Managing Uncertainties in Projects

Most project management software does not work as promised. Though more than $1 billion per year is spent on project management software, most projects end up being late, over budget or under scope. That's because older, traditional software assumes a perfect world, which doesn't exist. In reality, as soon as you create a plan, uncertainties hit, making your plans obsolete. You can't wish uncertainties away. You can't ignore uncertainties. But you can make project management software useful by providing a way to manage them.

More than a billion dollars is spent on project management software every year[1], but when was the last time you could rely on your project management software to bring your project out on time, on budget or on scope? The truth is that most projects, regardless of industry or type, are delivered late, over budget and under scope:

- ✓ Over 83% IT projects are delivered late/over-budget. Projects completed from large companies have only 42% of the originally designed features and functions (Standish Group Report – Chaos, 2000)
- ✓ Over 85% of engineering projects in semiconductor industry finish late (2001 survey by Numetrics, Inc., a semiconductor productivity research company)
- ✓ On average, high-tech projects are late by 100% despite the use of project management software and traditional tools (University of California at Berkeley)
- ✓ 80% of all embedded systems are delivered late (The Gansale Group, 2001)
- ✓ Most defense projects take too long/cost too much. Seven of the ten largest smart procurement projects are late/over budget (National Audit Office, UK, Dec 2002)

Too much project management software assumes a perfect world, which doesn't exist.

In theory, if you create a good plan and follow it, your projects will get done on time. In reality, too many uncertainties hit you along the way: requirements change, technology fails, vendors do not deliver, work materializes slower than expected, approvals do not come on time and priorities change.

As uncertainties strike, plans go haywire. People are pulled into multiple directions and start multitasking. Delays compound. Managers complain about losing control. Your focus shifts from delivering projects to explaining delays.

The next time, you are forced to create a more meticulous plan. Of course, that only means you now have even more details to track and explain. Managers at every level, wary of all uncertainties and delays from their previous experience, begin hiding safeties in their commitments before sending the plan upwards. Finally, everyone gives up on planning. Dictating commitments and managing by the seat of the pants looks more attractive.

It is tempting to fight uncertainties, but it is futile. Consider, for example, the following solutions:

- × Start measuring uncertainties: Uncertainties, by definition, cannot be predicted. And even if you could somehow measure them, so what?
- × Detailed planning and tracking: Uncertainties will still occur and plans will go obsolete even faster. Detailed planning and tracking only adds to chaos and administrative burden.
- × Individual time tracking/cost management: This only encourages people to hide even more safeties, killing any chance that people will report early finishes.

Making project management software useful requires understanding how uncertainties affect projects, and crafting a solution to manage them.

[1] Research Note on Project/Resource Management dated 24 July 2002 from Gartner, Inc.

HOW UNCERTAINTIES AFFECT PROJECTS

Uncertainties affect projects adversely in three ways:

- Cascade Effect – Delays propagate but gains do not add up
- Multitasking – People shuttle between tasks, killing productivity and stretching projects, and
- Human Behavior – People at every level hide safeties in their commitments, but these safeties invariably get wasted because of procrastination and not reporting early finishes

As the box on right shows, uncertainties unleash a "**cascade effect**" in projects, whereby delays multiply but gains do not add up. Substantial time and capacity are lost as a result:

– Projects lose time because either all of the preceding activities have not finished, or the needed resources are working elsewhere.

– Resources go idle waiting for work to arrive. Such idling is often not visible because people can continue to fine-tune already completed work in the meanwhile.

As schedules start slipping, people are needed on multiple tasks at once. As people shuttle between tasks without finishing one at a time (**multitasking**), it results in:

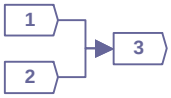
– Duration stretch: With parallel processing, each task takes longer.

– Switching costs: Extra capacity is needed for task set-up and set-down.

– Concentration lapse: Quality suffers when people cannot concentrate on one task at a time.

