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Reducing Learning Object Inspection/Evaluation Costs in Instructional Design

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REDUCING LEARNING OBJECT INSPECTION/EVALUATION COSTS IN INSTRUCTIONAL DESIGN

by

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GRADUATE COMMITTEE APPROVAL

of a dissertation submitted by

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This dissertation has been read by each member of the following graduate committee and by a majority vote has been found to be satisfactory.

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BRIGHAM YOUNG UNIVERSITY

As chair of the candidate's graduate committee, I have read the dissertation of Larry L. Seawright in its final form and have found that (1) its format, citations, and bibliographical style are consistent and acceptable and fulfill university and department style requirements; (2) its illustrative materials including figures, tables, and charts are in place; and (3) the final manuscript is satisfactory to the graduate committee and is ready for submission to the university library.

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ABSTRACT

REDUCING LEARNING OBJECT INSPECTION/EVALUATION COSTS

IN INSTRUCTIONAL DESIGN

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Doctor of Philosophy

A widely employed instructional design approach, the ADDIE (Analysis, Design, Development, Implementation, Evaluation) model, has been one of the most popular and well documented instructional design models (Wilson, Jonassen, and Cole, 1993) for decades. Despite its widespread use, Thiagarajan, a leading instructional technologist, asserts that ADDIE, as an instructional design approach, is comparable to an outdated 1950's manufacturing model (Zemke, 2002). Since the 1950's, manufacturing has evolved, focusing initially on reducing inspection or evaluation costs and later on shifting these cost improvements throughout the organization. Just as manufacturing models and their application have evolved, service operations models such as instructional design models and especially their application are evolving. This dissertation reviews these changes in manufacturing models and associated service operations models in order to

examine how these changes have informed instructional design models such as ADDIE and their usage in practice by those attempting to design conditions for learning and to create associated learning objects.

In order to better understand how this shift may be applied to both theory and practice in instructional design, this dissertation uses an exploratory case study methodology to examine best practices in the inspection/evaluation process employed during the development of courses. This methodology reflects procedures used in a major study (Institute for Higher Education Policy, 2000). They followed a three-step process, which included a comprehensive literature review, the identification of subjects that "have substantial experience and are providing leadership in distance education." (p.9), and surveying leaders.

In similar fashion, during the first phase of the study reported in this research, quality management and instructional design literature is reviewed. In the second phase, the case study subject, the Center for Instructional Design at a major university is selected. In the third phase, instructional design practices used at the Center were studied and areas for reducing inspection/evaluation costs were identified.

Principles and methods surmised from the literature reviews and the case study research are presented along with application examples from the case study. These principles and methods illustrate how ADDIE has evolved and continues to be a viable model for the creation of instruction.

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Chapter One: Introduction and Problem Identification

One of the most widely employed instructional design approaches is the ADDIE (Analysis, Design, Development, Implementation, Evaluation) model. For decades it has been one of the most popular and well documented instructional design models (Wilson, Jonassen, and Cole, 1993). Despite its widespread use, Thiagarajan, a leading instructional technologist, asserts that ADDIE, as an instructional design model, is comparable to an outdated 1950's manufacturing model (Zemke, 2002).

Problem Identification

Since the 1950s, manufacturing models have evolved, focusing initially on reducing inspection costs and later on shifting such cost improvements throughout the organization. Just as manufacturing models and their application have evolved, services operations models such as instructional design models and especially their application are evolving. The problem dealt with in this dissertation reviews these changes in manufacturing models and associated service operations models in order to examine how these changes have informed instructional design models such as ADDIE and their usage in practice by those seeking to design learning and to create learning objects.

Research Purpose

My research purpose is to examine literature in the field of manufacturing and services quality as well as the field of instructional design relating to ADDIE, surmise how models in each field may have evolved, and then to examine the practices of a major instructional design organization that uses ADDIE to develop instruction. With this

research done, evidence of the current state of the ADDIE model can be postulated and tentative conclusions about ADDIE's status as a model are suggested, examining and importing best practices from the case study organization to see which, if any, of the theory, methods, and practices of an evolved ADDIE model are being used. Additionally, other best practices and methods identified in use by the case study organization but not previously identified during the literature review can be added to the reconceptualization of the ADDIE model. Learning objects and their definition are discussed in the context of ADDIE as well.

To some readers of this research, it may seem as if the research purpose is to tell instructional designers to be more like manufacturers, hearkening back to a factory model of teaching. However, as Schwandt (1997) has been arguing, this researcher acknowledges that teaching, instructional design, and especially evaluation (or inspection, to use the business term) are human endeavors that involve art as well as science-like choices to be made. This analogy with manufacturing isn't meant to exclude those ways of seeing the process but to build on them. Instructional designers and other educators are invited to make use of the principles presented if they will help them to make the human choices that are needed and that manufacturing rule-based decision trees and automated systems can not make.

This research itself begins with a human choice, in that a thorough examination of all aspects of the ADDIE model would be too large an undertaking for a dissertation. Therefore, an incremental approach in examining the ADDIE model will be pursued. A component of the ADDIE model provides for use of evaluation throughout the model

(Tracey, Flynn3, and Legere, 1966, Clark, 1998, and Dick and Carey, 1985). A focus on the evaluation component of the ADDIE model would be one possible incremental approach. A factor favoring focus on the evaluation component of the model is that evaluation, whether in education or training, is expensive. An illumination of theory, methods, and practices from another field with the intent to better understand this evaluation component of instructional design use of ADDIE combined with an examination of some current ADDIE practices surrounding evaluation, may result in more cost effective design processes for other instructional design users of the ADDIE model.

Chapter Two: Literature Review

This review of literature takes a two-pronged approach as suggested by the research purpose. A review of literature on instructional design usage of ADDIE highlights the current status of the ADDIE model as well as providing a definition of instructional design quality. A quality management literature review examines a shift in the historical cost of quality model first identified by manufacturers in Japan, illustrating how a 1950's manufacturing model has evolved. This quality management literature review is extended to include service operations quality management literature because services operations closely resemble the processes employed by instructional design users of the ADDIE model. Finally, these literature reviews will be couched, where possible, in terms of Internet-based operations or products, as the case study examines courses and instructional products developed for Internet-based use. As both prongs of the literature deal with quality, a brief review of various definitions of quality is needed.

Definitions of Quality

First I'll consider quality definitions from manufacturing, then from services, and finally from instructional design.

Manufacturing.

There are numerous conflicting definitions for product quality in the literature. To illustrate this variety in definitions, Garvin (1988) identified five major areas of quality definitions reported in the literature:

1. transcendent or perceived,
2. manufacturing-based or conformance to design specifications,

3. product-based or results based,
4. user-based or amount of customer satisfaction, and
5. value-based, combining user-based satisfaction with price considerations.

These various areas of quality definitions show the kinds of approaches that can be taken to assess quality. Garvin concludes that the best competitive advantage can be gained by focusing on the quality dimension that best fills the customer needs.

Services.

In defining quality associated with services, the assessment of quality is made during the service delivery process (Fitzsimmons, 2000). The dimensions of measuring this service quality are reliability, responsiveness, assurance, empathy, and tangibles. Reliability is the ability to perform the promised service both dependably and accurately. Responsiveness is the willingness to help customers and to provide prompt service. Assurance is derived by the knowledge and courtesy of employees as well as their ability to convey trust and confidence. Empathy is the provision of caring, individualized attention to customers while tangibles are represented by the appearance of physical facilities, equipment, personnel, and communication materials. Customers use these five dimensions to form their judgments of service quality, based on the gap between expected and perceived service.

This services quality gap is viewed from five perspectives: content, process, structure, outcome, and impact. Content refers to establishment of and the adherence to standard procedures while process asks if these procedures are sequentially appropriate. Structure deals with the physical facilities as well as the organizational design and their

adequacy to address service needs. The outcome measures the change in status as a result of the service, asking if the customer is satisfied. Impact of the service is the long-range effect of the service on the customer, including a measure of the accessibility of the service. Fitzsimmons cites an example of accessibility in the United States education system, where the US literacy rate lags behind many other countries, including several Third World countries (p. 52).

Instructional Design.

Quality in instructional design usage of the ADDIE model relies on the use of formative evaluation to improve learner performance (Gagné, Briggs, and Wager, 1992). This definition of quality as an improvement in learner performance is often difficult to measure and is subject to a number of environmental variables, such as learner motivation, the learner's opportunity to spend the needed time, etc.

Another measure of quality in a design model such as ADDIE is the degree to which the methods, processes, and practices associated with the model are better than other known methods, processes, and practices for attaining the desire outcome (Reigeluth and Frick, 1999). The procedure used to determine what is 'better' cannot be stated with certainty however, since standards of quality vary for different users and varying situations (Patton, 1997). Patton also asserts that the definition of quality is not meeting some absolute standard but, rather, making sure that methods and measures are appropriate to the validity and credibility needs of a particular evaluation purpose and for specific intended users.

A firm quality definition for instructional design implementations of ADDIE is undermined by the uncertainty identified by Reigeluth and Frick's 'better' and by Patton's 'making sure that methods and measures are appropriate.' However, Osguthorpe, Osguthorpe, Jacob, and Davies (2003) assert that application of reflexive judgment or relying on more than just performance data alone on the part of instructional designers will aid in determining what is appropriate and better. This reflexive judgment calls for a reflection on the more subtle moral effects of design decisions; decisions that will likely have more far reaching effects when based on this moral reflection than decisions based on performance data alone. A quality definition for instruction produced using the ADDIE model then must be situational and based on the values of the stakeholders of those using or producing the instruction or learning object.

Increasingly, one of the situated learning environments ADDIE users develop instruction for is technology-based and often Internet or Web-based. The American Society for Training and Development (ASTD), one of two major training and education industry groups, joined in 2000 with the National Governors Association to form a commission to define and encourage a technology-enabled environment. The Commission on Technology and Adult Learning issued "A Vision of E-Learning for American's Workforce," that produced five recommendations to ensure quality in Internet-based education and training (Commission on Technology and Adult Learning, 2001).

Under-girding these recommendations was a definition of e-learning as an experience that "provides just the right content at just the right time, helps learners master

needed knowledge and skills, and draws people in so they are motivated to learn and apply their learning to improve individual and organizational performance" (p. 18). Evaluating whether people have learned by observing improvement in either individual or organizational performance, known as Kirkpatrick Evaluation Level 4 (Kirkpatrick, 1959), is problematic at best, due to many confounding factors that usually accompany such observations. Nevertheless, this definition of quality in Internet-based distance education elevates the learner since the learner by process definition, should be critically involved in the quality course development process.

Learning Object.

Various definitions of the term "learning object" exist. The Digital Library Network for Engineering and Technology at Virginia Tech defines learning object as "a structured, standalone resource that encapsulates high quality information in a manner that facilitates learning and pedagogy" (DLNET, 2003). For purposes of this research, this definition is sufficient in that instruction developed using the ADDIE model is generally self-contained information of some form created with the intention of facilitating learning. The term "learning object" does not refer to people as the object of learning, including teachers as an object.

With these definitions of quality from manufacturing, services, and instructional design in mind, an examination of literature from these fields is presented.

ADDIE Model Theory Considerations

ADDIE model theory traditionally provides for cyclical evaluation throughout the model process (Figure 1). However, usage in practice sometimes proceeds in a linear manner once the needs and goals are identified, often due to the enormous cost of "cycling back" to previously completed phases (Wilson, Jonassen, and Cole, 1993).

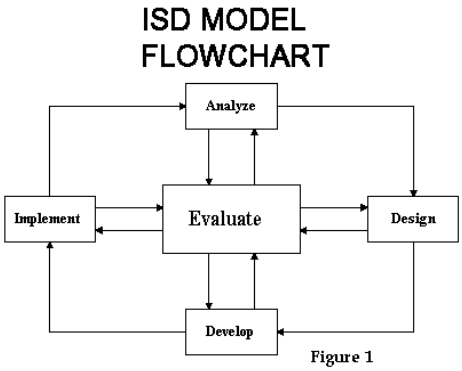


Figure 1. Typical Instructional Design Model

Quality management literature discusses this same issue in the dilemma of increasing inspection costs expended in order to increase quality while simultaneously not increasing the cost of the product. In quality management, significant measures have been undertaken to *change* the cost curve as a way to overcome this inspection cost dilemma of increasing quality via inspection without increasing costs. Industries such as automobile and software manufacturing employ methods and practices that result in these changed cost curves. These industries essentially employ the basic steps of the ADDIE model in the development of their products.

A review of educational literature focusing on current theory, methods, and practices implementing the ADDIE model is conducted. A review of quality management literature reports on theory, methods, and practices used to both reduce inspection costs

(that in the instructional design usage of the ADDIE model are evaluation costs) while simultaneously increasing product quality. The literature review shows that a major portion of this reduction in inspection costs is accomplished by changing the purpose of inspection from detection of errors to prevention of errors.

The term ADDIE (**A**nalysis, **D**esign, **D**evelopment, **I**mplementation, **E**valuation) appears to arise from a synthesis of the systems approach models for designing instruction developed by Dick and Carey (1990) and Gagné and Briggs (Gagné, Briggs, and Wager, (1992)). The instructional systems design (ISD) approach epitomized by the Dick and Carey model employs nine stages. However, many practitioners actively developing instruction use an abbreviated model known as the ADDIE model (Rosenberg, et al., 1999). The five step ADDIE process model is widely used in business and industry as well as in training and education, where ADDIE comprises six (two A's being presented instead of one, namely, Assessment or evaluation of the need and Analysis of the performance limiting factors) of the ten performance improvement standards of the International Society for Performance Improvement (ISPI), one of two large professional instructional technology organizations (ISPI, 2002).

The 'A' of ADDIE (Analysis) traditionally includes analysis of instructional goals and some sort of task, procedural, or information-processing analysis (Gagné, Briggs, and Wager, 1992). The analysis of instructional goals usually occurs with at least some of the stakeholders. As implemented by many instructional designers, the person or entity funding the development of the course is frequently the sole stakeholder employed as a source for feedback on quality of the instruction (Benjamin and Levinson, 1993). Were

additional primary stakeholders, such as learners, as well as this funding stakeholder included throughout the instructional design process, the resulting course design would be much more user-focused (Patton, 1997) and accordingly, more useful for learning.

The next phase of ADDIE, design, includes instructional analysis, audience analysis, and the development of performance objectives and assessment items. Some implementations of ADDIE also include the development of educational goals in the design phase rather than the analysis phase (Hannum, 2001). During the design phase, information discovered during the analysis phase is developed into a plan for the creation of the learning object. This plan guides subsequent ADDIE efforts to ensure that all education and training links back to the instructional goals identified during the analysis phase. This linkage back to the analysis phase is depicted in the model as part of the

Figure 2. Model Enlarged

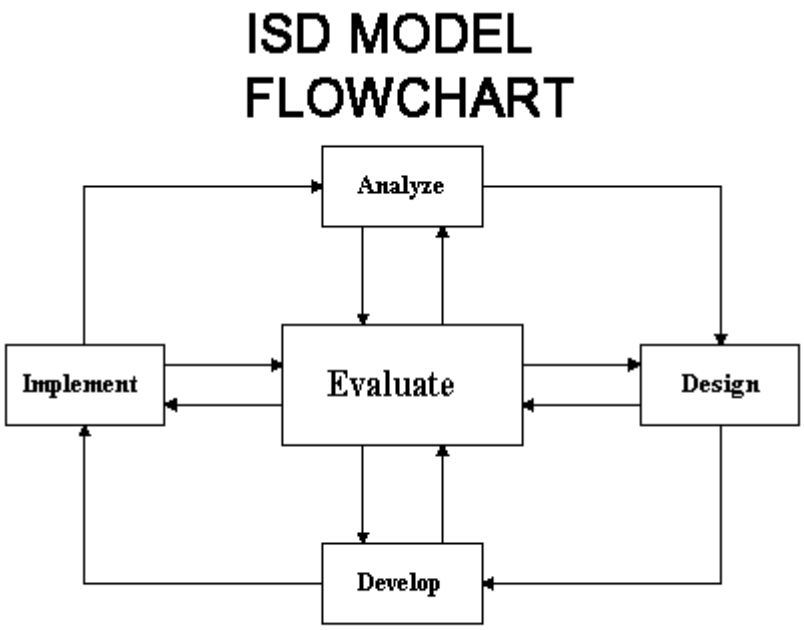


Figure 2

evaluation cycle that persists throughout all the phases, as indicated in Figure 2.

With the basic plan in place, the next phase of the ADDIE model, development, is begun. During this phase, the instructional strategy is developed with instructional conditions and events being specified, methods and media being selected, the actual learning object being designed, often in the form of a prototype. This prototype, or working model, is then formatively evaluated, with the feedback being integrated into the ongoing development process (Lisle, 1997). The result of the development phase is the fully functional learning object. In the situation of the case study subject, this learning object is often an Internet-based distance education course or a lesson within that course.

The implementation phase decisions and associated issues are interwoven within the analysis design decisions made during analysis, design, and development phases of the ADDIE model when the resulting course is destined for Internet-based delivery. The first implementation issue to be considered is the cost issue associated with selection of media used in the Internet-based course. Most educational institutions and businesses are faced with decreasing funds available for training and education while at the same time faced with increased costs associated with meeting the challenges of responding to competition's use of the latest technology in delivering their training and education.

Another significant implementation issue is the timeframe for rollout of the course. This timeframe is generally not the result of the development plan or even of the overall project management plan but usually is determined by such development-independent criteria as the start of the semester, the publication of the next catalog, or the introduction of a new product. Other design decisions are also critically impacted by

implementation plans. Among these are the hardware limitations imposed by the rollout platform, bandwidth limitations imposed by the distribution network, and software limitations imposed by the target learner's system environment (Gibbons and Fairweather, 1998). As these analysis, design, and development decisions are made, they dictate the actualities of the implementation plan. When the instruction is scheduled for availability via the Internet (or Intranet), support structures are put into place to provide help to learners as well as instructors. Additionally, provisions are made for the formative and summative evaluation of the instructional product.

The final phase of the ADDIE model is evaluation. In addition to the cyclic iterations of formative evaluation indicated in the model process definition, formal plans for summative evaluation are developed and implemented during this evaluation phase. Formative evaluation typically includes at a minimum, Level 1 evaluation (Kirkpatrick, 1959) with provisions made in the ADDIE model to revisit any phase of the model that is identified as needing improvement. Level 1 evaluation, assessing the reaction of learners to the instruction, is generally done at the conclusion of the instructional experience. This reaction is often gauged by participant completion of an opinion survey about what they liked and didn't like about the education or training. This sheet is commonly referred to as a "happy" sheet because it may show if a participant is happy with the education or training. Level 2 evaluation assesses the amount of instruction that was learned while Levels 3 and 4 measure the amount of learning that is applied on the job and the impact the learning has on the performance results of the organization.

Summative evaluations can occur at the end of final course testing, and at the completion of each offering of the course. Summative evaluations provide feedback on needed improvements in the course and provide information on the overall quality. When evaluation is implemented according to the ADDIE model with iterative formative and conclusive summative strategies, the resulting course should require little reworking and should adequately target the primary goals of instruction.

