

Project Workflow Management¹

Project Construction Frame Process²

By Dan Epstein

Note: *This article is based on the book [Project Workflow Management: A Business Process Approach](#) by Dan Epstein and Rich Maltzman, published by J Ross Publishing in 2014. The book describes PM Workflow® framework, the step-by-step workflow guiding approach using project management methods, practical techniques, examples, tools, templates, checklists and tips, teaching readers the detailed and necessary knowledge required to manage project “hands-on” from scratch, instructing what to do, when to do and how to do it up to delivering the completed and tested product or service to your client.*

The project workflow framework is the result of Dan’s research into the subject, having the following objectives:

- 1. Create the virtually error-free project management environment to ensure significant reduction of project costs*
- 2. Reduce demands for highly qualified project managers using the step-by-step workflow guiding approach.*

While PM Workflow® is the continuous multi-threaded process, where all PM processes are integrated together, this article will attempt to describe the Project Construction management group of processes as a stand-alone group that can be used independently outside of PM Workflow® framework. It will be difficult in this article not to venture into processes outside of the current subject, such as planning, quality, communications and other management processes, so they will be just mentioned. However, to get full benefit and the error free project management environment, the complete implementation of PM Workflow® is required. In order to understand how PM Workflow® ensures this environment, I strongly recommend reading my article [Project Workflow Framework – An Error Free Project Management Environment](#). in the PMI affiliated projectmanagement.com

(<https://www.projectmanagement.com/articles/330037/Project-Workflow-Framework--An-Error-Free-Project-Management-Environment>)

For more information, please visit my website www.pm-workflow.com

¹*This series of articles is based on the book [Project Workflow Management: A Business Process Approach](#) by Dan Epstein and Rich Maltzman, published by J Ross Publishing in 2014. The book describes the PM Workflow® framework, a step-by-step approach using project management methods, practical techniques, examples, tools, templates, checklists and tips, teaching readers how to manage a project “hands-on” from scratch, including what to do, when and how to do it up to delivering a completed and tested product or service to a client.*

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Purpose

The purpose of the Construction Frame is:

- Producing project deliverables
- Monitoring project progress and tracking implementation of all project activities against the project plan
- Implementing and tracking scope changes
- Resolving and tracking issues
- Identifying the schedule and cost variances between the project plan and actuals
- Taking corrective measures, when necessary, to bring the project back on track
- Ensuring that all the deliverables are producing results which satisfy quality standards
- Ensuring that all project management processes and quality standards are followed
- Keeping records of all project events for quality management activities in order to avoid similar issues in future projects
- Gather statistics for the project management process improvement

Roles and Responsibilities

The following roles and responsibilities will be required in the Construction Frame:

- **Project Manager (PM)** - responsible for ensuring all steps of the project management process are followed. The PM ensures that the project team is involved in all stages of the project implementation and tracking. The PM tracks the construction, the detailed design and reviews the status of the Frame on a weekly basis with the Client and on monthly basis with the Senior Business and Senior Delivery Management. In some environments, the PM reports status of the project to the Senior Business Manager on a weekly, rather than monthly basis.
- **Delivery Team (DT)**, also referred to as Delivery Team Members. The assigned Delivery Team Members will be responsible for producing detailed design and design implementation. They will also participate in Quality audits and reviews. Each member of the Delivery Team will present individual weekly status reports to PM during the scheduled project status meeting.
- **Client** – This is a lead client and a single focal point to the business. The Client should participate in all status review meetings scheduled by the PM. The Client sometimes is referred to as the Business Project Manager or the Business Area Lead. The Client usually reports to the Senior Business Manager.
- **Technical Lead** - this is a leading technical specialist, a member of the Delivery Team. The Technical Lead is responsible for producing the detailed design and the design implementation. The Technical Lead will assist the PM in updating the WBS and gathering estimates from members of the Delivery Team.
- **Senior Business Manager** - This person will review Monthly Status Reports with the PM. The Senior Business Manager usually reports to the Project Sponsor.

- Senior Delivery Manager – This person owns a delivery budget, whose signature is required on the Statement of Work.
- The Project Sponsor is a major stakeholder. A Project Sponsor is responsible for the business success of the project, specifically, ensuring that the business objectives are met for which the project has been undertaken. The Project Sponsor is the owner of the overall project.
- Quality Assurance Analyst – responsible for running Quality Management reviews and audits throughout the project lifecycle in accordance with the Quality Management process. The QA Analyst runs all reviews in strict compliance with the Quality Management process and is responsible for documenting reviews, rating them and for follow-ups when needed. The QA Analyst should be a person with QA training, who is not directly associated with the project. However, for smaller projects, the PM may play this role.

Inputs / Outputs

The Construction Frame processes interact with the rest of project frames via the entry and the exit points, as shown on the Construction Frame process flow diagram Fig. 15-1:

