Electronic Performance Support for E-Learning Analysis and Design

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Electronic Performance Support for E-Learning Analysis and Design

by

Thomas W. Jury

A dissertation submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy in Computing Technology in Education

Graduate School of Computer and Information Sciences
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March 2007

Corporate instructional designers often follow an instructional systems design (ISD) process to plan, create, and implement training programs. Increased demand for e-learning as a replacement or addition to classroom training means that, in the current corporate environment, instructional designers are called upon to produce a wide variety of instructional formats and have to make more decisions during the ISD process.

E-learning is evolving into a total performance improvement solution rather than simply as a means to delivering distance training and consequently, in an effort to achieve business goals, many corporations are turning to it as a cost effective way to deliver training and support to employees and customers. Corporate e-learning applications can incorporate knowledge management and electronic performance support as well as support for multiple formats of online learning, adding to the complexity of the instructional designer’s job and the ISD process. While the ISD process is well documented and numerous operational models exist, instructional designers often have difficulty in its application given the complexity of an e-learning application.

The study analyzed the impact of an experimental electronic performance support system (EPSS) on the performance of e-learning instructional designers. An EPSS intended to provide assistance during the analysis and design stages of an e-learning project was created to aid corporate instructional designers make tradeoffs among time, cost, and quality of various analysis and design procedures and techniques. Formative reviews by instructional designers experienced in e-learning added to the validity of the contents of the EPSS. Summative evaluators pilot tested the EPSS by using it in conjunction with the analysis and design activities of three corporate e-learning projects.

Evaluation results indicated that an instructional design EPSS can help designers sequence and prioritize tasks, allocate time and resources to task execution, and focus tasks on user performance and client goals.
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Chapter 1
Introduction

Problem Statement

The use of technology to deliver training continues to increase in U.S. corporations. More than 35% of all U.S. corporate training was technology-based in 2005; 60% of that was e-learning and almost 90% of that was self-paced (ASTD, 2006). Since more than $109 billion is being spent annually on workplace learning and performance, improving training results is a major business driver for many corporations (Ketter, 2006). Companies are opting for e-learning over more traditional classroom courses due to the increasing mobility of the workforce and the need to save on training costs. While often more expensive to create than classroom courses, it can quickly return those investments in reduced student and instructor travel costs. In addition, it can provide flexible content that can be easily updated and focused on individual employee needs which affords competitive advantages to large and small companies alike (Britt, 2004).

The design and development of corporate e-learning programs is generally the responsibility of instructional designers who usually follow a documented and standard structured process termed instructional systems design (ISD). Throughout the development process, instructional designers are continually making decisions and compromises as they execute ISD tasks. Generally, those decisions involve tradeoffs.
among time, cost, and quality. Time includes not only the period of time required for
development and implementation, but can also take into account the time when the
business or organizational effects pay off. Cost is often a measure of the outlay of dollars
spent in development and implementation, but also can include the opportunity lost by not
doing something else—either by the learners or the organization. Quality often describes
the sophistication of the look and feel of the developed product but should also measure
the increased performance of learners and increased organizational impact. During design
and development of an e-learning product, instructional designers often attempt to increase
their efficiency by minimizing the time and cost while maximizing the quality (Liu, Gibby,
Quiros, & Demps, 2001).

The problem is when designers follow the traditional ISD process in a lock-step
fashion they frequently fail to deliver e-learning solutions that meet their organization’s
business needs. Some training experts and scholars have characterized the standard ISD
process as too slow and clumsy to meet a corporation’s business goals of delivering up-to-
date training quickly to a diverse workforce. Instructional designers who adhere rigidly to
the ISD process often produce results that are too late to support the organization’s needs,
do not help learners perform critical job tasks, are over budget, or all three, thus offsetting
the potential business benefits of e-learning (Gordon & Zemke, 2000). Even seasoned
instructional designers have a tendency to over mechanize the process (Rieber, 2006).

Grennagel (2002) maintains that most e-learning programs do not take full
advantage of the capabilities of the current Internet-based computing systems because of
three interrelated major reasons. First, instructional designers do not appear to be
cognizant of how people learn and they continually use flawed instructional models.
Second, the motive of low cost, reinforced by corporations interested in throughput rather than learning gains, perpetuates cheaply developed programs. Third, the available platform technology drives the instructional strategy, which may not be appropriate to the learning style of trainees.

Some instructional designers have access to one of several electronic performance support tools that provide guidance and advice during the ISD process. These tools often automate parts of the ISD process or provide guidance in the use of one or more ISD design methodologies. In general, performance support systems that aid planning and evaluation phases of instructional design are not as widely used by practitioners as tools that automate or assist in the authoring and media production phases (Kasowitz, 2000).

**Dissertation Goal**

The goal was to develop and validate a set of heuristics (guidelines or decision support tools) to aid instructional designers’ decision making during the analysis and design phases of the development of corporate e-learning products, to integrate those heuristics into an electronic performance support system (EPSS) for e-learning developers, and evaluate the effectiveness of those heuristics during the analysis and design activities of one or more e-learning projects. An EPSS is an information technology that provides integrated training, guidance, advice, information, examples, and tools to support the user in the execution of a task or process at the time of need (Gery, 1991).

Heuristics or guidelines were assembled and incorporated into a decision support tool for each task or procedure within the e-learning analysis and design phases. Each heuristic was designed to provide instructional designers:
• a rationale or reason for the analysis or design task to be performed,
• standards or principles that would lead the instructional designer to efficient execution of the task or procedure, and
• evaluation criteria to help the instructional designer gauge the quality of the task outputs.

Taken as a whole, this set of heuristics are intended to assist instructional designers make judgments about the applicability of each analysis or design task for a given project and how its expected outcome will impact the overall project quality, time, and cost.

The study focused on the analysis and design phases of the ISD process, often referred to as the ADDIE (analysis, design, development, implementation, evaluation) model. Analysis involves investigation and research into the performance problem or issue in order to determine project requirements. The purpose of the analysis phase of the ADDIE model is to understand the problem well enough that an appropriate solution can be designed, developed, and implemented. Design consists of creating the plan, approach, and architecture for the proposed solution. Development is the creation of the materials and assets and incorporating them into a solution as specified in design. Implementation is the execution of the solution or product, usually according to the plans defined during design. Evaluation involves both formative and summative evaluation to ensure that the developed product meets analysis requirements. Evaluation plans are generally determined during design. While instructional designers make decisions during all ADDIE phases, major decisions that have the greatest impact on the final e-learning product occur during analysis and design (Peterson, 2003).
Research Questions

The primary research issue that was addressed was to determine the effectiveness of an EPSS that includes guidelines or heuristics to aid instructional designers make decisions concerning quality, cost, and time tradeoffs during e-learning projects. Reviews and revisions of those heuristics by experienced practicing instructional designers added validity to the results. Specific questions included:

1. What are the comprehensive analysis and design tasks for e-learning (online learning, knowledge management, and EPSS) development?

2. What heuristics would guide instructional designers during the analysis and design phases of the e-learning instructional systems design process?

3. In what ways would a set of heuristics or guidelines be beneficial to a corporate e-learning designer?

4. How do practicing instructional designers view the value of an EPSS containing analysis and design heuristics in making priority, resource, and scheduling decisions during a corporate e-learning project?

Definitions

ADDIE Model
Classical model of instructional systems design (ISD) that includes the phases analysis, design, development, implementation, and evaluation (Molenda, 2003).

Analysis
The first phase in the ADDIE model. In the analysis phase the audience is defined and performance improvement needs are identified (Gustafson & Branch, 2002).
Artificial Intelligence
The range of technologies that allow computer systems to perform complex functions mirroring the workings of the human mind. Gathering and structuring knowledge, problem solving, and processing natural language are activities possible by an artificially intelligent system (Preece, Rogers, Sharp, Benyon, Holland, & Carey, 1994).

Asynchronous Training/Learning
A learning program that does not require the student and instructor to participate at the same time. Learning in which interaction between instructors and students occurs intermittently with a time delay. Examples are self-paced courses taken via the Internet or CD-ROM, Q&A mentoring, online discussion groups, and e-mail (Bielwaski & Metcalf, 2005).

Authoring System or Authoring Tool
A program, like Macromedia Authorware, designed for use by a non-computer expert to create training products. An authoring system does not require programming knowledge or skill and can be used by non-programmers to create e-learning programs usually via a book or flowchart metaphor (Author).

Computer-aided Instruction (CAI)
The use of a computer as a medium of instruction for tutorial, drill and practice, simulation, or games. CAI typically does not require that the computer be connected to a network or provide links to learning resources outside of the learning application (Reiser, 2002).

Computer-based Training/Learning/Education (CBT, CBL, CBE)
An umbrella term for the use of computers in both instruction and management of the teaching and learning process. CAI (computer-assisted instruction) and CMI (computer-managed instruction) are included under the heading of CBT. Sometimes the terms CBT and CAI are used interchangeably (Kaplan-Leiserson, 2005).

Computer-managed Instruction
The use of computer technology to oversee the learning process, particularly the scheduling, testing, and record keeping aspects of a set of courses or training programs. See Learning Management System (Kaplan-Leiserson, 2005).

Delivery Method
Any method of transferring content to learners, including instructor-led training, Web-based training, CD-ROM, books, teleconferencing, and more (Kruse, 2004).

Design
The second phase in the ADDIE model. The design phase builds on the analysis information and includes the formulation of a detailed plan for the development, implementation, and evaluation of the learning product or program (Gustafson & Branch, 2002).
Designer
Technically refers to an instructional designer, but is often used to describe any member of an e-learning or training project team, usually referring to creators such as writers, graphic artists, and programmers. Sometimes used synonymously with the term developer (Kruse, 2004).

Developer
Used to describe a member of an e-learning or training project team who is involved in development activities or the project team as whole. Could refer to an instructional designer, programmer, graphic designer, technical writer, or project manager (Kruse, 2004).

Development
The third phase in ADDIE model. In the development phase the project team creates the e-learning or instructional assets and programs the application according to the plans devised during the design phase (Gustafson & Branch, 2002).

Distance Education/Learning
Distance learning is defined as an education process in which the majority of the instruction occurs when student and instructor are not in the same place. Distance learning may employ correspondence study, or audio, video, or computer technologies. Most distance learning programs include a computer-based training (CBT) system and communications tools to produce a virtual classroom. Generally, students communicate with faculty and other students via e-mail, electronic forums, videoconferencing, chat rooms, bulletin boards, instant messaging and other forms of computer-based communication (Author).

E-Learning
E-learning is delivered via a network, using standard and accepted Internet technologies, and expands the notion of learning solutions beyond typical training models to include new learning concepts such as performance support tools and knowledge management. E-learning includes learning, but also encompasses other performance enhancing functions such as information support and coaching, knowledge management, interaction and collaboration, and guidance and tracking (Rosenberg, 2006b; Rossett, 2002).

Electronic Performance Support System (EPSS)
An information technology that gives users integrated and immediate access to information, guidance, coaching, training, and other electronic resources necessary for the completion of a job task at the time of need to enable competent job performance with minimal support and intervention by others (Gery, 1991).

Enabling Objective
A statement in behavioral terms of what is expected of the student in demonstrating mastery at the knowledge and skill level necessary for achievement of a terminal learning objective or another enabling objective (Kruse, 2004).
End User
The person for whom a particular technology is designed; the individual who uses the technology for its designated purpose. In e-learning, the end user is usually the student (Kaplan-Leiserson, 2005).

Evaluation
The final phase of the ADDIE model. A systematic method for gathering information about the impact and effectiveness of a learning program. Results of the evaluation can be used to improve the program, determine whether the learning objectives have been achieved, and assess the value of the offering to the organization (Gustafson & Branch, 2002).

Expert System
An artificial intelligence application containing a domain-specific knowledge base which provides decision support based upon the collected knowledge of a group of experts (Kasowitz, 2000).

Flowchart
A graphic representation of a program in which symbols represent logical steps and flowlines define the sequence of those steps. Used to design new programs and to document existing programs. Flowcharts can also be used to represent a work or manufacturing process, organizational chart, or similar formalized structure (Alessi & Trollip, 2001).

Formative Evaluation
Evaluation performed any time during the instructional design process that is intended to provide the project team with information about a program’s quality and is used to make revision and improvements prior to a program’s release (Dick, Carey, & Carey, 2005).

Graphic User Interface (GUI)
A way of representing the functions, features capabilities, and content of a computer program by way of visual elements such as icons and menus (Alessi & Trollip, 2001).

Human Computer Interaction (HCI)
The study of how people interact with computers and to what extent computers are or are not developed for successful interaction with people (Preece et al., 1994).

Heuristic
Relating to solving problems by experience rather than theory. A common sense rule (or set of rules) intended to increase the probability of solving some problem (Abel, 2003).

Hypermedia
Applications or electronic documents that contain dynamic links to other media such as audio, video, or graphics files (Alessi & Trollip, 2001).
Hypertext
A computer-based text retrieval system that enables a user to access particular locations in Web pages or other electronic documents by clicking on links within specific Web pages or documents. At its most sophisticated level, hypertext is a software environment for collaborative work, communication, and knowledge acquisition (Alessi & Trollip, 2001).

Implementation
The fourth phase in the ADDIE model. The implementation phase involves the delivery of instruction to the intended audience. (Gustafson & Branch, 2002).

Instructor Led Training (ILT)
Usually refers to traditional classroom training, in which an instructor teaches a course to a room of learners. Also known as on-site training or classroom training (Kaplan-Leiserson, 2005).

Instructional Designer
An individual who applies a systematic methodology based on instructional or learning theory to create content for learning (Richey, Fields, & Foxon, 2001).

Instructional Systems Design (ISD)
The systematic use of principles of instruction to ensure that learners acquire the skills, knowledge, and performance essential for successful completion of their jobs or tasks. (Dick, Carey, & Carey, 2005).

Interactivity
A computer program feature that requires a user to do something to control the application (Kruse, 2004).

Interactive Multimedia
An application involving substantial user input or control and presenting at least two of the following: text, graphics, sound, image, video, and animation. Applications can be in the areas of education, entertainment, information and publishing, and transactions (Alessi & Trollip, 2001).

Internet-based Training
Training delivered primarily by TCP/IP network technologies such as e-mail, newsgroups, propriety applications, and so forth. Although the term is sometimes used synonymously with Web-based training, Internet-based training is not necessarily delivered over the World Wide Web, and may not make use of HTTP and HTML technologies that make Web-based training possible (Kaplan-Leiserson, 2005).

Job Aid
Any simple tool that helps a worker do his or her job. Job aids generally provide quick reference information rather than in-depth training (Author).
Knowledge Engineering
Knowledge engineering is the art and science that goes into creating computer systems that are able to emulate the behavior of human experts with particular domains of knowledge (Raybould, 1995).

Knowledge Management (KM)
The process of capturing, organizing, and storing information and experiences of workers and groups within an organization and making it available to others. By collecting those artifacts in a central or distributed electronic environment, often in a database called a knowledge base or knowledge repository, knowledge management attempts to help an organization gain a competitive advantage (Bielwaski & Metcalf, 2005).

Learning Objective
A statement establishing a measurable behavioral outcome, used as an advanced organizer to indicate how the learner’s acquisition of skills and knowledge is being measured or as a design engineering methodology to define learning requirements (Dick, Carey, & Carey, 2005).

Learning Management System (LMS)
Software that automates the administration of training. The LMS registers users, tracks courses in a catalog, records data from learners, and provides reports to management. An LMS is typically designed to handle course by multiple publishers and providers. It usually does not include any authoring capabilities; instead it focuses on managing courses created by other sources (Kaplan-Leiserson, 2005). See Computer-Managed Instruction.

Multimedia
Encompasses interactive text, images, sound, and color. Multimedia can be anything from a simple PowerPoint slide show to a complex interactive simulation (Alessi & Trollip, 2001).

Online Learning
Usually learning delivered by Web-based or Internet-based technologies. See Web-based Training and Internet-based training.

The term online learning is often used to define any one of a variety of educational delivery formats. Usually online learning is primarily characterized as an asynchronous learning network in which participants are geographically distributed and communicate asynchronously via Internet technologies such as e-mail, discussion groups, and Web pages.
At times, online learning means distance learning, where the students and the instructor are physically located in different locations. At other times, online learning can mean that individual students interact with a computer-based training program, which presents content, provides reinforcement and feedback, and maintains students’ scores. Sometimes, online learning includes the transmission of live video and audio with an instructor conducting class from a TV studio and students attending at remote mini-stations (Shank, & Sitze, 2004).

Performance
The accomplishment of a task in accordance with a set standard of completeness and accuracy (Dick, Carey, & Carey, 2005).

Performance Objective
The performance capability the user should acquire by completing a given training course or by using an e-learning application (Dick, Carey, & Carey, 2005).

Performance Engineering
A process and methodology for building performance-centered information and knowledge-based systems, electronic performance support systems or knowledge management systems (Raybould, 2000b).

Performance-Centered Design
Performance-centered design focuses on improving not only the usability of a system or software application but also the total performance of users. Performance-centered design employs the principles of focusing on users’ performance issues, following an integrated design approach, early and continual user testing, and iterative design (Massey, Montoya-Weis, & O’Driscoll, 2002).

Pilot Test
A version of the training or e-learning project that is delivered to a subset of the target audience, usually in a controlled environment, for an evaluation of its effectiveness (Kruse, 2004). Also referred to as a Validation.

Prototype
A working model created to demonstrate crucial aspects of a program without creating a fully detailed and functional version. Prototypes generally are ‘look and feel’ prototypes which demonstrate an application’s visual appearance or functional prototypes which demonstrate an application’s technical capabilities (Kruse, 2004).

Sharable Content Object Reference Model (SCORM)
A set of specifications, that when applied to electronic course content, produces small, reusable learning objects. A result of the Department of Defense’s Advanced Distributed Learning (ADL) initiative, SCORM-compliant courseware elements can be easily merged with other compliant elements to produce a highly modular repository of training materials (Advanced Distributed Learning, 2004).
Self-paced Instruction/Learning
A learning or training program in which the learner determines the pace and timing of the content delivery, generally without the guidance of an instructor (Kruse, 2004).

Simulation
Highly interactive applications that allow the learner to model or role-play in a scenario. Simulations enable the learner to practice skills or behaviors in a risk-free environment (Alessi & Trollip, 2001).

Subject Matter Expert (SME)
An individual who is recognized as having proficient skills and knowledge in a particular area, topic, or discipline (Dick, Carey, & Carey, 2005).

Storyboard
An outline of a multimedia project in which each page represents a screen to be designed and developed (Alessi & Trollip, 2001).

Subordinate Objective
A task or objective that must first be mastered in order to complete a higher level or terminal objective (Dick, Carey, & Carey, 2005).

Summative Evaluation
An evaluation performed after the training program has been implemented in order to measure the efficacy and return-on-investment of the project (Dick, Carey, & Carey, 2005).

Synchronous Training/Learning
A real-time, instructor-led online learning event in which all participants are logged on at the same time and communicate directly with each other. In this virtual classroom setting, the instructor maintains control of the class, with the ability to ‘call on’ participants. In some platforms, students and teachers can use an electronic shared whiteboard to see work in progress and share knowledge. Interaction may occur via audio or video conferencing, Internet telephony or chat rooms, or two-way live video broadcasts (Kaplan-Leiserson, 2005).

Target Population
The audience for whom a particular training program or course of instruction is intended (Dick, Carey, & Carey, 2005).

Task Analysis
The process of examining a given job or task in order to defined the discrete steps that must be executed in order to ensure effective and efficient performance of the job or task (Jonassen, Tessmer, & Hannum, 1999).
Technology-based Learning/Training (TBL/TBT))
The term encompassing all uses of a computer in support of training including but not limited to tutorials, simulations, collaborative learning environments, and performance support tools. Synonyms include computer-based learning, computer-based education, e-learning, and any number of variations (Kruse, 2004).

Terminal Learning Objective
A learning objective that the student should be able to accomplish after completing a training program (Dick, Carey, & Carey, 2005).

Usability
The measure of how effectively, efficiently, and easily users can navigate an interface, find information, and operate a device, especially a computer application, to achieve their goals (Preece et al., 1994).

User Interface
The components of a computer system employed by a user to communicate and control the computer (Preece et al., 1994).

User-Centered Design
Application design process and philosophy in which the end user’s needs are given highest priority. User-centered design principles include clearly specified, task-oriented business objectives and recognition of user needs, limitations and preferences (Preece et al., 1994).

Validation
The accomplishment of a task in accordance with a set standard of completeness and accuracy. Also, a process through which a course is administered and revised until learners effectively attain the base line objectives (Author).

Web-based Training (WBT)
Delivery of educational content via a Web browser over the public Internet, a private Intranet, or an extranet. Web-based training often provides links to other learning resources such as references, e-mail, bulletin boards, and discussion groups. WBT may also include a facilitator or instructor who provides course guidelines, manages discussion boards, and delivers lectures (Alessi & Trollip, 2001).
Chapter 2

Review of the Literature

The review of the literature summarizes findings in three major areas:

- **E-learning** examines the nature and benefits of e-learning applications and the major functional components that often comprise e-learning applications: online training, knowledge management, and electronic performance support.

- **Instructional systems design and the role of instructional designers** discusses the fundamental principles of the standard instructional systems design process and the manner in which instructional designers implement the process in creating e-learning solutions.

- **Electronic tools for instructional design** describes 14 electronic tools that have been developed and implemented in order to provide support for instructional designers as they execute all or parts of the instructional design process.

**E-Learning**

Corporate training is evolving from a traditional classroom seminar approach to a networked online learning approach, primarily because of the increased accessibility of Internet and Intranet resources. Rosenberg (2001) identifies five trends in corporate learning strategies:
- **From training to performance.** Organizations are focused on outcomes of training rather than on the number of days expended and they are replacing training with a variety of interventions and performance support.

- **From classroom to anytime, anywhere.** Rather than being dependent upon a specific training schedule, learning delivery is being made available 24/7 and accessible from any location.

- **From paper to online.** Online references and resources that can be kept current are replacing paper documents that quickly become outdated.

- **From physical facilities to networked facilities.** Large centralized or regional training centers are being downsized as more and more e-learning solutions are offered via the Internet or organizational intranets.

- **From cycle time to real time.** Learning is a continuous process and the time to create learning materials and resources is decreasing.

  Rosenberg (2006a) terms the response to these collective forces, *e-learning*, “the use of Internet technologies to deliver a rich learning environment that includes broad array of solutions, the goal of which is to enhance individual and organizational performance (p. 72).” E-learning is delivered via a network, using standard and accepted Internet technologies, and expands the notion of learning solutions beyond typical training models to include new learning concepts such as performance support tools and knowledge management. E-learning includes learning, of course, but encompasses other performance enhancing functions such as information support and coaching, knowledge management, interaction and collaboration, and guidance and tracking (Rosset, 2002).
Within the industry definitions of e-learning vary. Rosenberg’s (2006a) and Rossett’s (2002) description of e-learning is more encompassing than other technology-based training professionals’ definitions. In its Web-published glossary, the American Society for Training and Development defines e-learning as “a wide set of applications and processes, such as Web-based learning, computer-based learning, virtual classrooms, and digital collaboration. It includes the delivery of content via Internet, Intranet/extranet (LAN/WAN), audio- and videotape, satellite broadcast, interactive TV, CD-ROM, and more” (http://www.learningcircuits.org/glossary). Within the training industry, e-learning is also referred as Internet-based learning or training, and sometimes as Web-based training, all of which refer to synchronous or asynchronous learning conducted over the Internet, Intranet, extranet, or other Internet-based technologies. E-learning includes a number of different delivery methodologies, including virtual classrooms, online chats, threaded discussions, self-paced learning objects (delivered individually or combined to form modules or courses), simulated environments, and so forth (Kaufman & Brennan, 2004).

However, learners do not master new skills and acquire new knowledge through formal instruction programs alone, they learn in myriad ways—informally from books, magazines, conferences, job experiences, advice from co-workers and supervisors, as well as formal mentoring and on-the-job-training. One of the most significant changes in corporate e-learning practice is the shift from programs that emphasize instruction, either instructor mediated or self-paced, to those that incorporate knowledge management and other forms of learning, such as on-the-job activities, coaching and mentoring, as well as reading online and offline resources (Tyler, 2002). In light of this shift in corporate e-
learning, Bielawski and Metcalf (2005) along with Rosenberg (2006a) specifically include knowledge management and electronic performance support functions along with online training as being the primary components of e-learning applications. Rosenberg (2001) compares and contrasts those three functions: online training, knowledge management, and performance support (Table 1). By optimizing the combination of these three functions, instructional designers attempt to create e-learning solutions in such a way that they can maximize the performance impact on the users and their organization (Bielawski & Metcalf, 2005).

Table 1. Comparision of Online Training, Knowledge Management, and Performance Support

<table>
<thead>
<tr>
<th></th>
<th>Online Training</th>
<th>Knowledge Management</th>
<th>Performance Support</th>
</tr>
</thead>
<tbody>
<tr>
<td>Purpose is to</td>
<td>instruct</td>
<td>to inform</td>
<td>to guide directly</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Requires the</td>
<td>the interruption of work to</td>
<td>Normally requires less work</td>
<td>Least interruption from work</td>
</tr>
<tr>
<td></td>
<td>participate (even online)</td>
<td>interruption than training</td>
<td>(ideally integrated directly into work tasks)</td>
</tr>
<tr>
<td>Program dictates how</td>
<td>user will learn</td>
<td>User determines how he will</td>
<td>Task at hand defines what the tool will do</td>
</tr>
<tr>
<td></td>
<td></td>
<td>learn</td>
<td></td>
</tr>
<tr>
<td>Goal is to</td>
<td>to transfer skill and knowledge to</td>
<td>Goal is to be a resource to</td>
<td>Goal is to assist performance (or to do it completely)</td>
</tr>
<tr>
<td></td>
<td>user</td>
<td>user</td>
<td></td>
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Yuxin and Harmon (2006) propose a conceptual architecture, termed Integrated Working/Learning Environment, which combines knowledge management, electronic performance support, and learning technologies in order to leverage the strong points of each. Knowledge management has strengths in capturing and retrieving of knowledge but lacks a performance support interface; electronic performance support focuses on users’
performance but often overlooks knowledge capturing and storing; learning technologies concentrate on formal training solutions.

Within the Integrated Working/Learning Environment (Figure 1), the performance support tools component provides information, resources, and devices needed by individuals to perform job tasks. The intelligent learning portal component prescribes customized learning experiences and is accessed if and when performance problems cannot be resolved through the performance support tools. The community building and knowledge sharing component is used together with the other two components to enhance learning during social interactions.

**Figure 1. Integrated Working/Learning Environment Components**

<table>
<thead>
<tr>
<th>Performance Support Tools</th>
<th>Intelligent Learning Portal</th>
<th>Community Building and Knowledge Sharing Tool</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Advisory expert systems</td>
<td>• Modeling / visualizing tools</td>
<td>• Groupware</td>
</tr>
<tr>
<td>• Workflow automation systems</td>
<td>• Simulations / microworlds</td>
<td>• Bulletin boards</td>
</tr>
<tr>
<td>• Decision support tools</td>
<td>• Learning tools for facts, concepts, and procedures</td>
<td>• Discussion forums</td>
</tr>
<tr>
<td>• Data mining tools</td>
<td></td>
<td>• Information searching tools (accessing knowledge repositories and directories)</td>
</tr>
<tr>
<td>• Productivity software</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Job specific applications</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>


Raybould (2000b) defines a Performance Support Engineering Maturity Model which depicts five levels of integration of the Information Systems, Documentation, and Training functions within organizations (Figure 2). Raybould’s (2000b) Level Five: Integrated Performance-Centered Information Systems and Knowledge Management Systems is similar to Rosenberg’s (2006a) vision of e-learning as a combination of online learning, knowledge management, and performance support. In Level Five the
Information Systems, Documentation, and Training functions are completely integrated and that integrated function is responsible for managing the knowledge that is delivered to job performers via performance-centered interfaces. Interestingly, Raybould anticipates that this level of maturity or integration will occur sometime around 2010.

**Figure 2. Performance Support Maturity Model**


**Online Training**

Online training involves the use of network technologies to deliver, support, and assess formal and informal instruction (Shank & Sitze, 2004). Essentially there are three major formats of online training—self-paced computer or Web-based training, facilitated asynchronous training, and facilitated synchronous training (Capell & Hayen, 2004; Shank & Sitze, 2004; Bielawski & Metcalf, 2005).
Self-paced computer or Web-based training involves learners taking online courses at their own pace and schedule. This type of training is pre-designed and pre-recorded along with pre-determined learner interaction. Training is usually taken by individuals and their primary interaction is with the pre-recorded instructional content. Occasionally, learners have access to instructional support or a help desk that can provide direction, guidance, or advice regarding the instruction or the training application (Palmer, 2005); however, learners usually do not have access to an instructor or other students for help or collaboration and learner’s feedback consists mostly of online quizzes (Capell & Hayen, 2004). One of the major benefits of this format is its repeatability and consistency of the information provided to all learners (Bielawski & Metcalf, 2005).

Facilitated asynchronous training allows users to participate with an instructor and other students but not at the same time. Feedback and discussions are generally conducted via online discussion boards and other similar technologies (Bielawski & Metcalf, 2005). While learners have some flexibility in the schedule by determining when they participate, the overall pace and assignment deadlines are usually determined by the instructor (Capell & Hayen, 2004).

Facilitated synchronous training is most like a traditional course, there is a set schedule and learners meet in real time through the use of various synchronous Internet or video conferencing technologies (Capell & Hayen, 2004). Sometimes referred to as live online training, this format is actually a virtual classroom. Presentations and instruction are presented via an Internet connection, video-conferencing, or other interactive real-time medium and all participants attend the same presentation at the same time (Palmer, 2005).
The benefit of this format is the two-way real-time communication that can occur with students responding to information and asking questions (Bielawski & Metcalf, 2005).

Online training makes sense when it directly meets the needs of learners and the organization. Technology can provide access to people, opportunities, mentoring, help, and information that would not be available otherwise. With the right conditions, online training technologies can be beneficial to both the organization and the learners (Table 2) (Shank & Sitze, 2004).

### Table 2. Reasons For and Against Online Training

<table>
<thead>
<tr>
<th>Online training makes sense for organizations when:</th>
<th>Online training makes sense for learners when:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• People are comfortable using technology for their information and learning needs.</td>
<td>• They want and need to learn this way.</td>
</tr>
<tr>
<td>• Learning access is improved as a result.</td>
<td>• They have access to technology.</td>
</tr>
<tr>
<td>• Learning generally—and technology-based learning specifically—is vocally and visibly supported by key stakeholders and given the resources to succeed.</td>
<td>• They have enough time and skills to use the technology.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Online training may be a bad idea for organizations when:</th>
<th>Online training may be a bad idea for learners when:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• “Everyone else is doing it” is the reason for doing it.</td>
<td>• They are not comfortable with technology.</td>
</tr>
<tr>
<td>• It does not fit into the organization’s culture or processes.</td>
<td>• They do not have access or time.</td>
</tr>
<tr>
<td>• Resources and support are insufficient.</td>
<td>• They need more interaction and support than will be provided.</td>
</tr>
</tbody>
</table>


Organizations benefit when they need to provide ongoing instruction to a dispersed set of learners and have the right kinds of resources and support. Organizations achieve improved control and standardization because online training presents a consistent message to large groups of learners regardless of the location. Online training enables
faster delivery and cost savings (Muir, 2006). For organizations that need to convey targeted information that quickly becomes outdated, maintaining online modules is usually cheaper and faster than flying instructors and students to remote classrooms and online lessons do not require students to sit in classrooms for a set amount of time (Shank & Sitze, 2004).

Learners benefit from improved access and flexibility. Learners can log in at any Internet-accessible computer terminal, at home or at work, at any time, to complete a lesson or refer to learning materials. Learners also benefit when they have specific learning goals, are provided adequate support, and are willing to accept and use online learning (Shank & Sitze, 2004). In interviews conducted by Baldwin-Evans (2004), learners responded that online training enabled them to learn new skills, meet the requirements of compulsory training, and be more competent and efficient in their day-to-day roles. Because some learners respond better in a visual environment rather than an auditory one, online learning fits some learners’ learning styles better than traditional classroom instruction (Dagada, & Jakovljevic, 2004).

Knowledge Management

In many organizations and corporations, useful knowledge and expertise often reside within particular individuals or groups and is not widely known beyond that group or individual. Current technologies, such as database programs, groupware, intranets and extranets allow organizations to collect, filter, and disseminate that knowledge and expertise in ways that were not previously possible. This practice of identifying, documenting, codifying, and disseminating explicit and tacit knowledge within an
organization in order to improve the organization’s performance has come to be known as knowledge management (Reiser, 2001b).

Knowledge management is an organizational process that enables corporations to identify, gather, organize, refine and disseminate information to employees, customers, and other stakeholders in order to improve their productivity, efficiency, and quality (Miller & Nilakanta, 2001). Organizations generate value from their intellectual and knowledge-based assets using knowledge management processes. Most often, generating value from such assets involves codifying what employees, partners and customers know, and sharing that information among employees, departments and even with other companies in an effort to devise best practices. By collecting those knowledge artifacts in a central or distributed electronic environment, often in a database called a knowledge base or knowledge repository, knowledge management attempts to help an organization gain a competitive advantage. Knowledge management supports the creation, archiving, and sharing of valued information, expertise, and insight within and across communities of people and organizations with similar needs, generally supported by Internet technologies (Rosenberg, 2001).

Most definitions of knowledge management center on developing, preserving, organizing, using, and sharing knowledge. Knowledge management includes not only managing these knowledge assets but also managing the processes of creating, identifying, capturing, organizing, sharing, and adapting the knowledge itself (Nworie & Dwyer, 2004). Knowledge management allows effective control and management of the corporate memory—the knowledge that is within the organization (Bielawski & Metcalf, 2005). Since knowledge is often embedded in an organization in the form of employees’
experiences or memory, it has traditionally been known as organizational memory. This includes not only tacit knowledge, the employees’ personal experiences, intuition, and beliefs, but also stored records, such as corporate manuals, databases, and filing systems. Organizational memory is an important factor in the success of an organization’s operations and its responsiveness to changes and challenges of the marketplace. (Miller & Nilakanta, 2001).

Knowledge management can be organized into three levels: (1) document management, (2) information creation, sharing and management, and (3) enterprise intelligence. Document management involves the use of technology to store and access an organization’s documents, reports, forms, manuals, references, and other electronic records. As the simplest level of knowledge management, document management supports the distribution of information but not its creation, organization, or management of the content. The second level adds information creation, sharing, and management and is concerned with the contribution of new content and the growing of the knowledge base. It involves real-time information management as well as the communication and collaboration among users. This level of knowledge management enables the organization to capture and distribute the information contributed by participating subject matter experts. The third and final level, enterprise intelligence, is represented by a knowledge management system so robust and interactive that it can represent the collective expertise of the organization. At this level, the actual operation of the business depends upon the expertise embedded in the knowledge management system. Employees rely on it to perform their jobs and the resulting experiences and results are captured and fed back into
the system allowing it to grow to become the collective intelligence of the organization (Rosenberg, 2001).

Earl (2001) has developed a taxonomy of strategies of knowledge management that includes categories of knowledge bases, knowledge flows, knowledge assets, knowledge pooling, and knowledge exchange. Evans (2004) provides definitions of several of those categories. Knowledge bases capture subject matter expert knowledge and make it available to users. Representation of experiences, technical expertise, and best practices are often codified in case-based reasoning systems or best practices knowledge bases. Knowledge flows provide decision-relevant and context sensitive knowledge at the time of need in order to increase efficiency, learning, and adaptation. Knowledge assets include the organization’s knowledge or intellectual artifacts. Knowledge pooling is the use of the organization’s technical and social structure to exchange and share knowledge interactively, often through communities of practice which are designed and maintained to address a specific business purpose. Knowledge exchange enables interaction and discussion to promote discovery and exchange of primarily tacit knowledge.

