business Model that properly describes almost all businesses today. In short, the goal of balanced capacity with everyone working 100% to task is an anathema to a truly efficient operation.

TM^2 approaches the need to complete more projects in less time than before by focusing on the total collection of projects in the enterprise and the resources which are used to run them. The paradigm shift occurs when it becomes obvious that the management of the resources is the first step in outrageous improvement of project completion logistics. The other challenges to the common intuitive approach to project management come from changing a single key policy, a single operational measurement and a single performance measurement to create the huge improvement in project output.

There are 10 major organizational benefits which are a result of TM^2.

Table 1 Organizational Benefits of TM[2]

1. Senior management sees a significant sustainable increase in the bottom line.
2. For the first time the full matrix of projects, resources and timing is managed in its entirety unleashing the full capacity of the enterprise.
3. Everyone in the organization has a clear view of the current active projects and the need for their contribution.
4. The typical resource employee lives in a low-stress environment where there is a universally agreed upon proper sequence to the tasks in their in-box – the need for heroics is eliminated.
5. Project managers get management and resource support for their active projects in a timely manner without contention or conflict.
6. Resource managers at all levels gain far greater control over their resources and their contribution to the success of the company.
7. Senior management gains real-time operational measurements which allow for early detection of problems and delays, while there is still time for achievable remedies.
8. The front-end planners gain the confidence that the projects they identify can happen as promised.
9. The extra capacity allows more early stage what-if studies to increase the odds that a major winner may be discovered.
10. The organization is significantly more agile – emergency or major business opportunities can be handled with much greater speed than in the past. The cost to insert these projects into the system can be explicitly determined, so that the business decision is a well informed one with quantifiable overall benefit rather than just an intuitive argument.

This white paper discuses the fundamental business models, identifies the damaging policies and measures in place today, and shows how to make a few surgically precise changes to the organization to release the hidden capacity to complete projects.

The Additive Model

Early businesses could directly relate the amount of product produced to the number of people working. If one worker produced 2 pairs of shoes in a week, two workers could produce 4 pairs of shoes in a week. In fact we were taught this type of thinking in elementary math: "If 3 cobblers could product 6 pairs of shoes in a week, how many shoes could 9 cobblers produce in a week?...(18)" The concept is intuitive and appears correct even if the math may have made our head hurt when we first were learning it.

Figure 1 In Additive Systems the Output is Directly Proportional to the Number of Hours Worked

As businesses grew, managers started rewarding workers by paying them by the piece. At the turn of the century, the attempt to eradicate the sweatshop worker environment resulted in piecework compensation being made illegal. To replace it managers moved to an hourly rate to compensate workers. This is the source of the belief that there is a direct value to the business for every hour worked, and is a fundamental concept in the Additive Business Model.

For decades, we used mechanical tracking to keep track if an employee was present – the time clock. With the advent of the computer we have made it possible to track not just attendance, but actual time-on-task of all of the work performed during the day.

This continued use of the Additive Model is the foundation of "cost based accounting". In cost based accounting, the expense of the incremental labor, and cost of facilities is distributed across product to determine a cost basis" for each unit sold. Although this appears to be a valid process, it has been shown to lead to poor investment decisions. In their book[1] John and Pamela Caspari give rigorous proof that cost-based account consistently creates erroneous projections of the benefit of a given business decision.

One other major innovation occurred in the 1960's – the creation of matrix management. Professions had became evermore complex, and the age of the generalist who could do all things well ended with a resounding thud. Now teams of experts were required to complete the required projects. Very few projects could afford to hire the complex set of skills needed to be competitive in the new complex world.

Enter matrix management. The matrix is the process of having the expensive resources (people and equipment) hired and purchased by the enterprise, and then shared across the individual projects which need them. The matrix creates a major savings over the "skunks works" model where each project hires and purchases all of its resources independent of any other project within the company.

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[1] Management Dynamics, Merging Constraints Accounting to Drive Improvement, John Wiley and Sons (2004)

RESOURCE

	A	B	C	D	E	F	G	H	I	J	K
1	X				X					X	
2		X				X	X				
3			X		X			X		X	
4		X		X	X				X		
5					X		X				
6	X			X	X	X		X			
7							X				
8		X			X	X		X			
9		X	X	X	X				X		
10				X	X	X				X	
11		X	X	X		X			X		X

PROJECT (row labels 1–11)

Figure 2 The Matrix Organization is Intended to Improve the Efficiency of Resource Utilization

Thus the matrix of Projects and Resources was formed. We are no longer a collection of individuals who independently perform all of the steps to make a product. If you compare the matrix operation with the old Additive system where one worker can do all that is required to make the single pair of shoes, we see that the path is not clear to extending the Additive concept to the matrix organization. However without a replacement for both the model and the controls, the matrix operation continues to be managed using the Additive view of the world.

Through the use of computers we have become more and more efficient at applying the incorrect Additive Business Model in the performance of matrixed work.

The Interaction-Centric Business Model

The problem with the Additive business model is that it cannot properly account for the fractional contribution of multiple people in the completion of a task or operation. Because we are integrating the cost of every piece of labor along the way it appears that the incremental value is added at each step of the process (cost based accounting). However the problem is that a half finished shoe has no value. Only when the pair of shoes is complete is there any value.

The Interaction-Centric Model takes into account that any output from the organization requires the combined effort of many interacting people. Individual contributions (tasks) are logistically connected, and the work must be done at the right time in the right order. No longer can any individual work independently of the group.

The order that the work is performed is critical. It is worthless for the eyelets to be improperly inserted in a piece of leather before it is cut for a given the shoe. Performing all of the tasks in the right order is a set of interacting processes that at its end produces the final pair of shoes and hence value for the business.

Figure 3 In Interaction-Centric Systems the Product Only Has Value Once It is Completed

In the real world, the eyelet insertion process is used on many different shoes. The availability of this capability for one shoe is dependent of it first completing its current task for a different pair of shoes. This link between the manufacturing of specific items and resources to do the specific process steps causes the all of the shoe product lines to interact and they are no longer independent activities. It is this interaction that is completely missed in the management processes designed for Additive systems.

The interaction between the manufacturing of specific products caused by shared resources is directly analogous to the case of multiple projects in a matrix system where one or more resources are shared. The sharing of resources links all the projects together and they cannot be effectively managed as independent activities. This is the essence of the Interaction-Centric model – *projects directly interact through the resources*.

The fundamental result is that "improving" project management does not address the problem. The resources are where the constraints lie, and proper management of the resources is the key to eliminating the negative interactions between individual projects.
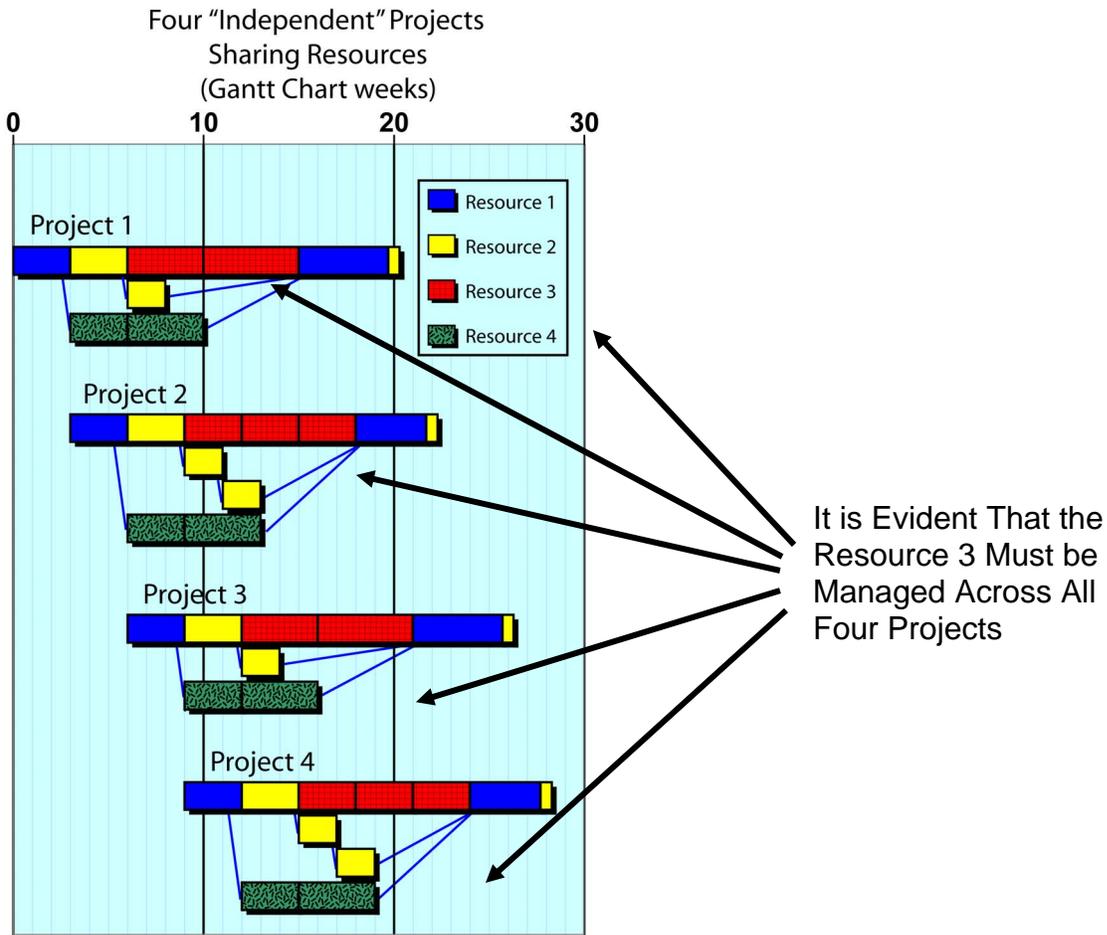
Figure 4 Projects Interact Through the Shared Resources

A simple action can be taken which allows the old Additive model to be valid. Stop all sharing of resources. Eliminating the matrix eliminates the project/resource links. This is in effect the concept of "skunk works[2]" where critical projects are given all of the resources required, free and clear of any other responsibility

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[2] Kelly Johnson of Lockheed is often attributed as the founder of the current concept of Skunk Works. The SR-71 is an example of a dedicated Skunk Works project.

