What Should Multi-Project Operations Focus on:

Resource Utilization or Cycle-Time?

The throughput of a single project is determined by the cycle time of the project. What limits the throughput (in terms of number of projects) of a multi-project organization? Is it the capacity of some resource? Is there a conflict between finishing a single project faster and doing more projects? In other words, is it possible to better use capacity by starting work earlier (increase the cycle time of projects to increase throughput)?

This article shows that there is no conflict. The way to increase the throughput in terms of number of projects is to reduce the cycle-time of individual projects. This has significant implications on how multi-project organizations are managed, which also are pointed out in this article.

How can an organization that does projects increase its throughput? What is the leverage point for the organization to do more projects faster? Should the focus be on exploiting the capacity of a limiting resource? Or should it be on reducing the cycle time of every project?

The situation is simpler in a single project. Once the project scope has been decided, throughput of a project is typically determined by how fast the project can be completed. It is clear in this case that the focus should be on the Critical Chain of the project. That does not mean that there are no resource bottlenecks in the project, in fact dealing with these bottlenecks is one way in which Critical Chain is distinct from critical path methods. Below are examples of different kinds of projects and the impact of cycle time on throughput

- For a new product development organization the cost of not being the first to market is lost market share and a smaller lifecycle for the product. For hi-tech companies the pace of innovation is so high that being that being the first can make a big difference. For pharmaceutical companies the sunset period on patents implies that reducing cycle time can have a huge impact on the return on investment for a new drug.

- For a construction project the longer the cycle time the longer the money is stuck not generating returns. Reduction in cycle time is a direct driver of increased throughput as it frees up money much faster that can be cycled much faster, because the property is sold and payments received faster.

- In maintenance, repair and overhaul projects, the asset being maintained is very expensive. Every day of the asset not being available is a day of throughput lost.

- In large engineering projects the speed with which the project is completed is directly tied to how fast the investment starts to generate returns.

If an organization were doing only one project it is obvious that the leverage for higher throughput from the project lies in reducing its cycle time. But in a multi-project organization that is continuously undertaking new projects, it appears that the same effect can be realized by starting earlier. In fact, starting work earlier may enable exploiting the precious capacity of resources. What is the right approach to increasing the throughput of the organization?

For people who are familiar with production environments, the internal limitation is generally a resource or machine. The capacity of this most limiting resource is the capacity of the entire plant. A day of production gained on the most limiting resource is a day of production gained for the entire plant. A day of production lost on that resource is a day of production lost for the entire plant. A day gained on the most limiting resource is a day gained for the entire plant!

What is the equivalent for a multi-project organization?

A week saved on the critical chain of projects is a week gained for the organization

Everyone knows that if all projects finish faster, their benefits will be realized earlier. We claim that even for increasing the organization's output/ capacity, projects should be managed to finish in the shortest possible time.

There is no conflict between reducing the cycle time of projects and increasing the number of projects an organization can do; shortening cycle times leads to higher throughput! This might sound like a radical claim, with crucial implications for how to manage. First, the reasons for our claim:

Why reducing cycle time is the way to increase throughput

<u>1. Evidence from how time and capacity are consumed in projects</u>

The existence of multi-tasking and Parkinson's Law indicate that resources are not a limitation; in fact typically a lot of capacity in project organizations is wasted because of how work is performed. Reducing cycle time of projects reduces multi-tasking and Parkinson's Law and increases organizational throughput.

WORK	INTERRUPTIONS	PARKINSON'S LAW

Most of us are familiar with the theory behind Critical Chain. Uncertainties make it hard to predict how long a task will take. Managers can get time estimates from individuals, but those estimates cannot be treated as commitments. Uncertainties imply that the estimates will either be too long (in which case Parkinson' Law will show up and work will expand to fill the time given; or they will fall short, making it impossible to hold the person accountable in any case.

Secondly, tasks are not executed continuously because people are pulled onto multiple projects at the same time (all projects are late). When people multitask, they lose time and capacity shuttling back and forth between tasks.

