Project Control Using AS4817 for Earned Value Management
"The VIPER Experience"

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Abstract

This paper discusses the evolution of VIPER into a fully-fledged, commercial project control system that uses Earned Value as its core progress reporting system. VIPER is designed to optimise repetitive project cycles (in this case, aircraft maintenance and repair programs) in a data rich environment.

Business and project communities are facing a number of contradictory trends:-

- The downsizing and deskilling of their work forces, particularly in the technical support, engineering and middle management areas
- The increase in litigation and lack of tolerance towards any processing errors and/or omissions and
- The need to be ever more efficient with reduced project budgets and shorter delivery timeframes. The combination of these factors is creating pressures on business systems (with particular reference to project control systems) to deliver enhanced efficiency and process integrity whilst minimising the opportunity for errors.

The VIPER system is used to manage and schedule aircraft deep level maintenance programs for the ADF and a number of commercial businesses. VIPER integrates maintenance data, timesheet data and hangar floor reports; using sophisticated data integration and management techniques, including automated data capture processes, to deliver an integrated management and control system. Since its introduction VIPER has generated cost savings in excess of 30% for the ADF's deep level maintenance programs.

VIPER integrates the prudential processes needed to ensure every aircraft servicing is 100% complete with an effective scheduling and management control system. Earned Value Performance Management is a central component of its project management and control mechanisms.

The new 'AS4817-2003: Project performance measurement using Earned Value' has been designed to encourage the use of Earned Value as a normal part of project control techniques in the general project and business communities. It provides a very practical framework for implementing Earned Value supported by useful guidelines.

VIPER complies with and uses the concepts of Earned Value described in AS4817 in a very effective and efficient manner. As implemented in VIPER, almost all of the data needed for the Earned Value calculations and reports is sourced from information already residing in the businesses management systems. Powerful and effective reports are generated quickly and easily.

VIPER's Earned Value reports are typically completed within hours of a nominated status date (often twice a week) and require virtually no additional effort to generate. This contrasts noticeably with the massive commitment of specialist staff and resources needed to process the Earned Value data on major Defence acquisition projects.

The approach embodied in VIPER allows project management systems to be designed utilising the most effective components (Scheduling, Earned Value, MRP, Timesheet, Data management, Accounting, etc) and then to use data integration techniques to ensure prudential processes are followed whilst:

- Optimising the overall efficiency of the business unit and reducing paperwork.
- Delivering a major boost in operational efficiency and management information.
- Using the power of effective information (with particular reference to Earned Value) as a catalyst for improving workforce culture and productivity.

Summary

From the perspective of "project management" VIPER is a system that combines the traditional project control methodologies of resource levelled, Critical Path Scheduling and Earned Value Performance Management with sophisticated data management techniques to provide a semi automated project management system that is quick, responsive and cost effective to operate. It is also a pseudo 'Expert System' that capture best practice and encourages performance improvement.

The primary purpose of VIPER [1] is the management of airworthiness issues associated with the validation, control, and tracking of maintenance data essential for the safe repair of aircraft and other capital assets (although these are only briefly mentioned in this paper).

The focus of the paper is on the underlaying philosophy of the VIPER process and its potential to be applied to other business endeavours that manage complex resource limited schedules on a routine basis. A secondary focus is the ease and effectiveness of applying Earned Value principles to enhance the effectiveness of project control processes, particularly when data capture is automated and integrated.

The primary source of data used in this paper is the personal observations of the authors based on a direct involvement with the development and implementation of VIPER and its predecessors of the last 15 years.

The Requirement for, and Evolution of, VIPER

Business Pressures in the 21st Century

A combination of factors is creating pressures on business systems (with particular reference to project control systems) to deliver enhanced efficiency and process integrity whilst minimising the opportunity for errors. These drivers include such elements as the downsizing and deskilling of the businesses work force, [2] increase in litigation and lack of tolerance towards any delays, processing errors and/or omissions, reduced project budgets and ever shorter delivery timeframes [3] and the increasing complexity of many projects and project systems.

The solution sought by businesses to overcome these problems is to look for systems that deliver accurate prudential processes, enhanced efficiency and improved outcomes whilst being quick to implement, and are cheap and easy to use. An interesting (but not impossible) challenge!

The Evolution of VIPER [4]

Commercial VIPER is the result of 15 years of development. The initial systems were developed under the auspices of Australian Defence Force (ADF) managers as they sought to respond to some of the business pressures outlined above. More recently, the drivers for VIPER enhancements have come from a combination of ADF and commercial managers seeking to reduce the cost and optimise the maintenance of ADF air assets.

VIPER is not the result of some sudden "flash" of inspiration, nor was the final form of the system foreseen during the early stages of development. Each change in process and its supporting technology was driven by real needs and issues at that time. Then, as the new "enhanced" processes were rolled out, new expectations were created, new issues and problems recognised and new opportunities identified. [5]

VIPER is an adaptive or evolving system.

VIPER

Vertically **I**ntegrated **P**rogrammed **E**ngineering **R**epair (VIPER) was initiated as a project by Support Command in late 1995 to further develop an earlier system called HERMES and make it available to all RAAF maintenance units. [6] [7]

The initial rollout was based on variants of HERMES customised to meet the requirements of individual units. Whilst the relatively quick deployment was an initial advantage, the large number of VIPER variants soon started to cause enhancement and maintenance problems.

