

Concept	Analyze	Design	Develop	Implement	Evaluate
	Identify the probable causes for a performance gap	Verify the desired performances and appropriate testing methods	Generate and validate the learning resources	Prepare the learning environment and engage the students	Assess the quality of the instructional products and processes, both before and after implementation
Common Procedures	1. Validate the performance gap 2. Determine instructional goals 3. Confirm the intended audience 4. Identify required resources 5. Determine potential delivery systems (including cost estimate) 6. Compose a project management plan	7. Conduct a task inventory 8. Compose performance objectives 9. Generate testing strategies 10. Calculate return on investment	11. Generate content 12. Select or develop supporting media 13. Develop guidance for the student 14. Develop guidance for the teacher 15. Conduct formative revisions 16. Conduct a Pilot Test	17. Prepare the teacher 18. Prepare the student	19. Determine evaluation criteria 20. Select evaluation tools 21. Conduct evaluations
	Analysis Summary	Design Brief	Learning Resources	Implementation Strategy	Evaluation Plan

Chapter 2

Design

Contents

Introduction to Design Phase	60
Conduct a Task Inventory	61
Compose Performance Objectives	68
Generate Testing Strategies	71
Calculate Return on Investment	73
Cost/Benefit for the Sample Case	76
Result: Design Brief	81

Abstract The purpose of the Design phase is to verify the desired performances and appropriate testing methods. Upon completion of the Design phase, you should be able to prepare a set of functional specifications for closing the performance gap due to a lack of knowledge and skills. The Design phase establishes the “Line of Sight” for progressing through the remaining ADDIE phases. Line of Sight refers to an imaginary line from the eye to a perceived object. An example of the line-of-sight concept is in communication where the transmitter and receiver antennas are in visual contact with each other. Line-of-Sight theory supposes that in order to view an object, you must sight along a line at that object; and when you do light will come from that object to your eye along the line of sight. Line of Sight is presented here as a practical approach for maintaining an alignment of needs, purpose, goals, objectives, strategies, and assessments throughout the ADDIE process. The varying levels of expertise among the stakeholders participating in the ADDIE process, and other contextual variables, require maintaining the line of sight throughout the entire ADDIE process. The notion of line of sight will directly influence the design team’s management and development activities. Activities beyond the scope of the project and matters unrelated to closing the performance gap may obfuscate the line of sight. During the client meeting where the Design Brief is delivered, there should be a high degree of confidence about the pathway to closing the performance gap.

Key Words Design · Process · Plan · Scope · Line of sight · High fidelity · Stakeholder · Project management · Testing

Introduction to Design Phase

The purpose of the Design phase is to verify the desired performances and appropriate testing methods. The common procedures associated with the Design phase are as follows:

1. Conduct a task inventory
2. Compose performance objectives
3. Generate testing strategies
4. Calculate return on investment

Upon completion of the Design phase, you should be able to prepare a set of functional specifications for closing the performance gap due to a lack of knowledge and skills. The Design phase established the “Line of Sight” for progressing through the remaining ADDIE phases. Line of Sight refers to an imaginary line from the eye to a perceived object. An example of the line-of-sight concept is in communication where the transmitter and receiver antennas are in visual contact with each other (Fig. 2.1). Line-of-Sight theory supposes that in order to view an object, you must sight along a line at that object; and when you do light will come from that object to your eye along the line of sight. Line of Sight is presented here as a practical approach for maintaining an alignment of needs, purpose, goals, objectives, strategies, and assessments throughout the ADDIE process (Fig. 2.2).