Another reason for multitasking is the constant support and decisions needed from technical experts, managers or peripheral functions. Unfortunately, such support and decisions are not available in a timely manner. The result is that the time spent on the actual work gets fragmented. In order to keep busy in this kind of an environment, individual contributors start more that one task at a time. This helps them stay busy but increases the workload of the technical experts, managers and other support functions which in turn increases the number of interruptions even more.

It is clear that major gains in time and capacity can be had by minimizing interruptions and Parkinson's Law. This implies that throughput can be increased by reducing the duration of tasks more easily than reducing the actual effort associated with the task.

2. Evidence from the Queuing Theory

According to the Queuing Theory, increasing utilization of any resource to more than 70% in the presence of uncertainties and variability gives rise to very long queues. Given the visible impact of such queues on resource loading, project delays and waiting time caused for downstream resources, managers would increase resources to bring queues down.

Let us accept that the throughput of the organization is constrained by the capacity of some specific resource or skill involved in project work. The Queuing Theory tells us that in if the utilization of a resource exceeds a threshold (70%) the queue size in front of that resource starts to grow dramatically. Given that time is so precious on every project, there is a huge incentive for organizations to mitigate any resource constraints.

Even from a cost perspective, the amount of effort spent by one resource on the project is a small fraction of the overall effort required on the project. Unless the resource is an expensive investment (test labs, wind tunnels, hangers etc.) the cost of increasing the capacity incrementally is dwarfed by the gains to be had. As a result it is very unlikely that a large fraction of the resources will be idle waiting for a single resource.

When the above argument does not hold, the resource is typically capital intensive equipment or the facility where project is executed (e.g.: aircraft hangers for maintenance projects). In these situations also the best way to exploit this resource is to reduce the cycle time of the projects so that the facility can then accommodate more projects.

This does not mean that resources cannot be bottlenecks once in a while. But they are not what limit an organization from increasing its throughput.

3. Evidence from how organizations use their expert and support resources

Many resources in a multi-project organization do not do project work; they manage and support project work. The mechanism to exploit their capacity is to have fewer projects in the pipeline, i.e. reduce the cycle time of projects.

Uncertainties are the most difficult part of managing projects. Managing them requires improvisation, problem solving and good judgment. These are skills that are developed with long hard experience. These are the skills that are involved in managing issues and keeping the people engaged on direct project work productive.

In most organizations, if one were to look for the work that such resources perform, it wont' be found in the project plans. That is because they are dealing with emergent situations wherever and whenever they occur. They are dealing with all the situations that cannot be planned for.
The workload on these resources is a function of the number of projects that are active. More the work-in-progress, higher the workload!

The best way to exploit the capacity of experts and support resources is to keep the number of active projects low so that these resources can keep the rest of the organization productive. The way to limit the number of active projects is to reduce the cycle time of projects.

Implications for Managing

Focusing on reducing the cycle time of projects instead of increasing resource utilization is a major switch. Typically organizations operate under the assumption that they are resource constrained. The table below contrasts the differences implied by focusing on cycle-time, not resources.

Traditional Operating Assumption ***The issue is not enough resources***	**Correct Operating Assumption** ***Reducing the cycle time of projects will increase overall throughput***
Set aggressive resource utilization targets for the resource or skill that limiting even if cycle times increase.	Set aggressive cycle time reduction targets to ensure that there is no room for Parkinson's Law in the project.
Keep work-in-progress levels high enough to ensure that resources do not run out of work.	Keep work-in-progress levels low to ensure that the issues are resolved swiftly and that the support work is performed in a timely manner.
Subordinate all actions and decisions to keeping the resources busy.	Subordinate all work to keep the critical chain flowing (follow buffer-based-priorities)
Focus improvement efforts on reducing the work content of each task.	Focus on reducing interruptions, streamlining issue-resolution and support functions, and better managing the Parkinson's Law.

