

A Framework Proposal for Monitoring and Evaluating Training in ERP Implementation Projects

Technical Research Report
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Abstract.

During the last years some researchers have studied the topic of critical success factors in ERP implementations, out of which 'training' is cited as one of the most ones. Up to this moment, there is not enough research on the management and operationalization of critical success factors within ERP implementation projects. This technical research report proposes a framework for monitoring and evaluating training in ERP implementation projects. In order to develop a set of metrics for such monitoring and evaluating tasks, we have used the Goals/Questions/Metrics (GQM) approach. The GQM approach is a mechanism for defining and interpreting operational, measurable goals. Because of its intuitive nature the approach has gained widespread appeal. As a result, we propose a GQM preliminary plan with different metrics to monitor, control and evaluate training while implementing an ERP system. We also propose a three dimensional framework to interpret the metrics defined.

Keywords: Enterprise Resource Planning, critical success factors, training metrics, GQM, ERP implementations

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1. Introduction

Training is one of the most cited Critical Success Factors (CSFs) in Enterprise Resource Planning (ERP) implementation projects (Bancroft et al. 1998, De Bruin 1997, Gibson and Mann 1998, Sumner 1999, Kale 2000). In order to realize significant benefits from ERP systems a considerable amount of training is required (Wortmann 1998). There must be a training plan and it should take into consideration both technical staff and end-users, with its scope depending on the type of implementation approach selected. Some case studies of ERP implementations have shown the importance of effective training at all levels (e.g. Bancroft et al. 1998, Miller 1999, Kale 2000).

However, little has been done in relation to the management and the operationalization of training metrics. Usually, the metrics proposed in the ERP implementation methodologies are related with milestones and costs aspects. Some organizations use an in-house training approach while others prefer to use training consultants from outside (Esteves and Pastor 2000). According to Esteves and Pastor (2002), training activities in a SAP implementation are in the ranking of the most critical activities. Koch (1996) mentioned that “without proper training, about 30 to 40 percent of front-line workers will not be able to handle the demands of the new system”. Hence, ERP systems are complex and demand rigorous training. As Bingi et al. (1999, p. 14) says: “it is difficult for trainers or consultants to pass on the knowledge to the employees in a short period of time”.

From the project management perspective a training evaluation activity may seem to be an add-on, a luxury, another costly element of a project consuming resources. Unlike training monitoring which focuses on technical aspects of delivery of training and control of planned variables. According to Goldstein (1993, p. 9), “most organizations do not collect the information to determine the utility of their own training programs”. We think that the same happens in the case of ERP implementation projects, especially when managers are only worried with the training costs rather than measuring its effectiveness.

One of the most important benefits on evaluating training is that it “can serve as a diagnostic technique to permit the revision of programs to meet the large number of goals and objectives” (Mann and Robertson 1996, p. 15). Other benefits gained by evaluating training affect decision making, particularly because evaluations can help decide between alternative training programs and to decide who should participate in future programs (Mann and Robertson 1996). Some of the main arguments for better evaluation of training are: to validate training as a business tool, to justify costs incurred in training, to help improve the design of training, and to help in selecting training methods.

This research study attempts to provide a set of metrics to control and monitor training in ERP implementation projects in order to help managers to achieve success in their projects. According to Jurison (1999, p. 28) the purpose of project control is: “to keep the project on course and as close to the plan as possible, to identify problems before they happen and, implement recovery plans before unrecoverable damage is done”. Sandoe et al. (2001, p. 164) pointed out that “having both business and project measures to show progress may be the momentum that keeps the project on track at critical times and keeps the project motivated to meet deadlines”. As a result of this study, we are interested in a set of metrics to help managers understand the situation of the ERP project. We used the Goals/Question/Metric (GQM) method to develop this set metrics. The result of the application of this method is a GQM plan. The GQM plan is a document that contains the goals, questions, and metrics for a measurement program (Solingen and Berghout 1999), in this case an ERP implementation project.

This technical research report is organized as follows. First, we present the research methodology used. Next, we present the background in training. Then, we describe the GQM method and we present the GQM plan proposed. We also propose a framework to interpret the metrics defined. Finally, we present some conclusions and further work.

2. Research Methodology

The purpose of this study is to develop a set of metrics to control and monitor training issues in ERP implementation projects. We used the GQM method to develop a measurement program. The steps were:

- Literature review on training topic.
- Definition of goals related with training in ERP implementation projects.
- Definition of questions associated for each goal.
- Definition of metrics associated to each question.
- Definition of the preliminary GQM plan.
- Interpretation of metrics.

A literature review on the training topic as related to ERP implementations was made in order to acquire knowledge related with this CSF. The information provided by the literature was the main source of information. We used the concept of preliminary GQM plan due to the fact that the project team that is going to use it must validate the final GQM plan. Here, we only provide a proposal for this plan.

3. ERP Training Overview

Training is important in an ERP implementation project not only to adapt users to the new ERP system but also to help in the organizational change process. Thus, training has at least two important advantages:

- It helps users to obtain knowledge of the ERP system before it is going live, what reduces uncertainty and allows a better participation in the implementation project.
- The fact of a person being called for training allows him/her to create the feeling that organization stills interested on his/her work, reducing the feeling of losing their jobs or work segregation.

ERP implementation projects engender large training requirements. Training is one of the most costly components of an ERP implementation project (Esteves et al. 2001a). According to Kale (2000), a training program may easily involve 10 to 20% of the manpower of an organization. An organization may have to undertake ERP training for three different groups (Kale 2000):

- The managerial personnel who are key members of their departments and have been nominated as the members of the functional team.
- Key-users who form the core of the super-users to be entrusted with the task of life-scale testing the system and also training other end-users.
- All other end-users who would be using the system as part of their routine operational duties.

There is another other important group that requires attention, the trainers. They should be carefully selected, since in most projects, trainers demonstrated lack of experience, and courses were inadequately structured, usually because those trainers were junior consultants. Trainers should be natural teachers, must be experts in the business processes they are teaching, and must recognize and understand the relationships between their processes and all the others (Bancroft et al. 1998). Another

important task they perform is training evaluation. Therefore, it is also important to analyse if they have the skills, time, or resources to do the training evaluation.

3.1 Training Methods

Training may include classroom instruction supplied by the ERP vendor or from Web, interactive, and other distance learning courses. It is helpful to ask referral ERP users what training tools proved most useful to them. “the company’s ERP evaluation committee should consider what kinds of training are available from prospective vendors and what percentage of the total cost of the new system should be budgeted for training. Many vendors recommend at least 10 to 15 percent (McAlary 2000, Kale 2000). Some recommend an estimated number of 120 hours per person. It is likely that the training investment will help drive the rollout plan. That is, the more you spend on training, the faster your rollout may be accomplished.” (McAlary 2000).

