Earned Value Management:
Making it Personal; Making it Work !!!

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Abstract

Defence, government, and commercial organisations have used earned value management (EVM) techniques for years - with varying degrees of success. The Australian Ministry of Defence has required its suppliers use EVM for decades, and industry has complied; some organisations use EVM to manage the project (internal-looking) and to coordinate effectively with stakeholders (external-looking); others find little value, bogging down in numbers, reporting, and bureaucracy. This paper presents the work of an organisation with which I have worked: Fujitsu Australia Ltd, in Canberra. They have embraced EVM, enhancing relationships with customers and throughout the entire team.

Keywords: earned value management, earned value, EVM, project management, success, case study

1 Introduction

The US Department of Defence and numerous government agencies have required the use of earned value management (EVM) for decades. [EVM1] Various Australian government agencies - including our Ministry of Defence - have standardised on EVM as well. [EVM2] [EVM3]

My first encounter with EVM was in the early-1980s, working for a US defence contractor as a junior manager. My instructions for using EVM were, "read the reports for my cost centre code; if anything is highlighted as x% beyond expectations, document (explain) it in a highlight report." As a result of that initial contact, I saw little value in what I now advocate as one of the top-10 metrics everyone should be collecting and using. [Top10]

My colleagues at Fujitsu Australia Ltd in Canberra embraced EVM, PRINCE 2 [PR2], and ISO 9000 [I9K] mid-1990s, with significant benefit to their organisation as it evolved.[1] This paper illustrates one powerful - and successful - use of EVM by examining its use on an on-going project. The Fujitsu case study provides a prime example of the value of EVM within the project team and with external stakeholders.

This paper contains little "new theory" for those using EVM effectively today. The key value of Fujitsu's work comes in how they have "humanised" EVM - including using practical "plain English" for the EVM code-words - and made it accessible - "personal" - to all stakeholders.

The rest of this paper is organised as follows:

2: The five principles of effective planning, tracking, and managing, illustrated by a brief case study

3: A detailed case study

3.1: Characteristics of the case study, including examples of how each of the five principles was applied by the project team

3.2: One detailed example, and the benefits for the team

[1] The organisation when through many owners: Aspect, KAZ, Telstra, now Fujitsu. From here forward, I use the term "Fujitsu" alone to represent the Canberra office of Fujitsu only, not corporate-wide Fujitsu.

2 Five principles of effective planning, tracking, and managing

On each of their projects, Fujitsu uses five principles of effective planning, tracking, and managing. These principles are:

(1) Use a standard work breakdown structure (WBS)

(2) Schedule the tasks

(3) Establish the tracking baseline

(4) Establish the activity list within a task

(5) Verify, track and manage the completion of each activity

2.1 Use a standard work breakdown structure (WBS)

As a normal part of business, Fujitsu has collected basic project measures throughout all its incarnations. In early Aspect days, knowing what could and could not be done, how much it would cost, when it would be completed were keys to commercial success and business survival among an ever-growing set of competitors, including much larger, multi-national organisations.

From the beginning of each project, Fujitsu uses historical data to estimate and plan accurately.

By having a standard WBS, traceability is ensured through estimates, plans, activities performed, time reporting, and outcomes.

Data are collected consistently; actual data are recorded against the standard WBS.

Each Fujitsu project is able to compare performance and quality results across projects and across releases (increments, builds) within a single project. Fujitsu management also use these data to identify opportunities for improving quality and performance within each on-going project and across projects.

Figure 1 illustrates the standard WBS used in the case study.

WBS	Task	Work pattern
1	Scope	Interpret the contractual requirements and reflect these in user transactions
2	Analysis	Establish the business implementation of the user transactions with the customer and specify this in scenarios
3	UI design	Agree with the customer on the physical implementation of the scenarios; create the UI design specification
4	System design	Specify the technical implementation of the system and identify demonstrable components
5	Test preparation	Prepare the test scenarios, test scripts and test steps for the system as designed
6	Build	Build the technical units to deliver and demonstrate components
7	Integration test	Verify the integrated components composing the system
8	System test	Verify that the system operates as specified
9	Acceptance	Work with the customer to verify all contractual requirements have been met

Figure 1. Use a Standard WBS

Fujitsu's management and engineering processes are oriented around this WBS, as is their internal training. This WBS is tailored based on the contractual scope of the work to be performed by Fujitsu. This tailored WBS is used with all life-cycle approaches: traditional (e.g., waterfall) through current (Agile). In all cases, the WBS describes the evolution of moving from something conceptual to something increasingly concrete to something verified and then accepted.

Two standard WBS items appear in later examples, but are not discussed in this paper:

- Design review (review and approval to proceed with Build)
- Delivery (packaging and implementation for Acceptance)

Several other standard WBS items are not shown for convenience:

- Project tracking (a level-of-effort task)
- Architecture support (a level-of-effort task)
- Project planning (replanning following the Scope task)
- Document preparation (only for projects that have extensive documentation or security requirements)

2.2 Schedule the tasks

Fujitsu practices "rolling wave" planning. Later tasks are planned-in-detail once

sufficient information and actual results from earlier tasks become available.

The Fujitsu Project Manager (PM) derives estimates for the initial task effort and duration directly from the effort estimates and staffing of each WBS element. The project team begins by characterising the "product": analysing the contracted requirements and counting function points to measure the size of the product.

The PM characterises the "work" by checking the product characteristics against historical data from previous projects and results from previous releases of the current project - including productivity.

The PM creates the schedule, again using historical data (e.g., overall effort allocation: 5% Analysis, 40% Build, etc) and staffing (e.g., for work like this, our staffing profile is 2 analysts, 7 developers).

Task duration is calculated as:

planned effort / staffing level

The PM revises these estimates again based on knowledge gained during down-stream activities. (The "rolling wave.")

The PM staffs each task so the product is scheduled to be delivered on time. If the PM discovers some risk to delivering all requirements on time, the PM has the opportunity early in the project to mitigate this risk and request assistance from the Project Board. The PM shares this information with the customer as appropriate, precisely to ensure "no surprises" later in the project. Backed by historical data, this approach enhances relationships between Fujitsu and its customers.

This disciplined approach, use of historical data and multiple feedback loops, enables Fujitsu to produce estimates that they genuinely expect to achieve. This approach is arguably one of the key reasons Fujitsu is able to exploit the value of EVM.

Figure 2 illustrates the standard WBS and the initial schedule, based on initial estimates, duration, and staffing, used in the case study.

