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LETTER FROM THE EDITOR(S)

Rick Price and I are the new editors of the Measurable News. Having read and contributed to this magazine since its beginning, we are both excited by the opportunity to contribute as co-editors.

Serving as co-editors makes sense for a number of reasons. Sharing the work load to pull together authors and topics is a plus as is having a shared vision of where our community can expand to now that the IPPM certification efforts are under way. Both Rick and I live in Colorado where there is a large aerospace contingent. Colorado also maintains one of the largest Federal Agency footprints outside the Washington D.C. area. A significant number of constituents practice Earned Value, Risk Management, and Program Planning and Controls (PP&C).

Denver also houses other domains that practice versions of Performance Management, Risk Management, and PP&C. Domains such as BioPharma, large construction, electric utilities, telecommunications, cable broadcasting, consumer and commercial electronics manufacturing, and major software product development all face similar program management challenges. All have members participating in professional societies that have shared interests - AACEI, ICEAA, INCOSE, IEEE, ACM. These are potential members of CPM, readers of the Measureable News, and contributors to advancing the art and science of integrated program management.

We both look forward to reaching out to our contacts within these domains to elicit contributions to the Measureable News.

Like the previous editions, we will continue with contributions from CPM leadership, articles of interest, letters to the editors, etc. We would also like to start a new feature section of the Measurable News called “Ask An Expert.” In this section, readers can submit questions on any topic germane to the topics of CPM. This includes earned value, risk, program performance management, work breakdown structure, Integrated Master Plan, Integrated Master Schedule, Agile development inside EVM, tools, and other tools on keeping the program “green”. Samples of the types of questions that would be appropriate to ask are as follows:

“We’re a Prime Contractor with a recent award that includes a flow down for an Integrated Master Plan and Integrated Master Schedule. We have traditionally not been on programs with IMP/IMS. Where can we look for guidance beyond the DOD Guide for how to construct this submission, including the “Do’s and Don’ts” of a good IMP/IMS?”

“I am a major subcontractor of a large Prime Contractor. The Prime Contractor is directing us to utilize our underruns to turn it into BCWS for additional scope. What do I do?”

Chances are that if you are seeking an answer regarding the application of Performance Management, Risk Management, or PP&C, others are as well. It is our belief that this approach will build a Community of Practice, enabling all to learn from the experience of others.

“Ask An Expert” questions can be submitted with your name or anonymously and should be submitted via email to the CPM Executive Director Don Kaiser at kaiser@mycpm.org.

Glen B. Alleman
Niwot Ridge LLC

Rick Price
Lockheed Martin
The CPM election season has ended. A big “thank you” goes to all those members who took the time to review candidates’ qualifications and vote – but especially to those members who stood for the board vacancies. We were blessed with excellent choices. I look forward to working not only with the successful candidates, but also with those dedicated members who, while not successful in their bid for election, remain invaluable to CPM as volunteers and potential future board candidates.

Your board has been busy! VP for Administration Lauren Bone is juggling the startup actions for several domestic and international chapters. VP for Education and Certification Bill Mathis and his team are preparing for the IPMW in a few weeks, including the rollout of our new Integrated Program Performance Management certification. VP for Conferences & Events Susan Wood is doing her usual masterful job of planning for and managing IPMW, ably assisted by VP for Research & Standards Dale Gillam. Lauren and Bill, along with past president Neil Albert, remain actively engaged with development of the new ISO standards for EVM and WBS. This is their busy season and we are all excited about the strong IPMW program.

As at last year’s IPMW, the Department of Energy has a dedicated track. DOE contractors and government people will gather in a collegial environment to discuss the topics of the day. With our IPMW co-sponsors ICEAA and NDIA, CPM is pleased to provide this important venue, as we also do for the Department of Defense and its contractors and program managers – and are prepared to do for any other government organization.

In closing, I hope you and your families have enjoyed a great summer. I look forward to seeing you at the IPMW in Bethesda, Maryland from October 31st- November 2nd.
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CPM is pleased to announce the following election results. Many thanks to our members that took the time to vote and to all of the candidates that stood for election.

EXECUTIVE VICE PRESIDENT

Kym Henderson

**Biography:** Kym Henderson is a practicing information technology project manager experienced in defense EVM application and commercial sector project recoveries utilizing tailored, innovative “EVM-like” techniques. His degrees are a Bachelor of Business and Master of Science (Computing).

Kym promotes adoption of EVM by teaching practical approaches to application in his “Applying Earned Value Concepts to Commercial [IT] Projects” course (part of PMI SeminarsWorld® in 2005-2007) at various locations in the USA, Europe and the Asia Pacific region. He is also a certified APMG EVM Trainer.

**Goals and Objectives:** Kym Henderson’s overarching goal and objective will be to continue his long standing advocacy of EVM focusing on promoting adoption to industry segments, geographies and organizations not currently utilizing the method while continuing the important engagement with US Government stakeholders and decision makers. He is uniquely placed to insure continuation of CPM’s Global Outreach initiatives from the new coordination role of the Executive Vice President.

VP CONFERENCES, WORKSHOPS & EVENTS

Kathy Evans

**Biography:** Kathy has been very involved with the College of Performance Management for the past four years. She currently serves as the Co-Dean for the Principles of Performance Measurement training track and was instrumental in the creation of the workshop format that is being integrated into the training tracks. She works with the VP Education and Certification to develop CPM’s new certification program to take Integrated Program Performance Management to a new level. Additionally, she is one of the founding members of the DC chapter of CPM and acts as their Treasurer. Kathy received the CPM President’s Award in June 2016.

**Goals and Objectives:** As Vice President-Conferences, Workshops and Events, I plan to conduct CPM’s annual EVM World and IPM Workshop in a professional manner which enables the growth and development of individuals’ and companies’ Integrated Program Performance Management understanding and experience. Coordinate with Finance to grow our sponsorship base. Leverage my relationships with the CPM Education & Training group to collaboratively promote the education, training, and upcoming certification programs to improve participation and attendance at the workshops. Assure seamless client service to vendors who participate in CPM events. Work with the communications team to migrate to a paperless environment. Work with local CPM chapters, as appropriate, to facilitate meaningful collaboration which will encourage local CPM members to attend EVM World and the IPM Workshop.
VP EDUCATION & CERTIFICATION
William ‘Bill’ Mathis

Biography: I have a deep background in Earned Value Management implementation, education, and system operations. But in the interest of focusing on what is most important to the vitality of CPM in the area of Education and Certification, I think it is best to abbreviate the details of my professional background.

In short - I own and operate a small business in northern Virginia focused on capital planning and investment control systems and support for the Federal Government. EVM and integrated program management is certainly a key part of this. Generally, my “day job” involves the non-DoD elements of the government, and mainly Agencies with portfolios of smaller-scale, IT-centric programs and projects. For these organizations, effectiveness is key and “strict compliance with ”rules of thumb” is often secondary. Throughout my career adaptability and effectiveness have been crucial to success.

Goals and Objectives: I believe CPM is well positioned as an association of the world’s greatest performance management talent. Our education programs are fundamental to our Mission, and I am dedicated to serve CPM in the role of VPEC, and help CPM be the leader advancing our profession. If re-elected to the position of VP of Education and Certification, I will continue to work toward two fundamental goals:
1. Maintain and improve the excellence of our professional training programs, and
2. Lead the introduction and maturation of the IPPM certification program.

I also plan to continue work with CPM’s education team volunteers on additional professional recognition for the benefit of our membership. I advocate the concept of introducing a CPM Fellowship. I am also actively promoting development of CPM’s own best practice guidance for IPPM to take the lead worldwide in the field of Integrated Program Performance Management.

VP FINANCE
Brian Evans

Biography: I am currently a managing consultant at Pinnacle Management Systems, Inc. specializing in (Integrated Program Performance Management) IPPM implementations, scheduling, and risk management. I serve as the Co-Dean for the College of Performance Management’s Government EVM Education track (CPM-600G). I am also the AACE International Certification Board EVP Committee Chairperson.

I am a frequent speaker, lecturer and trainer of IPPM and Project Management. For CPM, as stated previously, I am the Co-Dean for the CPM-600G track. I also teach the CPM-100F and CPM-300B training courses. I have delivered presentations at EVM World, IPM Workshop, and AACE Annual Meeting. I have delivered workshops at EVM World and IPM Workshop. Additionally, I used to host and manage a monthly IPM working group within my company to raise the level of IPM knowledge within my company.

Goals and Objectives: As the CPM Vice President Finance, I will seek to improve the financial footing of CPM. I plan to work with the CPM board to identify viable new revenue streams. Leverage my relationships with other Board Members identify the value of CPM original content to members and potential partners. Develop financial partnerships with other organizations where possible for CPM developed material. Eliminate wasteful spending.
Biography: Marty Doucette is the Chief Technology Officer of Pilgrim Companions, Inc. and has over 25 years of Integrated Program Management (IPM) and Earned Value Management Systems (EVMS) implementation experience. Marty began his project management experience in television program production which led to his authoring of Microsoft Project for Dummies™ and Digital Video for Dummies™.