A single unified system for the whole ADF, VIPER97, was released at the end of 1997. This system has been progressively improved and enhanced based on management requirements and user feedback.

VIPER migrated from being an ADF exclusive system to a commercial system with the outsourcing of aircraft maintenance for the Hercules and F111 fleets to Qantas and Boeing respectively. The needs of commercial operators differ significantly in some key areas from the requirements of defence force management, and have caused a fresh round of system developments. VIPER8 (V8) was released in 2002 followed by V9 in 2003.

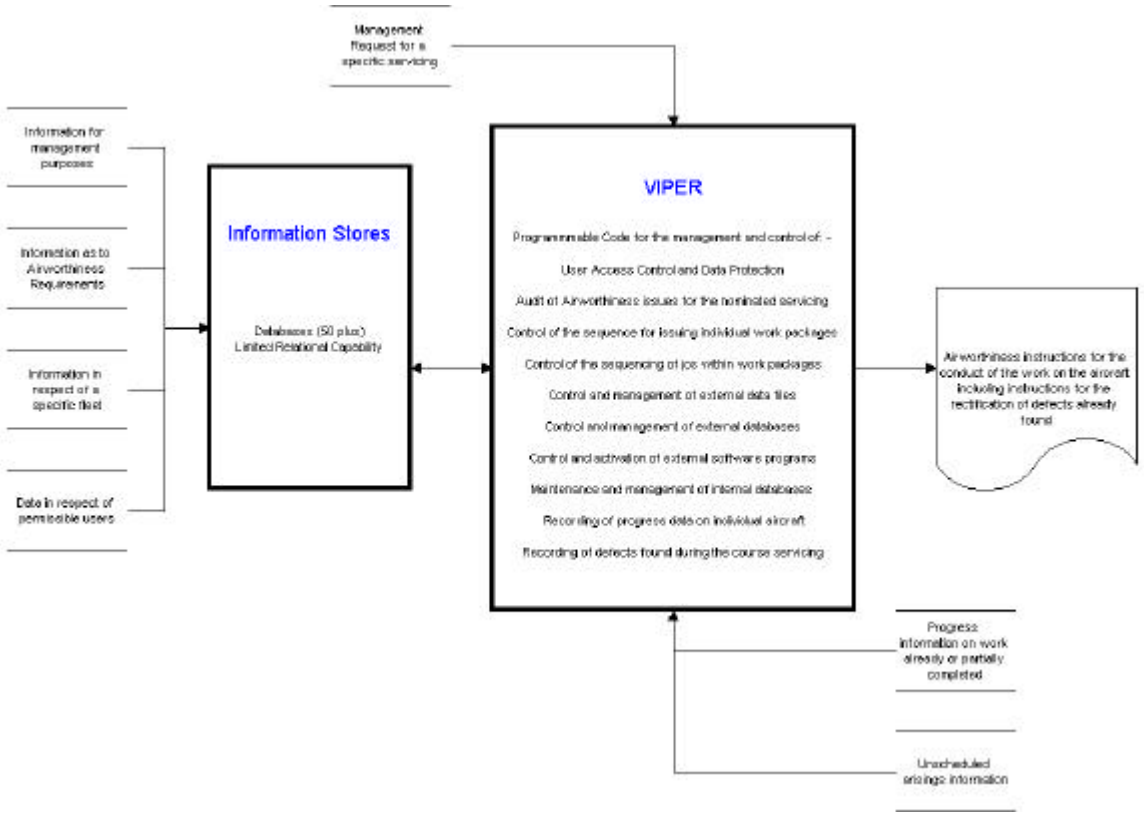
The balance of this paper will focus on these latest systems and the advantages to be gained from the effective integration of data management systems.

Current VIPER Functionality [1]

VIPER is a complex system with a range of interlinked processes. Rather than attempt to describe the whole system in detail this paper will focus on the features that support the use of Earned Value as an integral part of VIPER's management control processes.

VIPER Overview

Figure 1 - VIPER Overview



VIPER Packages

The concept of "Packages" used by VIPER significantly simplifies the paperwork needed to document a servicing. A package typically includes all of the work to be completed in a particular phase of a servicing, on a nominated part of an aircraft, by a trade. The "Package" is also the basic planning element, incorporated into the Master and aircraft specific schedules. Each "Package" becomes an Activity (or Task) in the schedule with an assigned duration, description, resource allocation and cost.

The major efficiency delivered by "Packages" is the reduction in time needed to deal with a servicing's paperwork. The packages contain all of the necessary information needed to complete the work and places for the work to be completely "signed off" as it is completed. Packages are issued progressively, to facilitate

the progress of the works, based on the requirements of the critical path schedule. A package cannot be returned as "complete" until all of the necessary signatures are attached. This makes tracking the "sign off" process a progressive function that was dealt with as the servicing proceeded and as a consequence, eliminates the massive "paper chase" that would otherwise be required at the end of a servicing.

One of the key elements of the VIPER concept design is that the same package (number, description and scope) should always refer to the same element of work at the macro level. This allows a history of performance on the package to be built up over time and improves the VIPER operators/managers ability to refine future estimates and to recognise when something "unusual" is occurring during an aircraft servicing.

Not all packages contain the typical work described above. Some packages may include tasks that need a combination of trades to be completed efficiently. Repair packages are typically empty (with an estimated duration and resource requirement but no actual work) until rectification works are identified and added during the inspection processes. The design of VIPER gives users the flexibility to specify packages in a way that optimises the performance of their business.