Since the intent of most knowledge management systems is to enhance organizational performance by improving individual performance, a deep understanding of how work is organized, how human performers become skilled, how knowledge is exploited, and how all these factors contribute to an organization’s competitive advantage, strategies, and culture is required. Knowledge management systems are most effective when developed and implemented within the context of the performance system surrounding knowledge workers (Massey, Montoya-Weis, & O’Driscoll, 2005).
Electronic Performance Support

An Electronic Performance Support System (EPSS) is an electronic system that provides integrated, on-demand access to information, advice, learning experiences, and tools to enable a high level of job performance with a minimum of support from other persons, to provide whatever is necessary to support performance and learning at the moment of need, to enable “day-one performance”, whereby novice performers are productive on the very first day of work, and to support higher levels of performance for the work being done (Rosenberg, 1995; Wager, & McKay, 2002). Employees’ performance is improved if the employee completes a task in less time, with better results, or with little or no support from other people (Mileva, 2000). The primary goal of most Electronic Performance Support Systems is to enable people to perform their work more efficiently by providing whatever assistance is necessary at the time of need and secondarily to enable novice workers to perform like more experienced workers, with little or no training (Wager & McKay, 2002).

Gery (1991) identifies and describes several EPSS software components:

- Advisory or expert systems for decision support or problem structuring aid users with complex or difficult tasks.
- Interactive productivity software such as spreadsheets, word processors, or task-specific interactive job aids can assist users by automating ancillary job tasks.
- Applications software which performs specific job tasks and is often the primary environment for a user. In many instances the role of the EPSS is to support users’ performance with the application software.
• Help systems assist the user navigate and manage the application software by providing explanations, advice, and alternatives for operating the software.

• Interactive training sequences provide self-directed learning, task-specific computer-based training segments that allow users to gain knowledge or skills about a job task.

• Assessment systems provide evaluation of user knowledge or skills and can be used for user self-evaluation or tracked as a basis for certification.

• Monitoring and feedback systems observe user activity and notify users when assistance or additional information is appropriate.

Williams (2004) incorporates some of Gery’s functionality into an EPSS model and depicts EPSS as a subset of an overall performance support system that includes both electronic interface components and manual interface components (Figure 3). Since the purpose of performance support is to maximize the usability and learnability of a product or system the model shows the relationships of performance support products, type of interface (manual or electronic), whether the product primarily supports usability or learnability and depicts EPSS as a subset of overall performance support systems. Williams’ model indicates that users interact with performance support systems through manual and electronic interfaces and access paper documents, performance aids (job aids), instructor-led training, and self-instruction texts via manual interfaces while online help, coaches, wizards, advisors, online instruction, and electronic documents are accessed via electronic interfaces. The collection of electronically available support comprises the components of electronic performance support.
Gery (1995) identified three levels of performance support: external, extrinsic, and intrinsic, which are primarily differentiated by the level of user task interruption required to access the support the EPSS provides. External support is the most basic type and is populated mainly by job aids and online documentation. The primary characteristic of performance support at this level is that users need to stop work in order to access the support systems or tools. Extrinsic support is usually delivered in the form of online help systems, wizards, cue cards, templates and other online job aids. These tools do not
necessarily require the user to stop working but they do require the user to determine when and what to look up in order to use the support. Intrinsic support is embedded directly into a system or software application. A sophisticated intrinsic support system can anticipate and adapt to a user’s needs.

Raybould (2000a) views these three levels, external, extrinsic, and intrinsic as a continuum rather than three distinct categories (Figure 4). External support is separate from the application software and includes tutorials, computer-based training, peer support, and telephone hotlines. Extrinsic support is linked to the application and includes wizards, cue cards, coaches, advisors, and help. User support components that are farther from the application software (to the left in the model) require more task or job interruption and are more expensive to use. Support components that are closer to the application software (to the right in the model) become more granular, more powerful to use, and less expensive in terms of time taken away from the job.

Figure 4. Performance Support Continuum

Cavanagh (2004) extends Gery and Raybould’s categories; external, extrinsic, and intrinsic; by adding two other classes: intuitive and integrated. Intuitive support is integrated into the task environment and workflow process, as is intrinsic; however, intuitive is more seamless. Intuitive support is more proactive, the support technology initiates interventions to improve performance, much as the way Microsoft® Word automatically corrects spelling errors. Intelligent support is anticipatory and aims to know what the user wants to do before he does it and is implemented through artificial intelligence and intelligent agents. At its ultimate, intelligent support becomes indistinguishable from the task it is designed to support.

Of the EPSS that have been implemented, most contain only a subset of the tools and resources originally proposed by Gery. In most cases, the components that are included depend upon the performance problem, the funds available for development and deployment, and finally the expertise of the design and development team. Gery’s goal and vision of Day One performance is generally unobtainable, although training time can be greatly reduced and savings can result. Most implemented EPSS have reduced but not eliminated the need for training. Consequently most implemented EPSS have proven to be cost-effective solutions to performance problems, at least in those cases where costs have been documented and analyzed (Wager & McKay, 2002).

E-learning Benefits

Corporations spent more than $12 billion on e-learning in 2004 and are expected to increase that yearly spending by 30 percent through 2008 (IDC, 2004). Economics is driving the proliferation of technology-based training. E-learning can accelerate product
release. For example, preparing workers to sell and support new products or services can be accomplished quicker using e-learning which reduces the time to market for those products and services. Training costs can be reduced with e-learning. While the cost to develop training materials for e-learning is usually higher, the total training expenditure including delivery, travel, instructor and student salaries, along with lost opportunity is often lower. Additionally e-learning can reduce performance gaps by providing just-in-time and just-in-need access to training (Pantazis, 2002).

E-learning provides large companies a financial payback, primarily via economies of scale. Design and development costs are generally greater for e-learning than for traditional instructor-led classroom courses, but e-learning gains significant economic benefits from reduced implementation and delivery costs. Even though custom e-learning may be outside the price range for smaller companies, off-the-shelf e-learning courseware can enable smaller companies to reap similar financial benefits (Tyler, 2001).

Increased enterprise use of the Internet and the World Wide Web, both to market products and services as well as support employee communications, has led to an increase in the use of these technologies to deliver corporate training and other information, such as job aids. Once training is delivered, training organizations are being held accountable not only for student learning in the class, but also for users’ job improvement and organizational impact. Training evaluation must measure not only learning gains but also transfer of skills to the job and job performance improvement (Richey & Morrison, 2002).

Rosenberg (2001) and Clarke and Hermans (2001) identify several qualitative and quantitative benefits to e-learning. E-learning is often the most cost-effective way to deliver instruction since it can cut travel costs, decrease the time to train employees and
customers, and reduce the dependency on the physical infrastructure of classrooms and instructors. E-learning’s reach is virtually unlimited being accessible simultaneously or at any time by an extensive audience. This *any time-any where* approach provides an organization with a global learning footprint. E-learning can ensure that everyone gets the same instructional message, while being customizable for different learning needs or audience groups. E-learning programs are highly scalable. As long as the network infrastructure is in place learning audiences can increase by multiple factors with little effort or incremental cost. Because the actual learning content and information resides on a small number of Web servers, e-learning can be updated almost instantaneously, providing users with immediate access to up-to-date accurate information. Because e-learning relies on standard Internet technologies and because Web access is becoming ubiquitous universal access to information is available to a wide audience of Web-savvy users. Additionally, because of this widespread and unconstrained access among learners, e-learning promotes the creation of communities of practice where users can share knowledge and insight long after a training program ends.

**Instructional Systems Design and the Role of Instructional Designers**

The role of instructional designer and the instructional design process, itself, have been evolving in response to changing business needs. The design and development of training has usually been the responsibility of instructional designers, sometimes referred to as trainers, course developers, or curriculum analysts. Originally charged with creating classroom training, instructional designers are now designing and developing e-learning
solutions in addition to or in place of traditional training, largely due to the emergence and infusion of personal computing and networking technologies (Reiser, 2001b).

The introduction of Electronic Performance Support Systems by Gery (1991) has expanded instructional designers’ domain beyond training to include job aids and coaches, wizards and tools, examples and hints, and other non-training support mechanisms. The realization that a significant amount of corporate knowledge and wisdom is lodged in an organization’s digital memory has given rise to the field of knowledge management. Connecting learners quickly, at the time of need, to the appropriate information residing in documents or experts has become as important as improving learners’ skills. Increased use and accessibility to the Internet, especially for distance learning, has caused instructional designers to rethink the way training is delivered, organized, and packaged. Training manuals formatted for paper have morphed into online documents arranged so they can be scanned quickly and downloaded. Training has become modularized so that learners can engage in small portions as their workload allows. EPSS, the Internet, and knowledge management have caused instructional designers to look to the discipline of software engineering for ways to modify and improve instructional design. As a result, rapid prototyping and usability engineering have been incorporated as tasks and methodologies within the instructional design process (Reiser, 2001b).

Instructional Design Process

The creation of e-learning solutions is a complex and complicated process. Many e-learning applications involve multiple integrated components and may include an online learning function, a performance support function, and a knowledge management function
(Rosenberg, 2006b). As currently practiced, the e-learning development process is usually divided into the standard ADDIE phases (analysis, design, development, implementation, and evaluation) of the instructional systems design (ISD) process, but often includes a myriad of procedures or tasks (Reiser, 2001a; Brown & Lu, 2000; Plass & Salisbury, 2002). The exact sequence and dependencies among those tasks generally depend upon the specific e-learning product, the capability of the project team, and the direction of the instructional designer/project manager. Tasks may be performed linearly, concurrently, or iteratively depending upon the particular ISD model, but all ISD models essentially incorporate the five ADDIE phases in some fashion (Figure 5) (Gustafson & Branch, 2002).

**Figure 5. ADDIE Process**

There is no original and authoritative version of the ADDIE model. The specific term ADDIE and the model it represents within the instructional design field is really an organizing or overarching umbrella term used to describe a systemic methodology which involves analysis, design, development, implementation, and evaluation. The term does not have a single author or inventor but has evolved through oral tradition. ADDIE has no formal elaborated model but is used to define a family of instructional systems design models that share an underlying structure (Molenda, 2003).

The ADDIE instructional systems design process is a cyclical procedure in five stages or phases, each with a distinct purpose, deliverables, and outcomes and includes these phases (Peterson, 2003):

- Analysis – also known as Front End Analysis, this phase is intended to determine the scope and extent of the performance problem and determine if an e-learning solution is appropriate.
- Design – determining what and how to build the e-learning application that will best address the performance problems identified during analysis.
- Development - creating the individual elements (reference content, expert system repository, dialogs and graphical user interfaces, graphics, etc.) and incorporating those into the e-learning application.
- Implementation - the delivery of the various releases of the e-learning application in conjunction with any other performance program components to members of the targeted audience.
- Evaluation - the process of determining the value and effectiveness of the e-learning application. This phase is ongoing throughout the entire process. That is, it is
performed in conjunction with the analysis, design, development, and implementation phases.

Analysis is sometimes referred to as the requirements phase and is concerned with initial investigation and research to identify and clearly define the organization, learner, and job skill requirements of an e-learning solution. Basically, the output of the analysis phase is a thorough understanding and description of the performance problem and the environment of use, including constraints, for any potential solution. Instructional design steps and activities focus on analyzing users' needs, the tasks that are to be performed, the environment of use, and possible technological solutions. User needs encompass the cognitive, behavioral, and attitudinal characteristics of users. Tasks may include the way users organize their work (mental models), what they want to accomplish (the goals), or how they currently go about performing their jobs. Environment of use is the setting in which the e-learning application will be used. It may include the location (at work or at home), in a classroom or at the user’s workstation, or physical characteristics of the environment (e.g., room lighting, workspace size and noise level) and/or other systems with which the user may interact. Technology is the platform on which the solution is delivered or developed. Ideally the appropriate technology is selected after first gaining a good understanding of user needs, their tasks, and the environment of use (Dick, Carey, & Carey, 2005).

During design, the findings and recommendations of analysis take visual form. Design involves any method or combination of methods that translate identified requirements into tangible ideas, concepts, prototypes, or specifications. During the design phase, instructional designers and other development team members work together to
propose and refine solutions. Feedback from the users or client is often obtained to help the development team evaluate and refine their solutions. Because this phase involves planning the framework or structure for the completed product the development team should work closely with the client to ensure that the proposed solution meets the client’s expectations and the proposed solution is within the agreed upon scope of the project.

Design is probably the most critical phase of the development process. Most large commercial projects involve team members from different disciplines— instructional designers, graphics and media designers, software engineers—who need to be involved in the design planning and communicate with each other to ensure that all the pieces of the final product work together and enhance the learning experience. The result of the design phase is a comprehensive description of the course and the foundation for the production of the course (Alessi & Trollip, 2001; Clark, 2002).

The development phase involves creating content and media elements (e.g., graphics, audio, animation, and video) and incorporating those into an expanded program according to the directions specified in the storyboards, flowcharts, and content outlines created during design. Development also includes testing the e-learning application by sample members of the target audience. This testing occurs during the pilot session. A pilot report is written that includes the observations of and feedback from the pilot participants. The information in the report influences the evaluation and revision of the project. Pilot testing is often referred to as validation because it involves validating the material by using representative samples of the target population and then revising the program as needed (Alessi & Trollip, 2001).
The implementation phase involves delivery of the e-learning application to members of the target audience. Often instructional designers are not directly involved in the implementation activities, but address implementation planning during the design phase. Designers contribute to implementation through the development of quality materials, planning of support for implementation, involving stakeholders in the design and development, and communicating information about the process and product throughout the ISD process (Visscher-Voerman & Gustafson, 2004).

The evaluation phase is ongoing throughout the entire process. That is, it is performed during and in conjunction with the analysis, design, development, and implementation phases. It is also performed after the users return to their jobs. Its purpose is to collect and document user performance in a training course, as well as on the job. Evaluation is the process of determining the value and effectiveness of a program. It uses assessment and validation tools to provide data for the evaluation. Assessment is the measurement of the practical results of the training or performance support in the work environment, while validation determines if the objectives of the training or performance support program were met. Evaluation is generally regarded as either formative, which occurs during the project and is used as feedback into the development process to improve product quality, or summative, which occurs at the end of the project and is used to determine the worth or effect of the overall program. Perhaps the best known training evaluation methodology is Kirkpatrick's four level evaluation model: reaction, learning, behavior, and results (Kirkpatrick & Kirkpatrick, 2005).

While there are several variations of the instructional design process, most include these five phases or stages, and are intended to present the designer with a methodological
process for creating instructional products, including e-learning applications. Simply stated, the ISD process provides a means for sound decision making to determine the who, what, when, where, why, and how of performance and enables decisions about specific e-learning projects. Having a defined process enables instructional designers, e-learning developers, and other project teams members to provide their users with predictably high quality results that meet their requirements as well as maintain fiduciary responsibility of the development resources. In a sense, the instructional systems design (ISD) process provides a way to deliver repeatable results that meet or exceed requirements, are developed on time, and are within budget (Alessi & Trollip, 2001; Segue, 2002).

**Instructional Design Models**

While the generic ADDIE process or model describes the relationship among the five core elements or phases of the instructional design model, other models depict the operational aspects of instructional design by attempting to represent the practice of instructional design within particular contexts. Gustfason and Branch (2002) describe and categorize instructional design models into three major groups: classroom-oriented models, product-oriented models, and systems-oriented models and identify pertinent characteristics of each category (Table 3).

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Classroom-oriented models</th>
<th>Product-oriented models</th>
<th>Systems-oriented models</th>
</tr>
</thead>
<tbody>
<tr>
<td>Typical output</td>
<td>One or a few hours of instruction</td>
<td>Self-instructional or Instructor-delivered package</td>
<td>Course or Entire Curriculum</td>
</tr>
<tr>
<td>Resources committed to development</td>
<td>Very low</td>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td>Characteristic</td>
<td>Classroom-oriented models</td>
<td>Product-oriented models</td>
<td>Systems-oriented models</td>
</tr>
<tr>
<td>----------------------------------------</td>
<td>---------------------------</td>
<td>-------------------------</td>
<td>-------------------------</td>
</tr>
<tr>
<td>Team or individual effort</td>
<td>Individual</td>
<td>Usually a Team</td>
<td>Team</td>
</tr>
<tr>
<td>ID skill/experience</td>
<td>Low</td>
<td>High</td>
<td>High/Very High</td>
</tr>
<tr>
<td>Emphasis on development or selection</td>
<td>Selection</td>
<td>Development</td>
<td>Development</td>
</tr>
<tr>
<td>Amount of front-end needs assessment</td>
<td>Low</td>
<td>Low to Medium</td>
<td>Very High</td>
</tr>
<tr>
<td>Technology complexity of delivery media</td>
<td>Low</td>
<td>Medium to High</td>
<td>Medium to High</td>
</tr>
<tr>
<td>Amount of tryout or revision</td>
<td>Low to Medium</td>
<td>Very High</td>
<td>Medium to High</td>
</tr>
<tr>
<td>Amount of distribution or dissemination</td>
<td>None</td>
<td>High</td>
<td>Medium to High</td>
</tr>
</tbody>
</table>


Professional teachers, such as elementary and secondary school teachers, community college and vocational school teachers, and university faculty along with some corporate instructors primarily use classroom-oriented models. In each case, the instructor and instructional designer is the same person, and the instructor/designer is responsible for deciding on the appropriate content and media, delivering the instruction, and evaluating learners. Resources for development of instruction are generally limited, primarily due to the ongoing nature of classroom instruction and the teaching load (Gustafson & Branch, 2002). Because of their characteristics, classroom-oriented models have limited applicability to e-learning programs.

Product-oriented models are characterized by four key elements. An instructional product is needed by users or learners. The instruction needs to be produced rather than selected or modified from existing materials. Tryout and revision will be emphasized.
during development. The final product will be used by learners with, at most, facilitators or managers but there will be no instructors to guide them. Gustafson and Branch (2002) include five instructional design models among the product-oriented category: Bergman and Moore model, de Hoog, de Jong, and de Vires model, Bates model, Nievven model, and Seels and Glasgow model.

Systems-oriented models generally assume the development of a large amount of instruction, perhaps an entire course or curriculum, and that significant development resources will be applied to the project. Systems-oriented models differ from product-oriented models in the amount of front analysis; systems models generally involve a significant analysis effort in order to determine the need for instruction as well as other performance improvement solutions. While systems-oriented models usually involve a larger scope and effort than product-oriented models, the design, development, and evaluation activities of system-oriented and product-oriented models generally involve the same tasks. Gustafson and Branch (2002) include the Interservice Procedures and Instructional Systems Development model, Gentry model, Dorsey, Goodrum and Schwen model, Diamond model, Smith and Regan model, and Dick, Carey, and Carey model among the systems-oriented group.

Related Processes and Methodologies

Instructional systems design is modeled after similar methodologies used in engineering disciplines that are based on design sciences such as information technology and software engineering. A design science is one that creates products built to achieve a practical goal and is characterized by a systematic process that involves planning,
development and testing stages, embeds scientific and technical principles in the design of products, and produces products intended to be functional and appealing to users (Clark, 2002). Since e-learning solutions are essentially information technology applications, it is not surprising that software engineering methodologies are often interjected into the ISD process for e-learning projects. Rapid prototyping, performance-centered design, and performance support engineering are among the e-learning design methodologies that have been adapted from software engineering.

Rapid prototyping is commonly used in software development and involves the creation of a working model, or a series of working models, of the finished e-learning product that is used during design to gather feedback and gain consensus from users, clients, and developers. Rapid prototyping can decrease development time by eliminating time-consuming revisions during development and allowing some design tasks to proceed concurrently rather than sequentially. Rapid prototyping can also increase quality by gaining buy-in from users and clients early in the project (Richey & Morrison, 2002).

Rapid prototyping is a design approach that solves a number of problems inherent in traditional linear development models (often referred to as waterfall). Unlike the traditional waterfall development cycle, a rapid prototyping approach typically proceeds in both a linear and parallel fashion. This means that even though design tasks are still generally sequential in order of completion, a number of tasks take place concurrently and iteratively. A rapid prototyping approach, especially in the area of technology-delivered instruction, provides multiple advantages. It helps define functional and design requirements, helps iron out technical complexities early in the project life cycle, makes visualizing the final product easier by providing earlier feedback, eliminates errors caused
by incorrect perception of the outcome, and promotes involvement of users, sponsors, and management (Jones & Richey, 2000).

Performance-centered design is an extension of a software methodology called user-centered design. Where user-centered design focuses on design of an improved interface that meets user needs performance-centered design focuses on improving the total performance of users. In the area of technology-based learning products, the key performance of users is often learning and hence performance-centered design focuses on building a product that improves and enhances the learning process itself (Battle, 2000a; Battle 2000b; Massey, Montoya-Weiss, & O’Driscoll, T, 2005). Performance-centered design employs these principles:

- Early focus on users: Designers focus on users' performance issues. The objective is to understand the users' cognitive, behavioral, and attitudinal characteristics, the learning tasks (specifically the level of objectives and the type of learning that will be required) they will perform and the environment of use.

- Integrated design: All aspects of usability (user interface, product functionality, help system, and documentation) should evolve in parallel, rather than be defined sequentially.

- Early-and-continual user testing: Presently, the only feasible approach to successful design is an empirical one, requiring observation and measurement of user behavior, careful evaluation of feedback, and insightful solutions to existing problems.

- Iterative design: A system under development must be modified based upon the results of behavioral tests of functions, user interface, help system, and documentation. The
process of implementation, testing, feedback, evaluation, and change must be repeated
to improve the system.

Raybould (2000a; 2000b) defines and describes a performance-centered design
methodology for electronic performance support systems which he terms *Performance
Support Engineering*. The first stage, *Performance Support Mapping®,* is analogous with
the analysis phase of the instructional systems design process and the second stage,
*Performance-Centered Design*, is analogous with the design phase of the instructional
systems design process (Figure 6).

**Figure 6. Performance Support Engineering**

From Raybould, B. (2000). Building performance-centered, Web-based systems,
information systems, and knowledge management in the 21st century. *Performance
Improvement, 39* (6), p. 34.
Each of the two stages of Performance Support Engineering, Performance Support Mapping® and Performance-Centered Design, are comprised of two phases. The Performance Support Mapping® stage includes Phase One: Look and Listen and Phase Two: Understand the Work. Phase One: Look and Listen focuses on gathering all the raw data about the work and the barriers to performance. In this phase, performance support engineers observe the current working environments, gather data from job performers and their managers, and interview management to understand the business goals and issues. Phase Two: Understand the Work and Feel the Pain consolidates the raw data collected in Phase One. In this phase, performance support engineers create models or maps of the work, identify key barriers to achieving organizational goals, identify factors that differentiate between high and low performers, analyze the organization’s knowledge flows, and create performance support maps that identify key work tasks and decisions, key barriers, and the knowledge, information, tools and communications needed to support the work. The Performance-Centered Design stage includes Phase Three: Design the Work and Phase Four: Design the Interface. Phase Three: Design the Work redesigns the way work should be done. In this phase, performance support engineers consider alternative approaches for work problems, redesign the work to remove the barriers, expand design ideas by building storyboards that describe the new system, and build abstract representations of the user interface flows. Phase Four: Design the Interface designs the interface of the new system using low-fidelity prototypes. In this phase, performance support engineers conduct heuristic evaluations of the design, and conduct usability tests with job performers (Raybould, 2000a; Raybould, 2000b).
From Raybould’s (2000b) perspective, Performance Support Engineering is a hybrid process that has its roots and foundations among several business process, information systems, instructional design, and technical communication disciplines. From Information and Systems Engineering it draws techniques such as iterative prototyping and joint application design. From Human Computer Interaction it draws techniques for heuristic evaluation and usability testing. From Business Process Reengineering it draws techniques for capturing and documenting business process and developing improvements to those processes. From Instructional Systems Design it draws techniques relating to audience analysis and cognitive analysis. From Human Performance Technology it draws techniques such as performance systems modeling and up-front analysis. From Knowledge Engineering, Structured Writing, and Expert Systems Engineering it draws many techniques of knowledge acquisition and knowledge modeling. From Knowledge Management it draws techniques such as the analysis of knowledge flows. The unique characteristic of Performance Support Engineering is that it integrates all of the processes and techniques of these related disciplines into a synergistic framework for creating integrated e-learning systems consisting of online learning, knowledge management, and electronic performance support functions.

**Role of Instructional Designers**

The majority of instructional design practice since the 1980s has been experienced in the private sector, which has been accompanied by the development of new approaches to instructional design and an expansion of designer competencies. These new competencies include technological skills, project management, collaboration, advanced
analysis techniques, non-instructional design strategy, and business skills. Depending upon the project, an instructional designer may be the sole designer, a team member or team lead, or an external consultant. Designers need to be knowledgeable about and skilled in innovative design approaches such as rapid prototyping, electronic performance support systems, technology-based training, and advanced evaluation techniques as they confront the dual challenges of reducing design cycle time and enhancing training effectiveness and efficiency (Richey & Morrison, 2002).

There are three broad categories of roles that instructional designers generally assume in corporate learning projects, as a sole designer, a team member or team leader, or as an instructional design consultant. On small projects or in small companies, the instructional designer may carry out all tasks on the entire learning project alone. In some instances a subject matter expert may provide advice and guidance and in other instances the instructional designer is a subject matter expert. In either event, the instructional designer is responsible for all analysis, design, development, implementation, and evaluation tasks. Depending upon the media chosen, media technicians such as directors, photographers, or graphic artists may act as subcontractors to the instructional designer. In some instances, when the final instructional product is a classroom course, the subject matter expert may do the teaching. Large-scale projects usually require a team with one or more instructional designers along with media and technology developers. Often one of the instructional designers is designated the lead designer or the project manager and has authority over all instructional design decisions. When an instructional designer serves as a consultant they often provide instructional design advice to a development team that might be lead by a subject matter expert. Sometimes an entire external instructional design
team will be hired from an outside instructional design company in order to produce a specific instructional product. In this case, the instructional design team consists of external consultants with the exception of the subject matter expert, who is an employee of the client company (Richey & Morrison, 2002).

E-learning designers are challenged to create content-rich, motivating, and stimulating instructional materials that engage learners and represent an improvement on classroom based instruction. Often they must weigh alternatives in order to recommend technology solutions that enable the proposed performer outcomes and meet client requirements and expectations (Richey, Fields, & Faxxon, 2001). During the course of a typical e-learning project, instructional designers make numerous design decisions, selectively completing instructional design tasks based upon the contextual situation and needs of each project. Christen and Osguthorpe (2004) surveyed 113 instructional designers and reported that designers most often selected design strategies by brainstorming with others on the project and based their design decisions on accepted instructional design and learning theories less than half the time (Christensen & Osguthorpe, 2004).

Experienced designers can be both quick and effective because they make good decisions about what to do and what to emphasize during product development (Zemke & Rossett, 2002), but even the most experienced practitioners rely on guidelines, templates, boilerplates, job aids, examples, and prior art to negotiate the elaborate development process, to improve their decision-making, and to increase their productivity and efficiency (Gustafson, 2002).
New designer skills are needed, especially those related to technology applications, project management and collaboration, advanced analysis skills, non-instructional strategy design, and business skills. Designers are expected to have a design specialization and fundamental business intelligence and savvy. Additionally, the best designers have an insider’s understanding of the industry of their organization in addition to design skills (Richey & Morrison, 2002). Because of the newer technologies that are available for e-learning, instructional designers have to find new ways to apply the principles of instructional design. The influx of network technologies in the workplace has caused a shift from instructor-led and group learning to independent and dispersed learning and a shift from place-bound learning to mobile and workplace learning (Dolezalek, 2006).

One of the challenges that designers face is coping with the uncertainties of outcomes of the ISD tasks given an environment of complex ill-defined requirements and multiple possible solutions. Research results related to instructional design, assuming an ISD practitioner looks for them, tend to be too narrow to be meaningful, too superficial to be helpful, and too theoretical to be practical (van den Akker, 1999).

Electronic Tools for Instructional Design

Over the years, efforts to help both novice and experienced designers have led to the development of electronic tools for instructional design. Computerized tools to support and assist instructional designers began to appear soon after Gery (1991) popularized the notion of electronic performance support. The earliest tools tended to help with one or a few process tasks or subtasks. For example, AT&T’s Training Delivery Consultant, which was developed in the late 1980’s, would make a recommendation about training formats
(e.g., classroom, self-instruction textbook, video, audio, and computer-based training) depending upon several parameters about the training need, the course length, and the target audience (Gery, 1991).

Currently the domain of software tools for instructional design is largely dominated by authoring software, such as SumTotal’s Toolbook™, Macromedia Authorware, and Macromedia Director, which are intended to streamline the development step of the ADDIE model (Holden, 2004). However, there are a few automated and computerized tools on the market and in research that support instructional designers during the other ADDIE phases, especially analysis, design, and evaluation (Oliveria et al., 2001). Some are targeted to novice or non-instructional designers, such as subject matter experts, and lead them through the steps of the ISD process. Rather than provide advice or recommendations about a procedure, many of these tools concentrate on automating tasks or ensuring that all steps are executed. Often a computerized ISD tool is based upon a particular ISD model and a learning theory. Tool users who want to follow a different ISD model or believe a different learning theory is more applicable to their project or the specific situation are typically out of luck (Gustafson, 2002; Nieveen & Gustafson, 1999; van Merriënboer & Martens, 2002).

Most instructional systems design tools fall into one of two categories. First, are those tools that span the domain of the entire ADDIE instructional design process. NCR Corporation’s Quality Information Products Process (Jury & Reeves, 1999) and the CASCADE family of tools from the University of Twente (McKenney, Nievven, & van den Akker, 2002) are two examples. Second, other tools focus on a subset of ISD process but provide an increased in level of sophistication or automation, such as IDXelerator™,
which includes a built-in set of instructional strategies. After the user/designer selects an instructional goal and strategy and the associated multimedia resources, IDXelerator automatically generates e-learning lessons in Toolbook, complete with practice exercises, learner guidance, and knowledge structure (Merrill & Thompson, 1999).

Some electronic ISD tools provide support for a specific design methodology and therefore are applicable in limited environments. Advanced Design Approach for Personalized Training – Interactive Tools (ADAPTIT) consists of a set of software tools that help instructional designers apply the 4C/ID* process to create instruction for complex skills (de Croock, Pass, Schlanbush, & van Merriënboer, 2002). The 4C/ID* model presumes that well-designed learning applications always include four essential components: learning tasks, supportive information, procedural information, and part-task practice. Courseware Developer’s Workbench (CDW), developed by Intelligent Automation, Inc. for the Naval Air Warfare Center-Training and Simulation Division, uses case based reasoning to provide advice to instructional developers about the design of Web-based training material. However, CDW focuses only on the motivational aspects of the course being developed, and bases its advice on Keller’s ARCS (Keller, 1987) (attention, relevance, confidence, and satisfaction) model (Fowler, Haynes, & Beltz, 2002). While both ADAPTIT and CDW may be beneficial tools, their usefulness would appear to be limited by their reliance on a single ISD approach.

*Instructional Design Tool Descriptions*

Following are descriptions of 14 electronic tools for instructional design. Some of these are proprietary, having been developed by a specific organization to meet its needs;
some are commercial tools which can be purchased from several vendors; and some were intended as research or experimental tools. These are presented in somewhat chronological order.

*Instructional Design Environment (IDE)*

Instructional Design Environment (IDE), a computer-aided design environment that supports an ID methodology for teaching the use of software in real-life problem-solving contexts, was developed by XeroxPARC. IDE incorporates a design methodology termed example-based minimalist design. This methodology incorporates GOMS analysis (goals involved in a task, operators or actions available in the task, methods for achieving the goals, and selection rules for choosing among the methods) (Card, Moran, & Newell, 1983) with minimalist instruction. Minimalist instruction focuses on the reduction of instructional materials by stressing guided exploration and assuming that the learner can infer a great deal of information. IDE was primarily used to teach spreadsheet use in business tasks. Instruction was designed using IDE by screen-recording expert solutions, developing GOMS analysis of those solutions, and then compiling presentations and learning activities into HyperCard instruction (Russell & Pirolli, 1992). Unlike some other tools which are designed to be used by novice instructional designers or non-instructional designers, IDE was intended to be used by experienced instructional designers (Muraida & Spector, 1993).

*AT&T Training Test Consultant*

Comware, Inc. of Cincinnati, Ohio, developed the Training Test Consultant Performance Support Tool for AT&T as a companion tool to the Training Delivery Consultant, mentioned previously. The purpose of the Test Consultant was to support
AT&T training developers during the test development and validation steps of the ISD process. The Training Test Consultant was an integrated system which included an advisor, infobase, and tutor. The advisor helped users structure the test development process by means of a dialog-based series of questions and answers with the user to obtain relevant information about the task, situation, test goals, and other data. The infobase was a collection of hypertext reference documents containing information about the best practices in test construction. The infobase was cross-referenced to the advisor and tutor so that users could quickly access its information. The tutor component was a compilation of practical exercises and questions that enabled a user to measure their knowledge and practice applying their test construction skills in authentic situations (Gery, 1991).

NCR’s Quality Information Products Process

In order to standardize the instructional design process (called the Quality Information Products Process in NCR) across its operating units, NCR Corporation developed an EPSS to help its training and documentation developers during the development of product training and documentation (i.e., information products). NCR’s process was an extension of the standard ADDIE process and included eight phases: analysis, design, development, validation, production, manufacturing, delivery, and customer satisfaction. The performance support system, QIPP EPSS, included templates or tools and examples for each process step along with instructions and advice about its use (Gustafson, 2000; Jury & Reeves, 1999). QIPP EPSS was based upon a previous system, IDioM, which was also a tool-kit of templates, forms, examples, and instructions of the tasks within each phase of an ISD design model (Gustafson, 2000; Gustafson & Reeves, 1990). IDioM was developed for trainers at Apple Computer to aid in their training design.
projects and assisted them by imposing structure on the instructional design process and ISD project management (Richey, Klein, & Nelson, 2004). What set QIPP EPSS apart from IDioM and other systems was its ability to be reconfigured by individual instructional design users. Designers could add their own forms, templates, and examples to the system and power users could even modify the steps of the ISD process by adding or deleting tasks on a project-by-project basis (U.S. Patent, No. 5,655,086). Later versions of the QIPP EPSS allowed users to share forms, examples, and templates among other EPSS users (U.S. Patent No. 5,918,054; U.S. Patent No. 5,937,197).

**ID Expert™ and IDXelerator™**

ID Expert from the ID2 Research Group at Utah State University was created to automate the design of instruction as defined by Instructional Transaction Theory. According to Instructional Transaction Theory, instruction is based on transactions (sets of interactions) between the system and the learner in order to accomplish a given task. ID Expert assists designers in creating transactions by presenting a set of decision-making steps involving instructional components, formatting, and resources (Kasowitz, 2000). ID Expert was intended to allow subject matter experts to create effective computer-based multimedia instruction without requiring them to have extensive training or experience in instructional design or authoring systems. The primary premise underlying ID Expert’s architecture and workflow is that subject matter can be decoupled from instructional strategy and that subject matter content can then be manipulated by an instructional algorithm or instructional transaction (Merrill, 1998).

IDXelerator, also by the ID2 Research Group, is an instructional design automation tool, too. Like ID Expert, it includes a set of built-in instructional strategies which
represent a complete set of all the interactions required for a learner to acquire a specific skill or knowledge. Similarly, IDXelerator only focuses on the development phase of the ISD process. Analysis decisions about audience requirements and instructional goals are outside the scope of the IDXelerator, as well as design decisions regarding the kind of instructional activity required for each goal and the multimedia objects necessary to support the instruction (Merrill, & Thompson, 1999).

**AIDA Project: XAIDA, and GAIDA**

The objective of the US Air Force’s AIDA (Advanced Instructional Design Advisor) Project was the automatic design of technical training materials. Two electronic instructional design tools have been developed as a result of this research: Guided Approach to Instructional Design Advising (GAIDA) and Experimental Advanced Instructional Design Advisor (XAIDA). Both use expert system technology to provide expertise to novice instructional designers and subject matter experts in the design, production, and implementation of courseware used by the Air Force in aircraft maintenance training. GAIDA uses tutorials and context-specific advice and examples. The GAIDA system provides guidance for the application of Gagné’s (1985) nine events of instruction in the design of interactive courseware and traditional classroom materials. The tool operates in two modes: guidance and lesson. The guidance mode consists of general instructional design advice based on the specific event of instruction, while the lesson mode presents examples of interactive courseware that demonstrate the event. User/SME-designers can switch back and forth between modes (Gettman, McNelly, & Muraida, 1999). GAIDA eventually evolved into a marketed product, GUIDE (Guide to
Understanding Instructional Design Expertise) (McNelly, Arthur, Bennett, & Gettman, 1996).