Advantages:
- Speed is phenomenal.
- Each project has a fully dedicated team.
- Plans can optimize "within-project" interactions.
- Project Mangers have real authority.
- Task-level prioritization is optimum.
- Cross-project interactions do not exist.

Disadvantages:
- **The cost is often 10X higher than when resources are shared**

Kelly Johnson of Lockheed used the Skunk Works approach to develop the SR-71 Spy Plane in Record Time

Figure 5 Skunk Works Aren't Perfect

The single drawback is that this approach is overwhelming expensive, and it is almost impossible to construct any profitable business argument for the approach.

So how do we manage the interaction between the projects and the resources? Enter the Total Matrix Managementtechnology.

Total Matrix Management(TM^2)

Overview

There is a rigorous management system which can be used to address enterprise management of the entire matrix. This management technology is called Total Matrix Management (TM^2).

The key to the TM^2 technology is the recognition that the matrix organization has two dimensions which must be managed in a unified manner at the enterprise level. Unlike all other project management approaches which treat the matrix as though it is a problem with the projects, TM^2 views the matrix as a set of interactions between the projects and the resources.

In the classic project manager approach to running the matrix, it becomes apparent that the delays are almost always in the completion of tasks by the resources. TM^2 applies the Theory of Constraints view of the world that, "a system's outputs are determined by its constraints". When we examine the matrix, we see that the primary constraints are in the resources not the projects. Until the task completion constraints are properly managed, the projects cannot be managed.

As an aside, once the matrix of active projects and resources are properly managed, then attention can be shifted to better up-stream methods and down-stream methods. The up-stream methods can include better capture of customer needs (E.g. QFD) and increased innovation. The down stream methods should address improving the leverage that the finished projects can bring to the company. For example if the projects increase the number of products, it could be very important to examine and improve the supply chain.

When applying TM^2, the initial action is to remove multitasking of the resources. Multitasking in this paper refers to the concept that a single resource has to make progress on two different project tasks simultaneously. Stopping multitasking does not mean that a resource cannot work on more than one project, nor that the first project must be completed before work is started on the second. It only means that the resources only work a single task at any given time, at a full level of effort, and to the exclusion of everything else until the task is completed.

At this point it is necessary to explain that the size of a task in TM^2 is significantly different (shorter and better defined) from the tasks as they are conventionally defined today. Proper task definition insures resources are able to effectively work on one task in their in-box at a time. The reason that this is happening is that the tasks are described properly. For TM^2, we define a task as work:

A. Completed by a single resource
B. When it begins the resource has all of the necessary inputs (they are not going to require other inputs later)
C. The last step in the task is to hand off a deliverable (there are no interim deliverables)

It is evident that in classic project plans defined "tasks" are often a collection of several tasks as defined by the TM^2 system.

Even when multitasking is eliminated, it is still possible to schedule multiple projects requiring the same resource. This is done by timing each project so that the shared resource is never scheduled for more than one project at a time.

Now if we have dozens of resources and dozens of projects, this scheduling appears to be horrific in complexity. Again, the concept of constraints is applied. In any given enterprise there is one or maybe two resources which are the rate-limiting resources for the majority of projects. These are by definition the constrained resources, and are used to create a critical chain of task activity through the active projects.

The Gantt Chart below implies that the solution is simple. The classic software tools are designed to allow resources work a percentage of the time across multiple projects (multitask). The standard tools have to be fooled into creating the proper enterprise plan. Software tools designed for TM^2 are discussed in the section "Tactical Implementation of TM^2".

Project Enterprise with Managed
Shared Resources
(Gantt Chart weeks)
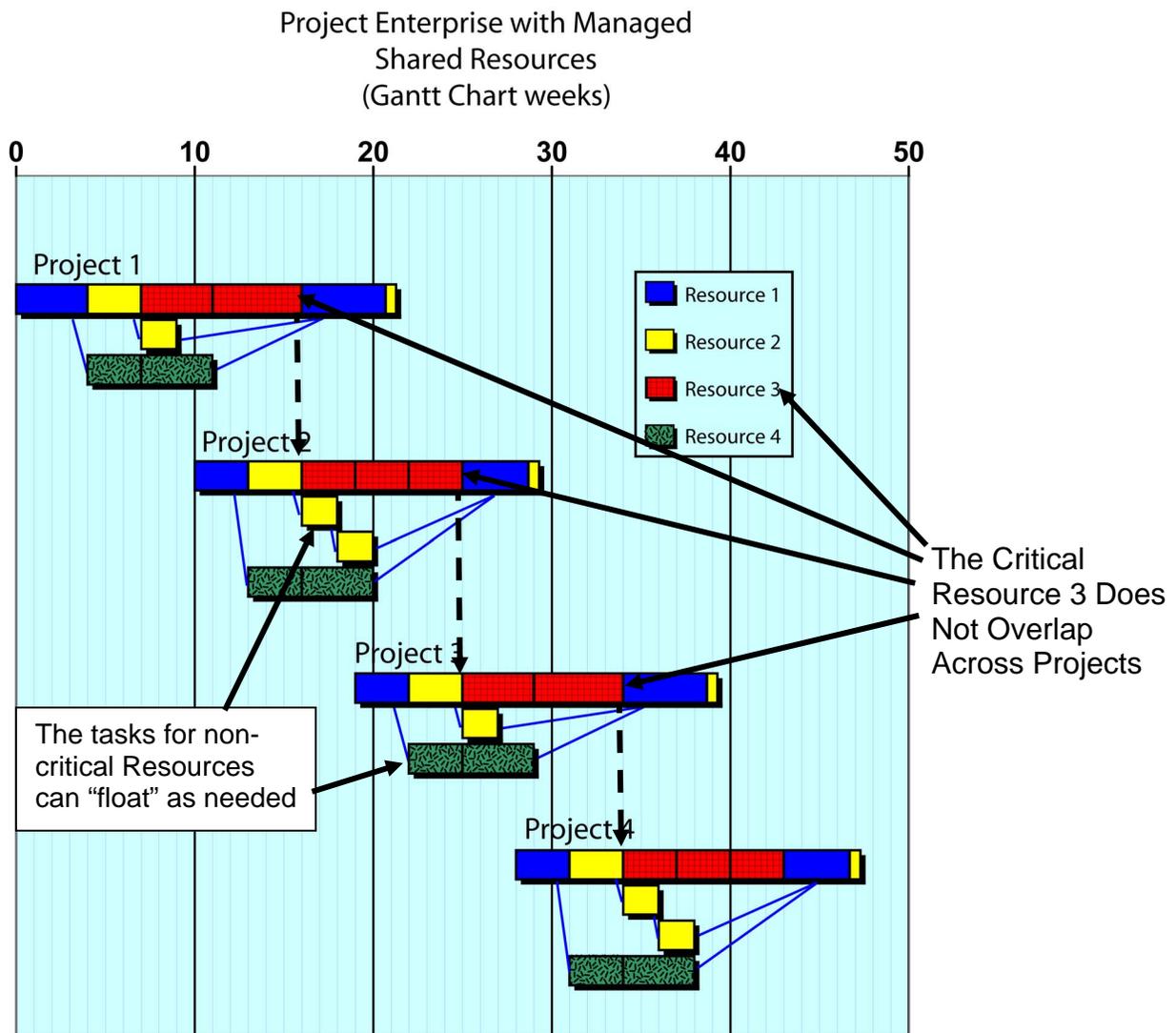
Figure 6 TM^2 Properly Schedules the Projects to Eliminate Multitasking of the Resources

We can see that the Critical Resource sets the pace for the entire project completion system.

The Gantt Chart implies that projects will be completed in some order. In order for the most important project to be completed first, it must be launched first. In fact, once projects are launched, their priority is automatically defined by the order they are released into the system. The launching of a project in the enterprise is on a pull basis. When there is scheduled capacity of the Critical Resource, the next project is released. Whether this is the "correct" one depends upon the Strategic team prioritizing and sequencing the list of projects waiting in the queue.

Once the constrained resources are properly identified and managed, the scheduling of the projects typically allows the remaining resources to be scheduled as is convenient. When one looks at the new schedule of projects it becomes obvious that there is excess capacity in the non-constrained resources. This is not only OK, it is a necessary condition for success. If one were to attempt to "balance" the organization by removing all of the excess capacities, the entire set of resources will become constraints, and work will virtually come to a stop.

Until a project is launched, it can be reprioritized and rescheduled at will. At the time the enterprise is ready for another project only the first project in the list is released. Once that project is in the system the queue can again be adjusted so any new marketing/business information can be factored in and the list adjusted. The desire to reprioritize the list presupposes that a proper business evaluation system is in place. This varies from business to business and is not addressed in this paper. QFD is one technology which can help in the prioritization process.

Figure 6 above has a very scary message hidden in it. If you look at the Critical Resource it is fully scheduled 100% of the time. However the other resources have many gaps where they do not have any assigned work. Resource-3 (the critical resource) workers feel the warm glow of job security. The rest of the workers regularly have periods requiring that they do not have task work. Unless there is an explicit acknowledgement that this is considered a very desirable result, intelligent people will either reduce their work output or create additional work (that often increases the load on the constrained resource) to eliminate the gaps.