The package paperwork is printed and held in a plastic ring binder for ease of use, it includes:

- Planned schedule and resource information (derived from the scheduling tool)
- Descriptions of the specific maintenance jobs to be completed as a part of the package, including references to any necessary technical instructions, manuals, etc.
- The optimum sequence for carrying out the individual operations included in the package.
- Places for all necessary signature requirements (both for each individual job and control of the overall package)
- Space for recording and signing off any minor repairs completed during the course of the work specified work on the package (pre-printed EE 508s)
- Barcodes for linking to MRP and Timesheet systems if required by the user

If a better sequence of working is identified, the improved sequence can be locked in and stored for use in future servicings, either at the operation level within and between packages, or at the schedule level.

Systems Integration & Functionality

VIPER is designed to facilitate integration with other business systems to add new capabilities, functionality and/or save costs and facilitate ease of use. The core processes addressed by VIPER are:

- The import and "packaging" of approved maintenance data.
- The creation and management of unique package numbers for each servicing.
- The creation and management of a schedule for each servicing based on a 'Master' schedule.
- Prudential processes to ensure every single item of work raised against a servicing has been properly acquitted
- Close coupling of the maintenance data with scheduling processes to optimise the efficiency of the servicing process.
- Reporting on the "completeness" and schedule aspects of the servicing.

MRP, Timesheet and Accounts systems are designed (as a part of their core competencies) to deal with material costs, labour costs, progress claims, payments, etc. VIPER recognises this and does not attempt to duplicate their functionality. Rather, key data are exchanged to facilitate the operations of all systems. Within this integrated environment, VIPER performs the following functions and processes:

- It ensures the prudential management of the servicing data through to completion.
- It facilitates the collection of all necessary maintenance data required prior to starting each aircraft servicing.
- Core data are protected.
- It facilitates the design and sequencing of packages.
- It allows the management of operations within packages.

- VIPER is an expert system.
- VIPER's packaging facilitates best work practice and benchmarking.
- VIPER integrates scheduling functionality.
- Integration with downstream analysis tools
- Integration with Timesheet, MRP and other systems

Whilst it is probably true to say, VIPER's primary focus is on the efficient management of maintenance data and airworthiness requirements, it is probably equally true to say VIPER attraction to commercial maintainers is in the significant efficiencies VIPER generates by closely coupling scheduling processes (including Earned Value) with the management of maintenance data.

Over it life with ADF maintenance units, VIPER has generated savings of many millions of dollars by increasing efficiency and reducing maintenance times by as much as 30%.

Earned Value – The Key Performance Indicator

VIPER's Earned Value Philosophy

Aircraft maintenance schedules generally have a few sequential tasks at the start and end joined by many dozens of short parallel paths through the "Inspection and Refit/Repair" processes. From the perspective of pure logic, there is no fundamental reason why all four engines on an Orion aircraft could not be removed simultaneously. However, resource constraints usually dictate a sequential approach to this type of work. As a consequence, the overall duration of a servicing is controlled by resource availability and the scheduled dates for many tasks by the resource levelling process.

Resource levelling at the beginning of a servicing may optimise tasks/packages in a particular sequence, (eg Engine #1, #2, #3, #4). A later analysis may optimise the sequence differently (eg Engine #1, #4, #3, #2), possibly because there is more work to complete after Engine #4 is finished (eg a fuel tank leak test). In these circumstances, comparing current schedule and baseline schedule dates on a task by task basis is not overly helpful. The servicing schedule is optimised but Engine #2 dates are substantially later than planned when the baseline schedule was stored.

VIPER addresses this issue in four different (but complementary ways):

- Overall progress is monitored against key milestones to check if the servicing is meeting the contracted Time to Make Serviceable (TMS) and other important internal checkpoints.
- Checks are implemented to note and action any packages that have been 'open' for an extended period (options exist to transfer incomplete work items to other packages if they are being delayed by external influences, eg spare parts).
- Performance on individual packages is monitored based on the hours of effort planned and expended. This means performance on the package is still relevant even if work had to stop for a week awaiting an engineering decision or a new part:

  Planned effort = 100 Hrs, Actual = 80 Hrs, Forecast to complete = 15 Hrs **OK**
  Planned effort = 100 Hrs, Actual = 80 Hrs, Forecast to complete = 25 Hrs **Problem**
- Overall performance (ie is adequate work being accomplished at a reasonable cost) is monitored using Earned Value techniques.

The metric used in VIPER's EV system is work hours. This metric was chosen for a number of reasons including:

- Confidentiality of financial information – For maximum benefit, VIPER's reports should be widely distributed within the workspace. Generally, financial performance data is seen as confidential; as are pay rates, charge rates, etc.
- Control and responsibility – Hangar management generally has little control over the cost of spare parts, etc. They have full control over the performance of the workforce.

- Relevance – It is possible to change workforce performance therefore measuring this component directly has the greatest impact on changing the performance of management, supervisors and workers.
- Variability (1) – The unit cost of spares and consumables is relatively static and unlikely to change during the relatively short period of a single servicing. The productivity of the workforce can change on a daily basis.
- Variability (2) – The total cost of spares consumed on a servicing can vary enormously. The cost of a new main landing strut or a new wing spar can add tens of thousands of dollars to the cost of a servicing, but management has no option other than to obtain and fit the parts. On other servicings there may be almost no new high cost components required. Adding this sort of unpredictable variable into a project control system simply devalues the overall information provided to management.