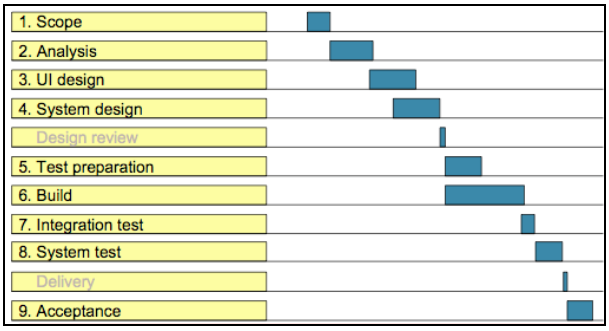

Figure 2. Schedule the Tasks

Using a "rolling wave" management approach asserts that estimates for early project tasks (e.g., Scope) are more fixed, and the estimates for later tasks (e.g., Build) are more fluid. In practice, Fujitsu does detailed planning only after they have sufficient information. For example, Fujitsu plans Analysis while specifying scope; Fujitsu uses the outcomes from Scope, Analysis, UI design, and System design tasks to review and revise Build estimates, resulting in plans that are achievable.

2.3 Establish the tracking baseline

Supplied with effort and duration estimates, the Fujitsu PM establishes the tracking baseline using Fujitsu's EVM approach. The tracking baseline reflects the cumulative planned effort expended over time. In EVM terminology, this is the Budgeted Cost of Work Scheduled (BCWS).

This information is made available to all stakeholders: external, including the customer and the Project Board; internal, to each project team member. The tracking baseline becomes the goal to achieve, and a talking point for how well that goal is being achieved. It is available to all; all stakeholders know when there are deviations from the plan; there are no secrets, no surprises.

Figure 3 illustrates the tracking baseline (BCWS) mapped against the standard WBS, the initial schedule, based on initial estimates, duration, and staffing used in the case study.

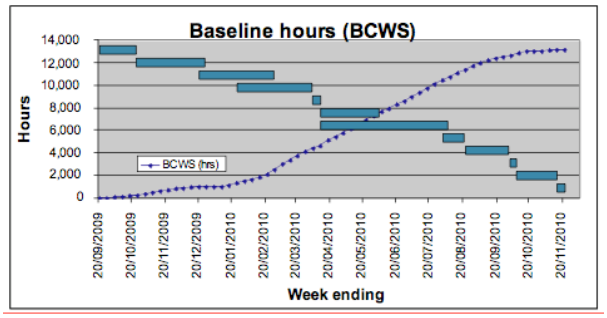

Figure 3. Establish the Tracking Baseline

The slope of the line represents staffing build-up and reduction: the smaller the slope, the fewer hours worked per day, the fewer full-time equivalent people required; the larger the slope, the more hours worked per day, the more full-time equivalent people required.

Early in any project, uncertainty is high. To help Fujitsu manage this uncertainty, the PM establishes its tracking baseline early. The PM tracks performance from the beginning, producing highly reliable leading indicators on project performance - whether it is - or is not - as expected.

These early and reliable warnings enable Fujitsu to manage customer expectations and to change approach, technology, or staff, as will be illustrated in one of the examples below.

2.4 Establish the activity list within a task

Each standard WBS task has a more detailed list of activities associated with it. Fujitsu ensures each activity has defined, verifiable exit criteria and, as appropriate, defined, measurable interim milestones. The exit criteria and measurable interim milestones form an objective basis to determine "% complete," which Fujitsu calls: "Achieved (%)."

This avoids the "I think I'm 90% complete" syndrome[2], as will be illustrated later in more detail.

[2] The "90% done" syndrome can be characterised as: When asked by a PM "how close to being done are you?", the developer could respond simply, "I'm 90% done." Without objective, interim milestones and verifiable exit criteria, a developer could genuinely believe "I'm 90% done" for weeks at a time. There is a long history of failed projects that were "90% done" for years.

This disciplined approach is arguably another key aspect of Fujitsu's success in implementing EVM.

Activity lists vary according to the WBS task and complexity of the work to perform. They are grouped to be integrated at the earliest possible time.

Based on experience, Fujitsu expects a certain number of activities to be identified for each WBS task:

WBS Task	Typical Number of Activities
Analysis	1 activity per identified user transaction
UI design	1-4 activities per scenario
Build	3-6 activities per user interface specified

Figure 4 illustrates one portion of an activity list for one instance of the WBS task Build.

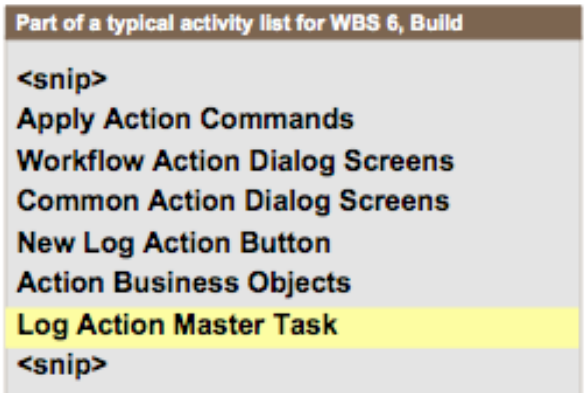

Figure 4. Establish the Activity List

This activity list is created by the developer when assigned the Log Action Master (Build) Task.

The yellow-highlighted item is the product to be delivered by this instance of Build. The non-highlighted items are the measurable interim milestones that, when achieved, integrate into the product to be delivered. Verified code and unit test results are among the items subject to the exit criteria for the yellow-highlighted item.

2.4.1 Activity lists: The key to measuring progress

Fujitsu measures progress by measuring Achievement, which can be measured in two ways:

The undisciplined, "promise me" habit

Achievement =
Planned effort – Estimate-to-complete

Determine estimate-to-complete for each activity. It can take considerable time and overhead to collect, collate and process. This habit leads directly to the dysfunctional 90% syndrome.

OR

The disciplined "show me" approach

Achievement =
Planned effort * Achieved (%)

Fujitsu has established clear, unambiguous exit criteria (review points) for each activity and defined Achieved (%) earned at each review point. This is based on Fujitsu's experience and depends on the work pattern for the task.

Activity lists are the key to measuring progress accurately, timely, and consistently - and thus to producing accurate, timely, and consistent measures of progress (Achievement). Fujitsu exploits the integration between Microsoft Team Foundation Server and Microsoft Excel to achieve this. Additional discussion of this can be found in [ARes].

Examples of typical review points are:

- Activity is allocated, "in progress"
- Text is written and submitted for review
- Code is integrated and functionality passes review

Figure 4a shows some Achieved (%) values Fujitsu uses based on its experience and historical data.

WBS	Task	Typical effort per activity	Review points and Achieved (%)	
2	Analysis	100 hours	In progress	20%
			Internal review started	70%
			External review started	90%
			Accepted	100%
6	Build	20 hours	In progress	40%
			Unit test complete and passing	80%
			Integrated and functionality reviewed	100%
8	System test	1 hour	Failed	0%
			Passed	100%

Figure 4a. Examples of Achieved (%) Values

Fujitsu uses review points to determine Achieved (%) objectively and to measure Achievement for each activity. This approach incurs less overhead and is substantially more objective. And, being objective, it can be automated to some extent, as Fujitsu has done.