Due to the variety of procedures associated with the ADDIE process, the varying levels of expertise among the stakeholders participating in the ADDIE process, and other contextual variables as well, maintain the line

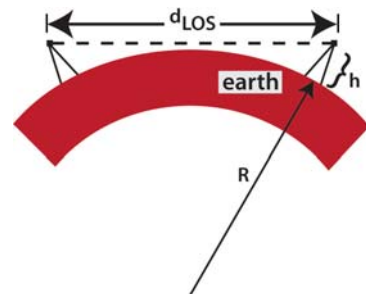
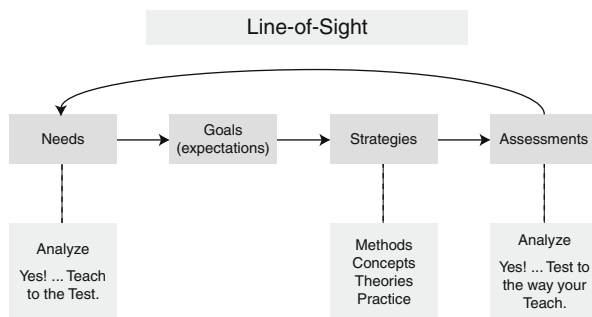


Fig. 2.1 Line-of-Sight concept

Fig. 2.2. Line of Sight applied to ADDIE



of sight throughout the entire ADDIE process deserves special attention. The notion of line of sight will directly influence the design team's management and development activities. Activities beyond the scope of the project and matters unrelated to closing the performance gap may obfuscate the line of sight. Identify strategies for maintaining line of sight throughout the ADDIE process and correct alignment problems early and often.

The result of this phase is a Design Brief. Common components of a Design Brief are as follows:

1. A task inventory diagram
2. A complete set of performance objectives
3. A complete set of test items
4. A testing strategy
5. A return on investment proposal

During the client meeting where the Design Brief is delivered, there should be a high degree of confidence about the pathway to closing the performance gap. If the client is satisfied, then obtain the appropriate endorsements and proceed to the Develop Phase. The remainder of this chapter is devoted to the common procedures of the Design phase.

Conduct a Task Inventory

Objective	Identify the essential tasks required to achieve an instructional goal.
You Should Already Know	1. The instructional goals 2. General characteristics of the student groups 3. All of the resources required to complete the ADDIE process 4. The probable delivery system

- 5. General budgets
- 6. The core team members and their primary tasks

Content

Introduction

Conducting a Task Inventory is the first procedure in the Design phase of the ADDIE process. Although the client may not see the Task Inventory, a task inventory is important because it

- 1. Specifies the desired performances
- 2. Identifies the primary learning tasks required to achieve a goal
- 3. Inventories the steps required to perform complex tasks
- 4. Facilitates a way to determine learner readiness

A Task Inventory logically organizes the content so that the students can construct the knowledge and skills necessary to achieve the instructional goals. The term inventory literally means a complete list of items. The items, within this context, refer to the performance tasks required by the student to achieve an instructional goal. The result of a Task Inventory is a diagram that specifies the *essential* Tasks Required to accomplish the instructional goals (see generic example in Fig. 2.3).

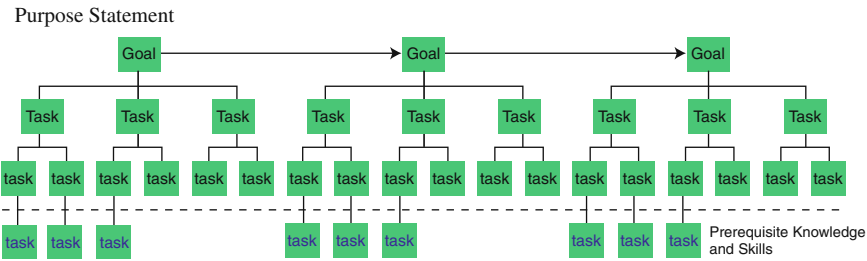


Fig. 2.3. Example of a generic Task Inventory

Assumptions¹

Some assumptions associated with the concept of task inventory are as follows:

¹ (Adapted from Task Analysis Methods for Instructional Design Jonassen, Tessmer & Hannum, 1999, pp. 3-5.)