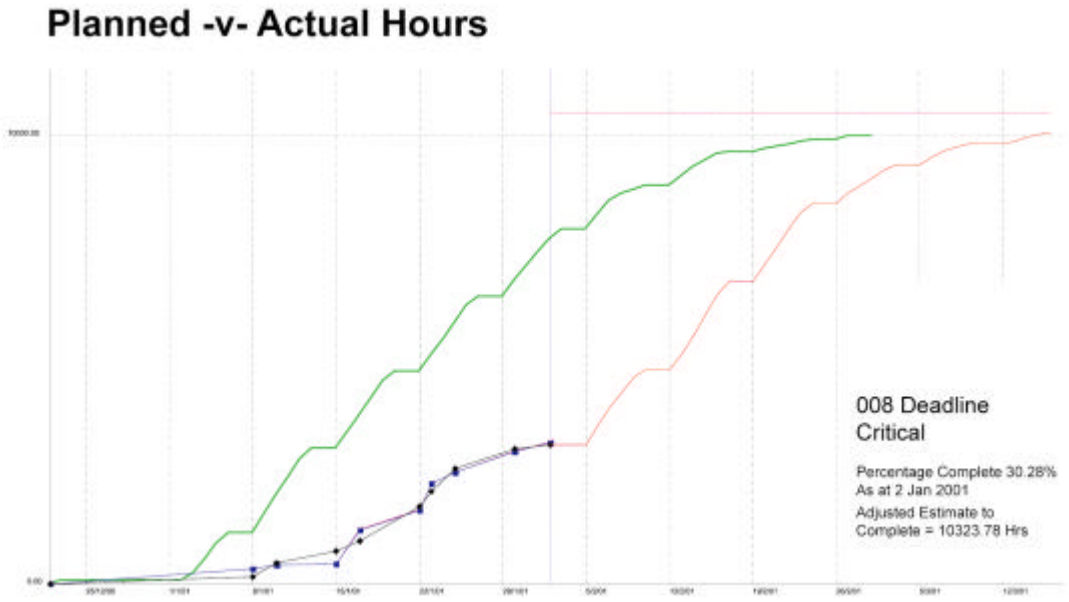
  On the other hand, the quantity of labour used on the servicing is far more predictable and controllable. The "fixed" components including preparation, teardown, inspection, refit and functional testing are "known". The "unknown" but expected repair component is estimated based on previous experience. Using these values in a project control system makes the information provided to management directly relevant to their performance.
- Easy access to data – The planned effort for a servicing (hours) is directly available from the resource plan. VIPER integrates with MRP and Timesheet systems facilitating the collection of actual hours worked. Aircraft servicing procedures require the identification of each person who has worked on a task and many maintenance contracts require the hours expended on each task/package to be recorded. Provided the data management systems facilitate its capture, all of the necessary information for generating EV reports is readily available.
- Communicability – The entire workforce is used to thinking and processing work hours. Using this common metric as the key performance measure makes the data far more relevant to everyone.

Unlike traditional Department of Defence Earned Value reporting systems, used on large acquisition projects, the VIPER system is designed to be very quick and easy to understand. Charts are produced within a few hours of the data date/time and updated once or twice a week. The focus is on providing "real time" information to all levels of management to facilitate actions to consolidate gains and mitigate losses "today".

VIPER's Earned Value Reports

VIPER uses a range of tabular and graphical reports. The primary information is the performance S-Curves. The precise layout of the report varies depending on the scheduling tool integrated into VIPER but as far as possible, the information displayed and the "meaning" of the information stays constant. The VIPER documentation, provided with each installation, is customised to reflect the scheduling tool used (ACOS, Open Plan, Primavera, Microsoft Project, etc).

Figure 2 - Typical Earned Value Chart



Interpreting Earned Value Data

The “Cost Profile” report encapsulates a vast amount of data to provide management with a complete overview of the project.

Time Related Data

A vertical dashed line positioned at the date of the last update separates actual data input by the planners from forecast data, based on information contained in the schedule.

The thick (green) line plots the original planned expenditure of effort on the servicing from its start to its original projected end date (planned TMS). The thin (red) line plots the current expected expenditure of effort required to complete the unfinished portion of the servicing.

The horizontal difference between the end of the thick line and the end of the thin line is the “Slippage” (gain or loss) between the current expected completion date for the servicing and the original planned date.

Figure 3 – Time Related Data

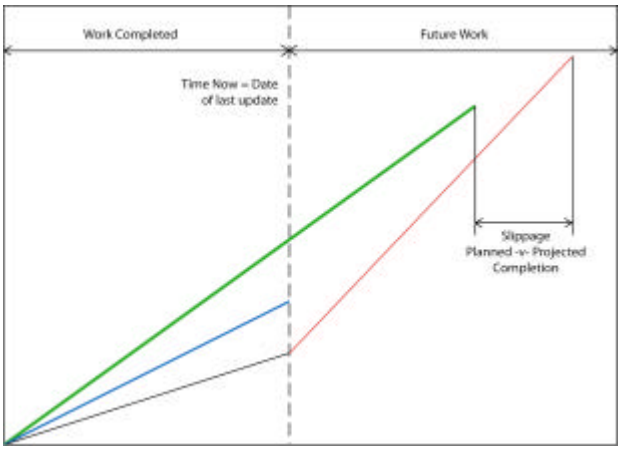
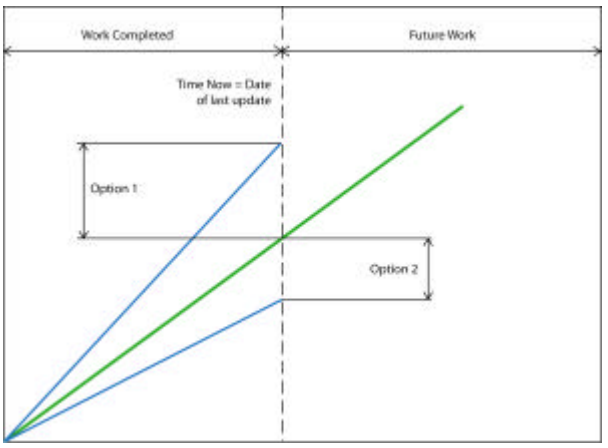