Marty was introduced to EVM in 2000 when contracted by a large DoD contractor to assist in their preparation for an integrated baseline review (IBR). Subsequently, Marty has written, taught and developed software applications and other tools to assist first timers and practitioners in programs with DFARS EVMS requirements. Marty currently provides EVMS surveillance and Integrated Program Management Review (IPMR) support to large DoD contractors. He is a voting member of the NDIA Integrated Program Management Division (IPMD) and currently serves on its Contracts Working Group.

Goals and Objectives: As is often the case, the research and standards responsibilities associated with this position exceed the budget and resources that are necessary to easily accomplish the job. The fact that the job will be hard is not a deterrent to me. Instead, it is a call to creativity, collaboration and shared goals with the many dedicated professional women and men who desire to support the objectives of this important College of Performance Management. Those who know me best would tell you that I am a servant leader who openly and daily expresses his gratitude to his God and Savior to be able to help others. And I can think of no greater honor than to do my best in helping advance research and standards in my own field of Integrated Performance Management. If I am elected, I will bring to this job the perspective of a person who believes in always finding better ways to accomplish more with less, in establishing ever-clearer paths of communication among all stakeholders based upon accepted, measurable norms, and in openness born of humility, strength born of faith.

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The CPMTV chapter held its summer quarterly meeting on Tuesday, September 6 in Huntsville, Alabama. With good representation from industry, education, and government, over 25 individuals attended the meeting. The meeting was graciously hosted by ClearPlan and Defense Acquisition University (DAU) with ClearPlan providing speakers and refreshments and DAU providing additional speakers and the meeting space at their Huntsville facility. The meeting was emceed by Truman Carroll, CPMTV Executive Vice President, and contained presentations by Josh Garvey, Scott Fish, and Joel Little.

Mark Lumb, Dean of DAU South, kicked things off by welcoming everyone and providing administrative remarks. He was followed by Truman Carroll who welcomed meeting attendees, presented the meeting agenda, and thanked the sponsors. He continued by mentioning the upcoming IPM conference and invited people to e-mail CPMTV board members discussion topics they would like to see at upcoming quarterly meetings. Mr. Carroll concluded his opening remarks by welcoming Mr. Garvey and Mr. Fish.

Josh Garvey, President of ClearPlan, and Scott Fish, Manager at ClearPlan, opened the presentations by discussing techniques for integrating Agile development processes into Department of Defense Earned Value Management Systems. Mr. Garvey and Mr. Fish were able to expertly summarize Agile techniques and show how they could be measured using an earned value system. Their talk included three different planning scenarios that helped illustrate their ideas. This proved to be an excellent presentation which received strong positive feedback from attendees including one describing it as “a very meaningful and thought provoking session.”

Joel Little, DAU Professor of Earned Value Management, then led an enlightening discussion pertaining to the 12 August 2016 Assistant Secretary of the Army for Acquisition, Technology, and Logistics (ASA(ALT)) EVM Waiver Policy. Mr. Little did an excellent job recapping conversations he had with the Army’s Performance and Root Cause Analysis (PARCA) office explaining the waiver and providing clarification on some of its language.

Truman Carroll closed the meeting by thanking the presenters, ClearPlan, and DAU. He encouraged meeting attendees to suggest quarterly meeting topics to the CPMTV board. Lastly, he invited everyone in attendance to the post-meeting reception.

Please look for additional details regarding the next CPMTV quarterly meeting in the coming weeks.
The College of Performance Management (CPM), an independent entity, is the premier organization for earned value management (EVM) and project planning and controls. As an international non-profit organization, CPM is dedicated to sustained improvement in project management and performance management.

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- **Promote Earned Value Management and Project Planning and Control**: Foster the recognition and use of earned value management and other project planning and control techniques as integrating processes for project management
- **Disseminate Information**: Provide opportunities for the exchange of ideas, information, solutions and applications
- **Improve Community**: Encourage and enable the advancement of theory and application through research, standards, and education
- **Grow Professionals**: Provide our diverse membership of project management professionals with growth opportunities through leadership, education, networking, and other benefits of a professional association
- **Enhance Membership and Benefits**: Improve membership benefits and expand our membership base through continued development of a professional association

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During 2015 the industry was working to produce written guidance for Agile and EVM implementation which resulted in the NDIA publication “An Industry Practice Guide for Agile on Earned Value Management Programs”, released earlier this year. The information in this guide was a key part of the Agile EVM discussions held at EVM World 2016.

Are you executing a contract implementing an Agile methodology and managing performance with an Earned Value Management System (EVMS)? Have either been tailored to work together? Do both process sets continue to evolve together? Is this the first RFP with EIA 748 and Agile requirements you have seen? The Agile Track at EVM World 2016 was comprised of five sessions; all focused on the current state of Agile and EVMS implementation based on the guidance the industry is producing. The first session was an introductory session designed to educate those new to Agile and EVM. The content of the next three sessions was strategically aligned with considerations for establishing and then executing a program plan, including how the various artifacts work together. The final session was an open discussion with all presenters.

The presenters represented multiple companies within the industry – Jim Duffy (Raytheon), Glen Alleman (Niwot Ridge), Laura Bier (CGI Federal), Dave Scott (BDO), and Ron Terbush (Lockheed Martin). The speakers shared their experiences documenting how they have adapted their corporate procedures and processes to facilitate the best way for Agile and EVM to work together – to measure progress of the products being developed and delivered. The speakers made this “Top 10” article update possible. As the joint government and industry working groups continue to meet and share ideas, there is a natural convergence of a consistent approach which is evident in the initial published guidance.

The “top 10” concepts discussed at EVM World 2016, based on industry experience as of June 2016 are below. Still in 2016, the most common response still seems to start with “well, it depends”. As the concepts below are applied to the program being executed, remember, everything “depends” on the contractual requirements and the customer’s experiences and expectations. Be agile.

1. Agile and EVM work together. Both are disciplined process sets that start with a plan (for example an Agile Product Roadmap and an IMP). Agile is applicable across a large spectrum of program types. EVM is a crucial management tool for programs with deliverables, regardless of contract type, including those implementing Agile methods. Embrace and adapt to report value to the customer faster.

2. Establish the Agile approach for the program early. What is the product hierarchy? (System, Capability, Epic, Feature, Story, Task). Determine (and ideally maintain) set teams with diverse, complementary skills to perform the work and establish a common sizing approach to the product backlog. Will all Control Accounts utilize an Agile methodology? Establish traceability between the Agile and EVM hierarchy for the functions and control accounts being executed in an agile manner. Complete the right amount of system architecture and engineering first, tracing Agile products to program requirements to check product backlog quality and completeness.

3. Engage the product owner (the person who “owns” the business value) early and often during the planning/discovery sessions. Do not commit to deliver more than required on the contract. Since customer collaboration and frequent feedback loops are crucial to Agile, determine the level of customer involvement and access to the Agile data – develop together with your customer how they will participate and what you will share.
4. The Agile process is disciplined. Teams tend to estimate or size the user stories optimistically in the beginning. Their velocity will normalize over time, as they continue working together. Teams do not arbitrarily move user stories across sprints or releases. It is a disciplined coordination between the team and the product owner to move user stories. Be cognizant of the “bow wave” and the burn down of the team completing user stories to monitor agile progress.

5. Consider the corporate culture with regard to both the Agile process maturity and the Corporate EVMSD. In 2016, teams and companies continue to underestimate the impact of the corporate culture and maturity level of embracing Agile and EVM processes. Agile philosophies will play into how the program is structured. That structure may drive how scope is documented. With a very prescriptive EVMSD, a lower level of tracking may be required than a company with a less prescriptive EVMSD. Likewise, the corporate infrastructure to support EVM may impact the ability to execute the EVMSD with an Agile program.

6. The Work Breakdown Structure (WBS) MIL-STD-881 standard provides product oriented templates and guidance. Establish a WBS structure that is best for the contract. Is Software the mission product? A product oriented WBS is important; adapt and tailor it accordingly to facilitate and report measuring product completion. There does not necessarily need to be a difference between a waterfall and Agile WBS. Gain consensus with the customer on the structure. Recent performance analysis reveals that driving the WBS down to too low of a level can reduce flexibility in execution without any apparent benefit in better program management.

7. Plan and schedule the feature and/or the functionality to be delivered, not the Agile recurring time cadence for performing work. Don’t include “sprints” or other time box “iterations” because they don’t represent technical accomplishment. Plan the work or the product to be delivered in the next Agile release planning window, consistent with the EVM rolling wave. Let the Agile process manage the details within shorter time boxes. Manage scope, not time.

8. In the EVMSIG, the term “freeze period” is discussed as being “a period of time when baseline changes are limited.” This period of time exists in order to ensure stability of the baseline plan for accomplishing the contractual scope of work and to facilitate accurate performance measurement. The primary intent of any freeze period is to maintain forward planning discipline and the integrity of the baseline for performing the work. This length of time of the freeze period is not prescribed by the EVMSIG; the performing contractors should decide on the appropriate freeze period time interval for the type of work being performed. For example, in an Agile development environment, a shorter freeze period may be appropriate to accommodate change based on rapid feedback loops, but that does not relieve the contractor from detail planning prior to starting work. If a contractor’s System Description Document (SDD) defines a rigid freeze period that does not align with their program management practices, the contractor may consider revising the SDD to match their processes. The Government requires that the contractor demonstrate some level of baseline integrity by establishing a freeze period with controls in place to manage the changes made.