The activity list and its review points provide:

- Clear expectations for each team member
- Detailed Achievement measures as a by-product of activity allocation

Clear, unambiguous exit criteria for each activity provide:

- Clear Achievement objectives for the team
- Well defined Achievement measures for the PM

2.5 Verify, track and manage completion of each activity

Fujitsu's project management discipline is accompanied by its disciplined software engineering approach, embedded in their processes.

The Fujitsu PM allocates each activity to an appropriate developer.

The developer follows the appropriate processes and produces the appropriate artefacts. The processes and artefacts are linked to the activity list, again ensuring consistency of measurement. As discussed in the previous section, the ***presence*** and ***quality*** of each artefact are verified at review points and are used to determine the level of completion of each activity.

The project team measures progress towards completion regularly: sometimes via automated tools, other times through team

meetings and status reporting. There are two components of progress measurement:

- Effort expended for each activity
- Product produced for each activity (this is the earned value (EV))

The Project Manager then verifies that the activity is complete.

When all activities are complete the project is done; the product is delivered; the customer is happy; the team is proud.

Figure 5 illustrates one portion of an activity list for one instance of the WBS task Build.

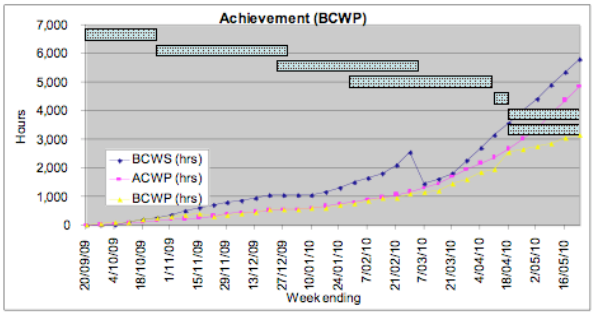

Figure 5. Verify, Track, and Manage

Figure 5 is a "typical EVM diagram. It contains information, that could be used by a knowledgeable PM. In the case of Fujitsu and the discipline they build around EVM, the full richness of this type of EVM diagram can be - and, in fact, was - fully exploited.

The next section illustrates this.

2.5.1 Leveraging the Discipline of EVM

Going back in time through the case study, the project was plagued by a staff shortfall during the first five months. This shows up clearly in Figure 5a (red arrow).

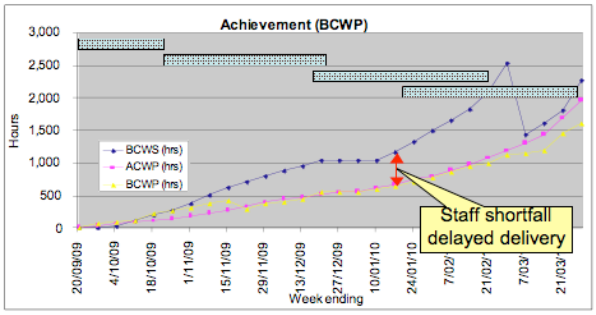

Figure 5a. The Staff Shortfall

Performance (productivity) was as estimated (BCWP = ACWP), as shown in the red circle on Figure 5b. The project team had the appropriate skills, tools, contact with the customer, etc; there just were not enough people to do all the work planned.

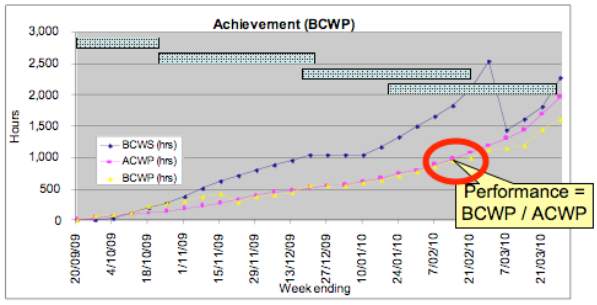

Figure 5b. Performance as Estimated

After negotiating with the customer, Fujitsu rescheduled and rebaselined the project, as Figure 5c illustrates.

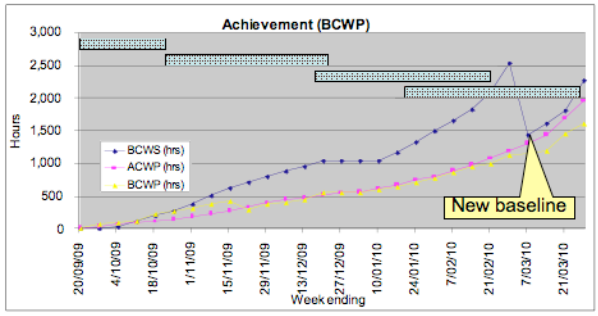

Figure 5c. New Project Baseline

Based on metrics to-date, the PM determined that it would be appropriate to assume performance would continue to be as estimated, so the rebaselined project goals could be achieved.

However, just one month later, the team discovered that Build performance was only half the estimate. This is highlighted in the red circle on Figure 5d.

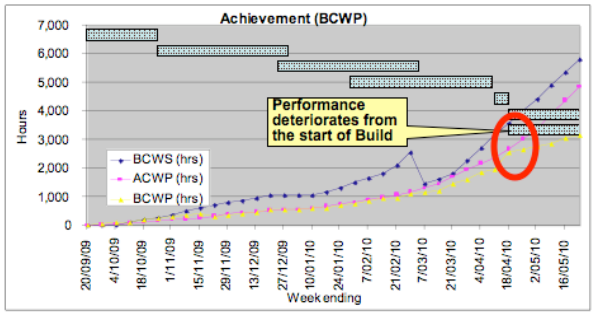

Figure 5d. Build Performance Half of Estimate

With six months remaining, Fujitsu had time to react.

The project team investigated the cause ("rally the troops"):

> Cause: A key development tool required by the customer provided much less "out-of-the-box" functionality than expected
>
> Consequence: The complete scope of the release could not be delivered by the planned delivery date

The PM acted (with Fujitsu support); the PM:

- Renegotiated the delivery approach with the customer (split the one large release into two, more manageable releases)
- Reorganised the team to support the split release
- Increased the total staffing with appropriately skilled people
- Rescheduled and rebaselined the project

Verifying, tracking, and managing provided metrics that demonstrated the issue early. The PM used recent project data and his professional judgement to conclude that the delay incurred during Analysis (staff shortfall) could be absorbed. At the end of UI design, that proved insufficient, so the project was rebaselined. Because actual performance was as estimated, the PM and Fujitsu management believed this corrective action would be sufficient.