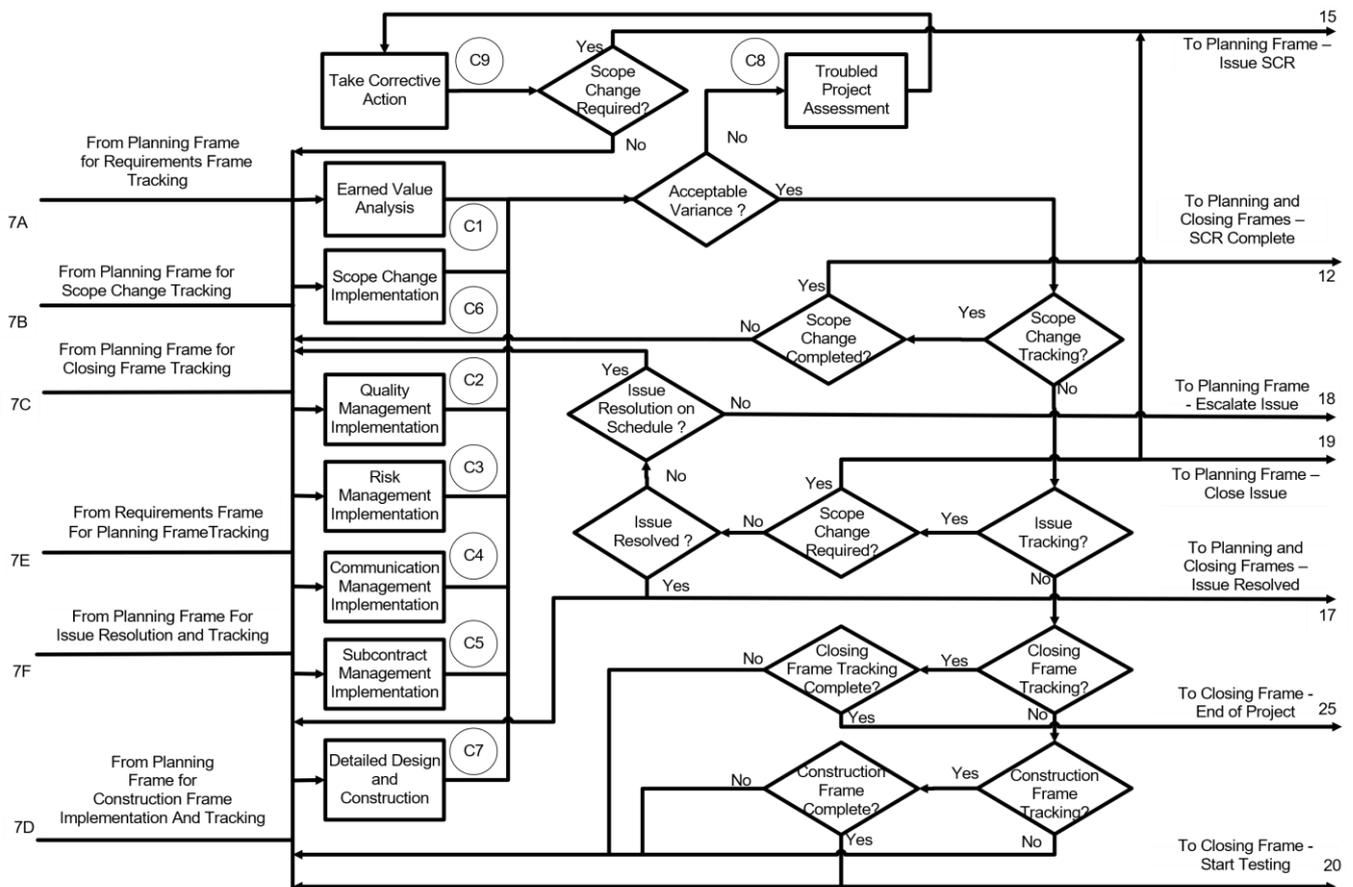


Fig 15-1 Construction Frame

Entry Point 7:

- 7A – Coming from the Planning Frame for the Requirements Management tracking
- 7B – Coming from the Planning Frame for the scope change tracking
- 7C – Coming from the Planning Frame for the Test and Closing Frame tracking
- 7D – Coming from the Planning Frame for the Construction Frame tracking and implementation
- 7E – Coming from the Requirements Frame for the Planning/HL Design Frame tracking
- 7F – Coming from the Planning Frame for the issue resolution implementation and tracking

Exit Point 12: To Planning Frame with indication that the Scope Change Request complete

Exit Point 15: To Planning Frame for issuing the Scope Change Request

Exit Point 17: To Planning Frame with indication that the issue has been resolved

Exit Point 18: To Planning Frame for escalation of the issue

Exit Point 19: For Planning Frame to close the issue for any reason

Exit Point 20: To Closing Frame for testing and project closing

Exit Point 21: To Closing Frame with indication that the project is complete

Construction/Tracking Frame Process Flow

Construction Frame Requests

There are six business requests coming to Construction Frame. As shown in the Table 15-1, the tracking of all activities in all frames, scope changes and issues is done in the Tracking Frame.

Table 15-1 Construction Frame Requests

Request	Coming From
Tracking of the Requirements frame activities (7A)	Planning Frame
Planning frame Tracking (7E)	Requirements frame
Construction frame Implementation and Tracking activities (7D)	Planning Frame
Closing frame Tracking (7C)	Planning Frame
Scope Change Implementation and Tracking (7B)	Planning Frame
Issue Resolution and Tracking (7F)	Planning Frame

Construction Frame Overview

Tracking and monitoring activities allow continuous reporting of the actual cost, the project timeline and quality, comparing them against the plan and the acceptance criteria. Tracking allows obtaining facts and comparing them to planned values. Monitoring is the analysis to determine the required corrective measures, if any.

Actual size, effort, cost and schedule will be tracked against the baseline to measure project performance in accordance with the project tracking process as described below. Baseline estimates and actual measurements are captured in the PCB. Estimates may be reviewed, but not

necessarily changed, as part of project tracking, based on the planned vs. actual variances. Corrective actions require addressing those variances. The Construction Frame consists of the following processes:

1. Earned Value Analysis and EVA Tracking (C1)
2. Quality Management Implementation and Tracking (C2)
3. Risk Management Implementation and Tracking (C3)
4. Communications Management Implementation and Tracking (C4)
5. Subcontract Management Implementation and Tracking (C5)
6. Scope Change Implementation and Tracking (C6)
7. Detailed Design and Construction (C7)
8. Troubled Project Assessment (C8)
9. Take Corrective Actions (C9)

Processes C2 through C6 had been described in details in the corresponding chapters of the Planning Frame, even though only the planning part of them is actually used by the Planning Frame. For clarity it was necessary to provide there the complete description of processes, since describing only the planning part would sacrifice the integrity of the process information. Therefore, at this point it would be beneficial to the reader to go back and review those chapters in the Planning Frame section again.

Implementation and Tracking are parts of the Construction Frame. Tracking is comparing actual results with the expected values as described below. Any discrepancy between them is evaluated against the acceptance criteria.

1. Implementation and tracking of the Earned Value means running the weekly Earned Value Analysis (EVA) and then comparing actual performance results to the plan. This is the main method to determine whether the project is on track or not. EVA applies only to tasks included in the project plan, which also covers implementation of scope changes.
2. Implementation and tracking of the Quality Management includes conducting quality reviews and comparing their results with the expected quality. If, for example, an answer to one of the checkpoint questions is NO, instead of the expected YES, there is a gap in the quality implementation, which must be fixed in order to get a passing quality audit grade.
3. Implementation and tracking of the Risk Management includes the scheduled risk assessments, risk evaluation and comparing actual risks occurred and their remediation efforts to the planned ones. When risk occurs, an issue is automatically generated, which may or may not require initiating a Scope Change Request for the issue resolution.
4. Implementation and tracking of the Communications Management includes producing all planned reports and conducting all project status meetings, as well as comparison between planned communication and the actual ones. An important part of the process is actively managing stakeholders, as described in the Planning Frame section.
5. Implementation and tracking of the Subcontract Management is the control and evaluation of the subcontract. It includes receiving status reports from subcontractors and comparing

them to the subcontractor planned efforts. Issues may be generated when necessary.

6. Implementation and tracking of the Issue Management process generates issues in the Planning Frame when required, tracks issue resolution and generates Scope Change Requests when necessary. When the issue is not resolved on schedule, it is escalated.
7. Detailed Design and Construction process produces detailed design and construction based on that design. Both design and construction are main parts of the project plan and therefore are tracked.
8. Scope Change Implementation process produces the necessary SCR design and implementation. Both are tracked against the project plan.