9. Use the Agile process and EVM together as an approach to control scope. For government application, always have a mapping of the items in the Agile Product Backlog to contract requirements. Each feature in the Product Backlog has a distinct set of both acceptance and exit criteria as defined to deliver the contractual scope. Requirements initially map to high level Epics and capabilities in the Product Backlog that describe the overall system functionality. Features are then developed that represent smaller elements of the high level capabilities and are recommended to be represented in the IMS and baselined. Lower level User Stories are inch stones and implementation details that describe how each feature in the IMS will be executed. As Features are completed, customer and contractor collaborate to deliver the target product, per contract requirements, within the constraints of scope, schedule and budget. Use your corporate contracting approach, program management procedures, Agile methodologies and EVMS to your advantage to control scope.
10. User stories are commonly used in Agile development as the detailed steps that implement a particular feature. Stories describe how the acceptance criteria for the feature is being completed / accomplished. Because completing stories results in technical accomplishment, the stories that implement a feature can be used as quantifiable backup data (QBD) to measure progress. Stories are typically “weighted” using Agile “story points” as relative size estimates for comparison to other stories to be performed, providing further fidelity for calculating the percent complete for a feature. It is important to remember that the product is the feature that is being developed, and the stories are just a means to measure the progress of the product being delivered. It is further recommended that stories are not tasks in the IMS.

11. Initial estimation and control account forecast assessments should be conducted based upon the individual Agile team in question and generalizations should be avoided, where possible. Specifically, each Agile team within an Agile train will have its own profile for velocity and overall work complexity. Because of this they should not be measured or forecast with a blanket velocity assumption as each team will produce on a different curve. Velocity can be used as a means to validate the estimate to complete (ETC) for a team supporting a specific feature, but do not replace standard analysis of work complexity for remaining work in the PMB when developing the control account ETC. The desired result is consistent Agile and EV metrics.

Where is your company on an Agile and EVM approach? Agile and EVM do work together. Manage your changing baseline. Embrace and adapt to report value to the customer faster.

References:


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PROBLEMS WITH SCHEDULING PRACTICE
By Pat Weaver

This article will briefly look at the three major problem areas affecting scheduling practice:

• The first is most organisations and managers simply choose to ignore the project schedule, in part because they have never worked with a good schedule produced and maintained by an effective scheduler (they don’t know what they are missing) and in part because of lax governance from the executive levels allowing the bad practice.
• The second is the inverse of the first – managers and lawyers failing to understand the purpose and limitations of scheduling and setting unrealistic expectations.
• The third is schedulers who know how to develop massively complicated files in various software tools, but have no idea what purpose and limitations of scheduling should be.

I will briefly look at each of these issues below.

MANAGERS IGNORE SCHEDULING AND PROJECT CONTROLS.
This is a combination of ignorance and bad experience. The only real solution is to fix the other two issues. One of the symptoms of this problem and a major destroyer of value is the approach adopted by many managers of setting ridiculously short timeframes for projects ‘to put pressure on the team to perform’ (without the benefit of a schedule analysis). The consequences are inevitably reduced scope and quality and increased costs resulting in massive reductions in value.

MANAGERS AND LAWYERS SETTING UNREAL EXPECTATIONS ON THE PROCESS.
The schedule is a model of what may happen in the future; it is not a statement of what will occur. A good schedule is based on a sequence of activities that are reasonable and importantly agree by the project participants as the optimum approach to accomplishing the work, based on what they know at that time the schedule is developed.

Whist it is reasonable and legally supportable to hold a contractor to a promise to complete a project within a specified time (the contract period) it is ridiculous to expect anyone to be able to determine in detail, exactly how they are going to achieve this outcome month or years in advance when many of the people who will be responsible for elements of the work are unknown. Detailed schedules for the next 2 to 4 months are a sensible way to coordinate work, using known resources who should be actively involved in developing the agreed plan (eg, the Last Planner approach). Beyond this timeframe detailed schedules are an arcane exercise that is potentially damaging - vast amounts of time and money are wasted developing the esoteric detail, then people spend even more time and money fighting over why the blind guesses entered by the planner months ago do not represent what’s actually happening. There are better options, ‘rolling wave’ and the more sophisticated ‘schedule density’ approaches work far better, but far too many managers, clients and lawyers expect schedulers to be able to perfectly forecast a ‘future’ involving 100s (or 1000s) of people months and years in advance. This crazily unrealistic expectation does more damage to project delivery than almost anything else!

The sole purpose of any model is to provide insight to support decision making. The project schedule is a model; the highly complex computer algorithms used to forecast weather are a model. The weather forecasters use their expertise to interpret the models with their millions

2) Different approaches are available but rarely used. For one, the CIOB Time and Cost Management Contract Suite 2015, see: http://www.mosaicprojects.com.au/Training-CIOB-CPC2013.html


5) Science and Statistics (1976)

6) Critical confusion – when activities on the critical path don’t compute..... see: https://mosaicprojects.wordpress.com/2016/06/12/critical-confusion-when-activities-on-the-critical-path-dont-compute/

of lines of code and based on their insights, prepare short term, medium term and long term forecasts. The useful information communicated in the nightly weather forecast is a carefully structured communication of the complex information designed to allow us to make informed decisions about our actions over the next few days. Importantly, as new information becomes available the experts in the weather bureau adjust and adapt the models they use and use the new data to update their forecasts.

From the information communication perspective they manage expectations, they will tell you within an hour or so when it is likely to start raining tomorrow, they will tell you which days are likely to be wet over the next week to 10 days and provide more general information for the next few months. They do not try to forecast that it will start raining at 16:18 in the afternoon on the Wednesday in three weeks’ time, even if their computer model has calculated this. They know there are too many variables in play to make this prediction viable so they say “We anticipate some rain mid-week in three weeks’ time”.

Schedulers are expected to produce multi-thousand line schedules that show precise dates for the start and finish of activities months and years in the future and then see their schedules attacked when the future unrolls differently. There are at least as many variables affecting the schedule as there are affecting the weather forecast!

The consequence of this demand for overly large, overly complex schedules is threefold:

• The schedule is too complex to provide useful insight to anyone, therefore cannot be used to support decision making.

• The schedule quickly becomes inaccurate and loses relevance as a working tool to help project decision making. People ‘switch off’ and ignore the schedule and the scheduler.

• The focus of contractual fights becomes the errors in schedule and the effect of delays on the schedule (despite the fact the actual sequence of work has very little to do with what was scheduled). This farce is continued by both sides for ‘contractual advantage’, rather than the focus of the project team (including the client) being on managing use of the available time proactively to finish the project on schedule.

Well-developed schedules are small enough and simple enough to actually support project decision making because they are fully understood by the decision makers. Moving to this situation requires the use of ‘schedule levels’ and other techniques by a skilled scheduler to provide the managers with the information they need when they need it, and to allow ‘what-if’ and options to be tested quickly and efficiently, while maintain vertical and horizontal traceability across the schedules. Think of the weather presenter and how they give you valuable information for your city or suburb, derived from some of the most complex models used anywhere.

SCHEDULERS WHO DON’T UNDERSTAND THE LIMITATIONS OF THEIR MODELS.

Good schedulers know the limitations of their tools and methodologies and work within these limitations to develop useful information for management. Bad schedulers know how to run their software and enter data and then believe the information produced is correct.

The schedule is a model and as the statistician, Professor George E. P. Box (University of Wisconsin), stated a few years ago “All models are wrong, some are useful.” He also stated:

• “Since all models are wrong the scientist cannot obtain a “correct” one by excessive elaboration.” (neither can the planner!); and

• “Remember that all models are wrong; the practical question is how wrong do they have to be to not be useful.”

The paradox is, once you accept the schedule is wrong to a degree, and then start looking to understand what the degree of error is in the schedule, the schedule becomes far more useful.

Some of the other key problems to be confronted in modern practice are:

• Understanding the limitations and inherent errors in a PDM schedule. Some of these problems were outlined in my blog ‘Critical confusion – when activities on the critical path don’t compute...’. Another issue is critical links; work by Murray Woolf suggests 30% of most critical paths are actually on the links, not the activities, but the work of the project is defined by the activities and every delay claim is based on delays to work... These are fundamental issues.
• Recognising any estimate about a future outcome is probabilistic and has a range. Using Monte Carlo or even the old fashioned PERT will frequently show the activities and paths with most influence on the project’s outcome are different to the deterministic CPM critical path. Modern practice largely ignores the probabilistic critical path (or paths).
• Risk events have different degrees of impact on the schedule. Modelling risk is essential, but rarely done.
• The problems associated with resource optimisation and critical resources (basically ignored in standard CPM tools).
• Volume of work -v- focusing on the ‘red line’ – all of the work has to be done eventually! Focusing exclusively on the CPM critical path whilst burning float on other paths is simply deferring an escalating problem for a short period. Earned Schedule is one solution.