However, very early in Build, this proved not to be the case. Once again, the metrics provided early warning. The PM was able to start negotiating with Fujitsu management and the customer so that when it became clear the Build performance shortfall would continue, versus just being a one-off, slow week, the appropriate corrective action was ready-to-enact.

Measures provided strong support for intervention - by the customer and Fujitsu management. The PM used all three dimensions of EVM data:

- Will future performance remain as planned?
- Will future performance remain as it is now?
- Is intervention required?

2.6 Five principles and Earned Value Management [EVM]

EVM is a systematic approach to implement the five principles just discussed. EVM provides a systematic way to:

- Record and report current status
- Reflect on past performance
- Predict most likely future outcomes
- Intervene based on measured performance and results
- Assess the impact of interventions

Fujitsu (then-Aspect) initially adopted EVM in response to government requirements. Because of the benefits Fujitsu obtained and the value to its customer base, Fujitsu continues to use EVM. And because Fujitsu has embraced the spirit of EVM, the value exceeds these points.

Fujitsu uses the concepts of EVM with various life-cycle approaches: e.g., Agile "burn down" lists are a variant of EV techniques.

EVM is not a "silver bullet," nor will using EVM guarantee project success. EVM does not replace project management discipline or professional judgement; it enhances both.

As the previous case study showed, even with effective use of data and EVM, the Fujitsu project team encountered difficulties that required significant intervention. The value of EVM to this project team included:

- The problems emerged; they were not hidden; they could not be hidden.
- The problems emerged early; there were time and opportunity to take corrective actions, and then-appropriate corrective actions were taken.
- The corrective actions were based on data and thus more readily supported by the customer and Fujitsu management.
- The same EVM discipline that identified the original problem was used to track the effectiveness of the first rebaselining (staff shortfall) ... and the second problem (insufficient Build productivity) was identified early.
- There was no blame; developers did not blame managers; managers did not blame developers; customers did not blame Fujitsu; Fujitsu did not blame customers. The team continued to behave as a team, internally and externally, with the ultimate goal of delivering a product the customer will use on renegotiated time and schedule.

The project is now on-track to deliver early 2011, and the team is fully committed.

At Fujitsu, the basics of EVM are implemented in four steps:

(1) Start with a schedule

(2) Create a baseline of planned work

(3) Track the actual effort expended

(4) Record the cumulative achievement (Achievement)

Using the case study graphs from before, each step builds a key component of Fujitsu's EVM discipline:

Figure 6a illustrates the standard WBS and task estimates.

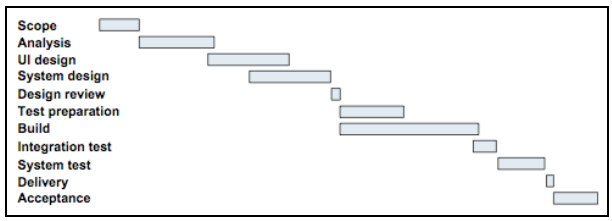

Figure 6a. Start with a Schedule

In practice, this comes from the Fujitsu project plan.

Figure 6b overlays this with the cumulative planned work baseline: the Budgeted Cost of Work Scheduled (BCWS).

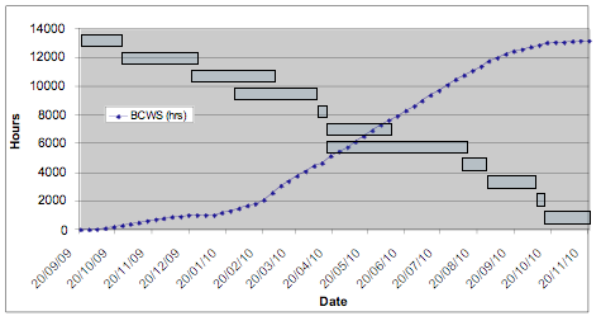

Figure 6b. Create a Baseline of Planned Work

In practice, these values come from the Fujitsu project schedule.

Figure 6c illustrates tracking the cumulative actual effort expended: Actual Cost of Work Performed (ACWP).

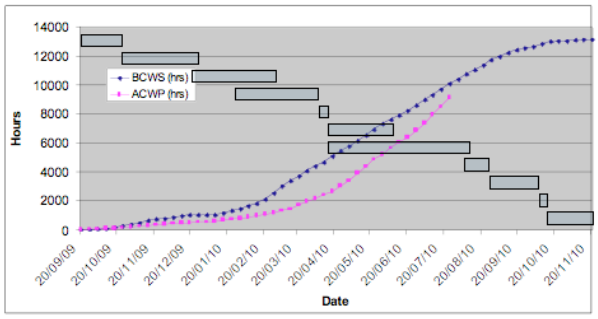

Figure 6c. Track the Cumulative Actual Effort Expended

In practice, these values come from Fujitsu's effort recording system, where effort is recorded against WBS tasks. The example shows that ACWP < BCWS: actual effort is less than planned effort.

ACWP shows hours expended, not work accomplished; not products produced; not goals achieved. So using ACWP (cumulative effort) alone to determine corrective action

affords a limited set of responses: Add staff (more hours) or reduce scope (less work). Those responses may not address the real issue.

What is missing is the link between effort expended and work accomplished, products delivered for that effort.

Figure 6d illustrates this important component: the cumulative achievement (Achievement): Budgeted Cost of Work Performed (BCWP). BCWP is also known (informally) as "earned value" (EV).

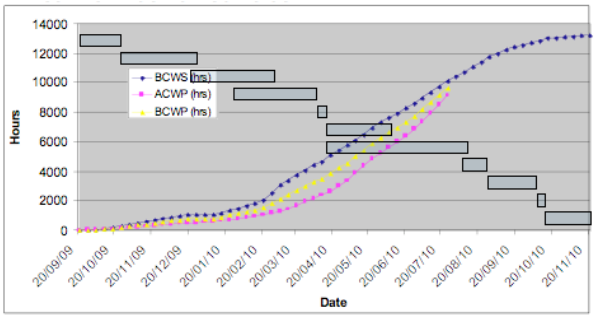

Figure 6d. Record the Cumulative Achievement (the Achievement metric)

These values come from the tools Fujitsu uses to enable and enforce its disciplined engineering processes.

Measuring performance (BCWP / ACWP) - linking demonstrable results to effort expended - opens up additional opportunities for the project team to improve performance. Now, when ACWP < BCWS (actual effort is less than planned effort), the ***results*** of that effort also become visible.

When ACWP = BCWP, performance is as expected; adding staff or reducing scope may be appropriate.

When ACWP > BCWP, as in the Build example discussed previously, additional considerations emerge:

- Developers may be spending more time on their activities than estimated due to the complexity of the activity (address skill deficiencies - training, reassignment)
- Many items may be in a wait-state, and productive work is blocked (remove bottlenecks)
- Developers may be expending effort on things that are not part of the project scope (address scope creep)

EVM becomes more reliable as the tasks become smaller and more predictable. That's precisely why Fujitsu divides the major scheduled tasks into many smaller activities with clear review points and exit criteria.