Current ADDIE evaluation practices employed in developing instructional materials may result in instruction that in some degree fails to meet the needs of the learner (Williams, 2000; Carnevale and Schulz, 1990; Holcomb, 1993; McMahon and Carter, 1990; Rossi, Freeman, and Wright, 1979), decreasing the cost effectiveness and the quality of the educational solution. Technology-mediated instruction, such as Internet-based courses, result in learning interactions that are more learner-centric than traditional classroom-based instruction (Gemeinhardt, 2002), highlighting the increased importance of learner involvement early in the development process. Indeed, a study by the Institute for Higher Education found that learner engagement in the analysis, synthesis, and evaluation of course materials must be fostered to ensure course quality (IHEP, 2000).

In current practice, various metrics are used to determine whether the instruction is of high quality. Yet, typical metrics such as grade point averages and standardized test scores may only be good descriptions of the capabilities students bring with them to the course or program, informing little about the value of the course or program (Doerfel, 2002). Metrics describing such dimensions as impact, value, relevance, need,

accessibility, subject-matter competence, or motivation for lifelong learning are not widely used indicators of quality, though, Doerfel adds, few would disagree with their centrality to the academic mission of most colleges and universities.

Indeed, looking only at metrics limits evaluation's scope. Benchmarking, another practice being imported from business to assist higher educators with decision-making, offers three types of comparisons that can be made; use of the aforementioned metric comparisons, use of process comparisons, and use of diagnostic comparisons (Doerfel, 2002). To approach some definition of quality in Internet-based distance education, this research examines in greater depth the impact of process comparisons, especially those utilizing some form of quality evaluation or quality inspection.

ADDIE Model Methods and Practices

With a review of the ADDIE process completed, methods and practices employed to implement ADDIE are explored. A division of labor is a common method that results when ADDIE is employed in developing the instruction. Through this division of labor, one or several faculty members in conjunction with one or several instructional designers, one or several graphic artists, one or several target learners as "product testers", etc., may develop a particular course. Division of labor has been cited (Peters, 1988) as a main prerequisite for effective and presumably quality distance education.

When the division of labor occurs primarily within an instructional design unit, potential cross-organizational communication difficulties can be reduced and may result in more rapid development of quality instruction. Typically, however, the involvement of at least the subject-matter expert who is external to the instructional design unit is

needed. Indeed, for most university-developed Internet-based courses, the subject-matter expert or experts are usually one or more professors whose course is being developed.

Randle (1996) investigated one approach to gaining user involvement in the design of the instruction that departs from the step-by-step approach typical of ADDIE-type instructional design models. A case study employed the use of a conceptual design model that emphasized teacher/designer's beliefs in an effort to create more real-world quality in the instruction. Randle found five sets of factors hindering collaboration and fostering the more centralized approach typical of ADDIE models: ambitious project goals, unresolved project ambiguities, absence of shared beliefs, inadequate utilization of personnel resources, and management of time and budget.

Another method employed to gain additional user involvement in the development of Internet-based courses is through rapid prototyping of instructional content. Although rapid prototyping can be considered a formative model in its own right (Tripp and Bichelmeyer, 1990), in the context of the ADDIE model, it can also be considered as a method of introducing evaluation at an early stage in the process. Rapid prototyping varies from ADDIE as it formally introduces evaluation as a separate step that reoccurs just after creation or refinement of any prototype. Rapid prototyping is also more commonly employed when the development team or individual is not familiar with the subject area or with the ways learners best learn the subject. The traditional view of ADDIE is that evaluation continuously occurs throughout the duration of the model utilization. Using rapid prototyping as a method within the ADDIE model can help to actualize this traditional conceptual use of evaluation throughout the model.

In typical usage of rapid prototyping, a mockup, skeletal representation, or prototype of the learning object is produced and shown to or given to a member of the target learning group as soon as possible in the development cycle, including where possible during the analysis phase. This user evaluates the worth of the prototype, usually with or observed by someone from the development team. If the prototype satisfied the objective to be attained with the learning object, the development process continues as the prototype is refined or enhanced into a more complete object. Depending on several factors, the most constraining of which are time and money, this prototyping cycle continues until the object is implemented. This concept can produce a continuously improving instructional system if the learning object is continuously refined based on user feedback given about the object.

Checklists are employed as an additional method used within the ADDIE process (Schlegel, 1995) to improve the efficiency and effectiveness of the instruction so developed. Checklists provide a step-by-step procedural process to ensure that all necessary actions are accomplished during the development of the instruction.

Templates have long been employed to increase efficiency as part of the ADDIE course development process. During the early 1980s, companies using software such as WICAT's authoring system employed templates that made mass production of custom courses highly efficient (Brown, 1997). Software-based templates continue to be popular methods to increase the efficiency of the instructional design process, with most major software authoring systems including templates in their approach to course design.

Associated with templates is the use of style guides to standardize the placement of text, multimedia, and control functions on the display screens of Internet-based distance education courses. Style guides increase the speed of course developers by reducing the choices needed for each instructional display screen.

Regardless of the theory, method, or practice employed, its mere availability or use does not guarantee success. The various evolutions of the latest technological innovations, i.e., books, audio recordings, film, video, interactive video, CD-ROM, personal computers, Internet, etc., may be necessary but are certainly insufficient preconditions for success (Brown, 1997).

Finally, a review of instructional design literature should include a consideration of what constitutes a learning object. An illustration used to show a learner how to perform a task is a learning object. The complete description of how to perform that task is also a learning object. The entire course in which the task is but a small section of the course is also a learning object. The granularity, or relative size of a learning object can be as small as a single fact to be learned or are large as an entire instructional course (Wiley, et al., 1999). Process changes initiated to reduce inspection/evaluation costs may be undertaken with regard to any size granularity.

Quality Management Theory Considerations

The quality management literature review begins with the historical view of manufacturing operations, in which appraisal or inspection costs have been an ever-

Figure 3. Historical Cost Model

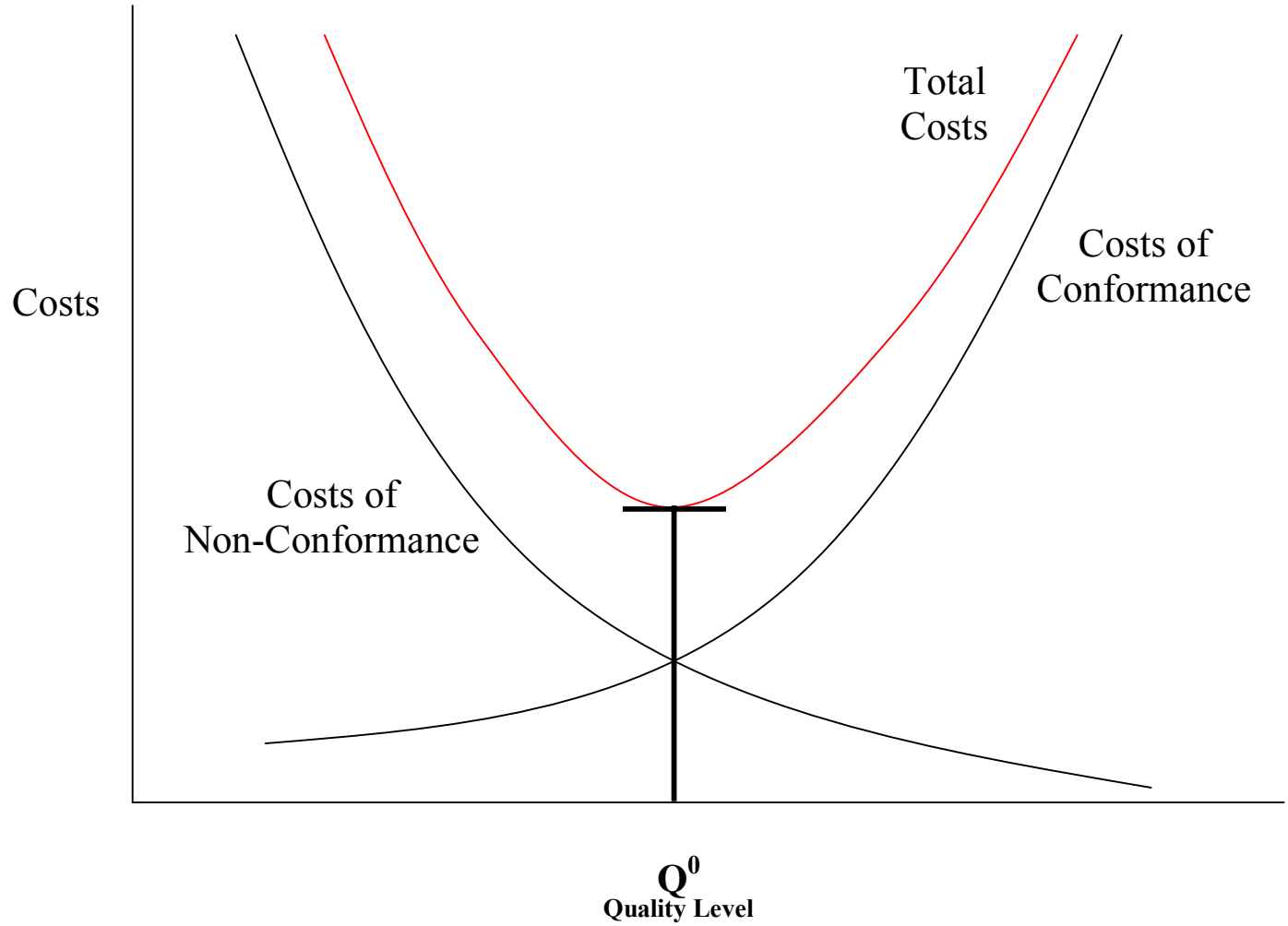


Figure 3

increasing curve (Figure 3). In this historical cost of quality model, the total cost line in the middle is the combination of the costs of conformance, consisting of prevention and appraisal costs, and the costs of non-conformance, consisting of internal and external failure costs. Costs of conformance are incurred in efforts to improve product or service quality, while non-conformance costs are those costs that result from less than perfect quality.

Costs of Conformance.

There are many methods that improve product or service conformance to requirements. These quality improvement techniques are achieved through appraisal activities or prevention procedures. Both of these classifications of quality improvement operations have costs associated with them.

Appraisal activities are based upon inspection and testing of processes, products, and environments and are performed to make a judgment concerning the quality of a product. Acceptance sampling is an appraisal application that leads to a decision on product disposition based upon quality. Another objective of appraisal is to make judgments on the control level of a process based on inspection tests of the output. Examples of this type of appraisal are measurements taken to facilitate statistical process control. This appraisal or inspection cost activity called statistical process control employs an agreed upon measure of system performance and the process of identifying and correcting deviations from that measure.

The costs that arise due to quality appraisal are generally associated with salaries of employees who perform the inspections and tests, and equipment for accomplishing the activities. These costs are incurred at any stage of the production process, from product or service design to product or service delivery and servicing.

As repetitious problems arise, finding permanent resolutions is often more cost effective than periodic problem solving. Defect prevention activities, which can range from design reviews to process operator training, are enacted to assure that specific

problems will not arise in the future. These activities will also generate costs associated from personnel salaries and equipment.

Typical graphical representations of quality costs display quality level (measured as percent conforming) along the x-axis, and cost per good unit of product on the y-axis (Juran, 1979). Figure 3 shows the relationship between quality level and cost per product for costs of conformance. At lower quality levels, the costs of conformance are low. As the quality level improves, costs of conformance increase. At the highest levels of quality the costs of conformance are extremely high because few defective products or services remain.

Failure Costs. Conformance activities generate costs required to improve product and service quality; however, significant costs also result from the failure to produce according to requirements. These costs, called costs of nonconformance (Montgomery, 1972) or failure costs (Juran, 1988), are classified into the areas of internal failure costs and external failure costs (Feigenbaum, 1956).

Internal failure costs result when a defective product or service is found prior to receipt by the customer. These costs are generated when rework is performed to correct the defect or costs are incurred if the product is scrapped. All costs associated with rework and scrap, including labor and equipment required to evaluate products and identify defects, are considered internal failure costs.

External failure costs result from product failure after customer acquisition. Some results of external failure include repair and warranty costs, complaint adjustment, lost customer goodwill, and lost current and/or future sales. At the lowest quality level, 100

percent defects, the cost per unit of good production rises to infinity because no good product is produced (Juran, 1988). As quality improves, product and service failures decrease, and failure costs decrease to virtually zero as the quality level approaches 100 percent conformance.

Total Quality Costs.

The total costs associated with quality are computed as the sum of the two components, costs of conformance and failure costs. As shown above in Figure 3, the total cost curve is a U-shaped curve with a distinct minimum point. Theoretically, the optimum quality level is at the point where costs are minimized.

Because of the marginal increases in the costs of conformance at the highest quality levels, the total cost curve rises dramatically as production nears zero defects. Edmonds, Tsay, and Lin (1994) state that "one hundred percent quality conformance is seldom desirable--it sounds good but costs too much."

Built into the historical cost of quality model are several assumptions about the costs of quality and the choice and application of quality management techniques. An examination of these assumptions will assist in understanding appropriate, cost effective approaches to zero-defect production.

Costs of Conformance.

The total costs of conformance are assumed to rise sharply at the highest quality levels (see Figure 3). This rise is due to the view that increasing marginal appraisal costs are associated with finding and correcting relatively small problems, which contribute minimally to increased failure costs (Ebrahimpour, 1985). As such, significant increases

in inspection and inspections costs are needed to detect small numbers of defective outputs. This emphasis on appraisal has encouraged the belief that costs of conformance must escalate at the highest quality levels.

Another assumption concerns the costs for defect prevention. A process may be said to be in control once managers decide that the operation produces consistent output. Once a process is in control, often the next objective is reduction in variation. Process automation is a common method for achieving this goal. The reduction in variation alone is not likely to reduce failure costs adequately to justify the cost of automation (Edmonds, Tsay, & Lin, 1994). However, there may be other advantages to automation, including increasing the ability to meet or exceed customer service expectations and controlling the customer interaction by use of customer usage of standard procedures.

Costs of Non-Conformance.

Rework and scrap are generally considered the primary internal failure costs and are relatively simple to measure (Feigenbaum, 1961). Other relevant internal failure costs, which are less apparent, may tend to be ignored. The increases in inventory carrying costs and overhead needed to support the volume of rework and scrap are usually not considered. Losses due to declining employee morale and the resulting productivity losses are impossible to quantify, but may contribute significantly to costs resulting from internal failure. External failure costs are the most difficult to identify and measure; however, the difficulty in evaluating these costs does not diminish their importance. They may make up the greatest proportion of failure costs in many firms; unfortunately, this fact may elude detection because external failure costs are often

severely underestimated. Taguchi (1990) discusses the portion of these external failure costs that are societal costs of failure. Most businesses are concerned about the costs they must incur and should have a realization of the impact of societal costs due to low quality outputs as an important macro-economic consideration.

The most easily measured external failure costs are those out-of-pocket costs incurred to repair products after they have left the plant. However, underestimates of overhead costs required to support such repairs are often overlooked and contribute to hidden failure costs.

Opportunity costs resulting from lost sales may be the largest component of external failure costs. If the quality level of goods and services produced by competitors continues to surpass that of the firm under consideration, then long-term lost sales may become a dominant external failure cost.

Revisions to the Historical Quality Inspection Cost View

The assumptions underlying the historical view of cost of quality have an impact on managerial decision-making. United States dependence on the old model of quality costs (Figure 3) caused the US to fall behind Japan in the production of high quality goods (Seawright, 1995). US producers worked under the assumption that appraisal and other failure prevention costs increased in a steady linear manner as quality steadily rose. Much was written during the 1980's and 1990's trying to understand the Japanese manufacturing miracle (Dertouzos, Lester, and Solow, 1989, Dobyns, and Crawford-Mason, 1991, Ebrahimpour, 1985, Garvin, 1986 and 1988, Ishikawa, 1984, Ishikawa and Lu, 1985, Sasaki and Hutchins, 1984, Stewart, 1992, Taylor, 1992), yet several US producers incorrectly

applied those lessons. They attempted to improve quality by increasing appraisal or inspection costs, generally via the post-production inspection process.

Erroneous actions based on the assumptions discussed may continue to negatively impact management decision-making and the long-term survivability of any organization. The following discussion presents modifications of the cost of quality model and examines the impact on the cost of quality curves, which will change management decisions.

Costs of Conformance.

Historically, the assumption that marginal costs of conformance increase rapidly at high quality levels has been a major deterrent to the pursuit of product perfection. Managers can eliminate this problem by decreasing marginal costs at levels of improved quality by shifting the focus of appraisal activities to one of control (Shingo, 1986). An example of a packing materials manufacturer is cited, in which increased focus on appraisal activities resulted in an increase in overall defects since even suspect materials were being prematurely rejected from further processing. A shift in focus to one of controlling the process by realigning the inspection process to become part of the work flow allowed errors to be immediately detected and the cause of the defect to be immediately corrected then resulted in a vast decrease in overall defects. Appraisal activities will still be necessary to insure that such prevention methods are operating as planned. This is a shift from the historical focus of appraisal activities that provide information used to control the manufacturing process to a new focus on providing information used to control defect prevention activities.

Costs of Non-Conformance.

Prevention costs are historically represented by a linear function, which assumes equal marginal costs at all quality levels. This shifted curve suggests that an increased

emphasis on early defect prevention activities should decrease the extreme marginal costs that occur as quality is improved. When one also considers the impact of hidden failure costs that result from managerial decisions to allow defects to be produced, shifting the curve becomes even more imperative.

The impact of competition on long-term external failure costs also must be acknowledged even though these important failure costs are likely to be the most difficult to measure. Yet, an implicit understanding that these costs rise sharply will at least provide an estimate of the total cost curve.

