

# The Essentials of Skill-Based Training Programs

*Bruce R. Duncil, PE, CSQE*

Effective training of the personnel performing development and management activities are integral to the success of those efforts. Although that statement seems self-evident, getting it done has often proven an entirely different matter. Training programs have been beset by problems common to all such functions: misunderstanding of purpose, lack of management sponsorship and participation, inability to plan a program, poor program implementation and misuse of resources. But perhaps the largest roadblock to success has been insufficient understanding on the part of key personnel as to how to go about establishing a training program that meets their organization's needs. The Software Engineering Institute's (SEI) Capability Maturity Model<sup>®</sup> for software, v1.1 (CMM<sup>®</sup>) outlines fundamental elements of a program designed to equip personnel with the skills needed to fulfill the responsibilities of their assigned roles. This article addresses the elements of an effective training program and how to put them in place in a software organization. These principles, however, are extensible to product development organizations at large. This article is one in a set of articles entitled "**The Essentials...**" focusing on reference models and appraisal methods to achieve business objectives. Whether you are struggling to implement improvements or you are an assessor striving for team consensus in the field, these thoughts are offered to stimulate discussion, guide decision-making and facilitate achievement of your goals.

## ***So, what is "training"?***

Successful product development is founded on three things: a process (methods, procedures, and standards), a technology (tools), and personnel proficient at executing the process using the technology. It is surprising, however, how many organizations still leave proficiency to chance. Some, for example, claim to hire only "trained personnel", thus justifying no further investment. Many others allow their employees to collect a hodge-podge of courses, from virtually any reputable source, with the only stipulation that successful course completion or certification look good on a resume. A few organizations, however, invest in formal employee training programs that prepare them to execute their responsibilities as they progress in their roles and their careers. But what do these organizations all have in common? They are all meeting their self-defined training needs. However, the outcomes are very different. Ultimately an organization's training program fulfills its vision of its employees and the customers they serve, defines its current capabilities and establishes its future. So, what are the training needs of your organization? Do they serve the customer and the employee in a manner that supports the future? How do you go about defining your needs more proactively?

One of the first steps in understanding the training needs within the organization is to identify and document roles and responsibilities. Personnel perform in various roles to develop or manage development of products. These roles include management roles, developer roles, and support roles as shown in Table 1, below. Each role has a set of formally and/or informally assigned responsibilities. It helps to include an over-arching "mission statement" for each role under which to fit these responsibilities. For example, the project manager's mission might be to direct, control, administer and regulate the project with full product responsibility to the customer. This mission statement can be used to clarify and properly assign responsibilities, especially those that involve multiple roles. A role-responsibility matrix will be key to determining the next step: defining the requisite knowledge, skills and abilities.

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**Table 1: Example Role-Responsibility Matrix**

<b>Role</b>	<b>"Mission Statement"</b>	<b>Responsibilities</b>
Functional Manager	Focus on the long-term viability of a segment (function) of the organization	? Define policy ? Provide resources ? Verify process performance ? Establish contractual commitments ? Take corrective action
Project Manager	Direct, control, administer and regulate the project with full product responsibility to the customer	? Assign project roles and responsibilities ? Plan the project ? Oversee execution of the project plan ? Report progress ? Take corrective action
Software Engineering	Perform software engineering activities and create software work products	? Identify product requirements ? Design the product ? Build the product ? Test the product ? Report progress ? Take corrective action
Software Configuration Management	Maintain the integrity of software work products throughout the project development cycle	? Identify products ? Status products ? Manage changes ? Audit products

Each set of responsibilities an individual performs is based on one or more processes, however well or ill they are defined. In Table 1, the project manager, for example, is responsible for planning the project. The planning process may include activities such as estimating project size, effort, cost and schedule, identifying and classifying risks, and assembling planning data to effectively integrate project and support functions into a complete, consistent and workable flow. The ability to perform these activities effectively and efficiently requires appropriate knowledge and skills.