Users are most often trained by a training staff that first learned how to use the ERP system during the project pilot phase. A key benefit in this approach is that after the initial training plan, users and trainers (in this case people from the organization) will work side-by-side (Bancroft et al. 1998). User training is ideally performed on the customer’s premises, using examples from the organization line-of-business data and the new ERP system. However, it is often difficult to get trainees to sit through day-long, onsite training. They are inclined to run in and out of the training sessions, answering telephone calls and responding to everyday problems, within their departments. This is disruptive and reduces the effectiveness of the training task.

The figure of the training manager is very important in an ERP project. His major responsibility is “to ensure the availability not only of the instructors, but also to release the various personnel from their normal functions at appropriate times so that they can participate in the scheduled training sessions” (Kale 2000, p. 233).

3.2 Training Schedule

Some case studies of ERP implementations have shown the importance of effective training at all levels (e.g. Bancroft et al. 1998, Miller 1999, Kale 2000). Training should be synchronized with the overall implementation project. Formal training of all users is not normally deployed at the beginning of the implementation. Some organizations embark upon training programs several months before the ERP goes live, by which time users have forgotten their training (De Bruin 1997, Welti 1999). As Gupta (2000) states, poor end-user training is a common problem in all ERP implementations. “The ERP system is ready to go live but no one in the organization knows how to use it, and personnel also lack training in the maintenance aspects of the system” (Gupta 2000, p. 116).

According to McAlary 2000, training can take place as late as two weeks before the beginning of the implementation cycle that deals with the trainee’s domain. One way to minimize the problems arisen from the time lag between the actual training and the commencement of ERP going into production is doing refresher courses (Kale 2000).

3.3 Training Curriculum

Bancroft et al. (1998) focus the importance of beginning the training program with an analysis of the needs of users. The purpose of this analysis is to understand what to present and how to deliver the information. From the results of the analysis, the training team can identify the number and types of

training courses. It will know the number of users to be trained, their locations, the number of days for each course, the number of courses to be delivered, and the number of trainers needed.

The consensus that is emerging in relation to ERP training is that the training that matters is not technological but rather it must develop the ability to figure out the underlying flow of information through the business itself (Wheatley 2000). This is not just training in using the new ERP system, but also in the new processes and in understanding the integration within the ERP system – how the work of one employee influences the work of others (Krammegeard and Moller 2000, Wheatley 2000). The implementation of an ERP system involves a lot of organizational change in organizations. When organizations are asked what they would have done differently, most respond that they would have offered more training on how the system would change processes and to use the system (Kraemmergaard and Moller 2000). Therefore, there is the need to incorporate specific training related with it.

Bancroft et al. (1998, p. 138) pointed out “users must be informed as to the business needs for such change as well as which keys to when”, where change refers to the reengineered process associated with the new ERP system and the novel way of operating. We call this type of training organizational training. Most consultants suggest that end-users should be trained by using the new ERP parameterization according to the organization needs as this provides a better and quickly adaptation to what they will find after the go-live phase.

Another important aspect is the commitment of users to training. In terms of short term perception of training skills transfer, Axtell and Maitlis (1997) mention that if new skills are to be transferred to the workplace, trainees first need to feel that the training course is relevant to their jobs, and must also be committed to using what they have learned. Therefore, is important at the beginning of the ERP training program to explain to users what are the objectives and benefits of training. After one year, the factors influencing the transfer of training skills are the degree of autonomy in their jobs and their original motivation to use what they have learned. Thus, the predictors of training skills transfer after one year are different from those just after the training course (Axtell and Maitlis 1997).

3.4 Training Evaluation

According to Brinkerhoff (1988), a good training evaluation should be able to prove that the program:

- Is aimed at important and worthwhile organizational benefits;
- Operates smoothly and effectively and is enjoyed by participants;
- Achieves important skills, knowledge and attitude objectives;
- Uses the best available and most cost-effective designs;
- Is used effectively on the job; and
- Provides valuable and cost-effective organizational benefits.

Training evaluation can be analysed at least at two levels: project level and organizational level. Project level concerns to the training program as a whole while organizational level concerns to the people involved in the training and the effects on the organization.

3.4.1. Training Evaluation at Project Level

Mulder (2001) proposes a model for training effectiveness where he distinguishes three variables: project definition, project implementation and project effects. For each variable he defines a set of items (see table 1). The model is oriented to evaluate a training program from a perspective of a

training organization and its clients. This is suitable for ERP implementation contexts since most of the training is given by external training organizations during the ERP implementation project.

Project Definition	Objective operationalisation	The level in which the objectives of the training project are specified.
	Distribution of responsibility	The level in which the training organization carries responsibility for attaining the results.
	Condition registration	The delivery conditions about which agreements have been made between the client organization and the training organization.
Project Implementation	Total satisfaction	This is the satisfaction about the total project handling, the preparation of the project.
	Condition-realisation consistency	The delivery reliability of the training organization.
	Condition-realisation satisfaction	The level of satisfaction about the performance of the training organizations with respect to the possible delivery conditions.
Project Effectiveness	Expectation realisation	The level in which the project results meet the expectations of the client organization.
	Objective realisation	The level in which the intended objectives of the training project are achieved.
	Success attribution	The level in which the training organization has been responsible for attaining the intended objectives.

Table 1 - The model of training effectiveness proposed by Mulder (2001).

The model proposed by Mulder (2001) focus on the effectiveness of training programs perceived by customers in relation to the training organisations. We extended this model by defining another variable which is related with the management and monitoring of the training program itself. We denominate this variable as management activities since it concerns to the management activities associated with the training plan/project. This variable has three important entities: courses (type of courses, goals, number of hours, type of instructional method and number participants per course), type of users and trainers. These three entities should be managed and integrated in a metrics program.

3.4.2. Training Evaluation at Organizational Level

Different approaches to training evaluation have been proposed. Following the six general approaches to educational evaluation: goal-based, goal-free, responsive, systems, professional and quasi-legal, Eseryel (2002) categorized and compared the most common training approaches. The most used training evaluation model was proposed by Kirkpatrick (1959) which follows the goal-based evaluation approach and is based on four levels of evaluation. Later, we describe in detail this model. Under the systems approach, the most influential models include: context, input, process product (CIPP) model (Worthen and Sanders 1987); Training Validation System (TVS) approach (Fitz-Enz 1994); and Input, Process, Output, Outcome (IPO) model (Bushnell 1990). According to Philips (1991), goal-based and systems-based approaches are predominantly used in the evaluation of training.