These efforts to alter the focus of appraisal activities early in the development process make the historic quality cost curve (Figure 3) obsolete. This is primarily accomplished with the introduction of quality control measures that both increase quality and reduce costs. Manufacturing examples of appraisal (inspection) that results in defect prevention are well known in manufacturing circles and include poka-yoke (mistake-proofing) devices and processes (Shingo, 1986). Figure 4 shows that Q^1 is shifted to the right of Q^0 (the optimum quality level from Figure 3) with both higher quality (quality

Figure 4. Revised Quality Cost Model

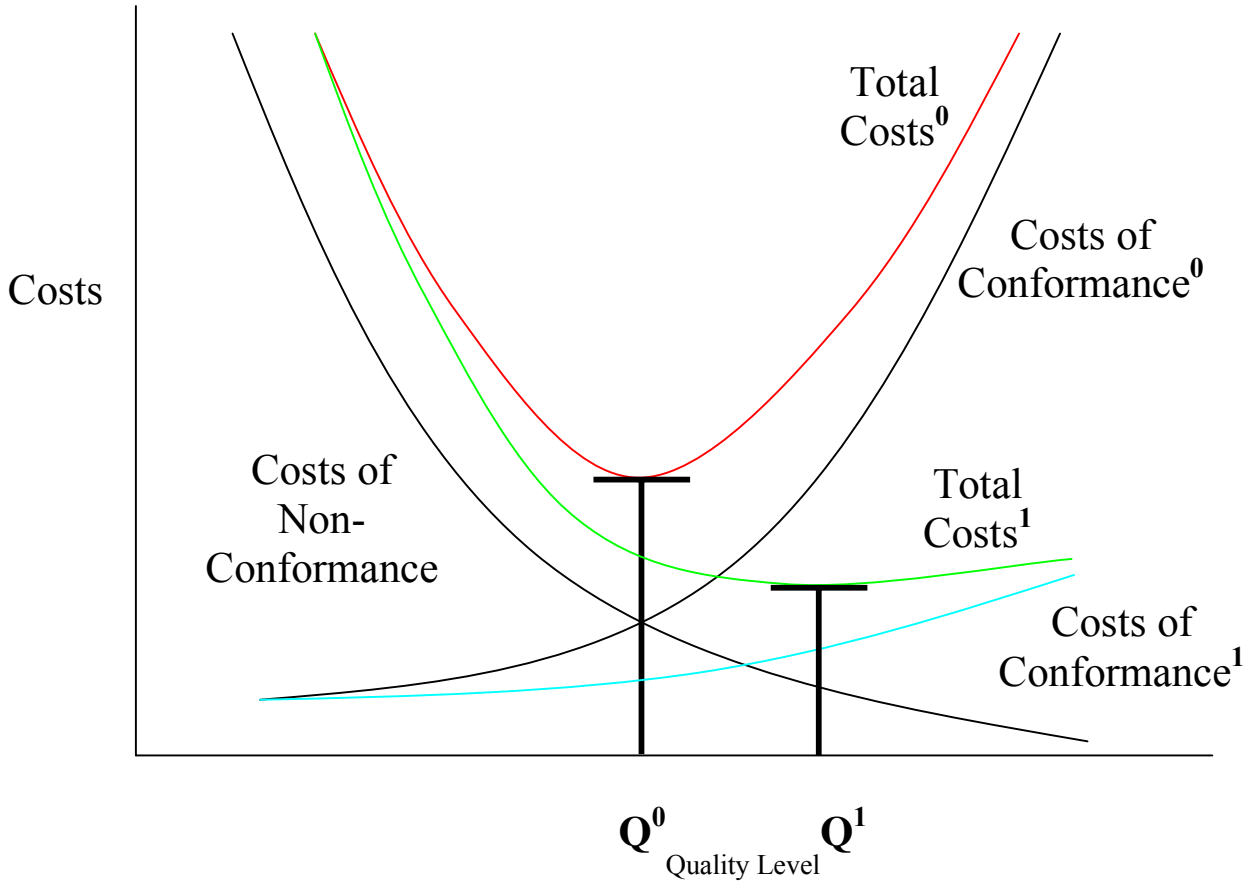


Figure 4

shifted to the right) and lower costs (costs shifted down) as the Costs of Conformance curve is shifted by the introduction of error prevention processes, techniques and devices.

Kume (1985) added that one important lesson can be extracted from a quality management cost discussion, indicating that quality costs are not the only costs of a product. Elements of this lesson include:

- Minimum quality cost does not necessarily mean maximum profit.
- Minimum quality cost does not necessarily mean minimum product cost.

- Losses due to failure cannot be calculated only by failure cost—this includes a critical invisible loss—the loss of market share.
- The cost of marketing research should be included in prevention cost.
- Quality of design cannot be evaluated only by quality cost.
- The important thing about prevention and appraisal cost is not the total, but the way the money is used.

Quality Management Methods and Practices

As previously mentioned, a well known method from quality management literature for shifting the quality cost curve is the poka-yoke or mistake-proofing concept introduced by Shigeo Shingo (Shingo, 1986). Shingo "…gave the name poka-yoke (mistake-proofing) to these devices because they serve to prevent (or "proof;" in Japanese, yoke) the sort of inadvertent mistakes (poka in Japanese) that anyone can make" (p.45). "A poka-yoke system possesses two functions: it can carry out 100 percent inspections and, if abnormalities occur, it can carry out immediate feedback and action. The effects of poka-yoke methods in reducing defects will differ depending on the inspection systems with which they are combined: source inspections, self-checks, or successive checks" (p.99).

Source inspection has as a goal the elimination of defects by clearly distinguishing between errors and defects, i.e., between causes and effects. Errors will not turn into defects if feedback and action take place at the error stage. This action includes both corrections of the defect as well as action taken to correct process problems causing the error.

"Thus, the most effective strategies for reaching zero defects are using source inspections to move through management cycles at the level of causes, and using source

inspections in combination with 100 percent inspections and poka-yoke devices to speed up feedback and action" (p.85). This 100 percent inspection is typically viewed as too expensive; however, low-cost poka-yoke devices solve that dilemma.

One major multinational company implements poka-yoke in all its manufacturing activities with low-cost tool called a checklist (Vasilash, 1995). While use of checklists at the conclusion of the development process can detect defects, poka-yoke checklists used during the development process can contribute toward error prevention.

Such self-check inspection systems rely on the simple proposition that statistical methods of appraisal and the feedback and corrective action taken as a consequence of that appraisal are too slow to be fully effective. The ideal solution to this dilemma would be to have the actual worker perform the inspection or appraisal. However, this solution has two inherent flaws associated with it; "workers are liable to make compromises when inspecting items that they themselves have worked on, and they are apt occasionally to forget to perform checks on their own" (p.77). This can be addressed by the installation of poka-yoke devices in cases where physical inspection is possible. Immediate illumination of errors allows the worker also to see more appropriate and effective countermeasures to be worked out and implemented to prevent such problems from occurring in the future. An example of a self-check system poka-yoke is the stem tightener inspection process. The target thickness was 10.0mm +/- .5mm. Two gauge/guides were installed; one at 10.5mm, under which product meeting the specification could pass, and one at 9.5mm, under which those not meeting the specification would pass. At the first gauge/guide, defects were shunted off to the side and an alarm was sounded, indicating an out-of-tolerance situation. At the second gauge/guide, products meeting the specification were shunted off to the side for

continued processing while defects (too thin) passed under the gauge/guide and dropped into a bin, again sounding an out-of-tolerance alarm.

Self-check systems, however, suffer from the problem that they are difficult to use where the detection of abnormalities depends on sensory methods. Nevertheless, efforts should be made to adopt "high-level detection techniques for items that absolutely require sensory inspections" (p.78).

Successive check inspection systems rely on the inspection of just-completed work by the individual next in processing the item. Any defects discovered are immediately passed back to the earlier process for corrective action, including action to prevent the occurrence of subsequent defects. "It is imperative to gain the thorough understanding and compliance of workers in the implementation of successive checks. Failure to do this will undermine interpersonal relations in the shop by creating an atmosphere in which each worker feels as though the worker at the next process is always criticizing him or her. It is therefore necessary for everyone to understand that inadvertent human errors are more easily detected by others and that workers help one another by checking each other's work" (p.73).

Chase and Stewart (1994) note two obvious differences between manufacturing and service operations that need to be addressed when applying poka-yoke principles to service. The first difference is that service fail-safing must account for the customer's activities as well as those of the producer. An example of this is the "dead man's" lever on power mowers that disengage power on the cutting blade if the operator releases the push handle. The second major difference is that many services evolve through multiple forms of interaction between the service provider and its customers. During these interactions, fail-safe methods must be set up to allow for correction of customer usage or product errors. However, these interactions are difficult to make error-free, primarily

because the customer is involved. Additionally, customer involvement in the product cycle makes direct measurement of satisfactory performance more difficult. In service quality management, this difficulty is addressed by surrogate measures of quality, such as customer waiting times.

In an attempt to provide some systematic approach to the development of service poka-yoke devices, Chase and Stewart suggest a framework classifying such devices by the errors they are designed to prevent. The two main types of errors are server errors (task, treatment, and tangibles) and customer errors (preparation, encounter, and resolution). An example of a task error would be an auto repair shop not repairing the car promptly or properly, including doing work incorrectly, in the wrong order, too slowly, or doing work not requested. Examples of poka-yoke devices to correct task errors would be placing cones on the hoods to cars to signal arrival time or using a French fry scoop to measure out consistent portions. An example of a treatment poka-yoke was a bank requirement that tellers record the customer's eye color at the start of a transaction, thus ensuring customer eye contact. An example of a tangible poka-yoke is the placement of mirrors in employee break rooms to promote appropriate appearance upon returning to the customer area.

Customer errors of preparation, encounter, and resolution can also be reduced through the use of poka-yoke devices. A preparation poka-yoke example is the use of a comprehensive medical questionnaire to ensure appropriate medical treatment. Encounter poka-yoke devices include height bars at amusement parks to ensure riders exceed size limitations and frames at airports to gauge allowable size of passenger carry-on luggage. Resolution poka-yokes help mold the behavior of customers as they exit the service, such as the placement of tray-return stands and trash bins at the exits of fast-food restaurants.

Another approach to improving service quality was used by Fitzsimmons (2000) who summarized elements of service quality development with a service quality ladder, illustrating the progressive steps. The first rung of the ladder is inspection, in which quality checks are performed after service is delivered. The next step is the use of statistical process control such as the use of a control chart to monitor a process performance measure that signals when intervention is needed to assure quality during service delivery. Next are quality training programs designed to give employees empowerment and responsibility for quality. The next rung of the service quality ladder is to determine the cost of quality by quantifying the cost of poor quality. At this rung, an unconditional service guarantee may be offered, focusing the attention of operations and marketing on service performance measures. With a focus on process quality enabled, quality service can be assured by the design of the service process for robustness and foolproof operation. At the top of the ladder is quality function deployment (QFD), in which the organization defines the voice of the customer in operational terms.

Hauser and Clausing (1988) developed this quality function deployment into a "House of Quality" to provide a framework for translating customer satisfaction into identifiable and measurable conformance specifications for product or service design. The essential steps in constructing a "house" are the establishment of the aim of the project; determination of customer expectations; description of the elements of the service; notation of the strength of relationship between the service elements; notation of the association between customer expectations and service elements; weighting of the service elements; establishment of service element improvement difficulty ranking; assessment of competition; and strategic assessment and goal setting. A powerful outcome of the construction of a house of quality is a decision matrix that can illustrate quality improvement priorities.

Finally, any discussion of quality improvement processes must include a continual improvement process. One approach to continual improvement is the kaizen process improvement method. Kaizen is a Japanese word that means improvement. A further implication of the word kaizen is that it implies continuing improvement not only in the work life but also in personal life, home life, and social life. The result of implementing kaizen is a sustained continuous improvement focusing on eliminating waste in all systems and in all processes in an organization (Kaizen Institute, 2002). Fitzsimmons points out that manufacturing application of kaizen approaches focus on elimination of idle material resources or inventory, resulting in "just in time" or JIT processes. In services, the focus would shift to human resources, resulting in the elimination or reduction of customer waiting lines and idle staff.

Summary of Instructional Design and Quality Management Methods and Practices

As discussed earlier, instructional design quality is usually user and context dependent. Stake (1999) also asserted that the 'best' qualitative evaluations of educational programs resulted in reports that defined quality in terms of those using the reports. Traditionally, the costs incurred to obtain evaluative information has been viewed as expensive whether the inspection/evaluation was done as part of a process that inspected quality after the fact (summative evaluation) when it was most expensive to change the instructional product or learning object or as part of the design process (formative evaluation). Quality management literature also showed that a process emphasis on appraisal encouraged the belief that costs of conformance must escalate at the highest quality levels. This increasingly high cost of inspection corresponds to the increasingly high cost of formative evaluation in designing education courses using the ADDIE model. In using the ADDIE model, it can be asserted that almost any formative evaluation expense beyond a subject-matter expert review of materials would contribute

to a rise in the slope of the high historic cost curve shown in Figure 3. The implementation of quality management process change approaches in instructional design processes could facilitate a shift in focus from defect correction after appraisal at the end of the cycle to error prevention during the development cycle.

A quality management process change that was initiated early in the quality movement was the introduction of poka-yoke devices and procedures into the manufacturing process. Such mistake-proofing devices and procedures are already likely to be found in instructional design processes as well, though perhaps not reported as such. Another common process improvement change suggested in the quality management literature was to automate processes as much as possible. Instructional technologists view templatized authoring systems and course development process tracking systems as examples of methods to begin to automate the instructional design process. This automation effort in reality is an attempt to reduce the amount of customer interaction and customization needed to meet customers' needs. For example, having standardized forms to request instructional design services is less labor-intensive than interviewing each subject matter expert separately. Just as in service operations, attempts to automate the instructional design process encounter customer forces that restrict automation. Customer inputs in the form of a wide variation in pedagogical and philosophical approaches among subject matter experts make it difficult to automate these customer inputs.

Application of Quality Management Lessons in Instructional Design.

Lessons learned about the differences between manufacturing and service operations may be applied in instructional design. When developing instruction, particularly computer-based instruction, designers often test the user interface (the push handle) to ensure that customer usage results in the expected learning. However, it must

be noted that fail-safing any computer-based application, such as an educational program, is difficult (there is no automatic cutoff "dead man's" lever though programmatic timers may be similar). Nevertheless, the concept of fail-safing can be applied as the most likely usage of the application can be observed during testing, with necessary adjustments made to accommodate unanticipated usages.

A second difference also has interesting application in education. Just as with typical service providers, educators have long evolved their courses, often on the spot, adjusting lectures and exercises to the needs of the students in that particular class or section. When courses are developed for use in distance education however, this direct interaction is delayed at best and absent at worst. The debate over how best to introduce effective interaction in Internet-based distance education courses can be found on almost any education discussion board. Discovering a "best" method is beyond the scope of this research; however, acknowledging efforts to introduce interaction into courses should be made.

For products developed using the ADDIE instructional design model, examples of internal failure costs would be the cost of developing multimedia items not used in the final course, procedures incorrectly depicted by the instruction, or simple content errors. Unlike most industrial scrap or rework, multimedia products sometimes can be utilized in other courses. However, the high cost of multimedia items in relation to the total development cost of most Internet-based distance education courses indicates that these items should have early user (learner) involvement in their design and implementation. An application of the ADDIE model focusing on reducing inspection/evaluation costs suggests that any multimedia item be user-tested via prototype or other "failure-prevention" activities as early in the design process as possible. This not only leads to better learning by providing multimedia that is useful to the learner but can actually lead

to overall reduced costs since multimedia deemed not useful to learning would be discarded while still in the prototype stage. Since the types of courses being developed with this limited implementation are Internet-based distance education courses, automatic tracking can be programmed into the course server to evaluate the ongoing usage of instructional multimedia. Thresholds can be set up so that media that is not used according to plan can be highlighted to the course designer for review and possible change or elimination. Elimination of this type of waste during the instructional design process is further developed with the kaizen process improvement method.

In the quest to improve quality, one researcher proposes using the ADDIE process as the implementation vehicle for continuous process improvement (Clark, 1998). The Japanese process improvement method known as kaizen is applied to the ADDIE model in the following way:

- Analysis Phase - Identify areas of opportunity and target specific problems. These areas and problems are based on team brainstorming sessions, process definition sessions, recommendations forwarded to the team by organizational members, and other various analysis techniques.
- Design Phase - Generate solutions through brainstorming sessions. Identify the required resources to implement the chosen solution and identify baselines to measure.
- Development Phase - Formulate a detailed procedure for implementing the approved solution.
- Implementation Phase - Execute the solution.
- Evaluation Phase - Build measurement tools, monitor implementation, and evaluate measurements to baseline. Note that this phase is performed throughout the entire process.

This application of kaizen for reducing inspection/evaluation costs in Instructional Design could lead to identification and elimination of appraisal or evaluation processes that do not contribute to the prevention of defects.

Other authors have written about the use of quality management principles in higher education. Chaffee and Sherr (1992) wrote about bringing quality concepts into

postsecondary education, emphasizing that quality in design (in both output and process), quality output, and a quality process are all necessary components of quality. They also assert that academic organizations in particular give less attention to quality process issues, while paying considerable attention to quality output (i.e., outcomes assessment) and quality in design (i.e., curriculum design, transfer of credit, etc.).

Principles and methods that can be applied to ADDIE models.

Total Quality Management (TQM) processes for process improvement, as cited in the quality management section, can be applied to the creation of instructional courses and learning objects, as illustrated by the following possible applications:

1) An overarching principle would focus process attention on methods, processes, and procedures designed to draw attention to error prevention rather than defect correction after appraisal.
2) Another principle is that service automation attempts should be limited to customer interaction events typified by less customer variation.
3) A method is the introduction of poka-yoke processes to failsafe specific high-cost, high-value activities should be pursued. Manufacturers implementing a poka-yoke system based them on their expertise in manufacturing and observations of the line, resulting in an increase in quality while reducing costs. One could observe that a similar system used in developing lower cost, higher quality instructional materials would likewise necessitate a reliance on the expertise of the manufacturers, in this case, the instructional designers.

4) Another method is the use of early prototypes, especially in the area of relatively expensive multi-media objects.

5) The use of Quality Function Deployment (QFD) activities could identify the most beneficial instructional design process areas to address for change.

6) The application of kaizen continuous process improvement efforts to the instructional design process could begin with the identification of inspection/evaluation practices that do not contribute to decreased defects.

The Methodology chapter reports on how process improvement to reduce inspection/evaluation costs in Instructional Design was to be observed in action, while the Results chapter highlights application of the process at the case study institution.

Chapter Three: Methodology

Methodology of the Case Study

In order to better understand how ADDIE is used in practice, this research uses an exploratory case study methodology to examine best practices in the evaluation/inspection process employed during the development of courses by a well-known developer of Independent Study courses. This dissertation methodology reflects that of a major study done in 2000 by the Institute for Higher Education Policy (IHEP, 2000). In "Quality on the Line: Benchmarks for Success in Internet-based Distance Education," the Institute followed a three-step process. The first phase included a comprehensive literature review. The second phase involved the identification of subjects that "have substantial experience and are providing leadership in distance education," (p.9). The third phase involved surveying these subjects.

In similar fashion, this dissertation has reviewed ADDIE and quality management literature and now addresses the identification of leaders in distance education. The selected institution produces Internet-based distance education courses. The selection of this subject for exploratory research is representative of the population for potential future research. Even though this research is based on an established model, the research is still exploratory in the sense that the constructs (i.e., best practices) being discovered during the research phase of this dissertation are not well articulated in the current ADDIE model.

In addition to this case study method, additional rigor will be added to the study by using concepts introduced by Stufflebeam (1971) and others. An evaluation model

(the CIPP model) with 4 elements to be examined—context, inputs, processes, and products, was offered by Stufflebeam. His CIPP model can be enhanced by viewing it from Scriven's (1991) elemental evaluation logic of comparing what is to what ought to be. Recently, Patton has advocated the notion that evaluations need to be user-focused if they are to be actually used (Patton, 1997). A combination of these approaches yields a comprehensive case study methodology that utilized the CIPP model with a user focus (user-focused CIPP).

Since the focus of the case study was on the process, the other elements of the CIPP model, namely, context, inputs, and products provide texture and triangulation for the instructional design process modeling.

Identification of the Case Study Subject

The case study subject selected is the Center for Instructional Design (CID) at one of the largest US higher education providers of Internet-based distance education courses. Its course offerings are well received, as represented by enrollments and awards. Enrollments in courses developed by this provider during the academic year 2000-2001 were 55,000. This provider also has received several awards for exemplary courses. Among the recent awards are the AACIS Helen Williams Award for Most Outstanding College Course of the Year and the UCEA Distinguished Course Award. These awards were given for courses that are Internet-based.