- 1. That a task inventory is essential to good instructional design
- 2. That a task inventory is the least understood component of the instructional design process
- 3. That a task inventory is less than an exact science
- 4. That a task inventory is only as reliable as the last verification
- 5. Different contexts demand different inventory methods, in other words, *one size does not fit all!*

The concept of a task inventory within the context of instructional design is a way to identify the essential items that need to be learned in order to accomplish a particular goal. This instructional design procedure is often referred to as task analysis. Instructional goals can be analyzed according to the knowledge, skills, attitudes, and procedures that one must perform in order to achieve a goal. Goals are broad and general descriptions of knowledge, skills, attitudes, and procedures. A task inventory specifies the performances required to achieve the instructional goals.

Task = An apportionment of work; usually an assigned piece of work intended to be finished within a certain period of time. This section focuses on three types of tasks:

- 1. Cognitive tasks
- 2. Motor tasks
- 3. Procedural tasks

(see Fig. 2.4)

<i>Cognitive Task</i>	Involves <i>thoughts, ideas, and perceptions</i>	Knowledge
<i>Motor Task</i>	Involves <i>physical</i> exertion	Skill
<i>Order Task</i>	Involves a <i>sequence</i> of tasks	Procedure

Fig. 2.4 Three categories of performance tasks commonly associated with instructional design

Performance Task

Performance tasks represent several types of learning and various levels of learning. Consider Bloom’s Taxonomy in Fig. 2.5 as an example.

Knowledge	· Observation and recall of information · Knowledge of dates, events, places · Knowledge of major ideas
Comprehension	· Translate knowledge into new context · Interpret facts, compare, contrast · Order, group, infer causes
Application	· Use information · Use methods, concepts, theories in new situations · Solve problems using required skills or knowledge
Analysis	· Seeing patterns · Organization of parts · Identification of components
Synthesis	· Use old ideas to create new ones · Generalize from given facts · Relate knowledge from several areas
Evaluation	· Compare and discriminate between ideas · Assess value of theories, presentations · Verify value of evidence

Fig. 2.5 Adapted from Bloom, B.S. (Ed.) (1956) Taxonomy of educational objectives: The classification of educational goals: Handbook I, cognitive domain. New York; Toronto: Longmans, Green

The four steps for conducting a Task Inventory are as follows:

- First.* Repeat the Purpose Statement
- Second.* Reaffirm the Instructional Goals
- Third.* Identify the primary performance tasks
- Fourth.* Specify prerequisite knowledge and skills

Step 1: Repeat the Purpose Statement

The purpose statement has probably evolved since the end of the Analyze Phase. Therefore, the most current statement

should be repeated to assure that all stakeholders refer to the same purpose.

Step 2: Reaffirm the Instructional Goals

Reaffirm the instructional goals as they relate to the stated purpose. The goals should complement the Purpose Statement. See the following examples in Fig. 2.6.

Purpose Statement	Instructional Goals
The purpose of this initiative is to develop skills and incorporate a Change Management process part of the project manager’s responsibility	1. Define change management 2. Promote consistent use of change management terminology 3. Create awareness of the change management process 4. Integrate change management into the project management process 5. Assess stakeholder willingness to accept change
The purpose of this training is to provide teachers with effective strategies for using modeling-based inquiry with Astronomicon in their 9–12 classrooms	1. Describe models using basic and complex astronomical concepts 2. Explain the function and meaning of each menu item of the Astronomicon software 3. Prepare a lesson plan for modeling-based inquiry activities using the Astronomicon software 4. Teach complex astronomy concepts using Astronomicon models 5. Assess the quality of peer and facilitator lesson plans using Astronomicon software

Fig. 2.6 Examples of complementary purpose statement and goal statements

Step 3: Identify the Essential Performance Tasks

Identify the essential tasks required to achieve an instructional goal. Identifying the essential tasks is accomplished through the following data collection strategies:

- a. Observation of skilled performers
- b. Videotape review of skilled performers
- c. Interviews
- d. Technical manual review
- e. Documentation review
- f. Focus groups
- g. Complete the task yourself

The following process techniques can facilitate the data collection process during independent work and teamwork as well:

- a. Flip charts
- b. Bulletin boards
- c. Concept maps
- d. Sticky notes
- e. Compiling separate diagrams for each goal inventory (Fig. 2.7)

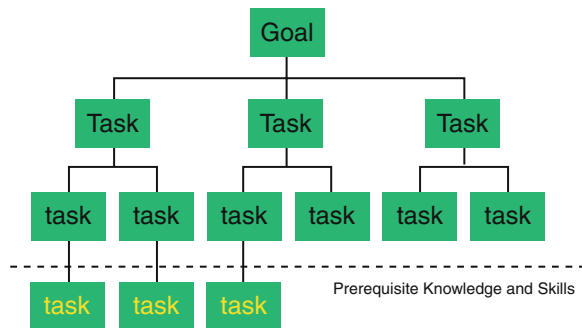


Fig. 2.7 Example of a single Goal Inventory

Guidelines for Constructing a Task Inventory

1. *All* tasks should begin with a performance verb [including prerequisites]
2. Tasks should *not* include the conditions for the performance
3. Tasks should *not* include the criterion for the performance
4. Do not repeat any tasks in the entire inventory diagram
5. Each task statement should be as specific as possible
6. Each task statement should be measurable
7. Use a visual convention for separating the prerequisites from the other tasks, such as a broken line
8. The inventory diagram should flow up and over to the right
9. Avoid the words “*Learn*,” “*know*,” and “*Understand*”
10. No objectives yet!

Practice Opportunity Identify the essential tasks for one of the instructional goals that you determined earlier from the *Firefighter Case* in Appendix A.

Directions

1st : Write the current Purpose Statement.

2nd : Select *one Instructional Goal*.

3rd : Identify *all* of the essential tasks required to achieve the selected instructional goal.

4th : Identify at least one level of prerequisite tasks.

5th : Create a diagram of a your single goal inventory.

- Closure**
1. The task is the foundation for a performance objective
 2. Performance objectives are the reference points for the remainder of the ADDIE process
 3. The next procedure is to compose performance objectives

Compose Performance Objectives

- Purpose** Compose objectives that include a condition component, a performance component, and a criterion component.
- You Should Already Know**
1. All of the main performance tasks for each of the instructional goals that have already been determined
 2. The capabilities and the general abilities of the students who will likely be engaged in the intentional learning environment
 3. The prerequisite tasks required in order to start the intentional learning process
- Content** Objectives are like the destination for a trip you're about to take. They're the end point that you have in mind as you begin to plan your trip. A performance objective is the destination for an instructional episode. A performance objective defines the
1. Performance the student should exhibit before considered competent
 2. Condition under which the performance is measured
 3. Acceptable standard of the student's performance

There should be high congruence between the performance objectives and the instructional goals. While the instructional goals provide the general expectations, performance objectives provide the specific expectations.

An objective provides a way to judge when a specific desired performance has been attained. Categories of learning such as Bloom's Taxonomy can be used to specify learning outcomes.

Cognitive Domain

The cognitive domain is divided into several levels with the lowest skill level placed on the bottom level and the higher levels radiating upward:

- Evaluation (Highest level)
- Synthesis
- Analysis
- Application

- Comprehension
- Knowledge (Lowest level)

A performance objective provides guidance for

- a. The proper testing methods
- b. The selection of content
- c. The selection or development of media
- d. Determining appropriate instructional strategies
- e. Assessing student readiness
- f. Measuring student achievement
- g. Identifying the knowledge and skills required by the teacher
- h. Required resources
- i. Translating performance tasks into student actions that can be measured

There are three components of a performance objective:

1. *Performance*
What the student will do?
2. *Condition*
Important circumstances under which the performance is expected to occur.
3. *Criteria*
The quality or standard of performance that is considered acceptable.

See the three-component performance objectives examples below:

1. Write a job description for a project manager prior to the next team meeting using 750 words (+ or – 50 words), and approved by your immediate supervisor.
2. Establish project parameters during an initial client meeting consistent with standard operating procedures.
3. Create the foundation layer for a patchwork quilt using cotton blend fabric according to the samples on display.
4. Generate a mnemonic for memorizing the four aerodynamic forces to use during the construction of a 20:1 scale model airplane.