Eseryel (2002) mentions that goal-based models may help practitioners think about the purposes of evaluation ranging from purely technical to covertly political purpose. However, he argues that these models do not define the steps necessary to achieve purposes and do not address the ways to utilize results to improve training. Systems-based models seem to be more useful in terms of thinking about the overall context and situation but they may not present the dynamic interaction between the design

and the evaluation of training. Again, few of these models provide descriptions of the processes involved in each step. Furthermore, these models do not address the collaborative process of evaluation, i.e., the different roles and responsibilities that people may play during and evaluation process.

3.5 Kirkpatrick Evaluation Training Model

Kirkpatrick created his model in 1959 but it is still the most used and accepted evaluation training model. His model focuses on “what” must be evaluated. Kirkpatrick (1998) has identified four levels of outcomes of training which are hierarchically ordered: reaction, learning, behaviour and results. Since the model was developed in 1959, several training researchers have augmented the model. Kirkpatrick model is especially suited to training contexts where specific outputs are of interest right from the outset (Athanasou 1998). Next we describe these four levels of training taking into account the improvements made by other authors.

3.5.1. Reaction

This level assesses the initial reactions of participants to a course. This, in turn, offers insights into participants’ satisfaction with a course, a perception of value. Trainers usually assess this through a survey, often called a ‘smiley sheet’. Warr and Bunce (1995) described three kinds of reactions that are measured:

- **Enjoyment of training (emotional reaction)** – “I found this training program to be enjoyable”. The reactions focus on how trainees view a program as enjoyable.
- **Usefulness of training (perceived value)** – “What level of values does the training content have for your job?”, this kind of reaction attempts to ascertain the perceived utility value, or usefulness, of training for subsequent job performance.
- **Difficult of training** – “I found the issues taught in training difficult to understand”. These reactions cover the cognitive and emotional effort required to perform well in the training.

A similar categorization is proposed by Alliger et al. (1997). However, in their case, they proposed only the emotional reaction and perceived value, and the third one is a mix of both. This level is usually evaluated after the training is completed. Warr et al. (1999) propose a fourth state: the extent to which individuals are motivated to apply the material they have learned. According to Noe (1986) there is often scope for variation in the degree to which course material is later applied in a job, and motivational differences between individuals at the end of a course may be linked to variations in subsequent job behaviour. Therefore, an additional measure should be taken at the end of training, recording motivation to transfer course into a job setting.

3.5.2. Learning

This level measures the amount of learning that results from training and determines how much behaviour can change back on the job. In most cases, focus is upon the acquisition of knowledge, but much training also has as an objective the modification of attitudes and values. Kraiger et al. (1993) identified three types of learning that might result from training:

- **Cognitive outcomes** – An evaluation of cognitive outcomes must focus on trainee knowledge and the processes of knowledge acquisition, organization and application. Usually assessed by multiple choice questions, open-ended responses, listing of facts, or similar methods. Knowledge checks such as these are very similar to tests used in schools to assign grades.

Measures of cognitive outcomes can be assessed immediately after training or later to assess knowledge retention over time.

- **Skill-based outcomes** – Kraiger et al. (1993) describe this category of outcomes as the development of technical or motor skills and is frequently measured by observing trainee performance in role plays or actual job behaviors. These outcomes are typically measured by requiring that participants demonstrate their new skills in the training environment. Skill-based outcomes are not the same as behavior-change outcomes (level 3) that occur in the work environment. Learning outcomes that focus on skills only measure participants' ability to demonstrate the skills.
- **Attitudinal outcomes** – these measures focus on how participants feel or think about the training content. They have implications for participants' motivation to use the training, their confidence for using the skills, and their ability to reach goals. Kraiger et al.(1993)define affectively based measures of training evaluation as variables measuring attitudes,motivation,and goals that are relevant to the objectives of the training program;they further state,measures of attitudes should indicate the direction (agree or disagree)and strength of the reaction to an object.

3.5.3. Behaviour

This level measures the degree of transfer from what was learned to how the trainee behaves on the job, which in turn determines how much organizational impact the training can have. This assessment is based on the objectives of the course and these assessed through tests, observations, surveys, and interviews with co-workers and supervisors.

Based on a literature review, Olsen (1998) summarized a set of factors which can influence behaviour: integration of training to the work setting rather than as an isolated occurrence, cues and reinforcement, a connection to the reward system, close and frequent supervisory (coaching and nurturing) feedback, group dynamics, employee attitudes about the work and the organization, the type of training conducted, and consistency between what is being trained and its applicability in the real job setting.

3.5.4. Results

This level is a measure of organizational and business impacts of the training. Some assess this measurement by tracking business measurements, others assess it by observations, some by surveys and still others assess by qualitative measures. Examples of might include: productivity, customer satisfaction, efficiency, morale, and profitability.

The last level is the most difficult level to assess. First, most of training courses do not have explicitly written their organizational/business goals; second, the methodology for assessing the impact is not yet refined; and third after a long period after training occurs, evaluators have difficulty solely in attributing changes in business results to training. An effective evaluation of a training program must evaluate each level in Kirkpatrick's hierarchy in order to an organization be able to understand the full effects of the training program (Kirkpatrick 1998). A survey from the American Society of Training and Development Benchmarking Forum suggests that most organizations conduct some evaluations at levels one and two and only a few evaluate levels three and four. The survey also found that participating organizations believed there to be diminishing returns from evaluating at levels 3 and 4. Furthermore, there may even be dubious results from measurement at these levels. The results are shown in Table 2.

Evaluation Type	% of Survey Participants
Level 1 – Reaction	88.9
Level 2 – Learning	27.9
Level 3 – Behaviour	13.2
Level 4 – Results	4.3

Table 2 - Implementation of 4 Level Model (Source: ASTD (1997))

Other authors such as Phillips (1991) suggested the addition of a fifth potential criterion to the model: return on investment (ROI). ROI, the quantity of money returned to the organization in relation to the training investment, is calculated as (program benefits - program costs) / program costs (Phillips 1991). The primary purpose of this type of evaluation is to determine whether the value of a training program exceeds its monetary costs. Researchers and practitioners are concerned about using ROI in the training field because (a) assigning a monetary value to subjective benefits data is difficult and (b) utility analysis/ROI should be used to decide between program alternatives, not to justify the use of a program after the fact (Alliger et al. 1996). In our case, during this stage of our research we will only consider the training costs since they are easier to measure and the topic of training ROI is complex and several approaches have been proposed.