Current scheduling practice largely ignores all of these issues, and many schedulers are completely ignorant them. The new Schedule Assessment Guide issued by the USA, GAO goes a long way towards driving a solution to some of these basic issues but is very new and has yet to make an impact on general practice.

SUMMARY
The ability of organisations to maximise the value they achieve from an investment in a project or program depends on how well the work is managed. One of the key tools needed to efficiently manage the work of a project is a realistic and achievable schedule. But there is a ‘chicken and egg’ problem.

Most executives have never seen a well-managed schedule in use on a successful project. There are an increasing examples of good practice in the public domain, including Cross-Rail in London, but these are ‘third hand’ reports, not lived experience. As a consequence, the Executives are reluctant to invest in developing the capabilities needed to produce good schedules (including training skilled schedulers), and as a consequence they continue to experience bad scheduling and controls and seek to minimise their costs. As a consequence, projects fail and value is destroyed.

Breaking this cycle will not be easy – my suggestion for the place to start is the scheduling community working to increase the skills of schedulers so at least the capability to do effective work is present. Then all that’s needed is an opportunity...

For free resources and more on scheduling skills development visit our website: http://www.planning-controls.com.au/

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About the Author
Pat is the Managing Director of Mosaic Project Services in Melbourne Australia. After 30 years in project management Pat is focused primarily on scheduling and PMOs, with primary interests on training the next generation of PMs both for formal credentials such as CAPM, PMP and PMI-SP and in areas of specific skills development around Scheduling, Earned Value and Communications.
Root cause analysis of why many DOD programs fail to deliver required 
capabilities within the planned time and budget has shown causes for failure 
begin with the buyer not knowing what “done looks like” before releasing 
the Request for Proposal (RFP). These are corrected with better guidance 
for preparing Measures of Effectiveness, Measures of Performance, and Key 
Performance Parameters in the RFP.

THE SITUATION
Far too many DOD programs fail to deliver promised capabilities within the planned cost and 
development schedules. Frequently, programs deliver less capability than planned, for more 
money, and beyond the requested need date. If the program exceeds the expected cost and 
more funds are required, the overrun adversely affects other development and/or production 
programs in the portfolio. Given fixed budgets, programs are inevitably stretched out, must 
reduce quantities and/or accept reduced or deferred capabilities. This situation reduces 
the warfighter’s ability to be successful as described in the agreed Concept of Operations 
(CONOPS) document. Not getting it right erodes the Department’s credibility with its 
Congressional stakeholders, the taxpayers, and adversely impacts obtaining funds for needed 
future systems.

WHY
Root causes for this imbalance have been studied for years. Major reasons for “not getting it 
right” include: [6]

- Poor initial requirement definition
- Changes in quantity requirements
- Errors due to limitation is estimating procedures
- Failure to fund programs at most likely cost
- Failure to understand and account for technical risks
- Top down pressure to reduce estimates
- Lack of valid independent cost estimates
- Over optimism
- Schedule concurrency
- Program stretch outs to keep production lines open
- Funding instabilities caused by trying to fund too many programs
- Funding instabilities caused by congressional decisions
- Inefficient production rates due to stretching out programs
- Failure to fund for management reserves

Perhaps the most succinct list of causes was published in a recent report by the DOD’s Office 
of the Secretary of Defense’s (OSD) Office of Program Assessment and Root Cause Analysis 
(PARCA) [12]. It concluded that the main reasons for poor performance were due to:

- Unrealistic performance expectations
- Unrealistic baseline estimates for cost or schedule
- Immature technologies or excessive manufacturing or integration risk
- Unanticipated design, engineering manufacturing or technology integration issues
- Changes in procurement quantities
- Inadequate program funding or funding instability
- Poor performance by government or contractor personnel

To this list, there are additional observations:

- Development contractors are not receiving clear descriptions about how the systems 
must operate to satisfy user requirements in offensive and defensive scenarios. In 
particular, Measures of Effectiveness (MOEs) and Measure of Performance (MOPs) are
not connected or relevant to the Concept of Operations document;

- Development contractors’ Performance Measurement Baselines (PMBs) do not appear to be connected to the contractors’ technical approach/plans;
- Contractor Control Account Managers (CAMs) are permitted to develop earning rules that are not objective or tied to technical progress; and
- Contractors are not required to show that reported cost and schedule progress is consistent with technical progress.

THE ART OF PROBLEM SOLVING

The term Root Cause Analysis describes a wide variety of methods used to identify the causes of problems (tracing problems to their origins) and helps answer the question of why they happened in the first place, which in turn, helps us put measures in place to prevent recurrence. The traditional root cause analysis (RCA) proposes that if you retrace the chain of causes that led to a particular event, you will eventually find the single cause that set everything else in motion, known as the “root cause.” The theory is that finding and eliminating this single root cause will solve the problem. Mr. Dean Gano concluded after much research that this approach is flawed because they were people-centric and subjective rather than principle-based and objective. [23] Mr. Gano developed a software tool to help users define problems, ask why the problem occurred, and then ensure that the answer includes both an action and a condition. The specific steps are discussed in a companion paper called RealityCharting [24]:

1. Define the problem by writing What, When, Where and Significance
2. Determine the known causal relationships. For each effect ask “why”. Look for causes in actions and conditions. Connect causes with “Caused by”
3. Provide a graphical representation of the causal relationships to include specific action and conditional causes
4. Provide evidence to support the existence of each cause
5. Determine if each set of causes is sufficient and necessary to cause the effect.
6. Provide effective solutions that remove, change, or control one or more causes of the event. Solutions must be shown to prevent recurrence, meet our goals and objectives, be within our control, and not cause other problems.
7. Implement and track the effectiveness of each solution.

Using RealityCharting®, DoD’s failure to deliver capable systems on time and within budget (steps 1-5 above) is depicted in Figure 1.0. This analysis should be considered a start to fully understanding this situation. The content of Figure 1.0 is notional, not complete, but includes the main drivers of not delivering required capabilities and is used to develop the recommended solutions (step 6).

The Contractor Did Not Understand Effectiveness of the System

In order for the contractor to develop an effective system, he must understand exactly how the user plans to use it to accomplish mission objectives so that he can create technical plans to deliver a system that meets those capabilities. He needs to understand Measures of Effectiveness (MOE), Measure of Performance (MOPs), relevant Key Performance Parameters and Key System Attributes (KSAs). These measures and attributes are to be developed and documented during the Mission Solution Analysis Phase within DoD Joint Integrated Capabilities and Development System (JCIDS) process. Figure 2.0 depicts the relationship to the capability requirement setting process to the acquisition process. The key output documents of the Mission Solution Analysis phase are the CONOPS, MOEs, MOPs, KPPs and KSAs.¹ The DoDI states that the CONOPS and these measures and attributes are to be included in the next phase Request for Proposal.² A review of three current programs shows that the measures and attributes are not closely connected to the users’ mission use scenarios sufficient to be effective. The JCIDS preparation guidance is inadequate to address this problem.

When this process is done correctly, and the measures and attributes are communicated to the contractor in the RFP, the contractor will be able to construct relevant Technical Performance Measures to gauge development progress. This concept is depicted in Figure 3.0.

1) Department of Defense Instruction 5000.02, January 7, 2015, paragraph 5(d)(2).
2) Ibid, paragraph 5(d)(3).
RealityCharting® for DOD’s Failure to Deliver Promised Capability on Time and Within Budget

Figure 1.0

Relationship between Capability Requirements and Acquisition Process

Figure 2.0

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To ensure that the MOEs, MOPs, KPPs and KSA are connected to the CONOPs, JCIDS guidance needs to be improved and documents should be presented and reviewed at the Development Request for Proposal (RFP) Release Decision (see Figure 2.0) which occurs prior to Milestone B. This would provide a thorough vetting that the government stakeholders collectively agree on “What Done Looks Like” before releasing RFPs.

To ensure development contractors understand system capabilities, the government should also require bidders to submit their Integrated Master Plans (IMPs) and Integrated Master Schedules in response to RFPs. A little more than decade ago, the DOD’s OSD recommended that the government customer create a top level Integrated Master Plan (IMP) and Integrated Master Schedule (IMS) and include the IMP/IMS in Requests for Proposals.3 The focus of this government IMP/IMS was on program objectives, capabilities evolution, and a summary schedule. The development contractor would then develop an Execution IMP/IMS that would describe how program capabilities would be developed and how those capabilities would be recognized as ready for delivery. In short, the contractor’s IMP was a top level plan to how they would deliver the required MOEs, MOPs, and KPPs in the context of the CONOPS. The contractor’s IMS is the more detailed plan to develop a system to provide these measure and attributes. The government PM would use the contractor’s submitted Execution IMP/IMS during the source selection process to determine if the contractor possessed a credible plan to deliver the required capabilities. The use of the IMP/IMS has fallen out of use, but the government should make this mandatory.

Contractor Program Management Baselines (PMBs) are Not Connected to Relevant Technical Plans
Because the government customer frequently does not fully understand “What Done Looks Like”, contractor implementation plans are not based on meaningful technical plans that evolve the required capabilities. PMB’s are thus based on technical plans that are not targeted to achieve capabilities; rather, they focus on detailed list of activities that achieve stated KPPs, by “due dates”, but don’t necessarily meet user needs.