EXECUTION MANAGEMENT RESULTS

	BEFORE	AFTER
Electrical Power Transmission, Engineer-to-Order ABB AG, Power Technologies Division	Throughput was 300 bays per year.	Throughput increased to 430 bays per year.
Transformer Repair and Overhaul ABB, Halle	42 Projects completed Jan-Dec 2007; On-Time delivery of 68%.	54 projects completed Jan-Dec 2008; On-Time delivery of 83% .
Theme Park Design, Install and Commissioning Action Park	121 projects completed in 2004.	142 projects completed in 2005. 153 projects completed in 2006.
Telecomm Switches Design, Development & Upgrades Alcatel-Lucent	300 to 400 active projects with 30+ deliveries a month. Lead times were long. On-time delivery was poor.	Throughput was higher by 45% per person. Lead times are 10-25% shorter. 90+% on-time delivery.
Customer Experience Systems – Customized SW Development for Telecommunications Amdocs, Israel	8 projects in crisis requiring CEO level attention in 2007; Market pressures to reduce cost and cycle time of projects.	Project cycle time decreased by 20%; Increase of 14% in Revenue/Man-Month across 4000 people; 0 projects in crisis in 2008.
Iron Ore Asset Development Projects BHP Billiton	25,800 man-hours of engineering design work had to be completed in 8 months. Historical delays of 2 weeks and man-hour overruns of 20%.	Project was finished 3 weeks early. Productivity increased by 25% with only 19,500 man-hours needed.
Satellite Design and Assembly Boeing Space & Intelligence Systems	Antenna Assembly and Test was the constraint of the Satellite.	Antenna Assembly and Test was no longer the constraint of the Satellite. Productivity increased by 64% on the next Satellite and a further 26% on the subsequent Satellite.
Nuclear Power Engineering Central Nuclear Almaraz Trillo	19 design evaluation and modification projects were completed per month.	Throughput increased by 25% to 24-30 projects per month.
Nuclear Power Engineering C.N. Cofrentes (Iberdrola)	Due date performance was 60%.	Due date performance increased to 95%. Throughput increased by 30%.
Oil & Gas Platform Design & Manufacturing LeTourneau Technologies, Inc.	Design Engineering took 15 months. Production Engineering took 9 months. Fabrication and Assembly took 8 months.	Design Engineering takes 9 months. Production Engineering takes 5 months. Fabrication and Assembly takes 5 months with 22% improvement in labor productivity.
Advertising Product Development Marketing Architects	Completed 7 projects in 2006.	Completed 7 projects in 8 months of 2007.
Steel Plant Maintenance TATA Steel	Boiler Conversion projects took 300-500 days. In 2007, first year of Critical Chain adoption —reduced cycle time by 10-33% in maintenance and upgrade projects.	Cycle times were reduced to between 120-160 days. Saving of $13.4 million. In 2008 achieved a further 5-33% reduction in cycle time.
Defense Products Design and Manufacturing TECNOBIT	Difficult to synchronize Design and Manufacturing. Long project cycle times with frequent delays.	Project cycle times were reduced by 20%.
Automotive Assembly Systems, Engineer-to-Order ThyssenKrupp (Johann A. Krause)	70% of projects were late. High overtime and outsourcing.	Lateness reduced by 50%. 63% productivity gain. 15% more projects completed.
Custom Furniture Design and Manufacturing Valley Cabinet Works	Struggled to complete 200 custom furniture projects per year. Revenues were flat and business was just breaking even. A lot of firefighting in execution.	Completed 334 projects in 9 months. Revenues increased 88% and profits increased by 300% in the first year. Firefighting and thrashing eliminated.
Equipment for Manufacturing Solar Panels, Engineer-to-Order Von Ardenne	Revenues of 130 Million Euros; Profits of 13 Million Euros; Cycle time 17 weeks; On-time 80%.	Revenues of €170 M; Profits of €22 M; Cycle time 14 weeks; on-time 90%.