Figure 4 – Budget Related Data



Budget Related Data

The thick (green) line plots the original planned expenditure of effort on the servicing. This is the original budget (measured in Man-hours) required to complete all of the work on the servicing.

The thin (blue) line plots the value of work achieved through to the last update.

The difference between these two lines (and how they are trending relative to each other) shows if an adequate quantity of work is being achieved on the servicing.

Option 1 shows a situation where the value (quantity) of work actually achieved is greater than the quantity planned to be achieved to date.

Option 2 shows a more usual situation where the value (quantity) of work achieved is less than the quantity planned to be achieved to date.

Comments

The value of work achieved (Earned Value) is based on the original plan. At the end of the servicing, the Earned Value will be 100% of the original budget; this is used to calculate the percentage complete.

Cost Related Data

The thin (black) line tracks the actual hours expended to date on the servicing, ie the Actual Cost (AC) of work performed, to achieve the work recorded as completed. The thin (red) line projects the anticipated expenditure of effort to complete the servicing from the last update through to completion.

The difference between the black and the blue lines (Actual Cost -v- Earned Value (EV) of the work performed) shows how efficiently the work achieved to date has been performed.

The Variance at completion (ie the vertical difference between the top of the red line and the top of the green line) shows the expected over run (or under run) of costs compared to the original budget at the completion of the servicing.

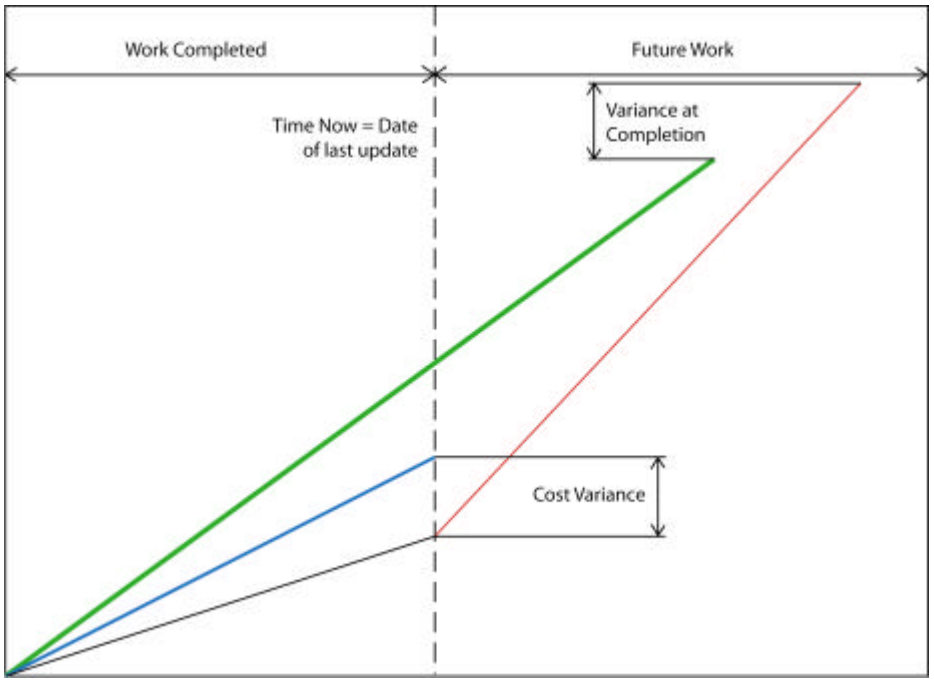


Figure 5 – Cost Related Data

Note

The value of this chart is in watching the trends develop over time. Generally a change in an established pattern is caused by an identifiable change in the project's operating environment. Similarly, to cause a desirable change in the trends, specific changes in the project need to be made. Research in the USA suggests that the Cost Performance Index (CPI) of a project will vary by less then 5% after the first 20% of a project and usually only in a negative direction.

Implementing AS 4817- 2003, Project performance measurement using Earned Value.

From early in its development, VIPER was designed to facilitate Earned Value Performance Measurement (EVPM) reporting as this was seen as the most effective way of evaluating progress on a typical aircraft maintenance project. The standards then available did not lend themselves to simple business requirements (being designed for major defence acquisition projects) and as a consequence, FPM developed processes and reports to meet the requirements of VIPER users.

The publication of AS 4817 - 2003, [8] has shown the practical systems embedded in VIPER have a wider application.