Processes C1 through C5 are executed in planned cycles, rather than continuously. For example, the EVA cycle is triggered and executed as a task most often once a week, before producing the weekly status reports. When it is done, it waits for the next week cycle. Quality Management process runs quality reviews periodically, as scheduled. When a review is accomplished, the process waits for a new cycle, which is triggered by the schedule.

Issue Management stands on its own, since this is an event-driven process that takes place only when an issue comes up. Issue tracking is required only when an issue is open. As soon as a new issue comes up, the request comes through the Entry Point 7F to start the Issue Resolution implementation and tracking cycle. Issue implementation is not a part of the overall project schedule. Issue resolution is the issue owners' responsibility, who may be members of the delivery or business teams. Issue status is tracked to determine whether the issue is expected to be resolved on time. The cost of issues is included in the cost of project overhead, unless the issue requires a Scope Change Request. The Issue Management process is described in details in the Planning section, even though the issue tracking is done in the Construction Frame. The issue does not trigger the EVA process and may or may not trigger C2 through C5 processes, unless it transforms into a Scope Change Request.

Similarly, to issue tracking, scope change tracking is required only when a scope change is being implemented. It is no different than any other type of tracking and includes execution of processes C1 through C5 at their scheduled time. When scope change implementation is complete, the tracking process flow loops back to the beginning of the Construction Frame, waiting for any new scope change. When the scope change weekly tracking cycle is complete, but the scope change implementation is still in progress, the flow also loops back to the beginning, waiting for the new scheduled tracking cycle of the existing scope change. Other types of the implementation tracking will usually continue in parallel with the scope change implementation.

The exception from the cyclic execution is the Detailed Design and Construction process C7. The Detailed Design and Construction process is executed continuously until finished in accordance with the implementation schedule of tasks, but the EVA is tracked on a weekly based cycle.

When a request enters one of the entry points 7A through 7F, it enables processes C1 through C7 to start their scheduled execution cycle in accordance with the schedule established in the Planning Frame. Tracking cycles do not necessarily start running all at the same time, but rather each one is enabled to start execution at the scheduled time.

Generally, the tracking process flow is multi-threaded and more than one type of tracking may run at the same time. For example, along with the tracking of the project planning, it may be necessary at the same time to track the scope change implementation and something else, subject to their tracking schedules. Most often, a frame implementation and SCR tracking cycles are triggered once a week under the normal circumstances, but the frequency may increase in case of troubled projects. The issue tracking frequency depends on the gravity of the issue and may be as frequent as daily or as infrequent as weekly. If the specific issue resolution is temporarily put on hold, no tracking of that issue will be necessary until the issue resolution is resumed in accordance with the new schedule. The risk tracking frequency is once every two or three months and also before the beginning of a new frame or when a new risk is identified. When a planned or unplanned risk occurs, an issue is automatically generated, followed by a possible scope change as a consequence. The quality tracking occurs in accordance with the quality review schedule. While the Project Management quality audit may occur once every two or three months, some quality control reviews occur as often as a new module's design or implementation is complete, which may be as frequent as several times a week.

Construction Frame Process Flow

The Construction Frame Process diagram is shown on Fig 15-1. The Construction Frame starts when one or more inputs 7A through 7D activate one or more processes C1 and C2 through C7. Those processes won't be executed all at once, but each one will wait for its scheduled execution. When the execution starts, tracking results are obtained and compared to the planned values and the process flow is directed to the control point (Acceptable variance?). If the variance between actuals and the planned values is unacceptable, as described in following chapters, and there is a little chance of improving it in the normal course of the project within two or three weeks, the flow goes to the Troubled Project Assessment process C8 to establish the reason for poor project performance and produce the corrective actions plan. This plan is executed in the Take Corrective Actions process C9, which in many cases leads to the project scope change. For example, if the Earned Value Analysis shows that the cost or schedule has slipped over 10% and it is impossible to deliver the project on time at the approved budget, one of several options may be to reduce the scope of the project. This situation may happen when it is critical for the project sponsor limiting project expenditures to the approved budget or delivering the project by the established deadline, as earlier explained in the Planning Frame section. In that case the answer to the control point question (Scope Change Required?) is YES and the process flow is returned to the Planning Frame via exit point 15 asking to issue new Scope Change Request.

Sometimes it is possible to bring the project back on track by administrative actions without issuing a SCR. For example, take the case of a poor result of a QA audit, when no serious project damage has yet occurred. This does not require a Scope Change Request, but the project **does** need corrective actions to avoid potential issues. In some other cases the variance can be reduced and the project may get back on track by improving productivity and the work efficiency of the delivery team. In those cases, the answer to the control point question (Scope Change Required?) is NO and the process flow goes back to the beginning of the tracking process, waiting for the next cycle of tracking and for the scheduled execution of one or more entry processes.

If the variance is acceptable, the project is on course and the answer to the control point question (Acceptable Variance?) is YES. The next control point question in the process flow is the (Scope

Change Tracking?). From this point on the process flow will depend on which of the following is being tracked:

1. Scope Change Implementation
2. Issue Resolution
3. Closing Frame
4. Construction Frame Implementation
5. Requirements Frame
6. Planning Frame

It was mentioned in earlier chapters, that:

- Implementation of Requirements Frame is done in the Requirements Frame.
- Implementation of Planning Frame is done in the Planning Frame.
- Implementation of Closing Frame is done in the Closing Frame.
- Implementation of Construction Frame is done in the Construction Frame.
- Implementation of Change Requests is done in the Construction Frame.

Tracking of all frames and Change Requests is done in the Construction Frame by using the Earned Value Analysis process C1. Tracking is done in the scheduled cycles, at least once per week.

The EVA process does not make any distinction between different elements of tracking. When scheduled, it calculates variances between actual and planned values. The implementation of any frame and the tracking of the same frame are done simultaneously, and the completion of the frame implementation does not have any bearing on the tracking cycle. As long as there is something to track, the EVA cycle will be scheduled. EVA tracking will stop when the project is complete. Upon execution of one tracking cycle, the flow always returns to the beginning of the tracking process, waiting for the next scheduled tracking cycle. The only tracking situation in which EVA is not used is in issue tracking, because *issues are not part of the project schedule*, unless they produce a Scope Change.

If the answer to the control point question (Acceptable Variance?) is YES, then the Construction Frame flows will be controlled and directed by a set of control point questions:

1. Scope Change Tracking?
2. Issue Tracking?
3. Closing Frame Tracking?
4. Construction Frame Tracking?

If the scope change is being tracked, the answer to question #1 is YES. The implementation of the scope change is done in the Scope Change Implementation process C6, where the scope change design and implementation take place. Design and implementation is a continuous process, which runs according to the schedule, until completed. While the implementation continues, the process flow reaches the control point question (Scope Change Completed?) If the scope change implementation is not yet finished, the answer is NO, and the process flow loops back to the beginning of entry processes C1 through C6 for the next scheduled cycle of tracking. If the scope

change is complete, the answer is YES and the flow goes back via exit point 12 to the Planning Frame with an indication that the SCR is complete.