Even though the awards given to the case study institution provide an indication that current instructional development practices of the institution already yield outstanding courses, we must also recognize that these awards are given for courses for

which the institution applies. Additionally, the selection committees consist of only four and seven members, respectively. The criteria may also not explicitly recognize the learning needs of students who take these courses. These disclaimers aside, it is more likely that the usage of an institution producing distance education courses recognized by peers as being excellent may yield useful conclusions when comparing this with theoretical approaches from other fields.

Further, since the case study institution produces award-winning (and presumably, high quality) Internet-based distance education, it may be possible to extend the lessons learned from this case study to other institutions or to other types of instructional design and course development such as classroom-based distance education offerings. Thorpe (1993) maintains that there is a range of commonalities between evaluation in traditional educational settings such as the classroom and distance education. Among these commonalities are the processes, including design, data collection, and analysis. One of the differences noted by Thorpe is that distance education tends to be less open to inspection. Thus, a case study using distance education courses is likely to be applicable to other types of instructional design but should emphasize the need to employ better inspection, i.e., evaluation methodologies.

Another reason why Internet-based distance education courses were selected as the target development environment is historical. We recall that distance education was introduced during the nineteenth century for commercial reasons. Learning opportunities were provided to those outside the traditional academic setting as a means of increasing revenue for the institution (Peters, 1998). The entrepreneurs who introduced this external

learning concept soon recognized that a group of learners who were unsatisfied with traditional teaching and learning methods could have those needs addressed via an "industrial goods" production model of education—distance education. This allowed teaching to become a product that could be optimized and *sold*. Incidentally, this industrialization *can* occur in a traditional university (i.e., mass sections of general education classes with standardized exams for all sections, regardless of teacher assigned) but under the current conceptualization of distance education, it may be asserted that it *must* be industrialized, with division of labor and specialization needed to produce and deliver distance education courses.

At the case study institution, this division of labor has occurred, with a substantial organization supporting the course development effort, including a staff of over 30 full time programmers, project managers, instructional designers, and administrators with over 100 part time (mostly student) employees working as instructional design assistants, multimedia creators, artists, programmers, and fulfilling other staff support activities. Because of the volume and award-winning quality of work done at this institution, it was selected as the higher education case study subject.

The last criterion for selection of the case study subject was to think in terms of what might optimize understanding (Stake, 1995). This case study subject and its processes were previously studied by the author, affording an opportunity to triangulate understandings from one study to another.

Survey Procedures with the Case Study Subject

Qualitative procedures were employed to understand best practices used by the subject in developing educational courses and learning objects using the ADDIE model. Interviews and reviews were used to document instantiations of best practices in utilizing appraisal/evaluation activities that result in shifting focus from defect prevention to error prevention. Interviews were conducted with multiple course developers, project managers, and instructional designers. A standard interview protocol as well as the records review process is available in Appendix A. The interview protocol was employed to guide the interview, with interaction with the subject determining follow-up and follow-on questions. Subjects were given the opportunity to review the transcribed interviews and make corrections or clarifications. From these completed transcripts, an abbreviated appendix (Appendix B: The Case Study Story—The Inspection/Evaluation Goal) was developed, telling the "story" of the instructional designers, project managers, and managers in a combined "conversation." The complete text of these transcribed interviews is available from the researcher upon request. All available records of external evaluation of the instructional design processes, including a preliminary study by the author three years ago, were reviewed.

An examination of documented policies, practices, and procedures was supplemented by observation of the course development process in use as evidenced during interviews with CID personnel.

Evaluation

In order to increase the likelihood of use of this dissertation by interested parties (Patton, 1997), an evaluation of this qualitative research is done. An examination of case study methodologies based on recommendations from Stake (1995) is the first form of metaevaluation. Stake advises "member checking" in which persons interviewed are requested to review rough drafts of the writing for accuracy and palatability. Accordingly, each interviewee was given the opportunity to provide alternate language or interpretation. Additionally, each was also offered the option of excluding their comments from the research.

Stake (1995) also identifies several protocols that can help illuminate or nullify some extraneous influences. The first of these protocols is the methodological triangulation. In this triangulation effort, observations and interviews are combined with reviews of existing records. All of the documentation used by CID was gathered and used to compare interview-described processes with documented processes.

Another protocol is data source triangulation. In that triangulation, I looked to see if the case remains the same at other times. After the above research was completed, the three external CID reviews (summarized in Appendix C) were again reviewed to triangulate, focusing on elements relating to inspection/evaluation cost issues.

Chapter Four: Results

The literature review indicated that manufacturing and service processes including process models such as ADDIE had evolved from a 1950's version. These manufacturing and services process models show evidence of concern for quality as part of the process earlier in the process and frequently manifest that concern by shifting quality focus from defect correction to error prevention. The Center for Instructional Design, the case study institution, also manifested evidence of that shift as shown by interviews and documentation obtained from the center.

This evidence of shifting quality focus is presented by a comparison of the CID instructional product development cycle with the ADDIE model development cycle. Additionally, observations about how CID may be employing elements of suggested principles that can be applied to the ADDIE model are presented. The documented current process that the Center for Instructional Design (CID) employs to develop learning objects and instruction and to incur associated inspection/evaluation costs was obtained. The following website shows the documented process as it existed during the research project: http://cid.byu.edu/images/8step.swf (as of March 24, 2003). The process

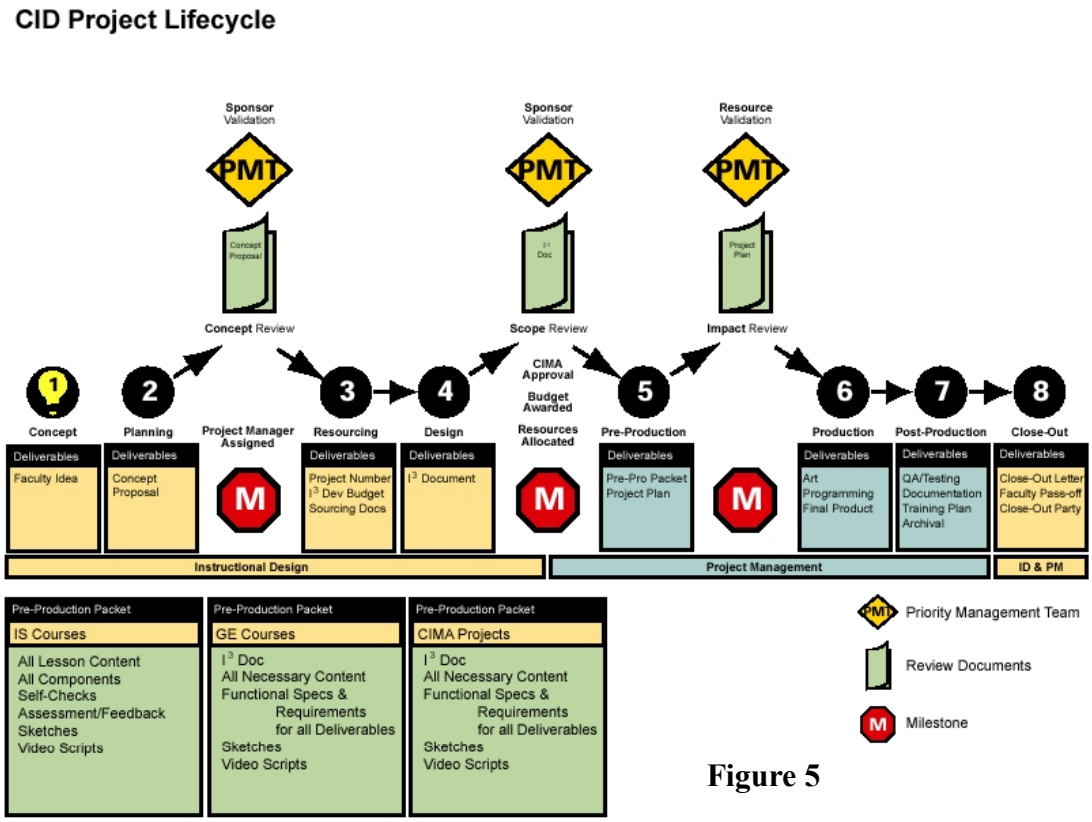


Figure 5

flowchart, called the "CID Project Lifecycle" is shown as Figure 5.

The above website is an interactive Flash file allowing access to details about each of eight documented steps in the instructional design process used at CID. Screen captures with details of the process description are contained in Appendix D. This depiction of CID's instructional design process formed the basis of the review of performed inspection/evaluation steps. Other documents obtained, shown in Appendix C, contributed to an understanding of instructional design processes as they were intended in CID and also mapped onto the ADDIE model.

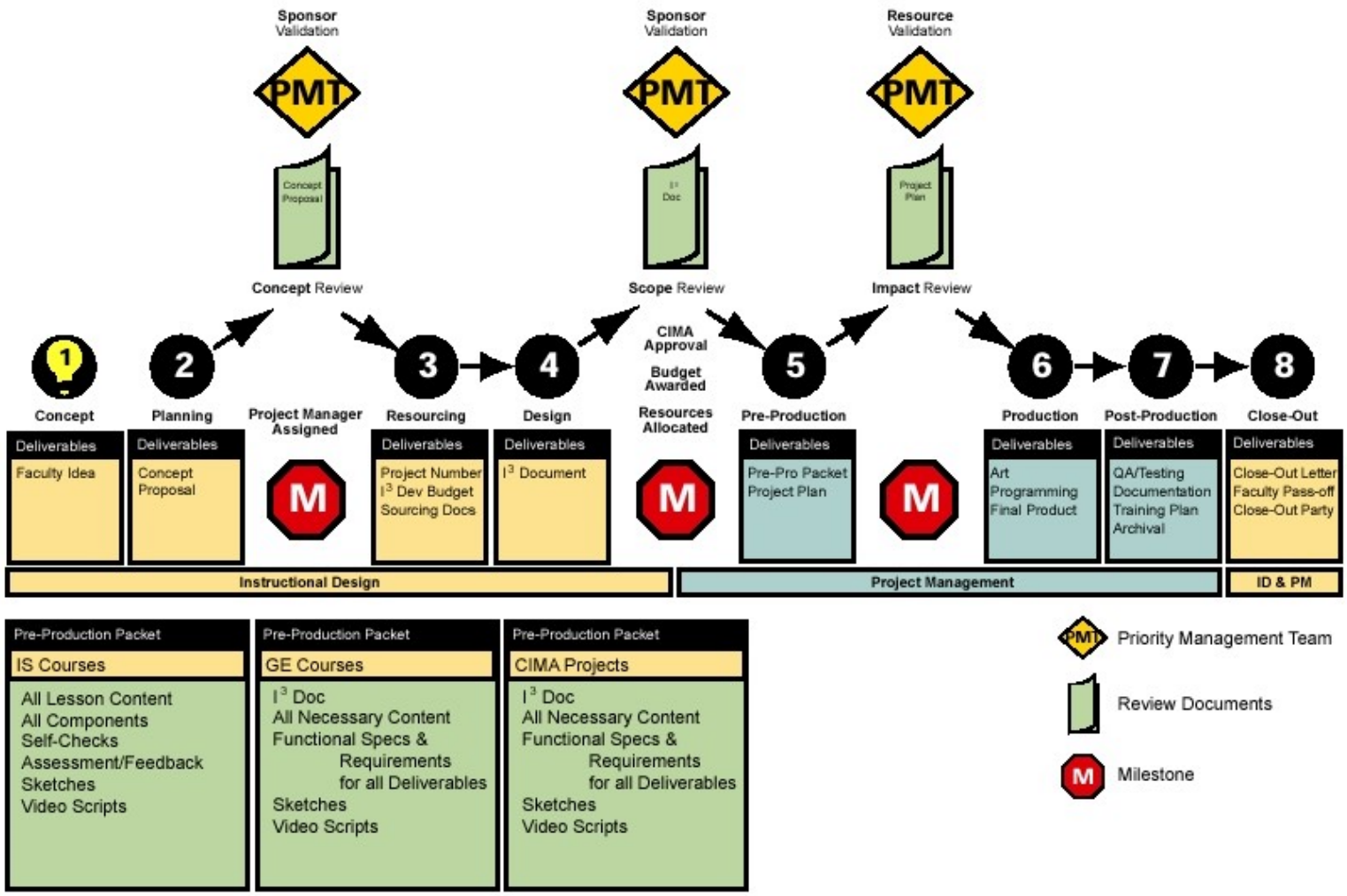
For example, the Project Concept Proposal document presented the CID approach to part of the Analysis step. In addition to providing further documentation of what was to happen during the Analysis step, the I^3 Documentation was an extremely important part of both the Design and Developments steps. The I^3 (Information, Instruction, and Interaction Design), when completed, outlined the basic instructional objectives and the strategies to achieve them, including sufficient detail about the instructional content. Further, a rough plan for assessment of the objectives and how the instruction would be implemented was to be presented. The CID Programming Development flowchart provided additional context for the defined process during the Design and Development steps. Bridging most ADDIE steps, a team roster was part of the described process in order to encourage participation of all needed instructional development team members. To further facilitate that participation during the Development and Implementation steps, the project managers were given a status report template to email to team members. Finally, as part of the Evaluation step, a pre-defined set of project close-out meeting questions and a project close-out template were provided.

In this chapter, these intended processes are compared with actual processes as well as contrasted with possible process improvements that stem from the quality management and instructional design literature reviews. Extracts from the CID Project Lifecycle flowchart and accompanying discussion of results depict these contrasts. The influence of external evaluations on the results of the case study are reflected in the development of the interview questions as well as in contributions to the extracted flowchart discussions. The interviews that were conducted with instructional designers, project managers, managers, and others at CID comprise the bulk of the research material.

These interviews were compressed into a fictitious "conversation" that depicts most of the actual processes used by CID employees to design and make instruction. This "conversation" is presented in Appendix B in the form of a dialog between the researcher and three people who have various roles at CID. These people are represented fictitiously as an instructional designer, a project manager, and a manager, all of whose comments are extracted directly from the actual interviews. In order to make the "conversation" more realistic, the extractions are modified slightly to conform to the "voices" of the three fictitious people. (A transcript of the actual interviews may be obtained by contacting the author.)

Excerpts from this "conversation" are used to illustrate the researcher's depiction of the observed CID Project Lifecycle shown in the CID Project Lifecycle flowchart extractions.

CID Project Lifecycle

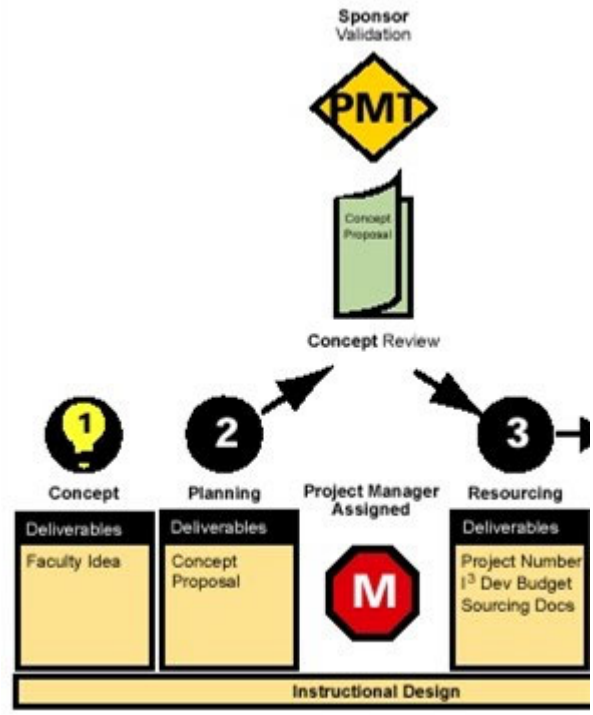


The CID Project Lifecycle flowchart depicts the course creation process in eight steps. These steps are analogous to the ADDIE model in the following way:

ADDIE Step	Case Study Example Process: CID Project Lifecycle Phase	Typical Elements of the Step
A—Analysis	Concept, Planning, and Resourcing	Audience analysis, needs assessment, and stakeholder identification
D—Design	Design	Subject matter content selection, learning objectives authoring, and instructional media selection
D—Development	Pre-production and Production	Learning experiences creation and testing
I—Implementation	Post-production and Close-out	Presentation of the learning experience to the learners with evaluation of results
E—Evaluation	Post Lifecycle Evaluation	Evaluation of the success of the learners and evaluation of the effectiveness of the instruction

Table 1. ADDIE Steps Comparison Table

The individual steps of the ADDIE model are reviewed in the context of the documented and observed CID processes. Further, areas of potential ADDIE model process improvement identified during the literature reviews are discussed in the same context. The first step in the ADDIE model is Analysis.



Analysis

The first three phases of the CID Project Lifecycle closely resemble the processes performed during typical uses of the analysis step of ADDIE. This step traditionally includes analysis of instructional goals, including audience analysis and some sort of needs assessment, often in the form task, procedural, or information-processing analysis. The depicted process suggests that this analysis will occur during meetings with faculty and academic department chairs and college or school deans. The Concept phase of the CID Project Lifecycle lists a "Faculty Idea" as the key deliverable while the actual concept proposal is a deliverable during the Planning Phase. The combination of these two phases would produce the instructional goal analysis associated with Analysis in ADDIE. The Resourcing Phase brings in an area of analysis not depicted in the reviewed instructional design literature; namely, the

business justification and preliminary budget processing information needed by a decision-maker.

Interviews suggested that sufficient instructional goal analysis is usually performed, however, audience analysis is often omitted due to the perceived expertise of the faculty member. Since most faculty employing the services of the Center are already tenured, instructional designers and others assume they have adequate understanding of the audience their material will address. This assumption will need to be tested with further research. It is clear though, that most faculty and instructional designers do not include early learner feedback in their analysis step as suggested by the literature.

Case Study Story Example

From my interviews with various people at CID, the case study institution, I have developed a "story" of the ADDIE process at CID (see the introduction in Appendix B for details of how this "story" was developed). I am inserting excerpts from this story to illustrate what instructional designers actually do when analyzing, developing, designing, implementing, and evaluating instruction. The following is from "Steve," a fictitious instructional designer:

Case Study Story (1) —"The CID process begins with this umbrella process, beginning at **the Concept Phase**, that involves creating some kind of conceptualization document. There are faculty members who are aware of us and what we do, so they come to us with an idea that they have had and together, we will make some kind of determination as to where it best fits. We have a proposal form and we talk it through and get a feel for how complicated the idea is to implement and put that idea into the proposal form. We have

some general guidelines we use to see if the project will be approved: will it impact a lot of students? Will it have a lot of department support, not necessarily in form of money but in the form of buy-in? (If we create this thing, will a lot of people use it?) In other words, will it really help the students in that department?

A lot of times, the faculty idea is a pretty high level idea. For example, faculty will want students to have more practice analyzing a text against certain criteria. The reason—they may not get enough of this practice in class. But in terms of an actual implementation idea, as instructional designers, we need to help a little more because sometimes the faculty will have it and sometimes they won't. Part of that is that there are a lot of options, a lot of different ways you could approach the problem. As an instructional designer, one of my roles is to kind of go through the world of options with them, teasing out from the faculty what their real goals are, stated and unstated. There are times when there are things that they have not stated and in some cases, have not even realized themselves, what they are trying to do. So, through the conversation, we try to clarify what the real goal is here.