Traditionally, EV for an activity is measured as:

> % complete =
> 40% complete reported = 40% of task value earned

Or

> Binary =
> 0% if activity is not complete or 100% if activity is complete

Or

> Work done =
> Scheduled Task Effort - Estimated Effort Remaining

Performance is measured as:

> Achievement / Effort expended
> (BCWP / ACWP)

Fujitsu uses a variant of EV reporting, as illustrated in Figure 4a. Fujitsu defines intermediate states for each activity and assigns a %-complete based on historical data modified by past project performance. Objective, measurable exit criteria (review points) are associated with each intermediate state.

Fujitsu's processes ensure that EV cannot be "claimed" until objective achievements have been demonstrated - verifying those exit criteria at review points, as discussed previously.

This is key to what enables Fujitsu to use EVM effectively on all its projects.

3 A Detailed Case Study

This case study highlights how Fujitsu shape the concept of EV to different stakeholders.

Always at the core are the fundamental definitions:

Achievement = BCWP

Performance = BCWP / ACWP

... And the principles:

- Reliable measurement of Achievement is the cornerstone of EVM
- Small activities with clear, unambiguous review points support accurate and timely measure of Achievement
- EVM prompts a Project Manager and team when intervention is required

3.1 Characteristics of the case study

The customer for the project used for the case study is an Australian government agency; the project is a major system upgrade/redevelopment. The system is critical to the health-security of Australia. The system is to be delivered in four releases, each about nine months duration.

Duration:	3 years
Total planned effort:	70,000 hours (1,900 person-weeks)
Average planned staffing level:	12 staff
Peak planned staffing level:	20 staff

The schedule and task lists shown are taken from the second release.

Duration:	14 months
Planned effort:	13,000 hours (340 person-weeks)
Average planned staffing level:	6 staff
Peak planned staffing level:	12 staff

Project governance was supported by the integration of MS Team Foundation Server (TFS) and MS Excel, as shown in Figure 3.1.

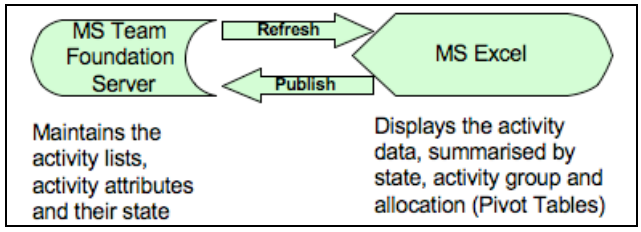

Figure 3.1. Integrated Tool Support.

This helped manage and present the data used by the Project Manager, team members, and the customer.

3.2 One detailed example

This example covers system testing. For this release:

- The design specified the testable interfaces
- Each interface was associated with one or more test scenarios
- Each test scenario was defined as a collection of tests
- Each test was defined as a collection of test steps
- All tests were executed by qualified test staff
- Each test was designed to be completed in less than one hour
- A test passed if all test steps passed
- A test failed if one or more test steps failed
- System test was complete when all tests passed

The Test Manager and Project Manager have two different - and equally valid - views of test progress.

The Test Manager tracked progress through the number of tests executed, passed, and failed.

The Project Manager tracked the acceptability of the product - measured against the contract

as defects delivered. The Project Manager needed an estimate of total defects.

Test Manager	Project Manager
Achieved (%) = Tests passed / Total tests	Achieved (%) = Defects removed / Total defects

Fujitsu uses two approaches to estimate total defects:

(1) At the start of the project they use historical metrics about defects introduced per week of developer effort:

A good product has 1 defect for every developer week in Build

A poor product has 5 defects for every developer week in Build

For this case study:

136 person weeks = 136-680 total defects

(2) During system test Fujitsu measures, assuming a uniform defect density in the product:

Total defects = (defects raised / tests executed) x total tests

Using these data caused some surprises among Fujitsu staff and consternation with the customer. Those new to Fujitsu were astonished: "680 defects???!!! No way; we're better than that! (Aren't we?)" The customer was concerned: "680 defects???!!! Why are we paying so much for such poor quality?!"

Experienced Fujitsu staff on the team knew what would happen, having worked on data-driven projects before. The pre-testing estimates were the bounds; the actuals would emerge once testing began; the early trends would be highly reliable.

Figure 3.2a shows data at the start of system testing. 500 tests were to be executed (Tt); after n-days, Td tests were executed; defects were raised (Dd).

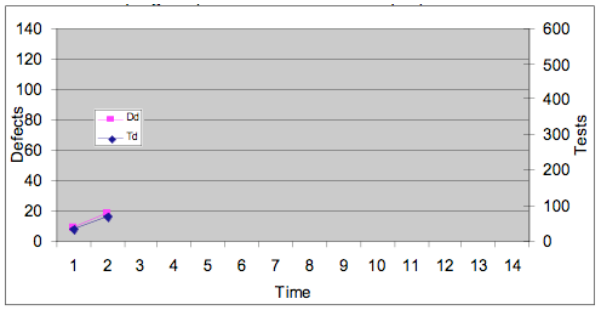

Figure 3.2a. Tests Executed (Td); Defects Detected (Dd).

Figure 3.2b adds the estimated number of defects in the product (Dp). The Project Manager estimated the total number of defects in the product as:

Total defects = (defects raised / test executed) * total tests

Dp = (Dd / Td) * Tt

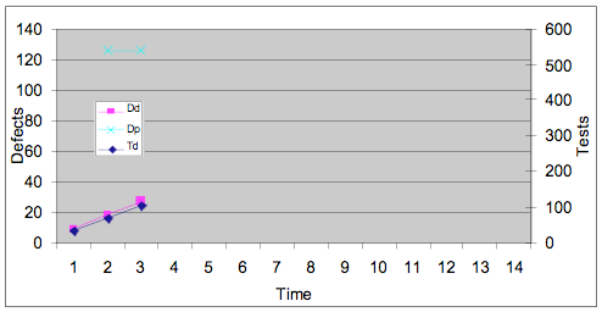

Figure 3.2b. Defects Predicted (Dp).

Over time, the project team repaired defects. Figure 3.2c shows this addition.

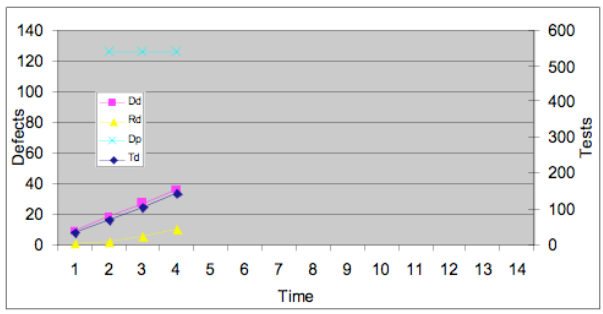

Figure 3.2c. Repaired Defects (Rd).