If the scope change is not tracked in that particular cycle, then the answer to the (Scope Change Tracking?) control point question is NO and the process flow enters the next control point (Issue Tracking?)

If the issue is being tracked, the answer to question #2 is YES, followed by the next control point question (Scope Change Required?) If the issue cannot be resolved without changing the project scope, the answer is YES. That means the issue must be closed and a new SCR must be opened. The request to close the issue is sent via exit point 19 and request to open a SCR is sent to the Planning Frame via the exit point 15.

If scope change is not required, the answer to the control point question (Scope Change Required?) is NO. The next control point question is (Issue Resolved?) If the issue is resolved by this point, the answer is YES, and the indication is sent to the Planning Frame via exit point 17. At the same time the process flow loops back to the entry processes C1 through C6, waiting for the next scheduled tracking cycle.

If the issue is not resolved, the answer to the control point question (Issue Resolved?) is NO and the next control point question is (Issue Resolution on Schedule?) As long as there is no unacceptable delay in the issue resolution, the answer is YES and the flow loops back to the entry processes C1 through C6, waiting for the next tracking cycle. If there are delays in the issue resolution and there is no breakthrough in sight, the answer is NO and the request to escalate goes to the Planning Frame via exit 18.

If no issue is being tracked in this tracking cycle, the answer to the control point question (Issue Tracking?) is NO. The next control point question is (Closing Frame Tracking?) If the current tracking cycle tracks Closing Frame, the answer is YES and the next control point question is (Closing Frame Tracking Complete?). If the answer is YES, the entire project is complete, and thus no more tracking is required. The request to close the project is sent to the Closing Frame via exit point 21. If the answer is NO, the project execution continues and the process flow loops back to the beginning of the process.

If the answer to the control point question (Closing Frame Tracking?) is NO, the next control point question is (Construction Frame Tracking?) If the Construction Frame is not being tracked in this tracking cycle, the answer is NO and the process flow loops back to the beginning of the Tracking Frame. If the Construction Frame is being tracked in this cycle, the next following control point question is (Construction Frame Complete?) If the answer is NO, the flow loops back to the beginning of the Tracking Frame, waiting for the next tracking cycle. If the Construction Frame is complete, the process flows to the Closing Frame via the exit point 20 to start testing and the Closing Frame implementation. At the same time, the flow loops back to the start of the cycle, waiting for tracking of the Closing Frame, scope change or issue, whichever is the next in the schedule.

If the answer is NO to all of the above control questions, this means that either the Requirements or Planning Frames are being tracked. The process flow will return to input processes C1 through C6, waiting for the next scheduled tracking cycle. When tracking of those processes takes place,

no special notification is required, provided that the variance is acceptable. The process flow will return to input processes C1 through C6, waiting for the next scheduled tracking cycle.

Earned Value Analysis and EVA Tracking (C1)

Earned Value Analysis Method

Earned Value Analysis (EVA) is a widely used method to keep track of the project work, report project financials and project health. EVA calculates relationship between the actual cost of work, the planned cost of work and the planned cost of the actually completed work.

The method avoids the problem of reporting progress in non-transparent ways, such as a subcontracting vendor indicating that the project is “half done” simply because 4 out of 8 weeks of the schedule has elapsed.

The EVA method can also help predict how much the project would cost and when it ends. EVA is supported by most project scheduling and tracking tools. Let us say that project X has five tasks and has estimated 6 months duration. The planned cost of the project, called **Budget At Completion** or **BAC** is \$100,000, as shown in Table 15-2. Let us assume that today is March 31. The actual spending so far is \$60,000. Is this good or bad? The answer will depend how much work is completed (“earned”) for \$60,000, which is 60% of the budget. If only 30% of the scheduled work is complete, this is bad. On the other side, if 70% of work is complete, this is good. The author has developed the Earned Value Analysis tool, which may be downloaded free from the author’s website <http://www.pm-workflow.com/download.html>

Please read description before using the tool

Table 15-2 Budget at Completion Calculation Example

Project X Tasks	Planned Cost
Task1 (Jan)	\$20,000
Task2 (Feb)	\$20,000
Task3 (Mar)	\$20,000
Task4 (Apr)	\$20,000
Task5 (May)	\$20,000
BAC	\$100,000

EVA is a method which takes all of this into consideration and puts the answers in monetary terms. The following are major elements of EVA, which are usually received from the project scheduling tools, provided that the schedule is up to date and resource rates are correct:

Planned Value (PV) - is the planned cost of work, which is performed by the time EVA is calculated. In our case, PV on March 31 is \$60,000.

Earned Value (EV) - is the planned cost of the actually completed work. If by March 31 we finished Task1, Task 2 and 50% of Task3, BCWP is \$50,000, instead of \$60,000 worth of work planned. In this case we are behind the schedule. However, if we finished Task1, Task2, Task 3 and 50% of Task 4, EV is \$70,000, which makes the project ahead of schedule.

Actual Cost (AC) - is the actual cost of the completed work. If by March 31 we finished Task1, Task 2 and 50% of Task3 at the actual cost of \$65,000, we spent \$15,000 more than the planned cost of the performed work (\$50,000) or, in other words, we are \$15,000 over the budget.

Based on the cost and schedule of the above tasks, on March 31 PV = \$60,000. Let's look at five variations of EV and AC and try to determine the health of the project X in terms of cost and schedule, as shown in example in Table 15-3.

Table 15-3 EVA Inputs

	PV	EV	AC
Case1	\$60,000	\$60,000	\$60,000
Case2	\$60,000	\$70,000	\$70,000
Case3	\$60,000	\$60,000	\$70,000
Case4	\$60,000	\$50,000	\$40,000
Case5	\$60,000	\$70,000	\$60,000

Case 1: By the end of March the project team accomplished work worth \$60,000 (EV), which is exactly what was planned. This means that the project is exactly on schedule. The actual cost of the work (AC) is \$60,000, which means the project cost is exactly as budgeted.

Case 2: EV = \$70,000, which means that the performed work exceeds the planned work worth of \$60,000. That means that the project team accomplished more work than planned and the project is ahead of schedule. AC = \$70,000, which means that the actual cost of the performed work is the same as the budgeted cost of the performed work. The conclusion is that the project is within the budget.

Case 3: EV = \$60,000, which is exactly as the planned work. The project is on schedule. AC = \$70,000 which is \$10, 000 over planned cost of work performed. The project is \$10,000 over the budget.