Finally, we would like to emphasize that there are a number of other variables that also impact on the effectiveness and outcome of a training program. We tried to cover the broadest number possible. Other variables should be integrated according to the training evaluation goals.

3.6 An ERP Training Evaluation Framework Proposal

Kirkpatrick's model and the extensions made to this model are a good start to develop an evaluation training program for ERP implementation projects.

Based on Kirkpatrick's model and on the structure of training proposed by Nickols (2000), we propose an ERP training monitoring and evaluation framework (see figure 1). The framework take into account the training activities, the implementation phases where they occur (we used as reference the ASAP implementation methodology described in table 3), the levels of evaluation proposed by Kirkpatrick, and the period when Nickols (2000) suggests evaluating each level. We also take into account the groups of trained personnel. In that sense we distinguish between project team training and end-users training. In the case of key-users, usually consultants recommend to have training at the same time as the project team does.

Phase	ASAP Training Activities
Project Preparation	Create project training team Align end-user training with the documentation strategy
Business Blueprint	Prepare Project training team Draft end-user training and the documentation plan
Realization	Conduct project training team Prepare end-user documentation and training material
Final Preparation	Prepare for end-user training Conduct end-user training
Go & Live	

Table 3 - ASAP Training activities of ASAP implementation methodology.

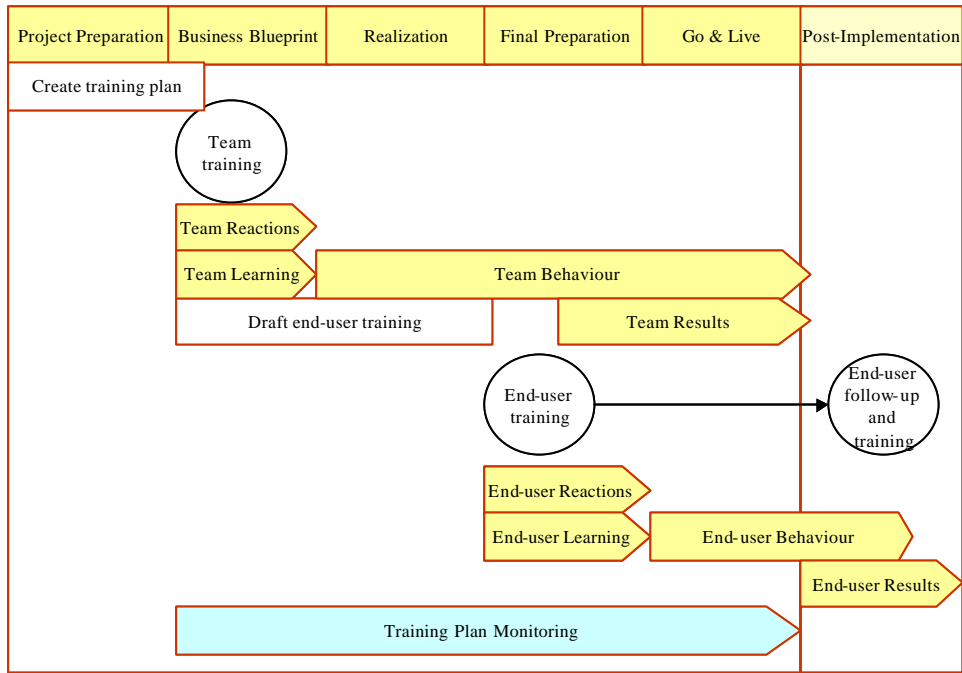


Figure 1 - A proposed ERP training schedule framework.

Based on the literature review we made, we present a framework to monitor and evaluate training plans in an ERP implementation context (see figure 2).

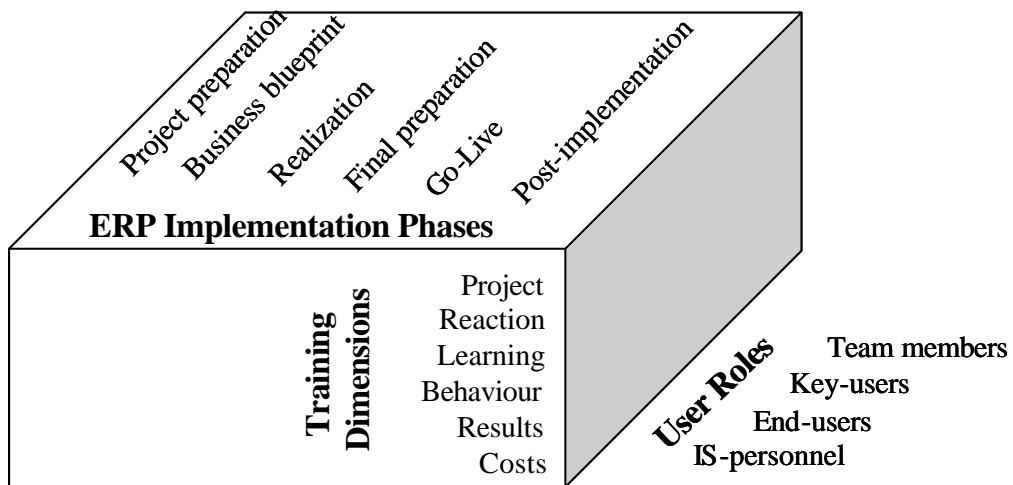


Figure 2 – A framework to interpret ERP training metrics.

We proposed that metrics should be interpreted taken into consideration three dimensions: training evaluation dimensions, ERP user roles and ERP implementation phases.

3.6.1. Training Evaluation Dimensions

This dimension is related with the inherent characteristics of the training evaluation process itself. Based on the literature review on training topic we defined five levels of training evaluation: managerial, reaction, learning, behaviour, results and costs (see section 3.5). Managers should not skip levels in training evaluation since these levels can help to understand and improve higher training levels. Managerial and costs training dimensions are related with monitoring task while the rest of dimensions are related with evaluation.

These training dimensions should be analyzed in relation to the different types of users (see figure 1) and it is also helpful in each training analysis not only have the training participant evaluation but also how peers, supervisors, subordinates and customers evaluate his/her training dimensions such as behaviour and results.

3.6.2. ERP User Roles

Depending of the user role, there are different needs of training. We defined five types of users: team members, key-user, IS personnel and end-users. Users can also be categorized by their different levels (Olson and Yves): executive management (top level), operational management (middle level), supervisory personnel, and operating personnel.