Although not shown in the RealityCharting in Figure 1.0, this situation occurs all too frequently and it is a direct result of the customer not really understanding or communicating “What Done Looks Like” to the development contractor. Consequently, Integrated Baseline Reviews (IBRs) fail to accomplish their major objective which is to determine if the contractor has a credible plan to delivering the required capabilities within the given cost and schedule.

Further, even when contractors do possess Technical Performance Measures (TPMs) that are meaningful to the users, the government does not require that the contractor show that reported cost and schedule is consistent with the technical progress.

Since the technical plan is based on achieving certain activity-based events, earning rules are not objective or related to meaningful technical progress metrics. Giving the contractor a clear picture of “What Done Looks Like” and requiring them to show implementation plans with appropriate technical metric progress will go a long way to correcting this imbalance. Figure 4.0 illustrates how this should work.
Program Budgets Are Wrong

In Figure 1.0, cost and schedule estimates are usually wrong because they are optimistic and fail to adequately address risks. The evidence for these statements are based reviewing DOD and NASA estimates and actuals.

In spite of mandates for independent estimates, there is enormous pressure to “adjust” estimates to recognize the advantages of unproved or immature technologies or processes that are claimed to reduce development cost and schedule. This tendency is primarily due to the fact that nearly all the stakeholders are incentivized to be optimistic. Table 1.0 below depicts the key stakeholders and their main objectives and perspectives (incentives). None of the stakeholders appear to be incentivized to support realistic cost and schedule estimates and all are incentivized to conceal problems during development.

<table>
<thead>
<tr>
<th>Stakeholder</th>
<th>Objectives</th>
<th>Perspectives</th>
</tr>
</thead>
<tbody>
<tr>
<td>Executive Branch</td>
<td>• Satisfy national security objectives</td>
<td>• Personal ambition</td>
</tr>
<tr>
<td></td>
<td>• Field systems that defeat threats to national security</td>
<td>• Re-election</td>
</tr>
<tr>
<td>Legislative Branch</td>
<td>• Balance national security and social needs</td>
<td>• Constituent interest</td>
</tr>
<tr>
<td></td>
<td>• Distribute federal $ by state and district</td>
<td>• Personal ambition</td>
</tr>
<tr>
<td></td>
<td>• Maximize competition</td>
<td>• Re-election</td>
</tr>
<tr>
<td></td>
<td>• Control industry profit</td>
<td></td>
</tr>
<tr>
<td>Industry</td>
<td>• Profit and Growth</td>
<td>• Stockholders’ interests</td>
</tr>
<tr>
<td></td>
<td>• Cash Flow</td>
<td>• Capitalism</td>
</tr>
<tr>
<td>Government PM</td>
<td>• Deliver a system that meets the warfighter requirements on time and within budget</td>
<td>• No bad news on their watch</td>
</tr>
</tbody>
</table>

DOD Acquisition Stakeholders and Their Main Objectives and Perspectives

Table 1.0

Government estimates that form the basis of a programs’ budgets are typically single point estimates that are rarely placed in context of the outcome variance in past similar programs. In short, single point estimates are generated with no information the risks that have effect similar past programs, nor do they specifically address unique risk to the given program.
To be credible, cost and schedule targets need to recognize the irreducible and reducible risks are included in the estimate with a 80% confidence level. With the actual results of similar programs, and specific risks identified for the current program, there should be an 80% probability that the program will be completed at or below the targeted cost and completed on or before the planned schedule date. These confidence levels provide higher probability of success and earn the trust of the taxpayers.

RECOMMENDATIONS

Ensure the Development Contractor Delivers Systems That Meets Required Capabilities

The following actions are recommended to ensure the development contractor develops the capabilities that the user requires:

1. Improve JCIDS guidance to development of MOEs, MOPs, KPPs and KSAs to better connect them with the CONOPS user mission profile scenarios.
2. Review the CONOPS, MOEs, MOPs, KPPs and KSA at the Development RFP Decision Point (prior to MS B decision) to ensure all government stakeholders understand “What Done Looks Like”.
3. Mandate that the PM develop a top level IMP/IMS and include it in the RFP along with the CONOPS, MOE, MOP, KPP, and KSA.
4. Require development contractors submit Execution IMP/IMS in response to the RFP and use that information to evaluate the credibility of the contractors’ plans in the source selection process.
5. Require the winning development contractor to show relevant technical performance measures at the Integrated Baseline Reviews (IBRs).

Ensure the Development Contractor Delivers Systems within Cost and Schedule Targets

The following actions are needed to improve the probability of the development contractor delivering the required capabilities within the Milestone B development budget and schedule:

1. Require Acquisition Program Baseline (APB) Cost and Schedules be separately set at an 80% confidence level. (Note: This implies that the analogous data used in the estimate be shown to the MS B decision authority).
2. Fully fund programs at the 80% confidence level of the independent estimate.
3. Require the sponsoring agency to include a government-generated risk register and include it in the Development RFP and ask how the contractor plans to mitigate those risks and any additional risks the contractor observes. The contractors’ response should be part of the source selection decision.
4. At the IBR, require the winning contractor to show that their technical plan is based on achieving appropriate Technical Performance Measures over time and that the plan is the basis for the contractor’s spend plan (the PMB).
5. Modify the Integrated Program Management Reports to add appropriate key technical progress metrics. (This ensures that monthly reported cost and schedule progress are consistent with the relevant technical performance measures).
6. Incentivize the contractor to deliver required capabilities within the APB cost and schedule targets.
7. Require government program managers remain with the program until the next Milestone and incentivize the PM to “Keep the Program Green”.

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About the Author
Thomas Coonce is an Adjunct Research Staff member at the Institute for Defense Analyses (IDA) where he has authored several papers on improving the utility of the Integrated Program Management Reports for the office of Program Assessment and Root Cause Analysis (PARCA). Prior to joining IDA, Mr. Coonce managed NASA’s cost and schedule estimating activities. Prior to NASA, Mr. Coonce provided independent estimates of Major Defense Acquisition Programs for DOD’s Cost Analysis Improvement Group.
ABSTRACT

Managing the uncertainty in a network of tasks that describe a schedule is the topic of this paper. There are six steps for building a risk-tolerant schedule from field experience in aerospace, defense, and large construction projects.

The hope that risk can be "programmed" out of the project schedule is a false hope. However, we can manage uncertainties by understanding the risk types and the uncertainties that create these risks, and addressing each in an appropriate manner.

BUILDING THE RISK TOLERANT PLAN AND SCHEDULE

In Against the Gods: The Remarkable Story of Risk, author Peter Bernstein states one of the major intellectual triumphs of the modern world is the transformation of risk from a matter of fate to an area of study. Risk analysis is the process of assessing risks, while risk management uses risk analysis to devise management strategies to reduce or ameliorate risk. Managing the uncertainty in a network of tasks that describe a schedule is the topic of this paper.

A method for incorporating schedule risk management in a visible manner that provides governance of the project’s technical and programmatic performance is necessary for risk tolerance. This method is based on three core concepts shared by all risk-tolerant plans:

1. Measures of progress must be qualitative rather than quantitative, counting objects, measuring consumption of time and money, are not measures of progress. Measuring increasing product maturity against planned maturity is how risks are identified and handled.
2. Normal and foreseen risk handling must be explicitly visible in the plan. These risks include both the probabilistic uncertainty of the occurrence of an event and the naturally occurring variances in the underlying processes that create risk to cost, schedule, and technical performance.
3. Unforeseen risks must be acknowledged and actions taken when they occur.

RISK MANAGEMENT STRUCTURE

Figure 1 describes the Risk Management structure defined in the Risk Management Guide for DoD Acquisition. This will be the structure used for developing the Risk Tolerant schedule. The mechanics of managing risk are described in [1]. It is the Risk Planning, Risk Handling and Risk Monitoring process that forms the basis of this article.
Figure 1 - Risk management process areas form the basis of an integrated management approach. Each of these processes must be in place and performed as a whole for Risk Management to be effective. Failing to do this, creates more risk, since visibility to the programmatic and technical risks are then masked.

To build a risk-tolerant schedule, the PMBOK® instructs us to:
• Identify the schedule activities needed to complete the project.
• Sequence these activities in their order of dependency.
• Estimate the resources needed for each task.
• Estimate activity durations using a variety of methods.
• Use this information to create a schedule.
• And control the changes to our schedule.

While this approach appears well grounded through processes used to build the schedule, it fails to address the core weakness of most risk planning processes by not specifically designing the schedule to be Risk Tolerant in four ways. These activities are:
1. Activity-based, not risk mitigation based. Technical risk is identified in PMBOK, but its connection to and with programmatic risk is not defined. [1]
2. Activity-based, not maturity assessment based. Progress is measured as the passage of time and consumption of resources, not the increasing technical or programmatic maturity along with the decreasing reducible or irreducible risk.
3. Activity-based, with no quantitative basis of assessing the risk reduction effort from the current state to completion. Explicit risk buy-down activities are not discussed in a manner consistent with an integrated plan.
4. §11.5.2 of PMBOK describes the recommended activities for Risk Response Planning, but it fails to make it clear how to integrate these mitigation activities in the plan.