Case 4: EV = \$50,000, which means the project is behind the schedule, since the team was supposed to complete work worth \$60,000 by the end of March, while they did work worth only \$50,000. AC = \$40,000. Since the work performed is worth \$50,000, but the cost is only \$40,000, the project is below the budget.

Case 5: $EV = \$70,000$. The project is ahead of schedule. $AC = \$60,000$. The project is below the budget.

Note: When a project in real life is consistently ahead of schedule and below the budget, this does not always mean excellent team performance. Rather it may be that the project was not planned properly and has poor estimates, which is another reason for senior managers to use the project manager as a piñata. Exceeding project performance always causes suspicion of the project manager's planning skill.

EVA uses BAC, PV, EV and AC to calculate the following values:

Cost Performance Index or **CPI** shows the cost efficiency of the project team to produce the required work. $CPI = EV/AC$. If CPI is less than 1, the actual cost exceeds the budgeted cost. Correspondingly, if CPI is greater than 1, the actual cost is below the budgeted cost.

Cost Variance or **CV** is the difference between the budgeted and the actual cost of the produced work in dollars or other currency. $CV = EV-AC$. If CV is negative, the performed work is worth less than the actual cost, which means the project is over the budget. If CV is positive, the performed work is worth more than the actual cost.

Schedule Performance Index or **SPI** shows the schedule efficiency of the project team to produce the required work. $SPI = EV/PV$. If SPI is less than 1, then producing the work takes longer than scheduled, which makes the project behind the schedule. If SPI is greater than 1, then producing the planned work takes longer than scheduled.

Schedule Variance or **SV** is the difference between the budgeted cost of the produced work and the budgeted cost of the planned work in dollars or other currency. $SV = EV-PV$. If SV is negative, there is less work performed than planned, which means the project is behind the schedule. If SV is positive, there is more work performed than planned.

Estimate at Completion or **EAC** is the estimated cost of the project by the time it is completed, provided that the cost performance index stays just about the same. $EAC=BAC/CPI$.

Variance at Completion or **VAC** is the difference between the planned budget and the estimated cost at completion. $VAC=BAC-EAC$.

The example of EVA calculation is shown in Table 15-4

Table 15-4: EVA Calculation Example

	PV	EV	AC	CV	CPI	SV	SPI
Case1	\$60,000	\$60,000	\$60,000	\$0.0	1.0	\$0	1.0
Case2	\$60,000	\$70,000	\$70,000	\$0.0	1.0	\$10,000	1.17
Case3	\$60,000	\$60,000	\$70,000	\$-10,000	0.86	\$0	1.0
Case4	\$60,000	\$50,000	\$40,000	\$10,000	1.25	\$-10,000	0.83
Case5	\$60,000	\$70,000	\$60,000	\$10,000	1.17	\$10,000	1.17

Estimated Completion Date or **ECD** is the date when the project is expected to be completed assuming that the Schedule Performance Index stays about the same. The calculation is cumbersome for the manual calculation, but it is easy to do using the following formula in the spreadsheet:

WORKDAY (Start_Date,(NETWORKDAYS(Start_Date, Planned_End_Date)/SPI))

CPI and SPI allow us to predict the cost and the project end based on the past performance. If CPI is 0.8, the project will cost 20% more, or \$120,000. If CPI is 1.2, the project will cost 20% less, or \$80,000 in our case. If SPI is 0.8, it will take 20% longer or six months to complete instead of the planned five. If SPI is 1.8, it will take 20% sooner or 4 months to complete the project.

EAC and VAC provide new project cost estimates and the variance between EAC and BAC.

ECD provides the estimated project completion date, based on the schedule performance index.

EVA Tool automates calculation and provides unambiguous project health information. The following are three sample screens for different EVA values: The samples are displayed in tables as follows:

Sample 1 – Earned Value Analysis is displayed in Table 15-5A

Table 15-5A Earned Value Analysis (1)

Sample 1 - EVA	
Date: 12/15/2009	
Budget at Completion (BAC) – Initial Budget	\$100,000
Project Start Date (mm/dd/yyyy)	10/1/2009

Planned End Date (mm/dd/yyyy)	3/1/2010		
Actual Cost of the Work Performed (AC)	\$60,000		
Budgeted Cost of the Work Performed (EV)	\$40,000		
Budgeted Cost of the Work Scheduled (PV)	\$50,000		
Cost Variance (CV=EV – AC)	-\$20,000	Over the budget	
Schedule Variance (SV=EV-PV)	-\$10,000	Behind the schedule	
Cost Performance Index (CPI=EV/AC)	0.67	66.7	% Cost Performance
Schedule Performance Index (SPI=EV/PV)	0.80	80.0	% Schedule Performance
Estimate At Completion (EAC=BAC/CPI)	\$149,998		
Variance at Completion (VAC=BAC-EAC)	-\$49,998		
Estimated Completion Date	4/7/2010		

Sample 2 – Earned Value Analysis is displayed in Table 15-5B

Table 15-5 B Earned Value Analysis (2)

Sample 2 - EVA			
Date: 12/15/2009			
Budget at Completion (BAC) – Initial Budget	\$100,000		
Project Start Date (mm/dd/yyyy)	10/1/2009		
Planned End Date (mm/dd/yyyy)	3/1/2010		
Actual Cost of the Work Performed (AC)	\$52,000		
Budgeted Cost of the Work Performed (EV)	\$52,000		
Budgeted Cost of the Work Scheduled (PV)	\$50,000		
Cost Variance (CV=EV – AC)	\$0	Within the budget	
Schedule Variance (SV=EV-PV)	\$2,000	On schedule or ahead of schedule	
Cost Performance Index (CPI=EV/AC)	1.00	100.0	% Cost Performance

Schedule Performance Index (SPI=EV/PV)	1.04	104.0	% Schedule Performance
Estimate At Completion (EAC=BAC/CPI)	\$99,999		
Variance at Completion (VAC=BAC-EAC)	\$1		
Estimated Completion Date	2/22/2010		

Sample 3 – Earned Value Analysis is displayed in Table 15-5C

Table 15-5C Earned Value Analysis (3)

Sample 3 - EVA			
Date: 12/15/2009			
Budget at Completion (BAC) – Initial Budget	\$100,000		
Project Start Date (mm/dd/yyyy)	10/1/2009		
Planned End Date (mm/dd/yyyy)	3/1/2010		
Actual Cost of the Work Performed (AC)	\$52,000		
Budgeted Cost of the Work Performed (EV)	\$52,000		
Budgeted Cost of the Work Scheduled (PV)	\$50,000		
Cost Variance (CV=EV – AC)	\$0	Within the budget	
Schedule Variance (SV=EV-PV)	\$2,000	On schedule or ahead of schedule	
Cost Performance Index (CPI=EV/AC)	1.00	100.0	% Cost Performance
Schedule Performance Index (SPI=EV/PV)	1.04	104.0	% Schedule Performance
Estimate At Completion (EAC=BAC/CPI)	\$99,999		
Variance at Completion (VAC=BAC-EAC)	\$1		
Estimated Completion Date	2/22/2010		

Most project scheduling tools support Earned Value Analysis. In order to be able to use it, the following must be done when developing the project schedule:

1. Assign all tasks in the project plan to specific resources.
2. Enter task dependencies.
3. Level the schedule, which distributes work load to prevent overloading of resources.
4. Enter the rate of each resource.
5. Baseline the plan.
6. Start receiving weekly status report as shown below.
7. Use a *tracking Gantt chart* to update the project plan weekly.
8. Scheduling tool will provide BAC, PV, EV and AC.