XAIDA uses the Instructional Transaction Theory framework to encapsulate context-specific knowledge (Muraida & Spector, 1993). While GAIDA used a weak approach (assists or enhances the designer’s decisions) to automated support XAIDA adopted a strong approach (decision-making is shifted entirely from the human designer to the automated computer system. XAIDA contains two components: Develop and Deliver. Subject matter experts create interactive training with Develop by describing the structure of an airplane subsystem, associate interactive media with the content, and configure practice lessons. Students use Deliver to see lesson overviews, lesson details, lesson reviews, or practice exercises (Wenzel, & Dirnberger, 1996). Because XAIDA was linked to the databases containing descriptions and drawings of the avionic components of military aircraft and troubleshooting procedures for those components subject matter experts could design and develop computer-based training modules based upon the current version of equipment installed on a specific aircraft (Spector & Ohrazda, 2004).

AGD

L’Atelier de Génie Didactique (AGD) (roughly translates as Didactic Engineering Workbench) provides pedagogical design assistance to subject matter experts in the instructional design phases of analysis and design (Spector, 1999). Based upon a specific learning systems engineering approach termed MISA, AGD contains an advisory system and contextual help for designing instructional systems, either teacher-based or computer-based (Paquette, Aubin, & Crevier, 1999). AGD provides procedural instructional design information to guide users in defining the learning system (e.g., analyzing training needs
and designing pedagogical structures) and a rules-based advisory component that offers advice regarding specific design decisions made by users (e.g., amount and nature of objectives) (Kasowitz, 2000). The procedural instructional design knowledge embedded in the advisory system provides designers with assistance in task sequencing, deciding when ISD tasks are completed and other tasks can be started or when tasks can be paused or revisited (Paquette, & Girard, 1996). The instructional design model implicit in AGD is consistent with Tennyson’s ISD4 (a fourth generation instructional design model), although AGD was not designed with that intent (Spector, 1999). Tennyson’s instructional design model advocates an overall systems approach within which instructional designers customize the steps, approaches, and timeline for each project (Tennyson, 1999).

*Designer’s Edge*

Designer’s Edge, a commercial instructional design EPSS intended for novice and experienced instructional designers, contains a set of integrated analysis, design, and evaluation tools and wizards that lead instructional designers through the steps of those ISD phases. Data entered by designer/users is cross-checked during all steps to help ensure continuity. Project reports and documents, such as evaluation forms, content outlines, lesson plans, and checklists, are also provided along with support for computer-based training production needs such as scripts and storyboards (Kasowitz, 2000). Designer’s Edge can also be connected to external authoring tools such as Authorware, Toolbook™, and Dreamweaver (Chapman, 1998). ISD guidance is offered in the form of online instructional design advice and an online tutorial in basic instructional design. The online advice is context-sensitive depending upon the instructional design task being performed (Chapman, 1995). Although the included design activities and forms imply a
specific instructional design methodology, Designer’s Edge users can customize the system by adding and deleting phases and modifying the online advice (R. Foshay, personal communication, Feb. 14, 2005). Designer’s Edge is still marketed and available commercially.

**CASCADE**

CASCADE (Computer Assisted Curriculum Analysis, Design, and Evaluation) is a family of computer-based instructional design tools designed to assist in curriculum development. The original CASCADE tool was intended to be used by professional curriculum designers during the analysis, design, and evaluation of professionally-made instructional materials. Subsequent derivatives of this initial software, such as CASCADE-SEA (science education in Africa) and CASCASE-MUCH (multimedia curriculum design in China), are intended to be used by resource teachers and classroom teachers in secondary schools in specific settings. Each CASCADE application includes implicit and explicit advice for decision making based on heuristics and provides recommendations to users based upon their previous choices. CASCASE applications provide templates and checklists to aid designers with process tasks and help them create draft products (McKenney & van den Akker, 2005). Even though the CASCASE acronym implies assistance for analysis, design, and evaluation, CASCADE incorporates support for all five of the ADDIE phases. While CASCADE is intended to produce paper-based learning materials and its online advice and examples adheres to a constructivist approach to learning, the tool can be used for a variety of delivery formats and instructional strategies (Gustafson, 2002).
Learning Designer™

Learning Designer is an e-learning design and development tool to help instructional designers create SCORM (Sharable Courseware Object Reference Model) compliant learning objects. It assists instructional designer’s decision making for content design and development by recommending different templates based upon content types. It also helps instructional designers sequence content and learning activities by prescribing appropriate learning models. Learning Designer is based on Merrill’s component display theory (Merrill, 1983) and limits its advice to that design methodology. In order to create the most effective learning experience, Learning Designer users identify the content and desired learning and then the software develops a prescriptive learning strategy (Merrill, 1994). Learning Designer helps designers categorize content according to type (well-structured or ill-structured), level of outcome (knowledge or performance), and level of difficulty (novice, intermediate, or advanced) then it recommends two or three appropriate learning methods from a pool of sixteen teaching/learning models. The final step in Learning Designer’s process is to create learning objects by adding the appropriate meta-tags and creating the XML control files that are required by the SCORM guidelines (Kang, Lim, & Kim, 2003; Kang, Lim, & Kim, 2004).

Instructional DesignWare

Instructional DesignWare, from Langevin Learning Services, is an instructional design EPSS intended for classroom trainers and instructional designers, ranging from novice to experienced. Instructional DesignWare provides productivity tools and advice for the all phases of the ISD process and tools for project planning. The software helps automate the creation of learning objectives, learning strategies, course outlines, and
evaluation checklists by providing wizards and forms which lead the designer through the information gathering necessary to complete the specific ISD step (Kasowitz, 2000; Oliveria et al., 2001; Wang, 2001).

Course Developer's Workbench

Intelligent Automation, Inc. designed and developed a prototype of the Courseware Developer's Workbench (CDW) for the Naval Air Warfare Center-Training and Simulation Division, Orlando, Florida. CDW uses case based reasoning to provide advice to courseware developers on how to improve the motivational aspects of their Web-based training material. Based on Keller's model (Attention, Relevance, Confidence, Satisfaction), CDW contains a database of over 500 tips, derived from published research on instructional practices and the advice of successful, expert instructors. The tips are designed to promote learners' motivation and interest in acquiring new information and skills, and include strategies for incorporating opportunities for social interaction, dynamic graphics and sound effects, and gaming/simulations. Developers interactively profile their course and target audience while CDW’s case-based reasoning system presents relevant advice for increasing the motivational aspects of the course (Fowler et al., 2002).

ADAPTIT

The Advanced Design Approach for Personalized Training—Interactive Tools (ADAPTIT) is a project to develop a set of software tools that will assist instructional designers apply the 4C/ID* process to create instruction for complex skills. The 4C/ID* methodology is an organized set of 10 steps that help to create a detailed training blueprint consisting of learning tasks, supportive information, just-in-time information, and part-task practice (van Merriënboer, Kirschner, & Kester, 2003). The 4C/ID* methodology assumes
that complex skills can be analyzed into their component parts, sequenced, and then taught in part or whole task fashion (Gustafson, 2002). ADAPTIT’s two software applications are termed Core and Eval. Core is intended to be used to perform the first three activities of the 4C/ID* methodology related to building a hierarchy of the entire constituent and component skills comprising a complex task (de Croock, Paas, Schlanbusch, & van Merriënboer, 2002; van Merriënboer, J., Clark, R. & de Croock, M. 2002). Eval supports instructional designers when they plan and implement an evaluation based on level one through three of Kirkpatrick’s (2005) model. Eval can be used to gather evaluation data, mapped to the training blueprint, and analyze the evaluation results, providing the designer information that can be used to modify and improve the training blueprint (de Croock et al., 2002).

**eCAD**

eCAD (electronic Course Analysis and Design) is a knowledge-based course engineering system designed to help instructors plan, design, and develop online instruction. The system includes several components that lead users through the various phases and activities of the instructional design process. Each of eCAD’s software components or modules assists the user in performing instructional design tasks specific to that module’s function. Software components accept either inputs from users or outputs generated by previous components and then generate outputs to be processed by subsequent components. For example, when a user provides the Learning Outcome Generator with a subject matter topic, the level of learning to be achieved, and the measurable behavior to be evaluated that component then suggests action verbs appropriate for the learning level, creates well-formed learning outcomes, and passes them along to the
Assignment Generator, Course Evaluation Generator, and Scratchpad components (Ellis, Hafner, & Mitropoulos, 2004). A prototype of eCAD was developed but a releasable version has not been completed or implemented (T. Ellis, personal communication, March 27, 2006).

Electronic Tool Summary

Several of the characteristics of the fourteen electronic instructional design tools described previously are summarized below (Table 4). While all of these tools are intended to improve the instructional design process and assist users in executing the ISD process, they represent a broad range of approaches and solutions to that goal. Each is an instructional design EPSS in the sense that each provides information, advice, learning experiences, or tools designed to enable a high level of instructional design performance without support from other persons. However, they vary in numerous ways, including the particular type of instructional solution, the ISD design phases supported, the implicit learning theories or design methodologies, targeted users, and type of EPSS support.

Nieveen and Gustafson (1999) presented a similar comparison of ten example electronic tools for education and training development, albeit using a different set of characteristics than those shown in Table 4. Some of the tools that Nieveen and Gustafson analyzed and reviewed have been described in this literature review (NCR QIPP, IDXelerator, GAIDA, AGD, and CASCADE), however, the analysis and characterization shown in Table 4 has been done by the researcher and is based upon the various tool descriptions as depicted in the literature.

The five characteristics shown in Table 4 are:
• **Outputs**: Types of e-learning (or instructional) products that are produced or supported.

• **Supported ISD Elements**: The phase(s) of the standard ADDIE ISD model which are supported.

• **Integrated Methodologies / Learning Theories**: Any particular design or engineering methodology(ies) that the electronic tool adheres to, either explicitly or implicitly, any specific learning theories that are reflected by the design philosophy embedded in the tool.

• **User Groups**: The primary user audience, the specific group of users that the instructional design tool is targeted towards.

• **Support Types**: The types of electronic support mechanisms that are included in the tool, including:

  • *Productivity tools* – intended to improve the efficiency of design and development or improve the quality by making tasks easier, examples include html editors, code generators, and storyboard editors.

  • *Task automation* – the instructional design tool automatically generates outputs based upon a set of criteria given by the user, generally the tool makes several decisions based upon its internal rules. May also involve artificial intelligence in the form of case based reasoning or an expert system, often instantiated as a wizard.

  • *Advisory* – provides instructional, pedagogical, or task advice to the users, generally in context with the user’s current task. May be passive, the user must invoke the advisory system – similar to an online help system, or an expert
system, which automatically reacts based upon the system state – similar to MicroSoft’s “Mr. Clippy.”

- **Training** – embedded or linked tutorials that teach, demonstrate, or lead a user through an instructional design step(s) or a process.
- **Templates/Forms** – pre-formatted documents, checklists, questionnaires, charts, etc. that users can complete with project specific information.
- **Examples** – completed forms or templates, completed project documents (such as design plans), models or exemplars of instructional materials that allow users to establish goals.

### Table 4. Electronic Instructional Design Tool Characteristics

<table>
<thead>
<tr>
<th>Electronic Instructional Design Tool</th>
<th>Outputs</th>
<th>Supported ISD Elements</th>
<th>Integrated Methodologies / Learning Theories</th>
<th>User Groups</th>
<th>Support Types</th>
</tr>
</thead>
<tbody>
<tr>
<td>IDE</td>
<td>Classroom training of business spreadsheets</td>
<td>Analysis, design, development</td>
<td>Example-based minimalist design</td>
<td>Experienced instructional designers</td>
<td>Productivity tools</td>
</tr>
<tr>
<td>AT&amp;T Training Test Consultant</td>
<td>Student tests and evaluations</td>
<td>Evaluation</td>
<td>Criteria referenced instruction</td>
<td>Training developers</td>
<td>Advisory, training</td>
</tr>
<tr>
<td>NCR QIPP</td>
<td>Classroom training materials and software documentation</td>
<td>Analysis, design, development, implementation, evaluation</td>
<td>Generic ADDIE tailored to NCR product development process, customizable</td>
<td>Instructional designers, technical writers</td>
<td>Advisory, templates / forms, examples</td>
</tr>
<tr>
<td>ID Expert and IDXelerator</td>
<td>Computer-based instruction</td>
<td>Development</td>
<td>Instructional Transaction Theory</td>
<td>Subject-matter experts</td>
<td>Task automation</td>
</tr>
<tr>
<td>GAIDA</td>
<td>Interactive courseware and classroom training materials</td>
<td>Design</td>
<td>Gagné’s nine events of instruction</td>
<td>Novice instructional designers</td>
<td>Advisory, training</td>
</tr>
<tr>
<td>XAIDA</td>
<td>Interactive courseware</td>
<td>Development, implementation</td>
<td>Instructional Transaction Theory</td>
<td>Subject-matter experts</td>
<td>Task automation</td>
</tr>
<tr>
<td>Electronic Instructional Design Tool</td>
<td>Outputs</td>
<td>Supported ISD Elements</td>
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<td>Support Types</td>
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<td>--------------------------------------</td>
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</tr>
<tr>
<td>AGD</td>
<td>Computer-based instruction, Internet-based distance courses</td>
<td>Analysis, design</td>
<td>Tennyson’s ISD, MISA engineering approach</td>
<td>Subject-matter experts</td>
<td>Expert advisory</td>
</tr>
<tr>
<td>Cascade</td>
<td>Primarily classroom materials, can be used for other formats</td>
<td>Analysis, design, development, implementation, evaluation</td>
<td>Constructivism</td>
<td>Primarily classroom teachers and resource teachers</td>
<td>Advisory, task automation, templates / forms</td>
</tr>
<tr>
<td>Designer’s Edge</td>
<td>Computer-based training, classroom training</td>
<td>Analysis, design, development (via external tool), evaluation</td>
<td>Generic ADDIE, customizable</td>
<td>Novice instructional designers, subject matter experts</td>
<td>Advisory, training, productivity tools</td>
</tr>
<tr>
<td>Learning Designer</td>
<td>Web-based instructional materials</td>
<td>Design, development</td>
<td>Component display theory</td>
<td>Instructional designers</td>
<td>Productivity tools, task automation</td>
</tr>
<tr>
<td>Instructional DesignWare</td>
<td>Classroom training materials</td>
<td>Analysis, design, development, evaluation</td>
<td>Generic ADDIE</td>
<td>Instructional designers and classroom trainers</td>
<td>Advisory, productivity tools, task automation</td>
</tr>
<tr>
<td>Course Developer’s Workbench</td>
<td>Web-based training material</td>
<td>Design</td>
<td>ARCS</td>
<td>Course developers</td>
<td>Expert advisory</td>
</tr>
<tr>
<td>ADAPT</td>
<td>Computer-based instruction</td>
<td>Analysis, design, evaluation</td>
<td>4C/ID*</td>
<td>Instructional designers</td>
<td>Productivity tools, task automation</td>
</tr>
<tr>
<td>eCAD</td>
<td>Online courses</td>
<td>Design, development, evaluation</td>
<td>Dick and Carey</td>
<td>Online instructors</td>
<td>Task automation</td>
</tr>
</tbody>
</table>

**Impact and Results**

van Merriënboer and Martens (2002) maintain that computer-based tools to support the instructional design process can assist in solving some of the problems and difficulties that occur in instructional design, especially ISD projects that have to do with multidisciplinary collaborative learning that deals with authentic, real-life tasks. This type of e-learning is often designed and developed via complex design models by collaborative
teams. Therefore, computer tools that help organize and manage the design process and aid in the development of instructional design deliverables would appear to provide opportunities to improve ID efficiency and quality.

Computerized tools that improve the efficiency of instructional designers are essential and have the potential to make businesses more competitive. Tools can speed the ISD process and make creation of e-learning faster and less expensive. The emergence of instructional design tools that provide support in a variety of situations is among the trends noted by Gustafson (2002). Tools are emerging that support both novice and experienced designers, support a variety of approaches to instructional design, support a variety of perspectives on learning, and promote increased user instructional design knowledge and skills. Increasing efficiency in the instructional design process while maintaining or improving quality would address one of the main criticisms of the ISD process—that it is slow and clumsy (Gustafson, 2002).

However, attempts to automate the ISD process and reduce the need for experienced instructional design expertise have had mixed results. Uduma (2002) compared and contrasted the quality of products produced by 12 instructional designers of various experience levels who used Designer’s Edge, an automated design tool, to create several instructional products. Results showed notable differences in instructional quality among the outputs of experts, novices, and non-designers as well as major differences in the design approaches used by the three groups. Expert designers spent more time understanding the problem, considered a variety of solutions, used a heuristic approach and produced higher quality instruction than the other two groups. Although the novice designers used Designer’s Edge for advice, guidance, and assistance and seemed to benefit
more than the other two groups, they still produced a significantly lower quality product than the more experienced designers. Uduma suggests that designing quality instruction requires both scientific and artistic skills that involve high-level cognitive processes that have not yet been captured in an automated ISD tool.

Douglas (2003) evaluated an EPSS approach to automated instructional design in order to understand its effectiveness in enabling instructional designers to develop well-designed instructional products. Twenty four graduate level instructional design students, all novice designers, used an author-created instructional design EPSS to support them in their first development project. The EPSS provided users with three modes of operation: design mode, learning mode, and example mode. Study participants could choose which parts of the support system and which modes to use as they completed their development projects. A rubric, essentially an evaluation of the extent to which users followed the defined ISD process, was created and used to evaluate the quality of the products developed by the students. Not surprisingly, users relied on the EPSS’ learning mode, which included descriptions and reminders of steps within tasks, most often. Douglas (2003) also determined that there was no correlation between specific EPSS functions and the quality of the resulting instructional projects created by the users.

Even though it is difficult to correlate the use of electronic instructional design tools with the quality of the designers’ instructional products or the ultimate performance of the users of those instructional products, attempts to automate instructional design have led to insights and greater understanding of the instructional design process and when and where human involvement is required and why. Human involvement in the instructional design process will still be necessary and the real value of automating portions of
instructional design will be in support of human activity and not a replacement to it. Most published research presents formative evaluation results of implemented electronic supported design systems or evaluations of the learning environments created by using such design systems. Research findings do not address deeper issues such as:

- Determining the association between system features and improved instruction.
- Evaluating the learning resulting from the instructional product that the electronic support system helped produce.
- Investigating the long-term trends in the development of learning environments.

However, research has shown that overall designers can improve their productivity by using automated design tools and performance support. While results vary, designers have demonstrated productivity improvements in an order of magnitude from the use of some electronic support systems (Spector, & Ohrazada, 2004).

In order to enable automated design software to choose automatically the most appropriate ISD outcomes, complex instructional design decisions must be represented by computer algorithms. Richey, Klein, & Nelson (2004) point out the difficulty of this endeavor given the level of understanding and knowledge of human decision making in relation to the ISD process. Based on this observation, they surmise that the most appropriate architecture for electronic tools for instructional systems design may be a hybrid system that incorporates open-ended tools for experts along with an advisory system and example library for novices.
Conclusion

E-learning is evolving, just as the network technologies that implement it are. Rosenberg (2006b) describes several transformations which are fundamental to the way in which e-learning applications are and will be applied in business settings. E-learning is becoming more than e-training. It includes informational and collaborative performance solutions and not just a delivery method for instruction and courses. As e-learning moves into the corporate environment it extends learning to include support for people directly on the job and focuses more on the workplace than the classroom. Blended learning is being redefined as an integration of formal (training) and informal (non-training) approaches that support learning and performance rather than the limited view of blended learning as a combination of classroom and online instruction. E-learning is becoming more knowledge-centric and less course-centric. Traditional training curriculums center around the concept of courses organized by domains, but e-learning incorporates other knowledge sources such as documents, Websites, experts, communities, tools, and events. It adapts as workers progress through various levels of mastery (e.g., novice, competent, experienced, and expert) and their primary learning requirements shift from formal to more informal, on-the-job learning that is more personalized. Technology is becoming a secondary issue as learning technologies are integrated into business’ networks and applications. E-learning designers will be able to focus on providing effective performance support and learning resources to constituent audiences rather than becoming wrapped-up with the delivery technologies.

Even while the corporate e-learning environment is changing, instructional designers continue to pursue the dual objectives of reducing e-learning design cycle time
and increasing training effectiveness and efficiency. Both of these objectives are essentially focused on the goal of improving job performance of learners quicker—by providing up-to-date instruction in a timelier manner and enabling learners to access that instruction at the time of need with minimal work disruption. The two primary tactics to reducing design and development time include the inclusion of rapid prototyping methodologies in the ISD process and the application of EPSS technologies to aid instructional designers, especially novice instructional designers, as they develop instructional products (Richey & Morrison, 2002). Electronic tools for instructional design which can increase the efficiency the ISD process by reducing the amount of time required by highly skilled designers and making use of subject matter experts have the potential for being successful in the corporate environment. Complex tools that require extensive instructional design expertise and have a lengthy learning curve will have little chance to succeed; simple and easy to use tools for instructional design are needed (Gustafson, 2002).
Chapter 3

Methodology

Background

The investigation is a type of developmental research that Richey, Klein, and Nelson (2004) and van den Akker (1999) refer to as formative research. Formative research typically involves situations in which the development process may be described and analyzed and the final product is evaluated. Alternately, it may involve product evaluation only and not address the development process (Richey et al., 2004). This methodology was used because it focused investigative efforts on resolving the four research questions:

1. What are the comprehensive analysis and design tasks for e-learning (online learning, knowledge management, and EPSS) development?
2. What heuristics would guide instructional designers during the analysis and design phases of the e-learning instructional systems design process?
3. In what ways would a set of heuristics or guidelines be beneficial to a corporate e-learning designer?
4. How do practicing instructional designers view the value of an EPSS containing analysis and design heuristics in making priority, resource, and scheduling decisions during a corporate e-learning project?
Formative research begins with the design and development of an instructional product or program. The design and development procedures used generally follow the accepted practices and standards of ISD, from front-end analysis, through design, development, implementation, and formative and summative evaluation. Research methods tend to vary widely, but the case study is commonly used along with evaluation methods such as surveys, questionnaires, and interviews. Conclusions reached from formative research often are context-specific and include suggested improvements in the product or program, conditions that promote successful use of the product, or impact of the product. Even though these conclusions are particular to a product, they provide direction to other researchers (Richey et al., 2004).

Developmental research is focused on the dual objectives of developing approaches to performance problems and at the same time creating a body of design principles that can guide future development efforts. Research methodology is generally comprised of four main steps (Figure 7), with iterations among and between steps as problems, solutions, and methods are refined (Reeves, 2000). Steps include:

1. Analysis of practical problems by researchers and practitioners. Development research begins with an intensive and systematic investigation of the research problem and its context including searching the literature for explicit connections of that analysis with state-of-the-art knowledge.

2. Development of solutions with a theoretical framework. Design solutions that are formulated during development research are explicitly tied to theoretical foundations.
3. Evaluation and testing of solutions in practice. Clear empirical evidence is delivered about the practicality and effectiveness of the design solution for the intended audience in an authentic setting.

4. Documentation and reflections to produce design principles. Systematic analysis, reflection, and documentation on the entire design experiment process and its outcomes contribute to the community’s knowledge (van den Akker, 1999).

**Figure 7. Developmental Research Methodology**

Developmental research uses a variety of methodologies applying whatever tools that meet the research requirements (Richey et al., 2004). Formative evaluation holds a prominent place in developmental research because it provides information that is fed back into the design and development process to refine the solutions and therefore contributes to the quality improvement of the solutions. The major aspect of quality shifts from validity, to practicality, to effectiveness during the course of the design, development, and evaluation of the solution. Validity refers to the extent that the solution is based on state-of-the-art knowledge and that the various components of the solution are consistent. Practicality refers to the extent that the targeted users consider the solution usable in normal conditions. Effectiveness refers to the extent that the outcomes of the intervention or solution match its intended goals. The methods and techniques of developmental research will usually vary during the research project to meet those three criteria. For example, validity could be evaluated through expert appraisal, practicality through usability tests and controlled releases, and effectiveness evaluated through formal field tests (van den Akker, 1999).

**Approach**

The approach fits within the developmental research methodology. As mentioned previously, developmental research is focused on development of approaches to performance problems and creation of a body of design principles that can guide future efforts. In this work, the performance problem is the need to create effective e-learning programs. The problem is addressed by the development of an EPSS that includes a set of heuristics that help instructional designers make sound decisions during the analysis and
design stages of e-learning projects. The heuristics that were developed can also serve as a set of design principles that other research can expand upon.

The specific methodology used was designed to address the four research questions identified earlier and to fit within the formative research approach advocated by van den Akker (1999) and Reeves (2000) and sometimes referred to as a design experiment. It specifically followed the design experiment model that Bannan-Ritland (2003) identifies as Integrative Learning Design Framework. The four major phases of the Integrative Learning Design (ILD) Framework, informed exploration phase, enactment phase, evaluation: local impact phase, and evaluation: broader impact phase, map directly to Reeves’ (2000) and van den Akker’s (1999) development research methodology (Figure 7).

**Informed Exploration Phase**

The first phase of the ILD is rooted in essential research steps of problem identification, literature survey, and problem definition (Bannan-Ritland, 2003). The research tasks were to determine a comprehensive set of instructional system analysis and design activities or tasks via literature review and action research. This phase was conducted in two steps. First, through literature review of various instructional systems design models, a set of analysis and design activities or tasks that are applicable to e-learning development was determined. The intent was not to suggest that every activity should be done every time, but that the set of analysis and design tasks account for the most recognizable ISD models. Second, a format or template for analysis and design tasks was created. Research question one was addressed in this phase.
Enactment Phase

The enactment phase of the ILD is comprised of initial intervention design, prototype articulation, and the subsequent development of a more fully detailed intervention (Bannan-Ritland, 2003). The research tasks were, first, based on a literature review, to formulate a set of heuristics for each ISD activity in the previous step. Second, to design and develop a prototype EPSS composed of the heuristics for each e-learning analysis and design activity. The final step in this phase was to contact and recruit experienced instructional designers who could provide feedback and comments during the formative evaluation step, in the next phase. Research questions one and two were addressed in this phase.

Evaluation: Local Impact Phase

In the ILD framework evaluation is a two-stage phenomenon: local impact and broader impact. The goal of the first stage is to evaluate the local impact of the intervention: how well does the intervention satisfy its clients (Bannan-Ritland, 2003). The two research tasks were to conduct formative review of the EPSS and design heuristics through reviews by experienced instructional designers and then to revise the EPSS based upon the formative review results. See Appendix B, Participant Consent Form, and Appendix C, e-learning Analysis and Design Advisor Formative Review Form. Research questions one, two, and three were addressed in this phase.

Evaluation: Broader Impact Phase

Within the ILD model, the goal of this second stage of evaluation is to look at issues related to successful dissemination and adoption in a broader context and to a broader audience (Bannan-Ritland, 2003). The research tasks were to deploy the EPSS,
conduct summative evaluation, analyze the results, and write the final report. The EPSS was piloted by deploying it to three e-learning project teams to use in an authentic environment during the analysis and design of corporate e-learning projects. Summative evaluation was conducted via surveys and interviews of the study participants. See Appendix B, Study Participants Consent Form, and Appendix D, e-learning Analysis and Design Advisor Summative Evaluation Form. The final step of this phase and the research was to summarize the results by analyzing, synthesizing, and evaluating the survey and interview results. Results were assessed with regard to research questions, areas for further research were determined and discussed, results were documented, and the final report was written. Research questions one, two, three, and four were addressed in this phase.

**Procedures**

The investigation was organized into four phases (Informed Exploration, Enactment, Evaluation: Local Impact, and Evaluation: Broader Impact) described in the Approach Section of this Chapter. Table 5 provides a summary of the research steps conducted during each of those four phases of this investigation.
Table 5. Research Steps Summary

<table>
<thead>
<tr>
<th>ILD Phase</th>
<th>Step Number</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Informed Exploration</strong></td>
<td>1</td>
<td>Researched and documented a list of industry-accepted e-learning analysis and design tasks, which are common to most e-learning instructional design models.</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Designed a format or template for task heuristics.</td>
</tr>
<tr>
<td><strong>Enactment</strong></td>
<td>3</td>
<td>Formulated a preliminary set of heuristics for each task identified in Step 1.</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>Designed and developed a prototype EPSS.</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>Contacted and recruited experienced instructional designers to review the prototype EPSS and provide feedback and comments. Designed and developed formative review forms and summative evaluation forms.</td>
</tr>
<tr>
<td><strong>Evaluation: Local Impact</strong></td>
<td>6</td>
<td>Conducted a formative review by distributing the prototype EPSS and task heuristics along with formative review forms to the reviewers.</td>
</tr>
<tr>
<td></td>
<td>7</td>
<td>Collected reviewers’ responses and analyzed and consolidated their comments and suggestions. Made revisions to task heuristics and revised the EPSS by incorporating the recommendations obtained during the formative review.</td>
</tr>
<tr>
<td><strong>Evaluation: Broader Impact</strong></td>
<td>8</td>
<td>Deployed the final EPSS to study participants (instructional designers) to use during an e-learning project.</td>
</tr>
<tr>
<td></td>
<td>9</td>
<td>Conducted summative evaluation via surveys and interviews with study participants from step 8.</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>Published and distributed final set of heuristics.</td>
</tr>
</tbody>
</table>

*Informed Exploration Phase*

During the Informed Exploration phase a literature review was conducted in order to create an inclusive list of 11 analysis and 16 design tasks derived from instructional systems design and related disciplines. That list of analysis and design tasks, along with references, is included in Appendix E, E-Learning Analysis and Design Task Descriptions.
A format or template for analysis and design task heuristics was created and specific heuristics for each analysis and design task were created.

*Enactment Phase*

During the Enactment Phase a prototype EPSS, *e-learning Analysis and Design Advisor*, containing the e-learning analysis and design task heuristics was developed. See Appendix H for representative screen shots from this EPSS. Additionally, a group of experienced instructional designers were recruited to participate in a formative review and provide feedback and comments about the *e-learning Analysis and Design Advisor* and to serve as an informal steering committee that could make recommendations and suggestions during a pilot test.

*Evaluation: Local Impact*

Evaluation: Local Impact. During this phase, the members of the steering committed conducted a formative evaluation by reviewing the analysis and task heuristics and making recommendations for changes. See Appendix C, *e-learning Analysis and Design Advisor* Formative Review Form. The researcher made revisions to the *e-learning Analysis and Design Advisor* EPSS after analyzing the reviewers comments, suggestions, and completed evaluation forms.

*Evaluation: Broader Impact*

In the final research phase, Evaluation: Broader Impact, a pilot test or summative evaluation of the *e-learning Analysis and Design Advisor* was conducted. The *Advisor* was deployed and used by instructional design teams during the analysis and design phases of three corporate e-learning projects. These study participants consulted with and referred to the *Advisor* in context with their actual projects and provided their comments,
observations, and appraisals using the summative evaluation form shown in Appendix D, *e-learning Analysis and Design Advisor* Summative Evaluation Form.

**Resources**

Two groups of participants were recruited for this case study (formative reviewers and summative evaluators) from the learning professionals employed by Lockheed Martin Information and Technology Services, General Dynamics Information Technology, Accenture, SI International, and Syracuse Research Corporation. All five companies contract with the federal government to design and develop learning and performance support programs. Some of these contracted learning programs are standalone projects and some are developed in association with larger information technology projects. Lockheed Martin, General Dynamics, Accenture, and SI International are among the top 100 federal information technology (IT) contracting companies as measured by total size of federal IT contracts; Lockheed Martin is first, General Dynamics is fourth, Accenture is twenty-fourth, and SI International is fortieth.

Lockheed Martin Information and Technology Services, a reporting unit of Lockheed Martin, includes operations in information technology integration and management, enterprise solutions, and application development. Lockheed Martin generates more than $37 billion annually and employs 135,000 people.

General Dynamics Information Technology provides systems integration and data networking services primarily to the Department of Defense and other national security agencies. With headquarters in Falls Church, VA, General Dynamics Information Technology’s 16,000 employees generate $1.75 billion yearly.
Accenture is the world’s largest consulting firm and offers management consulting, information technology and systems integration, and business process outsourcing (BPO) services to customers around the globe. Accenture employs 126,000 people and generates $17 billion annually.

SI International develops and implements information technology and network solutions for governmental organizations, primarily the Department of Defense and Federal Civilian agencies. The company is headquartered in Reston, VA, with branch offices in 15 states. Its 4,000 employees generate around $400 million in revenue each year.

Syracuse Research Corporation (SRC) is an independent, not-for-profit research and development organization. Headquartered in Syracuse, NY, SRC employs more than 750 people and generates about $70 million yearly.

Formative Reviewers

Participants for the formative review group were recruited from the senior staff of SI International’s Learning Division. SI’s Learning Division specializes in e-learning, performance support and knowledge management, and training and documentation. Clients include the National Security Agency, Department of Homeland Security, Defense Acquisition University, Immigration and Naturalization Service, Comptroller of the Currency, Federal Deposit Insurance Corporation, Federal Financial Institutions Examination Council, and Executive Office for the U.S. Attorneys, along with several commercial clients. The Learning Division is staffed by more than 120 learning developers, managers, and designers; nearly 40 are senior level instructional designers and
project managers. There is a broad range of experience. Entry level and junior developers tend to have very little practical experience (some less than one year); many senior designers have considerable practical experience (some more than 30 years). Approximately half of the design staff has had formal instructional design training—either at the university level or in corporate workshops.

Eight experienced e-learning instructional designers from the ranks of the program management, project management, and instructional design staffs volunteered to participate in the formative review. Each reviewed the contents of the EPSS and made recommendations of changes to improve the information contained in the EPSS. In addition, these reviewers completed a formative review questionnaire.

The formative review group average more than 19 years experience in the application of instructional systems design methodologies, with more than 12 years using ISD in the area of e-learning. All of these reviewers have advanced degrees (master’s level or higher) in education or related fields of psychology, communication, and engineering. See Appendix F for formative reviewers’ credentials.

**Summative Evaluators**

Instructional designers who were actively involved with the analysis and design phases of e-learning projects were recruited to participate in the summative evaluation. Thirty-one e-learning designers participated in this pilot test. They were members of one of three ongoing e-learning project teams. Project managers or senior instructional designers from SI Learning are directing these three e-learning design and development projects. The three projects are staffed by personnel from the five contracting companies
mentioned previously: Lockheed Martin Information and Technology Services, General Dynamics Information, Accenture, SI Learning, and Syracuse Research Corporation.

Summative evaluators were members of one of three e-learning project teams: FBI SENTINEL, NSA’s National Signals Intelligence Requirements Process, or Air Force Institute for Advanced Distributed Learning (AFIADL) Functional Area Management Support. The first two projects involved the design and development of e-learning to support users of custom developed application software; the third project was to create e-learning components to integrate into a community of practice Web page which provides support for a specific job tasks. See Appendix G for a profile of the three projects.

Summative evaluators consulted the e-learning Analysis and Design Advisor during the analysis and design phases of their respective projects and then completed a summative evaluation form and participated in follow up interviews.

The experience level and the background of the summative evaluation group varied more than the formative reviewers. While some summative evaluators have extensive experience and training in both instructional systems design and e-learning most of the evaluators are junior level designers and possess entry-level skills. Summative evaluators were asked to appraise their ISD and e-learning design and development skills and rate themselves as either novice, experienced, or expert in instructional systems design and as either novice, experienced, or expert in e-learning development. Table 6 shows how the summative evaluators rated their skills in instructional systems design and e-learning development. Figure 8 and Figure 9 provide graphic representations of the percentages.

See Appendix G, Pilot Project Profiles for more details about the summative evaluators and each of the three pilot projects.
Table 6. Summative Evaluators' Self-Ratings

<table>
<thead>
<tr>
<th></th>
<th>Instructional systems design</th>
<th>e-learning development</th>
</tr>
</thead>
<tbody>
<tr>
<td>Novice</td>
<td>18</td>
<td>18</td>
</tr>
<tr>
<td>Experienced</td>
<td>8</td>
<td>7</td>
</tr>
<tr>
<td>Expert</td>
<td>5</td>
<td>6</td>
</tr>
</tbody>
</table>

Figure 8. Summative Evaluators' Self-Rating ISD Skill Level

Figure 9. Summative Evaluators' Self-Rating e-learning Development Skill Level
Of the summative evaluators, 11 were from SI Learning, eight from Accenture, six from General Dynamics, five from SRC, and one from Lockheed Martin. Most of the expert and experienced summative evaluators were from SI Learning and have extensive experience in instructional systems design and e-learning; most of the evaluators from the other four companies were novice or junior level with some instructional systems design experience but little e-learning experience.