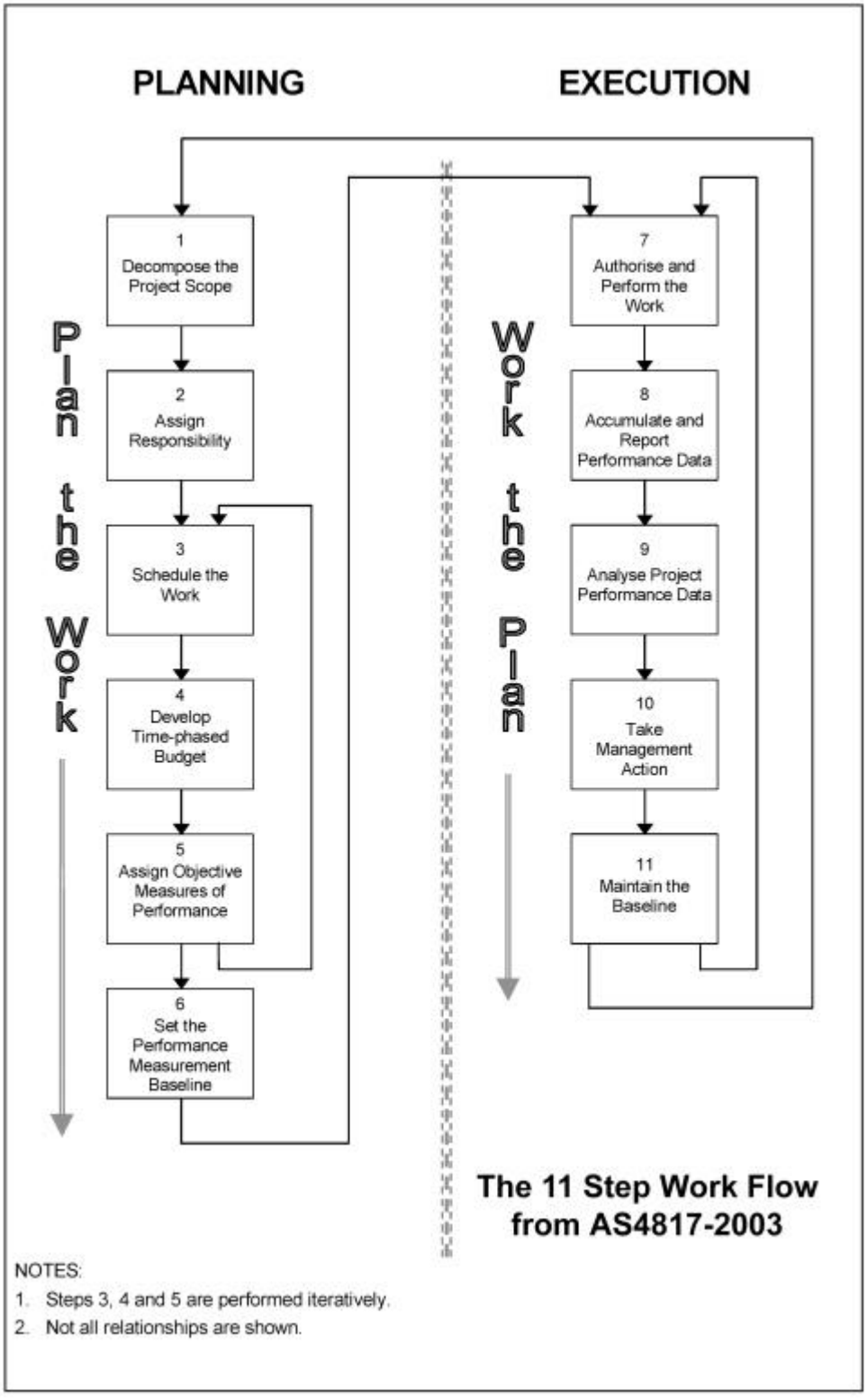
An overview of AS 4817 - 2003

AS 4817 - 2003 was developed to facilitate the adoption of Earned Value Performance Measurement (EVPM) in the general business community. The stated objectives of the Standard are:

- To define the essential elements of the EVPM method.
- To provide enough information about how to implement the method to allow the user to gain the benefits of the method.
- To be used as a measurement tool to determine whether the EVPM method has been implemented.
- To provide a basis for EVPM implementation for all industries and sizes of projects.

- To clearly communicate the benefits of the EVPM method.
- To be fundamentally compatible with any existing Australian or International Standards.
- To be relevant to Project Managers and executive management in organisations that manage by projects.

Two of the primary references used by the committee developing AS 4817 were the PMBOK Guide 2000 Edition, © Project Management Institute [9] and ANSI EIA-748, Industry Guidelines for Earned Value [10]. The common thread running through these referenced standards and AS 4817 has been the move away from the prescriptive and dogmatic processes, forms and implementation check lists found in the older CSSR [11], C/SCSC [12] and other "Defence" originated standards and guides to a results based approach suited to general business projects.



AS 4817 still contains a significant number of mandatory requirements, eg 'Management responsibility shall be clearly defined [for the accomplishment of each element of the work] (3.2.1b)', but how this requirement is achieved is open to the organisation implementing the Standard to determine. It is the author's view that this shift in focus from the old style prescriptive 'check lists' to AS 4817's 'normative requirements' will make the Standard easier to implement whilst at the same time creating a far more rigorous and disciplined process. Organisations no longer need to create artificial positions, reporting hierarchies and processes to obtain "ticks" in the relevant compliance boxes found in the old implementation guides. They simply need to show how their current systems comply with the requirements of the Standard.