Given the choice which should an organization strive for - the slow down, or the full level of effort? If you want the full level of effort, then you cannot punish the staff for creating the periods of zero task work. It is at this point that many organizations fail miserably.

In today's business climate, resources which routinely demonstrate excess capacity are subjected to a "cost management" cutback. This paradigm must be significantly modified before TM^2 will function successfully.

Queuing theory REQUIRES that in order to achieve a system's maximum throughput, many parts of the system be idle at times. Removing this "excess" capacity does two things. It tells the employees that they MUST never be idle (and consequentially slow down the project stream), and it makes every resource a constraint. The little savings realized by reducing the excess capacities will inevitably be rewarded with a major reduction in the enterprise's overall

capacity. Simply put, if you would rather cut costs than increase revenues, don't waste your time with TM^2. Instead, reduce your staffing with glee.

If several significantly different types of projects occur in a given enterprise, it is possible for more than one rate limiting resource to exist across the different types of projects. For this discussion we initially are looking at similar types of projects using approximately the same set of resources.   Thus we will start with a single limiting resource. Few organizations have more than three resources which behave in a critical fashion. When more are identified, it usually means that too large of an organization has been defined as the enterprise. This is easily solved by defining multiple independent "enterprises" – project/resource matrices which in general do not share resources with each other.

It is impossible to complete projects faster than that dictated by the Critical Resource. With this in mind, it appears that our existing project world has a rate limiting feature and we should not expect any increase in output without increasing staff. In most organizations this is a FALSE hypothesis. In reality, implementing TM^2 in most organizations increases the rate that projects are completed by a factor of two or more. We refer to this improvement as an increase in project completion rate or Enterprise Speed.

Another result of implementing TM^2 is that the average duration of projects (of identical complexity) decreases by a factor of two or more. We refer to this as an increase in the Enterprise Agility to complete projects.

Finally, once the enterprise system is under control, the Accuracy of on time completions increases to over 90%. This is not to say that variation disappeared, only that we are much better equipped to model it and make predictions with high confidence levels.

So in summary, the TM^2 management technology focuses on changing a small specific set of management policies, and using operational measures which properly indicate the performance of an Interaction-Centric system. There is excellent evidence in industry that once these changes are completed, the TM^2 system is easy to operate. The challenge is in the transition.

A typical weekly cycle of operation of TM^2 is as follows:

Step 1. **End of the day Friday or first thing Monday morning:** The resources report any completed tasks, and for their current task, the number of days of work remaining. (typically 10 minutes of work for each individual working on project related tasks)

Step 2. **Monday Morning:** The project managers input the information from the resources and update the project plan in the tracking software. If any tasks are having problems (the project tolerance is large) the project manager has the morning to document the problem and any perceived logistical or technical impact on the down stream tasks. The updated projects are sent to the enterprise analyst. (About 10 minutes per project to update, and all morning to deal with problems).

Step 3. **Monday Afternoon:** The Enterprise analyst takes the updated individual projects and levels the projects across the enterprise. Any problems reported by the project managers are documented. The analyst then sends the weekly report to the Tactical

Management team so that they can prepare for Tuesday's meeting. In a large organization there are always a few projects that are experiencing delays. Thus this usually takes most of Monday afternoon for the enterprise analyst to perform the update, and summarize the problem areas.

Step 4. **Tuesday morning:** The resource manager who has one of his/her staff having problems with a task works with the individual resource to determine how to fix the problem and determines the options for getting back on track. If there are no problems the report from the enterprise analyst is reviewed for accuracy and to determine if there are potential problems on the horizon.

Step 5. **Tuesday early afternoon:** The Tactical Matrix Management Team meets and decides what actions need to be taken so that the enterprise output will be optimized. As a group they answer the three golden questions. What went wrong? How do we fix it? What do we do to avoid the problem in the future? (This meeting is rarely more than 1 hour long.)

Step 6. **Tuesday late afternoon:** Any changes to the enterprise project plans resulting from the decisions of the Tactical Matrix Management Team are incorporated in the enterprise project model. On rare occasions the priority of a given project is changed in order to get it back on track. This requires additional time. In the very rare case where a project has met a major obstacle requiring that it be replanned, the project's new schedule needs to be in effect "relaunched". This is outside the normal cycle. (Usually the analyst has the updated enterprise project model completed, by the end of the day Tuesday).

Step 7. **End of the day Tuesday or Wednesday morning:** The updated enterprise plan is pushed out to all of the resources who check to see if there is any change on their task assignments. Usually the only change is in reordering of the tasks in the in-box. On rare occasion is an ongoing task tabled for a more urgent task.

The weekly cycle quickly becomes the norm, and the resources find it almost trivial to report their status in an accurate and timely manner. The project managers find that unless a major problem is encountered, the day-to-day operation of their projects is handled by the resources. The project manager's role becomes one of much higher strategic activities (project planning) rather than as a negotiator for resource allocation. The enterprise analyst finds that in most cases they are doing mostly a reporting function. The true mettle of the enterprise analyst occurs when emergency projects are brought on board, and the various what-if scenarios need to be examined to see how to insert the additional work into the active projects. Finally the resource managers find their role on the Tactical Matrix Management Team to significantly increase their ability to manage their resources.

The next section covers how the improvement to the organization can affect operations and marketplace position.

Understanding Enterprise Agility

The ability to complete projects in a shorter time improves Enterprise Agility in the marketplace or within the organization. We use the average project duration to measure Agility – the shorter the average duration, the higher the Agility. Project duration is defined to be the number of calendar days it takes to complete a project, not the number of days of effort. The total number of days of effort applied to a project is usually larger than the elapsed time on the calendar due to tasks being run in parallel, and/or more than a single person working of a given task.

The business advantage of Agility comes from consistently beating your competition to market with good products. The faster project completion rates can be used to both be faster to market and to allow for higher project complexity to create a better product on the first try.

W. Chan Kim and Renée Mauborgne have created a Blue Ocean metaphor[3] for products which make competition irrelevant. Your turn your market into a "Blue Ocean" by constantly putting your competitors in a mode where they are responding to your innovation rather than leading with their products. This requires that you routinely beat your competitors to market.

Using TM^2 in your product development enterprise can give you this effective "maneuver warfare" advantage. In "Appendix A: Measuring Enterprise Agility with the Boyd Interval" we discuss the concepts of maneuver warfare as codified by John Boyd. His concept is to consistantly be that "little bit ahead" of your adversaries. This is a very aggressive approach to business which is impossible to implement unless you have the ability to sustainable be faster to market than your competitors. Thus it was an unattainable strategy for most companies until the advent of TM^2.

- USAF fighter pilot, instructor, and engineer.
- Taught fighter tactics at Nellis AFB.
- Known by fighter pilots as 40-second Boyd.
- First to codify Maneuver Warfare.
- Designed the ground-war strategy for the 1991 Iraq conflict.
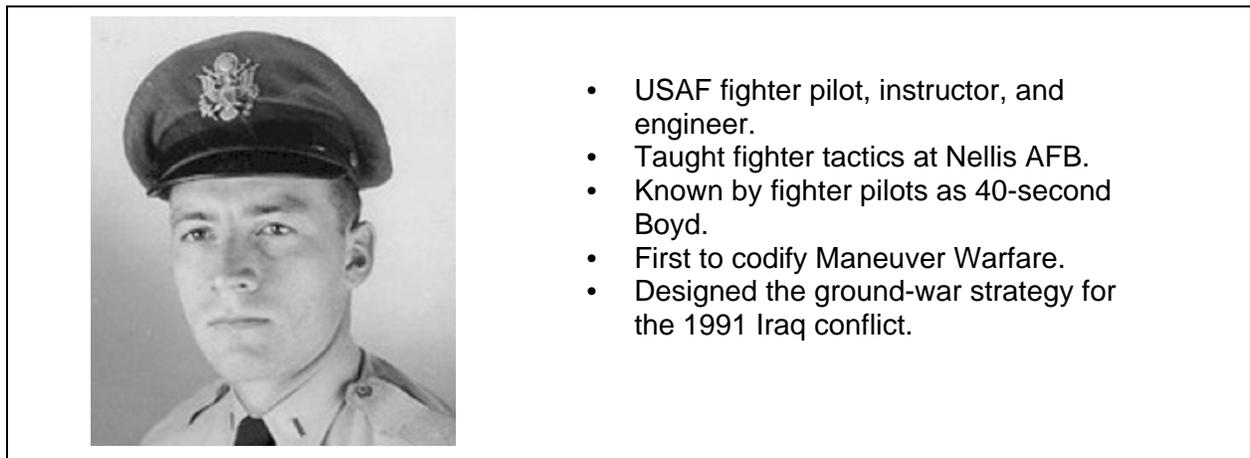
Figure 7 Col. John Boyd Credited with Codifying Maneuver Warfare

So the primary advantage of Agility is to dominate the marketplace with the right products at the right time. For many companies this improves the entire supply chain and mitigates pricing and other classic commodity product issues. It is almost impossible to put a generic dollar value on

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[3] Blue Ocean Strategy: How to Create Uncontested Market Space and Make Competition Irrelevant, Harvard Business School Press

this improvement, but most organizations can develop some estimate. For companies which routinely do projects for new and improved products the business impact can be immense. So the goal is to sustainably increase market agility by reducing the average project duration while maintaining or increasing the scope of the existing projects

The primary cause of extended project duration in the classic matrix organization is multitasking. In the classic matrix management world, there are several policies which force people to multitask their time. The discussion below focuses on the detrimental effect multitasking has on Agility.