**Methodology Summary**

Table 7 identifies the primary methodology that was used to address each of the four research questions.
Table 7. Research Question Methodologies

**Research Question 1:**
What are the comprehensive analysis and design tasks for e-learning (online learning, knowledge management, and EPSS) development?

- via literature review in the Informed Exploration phases and the Enactment phases
- via formative review in the Evaluation: Local Impact phase
  (Appendix C, *e-learning Analysis and Design Advisor Formative Review Form*)
- via summative evaluation in the Evaluation: Broader Impact phase
  (Appendix D, *e-learning Analysis and Design Advisor Summative Evaluation Form*)

**Research Question 2:**
What heuristics would guide instructional designers during the analysis and design phases of the e-learning instructional systems design process?

- via literature review in the Enactment phase
- via formative review in the Evaluation: Local Impact phase
  (Appendix C, *e-learning Analysis and Design Advisor Formative Review Form*)
- via summative evaluation in the Evaluation: Broader Impact phase
  (Appendix D, *e-learning Analysis and Design Advisor Summative Evaluation Form*)

**Research Question 3:**
In what ways would a set of heuristics or guidelines be beneficial to a corporate e-learning designer?

- via formative review in the Evaluation: Local Impact phase
  (Appendix C, *e-learning Analysis and Design Advisor Formative Review Form*)
- via summative evaluation in the Evaluation: Broader Impact phase
  (Appendix D, *e-learning Analysis and Design Advisor Summative Evaluation Form*)

**Research Question 4:**
How do practicing instructional designers view the value of an EPSS containing analysis and design heuristics in making priority, resource, and scheduling decisions during a corporate e-learning project?

- via summative evaluation in the Evaluation: Broader Impact phase
  (Appendix D, *e-learning Analysis and Design Advisor Summative Evaluation Form*)
Chapter 4

Results

Findings

Study results related to each of these questions were derived from methods incorporated into each of the research phases as shown in the Summary section of Chapter 3. The results are organized and presented as they pertain to each of the four research questions.

Research Question 1

The question, what are the comprehensive analysis and design tasks for e-learning (online learning, knowledge management, and EPSS) development, was primarily addressed via literature review in the first two phases: Informed Exploration and Enactment. A set of e-learning analysis and design tasks was produced following a through literature review of instructional systems design methodologies and related design disciplines of knowledge and information engineering and software engineering, along with techniques associated with usability engineering and rapid prototyping. Eleven analyses and 16 design tasks were determined to comprise a comprehensive collection of
procedures and techniques common to e-learning projects. See Appendix E, E-Learning Analysis and Design Task Descriptions for more details.

**E-learning Analysis Tasks**

- Identify business needs
- Needs assessment
- Audience analysis
- Job analysis
- Task analysis
- Instructional analysis
- Content and SME analysis
- Determine functional requirements
- Information resources analysis
- Determine strategic requirements
- User environment analysis

**E-learning Design Tasks**

- Establish creative treatment
- Determine terminal and enabling objectives
- Write content outline
- Organize instructional architecture
- Devise instructional strategies
- Plan technical architecture
- Devise user interface
- Create a low-level prototype
- Develop preliminary storyboard and flowcharts
- Create a style guide
- Identify media components
- Construct functional prototype
- Usability testing
- Write unit and integration test plans
- Write validation/evaluation plan
- Create the implementation plan

All formative reviewer and summative evaluators were asked two questions regarding the applicability of these 27 analysis and design tasks. Specifically:

- “Based on your experience in instructional systems design and e-learning, which Analysis or Design tasks in the e-learning Analysis and Design Advisor would you recommend removing?”
- “Based on your experience in instructional systems design and e-learning, what Analysis or Design tasks should be added to the e-learning Analysis and Design Advisor?”

Representative responses included:

- “All are valid tasks to consider.”
- “The key point in the overall approach is the inclusion of the traditional ISD tasks and the additional and critical components that are related to e-learning, such as the technical architecture, storyboarding, creating prototypes, devising the user interface, etc.”
During the final two research phases: Evaluation: Local Impact and Evaluation: Broader Impact, formative reviewers and summative evaluators were asked to identify any additional analysis or design tasks that should be included and to identify any tasks that should be eliminated. The only task that was recommended to be added was an organizational meeting or review before beginning the design phase of an e-learning project, which is a project management task. This is the specific comment:

“Though not a part of the formal process (but normally considered/encountered during the design phase), I would include info concerning project kick off – specifically:

- Human resource considerations (because someone has to accomplish these tasks)
- Brainstorming and the value of experienced input/lessons learned.
- Relationship building (team members, SME, client, consultants, etc.)
- Information sharing protocols: Who schedules meetings – PM or any team member based upon need, methods for version control, record keeping – shared drive or individual desktop.”

Research Question 2

The second question, what heuristics would guide instructional designers during the analysis and design phases of the e-learning instructional systems design process, was also addressed primarily through literature review and analysis in the second phase: Enactment. A preliminary set of heuristics or guidelines was formulated for each task identified in the previous phase and then a prototype EPSS, termed the e-learning Analysis
and Design Advisor (aka the Advisor), was developed. Task heuristics were modified and revised during the Evaluation: Local Impact (formative review) phase of the research following the recommendations of the formative review team.

Task heuristics were intended to aid instructional designers make decisions about how much time to spend on each task, when a task is sufficiently complete, how to sequence and prioritize tasks, how to focus on users’ performance and clients’ goals, and how to keep tasks on schedule and under budget. Each task heuristic included these topics or sections:

- A brief description of the task (What is the task?)
- The task’s purpose (Why do the task?)
- A summary of the task methodology (How to do the task?)
- Relevant references (Where to look for help?)
- A list of the significant factors which lead to success (Keys to success)
- A list of potential trouble spots (Major errors associated with the task)

See Appendix I, e-learning Analysis and Design Advisor Print Version for a complete list of task guidelines. See Appendix H, e-learning Analysis and Design Advisor Screen Shots for examples of the EPSS.

All formative reviewers provided specific comments and suggestions for individual task heuristics, and some offered overall comments on the general heuristic approach.

Representative comments included:

- “Overall structure of each major analysis and design component—why, how, where to look for help, keys to success, and major errors associated with the component—clarity and ease of use for these sections. I believe they are very
helpful to the end user. There may be some opportunity to expand on those areas—e.g. add examples where appropriate, add additional input from others who are known and respected in the field.”

- “A heuristic approach, as opposed to an algorithmic or procedural method is the only one that makes sense.”

Research Question 3

The third question, in what ways would a set of heuristics or guidelines be beneficial to a corporate e-learning designer, was addressed during the last two phases, Evaluation: Local Impact (formative review) and Evaluation: Broader Impact (summative evaluation).

During the formative review, reviewers were asked if the task descriptions in the Advisor would be beneficial to instructional designers as a learning or reference tool or in other ways. The same question was posed to project participants in the summative evaluation. Table 8 and Figure 10 show the results of the first question: “would the task descriptions be beneficial as a learning tool?” Table 8 shows the raw data for formative reviewers and the three project teams of summative evaluators. Figure 10 shows the aggregate results for all responders.

| Table 8. Would Task Descriptions Be Beneficial as a Learning Tool: Project Results |
|--------------------------------|--------|--------|--------|
|                           | Yes    | Not Sure | No     |
| Formative Reviewers       | 7      |         | 1      |
| FBI SENTINEL              | 13     | 4       | 1      |
| NSRP                      | 7      | 1       |        |
| AFIADL-FAM                | 5      |         |        |
| Total                     | 32     | 5       | 2      |
Table 9 and Figure 11 show the results of the first question: “would the task descriptions be beneficial as a reference?” Table 9 shows the raw data for formative reviewers and the three project teams of summative evaluators. Figure 11 shows the aggregate results for all responders.

Table 9. Would Task Descriptions Be Beneficial as a Reference: Project Results

<table>
<thead>
<tr>
<th></th>
<th>Yes</th>
<th>Not Sure</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Formative Reviewers</td>
<td>8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FBI SENTINEL</td>
<td>16</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>NSRP</td>
<td>7</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>AFIADL-FAM</td>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>36</td>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>

Figure 11. Would Task Descriptions Be Beneficial as a Reference: Total Results
Additional comments from formative reviewers and summative evaluators included:

- “The information provided is valuable; I see it as a very good reference.”
- “This has great potential as a learning tool if you provide more information, along with links to glossaries, and examples.”
- “This could be the beginning of a very valuable corporate delivery methodology.”
- “It provides a common model, a common language for all instructional designers.”
- “This should be made part of internal orientation for new ISD (‘this is the tool you should use and will be evaluated against in terms of your performance in yearly appraisals, etc.’)”
- “Production coordinators and project managers should design project management plans and project schedules around this.”
- “Internal reviews and audits should use this as the basis—at least as an informal checklist.”
- “Should be ‘published’ in marketing and documentation that we give clients to explain our internal standards and processes.”
- “Should be integrated into other internal corporate design and development tools”
- “It would remind experienced instructional designers of formal tasks and strategies. This could help standardize some tasks, but relies heavily on
Tessmer and Dick & Carey. It would be good exposure for those not familiar or comfortable with these tasks.”

Research Question 4

The last question, how do practicing instructional designers view the value of an EPSS containing analysis and design heuristics in making priority, resource, and scheduling decisions during a corporate e-learning project, was addressed during the final phase: Evaluation: Broader Impact (summative evaluation).

Members of three project teams—FBI SENTINEL, National Signals Intelligence Requirements Process (NSRP), and Air Force Institute for Advanced Distributed Learning: Functional Area Management (AFIADL-FAM) (Appendix G)—piloted the Advisor by using it in conjunction with the analysis and design phases of their respective projects. They were each given a copy of the Summative Evaluation survey form (Appendix D) at the start of the pilot test. They completed the questions included in the survey during the analysis and design phases of their project and returned the surveys to the researcher. Follow up interviews and discussions were held with some of the summative evaluators to clarify their responses and gain more insight into the individual project logistics.

Evaluators were asked a series of questions regarding their overall assessment of the EPSS’ ability to help them make scope, scheduling, priority, quality, and resource allocation decisions about the various analysis and design tasks in their project. The specific questions and their responses for each of the project teams are shown in Table 10, Table 11, Table 12, Table 13, and Table 14. Aggregate percentages are shown in Figure 12, Figure 13, Figure 14, Figure 15, and Figure 16.
Table 10. Helped Determine How Much Time to Spend on Task: Project Results

<table>
<thead>
<tr>
<th></th>
<th>Yes</th>
<th>Not Sure</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>FBI SENTINEL</td>
<td>13</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>NSRP</td>
<td>5</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>AFIADL-FAM</td>
<td>4</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>22</td>
<td>6</td>
<td>3</td>
</tr>
</tbody>
</table>

Figure 12. Helped Determine How Much Time to Spend on Task: Total Results

![Pie Chart]

Table 11. Helped Determine When Task is Complete: Project Results

<table>
<thead>
<tr>
<th></th>
<th>Yes</th>
<th>Not Sure</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>FBI SENTINEL</td>
<td>14</td>
<td>4</td>
<td></td>
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<td>NSRP</td>
<td>6</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>AFIADL-FAM</td>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>25</td>
<td>6</td>
<td></td>
</tr>
</tbody>
</table>

Figure 13. Helped Determine When Task is Complete: Total Results

![Pie Chart]
Table 12. Helped Sequence and Prioritize Tasks: Project Results

<table>
<thead>
<tr>
<th></th>
<th>Yes</th>
<th>Not Sure</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>FBI SENTINEL</td>
<td>15</td>
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<td>1</td>
</tr>
<tr>
<td>AFIADL-FAM</td>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>22</td>
<td>8</td>
<td>1</td>
</tr>
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</table>

Figure 14. Helped Sequence and Prioritize Tasks: Total Results

![Pie chart showing distribution of Yes, Not Sure, and No responses.]

Table 13. Helped Focus Tasks on Users’ Performance and Clients’ Goals: Project Results

<table>
<thead>
<tr>
<th></th>
<th>Yes</th>
<th>Not Sure</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>FBI SENTINEL</td>
<td>16</td>
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</tr>
<tr>
<td>NSRP</td>
<td>7</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>AFIADL-FAM</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>28</td>
<td>3</td>
<td></td>
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</tbody>
</table>
Figure 15. Helped Focus Tasks on Users’ Performance and Clients’ Goals: Total Results

![Pie chart showing 90% Yes, 10% Not Sure, and 0% No]

Table 14. Helped Keep Tasks on Schedule and Under Budget: Project Results

<table>
<thead>
<tr>
<th></th>
<th>Yes</th>
<th>Not Sure</th>
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<tr>
<td>FBI SENTINEL</td>
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<td>NSRP</td>
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<tr>
<td>AFIADL-FAM</td>
<td>4</td>
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<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>10</td>
<td>18</td>
<td>3</td>
</tr>
</tbody>
</table>

Figure 16. Helped Keep Tasks on Schedule and Under Budget: Total Results

![Pie chart showing 32% Yes, 58% Not Sure, and 10% No]

Evaluators were asked to identify any other advantages of the *Advisor.*

Representative responses included:
• “I would use it to show a client or non-ID project member (e.g. a SME) the anticipated tasks associated with an e-learning project. Somewhat like a primer of sorts.”
• “It would work well for a project manager wanting to write a proposal or a management plan. Also for an intermediate designer who wants some ideas or reminders.”
• “This is a good tool for new developers or occasional developers. Those of us with a lot of ISD/e-learning experience might still find it a good reference or memory jogger.”
• “This is an extremely helpful document for planning and designing an effective e-learning initiative. Adding resources would prove invaluable to accurately completing important tasks.”
• “It’s an excellent project resource for implementing new or potential e-learning projects.”

Disadvantages noted by the evaluators included:
• “Not enough visual aids, lacks a robust “how to use this advisor” section.
• “Task breakdowns are conceptual and provide no basis to estimate required time.”
• “Writing style is too techy/ID specific. If it will be used by other project members (SME’s, Client reps, consultants, etc.) then I would recommend revising the language to make it more generic.”
• “Suggest mapping out the process [i.e. graphically] and linking the tasks to the appropriate step in the process.”
“Use other colors besides blue.”

Summative evaluators were asked for other performance support components that should be added to the Advisor. Several suggestions were offered in the survey form: task templates and forms, examples, checklists, training and quizzes, and instructional design experts’ contact information. Responses by project teams are shown in Table 15, Table 16, Table 17, Table 18, and Table 19. Aggregate responses by percentage are shown in Figure 17, Figure 18, Figure 19, Figure 20, and Figure 21.

### Table 15. Task Templates and Forms: Project Results

<table>
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<tr>
<th></th>
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<tbody>
<tr>
<td>FBI SENTINEL</td>
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<td>NSRP</td>
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</tr>
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<td>AFIADL-FAM</td>
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<tr>
<td>Total</td>
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</table>

### Figure 17. Task Templates and Forms: Total Results

![Pie chart showing 97% Yes, 3% Not Sure]

### Table 16. Task Examples: Project Results

<table>
<thead>
<tr>
<th></th>
<th>Yes</th>
<th>Not Sure</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>FBI SENTINEL</td>
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<td>NSRP</td>
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<td>AFIADL-FAM</td>
<td>5</td>
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</tr>
<tr>
<td>Total</td>
<td>30</td>
<td>1</td>
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</table>
Figure 18. Task Examples: Total Results

Table 17. Checklists: Project Results

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<th>Project</th>
<th>Yes</th>
<th>Not Sure</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>FBI SENTINEL</td>
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<td>1</td>
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<td>NSRP</td>
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<tr>
<td>Total</td>
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</tbody>
</table>

Figure 19. Checklists: Total Results

Table 18. Training and Quizzes: Project Results

<table>
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<tr>
<th>Project</th>
<th>Yes</th>
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<tr>
<td>FBI SENTINEL</td>
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</tr>
<tr>
<td>AFIADL-FAM</td>
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<tr>
<td>Total</td>
<td>14</td>
<td>10</td>
<td>7</td>
</tr>
</tbody>
</table>
Suggestions for additional performance support components to be integrated into the EPSS included:

- “For it to provide true day-to-day performance ‘a la EPSS’ it should provide templates, tips, scripts, and other job aids so a designer can get the job done. Currently, it’s more of a reference guide.”
• “This would really benefit from templates for analysis activities (job aids for questions to ask SMEs; instructional, content, learner analysis). A template, job aid, or example for each task would be best.”

• “A guided exercise or case study of a small project.”

Summative evaluators answered two key questions, “would you use the e-learning Analysis and Design Advisor in other projects?” and, “would you recommend the e-learning Analysis and Design Advisor to colleagues?” Results of these two questions are shown in Table 20, Table 21, Figure 22, and Figure 23.

Table 20. Would You Use the EPSS Again: Project Results

<table>
<thead>
<tr>
<th></th>
<th>Yes</th>
<th>Not Sure</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>FBI SENTINEL</td>
<td>16</td>
<td>2</td>
<td></td>
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<tr>
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<tr>
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Figure 22. Would You Use the EPSS Again: Total Results
Table 21. Would You Recommend the EPSS to Colleagues: Project Results

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<td>AFIADL-FAM</td>
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</table>

Figure 23. Would You Recommend the EPSS to Colleagues: Total Results

So that each of the EPSS’ individual task heuristics could be analyzed and improved, summative evaluators were questioned about the value of each of the individual task descriptions. Evaluators were specifically asked if the EPSS helped them decide whether the task should be included in the project and then if the EPSS helped them complete the task.

Summative evaluators’ responses to the question “which of the task descriptions in the e-learning Analysis and Design Advisor helped in deciding whether to include them in your project?” are shown in Table 22, Table 23, Table 24, and Table 25. Results are shown for each of the three project teams (Table 22, Table 23, and Table 24) as well as the aggregate results (Table 25) since each team’s approach to and execution of the ISD process was different. The results of the FBI SENTINEL team are shown in Table 22; the
results of the NSRP Team are shown in Table 23; the results of the AFIADL-FAM team are shown in Table 24. The total results of all three project teams is given in Table 25. Only those summative evaluators who were involved in the decision to include the task in the project provided responses to this question. Generally, this decision making was restricted to the senior designers and task leads for each of the pilot projects.

Evaluators’ responses to the question “which task descriptions in the e-learning Analysis and Design Advisor helped to complete the task?” are shown in Table 26, Table 27, Table 28, and Table 29. Again, results are shown for each of the three project teams (Table 26, Table 27, and Table 28) followed by the aggregate results (Table 29). The FBI SENTINEL team’s responses are shown in Table 26; the NSRP team’s responses are shown in Table 27; the AFIADL-FAM team’s responses are shown in Table 28. Aggregate results for all three teams are shown in Table 29. Response totals for the individual tasks differ in some instances because occasionally evaluators did not provide any response for some tasks.

Note that the summative evaluation form included an additional option, “Didn’t consult the e-learning Analysis & Design Advisor” which respondents could choose to describe their use of each of the task heuristics. None of the evaluators checked this option for any task, so that has been excluded from the tables.
Table 22. Summative Evaluation - Task Inclusion: FBI SENTINEL

<table>
<thead>
<tr>
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<th>Helped in the Decision to Include or Not</th>
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<td>Job analysis</td>
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<td>Task analysis</td>
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<tr>
<td>Instructional analysis</td>
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<td></td>
</tr>
<tr>
<td>Content and SME analysis</td>
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<tr>
<td>Determine functional requirements</td>
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<td></td>
</tr>
<tr>
<td>Information resource analysis</td>
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<td>Determine strategic requirements</td>
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<tr>
<td>Determine terminal and enabling objectives</td>
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<td>Write content outline</td>
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<td>Organize instructional architecture</td>
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<td>Devise instructional strategies</td>
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<td>Create a low-level prototype</td>
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<td>Develop preliminary storyboard and flowchart</td>
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Note: Includes only those designers who participated in the decision to include ISD tasks.
Table 23. Summative Evaluation – Task Inclusion: NSRP

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Note: Includes only those designers who participated in the decision to include ISD tasks
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<td>Task analysis</td>
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<td>Instructional analysis</td>
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<tr>
<td>Content and SME analysis</td>
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<td>User environment analysis</td>
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<td><strong>Design Tasks</strong></td>
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<td>Write validation and implementation plan</td>
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Note: Includes only those designers who participated in the decision to include ISD tasks
Table 25. Summative Evaluation – Task Inclusion: Aggregate Results

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<td>Content and SME analysis</td>
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</table>

Design Tasks

| Establish creative treatment                         | 14                                       | 1                                           |
| Determine terminal and enabling objectives           | 14                                       | 1                                           |
| Write content outline                                | 14                                       | 1                                           |
| Organize instructional architecture                  | 14                                       | 1                                           |
| Devise instructional strategies                      | 14                                       | 1                                           |
| Create a low-level prototype                         | 15                                       | 0                                           |
| Plan technical architecture                          | 13                                       | 2                                           |
| Develop preliminary storyboard and flowchart         | 15                                       | 0                                           |
| Devise user interface                                | 14                                       | 1                                           |
| Create a style guide                                 | 14                                       | 1                                           |
| Identify media components                            | 14                                       | 1                                           |
| Construct functional prototype                       | 15                                       | 0                                           |
| Usability testing                                    | 15                                       | 0                                           |
| Write unit and integration test plans                | 15                                       | 0                                           |
| Write validation and implementation plan             | 14                                       | 1                                           |
| Write the implementation plan                        | 14                                       | 1                                           |

Note: Includes only those designers who participated in the decision to include ISD tasks.
Table 26. Summative Evaluation – Task Completion: FBI SENTINEL

<table>
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<td>Devise user interface</td>
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<td>Create low-level prototype</td>
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Note: Includes only those designers who participated in task execution.
<table>
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<th>Didn’t Do the Task</th>
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<th>Didn’t Do the Task</th>
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<td>Devise instructional strategies</td>
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<td>Devise user interface</td>
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*Note: Content and SME analysis was not a project task.
Note: Includes only those designers who participated in task execution.
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</tr>
<tr>
<td>Determine functional requirements</td>
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<tr>
<td>Information resource analysis</td>
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<tr>
<td>Determine strategic requirements</td>
</tr>
<tr>
<td>User environment analysis</td>
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<tr>
<td><strong>Design Tasks</strong></td>
</tr>
<tr>
<td>Establish creative treatment</td>
</tr>
<tr>
<td>Determine terminal and enabling objectives</td>
</tr>
<tr>
<td>Write content outline</td>
</tr>
<tr>
<td>Organize instructional architecture</td>
</tr>
<tr>
<td>Devise instructional strategies</td>
</tr>
<tr>
<td>Plan technical architecture</td>
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<tr>
<td>Devise user interface</td>
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<tr>
<td>Create low-level prototype</td>
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<tr>
<td>Develop preliminary storyboard and flowchart</td>
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<tr>
<td>Create a style guide</td>
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<tr>
<td>Identify media components</td>
</tr>
<tr>
<td>Construct functional prototype</td>
</tr>
<tr>
<td>Usability testing</td>
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<tr>
<td>Write unit and integration test plans</td>
</tr>
<tr>
<td>Write validation and implementation plan</td>
</tr>
<tr>
<td>Write the implementation plan</td>
</tr>
</tbody>
</table>

Note: Includes only those designers who participated in task execution.
Table 29. Summative Evaluation – Task Completion: Aggregate Results

<table>
<thead>
<tr>
<th>Analysis Tasks</th>
<th>Helped Complete the Step</th>
<th>Didn’t Help Complete the Step</th>
<th>Didn’t Do the Task</th>
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<tr>
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<td>Job analysis</td>
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<tr>
<td>Content and SME analysis</td>
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</tr>
<tr>
<td>Determine functional requirements</td>
<td>22</td>
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<td>7</td>
</tr>
<tr>
<td>Information resource analysis</td>
<td>21</td>
<td>3</td>
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<td>Determine strategic requirements</td>
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<td>Design Tasks</td>
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<tr>
<td>Establish creative treatment</td>
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<tr>
<td>Devise user interface</td>
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<td>4</td>
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<tr>
<td>Create low-level prototype</td>
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<td>4</td>
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<td>Construct functional prototype</td>
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</tr>
<tr>
<td>Write the implementation plan</td>
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<td>19</td>
</tr>
</tbody>
</table>

Note: Includes only those designers who participated in task execution.
Summary of Results

The primary research issue was to determine the effectiveness of an EPSS, which includes task guidelines or heuristics, to aid instructional designers make decisions concerning quality, cost, and time tradeoffs during e-learning projects. Eight formative reviewers, experienced and trained in the application of instructional systems design for e-learning, reviewed and critiqued an e-learning analysis and design EPSS. Revisions were incorporated in the EPSS which was then piloted by 31 instructional designers working on three different corporate e-learning projects. Summative evaluation was conducted through a survey questionnaire and follow up interviews.

By way of several questions, summative evaluators were asked how they valued the EPSS in making priority, resource, and scheduling decisions during a corporate e-learning project. They were also asked for recommendations to improve the EPSS and finally if they would use it again and recommend it to colleagues.

Summative evaluators’ responses were positive. With few exceptions, evaluators reported that the EPSS had helped in their decisions whether to perform specific tasks and had helped in the task execution. Evaluators said that the EPSS had helped them determine how much time to spend on a task, had helped them determine when a task was complete, had helped them sequence and prioritize tasks, had helped them focus on users’ performance and clients’ goals, and had helped them keep tasks on schedule and under budget. Approximately 90% answered that they would use the EPSS on subsequent projects and would recommend it to associates and co-workers.
Chapter 5
Conclusions, Implications, Recommendations, and Summary

Conclusions
This section presents some conclusions and deductions about the four research questions based upon the results outlined in the previous chapter. However, conclusions can only be determined based upon a thorough understanding of the context in which the research was conducted.

Context of Study
The study was designed to determine the effectiveness of an instructional design EPSS in helping designers make decisions concerning quality, cost, and time tradeoffs during e-learning projects. The scope was limited to corporate e-learning projects. In this case study, senior and junior instructional designers who were working on one of three e-learning projects used the EPSS in conjunction with their respective projects. See Appendix G, Pilot Project Profiles. These three projects share some common characteristics, but also have some differences. The three design teams do as well.

The client in each of the pilot projects is a federal government agency—the Federal Bureau of Investigation (FBI SENTINEL project), the National Security Agency (NSRP
project), or the Air Force (AFIADL-FAM project). While each organization has its own culture and idiosyncrasies, in general the overall rules (both tacit and explicit) for contracting and working with federal agencies apply to each project.

Contractors or consultants whose companies have much experience in federal contracting, often on multi-million dollar projects staffed each of the projects. The instructional design teams consisted of 24 designers for FBI SENTINEL (six did not return summative evaluations), 10 designers for NSRP (two did not return summative evaluations), and five designers for AFIADL-FAM. In most circles, these would probably be considered large design teams, certainly the FBI SENTINEL team would. In each instance a senior designer was assigned the role of team leader, who then assigned task responsibilities to other project members.

Both the FBI SENTINEL and NSRP e-learning projects were undertaken in support of a much larger overall project, a mission critical software application development and implementation initiative, and as such each e-learning project must meet overall project schedules and deadlines. The goal of each of these two e-learning projects is to enhance the performance of software application users (and potential users) as they apply it in context of their job tasks. Since the FBI SENTINEL software application is intended to replace an antiquated mainframe application, software users can expect major changes in their job functions. The NSRP software is an upgrade of an existing application; this new version adds additional features and functionality to a system already in wide use, so those users will experience only minor job changes. Both the FBI SENTINEL and NSRP e-learning teams must coordinate their analysis, design, development, implementation, and evaluation efforts with the software development team.
The AFIADL-FAM project, however, has only a tangential relationship to any application software. The primary objective of this project is to improve the job performance of the target audience through various e-learning components. The e-learning project team coordinates directly with the government’s project manager, drives their own schedule and requirements, and is essentially independent of any other initiative.

One common thread for all three projects, however, is that each is led by senior instructional designers from one company, the Learning Division of SI International. Because this company consults almost exclusively on learning and human performance projects with federal agencies and focuses specifically on e-learning, these instructional designers are knowledgeable and proficient in creating e-learning applications for their targeted client base. Although their parent company exerts no management control and the direction and administration of the three pilot projects is autonomous, the senior leadership of each of the three pilot projects shares a common corporate culture.

**Research Question 1**

*What are the comprehensive analysis and design tasks for e-learning (online learning, knowledge management, and EPSS) development?*

Formative reviewers and summative evaluators were in agreement that the e-learning analysis and design tasks included in the EPSS were comprehensive and applicable to e-learning projects. See Appendix E, E-Learning Analysis & Design Task Descriptions. Reviewers noted that this list integrated technical and standard instructional design tasks, i.e. tasks associated with both information technology (such as determining
functional requirements and planning the technical architecture) and human performance technology (such as job analysis and devising instructional strategies).

The only additional tasks that reviewers and evaluators recommended to be included were project-management type of tasks. While those certainly are worthwhile and useful they are outside the scope of this research so were not considered for inclusion.

Research Question 2

What heuristics would guide instructional designers during the analysis and design phases of the e-learning instructional systems design process?

Formative reviewers affirmed the heuristic approach to instructional systems design. Specifically, they commended the organization of the guidelines contained in the Advisor. They commented that the guideline sections explaining why to do a task, how to do a task, where to look for help, keys to success, and major errors associated with the task, provided clarity and ease of use. Summative evaluators agreed that the EPSS (and the task heuristics) aided them in making decisions about the priority, focus, and time allocation for the analysis and design tasks.

A procedural or algorithmic process would not allow for the many variations in e-learning projects. For the most part, each project team performed the same analysis and design tasks; in fact, each team did each task contained in the Advisor (Appendix I, e-learning Analysis and Design Advisor Print Version). However, an examination of how the three pilot projects performed their analysis and design activities demonstrated the variation of the approaches used by each of the design teams in the level of detail, the priority, and focus of the ISD steps.
For example, the FBI SENTINEL team placed considerable emphasis on determining business needs, needs assessment, audience, job, and task analysis but very little time on content and resource analysis. On the other hand, the NSRP designers simply revisited and reaffirmed the business needs, needs assessment, audience, job, and task analysis to ensure that previous results were still valid. The AFIADL-FAM group took a different approach, using much of what the government gave them as input for those tasks, but then produced a very formal report describing the results of the analysis phase and their design recommendations.

Given that sort of variation in analysis and design approaches and that the designers reported that the guidelines helped them complete their ISD tasks, the conclusion is that the heuristics in the EPSS were appropriate for corporate e-learning projects.

Research Question 3

In what ways would a set of heuristics or guidelines be beneficial to a corporate e-learning designer?

Formative reviewers and summative evaluators were supportive of using the contents of the Advisor as both a reference and learning tool. Additionally they recommended that it could be used as a means to create a common approach to instructional design for e-learning.

Most instructional designers have not performed every procedure or method of every analysis and design task, or if they have, it may have been some time ago. So the Advisor could be both a reference and learning tool. As a reference tool, it could be used, essentially as it is, by instructional designers and other members of e-learning project
teams to review the standard and common analysis and design tasks, remind designers of steps or procedures they may have forgotten, or point out steps or methodologies that were new to them. As a learning tool, it could be linked to short tutorials or case studies that would help instructional designers see how other project teams had approached and implemented the individual analysis and design tasks. Career advancement or promotions could be dependent upon completion of this type of training.

Marketing and contract acquisition or capture is critical within the corporate contracting setting. If consultants have not contracted with any customers to do any e-learning projects, they will not get paid. Responding to an RFP (request for proposal) from a prospective client is critical to capturing the client’s business. It is an intense activity and generally requires prospective contractors to produce a descriptive report which depicts the procedures, methodologies, and steps which the contractor will follow in executing the e-learning project. A resource such as the Advisor would be a good way for a contractor to demonstrate their adherence to a quality process.

Communication among project team members is important aspect of project management and organization, and more and more difficult as the size of the project team grows. A common set of guidelines would give all project members a common terminology, description of tasks and procedures, and understanding of the expected outcomes of each task. This commonality could help prevent team miscommunications and make sure all team members are working toward the same objectives.
Research Question 4

How do practicing instructional designers view the value of an EPSS containing analysis and design heuristics in making priority, resource, and scheduling decisions during a corporate e-learning project?

All three of the design teams appear to be successful. The three projects are on schedule and clients seem pleased with results so far. During follow up interviews, project team leaders reported that they did every task in the EPSS. The extent to which they did them, however, varied. Some tasks were done almost ad hoc; the approach to others was very orthodox. Since the design teams emphasized different analysis and design tasks and executed the analysis and design phases using different schedules and resources, the conclusion is that designers made decisions about what to emphasize and focus on. Summative evaluators generally agreed that the Advisor helped them make those decisions. Overall, summative evaluators said that the EPSS had helped them determine how much time to spend on ISD tasks, determine when a task was complete, sequence and prioritize tasks, and focus tasks on users’ performance and clients’ goals.

Scheduling and budgeting decisions were more problematic. A little more than half of the summative evaluators thought that the EPSS helped keep tasks on schedule and under budget. There are two different ways to view scheduling and budgeting. From an individual’s perspective, it means getting things done on time using the resources given to do the job. From a lead designer or manager’s point of view, it means determining ahead of time, when tasks should be done, how long they will take, and how many people will be required to do them. An individual designer is trying to complete the task within the time and resources constraints that have been determined; a manager is trying to decide what
those time and resource constraints should be. In dealing with this, managers are trying to predict the future, and while they can often make educated ‘guesses’ based on past experience, it is still somewhat like gazing into a murky crystal ball. It is also difficult to devise any kind of rubric which a manager can use to help with this process. So, it is not surprising that the EPSS did not help as much with this decision criterion as with others.

**Implications**

Businesses will continue to expand their use of e-learning and e-learning itself will continue to widen its scope extending beyond training to include more and more performance support capabilities. Perhaps e-learning should be more properly characterized as e-performance. Instructional design teams will be pressured to produce products quicker and to demonstrate their effectiveness in improving their users’ job performance. New and emerging network and Internet technologies and applications, such as podcasts, blogs, wikis, instant messaging, and virtual communities will make the use of e-learning more attractive to businesses and more challenging to e-learning design teams.

Instructional design is a complex process and involves many decisions regarding the sequencing of tasks, the required quality of task outputs, and the resources necessary for task execution. Each instructional design effort is unique, requiring differing levels of analysis, design, development, implementation, and evaluation. Several designers are often involved in these ISD processes. Some may work on one aspect of the problem while others work on a different design task. Design tasks may be completed in a different order on different projects.
Essentially, instructional design teams are called upon to find solutions to complex ill-structured problems. Ill-structured problems are not well defined and difficult to solve. In an ill structured problem, the problem or initial situation is not even well understood and usually requires investigation and analysis in order to understand the problem state or circumstances of the difficulty that need to be overcome. Ill-structured problems usually have several workable solutions. They have many possible answers and generally, no one best answer; the ‘best’ solution to an ill-structured problem depends on the priorities underlying the situation. What is best today may not be best tomorrow. Each solution has advantages and disadvantages that depend on who is affected by the solution. Ill-structured problems generally are not solvable by algorithmic or procedural approaches, although some parts or components of the problem may be, so heuristic approaches tend to work best.

E-learning solutions are a combination of three information technology applications: online learning, knowledge management, and electronic performance support. Not every e-learning project involves all three disciplines and even those that do will emphasize and integrate those three components differently. Designers should consider using methodologies outside traditional instructional design models, such as rapid prototyping, information and knowledge engineering, and software engineering to augment instructional systems design as they create e-learning applications.

Instructional designers are always on the lookout for examples, forms, templates, and models that they can follow when they perform their tasks. With continued development, the Advisor can include additional performance improvement components besides the online advisor portion. Access to an EPSS which links guidance and advice
about instructional design tasks with tools and examples that designers can model and adapt would be a means to improving the quality of their e-learning products while shortening the development time, thus addressing the concerns of ISD critics that the process is too slow, clumsy, and ill-suited for today’s business needs. The Advisor is, itself, an e-learning application, so the use of it to improve the performance of e-learning instructional designers is somewhat akin to providing shoes for the cobbler.

Recommendations

This case study was limited in scope:

- The EPSS contained guidelines or heuristics for use by instructional designers during the analysis and design phases only.
- The EPSS was intended to be used in corporate e-learning projects.
- Evaluation of the EPSS consisted of soliciting designers’ views of the EPSS’ value to them in decision making during the early stages of an ongoing project.

This research can be expanded and enhanced in several ways.

Expand the Capability of the EPSS

While summative evaluators were generally positive about the current version of the Advisor they did indicate some areas which might be improved. Several evaluators suggested improvements in usability and readability. Very little usability testing was conducted on this EPSS; heuristic reviews and informal usability tests were performed, but no systematic, organized usability test was done. Changes in the content layout, writing
style, and information organization could make the EPSS easier to use, not only for the instructional designer audience but other e-learning project members and client representatives as well.