EXECUTION MANAGEMENT RESULTS

	BEFORE	AFTER
Next Generation Wireless Technology Product Development Airgo Networks	Cycle time from first silicon to production for 1st generation was 19 months.	Cycle time from first silicon to production for 2nd generation was 8 months.
Customized Software Development Alna Software	Growth was stagnating, becoming insufficient to secure market position.	Throughput increased by 14% in first 6 months. Cycle time reduced by 25% and project completions increased 17% with over 90% on-time delivery.
IT Projects Celsa Group	15 SAP functionality projects were completed per month.	SAP functionality project completions increased by 30% to 20 projects a month.
Automotive Product Development Chrysler	Cycle time for prototype builds was 10 weeks.	Cycle time for prototype builds is 8 weeks.
Biotechnology Plant Engineering Danisco (Genencor)	20% projects on time.	87% projects on time. 15% immediate increase in throughput.
Pharmaceutical Product Development Dr. Reddy's Laboratories	In 12 weeks prior to Critical Chain 6 projects were completed; 20% were on-time.	In 12 weeks since Critical Chain was implemented, 11 projects completed; 80% on-time.
Telecommunications Network Design & Installation eircom, Ireland	On-time delivery less than 75%. Average cycle time was 70 days.	Increased on-time delivery to 98+%. Average cycle time dropped to 30 days.
Semiconductor Design and Manufacturing e2v Semiconductors	Actual cycle time of projects 38 months; 25% of projects were on-time.	Actual cycle time reduced to 23 months; almost all projects are within the committed cycle time of 24 months.
Home Appliances New Product Development Hamilton Beach/Proctor-Silex	34 new products per year. 74% projects on time.	Increased throughput to 52 new products in 1st year, and to 70+ in 2nd year, with no increase in head count. 88% projects on time.
Digital Camera Product Development HP Digital Camera Group	6 cameras launched in 2004. 1 camera launched in spring window. 1 out of 6 cameras launched on time.	15 cameras launched in 2005. 7 cameras launched in spring window. All 15 cameras launched on time.
ASIC Design Technology Development LSI Logic	74% projects on time for small projects. Major tool releases were always late.	85% of small projects on time. Major tools released on time for three years in a row.
High Tech Medical Product Development Medtronic	1 software release every 6-9 months. Predictability was poor on device programs.	1 software release every 2 months. Schedule slips on device programs cut by 50%.
High Tech Medical Product Development Medtronic, Europe	Device projects took 18 months on average and were unpredictable.	Development cycle time reduced to 9 months. On-time delivery increased to 90%.
Food Preparation & Packaging Oregon Freeze Dry	72 sales projects completed per year.	171 sales projects completed per year. 52% increase in throughput dollars.
Pharmaceutical Product Development Procter & Gamble Pharmaceuticals	In 2005 completion rate of 5 projects/Quarter; 55% of projects delivered on time.	In 2008, completing 12 projects/Quarter; 90% of the projects on time, with the same number of resources.
Marketing/Publishing Support Rapid Solutions Group	Projects were always late. Lead times were not acceptable.	On-time delivery improved by 30%. Lead times were reduced by 25%.
Garment Design Skye Group	Product ranges were late to market.	100% due-date performance. 30% reduction in lead times and sampling costs.