The effect of this change is to move the responsibility for the various aspects of management control and reporting from potentially artificial positions and processes (often created for the sole purpose of achieving compliance); to the organisations normal line and project management positions and processes, ie the people and processes that actually control the project. The alignment of visibility, responsibility and authority encouraged by AS 4817 should, as it is adopted and implemented by businesses, lead to far more effective project reporting and control systems.

Implementing AS 4817 - 2003 using VIPER

AS 4817 has adopted an eleven-step process model (refer diagram, above) to describe how EVPM will be implemented in a conforming organisation. Each of these steps has a number of mandatory requirements and some supporting guidance.

When supported by appropriate management structures and processes, VIPER's Earned Value system appears to be fully compliant with the requirements of AS 4817 - 2003. A summary of each of the steps defined by this Standard and VIPER's implementation of the process is set out below. For each 'Step', a brief summary of its requirements is included before the discussion of VIPER's support of the requirements.

1 Decompose the Project Scope

Decompose the entire project scope of work into manageable elements using a Work Breakdown Schedule (WBS).

VIPER uses a sophisticated WBS based on the PMI Practice Standard to decompose the project into elements and allow summary reporting [13]. The capability of this process varies depending on the COTS scheduling tool specified by the VIPER operator. The ACOS version of VIPER has the following standard levels in its WBS.

- Hangar
- Aircraft Type and Model (Fleet)
- Specific Aircraft (Tail Plane Number)
- Type of Servicing
- Phase of Servicing (or alternatively Physical Location on Aircraft)

The individual work packages are allocated to the bottom elements of the WBS.

2 Assign Responsibility

Assign responsibility for the accomplishment of each element of the work at an appropriate management level.

The VIPER system requires the assignment of individual packages to the relevant supervisor. This is a more detailed level of assignment than required by the Standard occasioned by the need to achieve airworthiness requirements. Higher levels in the WBS are typically assigned to the manager responsible for the servicing but there is no system restriction to prevent other managers being assigned responsibility where appropriate.

3 Schedule the Work

Create a schedule for all the work that identifies tasks, milestones and interdependencies. Activities are created at or below the level of work elements in the WBS. All elements of the work are to be scheduled into a logical sequence. The goal of the schedule is to provide a vehicle for evaluating actual progress (in time) against predefined objective measures of achievement. All tasks and milestones within the project should be linked with dependencies to produce a logic network that will allow the critical path, free float and total float for every task and milestone to be calculated.

VIPER fully complies with and supports this objective. The optimum schedule for each type of servicing is maintained within VIPER and translated into an aircraft specific schedule when the servicing is being set up within VIPER

4 Develop a Time-Phased Budget

Assign resources (and costs) to scheduled tasks and establish the time-phased budget. Tasks have a budget value assigned which is distributed over the activity duration and expressed in terms of dollars, labour hours, or other measurable units. Budgets should be assigned to all work elements (tasks) within a project. The time-phased budget at the detail level is defined as the Planned Value (PV). The total budget at the completion of the project is termed the Budget at Completion (BAC). The time phased representation of the total Planned Value (PV) for all tasks (or WBS elements) is the Performance Measurement Baseline (PMB). The PMB represents the formal plan for the project manager to do all of the project work in the amount of time allocated and within the amount of budget authorised to accomplish that work.

VIPER fully complies with and supports this objective. The metric used is 'Labour Hours' for the reasons discussed elsewhere in this paper.

5 Assign Objective Measures

The accomplishment of tasks is ultimately expressed in terms of Performance of their budgetary values (Earned Value). Objective measures of performance, are used to quantify the degree of completion of tasks in progress. These measure of performance should be established in such a way that they correctly measures accomplishment of in-progress tasks. The measuring of Earned Value should be computed using the same methodology as the original plan (budget). The resulting metric is referred to as the Earned Value (EV). Objective measures allows work achievement to be measured in a clear and unequivocal way. Setting the objective measures in advance enhances accountability and objectivity.

The measurement of progress used within VIPER is the estimated hours required to complete the package. This measure was selected to deal effectively with the unique problems associated with maintenance work. At any point in time, the quantity of work remaining in a package can alter suddenly, usually when an unforseen defect is discovered that requires rectification. The VIPER system always reserves adequate Planned Value (PV) to complete the package as it is assessed at each update and as a consequence, only takes as Earned Value (EV) any budgeted value for work that is genuinely completed.

6 Set the Performance Measurement Baseline

The Work Breakdown Structure, the Schedule, the Budget for each task and element and the time-phased budget as developed in steps 1-5 shall be approved by the Project Manager or higher authority and recorded as the Performance Measurement Baseline (PMB). This baseline provides the reference points against which actual project progress is compared, it should include the best estimates for task duration, scheduling, resource allocation, costs, and the other project variables required to be monitored. To be valid as a baseline, it should not only be logically constructed but it should also make sense when compared to available project resources.

VIPER fully complies with this requirement. Scope, cost and time baselines are stored for use in the management of each servicing. Whilst not forced by the system, obtaining management approval of the schedule before creating the PMB is normal practice for VIPER local management.

7 Perform the Work

Formally authorise all work to be undertaken and perform the work. In order for the Project Manager to exercise proper control of the project, the chain of authorisation for the commencement of work should emanate from the Project Manager either directly or indirectly. The work authorisation should clearly identify:

- What is to be done.
- Who is to do it.
- When it is to be done.
- The quantity of resources budgeted.
- Who is the person responsible for acceptance of the work.
- How progress and actual costs are to be aggregated.