When a resource is assigned a fraction of their time for several projects they have a choice to work each project task to the exclusion of all others until it is done or they can perform some work on all of the tasks currently in their in-box.

The need to multitask comes from the resource having no way to resolve priorities for the several projects to which they are assigned. Organizationally someone should prioritize the projects so this conflict is resolved before the resource even sees the work. However in most organizations it is easier to allow the resource to multitask, and to routinely identify individual critical programs that go to the front of the line. In some organizations this can happen on a weekly basis.

In business today, multitasking is ubiquitous. Multitasking is destroying project Agility. The proof is simple. Imagine a task that should take one week for the resource to complete. Now add a second one of identical complexity. If no multitasking occurs the first task is completed followed by the second one. It takes about 2 weeks to finish the two tasks (assuming some variability). On average the resource's output over two weeks is 2 tasks, and over 1 week the average output is 1 task.
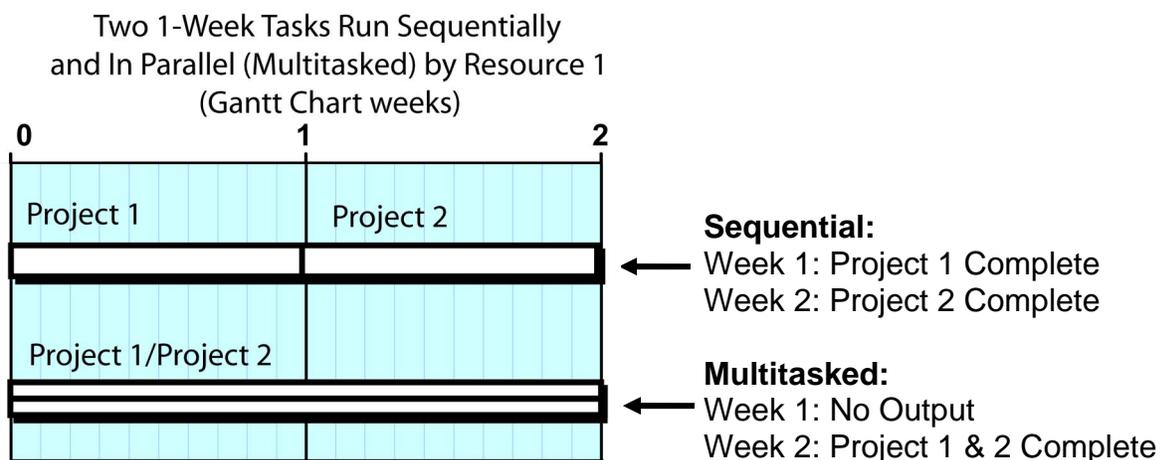
Figure 8 Multitasking Example Using Two Projects

Now let's allow multitasking occur. The resource now spends each day working half time on each task. At the end of two weeks 2 tasks are complete just as before. However at week one

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there was no output. What has happened is that the average duration of the tasks has doubled from 1-week each to 2-weeks per project.

We were looking at a simple best case example. It is possible that multitasking will not directly affect the quantity of tasks that flow through a resource in the steady state, but it always increases the average task duration significantly. Indirectly multitasking affects the overall capacity of the project enterprise, and is discussed in the "Understanding Enterprise Speed" section below.

When TM^2 is implemented, all multitasking is eliminated, and the typical improvement is a factor of 2 or 3 reduction in the duration of the projects. This is not a one time improvement, but a long term sustainable improvement in the faster completion of projects. This increase in Agility can provide a major advantage in the marketplace as described above.

The removal of multitasking forces a change in the way new projects are launched (added to the active project list). If the policy is that no resources will be simultaneously assigned more than one task at a time, new projects cannot be released until the first resource in the project has free time. We will see that TM^2 places additional restraint on the project launching in the discussion of the critical resource in the "Understanding Enterprise Speed" section below.

One other source of improvement in Agility comes from maintaining the prioritization of the active projects.

Maintaining a fixed prioritization is extremely important. The idea is that when a project is released into the enterprise it is intended to come after the already active projects, and before the projects still in the queue. If the priority of the projects varies several times during their execution, the effect is almost identical to multitasking. Constant reprioritization results in the duration of all of the projects being increased, even though the total amount of time applied to any single project may remain constant.

This is not to say that reprioritization cannot occur, only that it must be examined as to its effect on the entire enterprise before a properly informed decision can be made. Typically the enterprise cost to reprioritize makes the choice unattractive. Without TM^2 there is no effective way to quantify the negative impact of constant reprioritization. Experience shows that it can easily destroy 50% of the capacity to complete projects.

Understanding Enterprise Speed

In order for the project Speed (the number of projects per year) to increase, wasted capacity of the organization has to be captured and directed to productive work. Remember if there is untapped capacity it is due to the flawed Additive model rather than any lack of ability of the staff. In fact, the more rigorous the current Additive model is applied the more chance that there is capacity which is being misdirected.

We measure project Speed using the Boyd Rate (# projects/year as calculated from the Boyd Interval). Appendix A below describes the calculation and the statistical principles that discuss why this a superior approach to the classic measurements. Increasing the Boyd Rate can have a significant effect upon a businesses bottom line. The white paper "Calculating the Benefit of Enterprise Management Plus[4]" describes the background of the calculation.

Increasing project Speed means that more projects are completed per year. In an environment where there is no market limitation, this means that the number of new and improved products which can be released may be doubled or more. If increasing the Agility as described above creates market dominance, then the improvement due to speed can increase the contribution rate due to increased product sales by 20% to 100% (contribution rate is calculated as the amount of sales revenue that remains after the variable cost of making and distributing the product are subtracted – generally variable costs do not include salaries).

So how is speed increased? Let's revisit the concept of a critical resource. The critical resource sets the maximum pace of the project completion rate. It stands to reason that anything that delays the progress of work through the critical resource will delay all of the projects that use it. Specifically, reducing the work through the critical resource in effect puts a brake on the rate at which all projects are completed. Thus unloading all unnecessary work is a necessary action to capture the full capacity of the rate limiting output of the critical resources.

In the classic business where the critical resource/s is not properly identified, the capacity of the resource is spent carelessly on activities which do not meet the needs of the active projects. By focusing a critical resource on the proper set of tasks performed in the proper order, the apparent capacity of the critical resource is increased significantly. This is the single greatest source of increased enterprise Speed for most organizations.

Table 2 Examples of the Possible Changes in Workload for Critical Resources

Common Tasks	**Critical Resource Tasks**
Various Project Tasks	Only Critical Resource Project Tasks
General Meetings	Limited participation if any
Report Creation, Editing and Publishing	Writing Content Only
Handling all phone calls	Use a receptionist or assistant to screen calls
Expertise maintenance – conferences etc.	Only carefully selected activities
General activities – United Way, Meals on Wheels, Organizational Activities	Limited participation if any
General in-house technical consulting	Limited participation if any
Personal computer maintenance – backup, updating software, reloading software…	IT support does as much as possible

In some organizations, it may appear that the Critical Resources receive "perks" typically reserved for management. As bitter of a pill as it may be to swallow, the investment in a receptionist to screen calls for a critical resource can have a much larger positive impact on the

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[4] Available from Velocity Pointe. There is also an Excel spreadsheet estimator available which applies the concepts.

income of the organization than providing a receptionist for the President. Remember the critical resource is the pace setter for the entire project organization. Any output lost by the critical resource is lost forever, and no amount of work by the rest of the organization will reverse the loss.

When organizations multitask, the many simultaneous activities compete for the resources making it almost impossible to identify the critical resource/s. In the multitasking environment, most of the resources appear overloaded most of the time. Only in organizations where there is an extremely limited resource, is it sometimes possible to clearly identify the Critical Resources before TM^2 is in place, but this is not common.

Many organizational efficiency experts will concentrate on removing the non-revenue creating activities from the entire organization. Again this is Additive model thinking and completely misses the fact that many non-revenue activities can improve the environment for revenue related projects. This is because the activities "interact" with revenue generation often in positive complex ways that are very hard to document, particularly in view of the potential impact on the bottom line.

One of the fall-out results of the classic Business School concept of placing a value on each activity of the organization is the reinforcement of the concept that non-revenue activities should be abandoned. Cost-based accounting has been slowly losing favor, but much of its thinking still permeates the average organization. John and Pamela Caspari give rigorous examples in their book[5] showing cost-based accounting consistently giving erroneous projections of the benefit of a given business decision.

The goal should not be to remove non-revenue generating activities just because they are not directly connected to income. There are valid measures that can be used for evaluating these activities other than financial ones, but in the end some of the non-revenue activities need to remain since they can have major positive impact on the organization. Improving a company's image through charity participation is just one of many activities that are hard to quantify, but often extremely important for consumer-oriented businesses.

Implementation of 6-sigma is an example of an activity that pays for itself many times over, but is almost impossible to properly account for because of the amount of undocumented resource allocation it takes to bring it on board. It is interesting to see that 6-sigma vendors usually argue its net benefit by comparing the measured impact on a simplistic estimate of the bottom-line to the vendor fees. Without TM^2 they cannot determine the true cost due to lost time for the critical resources. Thus they cannot show the actual impact and cost to the organization.

Six-sigma involves weeks of training of all personnel. When the critical resources are taken off-line for weeks of training, this means that the output of the entire Enterprise is delayed by that many weeks (the definition of a critical rsource). None of these management improvement tools properly account for the loss in revenues caused by delaying the businesses revenue stream creation by weeks or more. The message isn't that 6-sigma is not effective, only that implementing it before TM^2 is in place can cause the business to lose significant project capacity.