## **Roles -> Responsibilities -> Activities (in accordance with process) -> Abilities with Knowledge and Skills**

For purposes of this discussion, we may think of knowledge as the understanding of the overall framework surrounding these activities; i.e., each activity has inputs and outputs, entry and exit criteria, controls and resources, as well as specific steps. Such knowledge would include the awareness of the activity and its context within the overall product development, understanding of the relationship between roles and responsibilities associated with the activity, and the details for performing that activity correctly. Skills then are the measurable proficiency at which the knowledge is employed to perform the specific activity in accordance with a defined methodology (process and technology). Proficiency may be measured in any scale, but a semi-

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quantitative example scale might include novice, journey-level, accomplished, and master (subject matter expert).

**Table 2: Example Ability, Knowledge and Skill Mapping**

<b>Role</b>	<b>Ability</b>	<b>Knowledge</b>	<b>Skill</b>
Project Manager	Estimating project size	<ul style="list-style-type: none"> <li>? Size estimating procedure</li> <li>? Work products for which size is estimated</li> <li>? Who estimates size and when</li> <li>? How size estimates are applied to planning</li> </ul>	<ul style="list-style-type: none"> <li>? Proficiency at using the size estimating procedure to estimate size of requirements, design, code and test work products</li> <li>? Proficiency at using the size estimates in the procedures for building project effort estimates and schedule</li> </ul>

Training can be defined as making individuals proficient with specialized instruction and practice. Training can be used to establish or to improve skills; the common link is the skill. Once the ability, knowledge and skills are determined for each role, the requisite training may be identified. In the case of our project manager, this would include training in the knowledge and use of the estimation procedures. Courses may then be purchased or built to develop the necessary skills and skill proficiencies. It is important to note that course identification and selection is the last step, not the first, in defining an effective training program that truly meets an organization's business objectives.

### ***What's in a training program?***

The CMM<sup>®</sup> outlines the elements of a successful training program. These elements include training plans, training execution, records and measurements. Clear responsibilities for the training program must be established. The model also addresses skill-building in 4 general categories: process, tools, technical and professional. Although many organizations today attempt to deal with training at the individual level, usually as part of an annual appraisal process, the model deals with the needs of the organization at both the organization and the project level. In a project-centric organization envisioned in the model, the aggregated project training needs become the organization training needs. Finally, the model draws the distinction between low and higher maturity organizations: lower maturity processes simply allow for personnel receiving some training and holding experience; higher maturity organizations are expected to define specific training that is "required" for individuals to fill certain roles. For example, project managers in a CMM<sup>®</sup> Level 2 organization need only have some training and/or experience in project planning and tracking. In a more mature organization, the project manager would have been required to complete a specified set of coursework to perform the responsibilities of that role *before* having been assigned. A training program would therefore encompass 4 elements across 4 categories of training along 2 levels (organization and project) for both required and non-required training. Based on your completed roles, responsibilities, abilities, knowledge, skills/proficiency and course mapping across the 4 training categories, you're ready to begin establishing the training program.

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## **Planning Training**

Organization management must, at the outset, establish responsibilities for planning and coordinating the training program. Project and functional managers are usually tasked with identifying training needs for project and organizational training categories, respectively. A dedicated individual or small group (not necessarily a full-time job) is then assigned responsibility for planning and tracking training to meet those needs.

As described above, the CMM<sup>®</sup> is premised on organizations aggregating project-level training needs and establishing plans for meeting those needs at either the project or organization level. However, many organizations address their training needs at the individual level. In many cases, organization and individual training are addressed consistent with human resources requirements and/or budgeting processes. Projects, on the other hand, have needs consistent with their development cycle - which can vary from just a few weeks to several years. There are also overlaps and gaps in areas of training covered at each level. For example, project training needs typically fall into the categories of domain or functional expertise and tools. Organization and individual training needs, however, may relate more to functional expertise and professional development categories. All of these training categories are more likely to be covered by formal courses. In contrast, most organizations use informal on-the-job training, shadowing or mentoring to meet any recognized process training needs, often after personnel assignment.