For example, they want their students to be able to write better legal briefs, better legal memoranda. But when you ask "what is it about that," they have to start digging a little bit so they can say, "these are the skills that go into that and these are the areas where students struggle." And then you can start asking questions about what delivery mechanisms they have in place already; what constraints they might have. Then you can start saying, "Here are some options."

I also like to keep the end-user in mind. I feel sometimes there is too much emphasis placed on what the faculty wants. I do think that we should be the advocates for the learning of the students. But it is a hard balance because we really work with the faculty but it is the students we are really trying to help. In our stakeholder identification, students aren't always mentioned as a stakeholder. I think that gets overlooked a lot. Our focus is just on what the faculty wants. I think there are some things that I can look at just by looking within myself—"If I were a student taking this class, would I use this?"

As we start to move from the concept phase to **the planning phase**, I think that some of the instructional designers get much more involved in a collaborative effort with the faculty and students. They will go and do some observations of existing classes, observing especially what the students are doing. You try to assume intelligence on the part of the learner and help the instructor in providing them with the tools, the experiences, and in some cases, the guidance to exercise that intelligence. And most students respond to that because there is that degree of self-investment rather than just passively 'soaking it in.' Even students who aren't very good at learning still like the experience.

We have one product where, even if the students don't do well, they still like the process; they still like what they are working with. This is a Virtual Chem Lab—they may have a hard time completing the assignment and getting it right but they still kind of enjoy the experience of trying to figure it out on their own and doing it in kind of a semi-realistic environment. So, it not just canned where you go through the motions and you walk out the door with an 'A' on the assignment because you followed all the steps listed

but you don't understand why you did what you did. The target is not that they get the color from the experiment that they are looking for—the real target is, can they think like a scientist? The proof that they can think like a scientist is that, ultimately, they can get the right color on their own. That is what you are shooting for. But they don't get there the first time around.

The goal during planning is to create a document that is clear enough so that the Priority Management Team (PMT) can make a resource decision. I do try to get a concrete representation, even if it is just sketches or throwing together a few graphics or a PowerPoint mock up. It really helps the faculty member to start to think of this thing as a real 'thing' and not just abstract ideas floating out there. It also helps to focus the discussion around the interactivity of the features—what needs to be there, what doesn't, at least from the content, the design, and the pedagogy standpoints. But the plan doesn't have to be a full description of the course; just enough detail so that the PMT can know what kind of resources are going to be required eventually.

If it looks good, we send that concept proposal to our manager who takes it to **the first PMT review**. They are mostly managers plus the project managers and maybe a couple of other people. They decide if we have the resources to work on some things by using a set of weights and numbers to compare this proposed course to that. My manager says that he would like to do is get it to the point where the designers could sit down with the faculty member and just check it off right there so that we could eliminate that step of having to take it to the PMT and wait for them to get back to us." **— End Case Study Story (1)**

Design

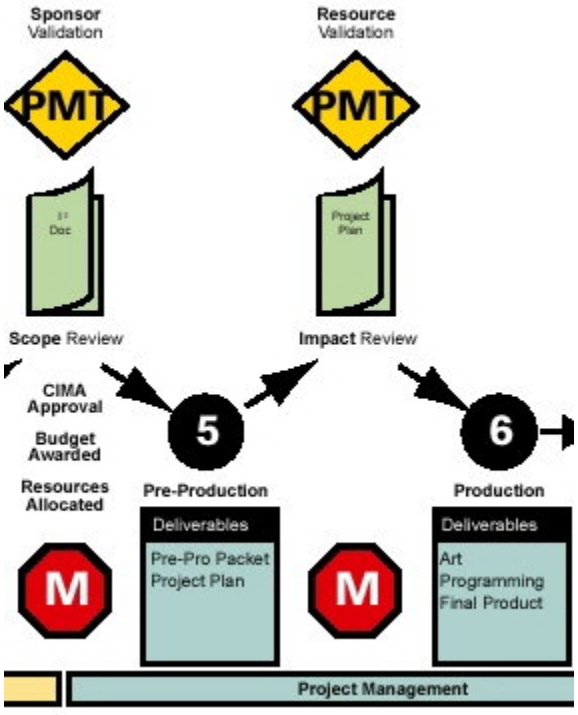
The next ADDIE step, design, includes instructional analysis, subject matter content selection, the development of performance objectives and assessment items, and the selection of instructional media. Instructional analyses as well as the development of performance objectives are tasks that are completed as part of the I^3 (Information, Instruction, and Interaction Design) document. Considerable variation among instructional designers in the completion of the I^3 documents made it difficult to draw a common conclusion about CID's ability to improve this aspect of the design process, although a recently introduced standardized I^3 document may reduce this variation.

Case Study Story (2) —"The other thing we have to do at that point is nail down expectations. "Ok, professor, what do you see us building? How many pieces will it have?" We want to collect the entire material for the course. We put it all together for the course with a complete script, storyboard, or whatever it needs. A lot of people put these two phases (design and pre-production) together but from a characteristic standpoint, they are completely different. In this **phase (design)**, you are designing it for the sake of the student. Your full thought process is "what is going to be the best way for the student to soak this stuff in?"

The approach we have for getting this done is through use of what we call the I^3 document. It is being updated to more accurately reflect what we are actually doing with our clients and the projects we develop with them. Sometimes it is hard to know if you have the most recent version of the I^3 but you just go with what you have. All in all, it

helps to keep the process going and ensure that the faculty and we have a good understanding of the learning needs of our students." **— End Case Study Story (2)**

Development



The development step of the ADDIE model process is represented by the pre-production and production phases in the CID Project Lifecycle. During the development step, the instructional strategy is developed with instructional conditions and events being specified, methods and final media being selected, the actual learning object being designed and produced, often in the form of a prototype. As we see from the illustration, project managers begin to assume a primary role at CID in directing the development efforts of the instructional design team. The CID deliverables are a completed pre-production packet as well as a project plan, both of which reflect deliverables submitted through traditional ADDIE implementations.

The actual process used at CID is very close to the diagrammed process with a fairly major exception. Project managers had been in the process at CID for less than a year, as of the start of the research. Instructional designers and their direct assistants had previously performed all of the current functions of project managers. Consequently,

some projects underway when the project managers were brought into the process have had muddled accountability, at best. Even projects that have commenced with a project manager assigned during the first Priority Management Meeting (PMT) and subsequently calling the pre-production meeting often have confusing roles between the project manager and the instructional designer. It was noted that this was particularly acute when it came to interactions with faculty members. Those interactions mostly still occurred between the instructional designer and the faculty member and were frequently not tracked in the project plan by the project manager. Additionally, the myriad of production tasks needed to produce courses and learning objects require a level of tracking that exceeds the capability of the two available project managers. During the research for the case study, each manager was accountable for over forty active projects.

Despite the burden of such a load, process measures have been instituted to improve the tracking of tasks during the development of instruction. One of the key measures is the pre-production meeting, during which much of the instructional content to be created is described in detail by those who will create it. A work breakdown structure is devised based on the input of all the responsible team members.

Case Study Story (3) —"I'm one of the project managers around here. We are fairly new additions to the process so there are still some gray areas we have to accommodate. What does it mean to be assigned to a project? We want to make sure that we have the people who are going to be actually working on the project doing the estimating of how much time it will take. You can see the problems otherwise—someone might estimate that it will take three hours to do something and the person who actually ends up doing it,

says, “there’s no way!” To help resolve these problems, we really want to have them get to the **pre-production** meeting for that reason. A lot of time we won’t have the whole team available yet here (pointing to the pre-production meeting area of the CID Project Lifecycle) because they are in the middle of another project. Since it is felt by some that we really don’t need them until we actually put the project into production, they aren’t asked to come to the pre-production meeting.

That meeting will be with what we call the core team. That will be myself, sometimes the faculty member, the instructional designer, our usability expert, and we usually have an artist and a programmer, depending on the project. We will review the proposal and make some assignments for tasks so we can get a better idea what the project is going to look like. We do some brainstorming about how we are going to make things happen. At that point, we go back and modify the I^3 document to match the recommendations from the people who are going to actually carry it out. It puts reality to the design and it also puts creativity to it because the instructional designer is not an artist; the instructional designer is not a programmer.

So, at the beginning, this I^3 document lays out information flow and basic interactions. Then when we get to this pre-production meeting, the artists and the programmers can say, “Well, that’s good but have you thought of doing this?” Or, “Yes, we can do that but we can’t do this.” So, creativity and reality come into play in this particular meeting. We want to keep it in place because this is a really valuable meeting as we look through the pre-production packet as all the questions are raised in the meeting and everybody gets an idea of what it is.

Finally, we also try to establish some completion dates but they are very fluid, often violated, and easily changed. Therein lies one of our problems here at CID—changing dates because priorities are changed. There are always conflicts with everyone wanting their work done right away, so how do you manage that; how do you manage the expectations? I don't know, maybe the pressure and desire to get things done and push things through results in getting things done on time. So all ten of the designers are feeling all the weight of all those instructors wanting their things done today. We try to communicate the urgency to management but I try not to add any pressure of my own. I try to point out to everyone the consequences of things if the schedule changes don't work out.

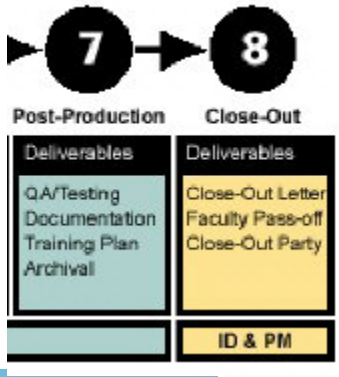
We are always trying to make things look as professional as possible but there is a point where there are diminishing returns and it becomes more extravagant than needed—art for arts sake rather than art for instructions sake. I don't know that there is any set of guidelines or checklists to do that. We do rely on what we create in the I^3 document and if we make changes in our core team meetings, we try to keep the I^3 document up to date. If you don't, what happens is the programmers may be working on a different set of criteria than the artists and vice versa.

When the faculty approves the art and hopefully there has been some student review process, it goes on to programming and they start doing their programming miracles and usually produce some kind of prototype. We will review the prototype and determine if it is operating according to specifications, that is, it has all the functionalities

we envisioned. We will do some tweaking on that as we need to and eventually come up with the nearly completed project.

For example, this object (pointing to a screen shot of a virtual chem. lab object) was initially described to us just verbally with a paragraph. Our artists translate it first to a paper sketch and say, 'this is what we think your words describe initially. Are we on board?' And if the artists are not on board, they make changes and fixes as needed. But we have found that doing that on paper as un-techno as it may be, it is just faster. So, we do this (pointing to an initial paper sketch of the screen shot he just showed me). We make descriptions of what every button does, what all of the interaction is and we march through it with the faculty member and the instructional designer ad nauseum until we have it on paper exactly how they want it. Then, we translate that to an on-paper color version of that. Still, nothing has been programmed. This is just a mock up of what the screen will ultimately be like. We get everything esthetically the way they want it and everything like that. Then, once that is all figured out—we've got the interaction figured out here; we've got the style guide figured out here—then we spend time doing the programming and basically, the project is finished." **— End Case Study Story (3)**

Implementation



The implementation step of ADDIE is represented by the post-production and close-out phases of the CID process. This step is traditionally concerned with decisions about how to move the

instructional design project from the design board to full use and how to evaluate that use. Those decisions and associated issues are interwoven within the analysis design decisions made during analysis, design, and development steps of the ADDIE model.

Implementation issues that surfaced during the case study research period included concerns about product delivery speed (the instructional product consumed too much of the available bandwidth when loading both initial and ongoing instructional items), delivering products that were too complicated for students to use, and accessibility and usability issues. In fact, the CID evaluator has recently submitted a paper for publication asserting that increasing the level of usability early on saves money, significant amounts of money (Waddoups, 2003).

Case Study Story (4) —"As Instructional Designer working together with the project managers, we usually stay on top of things but sometimes things aren't caught until we do some Quality Assurance (QA) testing during **the post-production phase**. Some other things that have popped up during our QA testing have been things like the delivery speed of our products. Some people we tested with didn't like the time that one of the learning objects took to load, so I had one of my Instructional Design Assistants (IDAs) create a low speed version that we will use for the Independent Study course. It has all the main learning objects and images but we got rid of all the graphics that took so long to load. We try to do a lot of the QA testing that technically should be post-production during the production phase so that we can make changes.

We will also do usability testing, although if the product is solely intended for an instructor to use we probably won't conduct a usability test because the instructor

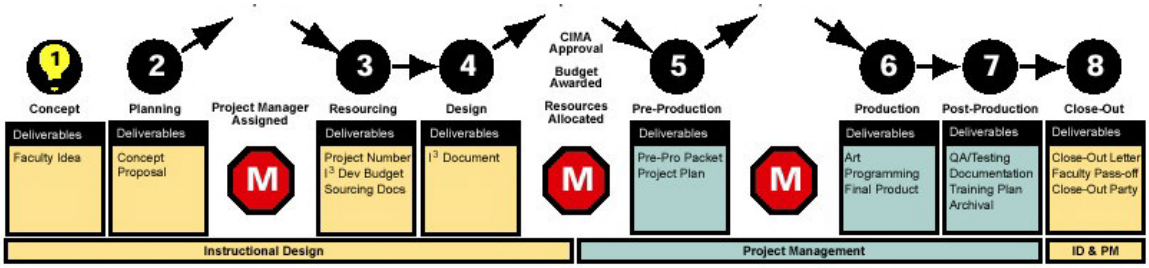
has been with us the whole time, and he has given plenty of input as to how he wants it to work. Then we will make any changes or modifications as have become necessary through the QA and usability testing process. Because we have been trying to get some of this testing done early on in the process, we are creating a better product without requiring us to go back and make the changes that we have had to make in the past. So, we've reduced those time frames to make those fixes by bringing users in early on.

The way we have evaluation set up is we combine testing, quality assurance, usability, and accessibility—that kind of evaluation—and we what we are calling implementation evaluation. There is kind of an overlapping Venn diagram that includes quality assurance—making sure something works, making sure that it is usable, that people understand how to navigate it—and this overlaps with implementation. So, that's the general philosophy that we have, is that evaluation doesn't start when the thing ends; it starts when the thing begins. So, the idea then is that when the I^3 documents are produced, our evaluator will write a little statement about how we intend to evaluate the effectiveness of the thing being produced." **— End Case Study Story (4)**

Evaluation

The final ADDIE step is evaluation. Most discussions of the ADDIE model show cyclic iterations of formative evaluation as part the model process definition and indicate that formal plans for summative evaluation are developed and implemented during the evaluation phase. Formative evaluation typically includes at a minimum, Level 1 reaction to the instruction evaluation (Kirkpatrick, 1959) with provisions made in the ADDIE

model to revisit any phase of the model that is identified as needing improvement. Since CID's Project Lifecycle flowchart officially does not include evaluation as a phase, it is



represented here with the entire flowchart, as iterative formative evaluation is actually a routine part of the design process used by all of the interviewed instructional designers, project managers, and managers.

Case Study Story (5) —" we deliver the product to the instructor(s) and formally close out the project with the project manager. They will compare budgets to actual and perform other work to closeout the project. Then, hopefully, our evaluator will be able to do a summative evaluation—did it work? That is a little hard because the new CID Project Lifecycle doesn't technically have summative evaluation in it. Plus we don't have a budget built in for evaluation. So, we put it out into the world and they find a bug in it—then what do we do? We don't do version 2 because we don't have the money to do that. With our Independent Study and General Education courses, we do have feedback set up with the last thing students do being to fill out the "how do I feel about" survey. We do get those back but again, since we don't necessarily view it as our course—it is really the professor's course, so for the evaluation part, we can do corrections, we can solve problems that might stop a student from proceeding but it's not pushing for a new version.

At the end of every Independent Study course there is a survey sent to each student—I believe this is still a voluntary survey but we do get survey results from these. It is the standard Independent Study survey. Unfortunately, it isn't really designed to address the objectives of the course specifically. Some of the instructors do ask for feedback from the students, say in the last lesson and that feedback is sent directly to the instructor. The instructional designers do get copies of these evaluation sheets from Independent Study. There is an opportunity for open-ended comments and some of these are fairly thoughtful and interesting but some are not.

So, there is some attempt made to evaluate the course, however, it could be stronger and more course-specific. It is also very hard to do Level three (transfer of learning) or Level four (assessment of business results) evaluation because learning is a tricky concept—what do you mean by 'learned?' Doing well on a test? Having a more positive attitude about the subject? Motivation? So, operationalizing that isn't an easy thing to do. And looking 5 years down the road at learning is just not possible most of the time in this environment." **— End Case Study Story (5)**

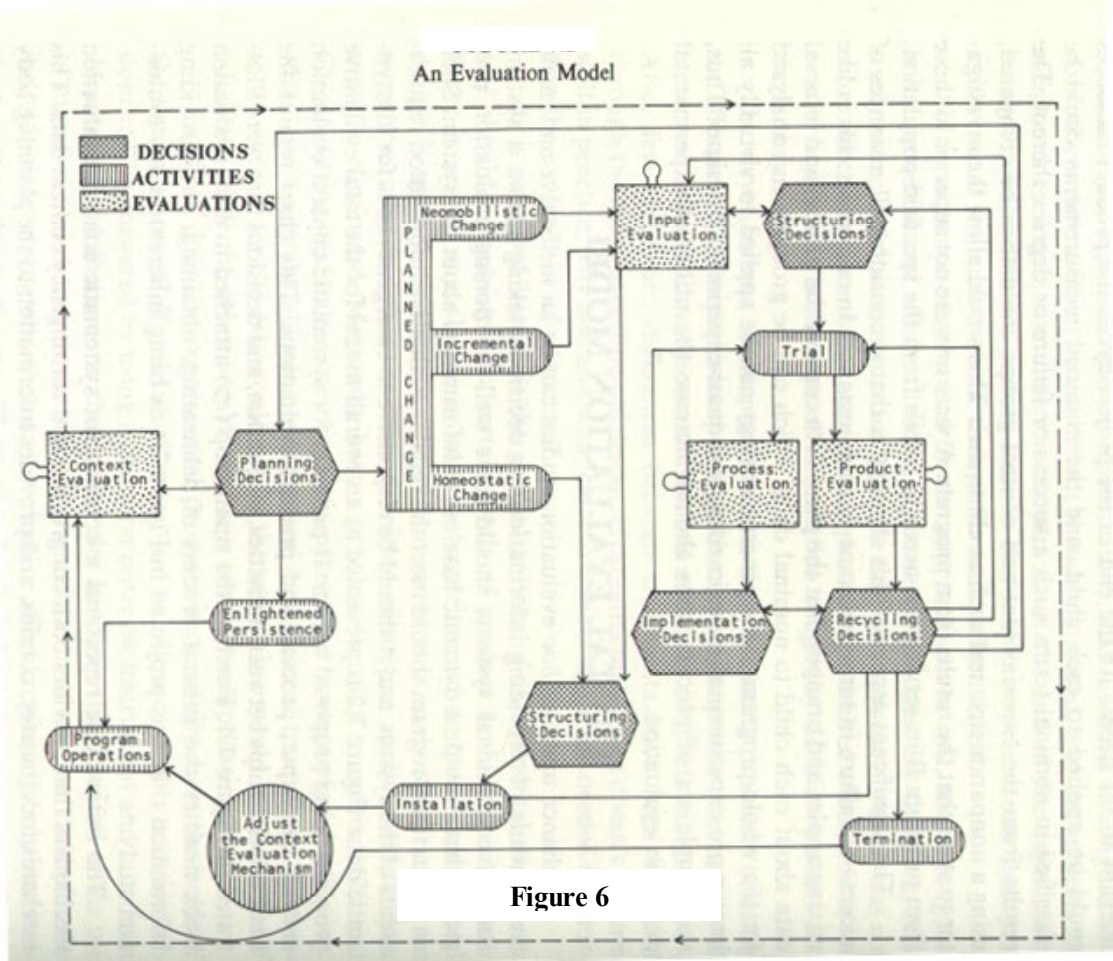


Figure 6

Finally, a review of the results in light of Stufflebeam's CIPP model is appropriate. Stufflebeam presented his Context, Inputs, Process, and Product Evaluation model (see Figure 6) as a process. As can be seen, the process evaluation that forms the bulk of this dissertation research would be performed along with product evaluation to determine if the instructional product that has been developed should be implemented. It can also be noted that process evaluation occurs within the loops of context and input evaluations.