How delays multiply, but gains do not add up

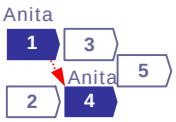
Integration dependencies



Delay: Activity 3 is delayed if either 1 or 2 is delayed

Gains: Even if 1 or 2 finishes early, 3 cannot be started

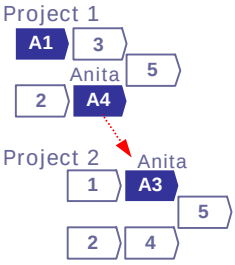
In-project resource dependencies



Delay: Delay on Activity 1 not only delays 3 but also 4 because Anita is not freed up

Gains: Even if Anita finishes Activity 1 early, she has to sit idle waiting for 2 to finish before she can start 4

Cross-project resource dependencies



Delay: If Activity 4 on Project 1 is late, 3 on Project 2 is delayed too because Anita is not available

Gains: Even if Anita finishes Activity 4 on Project 1 early, she has to sit idle waiting for Activity 1 on Project 2 to finish before she can start Activity 3 on Project 2

Finally, natural **human behavior** makes the situation worse. Having experienced constant delays and being pulled in multiple directions, people quickly learn to hide safeties in their estimates. However, these safeties are invariably wasted because of:

– Student syndrome: Most of us have a natural tendency to procrastinate. With safeties embedded in our commitments, it only becomes more tempting to take a slow start.

– Error reporting: People do not report early finishes because they are afraid that the next time, these early finishes will become hard expectations.

REALITY ENGINE™: MANAGING UNCERTAINTIES IN PROJECTS

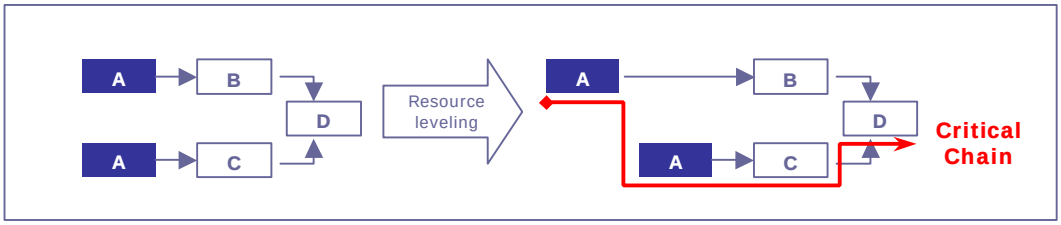
The Reality Engine™ helps contain the adverse effects of uncertainties in projects. It is based on practical methods outlined by Dr. Eliyahu Goldratt in his book "Critical Chain":

1. The Reality Engine makes room for uncertainties with blocks of unscheduled time, called **buffers** in your plan. These buffers weaken the cascade effect by absorbing and lessening the shocks of uncertainties. Explicit buffers also encourage people to hide less safety in their commitments, which in turn reduces "student syndrome" and "error reporting."

   Putting buffers in the plan does not make a project longer (it actually makes it shorter). With explicit buffers, people have less reason to hide safeties. Secondly, buffers are at the ***end*** of a series of tasks, and hence more efficient than safeties ***within*** each task.

2. As uncertainties create delays in execution, the buffer (or unscheduled time), gets used up. The Reality Engine™ then calculates how much of the unscheduled time is still available for future uncertainties, and sets **forward-looking priorities for everyone**, including managers.

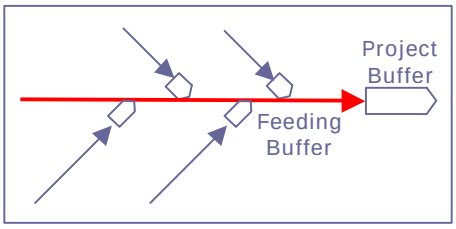
SOLUTION DETAILS



Types of buffers, where they are placed

Buffers are placed at the end of a series of tasks to absorb cumulative delays on those tasks. A notion of Critical Chain - the longest sequence of activities in a project, after resolving resource contentions within a project – is used to identify where buffers are placed:

- Feeding Buffers are placed at the intersection of critical and non-critical chains. They protect the critical chain from shocks of uncertainties in non-critical chains.
- Project Buffers are placed at the end of critical chain. They protect the project due-date from shocks of uncertainties on the critical chain itself.