The first step in planning your training program is to sort out the various training needs and the most appropriate means of meeting them; i.e., the funding source. Since most employees are not forced to pay for their own training, there is typically just organization and project level funding to consider. Using the 4 categories of training as the overall context for planning, the appropriate roles may be assigned to each category:

### **Process Training**

- Project Management processes
- Software Engineering processes
- Software Quality Assurance processes
- Software Configuration Management processes
- Software Subcontract Management processes

### **Technical Training**

- Domain Expertise (e.g., telecommunications)
- Functional Expertise (e.g., requirements analysis, design, code, test)

**Tool Training** (e.g., specific tools for processes or platforms)

**Professional Development** (e.g., certifications, soft skills, credentials)

Projects must figure their training costs directly into overall project costs. Most often these costs are simply passed through to the product customer. Hence, project training may be very limited in scope to minimize costs and to justify a customer-specific pass-through. Organizations often set annual budgets with per employee spending targets that may or may not vary by division or unit. Anything not paid by the project must come through the organization, or vice versa, depending upon corporate policy. Table 3, below, provides an example breakdown of training category by funding source. However, your organization's profile may vary significantly. Once the training category is aligned with a funding source, the needs can be aligned to the proper plan.

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**Table 3: Example Division of Training and Funding**

Training Category	Probable Funding Source
Process Training	Project
Technical Training - Domain Expertise - Functional Expertise	- Project - Organization
Tool Training	Project
Professional Development Training	Organization

The second planning step is to identify who needs what training and when that training is required. Training that is specified as required for the individual to perform their project or organization role would be first priority. Other planning decisions include identifying the training vehicle and any course make/buy decisions reflecting selection of internal or external training source. Examples are provided in Table 4, below. These will drive cost, resource and scheduling constraints.

**Table 4: Example Training by Source, Vehicle and Make/Buy**

Training Category	Funding Source	Vehicle	Make versus Buy
Process Training	Project	OJT, Mentoring	Not Applicable
Domain Training	Project	Formal Course	Make
Functional Training	Organization	Formal Course Self-Study CBT (automated training)	Make Not Applicable Buy
Tool Training	Project	CBT (automated training) Formal Course	Buy Buy
Professional Training	Organization	Self-Study Orientation	Not Applicable Make

The decision to build training must account for the resources and schedule to construct training materials prior to required delivery dates. In addition, the CMM<sup>®</sup> requires use of standards governing the construction and the final training product such that training includes course descriptions, review of training materials, and the management and control of the training products. Course descriptions are to address the audience, prerequisites, training objectives, and the format and content of materials. Obviously other planning considerations would include identification and preparation of subject matter experts including train-the-trainer preparations, construction requirements such as course length and format, and any course piloting and adjustment prior to deployment.

Major considerations in building formal training (courses) include the content, format and length of any training course. Content is often highly focused, but there may be classes that bundle a large number of topics into a single course. For example, size estimating may span 2 hours but be bundled with other estimating and planning courses into a week long project management class. The necessary course format should be dictated by the way people learn and how they learn. This includes lecture, visualization and hands-on usage. Unfortunately there is little information in the literature relating the types of skills to the best vehicles for building those skills. However, as skill complexity

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increases, less lecture and more visualization (examples) and usage (demonstrations and hands-on work) should be incorporated into the formal course.