This EPSS was limited to the first two phases of the ADDIE model, analysis and design, for good reason, since the decisions made in those two phases impact the activities in the other phases. However, heuristics would be helpful for the other ADDIE phases, especially evaluation. The EPSS should be expanded to include guidelines for the development, implementation, and evaluation phases of e-learning projects.

An EPSS usually consists of several components, an advisory system for decision support (such as an online reference), productivity software that can automate specific job steps (such as templates, wizards, and automated forms), completed exemplary work products that can serve as examples (such as previous project documents). The Advisor contains an online reference only; there are no other performance support elements. Expanding the Advisor to include additional support mechanisms would make it more appealing and useful for practicing instructional designers. A suggested architecture is depicted in Figure 24. In this architecture, an ISD EPSS is comprised of four components, an online reference, tools and templates, examples, and external resources. The current Advisor would serve as the core of the online reference component. The three other components are:

- Tools and templates, e.g. a master design chart used in content analysis or use case diagrams used in functional requirements analysis.
- Examples, e.g. completed instructional analyses or implementation plans from successful e-learning projects.
- External resources, e.g. Web sites or other network available references.

**Figure 24. ISD EPSS Architecture**

All four of the components should be linked contextually, so that users could easily and quickly navigate among components within the context of the ISD task that they were performing. Users should also be able to add other tools and templates, examples, and external resources which they found helpful, so that other instructional designers could benefit from them as well. This architecture would fit the recommendation of Richey, Klein, and Nelson (2004) for a hybrid system that incorporates an advisory reference system, examples, and open-ended tools.
Research Other Domains

The Advisor is intended for corporate e-learning projects and it was evaluated by three project teams comprised of contract designers. Those three teams worked on projects for three federal agencies. While the validity of the research results may extend to project teams working for private sector clients, the differences between government and non-government clients, especially in the business and contractual processes, may be enough to generate different results. Examining the impact of an ISD EPSS for design teams working on non-government projects would be one research area to explore.

Contracting instructional designers work for many different clients, serve on different project teams, and hence tend not to do the same thing twice. Therefore, procedural approaches to ISD are less effective than heuristic ones. However, an in-house instructional systems design team, who develops e-learning products for the same customer and who works together through several projects, may find that they perform ISD tasks in a similar manner again and again. A more procedural method may be beneficial to them. Examining the EPSS needs of in-house e-learning design teams is another recommended research area.

Academic e-learning projects are vastly different from corporate ones. The entire front-end analysis is different because business drivers, audiences, performance outcomes, and functional requirements of corporate and academic environments are unlike. Project team composition is different as well. This case study examined three project teams comprised of 24, 10, and five designers. An academic project would, in all likelihood, be much smaller, perhaps consisting of one or two instructors or professors aided by an instructional media specialist. In academe, the subject matter expert, the instructor or
professor, and the course designer is often one in the same. Corporate e-learning designers often are not subject matter experts; SMEs may be members of the team but are usually not the e-learning experts. So, the e-learning design process as well as the e-learning design EPSS needs for academic users would probably be much different from corporate users and well worth investigating.

_Link ISD EPSS Features and Functions to End User Performance_

This dissertation was predicated on the premise that an EPSS for e-learning instructional systems design could improve the performance of designers who would then be able to produce higher quality e-learning products. Those e-learning products would ultimately be used by end users whose job performance would be improved which then would help them achieve their organizations’ corporate business goals. That is a pretty long value chain. What this research showed is that in this particular case study, instructional systems designers believed that an ISD EPSS helped them perform analysis and design tasks. Whether that caused them to create higher quality e-learning products was not established. Whether those presumed higher quality e-learning products then, in turn, helped end users improve their job performance and whether that job performance improvement was above what would have occurred had the e-learning design team not had access to the EPSS is a long way from being determined. Altogether, showing causality between an instructional design EPSS and e-learning end users’ performance improvement is extremely difficult.

Some research has shown that use of an ISD EPSS can help designers adhere to an ISD methodology (Uduma, 2002; Douglas, 2003) and improve designers’ productivity
(Spector, & Ohrazada, 2004). However, that still leaves questions about the connections between ISD EPSS functionality and e-learning product quality, as well as e-learning end user performance improvement.

Summary

Corporations continue to increase their use of e-learning to solve performance problems. Instructional designers charged with creating effective e-learning applications find themselves juggling resources in order to produce quality programs on schedule. When designers follow the traditional ISD process in a lock-step fashion, they frequently fail to deliver e-learning solutions that meet their organization’s business needs.

In the corporate environment, e-learning has expanded beyond e-training; it focuses more on user performance rather than user learning. It concentrates more on organizational results rather than on learners’ knowledge acquisition. E-learning incorporates and integrates online learning, knowledge management, and electronic performance support technologies to provide users with immediate access to the information, guidance, advise, and support necessary to effectively perform their job tasks.

Corporate instructional designers who were originally responsible for developing and delivering classroom training are now applying those skills to create effective and engaging e-learning applications. Business pressures are pushing these designers to produce more effective products quicker and sooner in the business cycle. Electronic performance support tools for instructional design which can increase the efficiency the ISD process by reducing the amount of time required by highly skilled designers or
enhance the skills of novice designer have the potential for being successful in the corporate environment.

Several automated electronic tools for instructional systems design have been developed. Some were purely research or prototype systems. Some automated one or a few specific instructional design tasks. Most adhere to a specific theory of learning and instructional design. However, given the complex nature of instructional design, automating instructional design decisions is a difficult, if not impossible, undertaking. Simple and easy to use tools that rely on design heuristics rather than complicated algorithms are probably the best approach.

The goal was to develop and validate a set of heuristics (guidelines or decision support tools) to aid instructional designers’ decision making during the analysis and design phases of the development of corporate e-learning products, to integrate those heuristics into an electronic performance support system (EPSS) for e-learning developers, and evaluate the effectiveness of those heuristics during the analysis and design activities of an e-learning project. The primary issue was to determine the effectiveness of the EPSS in helping instructional designers make decisions concerning quality, cost, and time tradeoffs during e-learning projects.

The methodology consisted of designing, developing, testing, and evaluating an instructional design EPSS. An electronic support system consisting of an online reference containing heuristic advice for the analysis and design tasks, which are applicable for e-learning projects, was designed, developed, and tested in an authentic environment. Eight skilled instructional designers with extensive experience in both instructional systems design and e-learning development examined the contents of the EPSS and made
recommendations for improvements and changes during a formative review. The revised EPSS underwent summative evaluation during pilot tests by three e-learning project teams who used it while performing analysis and design tasks.

Eleven analysis and 16 design tasks were included in the EPSS, termed *e-learning Analysis and Design Advisor*. These tasks were selected based upon a literature review of instructional design, software engineering, knowledge engineering, and performance support engineering disciplines. Formative reviewers and summative evaluators generally concurred that those tasks included in the EPSS were appropriate for e-learning projects.

During the pilot test the EPSS was provided to instructional designers on three corporate e-learning projects. Thirty-one designers from five contracting companies participated in this summative evaluation. Evaluators referred to the EPSS during the analysis and design phases of their respective projects and completed an evaluation questionnaire which asked for responses to several questions intended to solicit participants’ views about the ‘usefulness’ of the EPSS. Project teams executed the ISD steps differently. They emphasized different tasks, they sequenced task differently, and they distributed tasks to team members differently. They made decisions and compromises about priority, scheduling, and resources.

Participants were specifically asked if the EPSS had helped them determine how much time to spend on each task, determine when a task was complete, sequence and prioritize tasks, focus on users’ performance and clients’ goals, and keep tasks on schedule and under budget. Their responses indicated that the EPSS had a positive impact on their performance and had helped them make decisions concerning quality, cost, and time during their projects.
Appendix A

IRB Approval
MEMORANDUM

To: Thomas Jury

From: James Cumady, Ph.D.
Institutional Review Board

Date: August 15, 2006

Re: Electronic Performance Support for e-Learning Analysis and Design

IRB Approval Number: cumady080150604

I have reviewed the above-referenced research protocol at the center level. Based on the information provided, I have determined that this study is exempt from further IRB review. You may proceed with your study as described to the IRB. As principal investigator, you must adhere to the following requirements:

1) CONSENT: If recruitment procedures include consent forms these must be obtained in such a manner that they are clearly understood by the subjects and the process affords subjects the opportunity to ask questions, obtain detailed answers from those directly involved in the research, and have sufficient time to consider their participation after they have been provided this information. The subjects must be given a copy of the signed consent document, and a copy must be placed in a secure file separate from de-identified participant information. Record of informed consent must be retained for a minimum of three years from the conclusion of the study.

2) ADVERSE REACTIONS: The principal investigator is required to notify the IRB chair and me (954-262-5369 and 954-262-2085 respectively) of any adverse reactions or unanticipated events that may develop as a result of this study. Reactions or events may include, but are not limited to, injury, depression as a result of participation in the study, life-threatening situation, death, or loss of confidentiality/anonymity of subject. Approval may be withdrawn if the problem is serious.

3) AMENDMENTS: Any changes in the study (e.g., procedures, number or types of subjects, consent forms, investigators, etc.) must be approved by the IRB prior to implementation. Please be advised that changes in a study may require further review depending on the nature of the change. Please contact me with any questions regarding amendments or changes to your study.


Cc: Protocol File
Office of Grants and Contracts (if study is funded)
Appendix B

Participant Consent Form
Consent form for Participation in
Performance Support for e-Learning Analysis and Design Study

IRB approval # (Generated by IRB)

Principal investigator
Thomas W. Jury
440 Rivendell Lane
Severna Park, MD 21146
410-981-4254

Co-investigator(s)
Dr. Gertrude Abramson
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Institutional Review Board
Nova Southeastern University
Office of Grants and Contracts
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SI International
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Suite 260
Hanover, MD 21076

National Security Agency
Ft George G. Meade, MD 20755-6557
Ft, Meade

Initials: ________ Date: ________
Description of the Study:

This research study examines the effectiveness and usefulness of an Electronic Performance Support System (e-Learning Analysis and Design Advisor). As a participant you will be asked to refer to and make use of the e-Learning Analysis and Design Advisor in concert with your normal responsibilities on one of your e-Learning development projects. You will be asked to evaluate the e-Learning Analysis and Design Advisor at the end of the analysis and design stages of your project. The time that this study will require will vary.

Risks /Benefits to the Participant:

You may not experience any direct benefits from your participation in this study. Your risk is minimal.

If you have any concerns about the risks or benefits of participating in this study, you can contact [name of principal investigator and advisors/collaborators] or the IRB office at the numbers indicated above.

Costs and Payments to the Participant:

There are no costs to you or payments made for participating in this study.

Confidentiality and Privacy:

Information obtained in this study is strictly confidential. All information obtained in this study is strictly confidential unless disclosure is required by law. Your anonymity and confidentiality will be protected and will only be disclosed upon your permission. All data will be stored at SI International and NSA facilities. The Institutional Review Board and regulatory agencies may review research records.

Participant’s Right to Withdraw from the Study:

You have the right to refuse to participate or to withdraw at any time, without penalty. If you do withdraw, you may request that any of your data which has been collected be destroyed unless prohibited by state or federal law.”

Initials: ________ Date: ________
Other Considerations:

If significant new information relating to the study becomes available which may relate to your willingness to continue to participate, this information will be provided to you by the investigators.

Voluntary Consent by Participant:

I have read the preceding consent form, or it has been read to me, and I fully understand the contents of this document and voluntarily consent to participate. All of my questions concerning the research have been answered. I hereby agree to participate in this research study. If I have any questions in the future about this study they will be answered by Thomas Jury. A copy of this form has been given to me. This consent ends at the conclusion of this study.

Participant's Signature: ___________________________ Date: ______________
Witness's Signature: _____________________________ Date: ______________
Appendix C

e-learning Analysis and Design Advisor Formative Review Form
Section 1: About you

1. What past experience have you had with Instructional Systems design?

2. What past experience have you had with e-learning development?

3. What formal training have you had in Instructional Systems design?
   *(Formal training includes degree programs, certificate programs, conferences, and other college or corporate training)*

4. What formal training have you had in e-learning development?
   *(Formal training includes degree programs, certificate programs, conferences, and other college or corporate training)*
Section 2: Review Guidelines

5. The attached guidelines are planned to be part of an EPSS for e-learning instructional designers and are intended to assist them make decisions about how to structure their analysis and design efforts.

These decisions would typically include making tradeoffs about time, cost, and quality of the various analysis and design tasks and may include deciding about:

- How much time to spend on each task.
- When a task is sufficiently complete.
- Sequencing and prioritizing tasks.
- Focusing on users’ performance and clients’ goals.
- Keeping tasks on schedule and under budget.

Please review the attached analysis and task guidelines and provide feedback, comments, and suggestions by editing and making comments on the guidelines as you see appropriate.

Section 3: Comments

6. Based on your experience in Instructional Systems Design and e-learning, which Analysis or Design tasks in the e-learning Analysis and Design Advisor would you recommend removing?

7. Based on your experience in instructional systems design and e-learning, what Analysis or Design tasks should be added to the e-learning Analysis and Design Advisor? (give a brief description-one or two sentences- of the procedure)
Section 3: Comments (continued)

8. Would the task descriptions in the *e-learning Analysis and Design Advisor* be beneficial to instructional designers in other ways?

<table>
<thead>
<tr>
<th></th>
<th>Yes</th>
<th>Not Sure</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>As a Learning Tool?</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>As a Reference?</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>In any other way?</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>

(please list your suggestions below)

9. List any potential benefits of the *e-learning Analysis and Design Advisor* or the included Analysis and Design Task Descriptions to SI Learning.
Section 3: Comments (continued)

10. Please include any additional comments, suggestions, recommendations, etc (add extra pages if necessary).

Section 5: Contact Information

11. Can you be contacted for a follow-up interview? (optional)

Yes ☐ No ☐

If Yes, what is your Name and Contact Information? (e-mail and/or phone number)

Thanks for your help.
Tom Jury
tom.jury@si-intl.com
410-981-4254
Appendix D

e-learning Analysis and Design Advisor Summative Evaluation Form
e-learning Analysis and Design Advisor Evaluation

Section 1: About you

1. What past experience have you had with instructional systems design?

2. What past experience have you had with e-learning development?

3. What formal training have you had in instructional systems design?
   (Formal training includes degree programs, certificate programs, conferences, and other college or corporate training)

4. What formal training have you had in e-learning development?
   (Formal training includes degree programs, certificate programs, conferences, and other college or corporate training)

5. Rate yourself

<table>
<thead>
<tr>
<th></th>
<th>Novice</th>
<th>Experienced</th>
<th>Expert</th>
</tr>
</thead>
<tbody>
<tr>
<td>Instructional systems design</td>
<td>□</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>e-learning development</td>
<td>□</td>
<td>□</td>
<td>□</td>
</tr>
</tbody>
</table>
**Section 2: About your e-learning development project**

6. What is the name of your project?

7. Who is the Client or Customer?

8. Give a brief description of the project.

9. What is your role? *(Title and description)*

**Section 3: About your use of the e-learning Analysis and Design Advisor**

10. Did you use the *e-learning Analysis and Design Advisor* in context with your project?

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
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<tbody>
<tr>
<td>☐</td>
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</tbody>
</table>

   Please continue explain with # 12. below.

11. If you answered *No* to # 10, give a brief explanation why you did not use the *e-learning Analysis and Design Advisor* and then turn to Question # 24 on the last page.
Section 3: About your use of the e-learning Analysis and Design Advisor (continued)

12. Here is a list of the Analysis tasks supported in the *e-learning Analysis and Design Advisor*. Which ones helped you in deciding whether to include them in your project?

<table>
<thead>
<tr>
<th>Analysis Tasks</th>
<th>Helped in the Decision to Include or Not</th>
<th>Didn’t Help in the Decision to Include or Not</th>
<th>Didn’t Consult the <em>e-learning Analysis &amp; Design Advisor</em></th>
</tr>
</thead>
<tbody>
<tr>
<td>Determine business goals</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Task analysis</td>
<td>☐</td>
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<tr>
<td>Job analysis</td>
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<td>Performance analysis</td>
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<tr>
<td>Instructional analysis</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Content and SME analysis</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
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<tr>
<td>Determine strategic requirements</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
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<tr>
<td>Determine functional requirements</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
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<tr>
<td>Information resources analysis</td>
<td>☐</td>
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<td>☐</td>
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<tr>
<td>Audience analysis</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>User Environment Analysis</td>
<td>☐</td>
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</tbody>
</table>

Answer # 12 only if you were involved in the deciding which ISD analysis tasks to include in your project.
Section 3: About your use of the e-learning Analysis and Design Advisor (continued)

13. Here is a list of the Design tasks supported in the e-learning Analysis and Design Advisor. Which ones helped you in deciding whether to include them in your project?

Answer # 13 only if you were involved in the deciding which ISD design tasks to include in your project.

<table>
<thead>
<tr>
<th>Design Tasks</th>
<th>Helped in the Decision to Include or Not</th>
<th>Didn’t Help in the Decision to Include or Not</th>
<th>Didn’t Consult the e-learning Analysis &amp; Design Advisor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Establish creative treatment</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Determine terminal and enabling objectives</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
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<tr>
<td>Write content outline</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Organize instructional architecture</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Devise instructional strategies</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Plan technical architecture</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Devise user interface</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Create low-level prototype</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
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<tr>
<td>Develop preliminary storyboard and flowchart</td>
<td>☐</td>
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<tr>
<td>Create a style guide</td>
<td>☐</td>
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<tr>
<td>Identify media components</td>
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<tr>
<td>Construct functional prototype</td>
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<tr>
<td>Usability testing</td>
<td>☐</td>
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<tr>
<td>Write unit and integration test plans</td>
<td>☐</td>
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<tr>
<td>Write validation and implementation plan</td>
<td>☐</td>
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</tr>
<tr>
<td>Write the implementation plan</td>
<td>☐</td>
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</tbody>
</table>
Section 3: About your use of the e-learning Analysis and Design Advisor (continued)

14. Here is a list of the Analysis tasks supported in the *e-learning Analysis and Design Advisor*. Which ones were helpful to you as you completed that step in the Analysis portion of your project?

<table>
<thead>
<tr>
<th>Analysis Tasks</th>
<th>Helped Complete the Step</th>
<th>Didn’t Help Complete the Step</th>
<th>Didn’t Consult the e-learning Analysis &amp; Design Advisor</th>
<th>The Task Wasn’t Part of the Project</th>
</tr>
</thead>
<tbody>
<tr>
<td>Identify business needs</td>
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<td>☐</td>
<td>☐</td>
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<tr>
<td>Needs assessment</td>
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<tr>
<td>Audience analysis</td>
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<td>Job analysis</td>
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<td>Task analysis</td>
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<tr>
<td>Instructional analysis</td>
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<tr>
<td>Content and SME analysis</td>
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<tr>
<td>Determine functional requirements</td>
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<tr>
<td>Information resource analysis</td>
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<tr>
<td>Determine strategic requirements</td>
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<tr>
<td>User environment analysis</td>
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</table>
Section 3: About your use of the e-learning Analysis and Design Advisor (continued)

15. Here is a list of the Design tasks supported in the *e-learning Analysis and Design Advisor*. Which ones were helpful to you as you completed that step in the Design portion of your project?

<table>
<thead>
<tr>
<th>Design Tasks</th>
<th>Helped Complete the Step</th>
<th>Didn’t Help Complete the Step</th>
<th>Didn’t Consult the <em>e-learning Analysis &amp; Design Advisor</em></th>
<th>The Task Wasn’t Part of the Project</th>
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<tbody>
<tr>
<td>Establish creative treatment</td>
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<td>Devise user interface</td>
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<td>Write validation and implementation plan</td>
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<td>Write the implementation plan</td>
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</table>
Section 3: About your use of the e-learning Analysis and Design Advisor (continued)

16. Based on your experience in instructional systems design and e-learning, which Analysis or Design tasks in the *e-learning Analysis and Design Advisor* would you recommend removing?

17. Based on your experience in instructional systems design and e-learning, what Analysis or Design tasks should be added to the *e-learning Analysis and Design Advisor*? *(give a brief description-one or two sentences- of the procedure)*
Section 3: About your use of the e-learning Analysis and Design Advisor (continued)

18. Indicate if you agree or disagree with the following statements concerning the e-learning Analysis and Design Advisor:

a. It helped me determine how much time to spend on each task.
   Agree  Not Sure  Disagree
   □    □        □

b. It helped me determine when a task is complete.
   Agree  Not Sure  Disagree
   □    □        □

c. It helped me sequence and prioritize tasks.
   Agree  Not Sure  Disagree
   □    □        □

d. It helped me to focus tasks on users’ performance and clients’ goals.
   Agree  Not Sure  Disagree
   □    □        □

e. It helped me keep tasks on schedule and under budget.
   Agree  Not Sure  Disagree
   □    □        □

f. List any other advantages of the e-learning Analysis and Design Advisor.

 g. List any disadvantages of the e-learning Analysis and Design Advisor.
Section 3: About your use of the e-learning Analysis and Design Advisor (continued)

19. Which of these performance support components should be incorporated into the e-learning Analysis and Design Advisor?

a. Task templates and forms

<table>
<thead>
<tr>
<th></th>
<th>Yes</th>
<th>Not Sure</th>
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b. Task examples

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<th>Yes</th>
<th>Not Sure</th>
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c. Checklists

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<th>Yes</th>
<th>Not Sure</th>
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d. Training and quizzes

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<th></th>
<th>Yes</th>
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e. Instructional design experts’ contact information

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<tr>
<th></th>
<th>Yes</th>
<th>Not Sure</th>
<th>No</th>
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f. List and other Performance Support components that should be incorporated into the e-learning Analysis and Design Advisor
Section 3: About your use of the e-learning Analysis and Design Advisor (continued)

20. Would you use the *e-learning Analysis and Design Advisor* in other projects?

<table>
<thead>
<tr>
<th>Yes</th>
<th>Not Sure</th>
<th>No</th>
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21. Would you recommend the *e-learning Analysis and Design Advisor* to colleagues?

<table>
<thead>
<tr>
<th>Yes</th>
<th>Not Sure</th>
<th>No</th>
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22. Would the task descriptions in the *e-learning Analysis and Design Advisor* be beneficial to you in other ways?

<table>
<thead>
<tr>
<th>Yes</th>
<th>Not Sure</th>
<th>No</th>
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<th>As a Learning Tool?</th>
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<th>As a Reference?</th>
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<thead>
<tr>
<th>In any other way? (please list your suggestions below)</th>
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<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

23. List any potential benefits of the *e-learning Analysis and Design Advisor* or the included Analysis and Design Task Descriptions to SI Learning.
Section 4: Additional Comments

24. Please include any additional comments, suggestions, recommendations, etc (add extra pages if necessary).

Section 5: Contact Information

25. Can you be contacted for a follow-up interview? (optional)

Yes ☐ No ☐

If Yes, what is your Name and Contact Information? (e-mail and/or phone number)

Thanks for your help.
Tom Jury
tom.jury@si-intl.com
410-981-4254
Appendix E

E-Learning Analysis and Design Task Descriptions

Analysis Tasks

Identify business needs: understanding of the business or organizational problem to be solved. Business needs are the operational goals of an organization and are presumably the reason for the e-learning project (Clark, Kwinn, (2005); Robinson & Robinson, 1996).

Needs assessment: examining any performance gaps and relating them to possible causes. The ‘gap’ is the difference between the performance that is desired and that that is may be rectified via e-learning or some other performance improvement solution (Dick, Carey, & Carey, 2005; Robinson & Robinson, 1996).

Audience analysis: identifying the audience characteristics that will affect the instructional, usability, or motivational aspects of the e-learning program. The users’ existing skills, knowledge, and attitudes will have an impact on determining what performance solutions are most appropriate.(Dick, Carey, & Carey, 2005).

Job analysis: investigating all aspects of the users’ job(s). Job duties, the job environment, tools and equipment, relationships with peers and supervisors all impact an incumbents ability to perform specific job tasks (Jonassen, Tessmer, & Hannum, 1999).
**Task analysis:** determining the tasks that users have to perform. This systematic method of identifying the tasks necessary to competently do a specific job is key to deriving the performance objectives—which ultimately is what any e-learning application should focus on (Jonassen, Tessmer, & Hannum, 1999).

**Instructional analysis:** determining the performance gaps and possible instructional solutions. This extends the task analysis to consider subordinate skills and knowledge (and attitudes) required to perform the user’s tasks (Dick, Carey, & Carey, 2001).

**Content and SME analysis:** reviewing the knowledge domain that users should comprehend. An understanding of the depth and breadth of the content domain often helps define the scope of the project (Jonassen, Tessmer, & Hannum, 1999; Ingram, Heitz, Reid, Walsh, & Wells, 1994).

**Determine functional requirements:** defining the general operating capabilities of the e-learning software. Functional requirements describe the technical behavior of the final e-learning application (Alhir, 2000; Malan, Bredemeyer, 1999; Talavera, Álvarez, Mondelo, & Terrés, 2001).

**Information resources analysis:** reviewing existing resources of user support information. This analysis examines any existing information resources to determine what can be used, repurposed, or needs to be developed (Jonassen, Tessmer, & Hannum, 1999; Stevens & Stevens, 1995).

**Determine strategic requirements:** defining budgetary, scheduling, and other non-tactical requirements. Strategic or non-functional requirements tend to impose constraints
on the design or implementation of the e-learning solution (Talavera, Álvarez, Mondelo, & Terrés, 2001).

*User environment analysis:* identifying the physical, social, and psychological influences of the environment on the users of the e-learning application. Environmental factors outside the e-learning application will affect its success (Tessmer, 1990; Tessmer, 1991; Tessmer, & Harris, 1992).

**Design Tasks**

*Establish creative treatment:* defining the look and feel of the e-learning product. The look and feel as defined by an application’s graphical design (colors, shapes, layout) and user interactions sets the application’s tone and helps increase ease of use (Lee, & Boling, 1999; Kirkley, & Boling, 1995; Skaalid, 1999).

*Determine terminal and enabling objectives:* defining, organizing, sequencing terminal and enabling learning and performance objectives. Performance objectives describe the behavior that users will be able to do as a result of the e-learning application (Dick, Carey, & Carey, 2005; Morrison, Ross, & Kemp, 2004).

*Write content outline:* writing a substantive outline of the e-learning content and online resources. A content outline will help organize the e-learning’s information and make subsequent detailed writing easier (McMurrey, 2001).

*Organize instructional architecture:* determining the organization of the instructional portion of the e-learning application. The instructional architecture defines and describes the organization of the instructional component as the learner would view it (Clark, 2000; Kostur, 2002; Barritt, 2002).
Devise instructional strategies: formulating at least one instructional strategy for each enabling objective. The instructional strategies, and there can be several, describe the approach that the e-learning application will take to help users achieve the terminal and enabling objectives (Alessi, & Trollip, 2001).

Plan technical architecture: defining the technical solution, from an engineering standpoint. The technical architecture identifies the various software components, their external properties, and their relationships with one another (Bachmann, Bass, Chastek, Donohoe, & Peruzzi, 2000).

Devise user interface: designing the graphical user interface, including navigation buttons, icons, controls, and dialog boxes that the user will interact with to control the e-learning product. The user interface will have a big impact on the users’ overall experience with the e-learning application (Dringus & Cohen, 2005; Gery, 1995; Lewis, & Rieman, 1994; Sharp, Rogers, & Preece, 2007; Shneiderman & Plaisant, 2004).

Create a low-level prototype: producing one or more graphical representations of the e-learning product’s interface. A low-level or low-fidelity prototype exhibits some of characteristics of the intended final e-learning product, but its construction is a simple, usually in order to quickly produce the prototype and test broad concepts (Jorgensen, & Pagery, 2000; Snyder, 2003).

Develop preliminary storyboard and flowchart: devising a set of storyboards or flowcharts that demonstrate the user’s typical (and atypical) navigation through the e-learning application. Eventually these may be improved and expanded as part of the development phase (Alessi, & Trollip, 2001; Liu, 2000).
Create a style guide: defining the standards, styles, and conventions to be consistently used throughout the e-learning project. Style guides help the e-learning design team create and share a common vision for the e-learning application (Quesenbery, 2001; Alessi, & Trollip, 2001).

Identify media components: identifying the major media components and their sources. Media often plays a significant role in an e-learning application and its design and development can have a big impact on the budget and schedule—as well as the users’ performance outcomes (Linden, & Cybulski, 2001).

Construct functional prototype: building a fully functional prototype to demonstrate that the technical solution can be produced in a timely fashion. Building a functional prototype helps ensure that the designed e-learning application can actually be built and implemented (Sharp, Rogers, & Preece, 2007; Shneiderman & Plaisant, 2004).

Usability testing: conducting usability tests on the low-level or functional prototypes. Early usability testing of e-learning applications helps find usability, performability, and learnability problems in time to make corrections (Preece et al., 1994; Reeves et al., 2002; Shneiderman & Plaisant, 2004; Spool, Scanlon, Schroeder, Snyder, & DeAngelo, 1999).

Write unit and integration test plans: creating plans to test the individual components and the integrated e-learning application. These tests provide a structured method to discover, and correct software errors (‘bugs’) (Whittaker, 2000).

Write validation/evaluation plan: creating plans for the e-learning application’s validation and evaluation test. These would include both formative and summative
evaluations and could also include revision plans (Islam, 2005; Kirkpatrick, 2006; Kirkpatrick & Kirkpatrick, 2005; Munoz & Munoz, 2000).

Create the implementation plan: formulating the plan for releasing and deploying the e-learning product to the target audience. Implementation plans might include policies and procedures for distribution of the e-learning application, user support, and revisions and updates (Chang, 2002; Sambrook, 2003; Van Dam, 2003).
Appendix F

Formative Reviewers’ Credentials

Steve Arrington

Position: Senior Instructional Designer

Current responsibilities: designing and developing classroom materials and e-learning programs for the National Personnel Security System Program Executive Office, Department of Defense. Previous experience includes the design and evaluation and usability of e-learning for George Mason University.

Experience

5 years – e-learning design and development experience

6 years – ISD experience

Education

M.S. Interaction Design and Information Architecture

M. Ed., Curriculum Design and Development

B.A., Spanish
Peter Berking

**Position: Senior Instructional Designer**

Current responsibilities: the design and development of Web-based training for the National Security Personnel System. His previous projects include design of interactive computer-based instruction for the U.S. Marine Corps, portal and application design and development of the Department of Defense Joint Staff Action Officer Electronic Performance Support System, design and development of Web-based training for the Defense Acquisition University, and creation of the Courseware Development Guide for the Immigration and Naturalization Service’s Virtual University.

**Experience**

12 years – e-learning design and development experience

24 years – ISD experience

**Education**

M.A., Education

B.A., Sociology

William Eastham

**Position: Director, Learning Operations**

Current responsibilities: oversees the development, implementation, and application of instructional design standards, methods, processes, and training; manages
the integration of new and emerging learning tools, technologies and methodologies into current ISD processes. Previously he has designed and managed several e-learning courses in various formats: multimedia CBT, CD-ROM, distance learning, instructor-led, video, and simulator training covering technical and management topics. He served on the United States Distance Learning Association’s (USDLA) Executive Board and is currently the Vice President for Membership for USDLA.

Experience

17 years – e-learning project management experience

17 years – ISD management experience

Education

M.S., Business Management and Supervision

B.A., Communication/Organizational Analysis

Ellen Epstein

Position: Senior Instructional Designer

Current responsibilities: designing and developing Web-based training for the Transportation Security Administration and for the Defense Nuclear Weapon School. Other projects include design and development of Web-based training along and usability measures and procedures for the Transportation Security Administration and the design and development of an eCard for the Department of Homeland Security.

Experience

17 years – e-learning design and development experience

17 years – ISD experience
Education

M.S., Civil Engineering

B.S., Chemical Engineering

Instructional Design for e-learning: Langevin Learning Services

Danielle Mozzetta

Position: Senior Instructional/EPSS Designer

Current responsibilities: design and development of performance support products and performance support interfaces for PaineWebber, International Monetary Fund and World Bank, and the Defense Acquisition University. She has been an Adjunct Professor for undergraduate Multimedia Technology Courses (instructor-led, Web-based, and interactive television delivery) at the University of West Florida.

Experience

9 years – e-learning design and development experience

14 years – ISD experience

Education

Doctoral Student, Curriculum & Instruction: emphasis in Instructional Technology

M.Ed., Educational and Training Management Subspecialty: Instructional Technology

B.A., Elementary Education
Debra Rebro

**Position: Principal Instructional Designer**

Current responsibilities: Conducting training needs analysis and job and task analysis for the U.S. Customers and Immigration Service and the development of mentoring training for Transportation Security Administration screeners. Previously conducted training needs analysis and job and task analysis for the Social Security Administration, U.S. Customers Service, Leadership Development Center, and the Food and Drug Administration, Center for Veterinary Medicine.

**Experience**

2 years – e-learning design and development experience

14 years – ISD experience

**Education**

M.A., Psychology

B.A., Psychology

Molly Wankel, Ph.D.

**Position: Manager, Learning and Performance**

Current responsibilities: recruiting and retention, coordinating staff assignments, identifying and disseminating best practices, and implementing a staff development and mentoring programs for instructional designers; serves as lead instructional designer on strategic projects and provides oversight to all project design plans; oversees the division’s CMMI (Capability Maturity Model Integration) initiative.
Experience

26 years – e-learning design and development experience

28 years – ISD experience

Education

Ph.D., Administration, Curriculum, and Instruction

M.S., Radio, TV & Film

B.S., Speech

Donna Williams

Position: Senior Project Manager

Current responsibilities: project management and curriculum development for e-learning solutions, including administrative as well as technical management of contract activities, development of project plans, determination of staffing level requirements, budget development and management, and quality assurance for the Department of Defense: Department of the Navy, United States Air Force, Defense Acquisition University.

Experience

10 years – e-learning design, development, and project management experience

35 years – ISD experience

Education

M.Ed., Business Education

B.S., Business Education
Appendix G

Pilot Project Profiles

FBI SENTINEL

This is a six-year project to develop an electronic case management system for the FBI. This Web-based system will replace a transaction-oriented mainframe system that is severely outdated, cumbersome to use effectively, and does not facilitate the searching and sharing of information. While some of the user tasks from the legacy system will directly transfer to the new application, most of the users’ job functions will be changed as a result of implementing SENTINEL. E-learning modules are being designed to help users make the transition to SENTINEL.

The e-learning part of SENTINEL is integrated with and a portion of the total software development effort. E-learning components include a Web-based tutorial demonstrating the use of the new software, context-sensitive online help which explains the system’s features and functionality, an interactive software simulation, downloadable job aids which include checklists of job tasks for various user audiences, and a small curriculum of courses delivered through a synchronous learning network.

The e-learning portion of the SENTINEL project is staffed by 24 instructional designers from four companies, SI International (the Learning Division of SI), Accenture, General Dynamics, and Lockheed Martin. Eighteen of these designers participated in the
summative evaluation. Table 30, Figure 25 Figure 26 Figure 27, and Figure 28 show the profile of the summative evaluators who were members of this project, including each designer’s company, their self rating for ISD and e-learning skills, and number of years of experience in ISD and e-learning.

Table 30. FBI SENTINEL e-learning Project Staff Profile

<table>
<thead>
<tr>
<th>ISD #</th>
<th>Company</th>
<th>ISD Rating</th>
<th>e-learning Rating</th>
<th>Years experience ISD</th>
<th>Years experience e-learning</th>
</tr>
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<tr>
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<td>8</td>
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<td>Novice</td>
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<tr>
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<tr>
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<td>Novice</td>
<td>Novice</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
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<td>Novice</td>
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<td>GD</td>
<td>Novice</td>
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</tr>
</tbody>
</table>

Legend:
Companies: SI = SI Learning, Acc = Accenture, LM = Lockheed Martin, GD = General Dynamics
Figure 25. FBI SENTINEL Designers’ ISD Skill Ratings

Figure 26. FBI SENTINEL Designers’ e-learning Skill Ratings

Figure 27. FBI SENTINEL Designers’ ISD Experience
NSA’s National Signals Intelligence Requirements Process (NSRP)

Three software applications continued to be revised in this multi-year project for the National Security Agency. These applications allow members of the United States intelligence community throughout the world to create and track requests for answers to signals intelligence questions from the NSA. The project is several years old and the software applications have been in use since 2004. Currently the applications are being redesigned and upgraded with the intent to move from separate standalone application to an integrated Web portal. User job tasks will probably remain the same but the way users interact with the software will change.