Some training courses are more adequate for some users than others, and the time to start their training is also different. For instance, the project team will be trained with an overview of ERP and their modules of interest. The key users will be trained with an overview of their module and all of the critical processes of interest. The end users will be trained only in the processes that are routinely used by them on a daily basis. Thus, there is the need to establish a rigorous training plan that takes into account the type of user and the implementation stages (the third dimension of our framework). For instance, is expected that training of team members be made during the first or second stage of the implementation phase, since they need to implement the ERP system. Usually key-users are trained with team members in order to help in the implementation process.

With all these concerns, seems evident the need to analyse the evaluation and monitor of training in relation to the different user roles involved. We also suggest this analysis in terms of the ERP stakeholders. For instance, it would be interesting to compare the evaluation that each supervisor makes about the behaviour of his/her employees after the training courses compared with the vision of the users.

Finally the sampling issue. You do not need to evaluate everyone since this would turn the monitoring and evaluation processes a chaos or even impossible to realize. Phillips (1994) recommends evaluating different percentages of programs at the four levels of Kirkpatrick model. He suggests 100% of all programs at level one, 70% at level two, 50% at level three, and 10% at level four.

3.6.3. ERP Implementation Phases

This dimension concerns to the different phases of an ERP implementation project, and the different training needs. Along the implementation phases, different users need to improve their skills in order to help in implementation tasks and learn how to use the ERP system in the future. Therefore, ERP implementation managers must acknowledge the need for such skills and develop and deliver training programs to meet this need.

The training plan should specify the training courses, their objectives, the resources required for each course, the number and type of users, trainers and a detailed schedule plan. Usually, the ERP implementation methodologies defined the various training tasks in order to develop and perform a training plan.

The training dimensions should be analysed along the different phases in order to verify if the training plan fits the ERP implementation project needs.

3.7 Training as a Continuous Process

We recommend that the training process be seen as a continuum, something that will not finish after the go-live of the ERP system. Not all the end-users are trained during the ERP implementation project nor training is sometimes the basic one to start working with the system. Training will follow along all the ERP lifecycle (Esteves et al. 2001). Managers must define clearly which employees and skills they will need at the moment of the go-live, in order to achieve a successful ERP implementation project.

Training objectives definition is an important aspect. Managers usually assume the interest of provided training courses. However, training courses can be inadequate to project and organization objectives or at least not focusing in the major project issues (see training curriculum section). The typical vision of “on time, on budget” in terms of training objectives definition is also sometimes applied. We think that this vision should be multidimensional and focusing into technological, organizational, process and strategic aspects.

In our study we only consider the monitoring and evaluation of training defined in the training plan. Some authors consider there must be a pre-training evaluation in order to know the motivation, the anxiety and self-efficacy of users. Some studies have shown that these aspects may influence the outcomes of future training programs. We assume that an ERP training plan is defined according to the organizational context and not merely in the ERP system itself.

4. A GQM Preliminary Plan for Training on ERP Implementations

We present below an overview of GQM approach and then we describe each of the components of the GQM preliminary plan: measurement goals, questions and metrics. For the measurement goal defined, the following aspects are described: goal description and its refinement into questions, and finally, refinement from questions to metrics.

4.1 GQM Method Overview

The GQM approach is a mechanism that provides a framework for developing a metrics program. It was developed at the University of Maryland as a mechanism for formalizing the tasks of characterization, planning, construction, analysis, learning and feedback. GQM does not provide specific goals but rather a framework for stating measurement goals and refining them into questions to provide a specification for the data needed to help achieve the goals (Basili et al. 1994). The GQM method was originally developed by V. Basili and D. Weiss, and expanded with many other concepts by D. Rombach. The GQM method contains four phases: planning phase, definition phase, data collection phase and interpretation phase (for more details see Solingen and Berghout 1999).

The definition phase is the second phase of the GQM process and concerns all activities that should be performed to formally define a measurement program. One of the most important outcomes of this phase is the GQM plan. A GQM plan or GQM model documents the refinement of a precisely specified measurement goal via a set of questions into a set of metrics. Thus, a GQM plan documents which metrics are used to achieve a measurement goal and why these are used - the questions provide the rationale underlying the selection of the metrics. The definition phase has three important steps:

- **Define measurement goals** - Measurement goals should be defined in an understandable way and should be clearly structured. These measurement goals should be relevant to the business, represent strategic goals from management, and support high priority processes of the organization (Solingen and Berghout 1999).
- **Define questions** - Questions should be defined to support the interpretation of measurement goals. Questions are a refinement of measurement goals from an abstract level to an operational level, which is more suitable for interpretation. By answering questions, one should be able to conclude whether a measurement goal is reached. As Solingen and Berghout (1999) state, the questions should be defined at an intermediate level of abstraction between the metrics and the measurement goals. The list of questions is developed through interviews.
- **Define metrics** - Once measurement goals are refined into a list of questions, metrics should be defined that provide all the quantitative information to answer the questions in a satisfactory way. The metrics defined must ensure that sufficient information should be available to answer the questions.

4.2 Goals of the GQM Preliminary Plan

In our case of training, the definition of the measurement goal associated with training is made using the template provided by Basili et al. (1994). We defined one measurement goal based in our CSF:

Analyse:	Training
For the purpose of	Analysing
With respect to	ERP implementation project
From the viewpoint of	Organization
In the context of	ERP implementation project

4.3 Questions

For the above measurement goal we defined a set of main questions based in the training levels. The questions for our measurement goal focus on identifying objective and quantifiable aspects that were related to the characteristics of the training program. Next, we discuss each dimension and the respective questions and metrics associated.

4.3.1. Project level

- Q1 Were training objectives specified?
M1 – Objective realization
- Q2 Did the training organization assume the responsibility for the attaining results?
M2 – % Distribution of responsibility
- Q3 Were the delivery conditions respected?
M3 – Condition registration
- Q4 What is the overall satisfaction for the training plan implementation?
M4 – Total satisfaction
- Q5 What is the delivery reliability of the training organization?
M5 – Condition-realization consistency
- Q6 What is the level of satisfaction about the performance of the training organization?
M6 – Condition-realization satisfaction
- Q7 Did the results meet the expectations?
M7 – Expectation realization
- Q8 Were the objectives achieved?
M8 – Objective realization
- Q9 What was the responsibility of the training organization in order to achieve the objectives?
M9 – Success attribution

4.3.2. Project Level: Management Activities

In this dimension we took into account the three main entities: courses, users and trainers.