**Practice
Opportunity**

First, Critique the objectives in Fig. 2.8.
Second, Compose two to three performance objectives for your work area (Fig. 2.9).

Objectives Critique Exercise	
Directions 1. Below are some sample objectives. Circle the components that appear correctly in the objective (C = <i>Condition</i> P = <i>Performance</i> S = <i>Criteria</i>). 2. Rewrite any parts of the objective that you think are missing or need to be improved.	
A. While preparing a cake for a group of diabetic residents in a long-term care facility, add heavy cream according to the guidelines established by the National Dieticians Society. Any Revisions? _____	
B. Given human anatomy charts (male and female), students will be able to locate and label human reproductive organs 100% correctly based on human anatomy guide of the class. Any Revisions? _____	
C. Having viewed the movie “Deep Impact,” students will propose at least two pros and two cons as evidence to judge the consequences of providing advanced warning for an impending Earth impact. Any Revisions? _____	
D. After 2 days of grilling lesson, grill a chicken. Any Revisions? _____	
E. Exchange e-mail with other students. Any Revisions? _____	
F. Understand the Bill of Rights for the Constitution of the United States of America. Any Revisions? _____	

Fig. 2.8 Objective statements of varying degrees of quality

Performance	
Condition(s)	
Criteria	
Performance	
Condition(s)	
Criteria	
Performance	
Condition(s)	
Criteria	

Fig. 2.9 Template for composing with performance, condition and criteria components objectives

- Closure
1. Confirm that the objectives are congruent with the Instructional Goals.

2. Begin to think about the best ways to generate e-learning opportunities that will help the student accomplish the performance objectives.

Generate Testing Strategies

Objective	Create items to test student performance.
You Should Already Know	That the criterion component of a performance objective provides the standard of measure for determining success.

Content Testing is an integral part of performance-based learning. Testing provides feedback to the teacher about whether learning is occurring, to the learner about the progress he or she is making toward accomplishing the performance tasks, and to the designer about how well the instruction is facilitating the goals and objectives.

The performance task is essentially the test. Testing strategies should have high fidelity between the task, the objective, and the test item. Test items should be authentic and simulate performance space.

It is important to discover answers to the following questions:

- 1. Did the student demonstrate the required performance?
- 2. Did the student meet the criteria for performance?
- 3. Did the student perform under the condition specified?

In other words, testing is necessary to discover whether or not the student accomplished the goals and objectives as determined during the ADDIE process.

Performance Match

The performance required by the student should match one of Bloom’s levels of learning.

Condition Match

The test should also be congruent with the condition that appears in the objective.

Criteria Match

The criteria used in the test should also be congruent with the criteria stated in the objective.

<i>Sample</i>		
Task	Objective	Test Item
Draw a floor plan	Draw a floor plan to give to the building contractor that satisfies all county codes and regulations	Using a computer-aided design tool, draw a floor plan for the lower level of a new home construction of approximately 1,175 square feet

Practice Opportunity

Apply what you’ve learned about *Generating Testing Strategies* to the *Firefighter Case* in Appendix A using the template in Fig. 2.10.

Directions

1. Select a task from the Firefighter Case.
2. Select a corresponding performance objective from the Firefighter Case.
3. Generate a test item congruent with each performance objective.

Task	Objective	Test item

Fig. 2.10 Template for practice composing performance objectives

Closure

1. The higher the congruency between the task, objective, and test item, the better potential for a successful course of study and companion learning resources.
2. The greater the authenticity of the instructional strategies and the learning resources, the greater potential for the course of study to close the performance gap.
3. Remember: you are limited only by your creativity.

Calculate Return on Investment

Objective

Estimate the cost for completing the entire ADDIE process.

You Should Already Know

The goals, objectives, testing strategies, and all of the resources required to complete the entire ADDIE process.