It is very important to get weekly project status information from team members, outlining the status of every non-completed task due or task being performed and enter actuals on the tracking Gantt chart. The report template is shown in the Communication Planning chapter of the Planning Frame section.

For example, if today is July 7, the report in Table 16-6 will show the tracking information, which must be entered into the scheduling tool in order to calculate EVA.

When the resource availability is 100%, it should be assumed that resources work on the tasks assigned to them for 6.5 hours a day. The rest of the 1.5 hours is not shown on the plan, because it is the daily overhead, like reading email, taking phone calls, attending meetings etc. However, the cost of overhead must be taken into consideration when calculating EVA. One of the options is to add 20% of effort to every task, when estimating the work in the Planning Frame. In this case, 8 hour workday will mean that task effort takes 6.4 hours and overhead is 1.6 hours.

EVA Tracking

EVA tracking process consists of the following:

1. Receive status reports from all delivery team members.
2. Enter the status data into the tracking chart of the scheduling tool.
3. Obtain BAC, PV, EV and AC from the scheduling tool.
4. Enter BAC, PV, EV and AC into the EVA Tool, if the tool is used for EVA calculations.
5. Based on the information entered, the EVA tool will calculate CPI, CV, SPI, SV, EAC, VAC, ECD or those values may be calculated manually using formulas shown above.

EVA Tracking Acceptance Criteria

EVA is used when tracking the implementation of:

1. Requirements Frame
2. Planning Frame
3. Construction Frame
4. Closing Frame
5. Scope change
6. Subcontract

EVA is not used when tracking issues. If a scope change request is generated during the issue tracking, then the scope change is tracked.

During tracking cycles, the EVA acceptance criteria must be used to determine whether the results are acceptable. While up to 10% of accumulated variance from the cost or schedule or the calculated variance at completion is usually acceptable, a higher number may be temporary acceptable too, if it is reasonable to believe that the variance has a good chance of improvement.

Quality Management - Implementation and Tracking (C2)

The Quality Management Implementation process is implementation of the planned quality reviews and audits. The Quality Management Tracking process compares the planned versus the actually executed quality reviews and audits. To see the quality audit and the quality review process flows, please refer to the corresponding diagrams in the Quality Management section of the Planning Frame part.

Quality management audits and reviews take place in accordance with the schedule developed in the Planning Frame. Quality reviews are usually performed when project deliverables are being developed. Quality audits are usually performed every three to four months. If serious project issues are found, they will be executed every one or two weeks until quality issues are resolved and project management processes are strictly enforced.

Please refer to the Quality Management description in the Planning Frame section of the book.

QM Tracking Acceptance Criteria

QM acceptance criteria are determined by QA Audit or QC Review passing criteria, whichever is applicable. Results of QA Audit are acceptable, when the QA Audit has a passing grade, as described in the QA process flow diagram. If during the QA Audit all gaps have not been resolved, a flag is set that the QA audit results are unacceptable. During QM tracking the answer to the control question (Acceptable Variance?) is NO and the flow is directed to the Troubled Project Assessment process C9.

The results of the QC Review are acceptable when the QC Review Passed, as described in the QC process flow diagram. If during the QC Review, after modification of deliverable the passing grade is not received, a flag is set that QC results are unacceptable. During QM tracking the answer to the control question (Acceptable Variance?) is NO and the flow is directed to the Troubled Project Assessment process C9.

The determination whether QM results are acceptable is made when the QA or QC processes are complete and the chance is given to fix unacceptable results before admitting failure.

Risk Management Implementation and Tracking (C3)

Risk Management process consists of three processes:

1. Risk Assessment
2. Risk Planning

3. Risk Management Implementation and Tracking

The first two have been described in the Risk Management section of the Planning Frame. Risk management implementation is the execution of planned and sometimes unplanned risk assessments. The planned and scheduled risk assessments run according to the plan developed in the Planning Frame. The unplanned risk assessments happen when a new risk is discovered.

Risk Tracking is a process of monitoring risk occurrence. When a planned or unplanned risk occurs, it is initially treated as an issue in accordance with the Issue Management process. As described there, some of the issues require generating the project Scope Change Requests. The Risk Containment plan is executed as a scope change in accordance with the Scope Change Control process section. When the scope change is generated, then the project plan is adjusted for each occurred risk and its implementation is tracked.

The following elements of Risk Management are documented:

- Record of each risk assessment and the reason for assessment.
- Total number of risk assessments.
- All occurrences of the previously identified risks (This comes from the Issue Management metrics).
- All occurrences of new previously unknown risks (This comes from the Issue Management metrics).
- Planned cost of each risk mitigation and the overall planned cost of all risk mitigations.
- Actual cost of each risk mitigation and the overall actual cost of all risk mitigations.
- Planned cost of each occurred risk and the overall planned cost of occurred risks. (This comes from the Issue Management and the Scope Change Control metrics).
- Actual cost of each occurred risk and the overall actual cost of occurred risks. (This comes from the Issue Management the Scope Change Control metrics).

Risk Tracking Acceptance Criteria

Risk tracking results are acceptable when the actual risk management cost does not exceed 10% of the planned cost. This number comes from the Scope Change EVA, because risk mitigation is usually guided by the Scope Change management, as described earlier. When the unknown risk occurs, the total cost of all unknown risks cannot exceed the allocated margin for those risks, which is usually 10% of the project cost.

Communications Management - Implementation and Tracking (C4)

The purpose of Communications Management Implementation is maintaining communication between project team members in delivery, subcontractor and business organizations in order to generate and exchange project related information and create understanding between the originator of information and the receiver. All types of communication and methods of communication, as well as description of proactive communication, meetings, forms, reports, Communication plan, orientation and training have been provided in the Communication section of the Planning Frame. Communications Management tracking compares actual dates when meetings, orientation and training took place versus Communication plan.