Where do buffers come from in practice

There are three common approaches:

- Option 1 – Just do it: Start with the due-date, put buffer (i.e. 1/3rd of task estimates) and then shrink task durations to fit the available time. Half of all the practitioners use this approach.
- Option 2 – Take estimates from the management: Experienced managers normally know how long it takes to finish a task. Around one-third of the practitioners use this approach.
- Option 3 – Ask people to provide estimates assuming they will be working on only one task and will not be penalized for exceeding the estimates.

How to set forward looking priorities

During execution, project participants provide periodic estimates of how much longer it will take to finish their task in progress. With this simple information, taking only a minute or two to enter, the engine calculates a Reality Index™ – the ratio of buffer consumed for a chain of tasks compared to the work completed in that chain – for each chain of tasks. The Reality Index is then used to set forward-looking priorities for all managers. For example:

- Task Manager's Priorities: Task managers get a report on all current and upcoming tasks across projects, in order of priority. Highest priority is assigned to tasks that lie on chains with the highest Reality Index.

  Getting clear priorities reduces the pressure to multitask. The tendencies to procrastinate and not report early finishes are also curbed. A high index task on people's plates serves as a constant reminder to start quickly and also to immediately report completions.

- Project Manager's Priorities: Project managers get a list of all chains, along with the activities and Reality Index of those chains. They can now focus on upcoming activities on the chains that have the highest index.

  Also, the Reality Index for the project is the same as index for the "worst" chain. The project's index is also tracked over time to spot early trends.

RESULTS FROM THE FIELD

Over 50 organizations including FMC Energy Systems, LSI Logic, Medtronic, SheaHomes, NASA, Pharmacia, the US Air Force and even the US Navy (where old project management was invented) are already experiencing a range of improvements by managing uncertainties:

- More than 90% of their projects are on time, instead of 90% projects being late.
- They are able to accomplish more projects with more scope in each project.
- Managers at all levels have more control. With the right priorities, they spend less time in meetings and firefighting, and more in managing.

Following are some of the examples of projects being managed using the Reality Engine, and the benefits being reaped by various organizations.

1. Forklift product & manufacturing development – NACCO Material Handling Group

The Counterbalance Development Center at NACCO Materials Handling in Portland, Ore. employs 200 design engineers. The group was asked to bring a new line of lift trucks to the market in a record time (design eight new products, product, test for manufacturability, qualify suppliers and set up production lines in under three years).

Given the strategic importance of the program, and the fact that the group had experienced persistent difficulty in delivering projects on time, the VP of Engineering decided to explore a more effective way to manage projects. After attending a seminar by Dr. Goldratt, and hearing of successes that other companies had managing uncertainties of projects, the key managers were convinced that the Reality Engine would give them the results they needed.

They began the implementation in December of 2001. By the end of January 2002, they were executing the major program (8 products, 25 intermediate deliverables, 150 engineers, 3 manufacturing facilities and 10+ major suppliers) using Reality Engine.

<u>Results</u>

- Planned project length for the major program was reduced by 20%.
- The major program hit its first milestone as planned in December 2002. Furthermore, per managers' estimates, they were able to accomplish 40% more features for this milestone, compared to similar milestones in the past.

Management has also expanded the implementation to include all development projects.

2. Semiconductor product development – LSI Logic

LSI Logic is a leading ASIC (Application Specific Integrated Circuit) company; it undertakes projects to design customized chips for specific applications. Its Design Technology Development Group has more than 300 engineers who create IP, Libraries, Tools and Technology. All have to be available on promised dates so that the company can design cutting edge chips, as per the customer requirements.

The group tested the critical chain concepts on small projects using customized software they developed in-house, and was encouraged by the results. They bought the Reality Engine to expand the implementation to include all projects and gain the full range of benefits. They have been able to realize improvements throughout the development design chain. First, a project plan is constructed, with aggressive task estimates and pooled buffers. Second, a "firm" date is committed after checking for the availability of resources across projects. Third, when projects are in execution, buffers are monitored and used to set priorities. Even the executive reviews are based on buffers and focused on tasks that are consuming buffers.