The case study institution, CID, has demonstrated attention to the context evaluation component of CIPP, with various instructional designers, project managers,

and managers giving heed to aspects of context. For example, various projects are assigned various priorities based on perceptions of political and economic clout at the case study parent institution. The input evaluation component of CIPP is acknowledged during the ADDIE process when instructional designers meet with faculty members and assess the instructional and product viability of the proposed learning object or course.

The product evaluation component of CIPP, performing both formative and summative product evaluations to varying degrees is increasingly part of the instructional design process used at CID. This is largely a result of the efforts of the CID Evaluator who has made a conscious effort to introduce evaluation into all phases of the CID Project Lifecycle.

Chapter Five: Discussion and Conclusions

Discussion

This research began by asking the question of how changes in manufacturing models related to inspection costs have informed instructional design models such as ADDIE and their application. As I have highlighted in the results chapter, possible applications of the guiding principles summarized from the quality management and instructional design literature reviews may be applied to the ADDIE model usage employed at the case study institution. These principles are again reviewed in this chapter with continued discussion of the possible application of each principle or method proposed to the case study environment. Finally, conclusions about how these principles have informed the ADDIE model and conclusions about additional application to the ADDIE model are discussed.

The principles and methods summarized from the literature reviews are presented here in tabular form, following which is more detailed discussion.

Principle or Method	A	D	D	I	E
	Application in the case study institution				
Shift Focus to Error Prevention	-Use TAs, expert Instructional Designers as early error checkers. - Use standard development procedures and documents. -Involve QA specialists early to avoid ADA/usability issues.	-Use standard development procedures and documents. -Prioritize resources at the department level to reduce constant shifting of people.	-Emphasize error prevention during pre-production meetings by thorough discussion of specifications.	-Begin Implementation Evaluation when the project begins.	-Evaluate in small increments early and often.
Automate only where Sensible	-Provide SMEs with online standardized instructional concept proposal forms.	-Set QA testing levels so that error-free projects automatically move to the next process step.	-Use appropriate project mgt. tools. -Attempt to automate or mandate the use of at least elementary metadata tags to facilitate reuse.	-Develop and use standardized product test suites.	-Automate accumulation of evaluative data to allow analysis.
Adopt Mistake-Proofing Activities	-Use TAs, expert Instructional Designers as early error checkers.	-Design quick prototypes to test for learner concept understanding. -Make learner interactions database easy to access and use by designers and SMEs.	-Use heuristics during development to guide usability issues.	-Develop and use standardized product test suites. -Employ expert external reviewers.	

Principle or Method	A	D	D	I	E
	Application in the case study institution				
Make Early Use of Prototypes	-Use prototypes to establish proof of concept understanding with stakeholders.		-Use project management software to track prototype feedback and set up follow up actions.		
Analyze Changes in Costs/Benefits for Maximum Payoff (QFD)	-Use cost/benefit analysis to set threshold for accessing Instructional Design services. -Weigh impact of using/not using actual learners in analysis step.	-Weigh impact of using/not using actual learners in design step. -Use QA specialists to weigh consequences of non-compliance with ADA.	-Weigh value of project detail versus time required to update in setting up project tracking milestones.	-Weigh impact of frequently shifting resources to meet "routine" crises.	
Apply Continuous Process Improvement to the Process	-Introduce inspection / evaluation practices as early as possible into the process.				-Identify inspection / evaluation practices that do not contribute to decreased defects.

Table 2. Case Study Institution Application

Shifting Focus.

The first principle gleaned from the literature suggested an overarching principle from manufacturing and services of shifting process focus on methods, processes, and procedures designed to draw attention to error prevention rather than defect correction after appraisal or inspection. A basic paradigm shift occurred as manufacturers and

service providers realized that quality in the goods and services they delivered could be greatly increased by application of these methods, processes, and procedures in low cost ways. At the case study institution, an application of this principle to the CID instructional design process would be earlier learner involvement with the goal of error prevention rather than identification of defects later in the process. Additionally, this early attention should be focused on high cost areas of the process (see principle five below dealing with QFD).

One high cost area in the case study is the development of a planning document called the I^3 (Information, Instruction, and Interaction Design) that spans both the Analysis and Design phases. Application of the error prevention paradigm to the use of this document might encourage the case study institution as well as other entities to involve faculty or subject matter experts and learners, such as TAs early in the preparation of the I^3 or other initial design and development documents.

Based on interviews, a possible application of this principle to the analysis step (or in the case study example, the Concept, Planning, and Resourcing phases) would suggest that errors in analyzing content or audience might be best exposed by quickly reviewing the proposed concept with an "at hand" student—perhaps a teaching assistant (TA) already familiar with the course or subject material. This would be especially important for the high cost items associated with the proposal such as multimedia elements. Additionally, the expertise demonstrated by several of the instructional designers or of the evaluator could be leveraged to similarly review the proposed element before much of the cost is expended.

Another potentially high cost item to be considered during Analysis is user assurance and compliance with Americans with Disabilities Act (ADA) provisions. At CID, the user assurance specialist indicated that for several projects, earlier involvement during the analysis step might have identified areas with ADA compliance and user ease of use that resulted in user problems that can be classified as defects, later in the development process.

An existing application of shifting focus to error prevention rather than defect correction in the Design step would be the portion of the I^3 document dealing with the design process. For error prevention, this design portion was developed with and reviewed by both faculty and in at least one case, one "at hand" learner, such as the previously described TA.

A management action during the design phase involves rolling up the results of individual pre-production meetings into a department-wide work prioritization schedule. This action allows an overall focus on error prevention. Previous to this department-wide prioritization, resources were constantly being shifted about to meet the project crisis of the day.

Application of shifting focus to error prevention to the development step at CID could begin with CID emphasizing error prevention during the pre-production meeting in which task dependencies and formative evaluation techniques are built into the project plan and schedule. CID already does emphasize user assurance involvement during pre-production meetings, assuring that project people involved with the actual production of the courses or course elements are aware of ADA and other accessibility requirements.

Shifting focus to error prevention is also already taking place at CID, where the evaluator has implemented something he terms implementation evaluation. He asserts that just as implementation really begins when the initial project analysis begins, so too must evaluation, the heart of error prevention, begin with that initial analysis. The general philosophy of the CID evaluator is that evaluation doesn't start when the thing ends; it starts when the thing begins.

Automate only where sensible.

In the case study example, both faculty (subject matter experts) and students (learners) are customers. The second principle indicates that service automation attempts should be limited to customer interaction events typified by less customer variation. When there is not a great amount of such variation, service automation can help reduce costs of instructional content development. In the case study example, offering to faculty the use of standard Web-delivered concept proposal forms enables some "automation" during the Analysis phase. An element of the automation could include a decision tree used by faculty members or subject matter experts to determine the applicability of their instructional idea to the design process at CID or elsewhere. It could include a go/no-go decision point guided by thresholds set for potential impact of the instruction. Negatively, the "automation" at the entry point of instructional design also serves as a gate, possibly reducing the number of faculty members willing to enter into the instructional design process.

Additionally, the literature reviews indicated that caution should be exercised in requiring the use of this type of automation as the sole entry point for services.

Considerable variation exists now and will definitely continue to exist, given the independent nature of most academics. Nevertheless, for CID, automation of the analysis and design steps present good candidates for the introduction of a measure of "service automation" into the process as evidenced by the recent process addition of the standard I^3 document. While significant customer variation currently exists in the form of widely divergent approaches in presenting instructional ideas, it is possible to facilitate a common method of expressing those ideas through the use of standardizing questions and checklists.

One area of wide variation among those involved in the development of instructional courses or products is the basic approach or pedagogy employed. Recently, tools have become available that can reduce this variation by forcing users to use a common pedagogy dictated by the tool. It is the author's experience that the use of these tools is still too complicated for most subject matter experts not to mention instructional designers. However, should such tools become sufficiently easy to use while also becoming powerful (usually meaning flexible to most people), it is possible this type of automation may yet have an impact on the field.

As mentioned in the results section, some of the projects discussed during the interviews have early quality assurance testing done with several students from the target audience. Based on how much variation is revealed during this QA testing, decisions could be made about the level of service automation to be done. For example, if the early QA testing shows little variation in results, project management software can be programmed to pass the project along to the next stage in the process. A threshold could

be specified for this variation and could even include such variables as the number of testers, requiring a higher threshold be met if fewer testers are used.

One area that approaches automation at CID as well as at other entities in possession of a substantial amount of reusable learning content is cataloging or metadata tagging and making such objects available for reuse. In the case of CID, many types of learning interactions have already been designed. These include drag and drops, matching, crossword puzzles, and others. Merely describing these interactions in a text form and showing those to potential users may advance reuse by a significant degree. While such cataloging is not automation in the factory model sense of the word, it does provide automation in that once an interaction is selected for reuse, its production is automated, in that only a few fields typically require modification for the reuse. Additionally, these reusable objects have already been through evaluative measures designed to ensure their success for use in the prescribed interaction.

Using sophisticated project management software that allows task responsibility to be assigned by position as well as by person, with various follow up attention levels assignable and trackable, can facilitate automation of some tasks currently manually tracked. As CID adopts a more advanced project management software package, consideration will also be given to how a course or instructional content management system will link to that. The intent is that the project management system will provide a way to "automate" metadata entry by capturing that information during the course design process and linking it with the appropriate course management system. Such an effort

may result in significant cost savings as course and learning object reuse becomes feasible.

Standardized test suites have been developed in CID to ensure that the instructional product functions correctly under the supported software platforms, such as Netscape and Internet Explorer. While not totally automatable, the test suites used reduce the variation that exists when humans make decisions about what to test.

Once a project at CID has been closed out, summative evaluation, not officially a part of the CID Project Lifecycle, is conducted, when financially feasible. As of the writing of this research, summative evaluation is not usually budgeted for instructional design projects. However, some summative information is available for some products.

For Independent Study courses, surveys are given to each student at the completion of the course. In the past year, processes have been put into place to automate the aggregation of this information into an analyzable format. It is now possible to easily conduct item analysis on individual questions and perform cross-section and cross-course analyses. Written comments have not become part of this automated service operation, although the comments are transcribed and made available to designers and course owners, such as faculty members.

Adopt poka-yoke or mistake-proofing processes.

This poka-yoke or mistake-proofing concept introduces processes to failsafe specific high-cost, high-value activities. Manufacturers implementing a poka-yoke system based them on their expertise in manufacturing and observations of the line, resulting in an increase in quality while reducing costs. One could observe that a similar

system used in developing lower cost, higher quality instructional materials would likewise necessitate a reliance on the expertise of the manufacturers, in this case, the instructional designers.

Instructional designers have many of the expert skills used by other "manufacturers" to identify and reduce error and waste. The types of poka-yoke processes they could introduce include a practice already in use. At least one instructional designer makes use of an already employed teaching assistant (TA) to serve as a poka-yoke-like screener for instructional content and materials. In this process of checking with the TA, the resulting instruction has been mistake-proofed to some extent. Developing a quick prototype and showing it to the TA, asking if it conveys the intended lesson or message, would serve the same function as a poka-yoke device that shunts specification-failing parts off the production line. An additional method of mistake-proofing occurs when instructional designers themselves act as mistake-proofing agents in assuring that faculty members have adequately thought through their instructional goals when they present ideas for their projects.

In addition to standardized questions, checklists, and forms offering a form of automation (indeed, they could actually be automated by accessing them through a database-driven application), this approach to service delivery presents the opportunity to build in poka-yoke devices or activities to reduce costs or increase productivity. For example, only a few people currently involved in the CID production process have intimate knowledge of existing learning activity interactions. The concept of mistake-proofing how interactions are designed in courses might stipulate that a database of

existing interactions be consulted by instructional designers, faculty, or both, prior to specifying the creation of a new interaction.

As previously mentioned, standardized test suites have been developed and could be considered a type of poka-yoke process. Another poka-yoke process employed for all of the instructional products that become Independent Study courses is an external editor review. When questioned about the possible high cost of paying external editors to review every course, the evaluator indicated several factors mitigated concerns about costs. A process has been developed to identify, try, and retain qualified reviewers. CID's host institution is located in a relatively small valley urban environment having over 50,000 college students where an abundance of under-employed Liberal Arts-trained professionals are available to fill the reviewer ranks. Ensuring consistency of reviews is accomplished via that most common of poka-yoke devices, the checklist.

Another type of poka-yoke employed by CID in the design process has been the development of heuristics for certain things. For example, CID has developed accessibility heuristics, having accumulated knowledge that certain ways of placing text on screen and certain kinds of on-screen contrasts are easier to use for people with physical disabilities. Legal requirements have dictated some heuristics but there are also design heuristics that CID is attempting to adhere to. To ensure that these heuristics are introduced as early as possible into the project plans, these concepts are discussed in the design team meetings. A requirements list has been developed, against which the final product is tested.

Make early use of prototypes.

One process often employed that assists in mistake-proofing learning objects is the use of prototypes. The use of early prototypes, especially in the area of relatively expensive multi-media objects should be pursued. The concept of using early primitive prototypes is already a part of the process used by many of the instructional designers in the case study institution. Rough paper sketches representing potential computer simulations were created for use in presenting the proposed instructional product to the budgetary approval entity. Additionally, some even applied the concept of error prevention by showing those preliminary sketches to students to ensure intended understanding was occurring.

During discussions about the pre-production meetings of the case study institution, several instructional designers expressed the desire to be able to design in appropriate levels of rapid user feedback from prototypes during the development process for high-cost multimedia items. Project managers indicated that it may be possible to employ software settings in the upcoming project management software to set check-off requirements at certain points during the development process to assure project workers obtain the needed feedback.

Use QFD to identify maximum payoff areas for change.

The use of Quality Function Deployment (QFD) activities can identify the most beneficial instructional design process areas to address for change. As suggested in the results section, a quick Quality Function Deployment review might result in an instructional design process change to focus go/no go development decisions as close to

the start of the process as possible. For the case study institution, this would necessitate recognition of learners as one of several critical stakeholders and accordingly, would require at least some learners in a review process early in the instructional materials development.

For instructional designers in general, serious consideration should be given to the early inclusion of target learning populations in the design and development process. Additional weight is given to this consideration if one perceives the paradigm shift suggested in the shift to error prevention is valid, as learners would provide excellent resources to prevent errors early in the process.

For project managers, an application of the QFD principle would be an examination of the balance that must exist between providing sufficient detail in project management software to properly track important elements of the project and limiting that detail so that project managers are not overwhelmed within days of trying to get new projects underway. The QFD activity of identification of high impact project elements can assist in determining the detail level by which such elements should be tracked. Another important QFD activity to undertake would be to try to understand the potential value of assigning either the project manager or the instructional designer ultimate project responsibility.

For managers, the application of QFD activities to focus prospective resource rebalancing on the highest payoff process areas would decrease the churn often currently experienced when resources are shifted because of outside pressure that lacks real context value to the organization.

Some instructional designers at the case study institution performed a form of QFD analysis. As previously discussed, rough paper sketches representing potential computer simulations were created to present the proposed instructional product to the budgetary approval entity and to students. QFD analysis might show that such approaches present significant opportunities to avoid unnecessary or incorrectly directed development of instructional products. Another high value activity similar to a QFD analysis that has been performed during design activities at CID is the review of instructional design proposals by quality and usability assurance specialists. Such reviews were reported during interviews to have reduced the incidence of non-ADA (Americans with Disabilities Act) compliant courseware at the case study institution.

Apply Kaizen continuous process improvement

The application of kaizen continuous process improvement efforts to the instructional design process could begin with the identification of inspection/evaluation practices that do not contribute to decreased defects. At the case study institution, the use of meta-evaluation, or looking at how much value inspection/evaluation brings to the process, has been ongoing since the introduction of a full time evaluator to the staff several years ago. This person has made efforts to shift the inspection/evaluation process forward and into the instructional design process with the goal of continually improving the learning objects produced by CID. Even though the documented CID Project Lifecycle flowchart does not reveal this inspection/evaluation throughout the process, it is occurring.

Indeed, this dissertation is made possible by a commitment to meta-evaluation on the part of the case study institution, as the dissertation is largely a meta-evaluation of the instructional design processes and procedures at CID. The discussion and conclusions of this dissertation were sent to CID management staff for their reaction and as a form of member checking (Stake, 1995). The recommendations are being considered for adoption.

Conclusions

The six principles and methods summarized from manufacturing and services quality management literature and from instructional design literature seem to have already informed the ADDIE model as represented by usage at the case study institution; however, they are not well articulated in instructional design literature.

Shifting Focus.

While not stated in any process document or procedure, the case study institution has shifted process attention to methods, processes, and procedures designed to draw attention to error prevention rather than defect correction after appraisal. However, the overall perception still prevails that inspection/evaluation is expensive, especially with the target learner population. At the case study institution, this has resulted in a lack of broad adoption of inexpensive processes and procedures that could facilitate early learner involvement in the inspection/evaluation process. This research is limited to a single case study so application of observations to other instructional design entities or to the field is not generalizable. However, the author has not observed the substantial commitment to

meaningful early learner involvement in the inspection/evaluation process that might arise out of a paradigm shift from defect correction to error prevention.

Automate only where sensible.

Numerous attempts have been and continue to be made to introduce forms of automation into the ADDIE process. Such efforts include the development and promotion of course and learning object authoring tools designed for both instructional designers and end-users such as subject matter experts. The financial failure of such tools in the marketplace, caused primarily by lack of integration into the organizational culture and by the tools themselves remaining so difficult that only experts can use them (Learmonth, 2003), validates the notion that this type of service automation should be limited to customer interaction events typified by less customer variation. However, automation attempts should be pursued where they also support other principles, such as the effective introduction of low cost poka-yoke devices and processes.

Adopt poka-yoke processes.

The third principle, the introduction of low cost poka-yoke processes and devices to failsafe specific high-cost, high-value activities has definitely impacted the ADDIE model usage in manufacturing and services. It is making inroads in instructional design usage of the ADDIE model as well. Examples include the use of target learning population representatives to provide early reviews of proposed learning activities and objects.

Make early use of prototypes.