RISK BUY–DOWN ACTIVITIES
To make a plan risk-tolerant, the planner must include “Risk Buy-Down Tasks”. These are like any other work activities in the plan. These tasks reduce the uncertainty in the project. The term uncertainty has a broader meaning than risk. Risk is created from Uncertainty which comes in two forms: reducible and irreducible uncertainty. Project planning involves uncertainty. This uncertainty is characterized by:
1. Uniqueness - a project is a unique undertaking. This does not bode well for the management of technical or programmatic risk, since there is little, if any, historical data by which to calibrate the models describing this risk.
2. Variability - there are various tradeoffs between performance, cost, schedule, quality and risk. A model of these tradeoffs requires that the correlation between each of the elements of the model be known in some way.
3. Ambiguity - a state that emerges from the lack of clarity and structure as well as the built-in biases of estimating cost, schedule and risk.

Although mature organizations use many tools to support project planning, quantifying the uncertainty in these plans is not as common as we think. The PMBOK Guide identifies risk as a key area of concern, but does not describe the management of the underlying uncertainty that produces the risk. Transforming project uncertainty into project risk management often requires that the concept of risk as an event ignores the source of risk emerging from the probabilistic and statistical nature of the project’s technical and programmatic activities.
The concept that uncertainty and risk can be programmed out of the schedule is a false hope. Intrinsic variation pervades all natural systems. Observe or measure any characteristic of anything, and the result will vary from instance to instance. Plan or measure a task-duration, or a cost associated with that task, and a natural variance will appear. Management thought leaders Walter Shewhart and W. Edwards Deming taught that reacting to random changes in the system as if they mean something always degrades the process.

Let’s put some bounds on the term uncertainty. There are four sources of uncertainty in projects and corresponding mechanisms to address them.

**IDENTIFYING THE RISK MITIGATION TASKS IN THE PLAN**

Planning for risk management starts after risks have been identified and assessed. Risk Analysis makes use of mathematical models to evaluate the effects of choices of risk and mitigation. Risk Analysis determines the sensitivity of risks to changes in independent and dependent factors described in the plan.

The actual schedule (a network of tasks) contains two types of uncertainty. These uncertainties are used to describe each of the project variations shown in Table 1. [2]

- Systematic uncertainty which is uncertainty about a specific parameter. This uncertainty comes from limited knowledge or data about the project. These systematic uncertainties are due to things we could in principle know but don’t know in practice. This may be because they have not measured a quantity sufficiently accurately, or because their model neglects certain effects, or because particular data are hidden. We need more knowledge (epistemology is the study of knowledge) about these uncertainties to protect the project from the risk they create and the resulting issues. This uncertainty is labeled epistemic or reducible uncertainty.

- Statistical uncertainty is representative of unknowns that differ each time we perform some class of work. The duration of any work, the first time it is performed contains statistical uncertainty. This uncertainty comes from the stochastic behaviors of the underlying environment, system, processes, or project elements.

<table>
<thead>
<tr>
<th>Source of Uncertainty</th>
<th>Mitigation For This Uncertainty Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>The normal variations that occur in the completion of tasks arising from normal work processes. Deming has shown that these uncertainties are just part of the process and attempts to control them, plan around them, or otherwise remove them is a waste of time.</td>
<td>Fine-grained assessment points in the plan verify progress. The assessment of these activities should be done in a 0% or 100% manner. Buffers and schedule margin are inserted in front of the critical activities to protect their slippage. Statistical process control approaches forecast further slippage.</td>
</tr>
<tr>
<td>Foreseen uncertainties that are identified but have uncertain influences.</td>
<td>Creation of contingent paths forward are defined in the plan. These “on ramp and off ramp” points can be taken if needed</td>
</tr>
<tr>
<td>Unforeseen uncertainties are events that can’t be identified in the planning process.</td>
<td>When new problems appear new approaches must be developed.</td>
</tr>
<tr>
<td>Chaos appears when the basic structure of the project becomes unstable, with no ability to forecast its occurrence are the uncertainties that produced</td>
<td>Continuous verification of the project’s strategy is needed. Major iterations of deliverables can isolate these significant disruptions</td>
</tr>
</tbody>
</table>

The probabilistic (Epistemic) uncertainty is addressed by mitigation tasks in the plan. If X occurs, I’ll deal with it by doing Y. This type of schedule risk planning is embedded in the baseline plan. Making these risks visible demonstrates explicit mitigation steps.
The statistical (Aleatory) uncertainty is addressed by first determine the probability distribution of the statistical processes that create the uncertainties. This does not mean the specific shape of the probability distribution function - that should be done for the probabilistic uncertainties - but the likelihood of occurrence profiles. This can be done through a risk classification scheme shown in Table 2.

Table 2. - The ordinal classification of risk resulting from statistical uncertainty needs to have descriptions meaningful to the decision makers. The ordinal values should not be numeric. This avoids the temptation of performing arithmetic on the risk ranking.

<table>
<thead>
<tr>
<th>Classification</th>
<th>Uncertainty</th>
<th>Overrun (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A Routine, been done before</td>
<td>Low</td>
<td>0 to 2</td>
</tr>
<tr>
<td>B Routine, but possible difficulties</td>
<td>Low to Medium</td>
<td>2 to 5</td>
</tr>
<tr>
<td>C Development, with little technical difficulty</td>
<td>Medium</td>
<td>5 to 10</td>
</tr>
<tr>
<td>D Development, with some difficulty</td>
<td>Medium to High</td>
<td>10 to 15</td>
</tr>
<tr>
<td>E Significant effort with technical challenge</td>
<td>High</td>
<td>15 to 20</td>
</tr>
<tr>
<td>F No experience in this area</td>
<td>Very High</td>
<td>25 to 50</td>
</tr>
</tbody>
</table>

For this approach to be effective, classification levels need to be calibrated to match the vocabulary of the project. Then the percentage overruns need to be calibrated to the class of project.

**NEXT STEPS**

Using the risk rankings in Table 2, the explicit risk mitigation tasks (risk buy down for reducible risk or margin protection for irreducible risk) need to appear in the Integrated Master Schedule (IMS) as discrete activities and margin tasks in the same way any work activity does that delivers project outcomes.

With these risk mitigation activities in place, the next steps in building a risk tolerant plan and schedule are:

1. Identify probabilities for the various durations for activities in the plan and the durations of the mitigation activities – the period of exposure.
2. Assess the risk adjusted completion dates for the deliverables defined in the schedule.
3. Assess the impact of these risks and the mitigations on the cost and schedule described in the activity network, including the residual risk after mitigation.
Table 3. Applying risk management to the four attributes of any project shown in Table 1 - the state of the project, product, process and work - improvements can be made in the probability that the project will receive the benefits from the delivered capabilities.

<table>
<thead>
<tr>
<th></th>
<th>Traditional Approach</th>
<th>Risk Tolerant Approach</th>
</tr>
</thead>
<tbody>
<tr>
<td>State of the Project</td>
<td>Progress is measured as the passage of time, the completion of tasks or the reaching of milestones with no quantitative assessment of the technical and programmatic maturity of the project.</td>
<td>Maturity Events provide not only a review of the progress to date, but also an assessment of the readiness of the project to proceed to the next step. The fidelity of a design, a fabrication or an operational capability can be assessed at each project Event.</td>
</tr>
<tr>
<td>State of the Product</td>
<td>There are no quantitative measures of completion other than they are “done.”</td>
<td>The Significant Accomplishments that define the increasing maturity of product elements are explicitly stated in quantitative terms.</td>
</tr>
<tr>
<td>State of the Process</td>
<td>No specific process measures are provided in the plan.</td>
<td>The Accomplishment Criteria – exit criteria – by which the state of product is measured, are explicitly defined as the conditions of completion for each accomplishment.</td>
</tr>
<tr>
<td>Work Delivery</td>
<td>Tasks describe the work necessary to complete the project. When all the tasks are done it is implied that the project is done.</td>
<td>Only those tasks that support the completion of the exit criteria are defined in the plan. They are discrete work. All other work is defined as level of effort, since it has not specific defined outcome.</td>
</tr>
</tbody>
</table>

Building a Risk Tolerant schedule starts with understanding that the traditional approaches to planning described above, leaves out of the plan the very elements needed for risk tolerance. These elements start with the identification and assessment of the project, product and process states as part of the schedule.

**STEPS IN BUILDING A RISK TOLERANT PLAN**

1. Define the measurable maturity Events of the project. These are assessment points to determine if the measures of effectiveness and performance of the capabilities and their deliverables agreed with the needed measure of effectiveness and performance by the customer. Capabilities describe a defined outcome that is not the final conclusion, but lays the groundwork for the continued delivery of value. Objectives are reached and the operational value delivered when a defined capability is available for use. Features and functions describe the static and dynamic behaviors of a system, but they are not directly connected to a strategy, mission or vision defined in the chartering session of the project. Milestones indicate the arrival of a point in time. Capabilities delivery provides an answer to the question: in order to achieve the objective of this project, what capabilities must be possessed?