Figure 3.2d adds the estimated number of defects remaining in the product (Dr). With test and defect data collected to-date, the Project Manager calculated the estimated number of defects remaining in the product as:

Defects remaining = total defects estimated - defects repaired

Dr = Dp - Rd

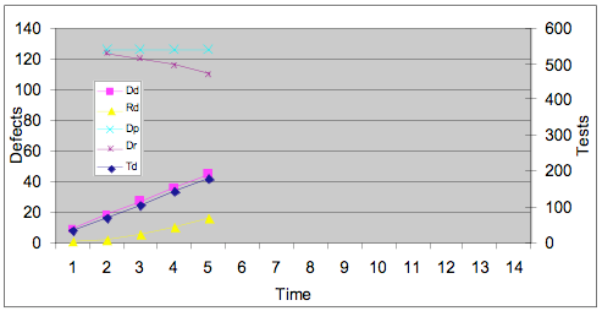

Figure 3.2d. Defects Remaining (Dr).

By this time, the team and the customer gained increased confidence in the quality of the product; the "voice of the data" spoke loudly and clearly.

Figure 3.2e shows how the Project Manager used trend analysis to determine the number of defects expected in the product at the end of the system testing period. This was well within the bounds of contractual requirements, and would be handled easily by the post-delivery warranty period.

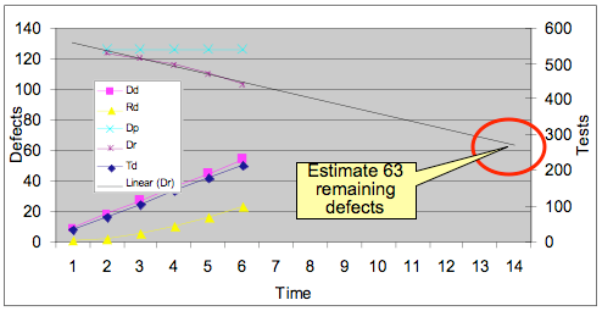

Figure 3.2e. Estimated Defects Remaining at the End of System Test.

By this time, both the project team and the customer were celebrating success - finding and fixing defects, knowing they were improving the quality and acceptability of the product. Again - the data did the talking.

The benefits were clear:

- Progress measurement against a task (test) with clear exit criteria (pass)
- Progress measurement in terms of the desired outcome: defects (or lack thereof)

The team focused on: Are we keeping up with the test results? Are we addressing the defects effectively? The Project Manager asked: Are we progressing fast enough? The customer wondered: Are we getting a quality product?

Tools and their integration assisted the team members to provide data easily, and they did. Tools and their integration also assisted the Project Manager, team members, and the customer to review results regularly and hold discussions based on facts and achievements. All project stakeholders had accurate and timely information about the status of system testing, quality, and projected end-date.

3.3 Case study conclusions

Conclusions from the case study are straight forward for Fujitsu:

- Earned value management supported effective and timely intervention.
- Earned value management relied on accurate and timely feedback on achievement, keeping the team, Project Manager, and customer informed.
- Achievement was measured reliably by reporting measurable milestones achieved on small tasks, bypassing the need for guestimating effort "estimate-to-complete."
- Tools supported administration of many small tasks effectively, avoiding administrative bottlenecks.

But what made it work for Fujitsu? Many organisations have processes, use EVM, integrate tools ... what was/is "special" about Fujitsu?

4 Making it Personal

Talking with key Fujitsu people on this project, I attribute Fujitsu's successful use of EVM to 12 characteristics. Each of the first 12 sub-sections introduces one characteristic

from my view, along with examples from Bram van Oosterhout, Fujitsu. They are in no particular order.

The final sub-section (4.13) examines these characteristics against two familiar models of "institutionalisation."

4.1 People are trained in EVM (Train)

New hires receive induction training when they enter Fujitsu. Fujitsu also provides project management and governance training. EVM is introduced as "the way we do business" during induction, and provides a framework for project management and governance training. This increases the confidence and competence of all staff - whether managers or engineers - to play their roles, provide their data, understand their results.

"We trained our own team. Everybody. 'Here is how we are going to manage ourselves.' The Project Manager and I provided the training. Our customer provides the raw tools (TSF, Excel); we integrated them. We provide 'briefing notes' - tailored from our QMS - who does what when, how to get/start a task, report/record progress, consolidate, analyse, report ... " [Bram]

4.2 EVM is a required part of common practice (Practice)

EVM is part of the standard project reporting regime within Fujitsu - within projects, to individual Project Boards, and to the customers. EVM-related records are audited as part of internal quality audits (IQAs).

"There's a reporting line all the way through Fujitsu that - at one level or another - looks at the reports and notices/sees trends. Each level has a role to play, and they do. It's part of our roles and responsibilities. Even if I weren't there, EVM would continue because we believe it works!" [Bram]

4.3 EVM is required by many Fujitsu customers, so EVM became common practice (Required)

From the earliest, pre-Fujitsu days, many of Aspect's, KAZ's, and Telstra's major customers required EV reporting (primarily Defence). Thus, EVM became an integral part of the way the organisation does business, through today.

4.4 EVM is a common language across stakeholders (Language)

Objective, repeatable, well-defined data are the professional, disciplined basis for progress discussions. There is none of "best guess" or "I think" or "90% done" week after week.

Professional and disciplined creation and use of project data lead to effective, clear, timely, and accurate understanding of the project status among all key stakeholder groups - Project Manager, project team, and customer.

"EV has predictive value. You look at trends; you track on a short cycle; you deal with averages over a large sample. You can decide to take action, take that action, and see the results of that action within a relatively short timeframe. The feedback loop works." [Bram]

4.5 Fujitsu has nourished a culture of openness, honesty, and "fearless reporting" (Culture)

Staff are able to - encouraged to - surface problems without blame, without retribution. There are numerous instances of people "terrified" before attending Project Board meetings - and after the meeting, emerging with smiles and great relief at the praise, assistance, support, and appropriate correction received.

4.6 People use EVM as a signal (Signal)

If a person or team is behind, EVM signals a request for help by others. If a person or team is ahead, they can be asked for help by those who are behind, or they can offer their assistance to those who need their help.

Managers use personal EVM data to help, coach, and support individual staff members. This may result in encouraging an individual to adjust estimates to be more realistic, or for the manager to provide more training for someone who demonstrates that need. Personal EVM data are ***not*** used for reward or punishment.