These requirements are met and exceeded by VIPER and closely align with the airworthiness objectives of the VIPER system.

8 Accumulate and Report Performance Data

Record and accumulate schedule progress, earned value and actual cost for each activity on a consistent and periodic basis. Their Planned Value, Earned Value, Actual Costs, Budget at Completion

and Estimate to Complete are calculated and logically summarised through the project decomposition (WBS) to properly represent the status of the individual tasks and the project in total. In addition the current schedule shall be progressed to show achievement and to provide forecast completion dates for the scheduled work.

The update module of VIPER fully supports this requirement.

All costs (Labour Hours) actually incurred in the performance of the tasks (AC) are accumulated at a level which will identify the cost elements and factors contributing to cost variances. The Actual Costs (AC) is compared with the Earned Value (EV) to establish the Cost Variance (CV). Earned Value (EV) is compared with the Planned Value (PV) to establish the Schedule Variance (SV).

Forecasts at completion both in terms of cost and schedule are made for comparison with current period status information and performance Reports are distributed to appropriate management levels on a consistent and periodic basis.

9 Analyse Project Performance

Identify and analyse variances from the Performance Measurement Baseline (PMB). Earned Values (EV) for tasks, elements, and totals are compared with the corresponding Planned Value (PV) to identify any variance between the amount of work accomplished and the amount of work scheduled.

The progressed (current) schedule is compared with the baseline schedule to determine slippages and forecast completion dates.

Earned Value (EV) for tasks and work elements is compared with the corresponding Actual Cost (AC) to determine the Cost Variance (CV).

Cost and schedule variances should be evaluated to determine their cause and the likely impact on the project.

Estimates of the costs at completion should be routinely developed and updated based on past trends and current knowledge and compared with the corresponding Budget At Completion (BAC) to identify the extent of the cost Variance at Completion (VAC). Forecasts of the scheduled completion should also be routinely developed and updated based on past trends and current knowledge for comparison with the planned completion dates.

These requirements are management processes supported by VIPER, recommended in the VIPER manuals and typically undertaken on a routine basis by VIPER users. However, the performance of the analysis required by this step requires the operator to comply with the requirements of the Standard and is not 'forced' by the VIPER system.

10 Take Management Action

Take management action to compensate for past deviations or to rectify projected deviations from the Performance Measurement Baseline. The required corrective action should be determined based on the source and cause of the variance.

Corrective actions require either a change in the baseline planning or the development of a short term get well plan that is incorporated in the forecasts. In either case, revisions to planning should only be accomplished prospectively. Retroactive changes to cost, schedule or technical planning or accomplishment should not be allowed other than to correct administrative or typographical errors.

Again, these requirements are management processes supported by VIPER, recommended in the VIPER manuals and typically undertaken on a routine basis by VIPER operators. However, the undertaking of 'management action' required by this step requires the operator to comply with the requirements of the Standard and is not 'forced' by the VIPER system.

11 Baseline Maintenance

Changes to the Performance Measurement Baseline can originate either internally through the identification of unforeseen scope changes or resource requirements or where changes have been directed from other stakeholders. Where there have been changes to the project, it will be necessary to replan certain elements of the work. Due to the importance of maintaining a valid baseline for performance measurement, replanning should be accomplished:

- with proper authority;
- in a systematic and timely manner;
- should be carefully controlled; and
- adequately and visibly documented.

Replanning should not be used as an alternative to proper initial planning, nor should it be used to mask legitimate variances.

Maintenance of the Performance Measurement Baseline is required to ensure that baseline changes are properly recorded and visible and can be examined to determine their causes and potential impact on completion dates and costs. In order to maintain the integrity of the Performance Measurement Baseline the project manager should not transfer scope or budgets independently of one another.

VIPER procedures allow proper maintenance of the PMB and track and record the changes as they are made. Provided VIPER is operated in accordance with its manual, a complete history of the servicing (project) is maintained for future reference.

Conclusions, AS 4817 – 2003 using VIPER

For a VIPER system to achieve full compliance with AS 4817 - 2003, a proper combination of management processes and the built in VIPER procedures is needed. VIPER supports the prudential processes defined in AS 4817 - 2003 but software alone cannot achieve the objective and benefits offered by adopting the AS 4817 methodology.

Discussion of the 11 Steps above has by necessity been at a summary level. A detailed assessment of VIPER against each of the individual 'normative requirements' is available from Fallon Project Management Pty Ltd on request.

In conclusion, it is important to note, the more sophisticated and successful organisations using VIPER have consistently used EV reporting as one of their key business indicators for many years and consider the summary S-Chart to be the most important single piece of management information produced at each update.

Overall Conclusions

- With the overall process of 'schedule control' an effective implementation of EVPM, particularly when it is linked directly to the core business processes provides a powerful insight into project performance that changes behaviours and drives efficiencies.
- VIPER and its predecessor system have delivered significant measurable benefits to both management and workers engaged in the maintenance of ADF air assets. The processes and concepts discussed in this paper have a far wider application than the rather specialised area of aircraft maintenance management.
- Provided organisations are prepared to invest the time and resources to build effective integrated data processing systems and make schedule control an integral part of the process, similar benefits can be expected in a wide range of situations where the effective use of skilled resources to deliver complex outcomes is required.

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