4.3.2.1. Courses

We focused on the following aspects related with courses:

- Realization of all the training courses planned in the training plan.
 - Realization of the training hours planned in the training plan.
 - Realization of training courses according to the schedule training plan.
 - Analysis of the different type of training courses made.
 - Analysis of the number of training hours.
 - Realization of training hours by ERP module.
 - Realization of courses in the locations planned
 - Realization of training courses according to training methods planned.
- Q10 What is the percentage of courses made according to the training plan?
M10 – % of training courses made
- Q11 What is the percentage of training courses done according to schedule plan?
M11 – % of courses made according to schedule plan.
- Q12 What is the percentage of training hours made according to the training plan?
M12 – % of training hours made

- Q13 What is the proportion of organizational training Vs technical training courses?
M13 – ratio technical Vs organizational training courses
- Q14 What is the proportion of organizational training Vs technical training hours?
M14 – ratio technical Vs organizational training hours
- Q15 What is the proportion of training hours by ERP module?
M15 – % of training hours of by ERP module
- Q16 What is the percentage of training courses made according to the training methods planned?
M16 – % of training courses made using the training method planned
- Q17 What is the percentage of training courses made in the location planned?
M17 – % of training courses made in the location planned

4.3.2.2. Users

We focused on the following aspects related with users:

- Realization of training plan for the users planned.
- Assistance of users to the training courses.
- Realization of number of hours planned for each user.
- Realization of training courses with the number of users planned.

- Q18 What is the percentage of users trained according to the training plan?
M18 – % of users trained
- Q19 What is the percentage of users per course in relation to what was planned?
M19 – % n°. users per course
- Q20 What is the percentage of assistance of users per course?
M20 – % of users assistance per course
- Q21 what percentage of training hours each user will have?
M21 – % of n°. hours per user

4.3.2.3. Trainers

We focused on the following aspects related with trainers:

- Realization of training courses with the number of trainers planned.
- Courses realized by each trainer.
- Analysis of the quality of trainers.
- Type of trainers used.

- Q22 What is the percentage of trainers per course in relation to what was planned?
M22 – % n°. trainers per course
- Q23 what sorts of people are selected to provide training and how are they chosen?
M23 – quality of trainers
- Q24 What proportion of training courses made by each trainer in relation to what was planned?
M24 – ratio of training courses made by trainers
- Q25 What is the type of trainers, internal or external per course?
M25 – type of trainers per course

4.3.3. Reaction Level

- Q26 Was the training enjoyable?
M26 – enjoyment
- Q27 To what degree will this training influence trainees' ability later to perform their job?

- M27 – usefulness
- Q28 Was this training course relevant?
M27 – usefulness
- Q29 Was the training of practical value?
M27 – usefulness
- Q30 Was the training difficult?
M28 – difficulty of training
- Q31 Are trainees motivated to apply the material they have learned?
M29 – motivation to transfer

4.3.4. Learning level

For this level, we adopt the three types of learning suggested by kraigers et al. (1993): cognitive outcomes, skill-based outcomes and attitudinal outcomes.

- Q32 What Knowledge was learned?
M30 – cognitive outcomes
- Q33 What skills were developed or improved?
M31 – skill outcomes
- Q34 Were attitudes, self-efficacy, or motivation changed??
M32 – attitudinal outcomes

4.3.5. Behaviour level

- Q35 What skills, knowledge, or attitudes have changed?
M33 – Behaviour

4.3.6. Results level

- Q36 Are the newly acquired skills, knowledge, or attitude being used in the everyday environment of the learner?
M34 – results

4.3.7. Costs level

- Q37 What is the overall cost of training?
M35 – total cost of training
- Q38 Are there enough resources for the training program?
M36 – training budget

4.4 Description of Metrics

In this section we show the relationship between the questions defined above and the metrics (see table 4). In appendix A we present a detailed description for each metric using a special form.

Project level	Project Definition	1	Objective realization	Q1
		2	Distribution of responsibility	Q2
		3	Condition registration	Q3
	Project Implementation	4	Total satisfaction	Q4
		5	Condition-realization consistency	Q5
		6	Condition-realization satisfaction	Q6
	Project Effects	7	Expectation realization	Q7
		8	Objective realization	Q8
		9	Success attribution	Q9
	Management Activities	10	% training courses made	Q10
		11	% courses made according to schedule plan.	Q11
		12	% training hours made	Q12
		13	ratio technical Vs organizational training courses	Q13
		14	ratio technical Vs organizational training hours	Q14
		15	% of training hours of by ERP module	Q15
		16	% of training courses made using the training method planned	Q16
		17	% of training courses made in the location planned	Q17
		18	% of users trained	Q18
		19	% n°. users per course	Q19
		20	% users assistance per course	Q20
		21	% n°. hours per user	Q21
		22	% n°. trainers per course	Q22
		23	quality of trainers	Q23
		24	ratio training courses made by trainers	Q24
	25	type of trainers per course	Q25	
Reaction Level	26	Enjoyment	Q26	
	27	Usefulness	Q27, Q28, Q29	
	28	Difficulty	Q30	
	29	Motivation to transfer	Q31	
Learning Level	30	Cognitive outcomes	Q32	
	31	Skill outcomes	Q33	
	32	Attitudinal outcomes	Q34	
Behaviour Level	33	Behavioral	Q35	
Results Level	34	Results	Q36	
Costs Level	35	Total cost of training	Q37	
	36	Training budget	Q38	

Table 4 - The definition of metrics and their relationship with questions.

5. Conclusions

This study attempts to define a first set of metrics for training in ERP implementation projects. Training is cited as one of the most relevant CSFs in ERP implementation projects. We think these metrics have two important proactive characteristics: metrics help to detect deviations from the project plan and to act before damage is made, and second, the feedback from the participants is important for the training manager and the training team for improvement for subsequent training causes. They can analyse the feedback and possibly incorporate improvements in the training plan.

The purpose of this study is not to describe an exhaustive list of metrics. Instead, we attempt to present a form to develop these metrics in future ERP implementation projects and we provided the first set of metrics that should be extended and adapted according to the specific needs of ERP implementation projects. Managers should analyzed for each metric if it is relevant in their context and if there are the resources to measure it.

Next steps in this research are the validation and interpretation of these metrics. Two possible kinds of validation methods can be applied: case study or control experiments (Calero et al. 2001). We would like to remark that we are conscientious that this GQM preliminary plan will be subject to changes during the next steps of the research due to new information gathered and experience gained in the feedback sessions. Currently, we are developing a software application for the management of the metrics defined here. Additional research will attempt to define metrics to other CSFs defined in the literature of ERP implementation projects.