2. Define the Significant Accomplishments and the Exit Criteria that deliver the needed Capabilities for the project. A capability is defined for each point along the maturity line - from immature to complete. Each Significant Accomplishment and its Exit Criteria needs to be worded as a past tense statement about the delivery of an end item. This delivery must be 100% of some defined result. No percentage complete is allowed! Rather 100% of a partially defined capability, product, or service clearly states what “done” looks like at each place along the way to completion of the project.

3. Define the work needed to deliver these Significant Accomplishments and their Exit Criteria. This provides the focus needed to define what “done” looks like for each exit criterion. These tasks should represent the vast majority of the activities in the plan. Any other work should be classified as Level of Effort.
4. Rank each task according to an ordinal risk scale. Each task must be ranked since, it is not clear in the beginning which tasks will be critical to the completion of the schedule, which ones will interact and cause programmatic risks to appear.

5. The ranking of risk. Six basic classes are commonly used. [3] The probability scales commonly used are un-calibrated in most instances. These types of scales (un-calibrated) generally produce poor results unless the process is well structured, stable and repeatable. This is usually represented in the 5 x 5 chart [cox paper].

6. Define the explicit tasks to mitigate the known risks. These are risks with a probability of occurrence and a probable impact. These tasks should be placed in front of Significant Accomplishments to provide a buffer or time for correction.

7. Define alternative paths through the schedule for unknown risks – risks with a probability of occurrence but with an unknown impact. These paths are indicated as branching probabilities in the plan.

The result is a plan where risks and their mitigations are visible with risk ranking for each task delivering results for each Exit Criteria. Table 4 shows how uncalibrated ordinal scales can be defined for various risk domains.

Table 4. - Uncalibrated ordinal scales should not be used to rank risk. Instead specific descriptions of the meaning of High, Low and the ranges between should be stated

<table>
<thead>
<tr>
<th>Domain</th>
<th>High Risk Example</th>
<th>Low Risk Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maturity</td>
<td>Basic principles observed</td>
<td>Item are deployed and operational</td>
</tr>
<tr>
<td>Sufficiency</td>
<td>Research required</td>
<td>Processes defined and operational</td>
</tr>
<tr>
<td>Complexity</td>
<td>20% of interfaces defined</td>
<td>Less than 5% of design altered during final review</td>
</tr>
<tr>
<td>Uncertainty</td>
<td>Frequent changes in requirements</td>
<td>No changes in requirements</td>
</tr>
<tr>
<td>Estimate</td>
<td>No chance (&lt; 5%)</td>
<td>Certain (&gt; 95%)</td>
</tr>
</tbody>
</table>

**PROCESSES AND PRACTICES OF RISK MANAGEMENT**

“Risk monitoring is the process that systematically tracks and evaluates the performance of risk-handling actions against established metrics throughout the project and develops further risk-handling options, as appropriate. It feeds information back into the other risk management activities of planning, assessment, and handling.”[3]

If monitoring is passive, then it is just a bookkeeping function. Proactive risk monitoring provides quantitative information to decision makers through variance in the Cost, Performance, Schedule and changes in the risk analysis data. Earned Value provides cardinal values for Cost and Schedule (C-S) metrics. Technical Performance Measures provide cardinal values for Performance (P) metrics. The C-P-S cardinal values are the basis of a continuous risk management process by aligning risk reduction tasks with the Significant Accomplishments and their Exit Criteria.

These risk monitoring metrics provide adjustments to the risk handling strategy and the Risk Handling Plan and provide information to update the risk probability and risk consequence portion of the risk analysis.

Learning to create a risk tolerant schedules and managing the technical and programmatic risks created by uncertainties represented by this schedule is a professional practice. A high technology program manager once noted, “You can’t learn surgery from reading a book — you need to successfully complete a surgical residency.”

No amount of attending seminars or reading books or articles (even these articles) will provide the solution to managing schedule risks. But there are two good starting points: *Risk Management Guide for DoD Acquisition, Fifth Edition (Version 2.0)*, Department of Defense, Defense Acquisition University, June 2003, and *Effective Risk Management: Some Keys to Success*, Edmund H. Conrow, AIAA Press, 2003.

These are recommended practicum guides. PMBOK®, while introductory in nature, does not provide an integrated approach to Cost, Performance, and Schedule risk management.

These all provide the basis of understanding the issues with tradition approaches to risk management and it flaws. The paper, “Building A Credible Performance Measurement Baseline,” in Measureable News, 2014.04 provides the mechanics for correcting these flaws.

**BIBLIOGRAPHY**


**About The Author**

Glen Alleman has over 30 years of software engineering and management experience in the high technology management business. His recent assignments include architecting the project controls structure for a $4B manned spaceflight program, leading the Program Management Office for an $7B nuclear waste remediation project, and numerous ERP and Enterprise application system deployments. Prior to these enterprise projects Glen worked in aerospace, petro-chemicals, electric utilities and other industrial business domains leading software and product development teams. Glen’s education includes Physics, Systems Engineering and an MBA. Over the years Glen has published professional journal papers, articles and book chapters on a variety of project management and programmatic risk management topics.

**Endnotes**

1. PMBOK®, the British Standards Institute, and the UK Institution of Civil Engineers as well as numerous internal risk management handbooks combine risk and opportunity into single assessment criteria. It could be argued that risk includes both opportunities and losses. However, there is rarely an opportunity without the possibility of loss. On the other hand there is almost always a chance of loss without opportunity. The PMBOK approach changes the definition of risk: the potential for the realization of unwanted, negative consequences of an event. Opportunities are generally events that require intentional actions in order to achieve value. Risks are events that can be ignored. For a detailed discussion of this issue as well as a definitive presentation of risk management, see Appendix E, “Changing the Definition of Risk – Why Risk It?” Robert N. Charette, in Effective Risk Management: Some Keys to Success, 2nd Edition, Edmund H. Conrow, American Institute of Aeronautics and Astronautics Press, 2003.


INTEGRATING SYSTEMS ENGINEERING WITH EARNED VALUE MANAGEMENT, PART 2
By Paul Solomon, PMP

ABSTRACT
In February 2004, a new U.S. DoD Policy for Systems Engineering (SE) called for SE to provide the integrating technical processes to define and balance system performance, cost, schedule, and risk. In May 2004, the DoD magazine, Defense AT&L, published my article as a best practice, “Integrating SE with Earned Value Management (EVM).” It stated that Program Managers (PM) should require contractors to adhere to industry standards for SE engineering processes and base EV on technical performance measures (TPM). This has not yet happened.

In 2010, DoD submitted a report to Congress which stated that EVM can be an effective PM management tool only if the EVM processes are augmented with a rigorous SE process and SE products (including TPMs) are costed and included in EVM tracking.

The National Defense Authorization Act for FY 2011 required the Secretary of Defense to review the acquisition guidance of the DoD, including DoD Instruction 5000.02, Operation of the Defense Acquisition System (DoDI 5000.02), to consider and report “whether measures of quality and technical performance should be included in any EVM system.” In 2015, DoDI 5000.02 was revised to require the PM to use TPMs to assess program progress. Per the Instruction, “Analysis of TPMs and metrics, in terms of progress against established plans, will provide insight into the technical progress and risk of a program.” However, DoDI 5000.02 is applicable only to DoD PMs and not to contractors.

Today, contractors are not integrating TPM with EVM and are not required to use processes that would enable a PM to adhere to DoD instructions and guidance regarding TPMs and SE. Why and what is the remedy?

Although the topics and recommendations herein address the needs of DoD, they are applicable to all high tech, high risk development projects, including government and commercial, and are relevant to the College of Performance Management’s (CPM) objective to lead EVM into the next generation – Integrated Program Performance Management (IPPM).

KEY EXCERPTS FROM 2004 AT&L ARTICLE
This article is a sequel to the 2004 AT&L article (Part 1).

Key excerpts from Part 1:
- EVM data will be reliable and accurate only if the right base measures of technical performance are selected and if progress is objectively assessed.
- If you are measuring the wrong things or not measuring the right way, then EVM may be more costly to administer and may provide less management value.
- EVM can be more effective as a PM tool if it is integrated with technical performance and if the EVM processes are augmented with a rigorous SE process.
- A contractor may be compliant with EVMS but fail to truly integrate measurement of cost, schedule, and technical performance.
- A PM should ensure that integrated plans, schedules, and the earned value Performance Measurement Baseline (PMB) are linked with the contract requirements, TPMs, and unambiguous exit criteria.
KEY EXCERPTS FROM DOD SE POLICY
In February 2004, the USD for AT&L, Michael Wynne, published the Policy for SE in DoD. It included the following key points.

- SE must be embedded in program planning and performed across the entire acquisition life cycle.
- Programs shall develop a SE Plan (SEP) that describes the program’s overall technical approach, including processes, resources, metrics, and applicable performance incentives.
- It shall also detail the timing, conduct, and success criteria of technical reviews.