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[5] Management Dynamics, Merging Constraints Accounting to Drive Improvement, John Wiley and Sons (2004)

This is particularly true when the critical resource/s personnel become black belts and are engaged in activities other than their critical resource contribution.

So if the decision is to continue the non-revenue activities, how do you keep them from impacting the ability of the enterprise to complete revenue generating projects? Simple, identify the critical resource. Then, as much as is possible, unload it of all non-revenue generating activity.

Once the critical resource is identified, the rate of new projects are launched should never be higher than the sustainable rate of completion defined by the critical resource. In the TM^2 enterprise model we have the tools to account for the loading of all of the resources so that the new projects are pulled into the enterprise as capacity becomes available, not before.

A problem with organizations that both multitask and routinely reprioritize projects is that the proper sequence of the tasks can be lost. A resource can start its task before all of the required inputs are completed by the other resources feeding the task. The result is that the task is delayed or interrupted while waiting for the other task to complete. This specifically results in lost capacity of the waiting resource. TM^2 provides each resource with a prioritized list of tasks so that the right task is performed in the right order at the right time.

Finally in the old world of repeated delays, projects can lose their importance to the point that they are abandoned, or even if technically successful, miss the critical window and produce no revenue. The capacity which was spent on these projects is 100% wasted. This is one source of capacity that TM^2 captures in increasing the enterprise Speed.

So in general, using proper plans managed on the enterprise level to control the use of the critical resource often results in a more than doubling of the organizations capacity to complete projects. This doubling of speed has a good-news bad-news twist. After a year of operation using TM^2 many organizations find their project pipeline being emptied because the new rate limiting step is the definition of new of solid revenue generating projects. This is a great problem to have and offers opportunities to grow in ways companies have previously never been able to consider. The second phase of TM^2 deployment includes examination of the new project creation system often including concepts such as QFD.

Understanding Enterprise Accuracy

Project Accuracy is defined as the ability to determine initial commitment date estimates which can be met more than 90% of the time. We are NOT claiming that variation is eliminated – only that we can, at the project launch, properly estimate the date where we have a 95% confidence that the project will be complete. Translated to the enterprise, the enterprise Accuracy is the ability to determine commitment dates and then to meet them.

One fact of life is that "shift happens". All plans have tasks that take a different amount of time to complete than was initially estimated. That variability cannot be eliminated. However in the

current multitasking environment there is a large amount of variation related to the fact that the individual resources are multitasking across projects creating an additional amount of uncertainty in the ability to predict the time required to complete the task.

Eliminating multitasking results in a significant improvement in the ability to predict the duration of a given task. Again we haven't reduced the fundamental variance in project duration, only the noise induced by multitasking.

We have left for last, one of the most devastating project practices that negatively affect Agility Speed and Accuracy – deterministic, date-driven project management. The problem is more one of human psychology rather than a business model concept. First we know that we cannot determine beforehand the amount of time it will take to complete a task. We can only estimate it. However when we put a start date and a completion date on a task we have created an implicit contract with the resource that the work will be done during that time and it will be completed on a given date.
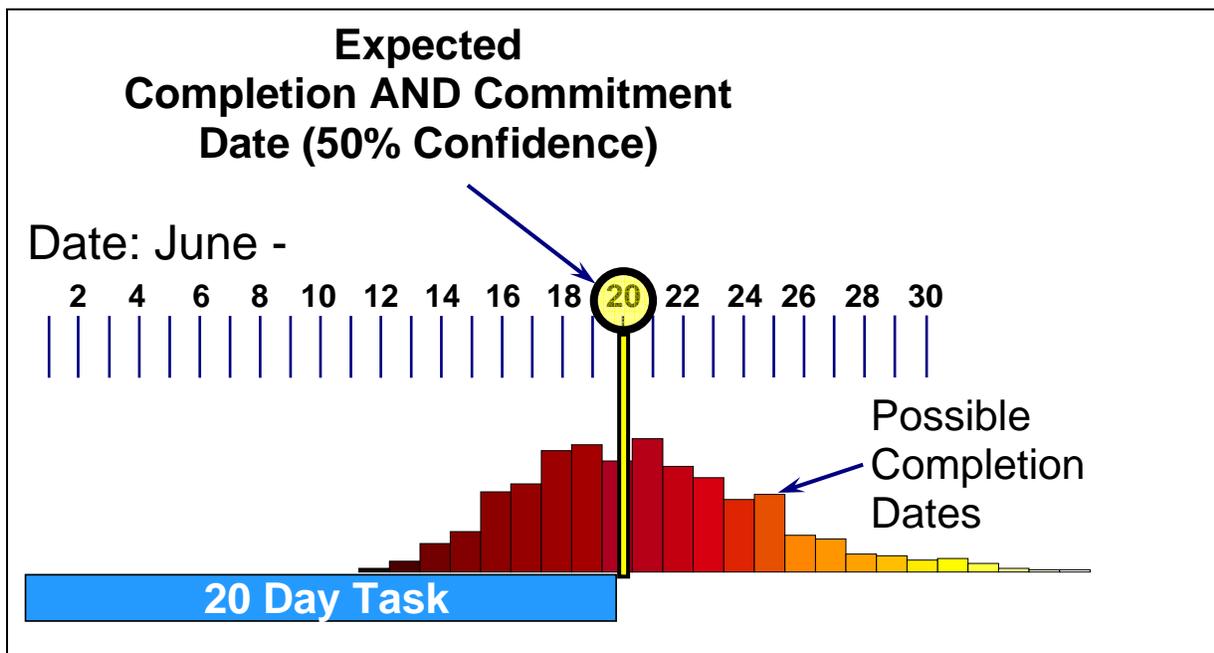
Figure 9 Single Task, Date-Driven Project

The hidden message is that if the due date is missed, it will be noticed in a potentially very negative manner. However nothing in the process implies that a benefit to the project will occur if the work is completed early. In fact in many organizations is it not healthy to have completed work early and be left with nothing to do. Early handoff tends to also fail since few resources have the ability to respond to the early delivery of deliverables required for their contribution on the next project task in their queue. So resources either work to fill the time to the deadline or create new work to fill the gap, and avoid early release of the work.

Since the due date is the milestone where they will be measured, the resources often pad their estimate during the planning stage. Once they know their task estimate is padded with extra

time, there is a temptation to not start the work on day-one while they perform other activities. This behavior is extremely common and results in the removal of any built-in protection time. So if a real problem hits the task it is guaranteed to delay the completion of the task beyond its estimated date.

The result is a feed forward filtering of delays, and a complete lack of early completions.

The deterministic nature of the project plan is another flawed process. Variation is real and should be part of a plan. When the plans have fixed duration (are deterministic), the due date only has some overall probability (less than 100%) that it will be met. If we look at past history for a resource performing similar tasks we can come up with an estimate which gives the 50% chance of on-time completion. The 50% confidence completion dates are what should be used to specify the duration of a task. However, this means that half the time the tasks will take longer than planned. How early and late completions should be handled is discussed below.

There has been a lot of study in the literature of how long one should plan a task to estimate the 95% chance of on-time completion. For most project environments, this is about a factor of 2 longer than the average completion (50% on-time completion) estimate. In other words, if a task on average takes 15 days to complete, the duration estimate for 95% confidence of completion is about 30 days.

Again, human psychology comes into play. Just extending the time allotted for a task, making the 95% Commitment Date the Expected Completion Date just creates the environment where the job can be worked at a leisurely pace and always meet its deadlines. This means that we might have a higher on-time completion of the projects, but we will have doubled the normal time to complete projects. Again, using a single date still encourages the resource to delay start of the project because "there is still plenty of time to complete the task." This underlying assumption results in the resources delaying the start of the tasks until we return to the situation where completion dates are missed – only now we have tasks which are twice as long on average.

The solution is to implement an event driven project management system using an expected completion date along with a second date which is the actual commitment date. Resources are expected to work full level of effort until the task is complete, and then the output is passed on to the next resource in the project plan. This now allows both delays AND early completions to propagate down through the project's tasks.

There still remains the need for how to deal with the 50% of the time that tasks take longer than average. This is accomplished by adding Project tolerance to the project plans. Some people have used "buffers" to capture the uncertainty in task duration. The problem with "buffers" is that they appear to arbitrarily create "slack" in the system, and there is no fundamental process to determine how big of a buffer is required.

Project Tolerance formalizes the buffer concept and uses fundamental statistics to deal with the creation and addition of the tolerance from the individual tasks. The net project tolerances are inserted into the plan where needed.