Communications Management Tracking Acceptance Criteria

Communications Management tracking results are accepted if no communication failure is detected. Signs of communication failure are two or more following occurrences in one month:

- Meetings are not prepared, agenda is not communicated or participants are not invited in a timely fashion
- Meetings are not held in accordance with the project plan or attendance of key people in such meetings is limited.
- Status reports are not produced, not communicated or not reviewed by addressees.
- Not all stakeholders are identified or stakeholders are not participating in the project.

Outsourcing Management - Implementation and Tracking (C5)

Outsourcing Management planning has been described in the Outsourcing Management section. Tracking of the outsourced parts of the project is based on status and financial reports provided by the outsourcing organization and is no different than implementation tracking. If variances are detected with quality, cost or schedule of deliverables, then an unacceptable variance flag is raised.

Scope Change - Implementation and Tracking (C6)

Scope Change Implementation is the design and implementation of the scope change plan in order to deliver a scope change. Scope change tracking is the tracking of actuals vs. plan. Since the scope change plan is usually embedded into the overall project plan, its tracking is a part of the overall project implementation tracking. EVA may be calculated separately for scope change implementation using the supplied EVA Tool. The Scope Change process and the flow diagram are provided in the Scope Change Control Chapter of the Planning Frame description.

Scope Change Tracking Acceptance Criteria

The scope change implementation tracking results are acceptable if:

- EVA calculation results for the scope change are acceptable (+/-10% of the planned scope costs and schedule)
- Quality Management ratings for the scope change activities are acceptable.

Detailed Design and Construction (C7)

Tasks required to implement detailed design and construction are different for different types of projects. Considering that planning of the Construction Frame, including detailed design is done in the Planning Frame, the main goal of C7 process is implementation of the existing project plan.

Detailed Design Tracking Acceptance Criteria

Detailed Design and Implementation tracking is acceptable if:

- EVA calculation results are acceptable (+-10% of the planned costs and schedule)
- Quality Management results are acceptable (Acceptable rating of planned QA audits and QC reviews)

Troubled Project Assessment (C8)

Troubled Project Assessment is the process to determine major reasons why the project is unable to proceed as planned.

Most problems do not happen suddenly. Most projects start running into trouble soon after the beginning of the project. Some authors on this subject suggest that the main reason is not following the change request process; some others blame lack of the proper issue and risk management processes. Many blame the delivery team, sponsors and management for the project outcome.

All of them are correct, but there are many more reasons for a project's poor performance. The question is how to find those reasons and whether it is really possible and necessary to find all of them.

In 1906 the Italian economist V. Pareto observed that 20% of the people owned 80% percent of the wealth. Scientists proved that the observation, called 20/80 Pareto Principle is correct for most business areas:

- Software: 20% of the most reported software bugs cause 80% of the errors and crashes.
- Service: 20% of customers take up 80% of the service organization's resources.
- Health Care: 20% of patients use 80% of health care resources.
- Law: 20% of criminals commit 80% of crimes.
- Engineering: 20% of components are responsible for 80% of failures.

We like to simply say that 80% of your aspirin consumption is caused by 20% of your headaches.

The Pareto Principle may be generalized to claim that roughly 80% of the effects come from 20% of the causes. This makes the task of determining causes for the poor project performance easier, since fixing only 20% of causes will improve project performance by 80%.

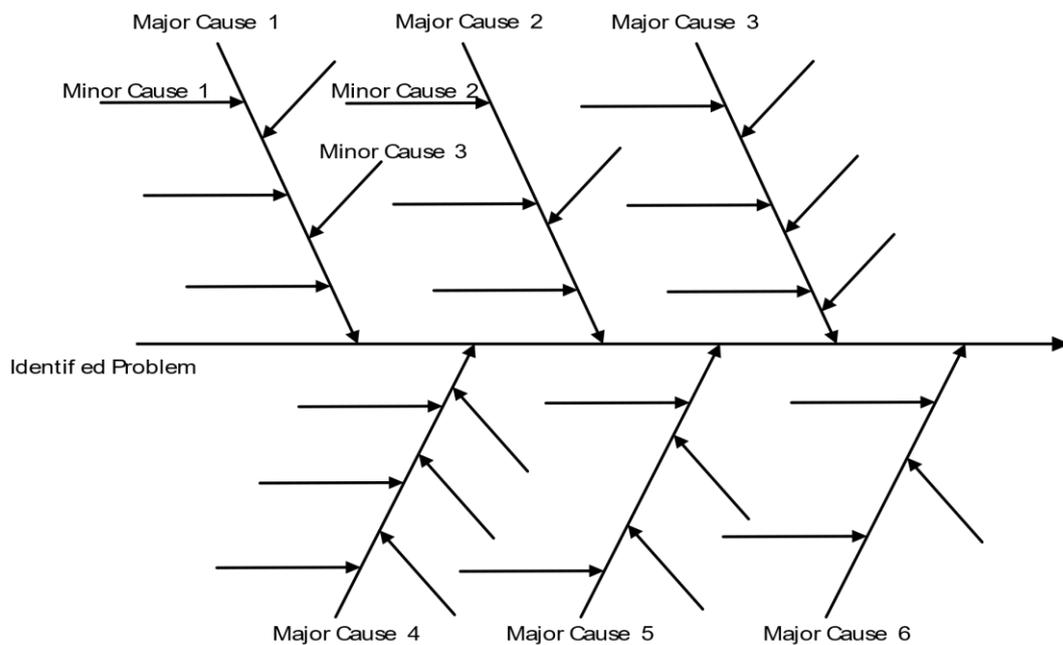
The method to determine causes is called Cause and Effect Analysis, which allows analyzing the situation and coming up with major reasons for poor project performance. The tool used for the analysis is the Cause and Effect Diagram, also called the Fishbone (for the way it looks) or Ishikawa diagram (after its inventor, Dr. Kauro Ishikawa). Using this tool, it is possible to utilize ideas of all team members and consider all possible causes of the problem. This approach uses a brainstorming session with participation of all relevant team members and clients. It is a good idea to have an outside moderator for the session. Conclusions are presented to management and sponsors.

The Cause and Effect analysis consists of the following steps:

1. Identify the problem
2. Identify the possible major causes involved (these form the "ribs")

3. Break down major causes into possible minor causes (done by asking, “why” repeatedly)
4. Analyze the diagram and provide more details about all relevant minor causes. Additional investigation may take place.
5. Propose a solution to improve project performance.

The overall Fishbone Diagram and the example for Information Technology is shown on Fig 15-2.