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8. Appendix A - Metrics Description

In this appendix we present the description of all metrics using a special form we created. For each metric we define the following aspects: what they are measuring, when they must be measured, what possible values they could have, who will measure it, what medium is used for data collection. We created a special form for the metrics description. Most of the metrics proposed are direct measurements except the metrics related with percentages.

Training level	Direct measurement	Indirect measurement
Project level	N°. training courses planned N°. training courses made N°. training courses in time N°. training hours made N°. training hours planned N°. organizational training hours N°. technical training hours N°. training hours by ERP module N°. training courses made by planned training method N°. training courses made by planned location N°. of users trained N°. users planned to be trained N°. of users per course N°. training hours per user N°. trainers per course N°. trainers planned per course N°. courses by trainer N°. courses planned for each trainer Type of trainers per course M25 – type of trainers per course	M1 - Objective realization M2 - Distribution of responsibility M3 - Condition registration M4 - Total satisfaction M5 - Condition-realization consistency M6 - Condition-realization satisfaction M7 - Expectation realization M8 - Objective realization M9 - Success attribution M10 – % of training courses made M11 – % of courses made according to schedule plan. M12 – % of training hours made M13 – ratio technical Vs organizational training courses M14 – ratio technical Vs organizational training hours M15 – % of training hours of by ERP module M16 – % of training courses made using the training method planned M17 – % of training courses made in the location planned M18 – % of users trained M19 – % n°. users per course M20 – % of users assistance per course M21 – % of n°. hours per user M22 – % n°. trainers per course M23 – quality of trainers M24 – % training courses made by trainers
Reaction level		M26 – enjoyment M27 – usefulness M28 – difficulty M29 – motivation to transfer
Learning level		M30 – cognitive outcomes M31 – skill outcomes M32 – attitudinal outcomes
Behaviour level		M33 – behaviour
Results level		M34 – results
Costs level	M36 - Training budget	M35 – Costs of training

Metric name	M1 - Objective realization
Definition	This metric assesses the level in which the objectives of the training project are specified.
Calculation method	
Frequency	
Values	
Responsible	Training manager
Medium	Manual
Type	Indirect

Metric name	M2 - Distribution of responsibility
Definition	This metric assesses the level in which the training organization carries responsibility for attaining the results.
Calculation method	
Frequency	
Values	Percentage
Responsible	Training manager
Medium	Manual
Type	Indirect

Metric name	M3 - Condition registration
Definition	This metric assesses the delivery conditions about which agreements have been made between the client organization and the training organization.
Calculation method	
Frequency	
Values	
Responsible	Training manager
Medium	Manual
Type	Indirect

Metric name	M4 - Total satisfaction
Definition	This metric assesses the satisfaction about the total project handling, the preparation of the project.
Calculation method	
Frequency	
Values	
Responsible	Training manager
Medium	Manual
Type	Indirect

Metric name	M5 - Condition-realization consistency
Definition	This metric assesses the delivery reliability of the training organization.
Calculation method	
Frequency	
Values	
Responsible	Training manager
Medium	Manual
Type	Indirect

Metric name	M6 - Condition-realization satisfaction
Definition	This metric assesses the level of satisfaction about the performance of the training organizations with respect to the possible delivery conditions.
Calculation method	

Frequency	
Values	
Responsible	Training manager
Medium	Manual
Type	Indirect

Metric name	M7 - Expectation realization
Definition	This metric assesses the level in which the project results meet the expectations of the client organization.
Calculation method	
Frequency	
Values	
Responsible	Training manager
Medium	Manual
Type	Indirect

Metric name	M8 - Objective realization
Definition	This metric assesses the level in which the intended objectives of the training project are achieved.
Calculation method	
Frequency	
Values	
Responsible	Training manager
Medium	Manual
Type	Indirect

Metric name	M9 - Success attribution
Definition	This metric assesses the level in which the training organization has been responsible for attaining the intended objectives.
Calculation method	
Frequency	
Values	
Responsible	Training manager
Medium	Manual
Type	Indirect

Metric name	M10 – % of training courses made
Definition	This metric assesses the percentage of training courses made according to the estimated number of training courses.
Calculation method	
Frequency	
Values	Percentage
Responsible	Training manager
Medium	Manual
Type	Indirect

Metric name	M11 - % of courses made according to schedule plan.
Definition	This metric assesses the percentage of training courses that were made during the period that was established in the schedule training plan.
Calculation method	
Frequency	
Values	Percentage
Responsible	training manager

Medium	Manual
Type	Indirect

Metric name	M12 - % of training hours made
Definition	This metric assesses the percentage of training hours made according to the estimated number of training hours
Calculation method	$N^{\circ} \text{ training hours} / n^{\circ} \text{ estimated training hours} * 100$
Frequency	
Values	Percentage
Responsible	training manager
Medium	Manual
Type	Indirect

Metric name	M13 - ratio technical Vs organizational training courses
Definition	This metric assesses the proportion of technical courses versus the number of organizational courses
Calculation method	
Frequency	
Values	Ratio
Responsible	Training manager
Medium	Manual
Type	Indirect

Metric name	M14 – ratio organizational Vs technical training hours
Definition	This metric assesses the proportion of technical training hours versus the number of organizational training hours
Calculation method	$N^{\circ} \text{ technical hours} / n^{\circ} \text{ organizational hours}$
Frequency	
Values	Ratio
Responsible	Training manager
Medium	Manual
Type	Indirect

Metric name	M15 – % of training hours of by ERP module
Definition	This metric assesses the percentage of training hours done by ERP module.
Calculation method	$N^{\circ} \text{ training hours by ERP module} / n^{\circ} \text{ training hours} * 100$
Frequency	
Values	
Responsible	Training manager
Medium	Manual
Type	Indirect

Metric name	M16 – % of training courses made using the training method planned
Definition	This metric assesses the percentage of courses made according to the planned training method.
Calculation method	
Frequency	
Values	
Responsible	Training manager
Medium	Manual
Type	Indirect

Metric name	M17 – % of training courses made in the location planned
Definition	This metric assesses the percentage of courses made in the planned location.
Calculation method	
Frequency	
Values	
Responsible	Training manager
Medium	Manual
Type	Indirect

Metric name	M18 – % of users trained
Definition	This metric assesses the percentage of users trained according to the estimated number of users to be trained.
Calculation method	$N^{\circ} \text{ users trained} / n^{\circ} \text{ estimated users to be trained} * 100$
Frequency	
Values	
Responsible	Training manager
Medium	Manual
Type	Indirect