KEY EXCERPT FROM DOD EVM REPORT
The DoD EVM Report, “DoD EVM: Performance, Oversight, and Governance,” was required by the Weapon Systems Acquisition Reform Act of 2009 (WSARA). The DoD Report stated that the PM should ensure that the EVM process measures the quality and technical maturity of technical work products instead of just the quantity of work performed.

RECENT GOVERNMENT ASSESSMENT
In April 2016, Defense Contract Management Agency (DCMA) made a presentation to the National Defense Industrial Association (NDIA) Program Management Systems Committee. DCMA reported a common, EVM finding of a lack of objective measures to assess performance and stated “Measurement does not indicate technical accomplishment.” The presentation provided supporting data that included the number of deficiencies found that were both compliant and non-compliant with individual EVM Guidelines.

DOD INSTRUCTION, PRACTICE, AND GUIDES
DoD addresses the integration of SE and TPMs with EVM in many internal documents. However, the following documents are applicable only to the DoD PM and not to contractors:

- DoDI 5000.02
- Defense Acquisition Guidebook (DAG)
- Systems Engineering Plan (SEP)
- MIL-STD-881C DoD Standard Practice Work Breakdown Structures (WBS)
- Integrated Master Plan (IMP) and Integrated Master Schedule (IMS) Preparation and Use Guide (IMP/IMS Guide)
- Guide for Integrating SE into DoD Acquisition Contracts (Integ SE)
- DoD EVM System Interpretation Guide (EVMSIG), for EVMS compliance reviews by DCMA

Both the PM and DCMA are hindered from implementing the guidance and instruction because DoD has not developed any standard, contractual requirements for enabling, supplier processes and metrics.

Furthermore, DCMA is obstructed from issuing valid, EVMS non-compliance findings regarding TPMs because the use of TPMs is optional, not mandatory, in Guideline 2.2b (below).

DAG
The DAG guidelines are summarized in a tutorial that was presented to the NDIA SE conference in 2012, “Integrating SE with TPM.” The tutorial also provides practical examples. The tutorial and other articles discussed herein may be downloaded from www.pb-ev.com at the tabs, “Articles and Tutorial” and “Acquisition Reform.”

EVMSIG
EVMSIG provides the overarching DoD interpretation of the 32 EVMS Guidelines. Since September 2015, it serves as the authoritative source for EVMS interpretive guidance and is used as the basis for the DoD to assess EVMS compliance. Guidance for integrating TPM with EVM is in Guidelines 2.2.b and 2.2.e. Pertinent extracts follow.
Guideline 2.2.b
• Identify physical products, milestones, technical performance goals, or other indicators that will be used to measure progress.
• Purpose of Guideline: To ensure program schedule(s) establish and maintain a relationship between technical achievement and progress statusing and provide objective performance data that accurately reflects the progress of the work.
• Identifying objective criteria, linked to technical progress indicators, ensures performance assessments reflect the true technical performance of the program.
• Identifying and selecting appropriate objective completion criteria, that will align with how technical performance will be accomplished, for all discrete work and for each of the program’s key events, decision points, and milestones is essential for ensuring accurate schedule status and providing program management actionable information.

Guideline 2.2.e
• Determine discrete work and objective measures
• This provides PM accurate status and situational awareness of program execution for proactive resolution of issues impacting cost, schedule, and technical achievement of program objectives.
• Discrete work is defined as a specific product or service with distinct and measurable outputs that are relatable to the program’s technical objectives.
• Interim milestones representing measurable, technical accomplishment are required for performance measurement.

COMMON ELEMENTS IN DOD DOCUMENTS
The following table includes common elements in all DoD documents for integrating technical processes to define and balance system performance, cost, schedule, and risk.

<table>
<thead>
<tr>
<th>DoD Document/Guidance</th>
<th>DoDI 5000.02</th>
<th>DAG</th>
<th>SEP</th>
<th>WBS</th>
<th>IMP/IMS</th>
<th>Integ SE</th>
<th>EVM-SIG</th>
</tr>
</thead>
<tbody>
<tr>
<td>Event-driven timing of technical reviews</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Success criteria of technical reviews</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Include entry and exit criteria for technical reviews in IMP and IMS</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Assess technical maturity in technical reviews</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Technical reviews include independent (of program) subject matter experts</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Use TPMs to compare actual vs. planned technical development and/or design maturity</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Use TPMs to report degree to which system requirements are met in terms of performance, cost and schedule</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Integrate SEP with: • IMP • IMS • TPMs • EVM</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Integrate WBS with requirements specification, statement of work (SOW), IMP, IMS, and EVMS.</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Link risk management, technical reviews, TPMs, EVM, WBS, IMS</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Include risk mitigation plans in IMS</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Technical baselines (functional, allocated, and product baselines) are included in IMP/IMS</td>
<td>X</td>
<td>X</td>
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<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>
INTEGRATING RISK MANAGEMENT
The June 1998 issue of Measurable News included my article, “Integrating Risk Management (RM) with EVM (RM Comes Out of the Closet).” Per the article, RM was overlooked by the authors of the EVM Systems guidelines. Thus there is no guidance on how to effectively implement RM with EVM and the benefits of doing this.

Some of the recommended best practices in the article follow.

1. Establish RM Milestones on the Baseline Schedule
2. Define Exit Criteria for RM Decision Points
3. Budget the RM Effort
4. Use TPMs as a Basis for RM and EV
5. Address RM in Performance Analysis and Exception Reports
6. Establish Management Reserve for Risk Reduction
7. Consider RM in EAC Development

These recommendations should be addressed in acquisition reform and in the IPPM initiative.

INTEGRATING REQUIREMENTS
The June 2010 issue of Measurable News included my article, “Performance-based EV in Commercial IT Projects.” It discusses how leading information technology companies in South Korea and India used techniques to link EV with technical performance and the product requirements.

The techniques illustrated in this article include:

- Defining the requirements baseline for each planned product release
- Tracing the requirements baseline to the schedule and work packages
- Tracking status of each requirement
- Monitoring technical performance with meaningful variance analysis
- Accounting for deferred functionality
- Planning and measuring rework
- Making negative adjustments to EV for accurate status

These techniques should be also addressed in acquisition reform and in the IPPM initiative.

PROPOSED ACQUISITION REFORMS
I have proposed specific acquisition reforms to legislators and to DoD that include revisions to the Federal Acquisition Regulation (FAR) and Defense Federal Acquisition Regulation Supplement (DFARS). Recommendations are in the articles, "Path to EVM Acquisition Reform," Defense AT&L, May 2011 and CrossTalk, the Journal of Defense Software Engineering, "Basing Earned Value on Technical Performance," January 2013.
CONCLUSION
The DCMA status report provides recent evidence that there is a pervasive lack of integration of TPM with EVM. FAR and DFARS lacks contractual requirements to integrate SE with EVM. DoD has provided only instructions and guidance for the PM but has not published enabling, contractual requirements. We need acquisition reform to mandate that contractors embed SE and IPPM in program planning.

The guidance and recommendations herein, including those for integrating EVM with risk management and with the product requirements, should be also considered by CPM for inclusion in the next generation IPPM.

About the Author

The author can be contacted at paul.solomon@pb-ev.com.
Knowledge is of two kinds. We know a subject ourselves, or we know where we can find information upon it – Samuel Johnson

This section will provide information, processes, guidelines, and other sources of information that increase the probability of project success. Here’s a starting list covering measurement, cost modeling, EVM performance management, and risk management.

- **How to Measure Anything: Finding the Value of “Intangibles” in Business**, Douglas Hubbard, John Wiley & Sons. - There’s a myth that only certain things can be measured. This book shows a hands on approach using statistical techniques to address the immeasurable, including technology, Return on Investment, organizational flexibility and technology risk. This last item is critical to the success of all Earned Value Management programs.

- **Probability Methods for Cost Uncertainty Analysis: A Systems Engineering Perspectives**, Paul R. Garvey, CRC Press. Cost drives everything in high-technology systems during development, production, and sustainment. Quantifying how technology and economic risks may affect the system’s cost. This book provides a comprehensive treatment of how probability methods are applied to model, measure, and manage risk in the cost engineering applied to complex systems.

- **Performance-Based Earned Value**, Paul J. Solomon and Ralph R Young, John Wiley & Sons. This books shows how to effectively integrated technology, schedule, and cost- objectives. Specific instructions are provided for integrating Technical Performance Measures with Earned Value Management.

- **Effective Risk Management: Some Keys to Success 2nd Edition**, Edmund H. Conrow, AIAA Press. Risk Management is a critical success factor for all program success. As stated by Tim Lister (IBM Emeritus Fellow) says - *Risk Management is How Adult Manage Projects*. This books described practices used by project and technical management to increase the probability of success.
Get Involved In CPM: Become A Volunteer

Most people agree that the value of membership in any organization is greatly impacted by one’s involvement in that organization. CPM has many opportunities for you to become engaged in your organization.

You can help with our certificate program, become a leader in our two conferences each year or other volunteer opportunities as they appear on the website. Take the time to read each of the job descriptions and ask questions of the point of contact for each if you are not sure what is expected. PDU’s are available for volunteering in CPM.

These opportunities are listed on our website: www.mycpm.org./ABOUT US/VOLUNTEERS