The use of prototypes has been common in instructional design practice for many years and has included those employing the ADDIE in development of instructional objects. Focusing the use of those prototypes on high cost multimedia objects at an earlier stage would present implementing firms with increased savings potential compared with traditional usage.

Use QFD to identify maximum payoff areas for change.

Identification of optimal candidates for process changes such as the development of and use of poka-yoke devices and early introduction of prototypes can be done with approaches such as Quality Development Function activities. Such activities assess the cost savings (or revenue generating) potential of various process elements, ranking elements higher that have greater impact at lower costs.

Apply Kaizen continuous process improvement.

Such rankings and application of changes associated with their adoption can contribute toward a kaizen continuous improvement environment. A reconceptualization of the ADDIE model reflecting all of these principles would emphasize this continuous improvement done in a cost-effective way by focusing inspection/evaluation involvement of learners at an earlier stage than is currently done.

General Conclusions

While I have made several attempts to clarify that this research is not intended to present the field of education with yet another roadmap to become more "successful" by

emulating business practices, the mere use of business literature will prompt some to decry this effort. Students are not widgets to be re-designed and faculty and instructors are not machines to be tweaked into perfect performance. Yet the field of education and training can learn from business just as business has learned from educators. Shifting focus to error prevention has many labels such as do it right the first time. In applying this to education, does that mean that faculty must do it right the first time or they are defective?

The error detection and correction this research examines deals with learning objects, not the people who work with the objects. Nevertheless, educators may obtain some benefit from the concepts developed in this research as they develop their own learning objects such as classroom discussion outlines, presentations, and even entire courses.

At the beginning of this dissertation, I cited an assertion attributed to Thiagarajan, comparing the ADDIE model to an outdated 1950s manufacturing model (Zemke, 2002). Thiagarajan offers Rapid Instructional Design as an alternative to ADDIE (Thiagarajan, 2003). This approach has ten strategies for designing instruction:

- Strategy 1. Speed up the process.
- Strategy 2. Use a partial process.
- Strategy 3. Incorporate existing Instructional materials.
- Strategy 4. Incorporate existing non-instructional materials.
- Strategy 5. Use templates.
- Strategy 6. Use computers and recording devices.

- Strategy 7. Involve more people.
- Strategy 8. Make efficient use of subject matter experts.
- Strategy 9. Involve trainees in speeding up instruction.
- Strategy 10. Use performance support systems.

Even though Thiagarajan has apparently abandoned the outdated ADDIE model, his strategies reflect many of the principles that are developed in this dissertation to improve ADDIE. His strategies 3, 4, 5, 6, 8, and 9 could be directly mapped onto some of the examples discovered in use in the case study institution that employs a fairly direct version of the ADDIE process model in developing instruction. Perhaps ADDIE has evolved just as manufacturing and service operations have evolved.

Recommendations

While this research was conducted with a fairly large instructional design organization with departments full of instructional designers, project managers, artists, and programmers, the principles and methods summarized from the literature review and observed in action can be used by anyone involved with creating instruction (or practically any service activity for that matter.) Whether one is working on their own to create a new lab experience for elementary school children or working with a team to improve the district curriculum, shifting focus to error prevention from defect correction will improve quality and reduce costs.

The following are recommendations that are specific to the case study institution but may also have more universal applicability in reconceptualizing the ADDIE model. Recommendations that can have **immediate** application:

1) Include a stronger emphasis on the student as both a stakeholder and as the actual end-user of the instructional product being developed. In the case study example, the student is frequently mentioned as being important and as being the one who designers, artists, programmers, and testers are thinking about. However, during the interview process, rarely were students mentioned as the "customer" of the design and development process. Rather, faculty members or instructors were frequently mentioned in that context. A broader application of this recommendation would be that end users should be considered important stakeholders who should be consulted throughout the instructional development process. Employing end users early in the development process will also facilitate the shift in focus to early error prevention.
2) Instructional designer expertise can substitute for a portion of obtaining end user feedback. Just as the case study institution has developed heuristics for text placement on computer screens, the instructional designers working there have developed personal heuristics by developing similar types of instruction in the same colleges and schools. Further, the best experts in any process are often those using the process to perform their work. Instructional designers may have sufficient experience to reduce some of the feedback needed from end users to ensure that learning materials are meeting their needs. Instructional designers may also be the best people to design and implement poka-yoke processes in their organization.

3) A scarce resource in the instructional design process is the subject matter expert or the faculty member in the case of a higher education institution. Many faculty members have teaching assistants (TA) for the various courses they teach. Assigning the TA to work closely with the instructional designer for the bulk of the course creation effort may improve the availability of the faculty member for critical content reviews and multimedia learning object reviews. Coincidentally, it would expand the learning opportunity for the TA, as they would likely be at least somewhat stretched as they provide subject matter expertise in a subject they are just in the process of acquiring. In other settings, an administrative assistant or trainee who has some experience and is working to become more expert may perform this TA role of substituting for a more expensive and busy subject matter expert. Substituting this less constrained resource can improve both the instructional product and the organization's depth and experience in the subject as the trainee learns and grows. This substitution may resemble a form of a poka-yoke process.

4) Conduct in-person content reviews with faculty members rather than sending materials for review at their own time. This helps increase the likelihood of early error detection versus attempting to correct defects later. (The development process will likely continue while the materials to be reviewed are in the faculty member's queue, introducing defects that will need to be corrected after the review is completed.) Similar to prototype testing, in person content reviews may be just as valuable in other settings, likewise

affording the important shift to early error detection from later defect correction.

5) A continuous improvement process that could make learning resources widely available would be the adoption of a metadata standard for learning objects. For CID, instructional assets developed within the organization are not currently made widely available for reuse to others within the organization. At a minimum, a listing of all the titles of created learning objects could be assembled and made available. Learning object definition varies but in this case should be an economically viable definition. For example, the title and type of learning activity interaction could be the finest level of granularity rather than each screen within that interaction. This listing of available learning objects could be considered a component of a templatized authoring system. As noted, such templatization may be viewed as a way to automate production. Business and industry use of templatization of metadata tagging may be an effective method of introducing this form of automation.

6) Quality Assurance and other inspection/evaluation practices to assure quality are often part of the documented processes at CID yet they are sometimes dropped intentionally or inadvertently. This appears to happen due to time and budgetary constraints and should be acknowledged and responded to by CID management. Business and industry practices may mirror those of CID in intentionally or inadvertently dropping inspection/evaluation practices. In view of the key principle of shifting from defect correction to error

prevention, those responsible for inspection/evaluation should reconsider how to economically include inspection/evaluation in redesigned processes.

Recommendations that can have **longer-term** application:

7) A form of automation that would make sense for CID would be the development of a standard prospective instructional design project rating form with values. Such a form would result in a calculated total that can be compared to a decision table with not only a go/no go decision but also with an indication of a projects' relative priority; e.g., this is a class "C" project which will be completed within three to six months, depending on the volume of other higher priority projects. A feature of the rating form could be that as a project ages, it could automatically be incremented with a higher value in one of the table cells, ensuring that it will be completed no later than the original outside range. In the example being proposed, it would not take longer than six months to complete. Another feature of this ratings process could be the option given to departments to increase the priority of the project by contributing more money to the project. Other organizations may likewise investigate routine items where instructional designer judgment is relied upon to establish priorities and set work schedules. Careful delegation of authority and responsibility to designers may be possible by "automating" these decisions with such tables or decision trees. (Recommendation caveat—even when a standardized process is carefully developed and implemented within an organization, actual usage of any standardized instructional design process

will vary. This may be typified by likely variation that exists from one instructional designer to another in defining "good enough." The "quality call" ultimately ends up based on that designer's (or possibly the faculty member's) decision to accept something or push for something better, thus inducing variation in the definition of quality.)

8) A method of automation that is always tempting is the implementation of the latest instructional design technology (see history of training use of tape recorders, video recorders, television, telephones, satellites, the Internet, etc). A recently available form of automation is distributed authoring. In the event that a truly easy to use form of distributed authoring is made available to faculty members, usage guidelines should be formulated with a task force that includes faculty members. These guidelines should include a provision for some type of firewall between courses in current use and the faculty updates to that course. This process would prevent a faculty member from inadvertently making assessment changes that could impact a students' test preparation. Additionally, content and quality review processes could be implemented to ensure changes to courses meet department, college, and university standards. Of course, such review processes might discourage faculty members from using the distributed authoring function, considering "reviewed" distributed authoring an oxymoron. Non-academic institutions should also exercise care when implementing distributed authoring within their organizations. In many cases, this distributed authoring is already

occurring as manager, trainers, and employees develop learning objects needed to develop important skills, abilities, and knowledge. The organization may actually be limiting a freewheeling distributed authoring environment by trying to restrict authoring to the firms now favored approach. However, this attempt at "automation" may be very valuable to the organization as a whole if learning objects that are developed using the standardized authoring tool are widely made available within the organization.

9) While faculty compensation issues are important, they may not need to be addressed. How faculty members are compensated for their participation in the creation and support of distance education courses seems to have little impact on their dedication, enthusiasm, or commitment to the process of creating learning objects (IHEP, 2000). However, a QFD process to review subject matter expert commitment and impact on the learning object development process should occasionally be undertaken.

Metaevaluation Results

The summary conversation contained in Appendix B illustrates that CID, in general, follows its documented processes. Several issues identified in these three external reviews were not addressed in the results section of this research. However, most conclusions concerning inspection/evaluation cost issues were similar between those three reviews and this research and generally confirm the data source triangulation. Exceptions are noted at the end of the external review summary in Appendix C.

Limitations of the study

The case study institution had not had sufficient time to establish precise cost measures based on the recently introduced instructional design process. Further, previously used processes recorded only total project costs, not component or processing costs. This lack of data makes pre and post comparisons of cost savings actions taken as a result of this study impossible to measure.

A lack of direct contact with learners impacted by the design decisions being made as a result of the study limits the value of the study while lack of sufficient time and resources to conduct additional case studies with multiple subjects also limited the value of the study.

Subjectivity of the researcher may have impacted how observations were made and recorded. Indeed, the selection of the case study subject was based mostly on subjective factors easily distorted by the researcher's own bias (see Appendix F).

During the interview transcription process, respondents made several suggestions for process improvements during the course of the interviews. However, there should not be much concern with Hawthorne effect since the research project is not a controlled experiment but rather a qualitative study centering on learning object inspection costs in the design process. Still, one wonders if the mere act of interviewing so many people in a relatively small organization might increase the likelihood that the organization will focus more on those costs and subconsciously, try to reduce the costs or improve the way it obtains inspection information.

Further Research Recommendations

Further studies to document actual costs associated with inspection/evaluation of instructional design products produced using the ADDIE model could quantify results of implementing process changes when the organization focuses on error prevention versus defect correction. Pursuit of such studies could be based on the foundation established with this work.

For organizations attempting to implement instructional design process improvement using teams, sponsorship by top management in the university or organization is crucial. More precisely, because top management has identified a process improvement initiative as important, there is usually little question about the commitment of the organization to engage seriously in the effort (Fairfield-Sonn, 1999). With a strong top management commitment come the resources and independence of operation needed by the process improvement team to implement the changes that often stretch beyond the organizational boundaries of the instructional design and development unit. Among these changes are the administrative processes that need to be added or updated to support the new design process and the related instructional product output (i.e., the courses and course materials). Among the questions that require attention is the matter of the technical infrastructure and its sufficiency to support the increased throughput demand generated by the course participants (Gibson & Herrera, 1999). Another interesting question might be whether faculty compensation issues were reviewed as part of the instructional design process improvement effort (Roberts, 2000).

Any process change made by an institution should have boundaries defined and guidelines established concerning the impact of the process change. Is the improvement process change applicable to all projects within a department or is there a threshold below which projects are too small to improve? For projects to which process improvement changes are applicable, are guidelines available that articulate when the improvement process is finished? Or in other words, when is one done?

While this dissertation research is concluded with this paragraph, the research is not done. Continual process improvement to the ADDIE model is inevitable, with or without the research involvement of this investigator. ADDIE will continue to evolve; just as manufacturing implementations of it have done and continue to do.

Appendix A: Process Review Procedures and Interview Protocols

Process Review Procedures and Processes

Obtain and review all documentation relating to the instructional design processes and procedures used.

Obtain and review copies of external instructional design process reviews or other case study institution evaluations.

Develop a flowchart of intended operations relating to instructional development. The flowchart should be especially in-depth as it relates to inspection (or evaluation) processes.

Interview Protocols

Research issue (These questions will not be asked—what is the role of evaluation/inspection in instructional design practice? How is it actually performed during the process?)

What are the documented processes you follow in designing instruction?

Are there processes you follow that are not documented?

Are there processes you follow that differ than those of your colleagues?

What is the role in evaluation in your process?

At what points do you inspect your product (evaluate your instruction)?

Are there any "tricks" you use to ensure that your instruction meets the needs of the target learner population?

Is there a particular instructional design paradigm that you follow?

Do you use ADDIE as the basis for your instructional design work?

How do you control what Cronbach called the "infinite hall of mirrors" that can occur with striving to obtain substantial user feedback?

Appendix B: CID Case Study Story—The Inspection/Evaluation Goal

The initial orientation for the researcher included a tour of the facility and introductions to many of the personnel. The organization chart in Appendix C depicts the organization as of the start of the research effort. One of the managers described the organization as follows:

'We have a production side and an instructional design side and they had to find a way to work together and to share information and to make their decisions. And out of that emerged this organization and process. It was needed because the job of production is to make people's dreams come true and they are really good at that. But the instructional designers would not say 'no, we can't build that' because of time or budget constraints. So, we added the project managers who are now the moderating voice. They act as a go-between for instructional designers and production.'

Based on the organizational structure, interviews with all of the instructional designers, project managers, and managers were arranged. Additionally, a Senior Production Designer or SPD (pronounced 'spud') and a Senior Programming Developer or SPD (also pronounced 'spud') were also scheduled for interviews. During January 2003, all of the interviews were completed, resulting in 123 pages of interview transcripts that are available upon request from the author. The resulting transcripts, the external reviews, and personal observations form the basis for the following story.

As I neared completion of the course of study in my doctoral program in Instructional Psychology & Technology, I struggled as many Ph.D. students do with the

selection of a meaningful dissertation topic. I had been pursuing the degree either full or part time for the previous four years, interrupting (or abandoning) a career centered in the information systems industry. My studies led me to become interested in the evaluation of instruction in the context of the instructional design process. What research question might accommodate this interest and yet be of interest to the field of instructional design? In discussing this problem with my advisor, we reviewed my extensive business background as well as the evaluation and instructional design projects with which I had been associated up to that point.

During the discussion of business process improvement trends, we realized that similar process improvements could be discovered and documented in the instructional design world, especially in the usage of a very common model employed for development of instruction known as ADDIE. So, after the usual prospectus development process was completed, including an intensive literature review of both quality management and instructional design literature, off I went to discover and/or develop an exemplar of ADDIE usage informed by proper focus on inspection/evaluation costs during the design process. This is what happened…[1]

I met Howard at the entrance of the Center for Instructional Design (CID) at the appointed time. Howard, one of the managers at CID, had agreed to give me a brief tour of the facility before we began our interview, the first of many with CID personnel. I had previously telephoned Howard's boss, the Director, and explained my desire to conduct

[1] The case study institution is known as the Center for Instructional Design (CID) at Brigham Young University. Rationale for its selection is detailed in the Methodology section. For privacy reasons, a fictitious instructional designer, a fictitious project manager, and a fictitious manager are generated out of the real interviews with CID personnel. There is no Steve, Alice, or Howard at CID.

research with his organization; promising confidentiality as well as great research results that would help him reduce costs in the area of inspection and evaluation. With some skepticism, the Director agreed to do what he could to facilitate the research while adding that it might be difficult to document any cost improvements since the records to support such assertions might prove difficult or impossible to obtain. He would explain that during our interview.

Howard and I passed the small (CID) reception area and entered the main bullpen. Along one wall were the offices of the managers; along the other wall were the larger cubicles of the instructional designers. In the center were cubicles of various sizes as well as tables of computers for the project managers, spuds, artists, and programmers. *What are spuds?* Howard indicated that a layer of first level supervisors was placed over student employees to coordinate and supervise their work. The spuds were SPDs for Senior Production Designers or Senior Programming Developer, to keep the acronym the same.

I was introduced to many of the managers, project managers, and instructional designers, with Howard letting them know the Director has cleared it so that they could take work time to meet with me. As Howard led me back to his office, he assured me he would provide this information to the other CID folks I needed to meet with via email. Once in his office, an organization chart and a flowchart called the CID Project Lifecycle were given to me. Additionally, an email was sent containing the following CID process documents: I^3 Design Document.doc, I^3 Coversheet.doc, Concept Proposal.doc, team-roster.xls, Status Report Template.doc, Project Plan Template.mpp, template closeout letter.doc, PMT Agenda.doc, closeout questions.doc, Programming Development.pdf,

CIDProjectLifecycle.pdf, and PMT Scoring Model Revision.doc. Howard also gave me the documentation of three external reviews of the instructional design process and evaluation that had been done for CID. Thanking Howard for his time and the materials and confirming our appointment time in the coming month, I returned to my office and began trying to understand how CID and others thought they were doing things.

First examining the three external evaluations that had been done on various aspects of the instructional design process at CID, I found that they varied in comprehensiveness and approach. The first evaluation on Semester Online Courses comprehensively dealt with evaluation of eleven courses that were largely migrated from paper-based Independent Study courses to on-campus Web-based courses. My review of this evaluation examined in particular recommendations about the inspection/evaluation process. Six recommendations spoke to that process and are examined in the conclusions section in light of this research. The second evaluation is my own preliminary research work on the instructional design process previously used at CID to obtain student feedback. Of the ten recommendations made to improve that process, six have fairly direct application in the process of reducing inspection/evaluation costs. Once again, those are examined in the conclusions sections of this research. The final evaluation, a value stream mapping of the CID instructional design process, coincidentally also contains six recommendations that address the issue of change of inspection/evaluation process focus. These recommendations likewise illuminate the conclusions of this research endeavor.

Turning to the CID documentation, it seemed that the flowchart would provide a general overview of what should be happening at CID. The flowchart was fairly detailed, especially when accessed online with links to explanations of the various steps. I downloaded and printed out those detailed steps so that I could refer to them during my interviews with people. The CID Project Lifecycle seemed to map quite well onto the ADDIE model, with the concept, planning, and resourcing phases covering the Analysis step, the design phase covering the Design step, the pre-production and production phases covering the Development step, and the post-production and close-out phases covering the Implementation and Evaluation steps. Of course those PMT (priority management team) steps along with an additional documentation item, a PMT Scoring Model, were sort of just stuck in there and would have to be factored into the process as well. Considering the fairly good detail of the process, it seemed that there might be opportunities during the interviews to compare the detail of the process with actual performance to identify where some inspection/evaluation costs might be reduced.

Other documents given to me as part of the CID instructional design process also contributed to a deeper understanding of what was supposed to happen and also seemed to map onto the ADDIE model. For example, the Project Concept Proposal document presented the CID approach to part of the Analysis step. In addition to providing further documentation of what was to happen during the Analysis step, the I^3 Documentation was an extremely important part of both the Design and Developments steps. The I^3 (Information, Instruction, and Interaction Design), when completed, outlined the basic instructional objectives and the strategies to achieve them, including sufficient detail

about the instructional content. Further, a rough plan for assessment of the objectives and how the instruction would be implemented was to be presented.