Metric name	M19 – % n° users per course
Definition	This metric assesses the percentage of users per course according to the estimated number of users per course
Calculation method	$N^{\circ} \text{ users per course} / n^{\circ} \text{ estimated users per course} * 100$
Frequency	
Values	
Responsible	Training manager
Medium	Manual
Type	Indirect

Metric name	M20 – % of users assistance per course
Definition	This metric assesses the average percentage of users assistance per course
Calculation method	$\text{Average}(N^{\circ} \text{ users assistance} / n^{\circ} \text{ estimated users per course} * 100)$
Frequency	
Values	
Responsible	Training manager
Medium	Manual
Type	Indirect

Metric name	M21 – % of n° hours per user
Definition	This metric assesses the percentage of training hours per user
Calculation method	$N^{\circ} \text{ hours per users} / n^{\circ} \text{ training hours} * 100$
Frequency	
Values	
Responsible	Training manager
Medium	Manual
Type	Indirect

Metric name	M22 – % n°. trainers per course
Definition	This metric assesses the percentage of trainers per course in relation to the estimated number of trainers defined
Calculation method	$N^{\circ} \text{. users trainers} / n^{\circ} \text{. estimated trainers per course} * 100$
Frequency	
Values	
Responsible	Training manager
Medium	Manual
Type	Indirect

Metric name	M23 - Quality of trainers
Definition	This metric assesses the quality of trainers.
Calculation method	Surveys. Observation of trainers.
Frequency	Ideally, it should be measured before and after the course.
Values	
Responsible	Training manager
Medium	Manual
Type	Indirect

Metric name	M24 – % training courses made by trainers
Definition	This metric assesses the percentage of course made by each trainer in relation to the planned number of courses for each trainer.
Calculation method	$n^{\circ} \text{. courses per trainer} / n^{\circ} \text{. estimated courses per trainer} * 100$
Frequency	
Values	
Responsible	Training manager
Medium	Manual
Type	Indirect

Metric name	M25 – type of trainers per course
Definition	This metric assesses the type of trainers per course.
Calculation method	
Frequency	
Values	Internal trainer , external trainer
Responsible	Training manager
Medium	Manual
Type	Direct

Metric name	M26 – enjoyment
Definition	This metric assesses how trainees view a program as enjoyable.
Calculation method	Post-session participant questionnaire (typical smile sheets). Verbal feedback. Observation of trainees.
Frequency	Usually, it is collected after the training course is completed.
Values	
Responsible	Trainers
Medium	Manual
Type	Indirect

Metric name	M27 – usefulness
Definition	This metric assesses the perceived utility value, or usefulness, of training for subsequent job performance.
Calculation method	Post-session participant questionnaire. Verbal feedback. Observation of trainees.
Frequency	Usually, it is collected after the training course is completed.
Values	
Responsible	Trainers
Medium	Manual
Type	Indirect

Metric name	M28 – difficulty
Definition	This metric assesses the reactions that cover the cognitive and emotional effort required to perform well in the training.
Calculation method	Post-session participant questionnaire. Verbal feedback. Observation of trainees.
Frequency	Usually, it is collected after the training course is completed.
Values	
Responsible	Trainers
Medium	Manual
Type	Indirect

Metric name	M29 – motivation to transfer
Definition	This metric assesses the extent to which trainees are motivated to apply the material they have learned.
Calculation method	Pre-test/post-test change scores on measures of skill or knowledge. Performance tests or simulation to gauge learning.
Frequency	
Values	
Responsible	Training manager
Medium	Manual
Type	Indirect

Metric name	M30 – cognitive outcomes
Definition	This metric evaluates the trainee knowledge and the processes of knowledge acquisition, organization and application.
Calculation method	Usually assessed by multiple choice questions, open-ended responses, listing of facts, or similar methods. Pre-test/post-test change scores on measures of skill or knowledge.
Frequency	
Values	
Responsible	Training manager
Medium	Manual
Type	Indirect

Metric name	M31 – skill outcomes
Definition	This metric assesses the development of technical or motor skills.
Calculation method	Measured through observation of trainee performance in role plays or actual job behaviors. These outcomes are typically measured by requiring that participants demonstrate their new skills in the training environment. Pre-test/post-test change scores on measures of skill. Retrospective assessment of skills before training Vs skills after training.
Frequency	
Values	
Responsible	Training manager
Medium	Manual
Type	Indirect

Metric name	M32 – attitudinal outcomes
Definition	This metric measures attitudes,motivation,and goals that are relevant to the objectives of the training program;they further state,measures of attitudes should indicate the direction (agree or disagree)and strength of the reaction to an object.
Calculation method	Performance tests or simulation to gauge learning.
Frequency	
Values	
Responsible	Training manager
Medium	Manual
Type	Indirect

Metric name	M33 - Behaviour
Definition	This metric assesses the degree of transfer from what was learned to how the trainee behaves on the job, which in turn determines how much organizational impact the training can have. This assessment is based on the objectives of the course and these assessed through tests, observations, surveys, and interviews with co-workers and supervisors.
Calculation method	Tests (skills demonstrations), personnel performance evaluations, supervisor's reports, analysis of production, tests (paper/pencil), on-the-job observation, end-of-training surveys, follow-up interviews, calculate rate-of-return, follow-up surveys, longitudinal studies, calculates net present value, calculates payback period.
Frequency	
Values	
Responsible	Training manager
Medium	Manual
Type	Indirect

Metric name	M34 - Results
Definition	This metric assesses the organizational and business impacts of the training. Some assess this measurement by tracking business measurements, others assess it by observations, some by surveys and still others assess by qualitative measures.
Calculation method	Changes against baselines. Evaluation of costs Vs benefits. Training curriculum yields “x” % of change, growth in dollars, etc.
Frequency	
Values	
Responsible	Training manager
Medium	Manual
Type	Indirect

Metric name	M35 - Total cost of training
Definition	Control of all the costs associated with the training plan, they can be categorized by type of training course and by user, the important is to achieve a total cost of the training plan.
Calculation method	Sum of training costs
Frequency	Phase by phase
Values	Numerical
Responsible	Project manager, training manager
Medium	Manual
Type	Indirect

Metric name	M36 - Training budget
Definition	This metric assesses if the training budget is accomplished
Calculation method	Estimated budget/total costs of training*100
Frequency	Phase by phase
Values	Percentage
Responsible	Project manager, training manager
Medium	Manual
Type	Indirect