Using the state-of-the-art project management tools now available, one can create the project tolerances in the initial plan and then track the change in the remaining tolerance as the project advances through the tasks. The concept is that if the project is 1/3 complete, then it should still have 2/3 of its project tolerance remaining. This ratio of %- of remaining project tolerance as initially planned to %-project tolerance calculated for the remaining work is an extremely powerful operational measurement for managing projects.
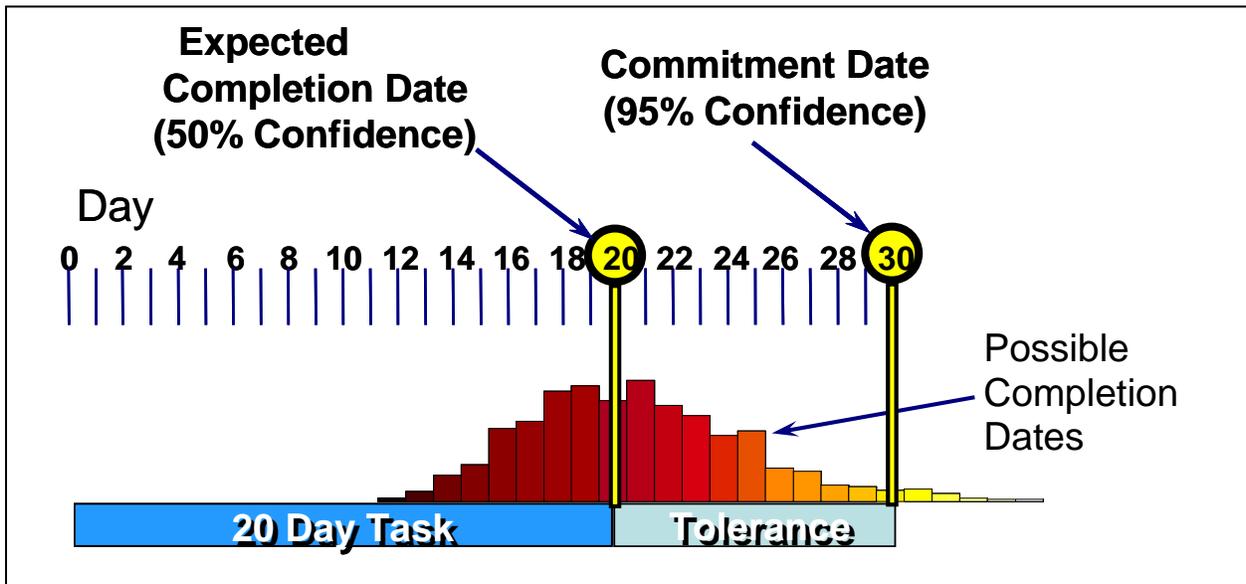
Figure 10 Single Task Project with Project Tolerance

The employee issue with event driven behavior is trust. The employee needs to believe that if they complete jobs early, they are not to be rewarded with a workforce reduction. If there is one singular barrier to the implementation of TM^2 in today's cost cutting world of business, it is the shortsighted path to utter failure achieved by concentrating on cost cutting instead of very the real revenue growth potential of this management technology.

Appendix B: "Project Management Methods" discusses how to replace deterministic date driven projects with event projects using project tolerance.

Once an organization is running in a project world with event driven project management using plans with project tolerance, the overall Accuracy is improved.

Expected Results of TM²

Once TM^2 project management system is in place the following changes in the business occur.

1. The enterprise projects are completed with the most important one first, the second next, the third after that…

2. Enterprise Agility is improved to the point that careful selection of new products and enhancements can be brought to market consistently faster than your competitors (typically duration is halved)
3. Enterprise Speed creates a hungry project system which needs more good ideas to sustain it (the number of projects completed per year usually doubles)
4. Enterprise Accuracy in the target completion date means that commitments can be made to customers which are met with regularity.
5. Some resources will by definition have excess capacity. The capacity can be used to leverage growth in the future as focused investment is made to improve the capacity of the critical resource.
6. The overall work environment improves. The new project environment gives each resource clear direction as to which task is next without any contention.
7. For product related projects, doubling the Speed and Agility can more than double sales.
8. For internal project environments, it is like creating a virtual second set of resources with very little if any increase in staffing or facilities.
9. Senior management gains the ability to improve the bottom line through increased revenues rather than reduced costs.
10. A philosophy of strong confident controlled growth replaces the cautionary fear-driven behavior common in highly competitive markets.
11. Management finds that its prioritization decisions produce results in the order they deemed important. They get what they wish for…

The overall change in the organization is the move toward revenue growth to improve the bottom line which replaces the ever present cost cutting squeeze most organizations live today. The progression is: a) Gain control of your ability to complete projects, b) Use this to gain control of your markets, c) Controlling your market gives you true control of your business.

The Hard Task: Tactical Implementation of TM^2

In the businesses that have implemented TM^2, running a high efficiency TM^2 project system turns out to be amazingly easier than the classical project management system. However the path to TM^2 is one of major change in culture and management practices. Once TM^2 is in place the organization often improves its use of the technology by an iterative process of learning with each new project.

The problem is that the implementation is a one time project which MUST be completed successfully, or else the business will be poisoned to the concepts for a decade or more. Failure to properly achieve effective TM^2 defines the technology as a failure even though the failure was in the implementation.

To date we know of no in-house led implementations of TM^2 which have been sustained. Some failed to ever achieve TM^2 operation. Some have made the transition process the norm, and will never complete the transition. Some achieved short term TM^2 operation but were unable to sustain the process when they were unable to bring new management up to speed before actions that permanently damaged the process were taken.

Velocity Pointe personnel have been involved in more implementations of TM^2 than any other staff. Early implementations were not always successful. The lessons learned from the failures were extremely educational. Steady state operation of TM^2 is the goal – not the activities of the implementation project.

So in brief, the skills to implement the transition to an TM^2 operation are significantly different than those required to run it. It is much simpler to drive a car than to design and build it.

TM^2 Implementation Tasks and Challenges

There are many issues that must be addressed in achieving a robust implementation of TM^2.

A. The senior management guiding coalition must be identified.
B. A rigorous implementation project plan must be developed. (Planning usually led by VP)
C. TM^2 strategic workshop must be provided for all managers, resources and project leaders. (Usually provided by VP)
D. A new role of Director of Matrix Operations (DMO) must be created.
E. The implementation must be led by a manager with extensive experience in the event driven style of project management. (Initially VP mentors the activity and trains the individual if necessary)
F. The senior management team must be mentored to ensure that they do not inadvertently undermine the new culture by using the old "best management practices". (VP typically physically attends the weekly meetings for the first two or so months, and then attends by phone for at least six months)
G. Management needs to explicitly inform the organization that the decision has been made to implement TM^2, and make the implementation plan a public document.
H. The existing system of active projects needs to be replanned, and the launching project identified. (VP usually facilitates this effort)
I. Human Resources issues must be addressed to eliminate reward structure which supports any behaviors that are in conflict with successful TM^2 operation. (VP usually coaches the HR manager in this process)
J. New software tools need to be brought on board and the key people taught how to use them. (VP can teach the MS Project based tools and integrate the material with that taught in the strategic workshop)
K. The new robust project planning process is taught in a just-in-time basis by having the project teams learn it by planning the first project for the TM^2 environment. (VP typically does the education and coaching)
L. A new position of enterprise analyst needs to be created and filled.
M. New operational measures need to be integrated into a management dashboard. (Usually VP coaches the enterprise analyst in the creation and maintenance of the new operational measures)
N. A weekly Tactical Enterprise Management Meeting must occur.
O. Periodic outside review should be used to sustain the operation.

These items are discussed in detail below.

A. The senior management guiding coalition must be identified.

TM^2 is a transformational strategy. The effective implementation of TM^2 requires the support of all those who wield significant authority throughout your enterprise. The issue is not so much a matter of budget as it is a matter of ensuring that the right changes are made throughout the enterprise.

This is the single most important step in the implementation. Top management must decide to be an active part of the enterprise management process (including participating in the weekly meetings described in Item 12 below), or be willing to divest ALL authority in deciding what projects should be getting which resources. This is not a fence than can be straddled.

The guiding coalition is responsible for the tactical long term operation of the TM^2 system. This coalition is typically made up of the Resource Managers, an enterprise analyst, and the manager responsible for the management of the organizational matrix of projects AND resources (we call this role the DMO. See Item 4. below).

In the decade that Tony Rizzo has been implementing TM^2, there has never been a successful sustained use of TM^2 unless the guiding coalition had the proper authority, and dedication to the process. Management by edict is a guarantee for failure.

So what changes? Under the TM^2 management system, the start-dates and commitment dates of new projects are not determined as they are now. The entire flow of projects throughout the enterprise is not allowed to trickle as it does now. The capacity of your expensive development resources is not utilized as it is now. Projects are not planned as they are now. Managers do not specify or alter the assignment of resources as they do now. And, most importantly, individual resources do not perform their work as they do now.

B. A rigorous implementation project plan must be developed.

It is easy to start down the path of TM^2 and miss the critical fact that the implementation is in itself a critical project that must be rigorously planned, resources allocated, and managed. To allow any change management project to be run as a simple check-off list almost guarantees failure. Just like any other project the sequence of tasks is extremely important. Also being able to anticipate the next task/s ensures that the resources are available in a timely manner.

We are changing one key policy - multitasking must be eliminated. Also, we are replacing workforce utilization/efficiency with the operational measurement of the control chart of project Protection Ratio (the amount of remaining project tolerance divided by the amount of tolerance predicted by the initial plan – 1.0 and above implies everything is OK). There is no doubt that TM^2 is easy to maintain once it is installed and running. The transition is the challenge.

A project cannot be managed if it is not properly planned. The implementation plans for TM^2 are usually fairly complex because they involve the entire enterprise! Another doomed strategy is to consider a change management process as something that can be gradually rolled out. You cannot gain a factor of two without a reprogramming of the project/resource culture.

Finally, one change management fundamental rule is, the longer you are in transition the higher the probability you will never get to the other side.

C. TM^2 strategic workshop must be provided for all managers, resources and project leaders.

Before the members of the guiding coalition can support the TM^2 implementation effectively, they all must possess the same valid understanding of TM^2. They also must understand the roles of their organizations in support of TM^2. Velocity Pointe uses a 2-Day workshop to teach the strategic concepts behind Enterprise Project Management Plus.

Once the senior team is trained, the all the resource managers, resources and project leaders attend the workshop. For maximum effectiveness, it is necessary that each group of stakeholders independently experience the training.

The workshop simulates a business which derives its income from products created by completed projects. Initially the business is run in the classical mode using the standard Additive business measures and policies. The company loses money consistently. Then the half-time analysis is performed. New measures are selected and one key policy is changed. The simulation is restarted and the company leaps into profitability.