Fishbone Diagram Sample for Information Technology Projects

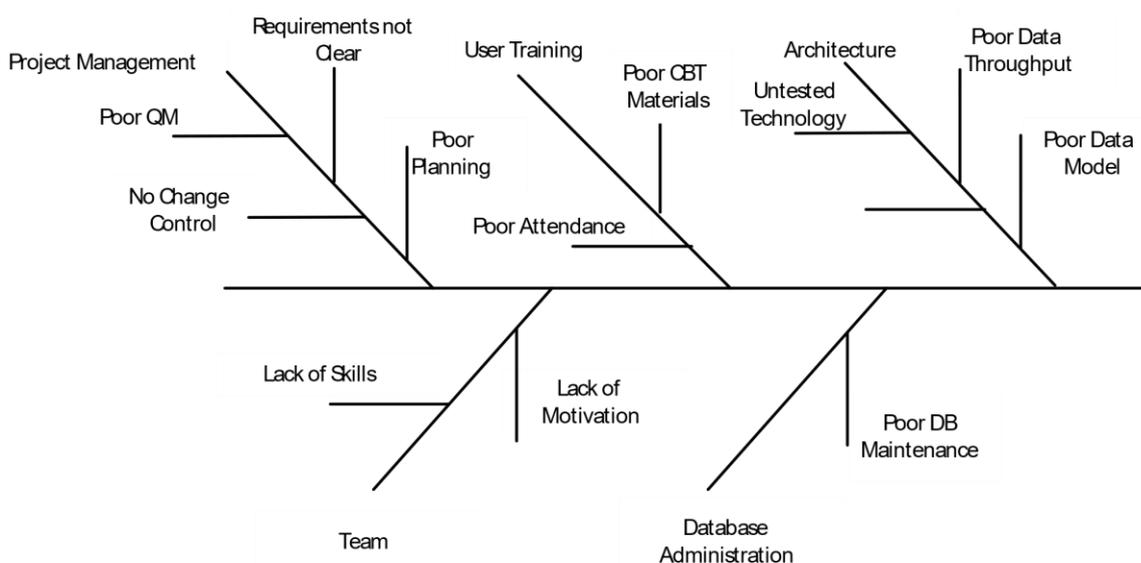


Fig. 15-2 Fishbone Diagram

Not all branches are required; this will depend on the problem type. For example, if the project slipped schedule during implementation, then the User Training branch is not required. The Database Administration branch may be needed only if developers have issues with database. The Architecture branch may or may not be required, depending on existing problems. On the other side, the Communication branch missing here may be needed if client communications don't seem to be as desired. Communications may be the issue if requirements are not clear. Also, the Management branch may be needed if the existing corporate environment is indifferent to violation of Project Management processes or if some managers ignore processes.

If issues occur during the acceptance test or after product release to production, then the User Training branch may be relevant.

When the list of possible reasons of poor project performance is analyzed, a meeting should be held to identify ways of improvement in each identified problem area and develop the corrective action plan. Engage team members and clients in those efforts. Key team members have good ideas about reasons for failure, even though they are not always outspoken in public. Invite them, one at a time, for a coffee and ask for their advice, trying to understand their point of view. The corrective action plan must provide the schedule and deadline for each corrective action taken. It must specify by name those responsible for implementation of each corrective action.

Ensure that team conflicts are not an issue. If team conflicts exist, use methods described in the Communication Planning section to resolve them. Introduce changes to the team to improve team morale. As the last resort, remove the poor performers. Consider reducing project scope, thus reducing complexity of the project. If undue management interference in the project is the reason for frequent changes in project plans, make sure this opinion is shared by majority of the team and then present this view to management. This won't win you favors from management, but the failure to deliver the project will be much worse.

The corrective action plan should not exceed two or three weeks. This is usually sufficient to improve the project performance. If it doesn't, either the analysis is wrong or recovery is not possible. Indeed, the recovery may not work even with the good recovery plan, when the corporate environment does not encourage practicing good project management processes. The following are a few samples of causes and effects in many projects:

- If the project scope is not fully documented or scope changes are not properly processed, as described in the corresponding section of the book, the project will have scope leaks and the final product will be different from what was documented. Clients may and will forget about their requests to change the scope. The project cost will overrun the budget if project modifications are not properly authorized and priced.
- If the project estimating process is not followed, the project will end up with the overly optimistic estimates.
- If risks are not managed as described in the Risk Management section, the project may end up with many issues and change requests, which would eat up the project budget.
- If the communication with team members, management and clients does not follow the process, the project will be uncontrollable.

- If the project is not planned or the progress is not tracked meticulously, the project is destined for failure.
- If the quality review process is not followed, the developed product will not fit the purpose for which it was designed.

It is very important that the project manager does not commit to a new baseline under pressure, but rather creates a new doable, controllable and properly funded plan first.

Recovery is not always possible or even needed. Some of examples of this situation:

- No required project skills may be available in the foreseeable future.
- Sponsors and the business lost interest in the project, because business benefits are no longer apparent.
- Technology changed to such an extent, that the product being developed will be “old” by the time it is completed.

Take Corrective Action (C9)

Corrective actions are taken in order to eliminate reasons affecting project performance and improve it in line with the project baseline, quality or expected results. The Corrective Action Plan describes when and what corrective actions should be taken.

Often, the project manager does not have enough power to implement corrective action without management assistance, especially if some reasons for poor performance lie in the client or management actions. Therefore, the developing organization management and sponsor must approve the corrective action plan and participate in assignment of action owners.

The corrective plan implementation is tracked daily or any other day until the plan is completed and the new project baseline is produced. Issues related to staff members that do not meet deadlines of the corrective action plan will be immediately escalated to the senior management.

About the Author



Dan Epstein

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Dan Epstein combines over 25 years of experience in the project management field and the best practices area, working for several major Canadian and U.S. corporations, as well as 4 years teaching university students project management and several software engineering subjects. He received a master's degree in electrical engineering from the LITMO University in Leningrad (today St. Petersburg, Russia) in 1970, was certified as a Professional Engineer in 1983 by the Canadian Association of Professional Engineers – Ontario, and earned a master's certificate in project management from George Washington University in 2000 and the Project Management Professional (PMP®) certification from the Project Management Institute (PMI®) in 2001.

Throughout his career, Dan managed multiple complex interdependent projects and programs, traveling extensively worldwide. He possesses multi-industry business analysis, process reengineering, best practices, professional training development and technical background in a wide array of technologies. In 2004 Dan was a keynote speaker and educator at the PMI-sponsored International Project Management Symposium in Central Asia. He published several articles and gave published interviews on several occasions. In the summer of 2008 he published "Methodology for Project Managers Education" in a university journal. His book, *Project Workflow Management - The Business Process Approach*, written in cooperation with Rich Maltzman, was published in 2014 by J. Ross Publishing.

Dan first started development of the Project Management Workflow in 2003, and it was used in a project management training course. Later this early version of the methodology was used for teaching project management classes at universities in the 2003–2005 school years. Later on, working in the best practices area, the author entertained the idea of presenting project management as a single multithreaded business workflow. In 2007–2008 the idea was further refined when teaching the project management class at a university. Since 2009, Dan has continued working full time in Project Management.

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