Calculating ROI

The procedure for calculating ROI is as follows:

1. Calculate the training costs
2. Calculate the benefits derived from the training
3. Compare the training benefits to the training costs

The formula looks as follows:

$$\text{ROI (In Percentage)} = \frac{\text{Training Benefits}}{\text{Training Costs}} \times 100$$

What Do the Figures Mean?

- If the figure that results from the calculation is greater than 100%, then the benefit the training provides outweighs the cost.
- If the figure that results from the calculation is less than 100%, then the costs of the training outweigh the benefit.

Calculating Training Costs

In order to determine the costs of the training, re-evaluate and further refine the costs you estimated during the Analysis Phase. Now that you have designed the training, you should be able to closely approximate actual costs for each phase.

Re-estimate the costs for each ADDIE phase:

Analyze
Design
Develop
Implement
Evaluate

Calculate Analyze Costs

One of the most overlooked expenses of curriculum development is the cost of analysis. At this point in the ADDIE process, you can actually total the costs you incurred during the Analysis phase.

The costs involved usually include items such as

- Salary for the person's who conducted the analysis (based on actual time spent on analysis)
- Travel and meals
- Office supplies
- Printing
- Equipment expenses

Sample Case

Look at the example presented in the *Sample Case*.

Design Costs

Next, re-calculate the Design costs based on actual costs incurred.

Costs for the Design phase include items such as

- Designer's time
- Travel and meals
- Office supplies
- Printing
- Equipment expenses

Develop Costs Now, re-estimate the costs for the Develop phase based on a more specific design concept.

Costs for the Development phase include items such as

- Designer time for development of the Facilitator and Participant Guides
- Media development costs
- CBT development costs
- Graphic artist costs
- Desktop production costs
- Travel and meals
- Office supplies
- Printing
- Equipment expenses

Sample Case

In the Sample Case, it was decided during the Design phase to produce two videos instead of one, one in Spanish and one in English. The revised development costs reflect the increased costs of production.

Implement Costs Next, re-estimate the costs for Implementing the training based on your revised Analysis and proposed Design. Costs for the Implement phase of the process include items such as

- Participant time (based on average salary)
- Facilitator time (based on average salary)
- Participant travel and accommodation costs
- Facilitator travel and accommodation costs
- Printing of materials
- Tracking and scheduling costs
- Facility costs

Evaluate Costs Lastly, revise your estimates of the cost to Evaluate the training based on your Evaluation Plan (see Section 6). Costs for the Evaluation phase of the process include

- Evaluator time (based on average salary)
- Evaluator travel costs
- Participant time (based on average salary)
- Office supplies
- Printing
- Equipment expenses

Total Costs Total the costs for each of the five ADDIE phases to obtain your Total Costs.

Sample Case

Notice the (revised) Total Costs for the Sample Case

Cost/Benefit for the Sample Case

Analyze	
Item	Cost
Instructional Designers’ Salaries/Benefits	3,200.00
Meals, Travel, and Incidental Expenses	800.00
Office Supplies and Related Expenses	40.00
Printing and Reproduction	0
Outside Services	0
Equipment Expenses	0
Professional Fees	0
Miscellaneous Expenses	1,000.00
Total	\$5,040.00

Design	
Item	Cost
Instructional Designers’ Salaries/Benefits	2,750.00
Meals, Travel, and Incidental Expenses	0
Office Supplies and Related Expenses	40.00
Printing and Reproduction	0
Outside Services	500.00
Equipment Expenses	0
Professional Fees	0
Miscellaneous Expenses	0
Total	\$2,790.00

Develop	
Item	Cost
Instructional Designers' Salaries/Benefits	3,200.00
Meals, Travel, and Incidental Expenses	0
Office Supplies and Related Expenses	0
Printing and Reproduction (Manuals)	12,500.00
Production Services	18,000.00
Equipment Expenses	0
Professional Fees	0
Miscellaneous Expenses	0
Total	\$33,700.00