The e-learning components of the project include a Web-based tutorial which describes the features and functions of the NSRP application, context-sensitive online help which explains the system’s features and functionality, and a curriculum of online courses delivered via a synchronous learning network.

Ten instructional designers from two companies, SI International (the Learning Division of SI) and Syracuse Research Corporation, staff the e-learning portion of the
NSRP project. Eight project members participated in the summative evaluation. Table 31, Figure 29, Figure 30, Figure 31, and Figure 32 show the profile of the project team who participated in this research, including each designer’s company, their self rating for ISD and e-learning skills, and years experience in ISD and e-learning.

Table 31. NSRP e-learning Project Staff Profile

<table>
<thead>
<tr>
<th>ISD #</th>
<th>Company</th>
<th>ISD Rating</th>
<th>e-learning Rating</th>
<th>Years experience ISD</th>
<th>Years experience e-learning</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>SI</td>
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</tr>
<tr>
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</tr>
<tr>
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<td>SRC</td>
<td>Novice</td>
<td>Novice</td>
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<td>1</td>
</tr>
<tr>
<td>4</td>
<td>SRC</td>
<td>Novice</td>
<td>Novice</td>
<td>0</td>
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</tr>
<tr>
<td>5</td>
<td>SRC</td>
<td>Novice</td>
<td>Novice</td>
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</tr>
<tr>
<td>6</td>
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<tr>
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</table>

Legend:
Companies: SI = SI Learning, SRC= Syracuse Research Corporation

Figure 29. NSRP Designers’ ISD Skill Ratings
Figure 30. NSRP Designers’ e-learning Skill Ratings

Figure 31. NSRP Designers’ ISD Experience

Figure 32. NSRP Designers’ e-learning Experience
AFIADL Functional Area Management Support (AFIADL-FAM)

This project for the Air Force Institute for Advanced Distributed Learning (AFIADL) is to design and develop an electronic performance support system to assist the Air Force’s Functional Area Managers. These managers have oversight of all personnel and equipment within a specific functional area and help support operational planning and execution. This project is different from the other two in that there is no application software to support, only several job processes. The EPSS for Functional Area Managers is the entire project. The envisioned EPSS will consist of three integrated components: a community of practice that provides a centralized location for training and support, a set of performance support tools and their associated interactive Web-based re-usable learning objects, and a Web-based course derived from existing classroom training. Content from an existing classroom course will be incorporated into the new Web-based training along with additional new learner objectives and content.

Five instructional designers from the Learning Division of SI International staff the AFIADL-FAM project and all participated in the summative evaluation. Table 32, Figure 33, Figure 34, Figure 35, and Figure 36 show the staffing profile for this project, including each designer’s company, their self rating for ISD and e-learning skills, and years experience in ISD and e-learning.
## Table 32. AFIADL-FAM e-learning Project Staff Profile

<table>
<thead>
<tr>
<th>ISD #</th>
<th>Company</th>
<th>ISD Rating</th>
<th>e-learning Rating</th>
<th>Years experience ISD</th>
<th>Years experience e-learning</th>
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<tbody>
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**Legend:**
- **Companies:** SI = SI Learning

### Figure 33. AFIADL-FAM Designers’ ISD Skill Ratings

![ISD Skill Ratings](image)

### Figure 34. AFIADL-FAM Designers’ e-learning Skill Ratings

![e-learning Skill Ratings](image)
Figure 35. AFIADL-FAM Designers’ ISD Experience

Figure 36. AFIADL-FAM Designers’ e-learning Experience
Appendix H

*e-learning Analysis and Design Advisor* Screen Shots
Figure 37. e-learning Analysis and Design Advisor Opening Screen

This advisor provides advice and guidelines about the Analysis and Design steps of e-learning projects.

These guidelines can help you make decisions about the priority, resource allocation, and scheduling of analysis and design tasks.

Keep in mind that all these tasks will not be appropriate for every project, you should choose them based upon the specifics of the project—client’s business goals, the user performance to be achieved, the budget, and so forth.

The order in which you do the tasks that you select can vary also, some may be done in parallel, some sequentially, and some iteratively. Again, the approach depends upon project specifics.

Contact Tom Jury to participate in the Summative Evaluation of this EPSS.

Click here for details about the Summative Evaluation.
Figure 38. e-learning Analysis and Design Advisor Introduction

The ISD model represented below is an emollient of what has become to be known as the ADDIE (Analysis, Design, Development, Implementation, and Evaluation) model. The specific term ADDIE and the model it represents within the instructional design field is really an organizing or overarching umbrella term used to describe a systemic methodology which involves analysis, design, development, implementation, and evaluation.

While there are several variations of the ISD model, most include these five phases or stages, and are intended to present the designer with a methodological process for creating instructional products, including e-learning applications. Simply stated, the ISD process provides a means for sound decision making to determine the who, what, when, where, why, and how of performance improvement, performance support, and training. It enables decisions about specific e-learning designs to be linked to overall user performance objectives.

Having a defined process enables e-learning developers and project teams to provide their users with predictably high quality results that meet their requirements as well as maintain fiduciary responsibility of the development resources. In a sense, the ISD process provides a way to deliver repeatable results that meet or exceed requirements, are developed on time, and are within budget.
Figure 39. *e-learning Analysis and Design Advisor* Content Page

### Job Analysis

A job analysis tends to be a more comprehensive analysis of users' performance than is typically conducted during task analysis. While a job analysis is concerned with the general topics or duties of the users' jobs, it also attempts to understand the intangible or recherche aspects of the job. Job analysis attempts to identify the knowledge, skills, and attributes required to perform a job correctly. It is often concerned with the subjective elements of a job that is, expectations and attitudes.

#### Why do a Job Analysis

Job analysis can result in a description of common duties, or tasks, performed on the job, as well as descriptions of the knowledge, skills, abilities, and other characteristics (KSAOs) required to perform those tasks. In addition, job analysis can uncover tools and technologies commonly used on the job, working conditions (e.g., a cubiclo-based environment, outdoor work), and a variety of other aspects that characterize work performed in the position.

#### How to do a Job Analysis

An important concept of Job Analysis is that the analysis is conducted of the job, not the person. While Job Analysis data may be collected from incumbents through interviews or questionnaires, the product of the analysis is an description of specifications of the job, not a description of the person.

Job Analysis should collect information on the following areas:

- **Duties and Tasks**: The basic unit of a job is the performance of specific tasks and duties. Information to be collected about these items may include frequency, duration, effort, skill, complexity, equipment, standards, etc.
- **Environment**: This may have a significant impact on the physical requirements to be able to perform a job. The work environment may include hazardous conditions such as offensive odors and temperature extremes. There may also be
- **Tools and Equipment**: Some duties and tasks are performed using specific equipment and tools. Equipment may include protective clothing. These items need to be specified in a Job Analysis.
- **Relationships**: Supervision given and received. Relationships with internal or external people.
- **Requirements**: The knowledge, skills, and abilities (KSAOs) required to perform the job. While an incumbent may have higher KSAOs than those required for the job, a job summary typically only states the minimum requirements to perform.
Construct Functional Prototype

The functional prototype, sometimes called a software architecture prototype, should contain the core functionality to be found in the completed project. The prototype should consist of sample topics, practices, introductions, scored events with feedback, reviews, summaries, graphics, and navigational functionality. The prototype should be developed in the authoring languages that will be used in producing the final product. Examples of multimedia components should be included in the prototype.

Why Construct a Functional Prototype

The functional prototype has two purposes. For the instructional designers and the customers, it demonstrates how the course will flow, the student interactions, and the navigation, but not necessarily the complete look and feel. This allows both the customer and the project team to have a common understanding of what the final product will do. For the programmers, software engineers, multimedia developers it is an opportunity to build a framework or architecture that will serve as the basis for the final product.

It also allows the development team to test all functional components to ensure all subroutines, data structures, imaging and media objects work together and that the development tools and processes will enable the final product to be created in a methodological fashion.

To Construct a Functional Prototype

Using the authoring system and tools intended for the development process, create a working e-learning application using a subset of the actual e-learning content and databases.

The functional prototype is a fully working sample, and as such should contain an example of every element of functionality to be used in the material. A functional prototype typically comprises the following:

- A minimal amount of content showing language style, graphical content and interactions to be used.
- An example of every question type or user interaction to be used.
- An example of every feature or functionality.

It’s important to remember that a functional prototype does not have to be beautiful it merely needs to be useful.

The prototype should demonstrate your ability to design and develop an end solution that will meet all of the functional requirements.

Where to look for help...
Figure 41. e-learning Analysis and Design Advisor Search

Determine Functional Requirements

In addition to technical requirements, technology-based learning products also operate within a set of functional requirements. For example: does the user need built-in testing or remediation functions to maximize learning? Should remediation be automated or available on request? Does the instructional strategy require a glossary or appendix? Does the learning product need to track the amount of material a learner has completed, present learner feedback in response to answers to test questions, or provide a printable user’s guide? Does the learning product need to track test scores to allow certification to be granted in accordance to a governing organization?

Why Determine Functional Requirements

A requirements analysis is the method of reviewing processes to determine the business needs and functional requirements that an e-learning application must meet. Failure to properly identify requirements makes it virtually impossible for the finished e-learning application to meet the needs of the client or be finished on time and within budget.

Establishing functional requirements help ensure the e-learning software will meet the business and engineering needs of the users and the design and development team.

How to Determine Functional Requirements

Use cases are a widespread practice to capture functional requirements.

A use case defines a goal-oriented set of interactions between users and the system under consideration.

A use case is initiated by a user with a particular goal in mind, and completes successfully when that goal is satisfied. It describes the sequence of interactions between actors and the system necessary to deliver the service that satisfies the goal. It also includes possible variations of this sequence, e.g., alternative sequences that may also satisfy the goal, as well as sequences that may lead to failure to complete the service because of exceptional behavior, user handling, etc.

A complete set of use cases specifies all the different ways to use the system, and therefore defines all behavior required of the system, bounding the scope of the system.

Generally, use case steps are written in an easy-to-understand structured narrative using the vocabulary of the domain.

A scenario is an instance of a use case, and represents a single path through the use case. Thus, one may construct a scenario for the main flow through the use case, and other scenarios for each possible deviation or path through the use case (e.g., triggered by options, error conditions, security breaches, etc.).

Steps in creating use cases:
Figure 42. e-learning Analysis and Design Advisor Glossary
Appendix I

e-learning Analysis & Design Advisor

(Print Version)
e-learning Analysis & Design Advisor
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This advisor provides advice and guidelines about the Analysis and Design steps of e-learning projects.

These guidelines can help you make decisions about the priority, resource allocation, and scheduling of analysis and design tasks.

Keep in mind that all these tasks will not be appropriate for every project, you should choose them based upon the specifics of the project—the client's business goals, the user performance to be achieved, the budget, and so forth.

The order in which you do the tasks that you select can vary also, some may be done in parallel, some sequential, and some iteratively. Again, the approach depends upon project specifics.
The ISD model represented below is an embodiment of what has become to be known as the ADDIE (Analysis, Design, Development, Implementation, and Evaluation) model. The specific term ADDIE and the model it represents within the instructional design field is really an organizing or overarching umbrella term used to describe a systemic methodology which involves analysis, design, development, implementation, and evaluation.

While there are several variations of the ISD model, most include these five phases or stages, and are intended to present the designer with a methodological process for creating instructional products, including e-learning applications. Simply stated, the ISD process provides a means for sound decision making to determine the who, what, when, where, why, and how of performance improvement, performance support, and training. It enables decisions about specific e-learning design to be linked to overall user performance objectives.

Having a defined process enables e-learning developers and project teams to provide their users with predictably high quality results that meet their requirements as well as maintain fiduciary responsibility of the development resources. In a sense, the ISD process provides a way to deliver repeatable results that meet or exceed requirements, are developed on time, and are within budget.

The ISD model includes these phases:

Analysis – determining the scope and extent of the performance problem and determining if an e-learning solution is appropriate (also known as Front End Analysis).

Design – determining what and how to build the e-learning application that will best address the performance problems identified during analysis.

Development and Integration – creating the individual elements (reference content, expert system repository, dialogs and graphical user interfaces, graphics, etc.) and incorporating those into the e-learning application.

Implementation – delivering the various releases of the e-learning application in conjunction with any other performance program components to members of the targeted audience.
Evaluation – determining the value and effectiveness of the e-learning application. This phase is ongoing throughout the entire process and is performed in conjunction with the analysis, design, development, and implementation phases.
Analysis

Sometimes referred to as the **Requirements Phase**, analysis is concerned with the initial investigation and research to identify and clearly define the organization, learner, and job skill requirements. Basically, the output of the analysis phase is a thorough understanding and description of the performance issues and the environment of use, including constraints, for any potential solution.

During analysis instructional design steps and activities focus on:

- **Analyzing users’ needs:**
  User needs encompass the cognitive, behavioral, and attitudinal characteristics of users.

- **The tasks that are to be performed:**
  Tasks may include the way users organize their work (mental models), what they want to accomplish (the goals), or how they currently go about performing their jobs.

- **The environment of use:**
  Environment of use is the setting in which the Learning or Performance Support solution will be used. The environment of use may include the location (at work or at home), in a classroom or at the user’s workstation, or physical characteristics of the environment (e.g. room lighting, workspace size and noise level) and/or other systems with which the user may interact.

- **Possible technological solutions:**
  Technology is the platform on which the solution is delivered or developed. Ideally the appropriate technology is selected after first gaining a good understanding of user needs, their tasks, and the environment of use.

Analysis serves as the foundation for subsequent design and development activities.

During analysis, an instructional designer organizes information, identifies problems or potential for problems, and points toward solutions.

Analysis requires a solid understanding the work environment and processes, including application software, e-learning users, and the available resources. Data collection and analysis methodologies are critical to documenting the existing and potential software environment and workplace situation and recommending performance improvement solutions.
Identify Business Needs

In most instances, analysis begins with an investigation to determine or define the business or organizational goals for any proposed e-learning solution. This might include developing an understanding of the client or sponsoring organization’s mission and vision.

Why Identify Business Needs

A goal is a statement that clearly describes actions to be taken or tasks to be accomplished by a company, a department or an individual. A business will have a number of goals, each describing a desired future condition toward which efforts are directed. If the goals are accomplished, then the business should be a success.

Presumably, the e-learning project is being undertaken in order to resolve a real, perceived, or potential performance problem. What metrics will be investigated or what will be evidence of milestones that indicate the problem is solved or alleviated?

How to Identify Business Needs

There are two types of business goals or needs: business problems and business opportunities. 

Business problems define a gap between what should be occurring operationally and what is actually occurring. Business problems exist when these two criteria are met:

1. There is a deviation between what should be occurring operationally and what is occurring.
2. Someone in management feels "pain" about the deviation and is, therefore, motivated to address the problem.

Business opportunities focus on a future operational goal. No current problem needs to be fixed; instead, an opportunity needs to be optimized. Business opportunities exist when these two criteria are met:

1. Operationally defined goals exist that are expected to be met from the business opportunity.
2. Some members of management desire to maximize the gain for the opportunity.

To obtain this information, interviews are generally conducted with the client team (individuals who own the business need or goal). If the business need is for a department, then the head of the department should be interviewed. If the need is for the entire organization, then individuals responsible for that entity would be interviewed.

Additionally, information can be obtained from:

- People who have some aspect of responsibility for the business goal.
- Internal and external documents, such as statements of strategic intent, business plans, operating statements, customer demographic information, competitive reports, etc.

Questions to ask include:

1. What are the major business needs for the unit or group?
2. What are the driving forces behind these needs?
3. How will the business needs be measured operationally?
4. What factors, external to the organization, will have an impact upon accomplishment of these goals?
5. What implications for performance does the client believe these needs generate?
Where to look for help

References


Keys to success

- Eventually, the business goals ought to be tied to the evaluation (see Write Validation/ Evaluation Plan).

- Common characteristics of a business goal are:
  - *Task-oriented:* A business goal must state what is to be accomplished as clearly as possible. Effective goals use action-oriented verbs such as deliver, implement, establish, and supply; avoid poor activity indicators such as facilitate and analyze which can mean that nothing significant or measurable gets done.
  - *Short term:* Goals used to be long term indicators, something an organization would accomplish in three or more years. Today business moves faster and e-commerce companies function at "Internet speed". Accordingly, goals tend to have shorter durations, rarely more than three years and frequently one year or less. Most business plans will have a mixture of time frames for accomplishing goals.
  - *Specific:* A goal must state, in one or two sentences, the conditions that will exist if the goal is to be accomplished. The more well-defined a goal is, the easier it will be to understand what is required and to measure successful achievement.

Major errors associated with Identifying Business Needs

- You have no access to the real client, the person or persons who own the business need or goal.

- The business goals are not defined operationally.
In many situations, the causes of a performance problem are not known, and therefore, an appropriate training intervention cannot yet be recommended. Lack of skill, lack of knowledge, lack of incentives, lack of motivation, lack of feedback, or lack of information could all be sources of performance deficiency.

An analysis of the performance gaps and their possible causes should help derive recommended solutions. Recommended solutions or interventions should be focused on the specific performance gaps and targeted to eliminate or reduce the causes that have been determined to be creating the performance gaps.

Sometimes referred to as a Gap Analysis.

**Why do a Needs Assessment**

A needs assessment determines the gap between actual employee performance and desired employee performance and takes into consideration if the gap can be eliminated through an effective e-learning program.

**How to do a Needs Assessment**

The first step is to check the actual performance of the organization and its people against existing standards, or to set new standards. There are two parts to this:

1. **Current situation:**
   Determine the current state of skills, knowledge, and abilities of current and/or future employees. This analysis also should examine organizational goals, climate, and internal and external constraints.

2. **Desired or necessary situation:**
   Identify the desired or necessary conditions for organizational and personal success. This analysis focuses on the necessary job tasks/standards, as well as the skills, knowledge, and abilities needed to accomplish these successfully. It is important to identify the critical tasks necessary, and not just observe the current practices. The analysis should distinguish actual needs from perceived needs or wants.

The difference or the "gap" between the current and the necessary will identify the needs, purposes, and objectives.

What to look for? Here are some questions to ask, to determine where e-learning may provide a solution:

- **Problems or deficits**
  Are there problems in the organization which might be solved by training or other e-learning programs?

- **Impending change**
  Are there problems which do not currently exist but are foreseen due to changes, such as new processes and equipment, outside competition, and/or changes in staffing?

- **Opportunities**
  Could the organization gain a competitive edge by taking advantage of new technologies, training programs, consultants or suppliers?

- **Strengths**
  How the organization takes advantage of its strengths, as opposed to reacting to its weaknesses? Are there opportunities to apply e-learning to these areas?
• New directions
  Could a proactive approach in the application of e-learning move the organization to new levels of performance?

• Mandated training
  Are there internal or external forces dictating that training and/or organization development will take place? Are there policies or management decisions which might dictate the implementation of some program? Are there governmental mandates which must be complied with?

Where to look for help

References


Keys to success
• Consider that performance deficiency may be caused by something other than a lack of training. Causes for performance deficiency may include:
  • Consequences, incentives or rewards
  • Data, information, and feedback
  • Environmental support, resources, and tools
  • Individual capacity
  • Motives and expectations
  • Skills and knowledge

Major errors associated with Needs Assessment
• Training isn’t always the answer when there’s a gap between actual and desired performance.
Audience Analysis

Critical information about the audience shapes a number of succeeding steps, especially the instructional strategy and media selection.

Why do an Audience Analysis
When designing an e-learning application, always keep in mind who it is intended for and how the information gained will be utilized.

How to do an Audience Analysis
The Audience Analysis identifies the following characteristics:

- Entry behaviors
- Prior knowledge of the topic
- Attitudes toward content and potential delivery system
- Academic motivation
- Education and ability levels
- General learning preferences
- Attitudes toward training organizations
- Group characteristics

After identifying the characteristics of the audience, the instructional designer describes the implications of these characteristics in the design and development of the e-learning application.

While there are various ways to collect data about the target audience, one method involves site visits for structured interviews with representatives of the target audience and their managers. Alternatively, either on site or using distance technology, designers could administer surveys and questionnaires to obtain similar information about the audience’s interests, goals, attitudes, and self-reported skills.

Where to look for help

References

Keys to success
- Do not assume that all users are at the same level of experience with technology; plan for the most naïve users.
- Do not penalize users with limited Internet/computer experience.

Major errors associated with Audience Analysis
- Audience analysis should also include the learner’s technology skills and previous experiences with e-learning.
Job Analysis

A job analysis tends to be a more comprehensive analysis of users’ performance than is typically conducted during task analysis. Similar to task analysis, job analysis is concerned with the general topics or duties of the users’ jobs, but it also attempts to understand the intangible or intrinsic aspects of the job.

Job analysis attempts to identify the knowledge, skills, and attitudes required to perform a job correctly, but also is often concerned with the subjective elements of a job, such as expectations and attitudes.

Why do a Job Analysis

Job analysis can result in a description of common duties, or tasks, performed on the job, as well as descriptions of the knowledge, skills, abilities (KSAs), and other characteristics required to perform those tasks. In addition, job analysis can uncover tools and technologies commonly used on the job, working conditions (e.g., a cubicle-based environment, outdoor work), and a variety of other aspects that characterize work performed in the position(s).

How to do a Job Analysis

An important concept of Job Analysis is that the analysis is conducted of the job, not the person. While Job Analysis data may be collected from incumbents through interviews or questionnaires, the product of the analysis is a description or specifications of the job, not a description of the persons holding the job.

Job Analysis should collect information on the following areas:

- **Duties and Tasks**
  The basic unit of a job is the performance of specific tasks and duties. Information to be collected about these items may include: frequency, duration, effort, skill, complexity, equipment, standards, etc.

- **Environment**
  This may have a significant impact on the physical requirements to be able to perform a job. The work environment may include unpleasant conditions such as offensive odors and temperature extremes. There may also be definite risks to the incumbent such as noxious fumes, radioactive substances, hostile and aggressive people, and dangerous explosives.

- **Tools and Equipment**
  Some duties and tasks are performed using specific equipment and tools. Equipment may include protective clothing. These items need to be specified in a Job Analysis.

- **Relationships**
  Supervision given and received and relationships with internal or external people.

- **Requirements**
  The knowledge, skills, and abilities (KSA’s) required to perform the job. While an incumbent may have higher KSA’s than those required for the job, a Job Analysis typically only states the minimum requirements to perform the job.

**Interview Methods**

Effective listening requires concentration and this can be disturbed by interruptions, the interviewer’s own thought processes, and difficulty in remaining neutral about what is being said. Notes need to be taken without loss of good eye contact. Cues need to be picked up so that further questions can be asked to probe issues and areas of interest.
Unstructured Interviews

An unstructured interview involves question and response and may be free flowing but it becomes structured in the sense that the interviewer has a purpose and needs skill to:

- establish a relationship
- ask well-structured questions to generate a conversational flow in which the interviewee offers information - factual, opinion, subjective and objective about aspects of the job
- to ensure information received is heard and understood - listening, clarifying and reflective summarizing

Structured Interviews

A structured interview may assume a definite format involving:

- charting a job-holder’s sequence of activities in performance
- questioning via an inventory or questionnaire

A structured interview may be akin to a staff appraisal or job evaluation interview carried out by a manager with a subordinate.

Care is needed to set up such interactions. Participants need to know what they are doing, why and what is expected as a result. Notes and records will be needed for subsequent analysis.

Where to look for help

References


Keys to success

- There are two key elements of a job analysis:
  
  1. Identification of major job requirements which are the most important duties and responsibilities of the position to be filled. They are the main purpose or primary reasons the position exists. The primary source of job requirements is the most current, official position description.
  
  2. Identification of knowledge, skills and abilities (KSAs) required to accomplish each job requirement and the quality level and amount of the KSAs needed. Most job analyses deal with KSAs that are measurable, that can be documented, and produce meaningful differences between candidates. Typically, possession of KSAs is demonstrated by experience, education, or training.

Major errors associated with Job Analysis

- Analyzing skills of the persons performing the specific jobs rather than analyzing the job itself.
Task Analysis

This analysis step is used to ascertain the flow of the users’ activities, the tasks performed, and the relationships involved in the exchange of information. A clear identification of the task workflow will distinguish rules of behavior and areas where guidance can be applied.

Why do a Task Analysis

In order to design instruction or support mechanisms it is essential to understand the tasks that learners will be performing. If you cannot describe the ways that performers are to act how can you design e-learning to help them?

How to do a Task Analysis

Task analysis is a process of analyzing and articulating the process or steps that a performer does when carrying out a job or assignment. A task analysis determines:

- The operational components of jobs and skills.
- What task performers do, how they perform a task or apply a skill, and how they think before, during, and after making task decisions.
- What knowledge states (declarative, structural, and procedural knowledge) characterize a job or task?
- Which tasks, skills, or knowledge can be supported during task execution and which need to be taught prior to task execution?
- The sequence in which tasks should be performed.
- How to select and design performance support objects that will foster high-level performance.

Due to the rapid changes that are the major workings of many of today’s organizations, a number of organizations are changing from task-based work to process-based. Jobs are no longer defined by a number of tasks, but by focusing on troubleshooting activities. In these cases, a cognitive task analysis may be more appropriate for identifying strategies involved in effective performance.

Cognitive Task Analysis

Cognitive Task Analysis (CTA) focuses on the underlying knowledge, skills, and structure of task performance. The primary goal of CTA is to acquire a rich body of knowledge about a domain from experts and to assemble that knowledge into a model.

A cognitive task analysis is performed to identify and to describe the cognitive components of a task. There are a variety of methodologies available to help the instructional designer to represent and define the various knowledge structures needed to perform a task or job.

There are three knowledge structures: declarative, procedural and strategic:

1. Declarative knowledge tells us why things work the way they do, or that the object or thing has a particular name or location. It includes information about the concepts and elements in the domain and the relationships between them. The type of knowledge found at this level includes facts, principles, rules of science and concepts. "Knowing the rules of good database design" is one example. Another is "knows the names, location, and prices of all the SKUs in inventory."

Methods for eliciting declarative knowledge:

- Card Sorting
  The researcher obtains sets of concepts that broadly cover the domain (derived from glossary, texts, or gleaned from introductory tutorial talk), then transfers each concept onto
a card. Subject matter experts then sorts the cards into common groups or functions according to similarity. The SMEs then creates the sorting criteria. The groups themselves are grouped until eventually a hierarchy is formed.

- Data Flow Modeling
  An expert is interviewed. The researcher then draws data flow diagram using data gathered from interview. Expert verifies diagram.

2. Procedural knowledge tells us how to perform a given task.
   Procedural knowledge contains the discrete steps or actions to be taken and the available alternatives to perform a given task. With practice, procedural knowledge can become an automatic process, thus allowing us to perform a task without conscious awareness. This automatically also allows us to perform more than one complex task at a given time. A couple of examples would be "creates a v-ditch using a motored grader" or "types a letter at 95 words per minute."

Methods for eliciting procedural knowledge:

- Interviewing
  This is a variation of a basic interview. There are several variations. Some of them are:
  - Working backwards through the problem
  - Drawing a concept map
  - Showing an expert photographs depicting system in a number of states and asking questions
  - Expert describes procedure to interviewer and then the interviewer teaches it back to the expert.

- Discourse Analysis (observation)
  An expert helps an user while a researcher records the process. The transcript is then analyzed for tasks and elements. The data is then converted into a taxonomy.

3. Strategic knowledge is comprised of information that is the basis of problem solving.
   Strategic knowledge includes action plans to meet specific goals, knowledge of the context in which procedures should be implemented, actions to be taken if a proposed solution fails, and how to respond if necessary information is absent. An example of this would be a production plant manager who formulates a plan to meet the needs of a greatly increased forecast.

Methods for eliciting strategic knowledge:

- Critical Decision Method (Interview) first method
  Interview of expert to identify non-routine events that challenged her expertise and events which expertise made a significant difference. A time line of events is then constructed and key points are further probed.

- Critical Decision Method (Interview) second method
  A semi-structured interview is performed utilizing specific probes designed to elicit a particular type of information. The data is then examined for perceptual cues, judgment details, and decision strategy details that are not generally captured with traditional reporting methods.

Where to look for help

References
Keys to success
- Decide upon the level of detail into which to decompose. Making a conscious decision at this stage will ensure that all the subtask decompositions are treated consistently.
- Present the analysis to someone else who has not been involved in the decomposition but who knows the tasks well enough to check for consistency.

Major errors associated with Task Analysis
- Different contexts demand different task analysis methods.
The major purpose of instructional analysis is to identify the skills, knowledge, and consequently, the learning outcomes that the e-learning application should focus on.

Instructional analysis should determine areas of knowledge and skills involved in achieving instructional goals. At this stage, the analysis is focused more on identifying and describing the knowledge and skills, rather than how they should be organized in the e-learning application (that is part of the Content Analysis).

Why do an Instructional Analysis

An instructional analysis is a process that results in the identification of relevant steps for performing a goal behavior or displaying the acquisition of an attitude or cognitive understanding. It includes the subordinate skills required for a user to achieve that goal. The acquisition of the subordinate skills makes learning the superordinate skills easier for the learner.

Instructional analysis ensures that instructional designers include only the information that is necessary for users to perform the tasks that are required of them.

How to do an Instructional Analysis

Instructional analysis is an extension or continuation of task analysis and in some ways overlaps with that activity. Instructional analysis divides the main instructional goals into constituent parts to improve instruction by identifying substeps and subordinate concepts, knowledge, and skills.

To conduct an instructional analysis:

- Determine what it is you want users to be able to do when during or following their use of the e-learning application. These performance goals may be derived from several sources, including a job or task analysis. After you have identified the performance goal, determine step-by-step what users are doing when they perform that goal. The final step in the instructional analysis process is to determine the entry behaviors, the skills, knowledge, and attitudes that are required before users can successfully use the e-learning application.

- Identify what learning steps will be involved in reaching the performance goal. This is done through a subordinate skills analysis, which identifies each step and the skills needed in order to complete that step, and an information processing analysis, which identifies the mental operations the learner needs to employ in performing that skill. The instructional analysis is performed by asking "What are all of the things the student must know and/or be able to do to perform this task or job?"

The subordinate skills analysis involves analyzing each of your goal steps and substeps to determine what prerequisite skills or knowledge are required to be able to adequately perform that step. These skills and knowledge are referred to as Subordinate Skills. This is different from what you did in task analysis, in which you determined the main steps necessary to achieve your goal. In other words, the steps and substeps are the activities that an expert or skilled person would describe as the steps in achieving the goal. The subordinate skills are not steps or substeps on the way to the goal; they are the supporting information that learners need to be able to perform those steps. Since they are supporting information, they may be overlooked by experts when they describe the process.

Subordinate steps should be defined and delineated in a way that clearly differentiates them from other steps and from the learning objective that they support. In other words, they should be organized in a way that provides a means for a learner to achieve the learning objective.
The final step in the instructional analysis process is determining entry behaviors. These are the skills and knowledge that the learners must know or be able to do before they begin activities designed to meet the objectives. If you followed through with your subordinate skills analysis, the bottom of your hierarchy should contain very basic skills. If all of your goal steps are analyzed in this manner then you will have a complete list of all the skills required for a learner to reach your instructional goal. It is likely, though, that the learners already have many of these skills, so they will therefore not need to be included in the instruction you develop. These are the skills that you will assume that the learners have before they begin the new instruction. You should not include such basic skills as “ability to read” which are demographic norms; however, you may need to include “ability to read at 12th grade level.”

Component Display Theory

Merrill’s Component Display Theory is of particular interest in Instructional Analysis.

Merrill uses a two-dimensional matrix or table to illustrate the dynamics of his Component Display Theory. On one side the types of content are listed (fact, concept, procedure, process and principle). Perpendicularly listed are the desired levels of performance, finding, using and remembering. This content/performance table comprises the desired level of student performance. In other words, the designer identifies what type of content and how the learner is expected to use the information.

<table>
<thead>
<tr>
<th></th>
<th>Remember</th>
<th>Use</th>
<th>Find</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fact</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Concept</td>
<td></td>
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<tr>
<td>Process</td>
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<td>Procedure</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Principle</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Once the correct content/performance is identified, then a set of prescriptions can be applied to the instructional strategy.

Where to look for help

References


Keys to success

- All relevant tasks are identified.
- Superfluous tasks are eliminated.
- The relationships among tasks are clearly designated.
- Producing a clear accurate analysis of tasks typically requires several iterations and refinements.

Major errors associated with Instructional Analysis

- Stating or defining objectives from an SME rather than a learner-centered perspective.
- Organizing objectives at too high or too low a level.
Lack of clarity about the goals that form the driver and top level for analyzing subordinated skills, knowledge, and attitudes.
To become familiar with the e-learning content, the instructional designer reviews any existing source materials that pertain to the content domain and interviews subject matter experts in order to get a representation of the body of knowledge.

**Why do a Content and SME Analysis**

This review prepares the instructional designer to develop content outlines and scripts during the design and development phases, provides information to base training and job aids on, and is used to elaborate knowledge into structures, elements, and relationships.

**How to do a Content and SME Analysis**

Jonassen, Tessmer, & Hannum (1999) present five different ways to approach content and subject matter analysis. Here are summaries of two of those approaches,

- **Conceptual Graph Analysis**
  
  See [http://classweb.gmu.edu/ndabbagh/Resources/Resources2/concept_graph.htm](http://classweb.gmu.edu/ndabbagh/Resources/Resources2/concept_graph.htm) for an example of a Concept Graph.

  Conceptual graphs are similar to concept maps, with a more formalized and detailed set of nodes and relations. The nodes can represent concepts in addition to actions, events, or goals. A specific set of relations exists for each type of node and there is a formal set of questions developed for each type of node. The analyst first develops a rudimentary conceptual graph which is later refined through the use of the formal questions with the SME.

  **Analysis Steps:**
  1. Clarify the uses for the analysis. Determine if you want a goal hierarchy (depicts procedures to accomplish a task), spatial network (map spatial relationships of some object), taxonomic hierarchy (displays conceptual relationships), or causal network (models system functions or processes). A single conceptual may incorporate several networks.
  2. Choose a set of situations for the expert to analyze. Include both easy and difficult situations as well a critical ones.
  3. Construct a rough graph based on experts interviews or document review.
  4. Prepare a list of follow-up questions.
  5. Expand the graph. Meet with the SME and ask the follow-up questions.
  6. Review the final graph with the SME or an outside expert.

- **Master Design**

  A master design chart represents instructional outcomes in a two-dimensional matrix with one axis containing items of content and the other containing a taxonomy of behavior. Cells in the matrix contain numbers representing the degree of emphasis placed on that specific behavior for a specific content item.

  **Analysis Steps:**
  1. Construct the behavior axis (the horizontal dimension).
  2. Identify the specific items of content for the content axis (the vertical dimension). This is similar to traditional methods of outlining content.
  3. Decide on the relative amount of emphasis to place on each cell in the chart.
4. Determine the relationships, if any, between (or among) pairs of content items in the master design chart.

Where to look for help

References


Keys to success

- The availability of well-informed SMEs who can effectively describe the knowledge domain will be a key factor in the success or failure. The SME needs to have an understanding of:
  - Task knowledge - What users will be required to do and be able to provide a functional decomposition of those tasks.
  - Domain knowledge - Comprehension of the relevant information within the users’ knowledge domain.
  - Inference knowledge - Basic reasoning steps that can be made in the knowledge domain and are applied to tasks.
  - Procedural knowledge - Knowledge of task and job procedures and best practices.
- Conceptual graph analysis offers a systematic questioning methodology to elicit complex and tacit knowledge.
- A Master Design Chart emphasizes learning of the structure of the content, reduces the omission of important content, and encourages higher level objectives.

Major errors associated with Content and SME Analysis

- Conceptual graph analysis is a complex method and takes time to learn to do it well.
- Design charts are time consuming to construct.
Determine Functional Requirements

In addition to user performance requirements, e-learning products also operate within a set of functional requirements. For example: does the user need built-in testing or remediation functions to maximize learning? Should remediation be automated or available on request? Does the learning strategy require a glossary or appendix? Does the e-learning product need to track the amount of material a learner has completed, present learner feedback in response to answers to test questions, or provide a printable user's guide? Does the e-learning product need to track test scores to allow certification to be granted in accordance to a governing organization?