After the simulation is complete, the mechanics of good individual project management are shown including the use of project variance, and event driven project management. The topic then moves to how do you measure an enterprise project system. Classic performance measures are shown to be bad indicators of operational status. A new management dashboard is discussed. The workshop ends by discussing real world demands and how to handle them. These include: major project delays, emergency projects that supercede the current active projects and techniques to deal with outside vendors in a critical time role.

D. A new role of Director of Matrix Operations (DMO) must be created and filled.

The problem with many organizations is that the roles of resources and project leaders are intermingled. On the other hand some environments have a dual management ladder of resources and project leaders. In either case there needs to be a single tactical manager overseeing the two activities – the Director of Matrix Operations (DMO).

The reason is simple, the only way that projects and resources can be simultaneously managed is by having a single leader to resolve the potential conflicts that arise in an imperfect world where few things progress exactly as planned. The process of resolving problems is codified in the TM^2 system, and avoids arbitrary actions. The job of the Director of Matrix Operations (DMO) is to keep the enterprise on track and maintain the required priorities for on-time project completion.

The DMO is a member of your senior team. He/she becomes the field commander of your enterprise. But this doesn't mean that the DMO replaces you and your senior team. Quite the contrary is true. You and the remaining members of your senior team retain full authority for all longer-term, strategic decisions. The DMO becomes responsible for tactical execution of the strategy that your senior team designs.

However, to execute your strategy effectively, the DMO needs complete authority for day-to-day, near-term, tactical decisions. He/she also needs your trust. So choose this candidate carefully.

E. The implementation must be led by a manager with extensive experience in the event driven style of project management.

Usually the DMO is the project manager of the implementation plan. However in most organizations this means on-the-job training of the TM^2 methodology. It is key that this person receive strong mentor support initially, and weekly assistance until the implementation plan is completed. In some organizations the DMO is a new hire, and in that case it is important that a temporary professional is engaged until the role is filled. This professional needs to be involved and contributing to the process on day-one and should have senior project management and TM^2 operational experience. Velocity Pointe can provide this level of support when needed.

F. The senior management team must be mentored to ensure that they do not inadvertently undermine the new culture by using the old "best management practices".

When EPM+ management technology is implemented, the old intuitions can betray even the most experienced manager. Through education and mentoring, the managers are shown where the old experience still holds and where it must be modified. The problem with any transition of this magnitude is that when something goes wrong, the old play book is pulled out of the bottom drawer.

The rest of the organization looks to the senior management to show confidence in the new way of doing business. This MUST be done by example rather than by management edicts. By mentoring the senior management behind closed doors, Velocity Points can coach them on techniques to deal with the many obstacles encountered during the implementation. This allows them to be confident when running the process in front of their staff.

There is a very critical understanding that needs to occur here. It is almost impossible to achieve a successful DIY (Do it Yourself) implementation of any management technology. The fundamental reason is that, unless the senior manager leading the effort is already a seasoned practitioner, the junior staff CANNOT correct their superiors when they go off track. It puts the staff in the position of, "Trying to teach your Mom or Dad how to drive."

The issue is not one where the senior staff cannot run TM^2 once it is up and running. Rather, it is the fundamental fact that no one can both lead and follow at the same time – this is in particular true when there is a major new skill set which must be mastered as part of the implementation.

G. Management needs to explicitly inform the organization that the decision has been made to implement TM^2, and make the implementation plan a public document.

The fastest way to communicate where you are going is to put the roadmap on the wall. Some people may try to use it to decide how to derail the effort, but in most organizations it helps the entire staff get involved and think the new thoughts.

Multitasking is eliminated by issuing the following work guidelines, "As much as possible, work tasks sequentially and at a full level of effort. Until better information is made available by the TM^2 system, resolve all conflicts for resources in a manner that is consistent with our list of prioritized projects.

H. The existing system of active projects needs to be replanned, and the launching project identified.

Prioritize and sequence all the existing active projects, 1 through n, and select the transition project. All major stakeholders and all members of the senior team whose projects might be affected by the prioritization and sequencing process should be invited.

This meeting will be the first serious test of your resolve to access that approximately 50% of your development capacity which was inaccessible in the past.

The following prioritization criteria are suggested:

A) Regulatory requirements. Projects that are needed to meet regulatory requirements are given the highest priority.

B) Support of the business strategy. This assumes that the senior team can prioritize the active projects using its current business strategy.

C) Contribution to shareholder value. All remaining projects are sequenced according to their anticipated contribution to shareholder value.

The worst project to use for the first project using TM^2 is the critical overdue project that has been dying as it misses deadline after deadline. An immediate action in the TM^2 implementation is to stop launching all new projects and to prioritize the active projects. Then the resources are assigned to the projects in the priority order.

Sometimes it becomes apparent that one or two projects have already died and just need to be pronounced dead. These are removed from the system so that precious resources are not continued to be spent on something that cannot succeed.

Once the projects are replanned it is fairly easy to identify whether one of the active projects or a new project should be the first project planned and executed using TM^2. From that point forward all new projects that are launched are part of the TM^2 system.

This is not a painless process, but ripping the band-aid off quickly gets you to the goal of the steady state TM^2 use in the fastest, lowest cost manner.

I. Human Resources issues must be addressed to eliminate reward structure which supports any behaviors that are in conflict with successful TM^2 operation.

Most organizations miss the connection between the employee's evaluation/compensation and the implementation of new management technologies. Implementing TM^2 will create idle time (lack of project work) for the non-critical resources. In many organizations putting several hours a week on "overhead" activities is a sure way to put your name at the head of the list for the next layoff. This must be addressed explicitly and strongly. Firing just one "excess capacity" employee during the implementation will kill the implementation.

Another set of problems comes from the TM^2 changing many job descriptions. People have to work differently. We recommend that the RARAR concept for the staff be adopted. The acronym stands for:

R: Responsibility – Clear understandable job description
A: Authority – People have to be able to decide as much as possible how best to do their job
R: Resources – The necessary tools must be readily available
A: Accountability – There has to be some form of overt recognition of correct behaviors
R: Reward – Since this is an interacting enterprise special recognition should be team based

Initially the punishment for the right behavior needs to be fixed immediately. The full RARAR analysis for all jobs is developed over time.

J. New software tools need to be brought on board and the key people taught how to use them.

Although the software tools are only 10% of the ongoing TM^2 operation, they are a critical piece of it. The ability to create the event driven plans with project tolerance and then manage the projects across the enterprise requires state-of-the-art tools. At this time Microsoft Project used with the cc-Pulse and cc-MPulse add-in packages (from Spherical

Angle, Inc.) is the best software solution. MS Project without the add-in is not a viable option for TM^2.

The single project software training for the DMO, the project managers, and the enterprise analyst is 3 days (e.g. cc-Pulse). This training reinforces the strategic concepts learned in the TM^2 2-day workshop and gives classroom exercises in the Robust Project Planning method. An additional 2 days of training in the use of the <u>enterprise</u> project management tool (e.g. cc-MPulse) is required for the same people.

The education needs to be skills based. The final step in the learning process occurs when the software is used in the planning and launching phase of the initial TM^2 projects.

K. The new robust project planning process is taught in a just-in-time basis by having the project teams learn it by planning the first project for the TM^2 environment.

Initially, Robust Project Planning is taught to each of your project managers with their first new project launches. These sessions constitute an indispensable step in creating an effective enterprise model for managing the projects and resources. If your enterprise is to complete projects at twice its previous pace, then it also must be able to create effective project plans at twice its previous pace.

Projects are only as good as the plans on which they are based. The planning process starts at the end deliverables and exhaustively explores tasks required to accomplish them. The planning technique is a codified process which is universal in its ability to create rigorous plans, regardless of the application. The process is taught to the project managers and the resources as they plan their first TM^2 projects.

The duration of this portion of the implementation depends upon the nature and scope of the projects and upon the number of project managers employed in your project management office. Success requires that each of your project managers undergo this process and learn the Robust Project Planning and Robust Project Design processes firsthand.

A moderately sized project (a dozen people spanning approximately one year) takes approximately two weeks of effort to plan properly, as the project manager and the team climb the learning curve.

L. A new position of enterprise analyst needs to be created and filled.

This person in this role provides the management dashboard for the weekly meetings. They need to be skilled in the use of the software, and understand the project/resource environment so that they can identify questionable data before putting it into the enterprise model. This person takes the decision of the guiding coalition each week and informs all of the resources the priority of the work in their in-basket.

M. New operational measures need to be integrated into a management dashboard.

The old measurements which look at workforce utilization must be eradicated from the organization. This doesn't mean that timecard reporting is abandoned. It means that the individual's on-project vs. overhead work not be tracked. The important measure comes from the use of the project tolerance remaining on a project.

N. A weekly Tactical Enterprise Management Meeting must occur.

For most organizations the typical project duration and task lengths result in a weekly meeting giving the proper update rate to catch problems in a timely manner. More frequent snapshots of the enterprise only look at short term noise. In organizations where resources have many weeks per task, the time between snapshots can be lengthened.

So for most organizations the periodic snapshot culminates in the weekly meeting. If the members of the guiding coalition treat this meeting as optional they will cause the system to falter and eventually fail. How can the senior management expect their staff to respect the process if they do not demonstrate their commitment by being an integral part of it?

It is advisable to wait until three to four projects are planned and placed in tracking mode, before the initial enterprise model is constructed.

The meetings are held by the DMO of the enterprise. An advisor experienced in the operation and implementation challenges of TM^2 participates in the meetings initially. Initially the advisor should physically attend the meetings. This allows for individual feedback after the meeting is completed. After the mechanics of the meeting are in order, the advisor participates via teleconference.

The purpose of the advisor's participation is to assist the DMO in running the meetings initially and later in interpreting the operational measurements with which to coordinate the real-time reassignments of resources.