"EVM can, should, must be used by each team member, the information owned / produced by each team member. This keeps the entire team on the same page. It focuses on objectivity versus blaming. It allows for pride in achievements. The team knows, expects, is not surprised when management intervenes." [Bram]

4.7 EVM plans, data, and results are published and available to all on the development team; EVM data are summarised for the customer (Publish)

Open, honest, candid communication is encouraged among all stakeholders. "No secrets" and "no surprises" are part of the Fujitsu culture. If/when there are problems, the entire team can contribute to understanding the cause(s) of the problems and formulating corrective action(s). Working together builds commitment to the results.

4.8 Past history / previous data give the team confidence in projections (History)

One such example was described in the case study (Section 3): early high defect arrival rate during system testing, but seasoned Fujitsu staff know it typically goes down over time.

"We do detailed planning only after we have sufficient information, so we must have credible metrics." [Bram]

4.9 Fujitsu has "humanised" the typical EVM jargon (Humanise)

To me, this is one of Fujitsu's biggest enablers; this is "making it personal." Using human - and motivational - words like "achievement" versus hard, cold acronyms like "BCWP" encourages people to embrace EVM - very different from my harsh, acronym-only introduction.

"Achieved (%)" is defined objectively, linked to specific tasks on activity lists, versus the squishy, ambiguous "% complete." There's no argument about "Achieved (%)"; no blame; it is or it is not. Period.

"Performance" (BCWP / ACWP) makes it clear in plain language exactly what is happening.

These words engage the team; there is powerful symbolism in these words. The words themselves are enablers; people want to show "achievement"; they want to celebrate "achievements"; so they strive for "performance" and "achievement."

"The development team aren't engaged with financial management; that's all done by the Project Manager. And financial-only outcomes can be manipulated to look better - just put on a 'cheaper' resource, and instant cost-savings. Instead, the team focuses on Performance; this engages the development team. Performance. It's in their language, their terms. And each individual sees and knows how her/his achievements contribute to project performance." [Bram]

4.10 "Done" is defined objectively - no quibbling - within the team, with the customer (Done)

Successes are noticeable, demonstrable. Non-achievements equally so. Everybody knows what is expected; there is pride in workmanship - a Deming quality principle.

"One advantage: each team member sees her/his progress, success. One disadvantage: the team member also notices when she/he founders. Team members ask for support, because they're all focused on a common goal: delivery of functionality and quality on-time, within-budget. Using EVM, they know that what they're doing is useful, how it contributes to project goals." [Bram]

4.11 Each team member shares responsibility for her/his outcomes, and contributes to planning the activities for producing those outcomes (Share)

Management sets the broad, major milestones, consistent with delivery for contractual requirements and customer needs. Linking back to the five principles: Management: (1) uses a standard WBS; (2) schedules the tasks at the WBS granularity; and (3) establishes the tracking baseline (BCWS).

Each developer plans her/his own work within this framework. Related to the five principles: Each developer: (4) Establishes the activity list, interim outcomes, and schedules specific to their task. The developer uses personal experience and productivity data to do this. Activities are manageable size: no more than 40 hours. The developer negotiates with management and the team if her/his schedule exceeds the larger milestones. Each developer reports achievements via timecards and tools, reporting against the activity list and EV on tasks. Team members discuss progress, problems, and plans objectively with managers and teammates regularly. Managers intervene only when there are significant delays.

Each developer "buys into" her/his commitments because she/he made them. This approach establishes clear expectations within the team, with each developer knowing, understanding the commitments of each other. Each developer is comfortable reporting, as everybody reports the same way, with the same degree of visibility. Managers are there to celebrate and to support.

Developers and managers both: (5) Verify, track, and manage: developers at the personal level; managers at the aggregate level. Verification, tracking, and management go up the governance hierarchy (including the Project Board, customers, other stakeholders).

4.12 Use of EVM builds confidence in the inter-team relationships and enhances the team-customer relationship (Confidence)

Fujitsu's use of EVM provides a great degree of transparency. With EVM embraced and practiced from bottom-to-top and top-to-bottom within a project, data are accurate and timely; the behaviour is professional and disciplined; the people focus on achievements and pride in their quality of work. Nothing hidden; no surprises.

"We learn how to do things faster and better. We learn our own limits." [Bram]

"Corporate focuses on cost and 'balancing the books.' The CPI dimension. Projects focus on cost connected to outcomes. Both the CPI and SPI dimensions. We record where time is spent and who spends it. We know who is ahead, who is behind; who needs help, who can offer help." [Bram]

"Your 12 points only scratch the surface of how it really feels in the middle of it. The difference is: when it works, it's about the collective; it's not about individuals any more. People start anticipating the performance results; we don't actually need metrics to know when someone needs help or is doing well. It's an awareness of circumstances, events occurring, and the impact on results that the corrections are done - often at a level that metrics don't record. It's about an awareness of things. When you're there, you feel like you don't really need the metrics. And without the metrics, you never really know that you're right!" [Bram]

4.13 Institutionalisation at Fujitsu

Fujitsu has been successful at institutionalising effective use of EVM - with emphasis on effective use. The 12 points and quotes above illustrate that. Examination of the 12 points against two models clarify why this is working for Fujitsu - and presents a framework against which anybody can measure their efforts to institutionalise effective practices.

4.13.1 Hand, Head, Heart

Briefly, people are influenced to change, to behave, based on three dimensions: Behavioural, Intellectual, Emotional. Each of us has aspects of all three; each has a generally dominant dimension; different contexts call for different dimensions. For a new behaviour - a change - to take hold most effectively, all three dimensions must be addressed.

Figure 4.13.1 illustrates this.

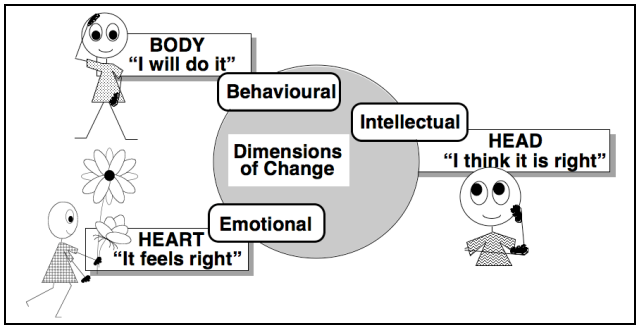

Figure 4.13.1. Three Dimensions of Change.

The hand, head, heart model focuses on what happens inside of each individual.

4.13.2 Enabling, Executing, Evaluating

Briefly, behaviours become common practice (execution) when they are enabled (encouraged from the beginning) and evaluated (reviewed throughout and at the end). This model was used in the original Capability Maturity Model for Software [CMM]; it was called the "common features."

"Enablers" help us "do things right the first time, every time." In CMM terms, these were Commitment to Perform and Ability to Perform, which included: policy, procedure, responsibility, funding, training, tools.