Why Determine Functional Requirements
Establishing functional requirements helps ensure the e-learning software will meet the business and engineering needs of the users and of the design and development team.

Failure to properly identify requirements makes is virtually impossible for the finished e-learning application to meet the needs of the client or be finished on time and within budget.

How to Determine Functional Requirements
Use cases are a widespread practice to capture functional requirements. See http://www.agilemodeling.com/artifacts/useCaseDiagram.htm for examples of use cases.

A use case defines a goal-oriented set of interactions between users and the system under consideration.

A use case is initiated by a user with a particular goal in mind, and completes successfully when that goal is satisfied. It describes the sequence of interactions between actors and the system necessary to deliver the service that satisfies the goal. It also includes possible variants of this sequence, e.g., alternative sequences that may also satisfy the goal, as well as sequences that may lead to failure to complete the service because of exceptional behavior, error handling, etc.

A complete set of use cases specifies all the different ways to use the system, and therefore defines all behavior required of the system, bounding the scope of the system.

Generally, use case steps are written in an easy-to-understand structured narrative using the vocabulary of the domain.

A scenario is an instance of a use case, and represents a single path through the use case. Thus, one may construct a scenario for the main flow through the use case, and other scenarios for each possible variation of flow through the use case (e.g., triggered by options, error conditions, security breaches, etc.).

Steps in creating use cases:
1. Identify all the different users of the e-learning system.
2. Create a user profile for each category of user, including all the roles that users play that are relevant to the e-learning application.
3. For each role, identify the significant goals that users have that the e-learning system will support.
4. Create a use case for each goal. Maintain the same level of abstraction throughout the use cases. Steps in higher-level cases may be treated as goals for lower level sub-use cases.
5. Structure (illustrate) the use cases.
6. Review and validate with users.
Where to look for help

References


Keys to success
- Users who
  - Understand what they want.
  - Will commit to a set of written requirements.
- Good requirements should be:
  - Necessary
    Something that must be included or an important element of the system will be missing for which other system components will not be able to compensate.
  - Unambiguous
    Susceptible to only one interpretation.
  - Concise
    Stated in language that is brief and easy to read, yet conveys the essence of what is required.
  - Consistent
    Does not contradict other stated requirements nor is it contradicted by other requirements. In addition, uses terms and language that means the same from one requirements statement to the next.
  - Complete
    Stated entirely in one place and in a manner that does not force the reader to look at additional text to know what the requirement means.
  - Reachable
    A realistic capability that can be implemented for the available money, with the available resources, in the available time.
  - Verifiable
    Must be able to determine that the requirement has been met through one of four possible methods: inspection, analysis, demonstration, or test.

Major errors associated with Determining Functional Requirements
- Addition of new requirements after the cost and schedule are fixed.
- Users who often do not participate in reviews or an incapable of doing so.
- Use cases are not well suited to easily capturing non-functional requirements of a system.
- Use cases templates do not automatically ensure clarity. Clarity depends on the skill of the writer(s).
Information Resource Analysis

The Information Resource Analysis assesses the inventory of extant data that are available to support user tasks. This analysis establishes a basis for determining any additional information or documentation that needs to be developed. Information should be reviewed and analyzed to determine if it is accurate and appropriate for the targeted users and their job tasks. All available information should be evaluated as a potential resource for the development of performance support components.

Why do an Information Resource Analysis
Can the information being reviewed be re-purposed, used more or less as is, or modified so as to comprise part of the e-learning components? Can the information be computerized, organized, and made accessible to fit within the users' workflow in order to support their job responsibilities with minimal task interruption?

How to do an Information Resource Analysis
What to include in an information resource analysis:
- Process or system manuals
- Procedure guides
- Instructional materials-course manuals, presentations
- White papers, concept papers
- Client furnished information (which often needs to be returned to the client)

Where to find information resources:
- Intranet sites
  In the past several years, intranet sites have cropped up at an alarming rate in most corporations. While these sites provide significant value to the group that published them, the proliferation of these sites has resulted in inconsistent look and feel, outdated sites, duplication of effort, and most importantly, an inability to navigate these sites in an efficient manner.
- Email messages
  Email has become a normal channel of communication. The knowledge that is built up in email threads usually contains important background information on almost every conceivable issue that is being worked on in the company -- from sales to back office. More importantly, email from customers and partners is considered valid corporate communications and usually contains key pieces of information about the customer's or partner's relationship with the company.
- Groupware applications (such as Lotus Notes or Microsoft Exchange Public Folders)
  Many companies have used groupware as a means for centralizing information relevant to a particular group or department. While this approach solved one problem, the proliferation of these applications has created another problem -- too much information.
- Public Web sites
  Companies usually put important information on their public Web sites that is important for both internal and external constituents to be kept abreast of -- including press releases, news, product information, etc.
- Extranet sites
  Secure Web sites or extranets are being utilized by more companies as a primary means of communication with their key suppliers, vendors, channel partners and customers. These extranet sites have become another silo of important corporate information. Similarly, many
companies subscribe to secure extranets from other companies such as Lexis/Nexis, Bloomberg, Reuters, etc., which provide them with valuable news and research information.

- Word processing documents, spreadsheets and presentations
  Desktop files such as Microsoft Office documents are being produced by knowledge workers in all parts of the organization. These documents usually reside on individual hard drives which makes them vulnerable to being lost or on shared file servers - making them difficult to locate. Furthermore, a significant amount of published information is now available in PDF formatted files.

- Multimedia files and objects
  Many companies have invested in creating graphics, videos, audio files, brochures, scanned images of documents and training materials that exist as multimedia objects on file servers or in media databases. These objects are often spread out among the organization and are not readily available.

Information Resource Analysis Steps
1. Gather the documentation.
2. Create a master source list, identifying where the information was obtained.
3. Determine if the content in the document is stable enough for review.
4. Determine if the documentation contains enough information to support the user tasks.
5. Read carefully through the documentation.
6. Organize the information gained in the review.
7. Test the analysis.
8. Return information sources to the proper owners.

Where to look for help

References


Keys to success
- Documentation of some sort is widely available for most hardware, software, and other systems.
- Well-written documentation may contain an entire instructional program, facilitating the instructional development of an e-learning program.

Major errors associated with Information Resource Analysis
- Documentation often is poorly written with un-interpretable directions or gaps and mistakes in content.
- Manuals and standards are often written by content specialists, so the approach and style may not be comprehensible by laypersons.
- Documentation may be organized by inappropriate content structures, for example, a conceptual model when a procedural one would be more useful.
Determine Strategic Requirements

Strategic requirements (sometimes referred to as *Non-Functional Requirements*) are restrictions or constraints to be placed on the system and how to build it. Their purpose is to limit the number of solutions that will meet a set of requirements.

Decisions and tradeoffs between product sophistication and budgets and schedule are often strategic decisions. An understanding of the relationship between product complexity, cost, and schedule is necessary in order to make intelligent strategic decisions about product's budget and development timetable.

**Why Determine Strategic Requirements**

Non-functional requirements may be more critical than functional requirements. If these are not met, the e-learning system may be useless.

Strategic requirements are important because they often affect the look and feel of a technology-based learning product. A client's strategic requirements might demand themes that set a particular tone, such as professional, progressive, or frugal. These are very different strategic goals and require learning products that look and feel very differently from one another.

Motivation of learners is an important outcome of an e-learning product's theme. Technology-based learning products often rely on the *ARCS* model (attention, relevance, confidence, and satisfaction) to enhance and maintain learner motivation.

Another important strategic issue is budget and schedule. Budgets for the development of classroom training tend to vary proportionally to the course length or hours of instruction as does the development time and resources.

However, there are many more factors to consider in technology-based learning budgets. For example, the level of interactive complexity, the extent of simulation, the type and quality of media elements, and record keeping capabilities affect the cost and development effort of a technology-based learning product.

**How to Determine Strategic Requirements**

Non-functional requirements specify criteria that can be used to judge the operation of a system, rather than specific behaviors and can be classified into these subsets:

- **Organizational requirements** which are a consequence of organizational policies and procedures, e.g. process standards used, implementation requirements, etc.
- **External requirements** which arise from factors that are external to the e-learning application and its development process, e.g. interoperability requirements, legislative or legal requirements, etc.
- **Product requirements** which specify that the delivered e-learning system must behave in a particular way, e.g. execution speed, reliability, scalability, etc. (Sometimes these may be considered functional requirements, but e-learning functional requirements generally describe what users will be able to do or how they interact with the system.)

**Where to look for help**

**References**

**Keys to success**
- Use a standard format and form for all non-functional requirements.
- Use language in a consistent way. Shall for mandatory requirements, should for desirable requirements.
- Avoid the use of computer jargon.

**Major errors associated with Determining Strategic Requirements**
- Sometimes it's difficult to determine if a requirement is strategic (non-functional) or functional.
- Requirements (both strategic and functional) should be validated with customer stakeholders.
User Environment Analysis

User environment analysis examines the context of use of the e-learning system, both where and how the application will be used. Life span of the e-learning application, management and coordination of releases, production factors such as production, storage, and distribution of software and ancillary materials are important considerations that can affect the success of the e-learning program.

Environmental analysis describes the world in which the e-learning product will be embedded. The goal of the analysis is to describe where a product will be used, how it will be used, and how it will be sustained in its use. It focuses on essential attributes, such as: cost, compatibility, and perceived relative advantages.

Why do a User Environment Analysis
A comprehensive user environment analysis is critical to designing and developing e-learning products that function properly and are intuitively easy to use. The e-learning application must be compatible with organization’s information technology environment and may need to work within the network infrastructure and cohabit with other applications. The e-learning product may need to integrate with commercial off the shelf or proprietary information management systems or application specific software.

How to do a User Environment Analysis
The two main aspects of an environmental analysis are the e-learning environment and the support environment. The e-learning environment refers to the physical environment of e-learning users as well as the technology environment. The support environment includes both the assistance required to ensure that learning occurs as well as the information technology support that will be necessary for reliable system access.

A User Environment Analysis considers:

- E-learning functions and components
- The types of user support information
- Potential instructional components and instructional philosophy
- Architecture and integration philosophy of any associated application software
- Organizational standards

Key questions to consider:

- Where will the e-learning application be used (all possible sites)?
- What are the computer environments of each location?
- How long will the product be used before revision or abandonment?
- What are the patterns of product use (sporadic, scheduled, etc.)?
- What are the training needs for product users and administrators?
- How will be product be disseminated, distributed, or released?
- Who will manage and monitor the product after implementation?
- How will product implementation impact the users’ other computer applications and computer environment?
Where to look for help

References


Keys to success

- Follow these guiding principles:
  - What aspects of the e-learning and support environments are central to the success of the program?
  - Within each environment aspect, what subsidiary aspects are most important?
  - Based on the data given, do each of these aspects complement or inhibit other aspects of the e-learning environment?

Major errors associated with User Environment Analysis

- Not accounting for other applications that coexist with the e-learning program.
- Not accounting for users’ network capabilities.
- Even for the smallest projects, a lack of information on the basic characteristics of the e-learning environment may guarantee failure of the best-designed product.
During Design, the findings and recommendations of analysis take visual form; analysis provides the foundation for the design phase. Design involves any method or combination of methods that translate identified requirements into tangible ideas, concepts, prototypes, or specifications.

During the Design phase, development team members work together to propose and refine solutions. Feedback from the users or client is often obtained to help the development team evaluate and refine their solutions.

Because this phase involves planning the framework or structure for the completed product, the development team should work closely with the client to ensure that the proposed solution meets the client’s expectations and the proposed solution is within the agreed upon scope of the project.

*Design is probably the most critical phase of the development process.* Most large commercial projects involve team members from different disciplines—instructional designers, graphics and media designers, software engineers—who need to be involved in the design planning and communicate with each other to ensure that all the pieces of the final product work together and enhance the learning experience.

Even a project which is being developed by a single instructional designer requires that all components—instructional, graphical, media, and programming—must support and reinforce each other so as to be able to integrated into a final complete package.

The result of the Design Phase is a comprehensive description of the e-learning product and the foundation for its development and implementation.
Establish Creative Treatment

Using outputs from the analysis phase, such as the strategic requirements, audience characteristics, and content analysis, the project team produces and reviews one or more creative treatments for the e-learning product. The result of this activity is a written or visual representation of the e-learning's personality, usually in the form of one or more sketches depicting possible creative treatments.

Why Establish the Creative Treatment

Good treatment (theme) helps focus attention on important information and attract and maintain interest.

The look and feel of your e-learning application is important. Studies have shown that looks count when users evaluate Internet applications for credibility. The importance of motivational factors in the design of e-learning applications has been recognized for some time, since interactive software must be appealing for learners for it to be effective.

Well-designed screens for interactive e-learning draw user's attention, motivate users to interact with the software, and help learners accomplish learning goals without confusion and fatigue and contribute to the usability and quality of the e-learning program.

Logos, color schemes, and graphical elements tie the e-learning application's look and feel together into a coherent package. The creative treatment should complement, support, and reinforce the performance, organizational, business, and strategic objectives and goals of the client organization.

How to Establish the Creative Treatment

Creative Treatment consists of four components:

- **Theme** is the underlying thread that runs through an e-learning application giving it a unique look and feel.
- **Setting** is the environment or background for the user actions or instructional activities in the e-learning application, including time, place, and character attributes.
- **Tone** refers to the attitude or mood of the e-learning application, which might be humorous or serious, formal or informal, competitive or relaxed.
- **Pacing** is the rate at which the e-learning application is presented; it can be brisk, slow, varied or even.

Select a theme, setting, tone, and pacing that can be applied consistently throughout all e-learning components. Try thinking or writing several words or phrases that describe the subtext or feel of the e-learning application. Use those phrases as a springboard to the design of the creative treatment.

A useful metaphor carried throughout the e-learning application may help user's navigation.

Use a grid to design screens. Map out where navigation elements will be located and be consistent from screen to screen.

Keep it simple: animation is almost always annoying; wild backgrounds disrupt a user's reading.

Use color to add reality, to discriminate between elements of a visual, to focus attention on relevant cues, and to logically link related elements.
Where to look for help

References


Keys to success

- Strive for consistency in style, layout, color, and balance across the whole e-learning application.
- Keep design principles of simplicity, consistency, clarity, balance, harmony, and unity in mind.
- Harmony is fostered by similar fonts and colors, pictures that match the topic, and graphics which are similar in tone.
- Unity can be fostered by ensuring that all items on a screen appear to belong together and different screens are similar in content and design.
- Superfluous graphics can interfere with understanding.
- An overabundance of fonts or colors can distract rather than assist learning.

Major errors associated with Establishing the Creative Treatment

- Creative treatment that doesn't support client organization's business goals, trademark or branding.
- Including design components that have the potential to be inadvertently offensive, distasteful, or insulting to portions of a diverse target audience.
Determine Terminal & Enabling Objectives

One terminal performance objective is written for each task as identified during job analysis and task analysis. Following that, as many enabling objectives as are necessary are written for each terminal objective. Generally, terminal performance objectives support the users' main tasks and enabling objectives support the subtasks.

Why Determine Terminal and Enabling Objectives

A key element in the instructional development process is to specify the objectives for the e-learning solution as clearly as possible. Vague or poorly stated objectives often result in inappropriate e-learning components or an invalid evaluation results. Writing clear performance objectives answers the question, "What will users be able to do as a result of the e-learning program?"

Of all the activities within the ISD process, this is one of the most critical steps. Without well-constructed performance objectives, instructional designers don't know what to include and what not to include in the e-learning, users don't know what the e-learning application is supposed to help them do, and clients don't know what they are investing their money in. Performance objectives form the basis for what users will be able to do, how well they will be able to do it, and under what conditions it is to be performed.

How to Determine Terminal and Enabling Objectives

A performance objective is a statement of what the users will be able to do as a result of using the e-learning application. It prescribes the conditions, behavior (action), and standard of task performance. Specific terminal performance objectives must be developed for each of the tasks selected in the e-learning program.

Each terminal objective is analyzed to determine if it needs one or more enabling objectives, that is, if it needs to be broken down into smaller, more manageable objectives.

Performance objectives contain three main components:

1. Observable Action (task)

   This describes the observable performance or behavior. An action means a verb must be in the statement, for example "type a letter" or "lift a load." Each objective covers one behavior, hence, only one verb should be present. If the are many behaviors or the behaviors are complicated, then the objective should be broken down into one or more enabling learning objectives that supports the main terminal learning objective.

2. At Least One Measurable Criterion (standard)

   This states the level of acceptable performance of the task in terms of quantity, quality, time limitations, etc. This will answer any question such as "How many?" "How fast?" or "How well?". For example "At least 5 will be produced", "Within 10 minutes", "Without error". There can be more than one measurable criterion. Do not fall into the trap of putting in a time constraint because you think there should be a time limit or you cannot easily find another measurable criterion -- use a time limit only if required under normal working standards.

3. Conditions of Performance (usually) (condition)

   Describes the actual conditions under which the task will occur or be observed. Also, it identifies the tools, procedures, materials, aids, or facilities to be used in performing the task. This is best expressed with a prepositional phase such as "without reference to a manual" or "by checking a chart".

e-learning Analysis and Design Advisor
Where to look for help

References


Keys to success

- Terminal objectives match skill level (according to Bloom's taxonomy) of required performance of end users (i.e. if successful users are required to perform tasks which require synthesis then terminal objectives should be written at that level).
- Useful objectives include a task, standard, and condition, although some components may be implied.
- Performance required in objectives should be as authentic as possible.

Major errors associated with Determining Terminal and Enabling Objectives

- Describing activities that do not state a performance and are not observable or measurable, such as knowing or understanding.
- Objectives are too broad in scope or include more than one performance and measure.
- Defining conditions for objectives in terms of instruction (e.g. "after three days of training").
- Objective criteria which don't let the user know explicitly how well then need to perform the behavior.
Using resources discovered during content analysis, the instructional designer develops a substantive content outline and maps that content outline to the terminal and enabling learning objectives.

**Why Write the Content Outline**

Learning requires quality content. So much of an e-learning program's content is related to the user through text and graphics, it's important to organize the program's content in a way that makes it easy for users to find, access, and understand. The e-learning program's content needs to be both correct and organized.

The content outline serves as the foundation for the e-learning application including the structural organization and the sequential presentation of information. Because it is more costly to make changes later in development, the instructional designer must get client and stakeholder approval of the content outline before development begins.

**How to Write the Content Outline**

When practical, modules relate to groups of terminal performance objectives, lessons are mapped one-to-one with terminal learning objectives, and topics (within a lesson) are matched with enabling learning objectives.

Usually outlines are generated iteratively, beginning with a rough outline and then elaborating by dividing and subdividing the outline items already listed.

**Where to look for help**

**References**


**Keys to success**

- Get the SME involved (if the SME will do most of the work, so much the better).
- Be consistent.

**Major errors associated with Writing the Content Outline**

- Including content that is not relevant to the user’s performance objectives (nice to know vs. need to know).
The instructional architecture describes the organization of the e-learning’s instructional components from the learner's perspective. How the user will navigate through the e-learning (be able to master all the performance objectives), what performance support or scaffolding mechanisms will be provided, the assessment strategy, the overall instructional strategy, organization of the content, and the major way in which users will interact with the e-learning are all part of the instructional architecture.

Why Organize the Instructional Architecture
Different architectures tend to support different types of performer outcomes and different types of users or target audiences better than others. If the manner in which content is presented to learners and the way in which learning is reinforced and scaffolded supports the learners’ cognitive processes, that should make the learning tasks more straightforward.

How to Organize the Instructional Architecture
There are four different categories or types of instructional architecture:

- **Receptive Architecture**
  In this design, the instruction provides information that the learner absorbs. Learners assimilate the new information as they receive it. This architecture provides relatively little in the way of learner interaction. Briefings and linear video programs are typical examples of the receptive architecture.

- **Directive Architecture**
  This design is characterized by short segments that include rules or definitions, examples, and practice exercises. Modules are generally sequenced starting with easier or prerequisite skills, and build gradually to more complex skills. Frequent questions with feedback are provided to build patterns of correct associations. This architecture is based on behavioral principles of psychology and served as the predominant architecture of instruction in early computer-based training.

- **Guided Discovery Architecture**
  As cognitive psychology became more predominant in the 1970s, greater concern was directed toward how instructional methods interacted with learner mental events. Instructional designs became more learner controlled and used greater amounts of simulation. While pure discovery learning can be very inefficient, guided discovery can be effective by immersing learners in problem situations and by providing support for their solutions. One type of guided discovery instruction is called the cognitive apprenticeship. Its main features include experiential learning in which learners are immersed in job-like problems and—with various support options including tutors, reference, and best practice models—are encouraged to solve the problems.

- **Exploratory Architecture**
  The advent of the World Wide Web (WWW) has given impetus to architectures that are highly learner controlled. The learner is free to access diverse repositories of information that can include demonstrations, examples, and practice exercises. The role of instruction is to provide a rich layered or networked resource of information and effective navigational and orientation interfaces so learners can acquire the knowledge they need.
This chart summarizes the key characteristics of the various architectures.

<table>
<thead>
<tr>
<th>Architecture</th>
<th>Features</th>
<th>Goals</th>
<th>Sample applications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Receptive</td>
<td>Provides linear information--typically with low learner control and few interactions</td>
<td>To inform or motivate performers</td>
<td>Briefings, marketing summaries, overviews</td>
</tr>
<tr>
<td>Directive</td>
<td>Short lessons</td>
<td>To teach procedural skills to novices</td>
<td>Training on new computer systems, mathematical computations</td>
</tr>
<tr>
<td></td>
<td>Frequent practice</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Corrective feedback</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Simple to complex</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Guided Discovery</td>
<td>Problem-based</td>
<td>To build expert-like problem solving knowledge and skills</td>
<td>Acquiring skills in principle-based domains such as designing computer programs, deciding whether a loan should be made, evaluating data for specific criteria</td>
</tr>
<tr>
<td></td>
<td>Situates learning in authentic environment</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Uses simulation to compress experience</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Errors are encouraged</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Support is provided</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>through coaching and expert models</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exploratory</td>
<td>High learner control</td>
<td>For reference or for training of learners with good self-regulatory skills</td>
<td>Learning a new programming language, researching information</td>
</tr>
<tr>
<td></td>
<td>Provides rich environment for learners to explore</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Provides effective navigation for learner orientation</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Where to look for help**

**References**


**Keys to success**

- Maintaining architectural consistency throughout the e-learning application.
- Choosing an architecture that matches the audience's performance needs.

**Major errors associated with Organizing the Course Architecture**

- Selecting an architecture that doesn't match performance needs of the target audience.
- Selecting an architecture that doesn't match the target audience's learning skills.
Devise Instructional Strategies

At least one instructional strategy should be developed and described for each enabling objective or e-learning topic. The instructional strategies (and there can be many in an e-learning application) are the sequence of events, resources, support, experiences, information, guidance, and practice that you will provide the user in order for him to successfully meet the performance objectives.

Why Devise Instructional Strategies

Instructional strategies describe the organization and structuring of activities that will be designed so that the user will be able to meet the performance objectives of the e-learning. Well-designed and appropriate strategies can help keep users engaged and improve their resulting performance.

How to Devise Instructional Strategies

Instructional components of e-learning products usually use one or a combination of the following strategies:

- Tutorial
  The tutorial strategy is used to introduce new information that must be taught in a sequential manner. It is useful for teaching factual information, simple discrimination, rules, and simple application of rules.

- Drill and Practice
  If mastery of a new skill or information is desired, this strategy provides opportunities for practice. It should be used after initial instruction.

- Training Games
  Training games supplement other instruction and are used to provide motivating and engaging opportunities for practice after a skill or new information is taught. Training games capitalize on the competitive interests of participants and add entertainment value to instruction.

- Simulation
  The technique of simulation is most often used when practicing a skill which in its real context is too costly or dangerous. It provides an opportunity for experimentation and allows participants to test assumptions in a realistic context. Simulations are also used to model real-world situations that are not physically dangerous or costly, in order to build realism and relevance into the training situation. Simulations help bridge the gap between learning and on-the-job performance since their intent is to approximate real-world situations.

- Problem Solving
  One of the most challenging techniques used in computer-based training is problem solving. It helps participants develop skills in logic, solving problems, and following directions and is generally used to augment higher order thinking skills.

- Demonstration/Presentation
  Demonstration or presentation is best used to support the introduction of new information. Demonstrations are especially useful in illustrating procedural skills or soft skills such as sales, HR issues, and so forth. They can also be used as a review tool. Demonstrations are often followed up with problem solving activities.

- Collaboration
  This strategy involves the interaction between two or more students. The most effective way to implement collaborative learning is to create groups of users with different skill set levels. By creating these groups that combine different ability levels, users learn from their peers. Collaborative learning helps performers learn to work well in a group environment and enhance their communication and critical-thinking skills.
Where to look for help

References

Keys to success
- Maximum learner benefit can be typically achieved by combining several instructional strategies in one program.

Major errors associated with Devising Instructional Strategies
- The merit of each strategy varies with learning goals and some strategies are ill suited to meet some needs.
Plan Technical Architecture

The technical architecture of an e-learning program is a definition and description of the program’s software elements or components, the externally visible properties of those elements, and the relationships among them.

The externally visible properties include the individual component’s functions or services provided, the performance characteristics, and the data that each manages (accesses or updates). The relationships among the components include a description of the component’s behavior or interaction with regard to other elements.

Additionally, technical architecture may include a detailed plan for the development processes or sequences that will allow the project team to efficiently produce the final product.

Why Plan the Technical Architecture

The technical architecture is a plan which enables the e-learning system to meet both the technical and non-technical functional requirements.

A sound technical architecture provides for flexible distribution of system functionality among processing components allowing individual components to be redesigned without having to modify other components. This in turn can reduce the cost of maintenance or evolutionary growth or modification of the system.

How to Plan the Technical Architecture

From an engineering standpoint, using functional and strategic requirements, the results of the user environment analysis, the instructional architecture and the instructional strategies as inputs, a technical solution (i.e. how the e-learning product will be coded) is determined. The delivery system is chosen— if it wasn't decided during the Analysis Phase.

The flow of the e-learning application is laid out using a flowchart, if appropriate, and the functions, objects, and subroutines that will be needed to execute the program that will generate the course are defined and described. Depending upon the complexity of the instructional architecture and instructional strategies along with the sophistication of the development tools and the delivery system, the technical architecture may be written in pseudo-code using step-wise refinement.

One approach analyzing the technical needs is to define the e-learning system’s use cases and scenarios (see Determine Functional Requirements).

Once the use cases have been described, the next step is to identify modules or software components to implement the use cases and to define sequence diagrams or create a dynamic or behavioral view of the system showing the interaction among software components for each scenario or use case.

This process tends to be iterative rather than a static; repeat the steps as you re-define components which will accommodate all the system’s use cases.

Where to look for help

References

Keys to success

- Align the technical architecture so that it supports the e-learning system’s performance and business objectives.
- Support all task scenarios and use cases in the technical architecture.
- Design a flexible technical architecture that is capable of growing or evolving to accommodate future user task scenarios and use cases.
- Create a technical architecture that is minimal and uncomplicated while ensuring that all system functionality can be implemented.
- Describe the architecture so that it is understandable by non-technical program audiences (non-programming project team members and key stakeholders).

Major errors associated with Planning the Technical Architecture

- Miss a use case or generate a technical architecture that does not support all use cases.
- Not accounting for strategic (non-technical) requirements such as usability, modifiability, and system performance (size or speed).
The Graphical User Interface is what the learner sees when he or she looks the screen of a computer-based learning product. The design sets the tone for the entire application. In order to achieve the right treatment for a particular e-learning application, the instructional designer(s), graphics artist(s), programmer(s), and project manager must provide input.

Why Devise the User Interface

People should not have to change the way that they use a system in order to fit in with it. Instead, the system should be designed to match their requirements. The goal of designing an easy-to-use user interface is to reduce the cognitive load of e-learners, to reduce the number of user errors and the severity of those errors, to improve the time to competence, and to increase users overall satisfaction with the e-learning system.

How to Devise the User Interface

Generally mockups of two or three different interface ideas or design treatments should be created using the same set of screens for each design treatment. The logic behind picking a single set of screens to be used in several different looks is to allow the project team to make unbiased judgments on various looks based on the artistic and instructional treatment of the screen and not on the content of one screen versus another. In short, it is easier to make comparisons of like screens that have a different visual treatment, rather than trying to choose a look based on screens that are entirely different.

The navigation buttons, icons, and control that will allow the user to interact with the product are designed. The dialog boxes and remaining actions that the user will use to interact with the product are designed as well. Both the visual design (look) and the definition of the user action (feel) for each of the navigation icons, buttons, and controls need to be determined.

As demonstrated in the mockups, the user interface should be designed to comply with usability heuristics including:

- Communicating learner status, location within the learning product, and progress toward completion.
- Presenting content in a logical order with a simple natural dialog.
- Providing user control and freedom.
- Maintaining consistency.
- Preventing user error or helping users recognize, diagnose, and recover from errors.
- Supporting both the experienced and inexperienced user.
- Using aesthetic and minimalist design.

Where to look for help

References


**Keys to success**


- Strive for consistency.
- Enable frequent users to use shortcuts.
- Offer informative feedback.
- Design dialogs to yield closure.
- Offer error prevention and simple error handling.
- Permit easy reversal of actions.
- Support internal locus of control.
- Reduce short-term memory load.

**Major errors associated with Devising the User Interface**

- Designers do not have enough knowledge of the user population.
- GUI increases—not decreases—the user's cognitive load.
- GUI doesn’t allow users to correct errors.
- Inconsistency.
Create Low-Level Prototype

Sometimes referred to as a low fidelity prototype, the low-level prototype is a design tool used to quickly generate ideas about the look and feel of the interactive product and to gain consensus among the project team and the customers.

Prototyping is much like a rough draft of a document. It still needs to be polished, but allows you to begin solidifying ideas, correcting major errors, and even start over without a lot of lost time. There are low-fidelity and high-fidelity prototypes.

Why Create a Low Level Prototype

Low-fidelity prototypes are quick, cheap, and designed to elicit user feedback as early as possible. Low-fidelity prototypes appear to be as effective as high-fidelity prototypes at detecting many types of usability issues. Low-fidelity prototypes have an additional advantage in that they can be created quickly and easily, and they do not require advanced computer skills.

High-fidelity prototypes are more expensive and usually involve coding, but are better for evaluating graphics and getting 'buy-in' that usability problems found during testing are not due to the 'rough' quality of the prototype.

How to Create a Low Level Prototype

You should prototype an e-learning product early in its development because it is much easier and cheaper to correct a prototype than a released product.

The low-level prototype can be generated by hand (sketches) or electronically (using graphics software). Generally an extension of the illustrations used to convey and define the creative treatment, the low-level prototype shows user interactions and typical system responses so that the project team and stakeholders can come to a common understanding of exactly what the e-learning application will do and how it will perform.

As an early-design tool, a paper low-fidelity prototype is ideal. Many ideas can be viewed and evaluated by the design team in a short period of time, and with very little cost. The basic idea is to have the design team work together, using little more than pen-and-paper, to draw the screens needed for a basic user interface to the product. Because it is done early, quickly, and with no expectation of creating a working version, the team is under much less pressure and generally works together more smoothly. In addition, little to no attachment for the prototype develops in the team, resulting in much less resistance to change.

Usability Testing with Paper Prototypes

Try to use the standard usability testing procedure as much as possible for paper prototypes.

The user still works through a set of tasks, thinking aloud while they do them. A questionnaire and post-test interview may still be administered. However, there are four major differences with a standard usability test:

The user is told they will be using a paper mockup, and they should point to an option they would select or say aloud what they would type.

A person (preferably a member of the design team) acts as the computer. When a user does something that would elicit a computer response, the 'computer person' (CP) responds instead. If available, the CP's response is to present the screen the selected option would display.

See Usability Testing.
Where to look for help

References

Keys to success
- A low-fidelity prototype is a ‘quick and dirty’ mockup that is cheap, easily changed, and can be thrown away without complaint.
- During usability tests, a low-fidelity prototype often uses a person as the computer and a pointer as the mouse.
- The goal of such a prototype is to create something as quickly as possible that will elicit user feedback.
- Very often, paper and pencil are used to construct this type of prototype, though presentation software (e.g., PowerPoint) may be used.
- Use low-level prototype in early project stages to show proof of concept and gather user requirements.
- Use low-level prototype later in design to validate evolving user requirements.

Major errors associated with Creating a Low Level Prototype
- Using a low-level prototype to test for system performance.
- Testing for aesthetics: fonts, images and colors that cannot be achieved in a low-level prototype.
- Using a low-level prototype to demonstrate functionality with clients or marketing departments.
Develop Preliminary Storyboard & Flowchart

The storyboard is an extension of the low-level prototype and becomes an input to the functional prototype. The preliminary storyboard presents a visual representation of the user interface and shows how the product theme will be carried out and how the learner will be able to navigate through the e-learning application.

Storyboards are similar to flowcharts which show the structure and sequencing of an e-learning application. Storyboards focus on showing what learners see and hear while flowcharts focus on showing the relationship among the e-learning components and the order in which the learner will access them.

While storyboards and flowcharts are different design artifacts, with somewhat different purposes, they are often produced in tandem since changes in one will generally result in changes in the other.

Sometimes referred to as a test-of-concept model, the preliminary storyboard/flowchart is produced when the design is at a malleable stage and serves as an aid to thinking about the performance and business problem and arriving at better and best e-learning solutions.

While the preliminary storyboard/flowchart and the low-level prototype share some similarities in both purpose and appearance, the primary difference is that the low-level prototype is intended to show how the user interacts and controls the application and the preliminary storyboard/flowchart tends to emphasize the user's experience with the e-learning content.

Why Develop a Preliminary Storyboard and Flowchart

Storyboarding and flowcharting provides project team members, and the client, with a common point of reference to verify and validate structural and content elements.

Storyboard and flowchart serve as both a modeling tool, allowing the project team to quickly create and evaluate e-learning designs, but also communication tool, facilitating the interaction of ideas and a shared understanding of design agreements.

Pictures of an e-learning application, as depicted through storyboards and flowcharts, are often more expressive than words, or written descriptions. Sometimes storyboards and flowcharts can help reveal the social context of design and the importance of particular situations.

Other benefits:

- Provide an overview of the system
- Demonstrate the functionality
- Demonstrate the navigation scheme
- Can be evaluated by others
- Omissions and lost links or path can be spotted in the storyboard
- Help focus on the total content of the project, both from the point of view of the overall size of the project and user interactions
- Problems may be spotted in the storyboard which may be costly to fix at a later stage

Producing a storyboard or flowchart is not necessary or beneficial for every e-learning application. In general, the more innovative, complex, and complicated the e-learning application, the more beneficial the storyboard and flowchart.

Storyboards are particularly helpful for multimedia rich e-learning applications. Flowcharts are useful for e-learning applications with complex and highly integrated architectures.
How to Develop a Preliminary Storyboard and Flowchart

A preliminary storyboard/flowchart does not have to include everything, but instead provides a high-level general idea of what the menu screens will look like, what images (both stills graphics and digital movies) will be seen and when, what audio and text will be provided, and the learner's path to the e-learning content.

Storyboards and flowcharts take many different forms. The sophistication of preliminary storyboards and flowcharts can range from hand-drawn sketches to complex computer-generated graphics. The amount of time and effort devoted to producing the storyboards and flowcharts will probably be correlated to their level of sophistication.

Storyboards can be developed with computer programs ranging from word-processing applications to programs designed specifically for creating storyboards. An even simpler approach would be to use 3x5 index cards.

Likewise, flowcharts can be created with PowerPoint or Visio or more sophisticated (and expensive) software. In some instances, hand drawn flowcharts will suffice.

No matter what the form, the preliminary storyboard/flowchart should include:

- The e-learning application's structure or logical organization (from a user's perspective)
- The e-learning application's screen elements
- User's interactions

If the e-learning application involves a considerable amount of multimedia content, the preliminary storyboards may evolve into the final storyboards during the development phase and serve as a roadmap or blueprint for the programming tasks. In which case, you may want to invest more resources to create formal preliminary storyboards during design.

Similarly, if the e-learning application requires complex customized programming, the preliminary flowchart may evolve into a programming tool to be used during the development phase. If this is the case, you may want to produce more formal flowcharts during design.