Subsequent to these decisions, training plans may be developed and integrated for all personnel, projects and levels. Plans should be placed under version control with defined review and approval requirements. Re-planning may be done annually; however, this is often best facilitated by reviewing the plan at least quarterly or if major changes occur. Organizations intending to be assessed at a maturity level against the CMM<sup>®</sup> have the requirement to demonstrate institutionalization of the planning process (repeated implementation) and often resort to more frequent planning to accomplish this objective. An example training plan format would include:

- Plan Purpose, Scope, Goals, Period of Coverage and Objectives
- Coverage (roles, responsibilities, abilities, knowledge, skills)
- Training Vehicles (courses)
- Training Sources for each Vehicle
- Schedules for Development, Purchase, Preparation and Delivery
- Funding Sources and Budget
- Planned versus Actual Funding and Scheduling
- Resources (personnel/effort and any tools, equipment and facilities)
- Assumptions and Risks

## ***Executing Training***

Training program implementation is, in essence, execution of a sound training plan. It is important, however, to ensure that factors affecting implementation do not create an adverse impact. This is best accomplished by the training group's routine tracking and reporting to the plans. Parameters that must be tracked include planned versus actual training, planned trainees versus who actual attendees, and planned versus actual budget and schedule performance (variance). Timely, effective management corrective action ensures that plans are met or adjusted as needed to meet requirements.

One of the most significant hurdles to program implementation is the fact that training is both time and budget sensitive. The best of plans can be instantly derailed by changes in funding source or impacts to the critical path or dependencies in training construction or delivery. The wrong training or training delivered too late are ineffective. Although many organizations simply decide to limp along when training fails, this is not always the best course. A sound risk management process, incorporating critical dependencies (including funding dependencies) and realistic schedules, as well as risk mitigation, contingency, avoidance, transference and acceptance strategies based on semi-quantitative risk probabilities and impacts, should be employed. Constant vigilance of cost and schedule variance, with opportunity to escalate issues before they impact the program, are pre-requisites for effective corrective action.

Execution of the program also involves managing the registration, delivery, and follow-up of training as it occurs. The goal is to make certain that planned training actually occurs on plan. One of the most significant impacts to the program success here is the inability of personnel to actually attend or complete scheduled training. In too many organizations, for example, employees are too busy with their day-jobs to participate in or complete planned training. The "waiver" process is a classic means of short-circuiting the training program. The CMM<sup>®</sup> requires a waiver process that allows personnel

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otherwise qualified by training or experience to be excused from completing required training. Often this "waiver" need only be approved by the project manager; i.e., the very person who has the most influence on the individual's daily activities and the least involvement in their long-term welfare. One of the best ways to ensure that the waiver process is not used to prevent completion of training is to require multiple approvals of all required training waivers.

In cases where trainees themselves decide not to participate in their registered training, creative means of motivating them (carrots and sticks) to attend are required. In some cases, such as the need to drive completion of required reading, simply obtaining and publishing signatures of those completing the training (and escalating to management those who have not) may provide sufficient motivation. If kept in the proper spirit of teamwork, such motivational techniques can prove both positive and effective.

## **Recording Training**

One question always comes up: "what is a training record"? The answer is: NOT E-MAIL!!! E-mail is far too transitory and rarely is it sufficiently detailed as to understand exactly who was trained, by whom they were trained, in what they were trained, how they were trained, and when training occurred. Those are the major parameters of a necessary and sufficient set of training records.

Besides the plans themselves, one would expect to find records of training requirements by role and individual, course registrations, and course completions. Often a database or similar tool is used to schedule and track registrations and completions. Although the database or tool is not a record, per se, reports generated from it are. These might include lists of registrants by class and date and lists of attendees based on attendance sheets or similar forms. However, these apply more to formal courses. Other vehicles may have very different types of records as shown in Table 5, below.

**Table 5: Example Training Vehicles and Associated Records**

Example Training Vehicle	Example Associated Records
On-The-Job Training	Memorandum of who was trained, by whom, with date and time; Formal qualification card denoting same with signature of trainer
Mentoring (or Shadowing)	Formal Mentor List with qualifications Formal Mentoree List with assigned Mentor Mentor program guidelines or requirements Mentor program completion criteria
Self-Study including Required Reading, Videos and/or CBT	Signature on completion Quiz completion (and score posting)
Formal Course	Course registration Course attendance Course completions Quiz completion (and score posting)

Key training records include the needs analysis described at the beginning of this article. This includes the records of roles, responsibilities, abilities, knowledge, skills, and required versus non-required (elective) training which forms the basis for planning. Lastly, records include the training materials themselves and training measures.