Implement	
Item	Cost
Student (meals, travel, lodging, salaries)	37,500.00
Instructor	17,695.00
Employee Replacement	0
Tracking and Scheduling	100.00
Training Materials and Supplies	500.00
Lost Production	0
Facility	0
Miscellaneous Expenses	0
Total	\$55,795.00

Evaluate	
Item	Cost
Salaries/Benefits	5,040.00
Meals, Travel, and Incidental Expenses	400.00
Learner Expenses	1,200.00
Office Supplies and Expenses	100.00
Printing and Reproduction	0
Outside Services	0
Equipment Expenses	0
Miscellaneous Expenses	0
Total	\$3,700.00

All five ADDIE Phases	
Analysis	5,040.00
Design	2,790.00
Development	33,700.00
Implementation	55,795.00
Evaluation	3,700.00
Total	\$101,025.00

Benefit After the projected costs have been revised, the next step is to quantify the value or benefit that is derived from the training. To determine the benefit, follow these steps:

- Generate a list of potential benefits
- Assign a realistic dollar value to each benefit
- Total the dollar benefits

- Generate a List of Potential Benefits**

Potential benefits of training include
 - Increased productivity
 - Improved safety
 - Decreased costs
 - Increased savings

Sample Case

Benefits expected from trained escalator maintenance technicians as described in the *Sample Case* include cost savings that will result from fewer personal injuries due to escalator malfunctions.

Assign Values

After determining the benefit derived from the training, assign a realistic dollar value to that benefit.

For example, if the result improves productivity, one can estimate how much that productivity would be improved as a result of the training. By multiplying the increased productivity by the average salary of the student, a dollar value can be assigned to the benefit.

Sample Case

The example shown below utilizes cost savings as the potential benefit.

Example

Assign values to the benefits expected from the training described in the Sample Case.

Average Costs Per Escalator Malfunction	
Maintenance cost	\$5,240
Repair cost	\$8,500
Equipment delay	\$2,270
Personal injury liability	\$13,100
Total cost per development	\$29,110

Potential Benefit (\$)

- The total cost of escalator malfunctions per year is \$3,493,200 or $(120 \times \$29,110)$.
- It is estimated that training for escalator maintenance technicians will reduce the number of escalator malfunctions by 25% (50% is thought to be caused by mischievous patrons and improved security is projected to eliminate half of the malfunctions caused by something other than mechanical failure).
- The total cost savings is projected to be \$873,300.

ROI Example Next, calculate the ROI for the *Sample Case* using the formula as follows:

$$\text{ROI (in percentage)} = \frac{\text{Training Benefits}}{\text{Training Costs}} \times 100$$

$$\text{ROI} = \frac{\$873,300}{\$101,025} \times 100 = 864\%$$

The ROI of conducting the training is 864%.

Our calculation shows that conducting the training as planned would return an investment of \$864 for every dollar it invests in the training. (Note: It is *very* unusual for training to provide a return on investment that is as high as this example.)

Closure Be very careful not to overestimate the benefit the client will derive from any single training event. Keep in mind the following facts:

1. Productivity is extremely difficult to raise and keep at a consistently high level
2. Training participants retain only a fraction of skills that are not reinforced on a regular basis
3. Transference from the classroom to the work site depends on many factors including the skill of the designer in designing practice opportunities that simulate the workplace as close as possible

Result: Design Brief

The result of the Design phase is a *Design Brief*. Common components of the Design brief are as follows:

1. A Task Inventory
2. A Comprehensive List of Performance Objectives
3. A Complete Set of Test Items
4. A Comprehensive Testing Strategy
5. A Cost–Benefit Calculation

During the client meeting where the Design Brief is delivered, usually one of two things happen: (A) the client requests changes to the functional specifications or (B) the client is satisfied. If the client request changes, repeat the Design phase or relevant parts of the Design phase and prepare a revised Design Brief. If the client is satisfied, then obtain the appropriate endorsements and proceed to the Develop phase.