Where to look for help

References


Software


Keys to success

- The storyboard/flowchart makes sense.
- The storyboard/flowchart depicts the main ideas that should be represented by the content.
- The flow of information or content is logical.
- Navigational elements are consistently placed.
Major errors associated with a Developing Preliminary Storyboard and Flowchart

- Not involving the key project stakeholders.
- If the storyboard/flowchart looks wrong, the e-learning application will be wrong also.
- Not gaining client approval of the storyboards before programming and other development activities begin.
Create Style Guide

The Style Guide is the document that provides the designers with all the instructional specifications pertaining to the course. Performance objectives, exercises, and instructional methodology are specified, and all components conform to the standards set within. This ensures a consistent look and functionality for all parts of the e-learning application, which allows users to focus their cognitive efforts on the content rather than expending cognitive capital on trying to understand how to use the product.

The style of writing that is used should be consistent throughout the e-learning application. This is especially critical if there is more than one writer assigned to the project. Basic writing principles and standards are specified to maintain uniformity and consistency of writing throughout the application.

Why Create a Style Guide

A major part of producing a professional quality e-learning product is consistency in the text, visuals, and other media used in the product. Defining standards and styles before beginning production and development assures consistency.

- To ensure that documents conform to corporate image and policy, including legal requirements.
- To inform new writers and editors of existing style and presentation decisions and solutions.
- To define which style issues are negotiable and which are not.
- To improve consistency within and among documents, especially when more than one writer is involved or when a document will be translated.
- To remove the necessity to reinvent the wheel for every new project.
- To remind the writer of style decisions for each project, when one writer works on several projects that have different style requirements.
- To serve as part of the specifications for the deliverables, when writing for clients outside your company or when outsourcing writing projects.

How to Create a Style Guide

Any portion of the e-learning application that needs to maintain consistency such as colors, properties of graphic and media elements, placement and size of dialog boxes, spellings and capitalization, etc. should be included in the style guide.

A project style guide focuses on rules for presentation elements including visual design elements such as color, logos, fonts or icons; page or screen layouts including spacing, justification and common items; and the correct usage of controls such as buttons, drop-down selections, ratio buttons or check boxes.

Some items to include in a style guide:

- User-centered Design Principles
  - Design Heuristics
  - Usability Goals
  - User Characteristics
  - Accessibility Guidelines
- User Interface Metaphors
• User Interface Concept or Vision
  • Key Metaphors
  • Architecture or Structure

• User Interface Architecture or Site Structure (if a Web Site)
  • Menus or Control Bars
  • Home Page, Desktop, or Main Menu

• Page or Window Layout
  • Page Structure
  • Layout Templates or Guide
  • Headers and Footers
  • Frame Structure (if a Web Site)

• Controls
  • General Guidelines
  • Control Comparison Charts
  • Descriptions of each control

• Interactions
  • Keyboard Shortcuts

• User Assistance and Text
  • Text in the Interface (labels and prompts, user terminology, writing guidelines)
  • Messages (status bar messages, error messages)
  • User Assistance (type of user assistance, tool tips, embedded help)

• Common Functions
  • Required Fields
  • Other Common Functions
  • Visual Design
  • Logos, fonts, colors
  • Icon styles
  • Image library

• Audio and Media Design
  • Audio, animation, video standards

Where to look for help

References


**Keys to success**

- Start early—especially if the style guide is support a current project. Don’t wait until the design is almost complete before creating the style guide.
- Make it available—this helps build support for the standards and makes it possible to get feedback from stakeholders before the guidelines are final.
- Give design elements "mission statements" to explain how the element enhances the user experience which helps guide developers’ design decisions.
- Include writing conventions, especially those that pertain to content specific issues such as capitalization.
- Develop templates and examples that show various style standards to used, including numbered and unnumbered lists and punctuation.

**Major errors associated with Creating a Style Guide**

- Including irrelevant information such as:
  - Process information (how we do things in this company or this department, who’s responsible for what, development and review process, etc.).
  - Grammar and writing tutorials.
Identify Media Components

Based upon the instructional objectives, the storyboards, and the creative treatment, the major media components that will be included in the courseware are identified. If existing media is being obtained from external sources, those sources are determined along with the logistics for acquiring the media. If customized or original media needs to be developed or created, the required production tools and the production resources necessary to create the media are determined.

Why Identify the Media Components
It is possible to create all required media components and artifacts from scratch, however, it may be much simpler to modify or reuse existing multimedia.

How to Identify Media Components
Search for existing media.

Do you need video, audio, graphics, images? What’s in the public domain or what do you have (or can obtain rights to)?

If original media needs to be created identify the resources—people or contractors (producers, directors, videographers, graphic artists)

Where to look for help

References

Media Libraries
Copyright Crash Course, University of Texas, http://www.utsystem.edu/ogc/Intellectualproperty/cprtindx.htm

Keys to success
- Determine the quality and amount of media required, especially any media that will need to be produced or acquired and review with the customer.
- Review and analyze the quality, applicability, and availability of any customer-supplied or other media already on hand.
- Be sure of license agreements, copyrights, and fair use issues.
Major errors associated with Identifying the Media Components

- Multimedia components that have not been specifically designed for reuse may not easily yield to modification and generalization.
- Creation and production of original media can consume considerable project resources. It is often time consuming and expensive.
- Over promising with regard to your ability to deliver original media.
- Underestimating the amount of original media that will be necessary to produce so that subsequent project planning (schedules, costs, etc.) can be accurate.
- Trying to retrofit existing media into courseware when it doesn't support the course objectives, or performance goals.
The functional prototype, sometime called a software architecture prototype, should contain the core functionality to be found in the completed project. The prototype should consist of a representative sample of all functions within e-learning components, performance support, instructional, and knowledge management portions.

The content chosen as a sample should be developed as fully as possible, to include the interface, graphics, instructor or training administrator reports (if any) and navigational functionality. The prototype must be developed in the authoring languages that will be used in producing the final product. Samples of multimedia components such as videos and animations should be included in the prototype.

Why Construct a Functional Prototype

The functional prototype has two purposes:

1. For the instructional designers and the customers, it demonstrates how the e-learning product components will be integrated and interrelate and includes the instructional flow, the user interactions, and the navigation, but not necessarily the complete look and feel (however, it may if time and funding allow). This allows both the customer and the project team to have a common understanding of what the final product will do.

2. For the programmers, software engineers, and multimedia developers it is an opportunity to build a framework or architecture that will serve as the basis for the final product.

It also allows the development team to test all functional components to be sure all subroutines, data structures, programming and media objects work together and that the development tools and processes will enable the final courseware to be created in a methodological fashion.

It is often a model and testing ground not just for product features, but the development and production process which will be used to create the delivered product. Storyboarding tools, document formats, staffing, and management processes should be modeled as well.

How to Construct a Functional Prototype

Using the authoring system and tools intended for the development process, create a working e-learning application using a subset of the actual e-learning content and databases.

The functional prototype is a fully working sample, and as such should contain an example of every element of functionality and content type to be used in the material. A functional prototype typically comprises the following:

- A minimal amount of content showing language style, graphical content and interactions to be used.
- An example of every question type or user interaction to be used.
- An example of every feature or functionality.

It's important to remember that a functional prototype does not have to be beautiful—it merely needs to be useful.

The prototype should demonstrate your ability to design and develop an end solution that will meet all of the functional requirements.

Where to look for help

References

Keys to success

- Prototype the critical functionality of the finished system to ensure that all components can be built and integrated.
- Obtain client sign-off on the prototype so that development of the full product can proceed.

Major errors associated with Constructing a Functional Prototype

- Not being clear about the type of information the functional prototype is designed to represent.
- The functionality of the prototype does not scale up to the functionality required of the final system.
Usability Testing

Depending upon time and budget, one or more usability tests should be conducted on the low-level prototype and the functional prototype.

Why do Usability Testing

Usability measures the extent to which users can use a product to achieve particular goals with effectiveness, efficiency, and satisfaction. Usability tests with several users selected from the targeted audience are conducted in order to determine the extent to which typical users can successfully perform their tasks using the e-learning application.

Usability experts conduct heuristic reviews by examining and analyzing software systems interfaces against a set of usability heuristics (guidelines, criteria, and standards) in order to determine possible user problems. Heuristic reviews are easier and less costly to conduct than full-scale usability tests with users. Heuristic reviews also help ensure that graphical user interfaces adhere to standards and are consistent.

How to do Usability Testing

*Usability tests can serve different purposes:*

- **Exploratory**
  Tests occur early in the design cycle, possibly helping to understand the learner's conceptual and mental models of the e-learning product.

- **Usability assessment**
  Tests typically occur after a working solution or product has been developed.

- **Validation**
  Tests help evaluate if an e-learning product meets established standards.

- **Comparison**
  Tests are performed to compare alternative product designs.

*Usability methods include:*

- **Think Aloud Protocol**
  The test learner uses the system while continually verbalizing his/her thoughts.

- **Constructive Interaction**
  A variation of Think Aloud Protocol where two test learners use the system together.

- **Performance Measurement**
  User performance is measured by having a group of test subjects perform a set of tasks while collecting time and error data.

- **Usability Prediction**
  Test subjects are shown models of the interface (or portions such as icons) and asked to predict system behavior.

- **Heuristic Evaluation**
  Expert evaluators go through the interface several times and compare and check the interface compliance with a predetermined set of heuristics or usability principles.

- **Cognitive Walkthrough**
  Expert evaluators construct task scenarios from specifications or prototypes and then role-play the part of a learner using the system.
- **Formal Usability Inspection**
  Product stakeholders (designers, support personnel, product managers) review usability issues using design documents that describe user tasks and goals, screen mockups, and content outlines. Each reviewer assumes the role of a typical learner and walks through typical learner tasks.

- **User Retrospection**
  Evaluates the user’s subjective view after using the system. The evaluator solicits relevant information in the area of user satisfaction through interviews, questionnaires, or focus groups.

- **Evaluator Retrospection**
  A form of self-reflection performed by an expert evaluator (not a user) after using the system.

In practice, multiple methods are usually used in some combination because different methods identify different problems.

### Usability Evaluation Methods

<table>
<thead>
<tr>
<th>Evaluation Method</th>
<th>When to Use It</th>
</tr>
</thead>
<tbody>
<tr>
<td>Think Aloud/Constructive Interaction</td>
<td>In later stage of development when the aim is to collect qualitative data on how the user interprets the interface.</td>
</tr>
<tr>
<td>Performance Measurement</td>
<td>In summative evaluation for determining whether usability goals are achieved.</td>
</tr>
<tr>
<td>Usability Prediction</td>
<td>Usually in the early design stage when the learnability is of central concern.</td>
</tr>
<tr>
<td>Heuristic Evaluation</td>
<td>In formative or summative evaluation when there are constraints in budget, time, or availability of users with the aim of checking the interface’s conformance with standards.</td>
</tr>
<tr>
<td>Cognitive Walkthrough</td>
<td>In early design stages when the prototype is not available and for identifying mismatches between users’ and designers’ conceptual scheme of user tasks.</td>
</tr>
<tr>
<td>Formal Usability Inspection</td>
<td>In early design stages before the prototype is created and users are not available (or should not be involved) and the promote ownership among development team members.</td>
</tr>
<tr>
<td>User Retrospection</td>
<td>After the user has interacted with the system and mainly for understanding the system from the users’ perspective.</td>
</tr>
<tr>
<td>Evaluator Retrospection</td>
<td>In any stage after using the system when users are not available to provide data on satisfaction use.</td>
</tr>
</tbody>
</table>

Steps in the Usability Testing activity include:

1. Writing the usability test plan.
2. Recruiting test participants (the instructional designers take the role of test participants for this project).
3. Conducting usability test.
4. Recording and analyzing results.
5. Making recommendations for modifications and schedule for implementing changes.
Where to look for help

References


Keys to success

- The best results come from testing with no more than 5 users and running as many small tests as you can afford.
- Test with additional users when an e-learning product has multiple audiences.
- Expert evaluations can help identify some potential user problems, but usually cannot uncover problems related to comprehension (which parts of the material learners will have difficulty with) and learning support (the amount of explanation learners will require).
- The usability test should closely model the actual user environment, but allow evaluators to gather data through unobtrusive observation.

Major errors associated with Usability Testing

- Using product development team members as test subjects.
- Prompting usability test subjects.
- Selecting usability test subjects who are not representative of the target audience.
- Testing for ease of use but not usefulness.
Testing of the developed program should be an ongoing part of the programming development. Testing by the programmer during the programming activity allows the programmer to more easily isolate any errors and make corrections while that particular piece of code is fresh in his mind. In most projects almost half of the programmer's effort is involved in testing the functionality of just-written code.

However, it is still advisable to conduct a formal testing procedure as a final part of development prior to delivery to the customer for implementation. Depending upon the scope of the project, testing may be divided into unit testing, testing of single lessons, and integration testing, testing of the whole integrated product.

A unit test is a procedure used to validate that a particular module of source code is working properly.

Integration testing (sometimes called Integration and Testing and abbreviated I&T) is the phase of software testing in which individual software modules are combined and tested as a group. It follows unit testing and precedes system testing.

Integration testing takes as its input modules that have been checked out by unit testing, groups them in larger aggregates, applies tests defined in an Integration test plan to those aggregates, and delivers as its output the integrated system ready for system testing.

**Why Write Unit and Integration Test Plans**

Like other software projects, e-learning applications require methodical and planned testing to find and correct software errors and to minimize the impact of any errors that either undiscovered or uncorrected.

**Unit Testing**

The goal of unit testing is to isolate each part of the program and show that the individual parts are correct. Unit testing provides a strict, written contract that the piece of code must satisfy. As a result, it affords several benefits:

- **Facilitates change**
  Unit testing allows the programmer to refactor code at a later date, and make sure the module still works correctly (i.e. regression testing). This provides the benefit of encouraging programmers to make changes to the code since it is easy for the programmer to check if the piece is still working properly.

- **Simplifies integration**
  Unit testing helps eliminate uncertainty in the pieces themselves and can be used in a bottom-up testing style approach. By testing the parts of a program first and then testing the sum of its parts, integration testing becomes much easier.

  For unit testing, isolate the unit to be tested using drivers and stubs.

- **Documentation**
  Unit testing provides a sort of "living document". Clients and other developers looking to learn how to use the module can look at the unit tests to determine how to use the module to fit their needs and gain a basic understanding of the API.

**Integration Testing**

The purpose of Integration Testing is to verify functional, performance and reliability requirements placed on major design items. These "design items", i.e. assemblages (or groups of units), are exercised through their interfaces using Black box testing, success and error cases being
simulated via appropriate parameter and data inputs. Simulated usage of shared data areas and inter-process communication is tested, individual subsystems are exercised through their input interface. All test cases are constructed to test that all components within assemblages interact correctly, for example, across procedure calls or process activations.

Ultimately, the goals of integration and test are to:

- Bring together the multiple pieces of a system
- Find and fix defects that couldn’t be found earlier
- Ensure that the requirements of the system are met
- Deliver a product of predictable quality that meets the business’s quality objectives as well as the customer’s quality expectations.

**How to Write Unit and Integration Test Plans**

One logical testing plan is to test the product in three phases, either by three individuals or in the case of this product, by a single individual assuming three roles.

The first tester is assigned the task of breaking the product. Their task is to run the product and to make unorthodox and unanticipated selections to see if the product can be made to stop working or to determine what errors can be forced. Following this test, programming corrections should be made based upon test results.

The second tester is assigned to perform a technical edit of the product. Their task is to look for spelling, grammatical, and stylistic errors. Corrections should be made following this test.

The final tester is assigned to run the product as an intended student might. Their job is to examine the product from a typical user’s point of view, ensuring continuity and logical flow of products. Again, corrections should be made following this test.

**Where to look for help**

**References**


**Keys to success**

- Simulate the users’ environment(s) as close as possible.
- Select test scenarios based upon users’ authentic tasks.
- During integration and test execution, whenever a defect is found, use it as an opportunity to find as many additional defects as possible. Since people tend to be repetitive in their actions, it is very likely that the same defect will appear within the code in several more locations.

**Major errors associated with Writing Unit and Integration Test Plans**

- Not allowing sufficient time for unit and integration testing.
Write Validation/Evaluation Plan

Evaluation is a general term and that usually relates to any procedure or method used to determine the quality of the e-learning product or an aspect of it. Validation is usually a more specific term that refers to a set of activities designed to demonstrate that the e-learning program works as intended. Validation often takes the form of a pilot class or pilot period during which time the e-learning project is used by representatives of the target audience who evaluate the product.

The Evaluation/Validation plan is a description of the methodology, logistics, and purpose of the project’s evaluation or validation procedures. Notice that this is not the evaluation and validation task, but rather the planning for evaluation and validation. Evaluation and validation would probably take place before, after, or during implementation, depending upon the specific goals of evaluation (what is it intended to measure? it is formative, summative, or both? and so forth).

Depending upon the project and the product, the evaluation/validation plan may also include plans for usability testing. However, evaluation and validation are different from usability testing, although there are some similarities. All these are, or can be, aspects of formative evaluation which aims to make improvements in the product by subjecting it to various types of user and customer review. Heuristics associated with planning for usability testing are offered in a separate task.

Again, keep in mind, this task is to create a plan for validation and evaluation not to do the actual evaluation, which would occur later in the project. The planning, itself, is not a lengthy or complex process, but be sure what you plan to do makes sense in context with the specific project.

Why Write the Validation/Evaluation Plan

If you’re going to evaluate an e-learning product, then some sort of planning document should be generated in order to communicate the plan to all project stakeholders. The major risk with not doing so is that formative and summative evaluation of the product will be short shifted, resources and time won’t be allocated, and errors in the product or in the project methodology will not be corrected.

There may be instances in which an e-learning product will be used for such a limited period of time and never reused, that results from formative evaluation will never impact the product. An EPSS that leads employees through their options related to a company’s initial public offering of stock might be an example of a short-lived e-learning product. Since the IPO will occur only once, by the time any closed-loop corrective action could be implemented, the IPO period will pass and the EPSS product never used again. In this instance, evaluation may be unnecessary, however, it may still be beneficial to produce an evaluation planning document that explains why no evaluation will be conducted.

In an e-learning program, validation and evaluation may address:

1. Verification of the design and implementation to ensure that the program meets the requirements specifications set forth in the analysis phase. (See Determine Functional Requirements and Determine Strategic Requirements).
2. Usability assessment that focuses on the user interface and components of the application to ensure that learners can achieve the learning and performance goals and objectives without the user interface getting in the way of their success. (See Usability Testing).
3. The effectiveness of the e-learning program -- the transfer of learning to the job and the impact on the users’ on-the-job performance.

How to Write the Validation/Evaluation Plan

1. First, determine what you want to evaluate or validate.
Examine the project goals, student learning or user performance objectives. What performance problem is the e-learning program intended to solve or alleviate?

What parts of the e-learning program would be changed based on evaluation data?

Involve the e-learning program stakeholders. What evaluation information would help them make decisions about this e-learning project or others?

2. Second, develop a plan to obtain the evaluation data. There may be restrictions on when and where you can have access to members of the target audience or users. Your prospective audience's availability may have an impact on what you can measure and how you do it.

3. Finally, review the evaluation/validation plan with your client, customers, and project stakeholders. Explain what you’re going to evaluate, how it will improve the program, and the benefits to each of the stakeholders.

Kirkpatrick’s education measurement model would be good to follow.

- **Level 1**: Reaction to the application
  In educational terms this is generally referred to as a “smile test”. Basically, this measures whether students liked the learning experience.

- **Level 2**: Did learning take place?
  Level 2 is often measured via a pre-test (a test before the training) and a post-test (a test after the training) to see if students’ test scores increased as a result of the training. Ideally, this evaluation would measure whether (and the degree to which) students achieved the learning objectives, which are usually defined during design. For EPSS-type projects, which might not have specific learning objectives, Level 2 evaluation would examine the users’ achievement of the application’s performance objectives.

- **Level 3**: Transfer to the job or workplace
  Level 3 measures the extent to which the skills obtained in training are used by students on the job or in context with their assigned tasks. Level 3 evaluations should map back to the performance problem that the training was intended to resolve.

- **Level 4**: Results
  Measures the final results that have been achieved because of the learning acquired or the performance improvement achieved as a result of the e-learning program. From a business or organizational perspective, this is the overall reason for the program.

- **Level 5**: Return on Investment
  Some evaluation models include a fifth level. Assuming students applied their training on the job, what was the impact on the organization? Usually this looks at business issues like profit, costs, quality, customer responsiveness, and so forth.

**Where to look for help?**

**References**


Keys to success

- The evaluation/validation plan should clearly map to the project’s objectives—the learning or performance objectives, the project’s goals, and the business rationale for the project.

- The plan should help determine if users achieved learning objectives or performance objectives and provide directions to improve product if it’s deficient.

- The evaluation plan should specify what is going to be measured and how the measurements are going to be done.

- Involve stakeholders—what evaluations would help the learners’ management team make subsequent decisions about this or other e-learning programs.

- The evaluation or validation which is planned should be do-able, and timely enough so that the results of the evaluation can impact the program.

- The expected effort to conduct the evaluation or validation and analyze the results should be proportional to the scope of the e-learning project.

Major errors associated with Writing the Validation/Evaluation Plan

- Develop an evaluation/validation plan which is not implemented or is implemented differently.

- Develop an evaluation/validation plan and perform the evaluation/validation but never intend to make improvements.
Create Implementation Plan

As technology enhanced training and e-learning become more sophisticated and complicated, implementation requires more planning. Controlled release of e-learning systems, especially those that support software applications, should be carefully planned and scheduled in order to ensure that user and support resources are available when and where needed.

The Implementation Plan describes the conditions (who, what, when, where) under which the e-learning will be offered or the solution deployed. This is done by reviewing the data collected during the life of the project, reviewing the lessons-learned about field conditions from the validation, and conferring with people who are knowledgeable about conditions at the work or training site. The outcome of this step is a definition of the guidance and support needed to ensure successful implementation.

Why Create the Implementation Plan
In the classic ADDIE model of training development, the details of the Implementation process is often left to the last. But even though this step involves more logistical elements than instructional ones, it is critical nonetheless. After all the hard work and effort exerted so far, you don't want your program to fail because of a delivery flaw.

How to Create the Implementation Plan
Roll-out of Web-Based Training
If the program is Web-based, it is likely that the software already exists on a private and secure server computer, either on the Internet or on a corporate Intranet. Changes are typically uploaded to the server, and reviewers are provided with log-on passwords to gain access. Assuming this is the case, releasing the Web-based training program is a simple matter of transferring the program from the test server to the final location of the program. Often, two copies of the program will be maintained. One version is the live version accessible to the students. The other version is the development site for new changes, which is kept on a mirrored or shadow server.

Roll-Out of Multimedia CD-ROM Training
Releasing a CD-ROM-based program is a bit more difficult than a Web-based one in that it requires the duplication and distribution of CD-ROMs. The developer copies the final program to a master CD-ROM, in a process known as burning the Gold Master. The master CD is usually sent to an outside duplication company that is equipped to produce a large volume of CDs, along with their labels and jewel or plastic cases.

Even though the training program is technology-based, it is a good idea to have an accompanying quick reference card or printed set of instructions. Depending on the computer literacy of the student audience, some may have problems installing the software onto their computer or launching the program directly from the CD-ROM. It is a good idea to have the instructions on both a quick reference card or jewel case cover, and on the CD label. While the instructions on the CD label cannot be read once the CD is inserted into the computer, those instructions will be there long after the printed instructions have been lost.

Internal Marketing
The internal marketing of your training program to the student audience is a step that usually is overlooked. In some cases, the training is mandatory and internal marketing is not an issue. In other cases, the training is optional support for those who need it. Don't assume that students will use a program just because you made it.

If CDs are shipped on an as-needed basis from the training department, or if Web-based tutorials are sitting on a training home page, students need to be notified and reminded that these
resources exist. A communication plan announcing the release of a new title, curriculum, or virtual corporate university might include all of these elements:

- Broadcast voice mail
- Broadcast e-mail
- Internal mail of announcement postcards
- Posters or banners displayed prominently in lobbies, cafeterias, and elevators
- Article in corporate newsletter
- Demonstrations and announcements at company meetings

**End-User Technical Support**

As part of implementation, a plan needs to be made to support the end users, the students. This is not necessarily support for content questions, but rather technical support to handle questions about installing or accessing the program, performance problems, or hardware issues. If it is a small deployment, a training manager or the vendor that created the program will often handle these types of calls directly. For larger audiences, the normal help desk or information technology department should handle technical support telephone calls.

**Where to look for help**

**References**


Stone, D. & Villachia, S. (2003). And then a miracle occurs! Ensuring the successful implementation of enterprise EPSS and e-learning from day one. *Performance Improvement (42)* 1, 42-51.


**Keys to success**

- Begin to plan the implementation early in the design process.
- Communicate often with customers and other stakeholders:-sponsors, management, IT, marketing, etc.
- Involve customers in decision making.
- Listen to them!

**Major errors associated with Creating the Implementation Plan**

- Not including all aspects necessary to support a successful implementation, including:
  - Distribution and installation of the e-learning application.
  - Users' network access.
  - e-learning application support.
Glossary

ADDIE
Classical model of instructional systems design that includes the steps of Analysis, Design, Development, Implementation, and Evaluation.

Analysis
The first step in the classic ADDIE model of instructional systems design. In the analysis phase the audience is defined and performance improvement needs are identified.

Artificial Intelligence
The range of technologies that allow computer systems to perform complex functions mirroring the workings of the human mind. Gathering and structuring knowledge, problem solving, and processing natural language are activities possible by an artificially intelligent system.

Asynchronous Training/Learning
A learning program that does not require the student and instruction to participate at the same time. Learning in which interaction between instructors and students occurs intermittently with a time delay. Examples are self-paced courses taken via the Internet or CD-ROM, Q&A mentoring, online discussion groups, and e-mail.

Authoring System or Authoring Tool
A program, like Macromedia Authorware, designed for use by a non-computer expert to create training products. An authoring system does not require programming knowledge or skill and can be used by non-programmers to create e-learning programs usually via a book or flowchart metaphor.

Computer-aided Instruction (CAI)
The use of a computer as a medium of instruction for tutorial, drill and practice, simulation, or games. CAI typically does not require that the computer be connected to a network or provide links to learning resources outside of the learning application.

Computer-based Training/Learning/Education (CBT, CBL, CBE)
An umbrella term for the use of computers in both instruction and management of the teaching and learning process. CAI (computer-assisted instruction) and CMI (computer-managed instruction) are included under the heading of CBT. Sometimes the terms CBT and CAI are used interchangeably.

Computer-managed Instruction
The use of computer technology to oversee the learning process, particularly the scheduling, testing, and record keeping aspects of a set of courses or training programs.

Delivery Method
Any method of transferring content to learners, including instructor-led training, Web-based training, CD-ROM, books, teleconferencing, and more.
Design
The second step in the classic ADDIE model of instructional systems design. The design phase builds on the analysis information and includes the formulation of a detailed plan for the development, implementation, and evaluation of the learning product or program.

Designer
Technically refers to an instructional designer, but is often used to describe any member of an e-learning or training project team, usually referring to creators such as writers, graphic artists, and programmers. Sometimes used synonymously with the term developer.

Developer
Used to describe a member of an e-learning or training project team who is involved in development activities or the project team as whole. Could refer to an instructional designer, programmer, graphic designer, technical writer, or project manager.

Development
The third phase in the classic ADDIE model of instructional systems design. In the development phase the project team creates the e-learning or instructional assets and programs the application according to the plans devised during the design phase.

Distance Education/Learning
Distance learning is defined as an education process in which the majority of the instruction occurs when student and instructor are not in the same place. Distance learning may employ correspondence study, or audio, video, or computer technologies. Most distance learning programs include a computer-based training (CBT) system and communications tools to produce a virtual classroom. Generally students communicate with faculty and other students via e-mail, electronic forums, videoconferencing, chat rooms, bulletin boards, instant messaging and other forms of computer-based communication.
e-learning

E-learning is delivered via a network, using standard and accepted Internet technologies, and expands the notion of learning solutions beyond typical training models to include new learning concepts such as performance support tools and knowledge management.

E-learning includes learning, but also encompasses other performance enhancing functions such as information support and coaching, knowledge management, interaction and collaboration, and guidance and tracking.

Electronic Performance Support System (EPSS)

An information technology that gives users integrated and immediate access to information, guidance, coaching, training, and other electronic resources necessary for the completion of a job task at the time of need to enable competent job performance with minimal support and intervention by others.

Enabling Objective

A statement in behavioral terms of what is expected of the student in demonstrating mastery at the knowledge and skill level necessary for achievement of a terminal learning objective or another enabling objective.

End User

The person for whom a particular technology is designer; the individual who uses the technology for its designated purpose. In e-learning, the end user is usually the student.

Evaluation

The final step in the classic ADDIE model of instructional systems design. A systematic method for gathering information about the impact and effectiveness of a learning program. Results of the measurements can be used to improve the program, determine whether the learning objectives have been achieved, and assess the value of the offering to the organization.

Expert System

An artificial intelligence application containing a domain-specific knowledge base which provides decision support based upon the collected knowledge of a group of experts.

Flowchart

A graphic representation of a program in which symbols represent logical steps and flowlines define the sequence of those steps. Used to design new programs, and to document existing programs. Flowcharts can also be used to represent a work or manufacturing process, organization chart, or similar formalized structure.

Formative Evaluation

Evaluation performed any time during the instructional design process that is intended to provide the project team with information about a program’s quality and will be used to make revision and improvements prior to a program’s release.
Graphic User Interface (GUI)
A way of representing the functions, features capabilities, and content of a computer program by way of visual elements such as icons and menus.

Heuristic
Relating to solving problems by experience rather than theory. A common sense rule (or set of rules) intended to increase the probability of solving some problem.

Human Computer Interaction (HCI)
The study of how people interact with computers and to what extent computers are or are not developed for successful interaction with people.

Hypermedia
Applications or electronic documents that contain dynamic links to other media such as audio, video, or graphics files.

Hypertext
A computer-based text retrieval system that enables a user to access particular locations in WebPages or other electronic documents by clicking on links within specific WebPages or documents. At its most sophisticated level, hypertext is a software environment for collaborative work, communication, and knowledge acquisition.

Implementation
The fourth step in the classic ADDIE model of instructional systems design. The implementation phase involves the delivery of the training to the intended audience and the use by that audience.

Instructional Designer
An individual who applies a systematic methodology based on instructional or learning theory to create content for learning.

Instructional Systems Design (ISD)
The systematic use of principles of instruction to ensure that learners acquire the skills, knowledge, and performance essential for successful completion of their jobs or tasks.

Instructor Led Training (ILT)
Usually refers to traditional classroom training, in which an instructor teaches a course to a room of learners. Also known as on-site training and classroom training.

Interactive Multimedia
An application involving substantial user input or control and presenting at least two of the following: text, graphics, sound, image, video, and animation. Applications can be in the areas of education, entertainment, information and publishing, and transactions.

Interactivity
A computer program feature that requires a user to do something to control the application.
Internet-based Training

Training delivered primarily by TCP/IP network technologies such as e-mail, newsgroups, propriety applications, and so forth. Although the term is sometimes used synonymously with Web-based training, Internet-based training is not necessarily delivered over the World Wide Web, and does not necessarily use HTTP and HTML technologies that make Web-based training possible.

Job Aid

Any simple tool that helps a worker do his or her job. Job aids generally provide quick reference information rather than in-depth training.

Knowledge Engineering

Knowledge engineering is the art and science that goes into creating computer systems that are able to emulate the behavior of human experts with particular domains of knowledge.

Knowledge Management (KM)

The process of capturing, organizing, and storing information and experiences of workers and groups within an organization and making it available to others. By collecting those artifacts in a central or distributed electronic environment, often in a database called a knowledge base or knowledge repository, knowledge management attempts to help an organization gain a competitive advantage.

Learning Management System (LMS)

Software that automates the administration of training. The LMS registers users, tracks courses in a catalog, records data from learners, and provides reports to management. An LMS is typically designed to handle course by multiple publishers and providers. It usually does not include any authoring capabilities; instead, it focuses on managing courses created by other sources.

Learning Objective

A statement establishing a measurable behavioral outcome, used as an advanced organizer to indicate how the learner’s acquisition of skills and knowledge is being measured or as a design engineering methodology to define learning requirements.

M-Learning

Learning that takes place via such wireless devices as cell phones, personal digital assistants (PDAs), or laptop computers. (M for mobile.)

Multimedia

Encompasses interactive text, images, sound, and color. Multimedia can be anything from a simple PowerPoint slide show to a complex interactive simulation.

Online Learning

Usually learning delivered by Web-based or Internet-based technologies. See Web-based Training and Internet-based training.
The term online learning is often used to define any one of a variety of educational delivery formats. Usually online learning is primarily characterized as an asynchronous learning network in which participants are geographically distributed and communicate asynchronously via Internet technologies such as e-mail, discussion groups, and Web pages.

Sometimes online learning means distance learning, where the students and the instructor are physically located in different locations. At other times, online learning can mean that individually students interact with a computer-based training program which presents content, provides reinforcement and feedback, and maintains students’ scores. Sometimes, online learning includes the transmission of live video and audio with an instructor conducting class from a TV studio and students attending at remote mini-stations.

**Performance**

The accomplishment of a task in accordance with a set standard of completeness and accuracy.

**Performance Engineering**

A process and methodology for building performance-centered information and knowledge-based systems, electronic performance support systems or knowledge management systems.

**Performance Objective**

The performance capability the user should acquire by completing a given training course or by using an e-learning application.

**Pilot Test**

A version of the training or e-learning project that is delivered to a subset of the target audience, usually in a controlled environment, for an evaluation of its effectiveness. Also referred to as a Validation.

**Prototype**

A working model created to demonstrate crucial aspects of a program without creating a fully detailed and functional version. Prototypes generally are ‘look and feel’ prototypes which demonstrate an application’s visual appearance or functional prototypes which demonstrate an applications’ technical capabilities.

**Self-paced Instruction/Learning**

A learning or training program in which the learner determines the pace and timing of the content delivery, generally without the guidance of an instructor.

**Sharable Content Object Reference Model (SCORM)**

A set of specifications, that when applied to electronic course content, produces small, reusable learning objects. A result of the Department of Defense’s Advanced Distributed Learning (ADL) initiative, SCORM-compliant courseware elements can be easily merged with other compliant elements to produce a highly modular repository of training materials.

**Simulation**

Highly interactive applications that allow the learner to model or role-play in a scenario. Simulations enable the learner to practice skills or behaviors in a risk-free environment.
Storyboard
An outline of a multimedia project in which each page represents a screen to be designed and developed.

Subject Matter Expert (SME)
An individual who is recognized as proficient in a particular area, topic, or discipline.

Subordinate Objective
A task or objective that must first be mastered in order to complete a higher level or terminal objective.

Summative Evaluation
An evaluation performed after the training program has been implemented in order to measure the efficacy and return-on-investment of the project.

Synchronous Training/Learning
A real-time, instructor-led online learning event in which all participants are logged on at the same time and communicate directly with each other. In this virtual classroom setting, the instructor maintains control of the class, with the ability to ‘call on’ participants. In some platforms, students and teachers can use an electronic shared whiteboard to see work in progress and share knowledge. Interaction may occur via audio or video conferencing, Internet telephony or chat rooms, or two-way live video broadcasts.

Target Population
The audience for whom a particular training program or course of instruction is intended.

Task Analysis
The process of examining a given job or task in order to defined the discrete steps that must be executed in order to ensure effective and efficient performance of the job or task.

Technology-based Learning/Training (TBL/TBT)
The term encompassing all uses of a computer in support of training including but not limited to tutorials, simulations, collaborative learning environments, and performance support tools. Synonyms include computer-based learning, computer-based education, e-learning, and any number of variations.

Terminal Learning Objective
A learning objective that the student should be able to accomplish after completing a training program.

Usability
The measure of how effectively, efficiently, and easily a user can navigate an interface, find information, and operate a device, especially a computer application, to achieve their goals.

User Interface
The components of a computer system employed by a user to communicate and control the computer.
Validation

The accomplishment of a task in accordance with a set standard of completeness and accuracy. Also, a process through which a course is administered and revised until learners effectively attain the base line objectives.

Web-based Training (WBT)

Delivery of educational content via a Web browser over the public Internet, a private Internet, or an extranet. Web-based training often provides links to other learning resources such as references, e-mail, bulletin boards, and discussion groups. WBT may also include a facilitator or instructor who provides course guidelines, manages discussion boards, and delivers lectures.
Reference List


Stone, D. & Villachia, S. (2003). And then a miracle occurs! Ensuring the successful implementation of enterprise EPSS and e-learning from day one. *Performance Improvement* (42) 1, 42-51.