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## ***Measuring Training***

There are two primary measures of the training program. The first measurement must help determine whether the program did the right thing. In other words, did the program meet the needs of the organization? Secondly, measurement must identify whether the program did things right; that is, was the program successful?

The CMM<sup>®</sup> includes a verification provision that the training program be periodically evaluated to ensure that is consistent with and relevant to the organization's needs. The measurements in this case would include variations between needed and delivered training. Many organizations involve an objective, external reviewer to perform such an evaluation, usually annually. However, other organizations have learned to review their needs assessment and planning process to make that determination directly. Periodic review of roles and responsibilities, along with the other elements of the need assessment which initializes planning described above, is very often sufficient to determine the relevance of future planned training. This process allows any realignment of needs and resources to occur in a manner that is then reflected in the training plans. Performing such a review as part of a quarterly planning process provides a suitable alternative to an external review.

Two types of measures are involved in ascertaining if training was done right. The first type of measures include planned versus actual training performance described above and the results of independent reviews and audits. Reviews and audits may be performed by Software Quality Assurance or another independent function and are designed to determine that the training program was executed in accordance with the requirements (policies, procedures, plans and standards) that define it. The second type of "rightness" measure includes measurement of the quality of training.

Measures of training quality are designed to ascertain its effectiveness in building or enhancing skills. Nearly all organizations use post-training evaluation forms that survey attendee perception of the instructor, the material, the facility, and the delivery. Aggregating this data often provides the ability to adjust the material, location, length, pace, delivery style or even change of instructor. Although these surveys are usually considered sufficient by appraisal teams in meeting CMM<sup>®</sup> Level 3 Measurement and Analysis requirements, they provide limited and indirect, often misrepresentative, data.

A more effective means of measuring the training quality is to relate the training directly to the skill and proficiency it built or enhanced. One means of doing that is through post-training testing. However, testing usually only records memorized knowledge and is not a sound measure of skills and abilities. A better mechanism for measuring abilities and skills must look at improved job performance. Some organizations have developed and use post-training job performance surveys on a 360-degree basis. The individual, in addition to the individual's manager(s), selected direct reports (if applicable) or assigned team members, and selected peers (which may also include internal suppliers and customers), provide input on the individual's performance across relevant parameters. These are then objectively analyzed (not by the individual's management) to ascertain, NOT the individual's performance, but the effectiveness of the delivered training. Obviously, great care is required to correctly apply these techniques to capture the relevant data and ensure its appropriate use. As with the post-training surveys, this data is then used to adjust training and delivery.



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## **Conclusion**

An organization's training program fulfills its vision of its employees and the customers they serve, defines its current capabilities and establishes its future. An organization's vision may be short-sighted and fail to adequately provide the means for carrying out its goals. Or, alternatively, an organization's vision may rest on a sound policy for ensuring organizational vitality by continually meeting or exceeding customer and employee expectations. The CMM<sup>®</sup> provides a framework for designing and implementing an effective training program. This article has explored various means and methods for planning and executing a training program capable of helping a development organization achieve its business goals. As with the vision it is founded upon, and the goals it is to accomplish, successful training program execution requires leadership.

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Notes: Capability Maturity Model<sup>®</sup> and CMM<sup>®</sup> are registered in the U.S. Patent and Trademark Office.

*About the Author: Bruce is an SEI-authorized Lead Evaluator (SCE) and Lead Assessor (CBA IPI), consultant and trainer. He has performed more than two-dozen appraisals, in addition to expert evaluations of quality, improvement and training programs, across contractor, commercial and research organizations at all maturity levels. Actively using industry standards and models since 1994, Bruce works with clients in a broad range of domains to coach, mentor and guide improvements in processes, methods and techniques to achieve business objectives. Bruce resides in Duluth, Georgia and can be reached at (678) 584-1750 or brd@isd-inc.com.*