O. Periodic outside review should be used to sustain the operation.

The last task in the implementation is the participation of an TM^2 professional in the weekly project review meetings. This gradually extends to a monthly participation. In the second year a quarterly review of the TM^2 process is made to ensure that the best practices are being maintained. All major system implementations need this outside audit to keep everyone on track. Otherwise, it is too easy to allow some of the old processes be revived after the experts leave.

Appendix A: Measuring Enterprise Agility with the Boyd Interval

The natural way to determine the number of projects per year is to count them. Unfortunately there is very low information content in a single number representing the annual count of projects. Statistically if it is a random counting process, the error is the square root of the number of counts. So if you had 9 projects completed in one year, the two sigma band would be from 6 to 12 projects.

So we are left with the need for a measurement that is effective for continuous-flow, multi-project systems. We have defined two such measurements, named after Col. John R. Boyd, USAF (1927-1997).

John Boyd codified the concepts of maneuver warfare. One of the key elements is the concept that true sustained agility in battle was the continuous application of actions where the enemy is "just that little bit slower" in every cycle of the engagement. This concept of needing to maintain a quicker action than the opponent is analogous to completing projects "just that little bit faster" than your business competitor.

So what is of interest is to measure the interval between completions of projects. This number averaged over several projects is the measure of one's sustained agility.

The fundamental unit is not the rate but rather the mean time between project completions. We use the interval between completions rather than between launch dates, because the benefit of the project is realized at its completion. We refer to the mean time between project completions as the Boyd Interval (BI).

Statistically this measurement has significantly more information which allows us to make a better approximation of the mean and the variation. This is because we have a scale with 260 tick marks in a year (e.g. the number of business days in a year). This scale gives plenty of resolution when measuring the BI. So in our example of 9 projects completed in a given year, we would have nine data points in units of days/completion instead of a single number count.

Once BI is calculated, the rate is just the inverse of the interval. We refer to 1/BI as the Boyd Rate (BR). BR is expressed as "# project completions" per "year or 260 business days" The exact form of the relationship is:

$$BR = (260/BI)$$

Thus once you have the completion dates for a years worth of projects, you simply average time in business days between each completion to find the mean. This mean is BI. Once BI is calculated, the BR is calculated using the above calculation.

Appendix B: Project Management Methods

The Enterprise Management Model requires that the projects are first properly planned before they are launched (launching refers to starting work on the first task). A predictive model is required for planning. Improper project models guarantee that the scheduling of the critical resource is ineffective. The model is only as good as the pieces upon which it is built. The first step in preparing a project for launching is the creation of a robust Project Plan.

The Robust Tactical Planning tool is described below. Its output provides all of the information required to define a projects tasks, logistics and overall expected duration.

Once the robust project plan is created, it is prioritized and sequenced in the queue. The strategy of what is in the queue and the relative priorities is a strategic process. Most companies have some type of criteria they use. Often the strategic operation can be improved. This makes sense AFTER the tactical execution of projects is working using TM^2. Once a project is in the queue, the Tactical Matrix Management Team decides when the resources are ready to launch the next project.

The software used record the project plan and to track its progress must allow the easy use of project tolerance, and be able to work with the collection of active projects in the enterprise. The management dashboard measure of the Protection Ratio is required to track the projects in the enterprise. It is extremely helpful if the software can do this without having to do the calculations manually.

At this time the best software suite available is cc-Pulse and cc-MPulse from Spherical angle. This software is a fully integrated solution to Microsoft Project. This Appendix will be discussing the different needs of TM^2 using this software as an example. It is up to the reader to determine if other software can perform the functions described in this paper.

Robust Tactical Planning for Projects

The Robust Tactical Planning tool is a process which starts at the end deliverables, and works exhaustively backwards until all the required tasks are clearly identified. The process alternates between a description of an item and actions required to create new items. The end deliverable is an item. The last task of the project creates this deliverable.

The process uses 5 questions repeated for every action (task) in the project.

1. What is the end deliverable?
2. Who makes this happen?
3. What is the last significant thing he/she does?
4. What tangible inputs are required to accomplish this task?
5. Are these enough?

The robust tactical planning process is demonstrated below using the deliverable of "There are enough of the right course notes at the workshop site, in time for the workshop." The project is a single task to print and ship a set of course notes.

Simple Single Task Plan for Printing Course Notes

Planning Direction

Execution Direction

Deliverable: There are enough of the right books at the workshop site, in time for the workshop.

Task: The printer produces the right number of books and ships them to the workshop site in a timely manner.

Safe: 5 days   Avg: 2 days

Item (noun)

Task (verb)

Item (noun)

Deliverable: The printer has a .pdf file for the workshop books.

Deliverable: The printer knows how many books to produce.

Deliverable: The printer knows where to ship the books.

Deliverable: The printer knows when the books should arrive.

Figure 11 Sample of a Tactical Project Plan

This is just the last step in the course notes process. For example, the input of "The printer has a .pdf file for the course notes." is the deliverable of a preceding task. The task to create the .pdf would require that the course slides are complete and available, and there is software available to convert from the electronic copy of the slides to the .pdf format. Working backward from the end deliverables by cycling from action to item to action… clearly identifies all of the work required to properly complete a project.

It is interesting to note that many people would consider this plan too simple. The printing is a many step process right? Yes it is, but the correct level of detail comes from answering, "Can the printer do his task without interim additional inputs or deliverables?" In this case the answer is yes, so managing the detail in between is the responsibility of the resource doing the task and if documented in detail for the project manager invites inappropriate micromanagement.

For project management planning purposes, delivering output from one step of a task to another step of the same task is not a deliverable/input. Just because the resource can track the internal steps of their task, the project manager should not be involved with them. At the end of every week, the project manager does not need to know how many steps remain, rather they only need the printer's best estimate of how many days will it take to complete the deliverable.

The deliverable/s from a task only occur at the end of the task. An incorrectly planned task has interim deliverables for other tasks in the project. Another improper task definition includes several iterations of inputs which are delivered over time. In both of these cases, the tasks need to be broken into smaller tasks with a single start event where all of the required inputs are at hand, and a single completion where the deliverable/s are handed-off to the next tasks.

The tactical project plan is complete when the inputs for all of the earliest tasks already exist and all of the tasks have been examined to ensure there are no missing inputs. At this point the logistic structure of a project has been created. The yellow task boxes can be input as the tasks into your project management software.

There is an Excel add-in called "Lean Project Planning" which was developed to implement the robust planning concepts described above. Currently it is available from PD Institute, Inc. www.pdinstitute.com.

Single Project Techniques and Tools

Part of the tactical planning process is to assign the time required for each identified task and input this information along with the logistics from the tactical project planning session plan into the project management software.

Before discussing the move of the plan into the project management software, two key concepts need to be discussed. The use of a project estimated duration and a task duration tolerance. Note that the goal is to move away from deterministic, date driven project management. The issues with that style of management are covered in the section "Understanding Enterprise Accuracy" above.

The determination of the estimated duration comes from asking the resource two questions.

The first question is, "If you had to stake your career on it, how much time would you want so that you can stake your career on the fact that the work will be done?" This answer to this question is the estimate we use for the 95% confidence completion date. It is from these dates that the overall estimated completion date and the commitment date are created.

The second question is, "For this task with these inputs and deliverables, how long on average would it take you to do complete this task assuming you worked only on it?" There are several important pieces to this question. The first is the focus on the last check of whether any inputs have been missed, and whether the deliverable makes sense to the person doing the work.

The piece of information is that we are looking for the average time to complete the task. This is assumed to be the 50% confidence completion date – half the time it can be done faster, half the time it will take longer. These dates are used to create the prediction of how long it is expected to complete the project.

The final part of the question is the implied assertion that multitasking will not occur while this task is being worked on.

It is at this point TM^2 differs from many of the other single project management practices. In the current state-of-the-art program management, buffers have been added to project plans to compensate for the usual slippage of the plan as the tasks are worked. The buffer approach is a step in the right direction, but unless it is part of an event driven project management process, it is nothing but a patch and does not remove the root causes for delay.

When one uses a statistical basis for the project buffers, we refer to the additional time as "project tolerance". It is assumed that the difference between the initial average duration, and the second later date chosen to guarantee completion is a measure of error in our ability to predict. It can be thought as a standard deviation (actually about 2 standard deviations to get the 95% confidence band).

If you have several tasks in a row, the average completion time is just the sum of the estimated individual average completion times for each task. However if we sum the estimates of error we get an erroneously large estimate for the group of tasks taken as a whole. The solution is to treat the estimates of error as standard deviations (SD). The overall estimate of error of a group of individual events in series is calculated using the sum of the variances. Variance is simple the square of the SD.

For simplicity's sake and since we rarely have firm data on exact estimates of error, we assume for task work that the 95% confidence estimate of task completion is twice that of the 50% confidence estimate of task duration. Thus the tolerance for a task is estimated as equal to the estimated average duration.

As an aside, the underlying statistics assume a log-normal distribution with a mean equal to the estimated average duration and the standard deviation equal to approximately one half of the mean. One can argue the validity of the assumption. However for the amount of noise in the system, this is a valid operational assumption and models constructed in this vein give intelligent guidance when used for project management.

So for a series of tasks with duration estimates of 10 days, 20 days, 15 days and 30 days, the task tolerances are estimated as the sum of variances. In this case this is the square root of the sum of the square of the estimated Standard Deviations: $(10^2 + 20^2 + 15^2 + 30^2)^{1/2} = 40.3$. This is one place where the simplistic use of "buffers" or "slack" results in the incorrect estimate of the sum of standard deviations of 75, a much larger number than the statistical one.