Results

LSI Logic described the benefits of adopting this "beautifully simple concept" at a Management Roundtable Conference in February 2002. For example

- Over 90% of projects in the library development group now finish within 2 weeks of planned dates.
- Customer relationships have improved since buffers allow the development group to update customers on expected delays – should there be any - sooner rather then later.
- There has been an overall improvement in throughput, as measured by the increased complexity of designs/ features sets that can be handled with the same resources.

3. Large equipment maintenance – United States Marine Corps Materiel Command

The mission of the Materiel Command is to provide the highest level of materiel readiness to the United States Marine Corps. Key customers include U.S. Marine Corps, U.S. Army, U.S. Air Force, U.S. Navy, FBI, Arizona National Guard and Foreign military sales. Its two maintenance centers in Albany Georgia and Barstow California perform depot level repair on track and wheeled vehicles. These maintenance centers are a critical link in the readiness supply chain – one extra day in repair means the vehicle is not available for field duty for that day. As a result, their customers demand quick turnarounds, on-time delivery, and competitive prices. This creates a constant pressure to improve.

The leadership team was looking for the next source of quantum gains in speed and efficiency of delivering projects, and heard how a new approach was delivering impressive results in other defense organizations. Leadership found the new approach simple and powerful, and decided to introduce it using Vector Strategies, a consulting firm specializing in maintenance and repair logistics.

Results

- Within 3 months of starting the implementation, cycle times have been reduced by 50%.
- Since vehicles now spend much less time in repair shops, there is a 5-10% increase in the effective capacity of the vehicle fleet (vehicles in the field duty).
- Throughput from the depots has more than doubled without adding resources.

The solution is now being adopted by more and more maintenance centers in the US Navy.

4. Construction projects – SheaHomes

SheaHomes is a general contractor that develops land and coordinates the building of homes. Its Phoenix division sells approximately 2000 houses per year. Being a general contractor, SheaHomes uses a network of partners for all the work but assumes the risk and rewards of the timely completion of houses.

Coordinating resources and work across multiple trade partners is complex. Partners support multiple projects across multiple sites and even multiple contractors. As uncertainties occur on one site, be it weather, customer demands or any other reason, partners need to respond – which often requires pulling resources from elsewhere.

The new approach to managing project uncertainties was introduced to the executives in its Phoenix division by Vector Strategies. After a two-day assessment, they gave it a guarded yes – the concept was sound and compelling but yet to be proven in construction. Implementation began in late 2000, and the target was to reduce cycle time from a current 91 days to 60.

Results

- Cycle time was reduced from 91 days to 56 in the first site. As the implementation was expanded to other sites, a 20-30% reduction in cycle time has been consistently achieved.
- Savings in interest costs from the first site alone paid for the investment many times over.

5. Pharmaceutical product development – Pharmacia

Pharmacia executives came to know of the new approach for managing project uncertainties through The TOC Center, a consulting company specializing in project management for research and engineering. Having spent substantial money in traditional project management tools and not getting the promised results, they were skeptical that there was a solution that could work. However, they liked the common sense logic of the solution, and decided to give it a try.

Pharmacia first implemented the solution in their clinical supplies at Kalamazoo to test the concept. Although it is a small link in the overall drug development chain, it is a crucial link. A delay here quickly propagates as the doctors and researchers cannot conduct clinical trials. The area was plagued by long lead times, typically 8-12 weeks between the initial request for clinical packaging and the actual start of the studies and low throughput. On-time delivery was 48%. Package rate was only 20 per month while active studies per month had climbed to 65.

Results

- Lead times were reduced from 8 weeks to 3 weeks.
- Due-date delivery improved from 48% to over 90%.
- The package rate more than doubled, from 20 to approximately 50 studies a month.

Seeing such results, implementation was expanded to a clinical supply operations facility in Italy and a research function in Chicago. While it is too early to quantify the results there (these are multi-year projects), early indications are very positive. Milestones are being hit and there is less firefighting and more control. Pharmacia is also continuing to expand the new project management solution in other areas.