EXECUTION MANAGEMENT RESULTS

	BEFORE	AFTER
Aircraft Upgrade and Repair SIAE/AIA Clermont-Ferrand	5 C-160 aircrafts on station; 150 days planned cycle time.	2 C-160 aircrafts returned to air force, 3 on station, replacement value of approximately €300 M; 100 days planned cycle time; 15% increase in man hours with 13% fewer resources.
Aircraft Upgrade and Repair B52, Tinker Air Force Base, Oklahoma City	Maintained 11 Aircrafts a year; cycle time of 225 days.	Increased to 17 aircraft a year; cycle time of 195 days.
Engine Repair & Overhaul Delta Air Lines, Inc.	Produced 40 engines per month. 4 weeks piece part cycle time.	Increased production to 50+ engines per month, 16%-26% reduction in engine turnaround time. 2.5 weeks piece part cycle time, 25% increase in piece part throughput.
Aircraft Upgrade and Repair E3, Tinker Air Force Base, Oklahoma City	4 Aircrafts on base; Cycle time of 183 days.	On average 2.6 Aircraft on base; 155 day cycle time; 11% capacity released for additional workload.
Helicopter Manufacturing and Maintenance Erickson Air-Crane	Projects were constantly delayed with only 33% projects completed on-time.	Projects completed on-time increased to 83%.
Aircraft Repair & Overhaul US Air Force, Oklahoma City Air Logistics Center, B-1 Bomber Line	Turnaround time 162 days. 7 aircrafts in repair cycle.	Turnaround time reduced to 115 days. 4 aircrafts in repair cycle (3 returned to customer). Production output increased from 185 hours/day to 273. 1 1/2 dock spaces freed up.
Aircraft Repair & Overhaul US Air Force, Ogden Air Logistics Center, C130 Production Line	21-24 aircrafts on station.	Reduced to 18 aircrafts on station. 25 out of 26 aircrafts delivered on-time or early. (accumulated 191 days of early delivery in 6 months total).
Warfighter Systems Testing US Air Force Operational Test & Evaluation Center	Long cycle times. Low utilization of resources. Poor visibility on project slips.	30% reduction in cycle time measured over 900 projects. 30% improvement in resource utilization. 88% on-time delivery performance.
Aircraft Repair & Overhaul US Air Force, Warner Robins Air Logistics Center, C5 Production Line	Turnaround time 240 days. 13 aircrafts in repair cycle.	Turnaround time 160 days. 7 aircrafts in repair cycle. 75% fewer defects.
Aircraft Upgrade & Repair US Air Force, Warner Robins Air Logistics Center, C17 Production Line	Throughput of 178 hours per aircraft per day, turnaround time 46-180 days. Mechanic output was 3.6 hours per day.	25% increase in throughput, turnaround time reduced to 37-121 days. Mechanic output increased to 4.75 hours per day. 40% overtime reduction.
Army Vehicles Maintenance & Repair US Marine Corps Logistics Base, Barstow, CA	Repair cycle time for MK48 was 168 days. Repair cycle time for LAV25 was 180 days. Repair cycle time for MK14 was 152 days. Repair cycle time for LAVAT was 182 days.	Repair cycle time for MK48 is 82 days. Repair cycle time for LAV25 is 124 days. Repair cycle time for MK14 is 59 days. Repair cycle time for LAVAT is 122 days.
Aircraft Repair & Overhaul US Naval Aviation Depot, Cherry Point	Average turnaround time for H-46 aircrafts was 225 days. Average turnaround time for H-53 aircrafts was 310 days; throughput was 23 per year.	Reduced H-46 turnaround time to 167 days, while work scope was increasing. Reduced H-53 turnaround time to 180 days. Delivered 23 aircrafts in 6 months; throughput of 46 per year.
Submarine Maintenance & Repair US Naval Shipyard, Pearl Harbor	Job Completion Rate was 94%. On-time delivery was less than 60%. Cost per job was $5,043.	Job Completion Rate increased to 98%. Increased on-time delivery to 95+%. Reduced cost per job to $3,355, a 33% reduction. Overtime dropped by 49%, a $9M saving in the 1st year.

The Votes Are Also in

Attendees at the 2004 Project World held in October in Washington, voted, by an impressive majority of 92 percent, not to continue to throw more software at project management software problems. The consensus was that whether it's called 'project portfolio management,' 'enterprise project management' or 'collaborative project management,' they simply get more reports, more graphs, and more useless data. Yet, their projects are still delivered late, over budget and under scope.

"Execution Management is an extraordinarily powerful method which aligns business priorities and product pipeline execution," affirms Medtronic's Steve Schwister. "It provides us with improved pipeline velocity and increased productivity."

Like Schwister, today's executives know that their organizations have to deliver more projects faster, sometimes with fewer resources. Now they no longer need to feel stymied by the limitations of traditional project management, and increase project flow to meet the needs of business.

Is Execution Management right for your organization?

- Is your organization project-driven? Does increasing project speed or throughput translate into higher sales, competitive advantage and customer satisfaction?
- Do your projects require coordination of more than a handful of people and a few tasks? Are resources shared among multiple projects and contention for resources frequent?
- Are your project teams constantly rewriting project plans? Is project administration consuming excessive overhead?

If your answers to the above questions are "yes", contact us at info@realization.com.