"Evaluators" help us ensure "we did things right the first time, every time!" ... getting value or giving us the opportunity to make corrections. In CMM terms, these were Measurement and Analysis (Directing Implementation in CMMI [CMMI]) and Verifying Implementation, which included: configuration control, measurement, management oversight, IQA.

Enablers and Evaluators are the "bookends" around successful execution, as Figure 4.13.2 illustrates.

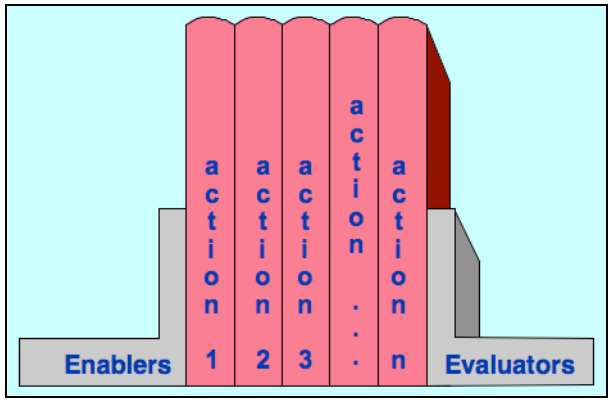

Figure 4.13.2. Enabling, Executing, Evaluating.

The enabling, executing, evaluating model focuses on what an organisation does to support each individual.

4.13.3 Mapping Fujitsu's EVM approach (the 12 points)

Table 4.13.1 plots the 12 points against a grid of these two models.

Table 4.13.1. Fujitsu's Institutionalisation Approach.

	Hand (Behavioural)	**Head** (Intellectual)	**Heart** (Emotional)
Enabling	4.3 (Required), 4.10 (Done) 4.11 (Share)	4.1 (Train), 4.7 (Publish), 4.8 (History), 4.9 (Humanise) 4.11 (Share)	4.1 (Train), 4.5 (Culture), 4.9 (Humanise) 4.11 (Share)
Executing	4.11 (Share)	4.11 (Share)	4.11 (Share)
Evaluating	4.2 (Practice), 4.6 (Signal), 4.12 (Confidence) 4.11 (Share)	4.4 (Language), 4.6 (Signal), 4.7 (Publish), 4.8 (History), 4.12 (Confidence) 4.11 (Share)	4.12 (Confidence) 4.11 (Share)

I could have allocated each of the 12 points across multiple categories; these are where I found a primary mapping.

Some observations - and lessons to learn:

- Institutionalisation happens when: (a) all three dimensions of change are covered well - hand (behavioural), head (intellectual), and heart (emotional); and (b) desired execution is both enabled and evaluated.
- In our industry, we often forget or under-emphasise the emotional dimension. Moreover, many of us who "lead" with the emotional dimension are often derided and told to "leave your emotions at the door when you come to work." The focus on the emotional dimension was an integral part of Aspect, KAZ, Telstra, and now Fujitsu. It's part of what makes the company special, and its employees know it.
- Training (4.1) works on multiple levels. In addition to providing us opportunities to learn new skills and improve/refresh old skills, training empowers us. It helps break down barriers between people and groups and helps build communities. It tells us that someone cares enough to invest in us. The emotional dimension of training is often under-estimated.
- Fujitsu "makes it personal" via training (4.1), providing a supportive culture (4.5), and "humanising" the EVM vocabulary (4.9). All three are Enablers; all have an emotional dimension. Fujitsu enlists the passion of its people, enabling them with processes, tools, training, and evaluating the results objectively, fairly, openly. Fujitsu staff are passionate about what they do and why they do it.

  And when these three components are missing - any of them - performance and morale suffer, turn-over increases, and quality decreases.
- Because Fujitsu "made it personal" as summarised just above and described throughout Section 4, developers and managers at all levels are comfortable relying on and using EVM. Objectivity and timeliness are built into Fujitsu's implementation of EVM. Training, providing a supportive culture, and humanising EVM terminology help create a "safe" environment. And when the environment is "safe," it is easier to signal for help (4.6), and accept help when it is offered. And there is no blame.
- EVM remains institutionalised across Fujitsu because it is a requirement both as an enabler (4.3) and an evaluator (4.2). As an enabler, EVM is part of the management and governance processes all projects are required to follow. As an evaluator, proper use of EVM is verified during IQAs. Both "bookends" of institutionalisation are embraced, so it is more than just "we know we should do it."
- When something is truly common practice, when it is fully institutionalised, it appears everywhere, as 4.11 does.

5 Conclusions

This paper showed how one company, Fujitsu, implemented EVM with great success. The principles, examples, and case studies provide tools and ideas for all.

The key to Fujitsu's success with EVM is in the 12 points, and how each addresses the dimensions of change and institutionalisation:

(1) People are trained in EVM

(2) EVM is a required part of common practice

(3) EVM is required by many Fujitsu customers, so EVM became common practice

(4) EVM is a common language across stakeholders

(5) Fujitsu has nourished a culture of openness, honesty, and "fearless reporting"

(6) People use EVM as a signal

(7) EVM plans, data, and results are published and available to all on the development team; EVM data are summarised for the customer

(8) Past history / previous data give the team confidence in projections

(9) Fujitsu has "humanised" the typical EVM jargon

(10) "Done" is defined objectively - no quibbling - within the team, with the customer

(11) Each team member shares responsibility for her/his outcomes, and contributes to planning the activities for producing those outcomes

(12) Use of EVM builds confidence in the inter-team relationships and enhances the team-customer relationship

The unique quality Fujitsu demonstrated on the project examined in the case study and examples is the power of "making it personal."

Those who have been with Fujitsu for any amount of time have faith in EVM; it works for them. Those new to Fujitsu learn from those with experience and from personal experience, and develop that faith.

Earned value management provides a clear, effective, and objective understanding of project status toward achieving the desired results, supported by a systematic measure of progress. It gives the customer confidence; it gives the team reasons to celebrate; it gives the project manager support to make decisions.

That is why this is working well for Fujitsu.

That is what you need to do to have it work for you.

Acronyms

Achievement	Quantity of output delivered = BCWP = EV = Planned effort * Achieved (%)
Achieved (%)	Fraction of task output completed
ACWP	Actual Cost of Work Performed = Effort expended
BCWS	Budgeted Cost of Work Scheduled = Effort planned
BCWP	Budgeted Cost of Work Performed = Achievement
CPI	Cost Performance Index = BCWP / ACWP
EV	Earned Value (= BCWP)
EVM	Earned Value Management
IQA	Internal Quality Audit
Performance	BCWP / ACWP
SPI	Schedule Performance Index = BCWS / ACWP
WBS	Work Breakdown Structure

Acknowledgments

The case study was documented by Bram van Oosterhout, Quality Manager, Fujitsu Australia Ltd. This paper is based on the success of the Fujitsu team described so eloquently in [ARes].

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