The CID Programming Development flowchart (see Appendix C) provided additional context for the defined process during the Design and Development steps. Bridging most ADDIE steps, a team roster was part of the described process in order to encourage participation of all needed instructional development team members. To further facilitate that participation during the Development and Implementation steps, the project managers were given a status report template to email to team members. Finally, as part of the Evaluation step, a pre-defined set of project close-out meeting questions and a project close-out template was provided.

The three external evaluations and the CID documentation informed my research question, leading to the development of the following list of questions to ask all of the interviewees was developed:

- What are the documented processes you follow in designing instruction?
- Are there processes you follow that are not documented?
- Are there processes you follow that differ than those of your colleagues?
- What is the role in evaluation in your process?
- At what points do you inspect your product (evaluate your instruction)?
- Are there any "tricks" you use to ensure that your instruction meets the needs of the target learner population?
- Is there a particular instructional design paradigm that you follow?
- Do you use ADDIE as the basis for your instructional design work?

- How do you control what Cronbach called the "infinite hall of mirrors" that can occur with striving to obtain substantial user feedback?

I knew that I would need to modify the questions slightly for project managers and managers, as the questions were really centered on the instructional design process but felt that I was ready to proceed. The instructional designers had a weekly ID meeting to discuss common issues. With permission, I began attending those meetings. The first time I attended the meeting, I was introduced to all of the instructional designers and gave a brief overview of my research purpose, indicating only that I desired to collect information about the process they used to do their jobs. I also distributed "Consent To Be a Research Subject" forms for each to sign. Since they all had their schedule planners with them, I also set up times to interview them.

Having assured each participant that their identities would not be made known, thus, hopefully encouraging more detailed responses, those interview responses are being presented in a process context, not an interview specific context. The CID process addresses the Analysis step of ADDIE in the Concept and Planning phases. The results of the interviews are present in the form of a discussion of these phases with a fictitious instructional designer, Steve, a fictitious project manager, Alice, and a fictitious manager, Howard, all of whose comments are excerpts from actual comments with all of the interviewed instructional designers, project managers, and managers. They discussed their work process as illustrated by the following blended conversation, set as a discussion with these three people.

Steve, what are the documented processes you follow in designing instruction?

The CID process begins with this umbrella process, beginning at **the Concept Phase**, that involves creating some kind of conceptualization document. There are faculty members who are aware of us and what we do, so they come to us with an idea that they have had and together, we will make some kind of determination as to where it best fits. We have a proposal form and we talk it through and get a feel for how complicated the idea is to implement and put that idea into the proposal form. We have some general guidelines we use to see if the project will be approved: will it impact a lot of students? Will it have a lot of department support, not necessarily in form of money but in the form of buy-in? (If we create this thing, will a lot of people use it?) In other words, will it really help the students in that department?

In some cases, the project may be too small, though that is usually not the case. Faculty members usually think big. If it is too small, it might be appropriate for the Instructional Media Center (IMC), say if they just have some slides that they want to put on a videodisk. We might say, here is a CIMA proposal form or we might say, let's talk about an Independent Study course. Another option we might talk about is putting that into BlackBoard, our campus course management system.

If it is not a full-blown course, I will make an initial determination whether or not it is applicable to the CIMA process. If it is a larger project, then I will meet with them to determine if it is something that can reasonably be done in our facility here. In some cases, I have had some individuals say that they want to design and construct sets and

have video shots, etc. It becomes a Hollywood production so I refer them to our campus TV station and their high production value facilities.

In other cases, the projects may be just a little bit too large, in which case I recommend that they do a subset of the project as kind of a proof of concept. So basically, we have to determine first of all if it is appropriate for us to do and if it isn't, we make a recommendation for external sources. And if it is too large, then we have to pare it down so that it is a manageable bite for us.

Even after we determine that the idea is something we can work with them on, a lot of times, it is still a pretty high level idea. For example, faculty will want students to have more practice analyzing a text against certain criteria. The reason—they may not get enough of this practice in class. But in terms of an actual implementation idea, as instructional designers, we need to help a little more because sometimes the faculty will have it and sometimes they won't. Part of that is that there are a lot of options, a lot of different ways you could approach the problem. As an instructional designer, one of my roles is to kind of go through the world of options with them, teasing out from the faculty what their real goals are, stated and unstated. There are times when there are things that they have not stated and in some cases, have not even realized themselves, what they are trying to do. So, through the conversation, we try to clarify what the real goal is here.

For example, they want their students to be able to write better legal briefs, better legal memoranda. But when you ask "what is it about that," they have to start digging a little bit so they can say, "these are the skills that go into that and these are the areas where students struggle." So, as you drive them back a little bit and they can examine

what it is they are really shooting for. And then you can start asking questions about what delivery mechanisms they have in place already; what constraints they might have. Then you can start saying, "Here are some options." So, for me, the design process is to help the faculty member really figure out what it is they want. And not nearly so much me saying, "Here is a solution."

I also like to keep the end-user in mind. I feel sometimes there is too much emphasis placed on what the faculty wants. Sometimes I feel like I am in a tough position because I'm thinking of the student as the end-user, the one who is trying to be able to learn and I feel like sometimes, in order to please the faculty member, we sacrifice something for the students. But sometimes politically because of the position of the faculty member, if they want to do this and they want to do it now, it will happen. I do think that we should be the advocates for the learning of the students. But it is a hard balance because we really work with the faculty but it is the students we are really trying to help.

Howard, who are the stakeholders in your projects? Broadly, it is all those who are interested in the success or failure of what we working on. *How do you define it operationally in what you really do?* It depends. The folks who do development work, including the faculty member, the production manager and his artists and programmers, the instructional designers, and there are also sponsoring stakeholders, depending on who is funding the course. The CIMA committee would be a stakeholder for CIMA projects. Independent Study would of course be a stakeholder for Independent Study courses. There are the large General Education courses that would involve a whole different set of

stakeholders. So it changes depending on the kind of project. And of course, the Academic Vice President responsible of our organization is always a stakeholder, given that he is my boss's boss and is leading the university charge in terms of strategy and policy. We try to bring those people in and try to understand what they are trying to accomplish.

Steve: Not to raise a sore issue, but students weren't mentioned as a stakeholder. I think that gets overlooked a lot. Our focus is just on what the faculty wants. I was just in a meeting in which our evaluator asked, "Well, what do you want the product to do?" I thought, well, certainly that is one of the first questions that should have been asked and I'm sure it was asked in the beginning phase of the project. But when we get into the work, we focus on delivering what the faculty want and when we deliver and that doesn't work—well, that is what the faculty wanted. I think there are some things that I can look at just by looking within myself—"If I were a student taking this class, would I use this?"

Sorry, just had to get that off my chest. Anyway, as we start to move from the concept phase to **the planning phase**, I think that some of the instructional designers get much more involved in a collaborative effort with the faculty and students. They will go and do some observations of the existing classes, observing especially what the students are doing. You try to assume intelligence on the part of the learner and help the instructor in providing them with the tools, the experience, and in some cases, the guidance to exercise that intelligence. And most students respond to that because there is that degree of self-investment rather than just passively 'soaking it in.' Even students who aren't very good at it still like the experience.

We have one product where, even if the students don't do well, they still like the process; they still like what they are working with. This is a Virtual Chem Lab—they may have a hard time completing the assignment and getting it right but they still kind of enjoy the experience of trying to figure it out on their own and doing it in kind of a semi-realistic environment. So, it not just canned where you go through the motions and you walk out the door with an 'A' on the assignment because you followed all the steps listed but you don't understand why you did what you did. The target is not that they get the color from the experiment that they are looking for—the real target is, can they think like a scientist? The proof that they can think like a scientist is that, ultimately, they can get the right color on their own. That is what you are shooting for. But they don't get there the first time around.

The goal during planning is to create a document that is clear enough so that the Priority Management Team (PMT) can make a resource decision. I do try to get a concrete representation, even if it is just sketches or throwing together a few graphics or a PowerPoint mock up. It really helps the faculty member to start to think of this thing as a real 'thing' and not just abstract ideas floating out there. It also helps to focus the discussion around the interactivity of the features—what needs to be there, what doesn't, at least from the content, the design, and the pedagogy standpoints. But the plan doesn't have to be a full description of the course; just enough detail so that the PMT can know what kind of resources are going to be required eventually.

We then get Department Chair approval and the Dean's approval that basically says, "We are aware of this and think it is a viable project." If we don't have buyoff from

the Chair or the Dean, then we don't pursue the proposal/project any further unless we think that it might be a project we could send to the Instructional Media Center. If it looks good, we send that concept proposal to our manager who takes it to **the first PMT review**. They are mostly managers plus the project managers and maybe a couple of other people. They decide if we have the resources to work on some things by using a set of weights and numbers to compare this proposed course to that. My manager says that he would like to do is get it to the point where the designers could sit down with the faculty member and just check it off right there so that we could eliminate that step of having to take it to the PMT and wait for them to get back to us.

What about that, Howard? That would be a step in the right direction. The thing what I would probably try to do is to go even further and get more development tools in the hands of faculty because faculty are the best qualified to make those judgments. They know the content—they know it better than we do; they know their students typically better than we do. A new instruction development product we are looking at seems to give us the promise of being able to do that but I don't think we will be able to do it for many, many more years. I think that product would do a very good job at helping instructional designers be more efficient authoring but faculty—I'm not convinced. But overall, I think that things that are developed by faculty with students in mind are generally pretty useful to students. But for now, we have found that it is better to help them create digital objects and a front-end that gives them easy access to use that and integrate that into their courses through Blackboard and they can set it up, still have their

personality in it but have access to all these digital libraries and digital medium that have been created. Then they can bring that in and use it to strengthen their course.

But if the faculty member and instructional designer decide to bring a course or project to us, we do need to review some basic things, something we haven't always done. For example, when the CIMA projects began about four years ago, our organization was quite a bit different than it is today. One of our ongoing projects is one of the first CIMA projects that CID took on and has been going for about three or four years but we are not even really getting close to being finished. I think the problem was that at first, when we took on any project possible we would say, "We'll do it; we don't care what you expect to get." As we have matured, we ask about who will do what, what is the goal, what are your outcomes—not, "Sure, we can do that!" I'm hoping that in our next round of CIMA projects, all of them will actually go through that kind of process.

Alice, the project manager, added: We need that kind of discipline with either of the two approaches we just talked about; giving our instructional designers a decision matrix they could use or giving faculty tools to do more on their own. With our existing process, we do want to know as much detail about this as we can get to help us know if we need to purchase some new product in order to complete this project. We will also try to anticipate from this information what kind of on-going project support will be needed. We also want to make sure there was enough user needs analysis to determine things like bandwidth requirements. So, oftentimes, we build things for on-campus students and consider they'll have a high bandwidth. Then, at the end, we have our university person who is in charge of trying to resell this. Other universities come in and say, 'hey this will

be perfect for this audience,' and we realize they don't have high bandwidth. So, it just doesn't work. I think we could do better at that with some better planning.

Howard, what happens in the PMT? Basically, we look at the proposal to see if it is deemed instructionally pertinent enough to warrant going further to the CIMA committee (Committee for Instructional Media Arts). That committee is made up of a couple of directors from CID and 7 faculty members who are asked to serve there. Before we send something there, we are very careful about the needs analysis, making certain that there is an instructional purpose and rationale and that there is, to some degree, a business rationale. The business justification falls more directly to our courses that are purely Independent Study and not so directly to our CIMA and General Ed courses, though the business justification is also a factor in that. For example, the Committee has generally adopted the position of the larger and greater impact over smaller, lesser impact. So, there is obviously some business implication there as well.

Alice: As project managers, we actually sponsor the project to the PMT meeting and help interpret the concept proposal in terms of project scope, resources, and schedule. The instructional design submits a budget that that is just a preliminary one estimating what it will take to do the project. We add a little more detail to the budget before the project goes to CIMA for approval. If we see that we're going to have to do ten videos, then we need to make time for video editing, for the studio. We try to break it down that way—we may need student researchers for 20 hours a week for the next 10 weeks, etc. Automatically, a certain percentage goes for overhead. We do the **resourcing** work that culminates in a budget that is worked out before it goes over.

Howard: Once we have deemed that concept proposal to be good and accurate, wholesome and everything, the instructional designer and faculty member are then free to spend a certain amount of money to get a full I^3 document together. It's that I^3 document that goes to the CIMA committee. The I^3 document is really just a much, much more fleshed out version of the concept proposal that was submitted to the PMT.

Steve: At this point, we will sit down with the professor and make sure that the proposal looks good, that they have covered all their bases. If necessary at that point, we can actually go and get an artist to briefly do a mock up to show the CIMA committee what we are talking about. The other thing we have to do at that point is nail down expectations. "Ok, professor, what do you see us building? How many pieces will it have?" We want to collect the entire material for the course. We put it all together for the course with a complete script, storyboard, or whatever it needs. A lot of people put these two phases (design and pre-production) together but from a characteristic standpoint, they are completely different. In this **phase (design)**, you are designing it for the sake of the student. Your full thought process is "what is going to be the best way for the student to soak this stuff in?" In this phase (pre-production), it's "ok, I've got a complete script—how many days and what kind of resources is it going to take? In the last two rounds, the CID director has had us do prototypes to document the process further so people on the committee can have a better idea of what the project entails—how it would look; how it would function—just to see if it is a viable project to do. The CIMA committee will look them all over and has x number of dollars to spend this round and so they decide which projects to fund and at what level.

If the project isn't approved, I get to talk with the professor and tell them about some alternatives, including the Instructional Media Center (IMC) helping to do some of those things. We try not to just leave them up a creek but to help them find a way to do something of what they were talking about doing. If it is approved, then we use that I^3 document to begin the process.

Alice: One of the problems we have had in the past is that the instructional designers kind of use a different format for their proposals to the PMT. Some people were better at it than others. Now, we have the I^3 document to help standardize things that get sent to the CIMA committee. Let's look at this I^3 document which has kind of evolved. When project management was rigorously put into the process here at CID, we had lots of existing projects that were being worked on but weren't being worked on in the new process so we had to find a way for them to fit them into it. We had to move a lot of projects back to obtain some documentation. To a large extent, we are still having some problems trying to overlay this new process over the old projects. You can't back everything up to square one and start with the new process. It reminds me of joke I heard. A mechanic went to a heart surgeon and said; "I don't really understand why you get paid so much more than I do—we do pretty much the same thing. We fix the part that runs the whole machine." The heart surgeon said, "well, yes, but have you ever tried to overhaul an engine while it's running?"

I think that is a lot what we are trying to do. We have these projects that are already half way through but they haven't been documented or maybe even designed very well. Do we stop production, go back and document and redesign it, only to find out

that all of the production has been a waste and throw it all away? That has been the biggest difficulty but I think the new process is beginning to show some results. Especially with the new projects, by the time we go through the scope review of those documents, I think all of them end up at a pretty good level for submission to the CIMA committee.

Howard: And we are trying to continually improve the I^3 document. For example, we are concerned about accessibility, cost platform and operability. So we want to put it in the next version of the I^3 document. And we want to expand how the I^3 document is used. These kinds of sketches (pointing to some paper prototypes displayed on the wall of the conference room) might be produced and included with an I^3 document. These sketches are part of a communicative device that will communicate to the CIMA committee what it is this project is supposed to do. If in words, the electromagnetic spectrometer (for instance) isn't clear enough, maybe a sketch will take care of it. As I mentioned, part of the concept proposal approval from the PMT may include the option of spending a certain amount of money, usually about $5,000 or less, to flesh out the concept proposal into the I^3 document. In the I^3 document are the sketchings and other things needed as a "sales pitch" to make the "sale" to the CIMA committee.

On some of our larger projects in the past, we have gotten into some difficulties. We were getting into some trouble with some project plans that were not as tight and as defined as they should have been and either ran afoul of timelines, budgets, or both. And

so with the bigger projects, we will seek CIMA approval to first do a pilot or a prototype. Even then, we reserve the right to kill the project or to inform the timeline and budget.

Once the CIMA committee approves the project, we have another PMT meeting to marshal resources using the project manager methodology. In this **second PMT meeting**, it will be prioritized based on how much work it will be, how many people will be involved, how many students it will eventually impact. Even factors such as how powerful is this department are considered. Do we want to make them happy by doing it right away? The PMT will sort out the priorities there and the project will begin to be worked on based on those priorities. For non-CIMA projects, the PMT acts as the CIMA or approval committee. We internally approve Independent Study courses using PMT but General Education courses are actually approved by the Academic Vice President's Council under the current model.

Alice: In this second PMT meeting, there is still a little bit of mushiness. What does it mean to be assigned to a project? We want to make sure that we have the people who are going to be actually working on the project doing the estimating of how much time it will take. You can see the problems otherwise—someone might estimate that it will take three hours to do something and the person who actually ends up doing it, says, "there's no way!" To help resolve these problems, we really want to have them get to the **pre-production** meeting for that reason. A lot of time we won't have the whole team available yet here (pointing to the pre-production meeting area of the CID Project Lifecycle) because they are in the middle of another project. Since it is felt by some that

we really don't need them until we actually put the project into production, they aren't asked to come to the pre-production meeting.

Steve, who calls that pre-production meeting and what happens there? Our office assigns the project manager to the project way back at the first PMT meeting so they can represent the project to the PMT. My manager has a flowchart that shows how this flows, with management team approval and going back to the faculty member, etc. After the CIMA approval, we are actually working with a project manager. I think the trigger now (it changes all the time) is when we have the I^3 documentation done. That is when it leaves my hands and goes into the project manager's. Then it actually enters production; it is on the conveyor belt. They may call the pre-production meeting or I may—it just depends on who does what first.

That meeting will be with what we call the core team. That will be myself, sometimes the faculty member, the project manager, our usability expert, and we usually have an artist and a programmer, depending on the project. We will review the proposal and make some assignments for tasks so we can get a better idea what the project is going to look like. We do some brainstorming about how we are going to make things happen. At that point, we go back and modify the I^3 document to match the recommendations from the people who are going to actually carry it out. It puts reality to the design and it also puts creativity to it because the instructional designer is not an artist; the instructional designer is not a programmer. So, at the beginning, this I^3 document lays out information flow and basic interactions. Then when we get to this pre-production

meeting, the artists and the programmers can say, "Well, that's good but have you thought of doing this?" Or, "Yes, we can do that but we can't do this."

So, creation and reality come into play in this particular meeting. We want to keep it in place because this is a really valuable meeting as we look through the pre-production packet as all the questions are raised in the meeting and everybody gets an idea of what it is. I have experience in being on the production level. Based on that experience, if I as a production person didn't attend the meeting and someone later showed it to me, no matter how thorough they are, they end up missing some details. So, it is usually best to hear it from the horse's mouth.

Alice: In these meetings, project managers should be the designated dummy and not be afraid to ask any type of questions. Everything should be completely clear so if you don't understand something, you raise a question. Maybe that will raise other questions that others hadn't thought of yet. It's very useful to have people assigned to roles, to have people look through different glasses.

From there, we will set up additional meetings to review the documentation that completely describes the project so that everybody understands what is included and what is not included in the project. We need to hammer out a concrete plan—instead of just having an idea say, for twelve modules on the different stages of adolescent development, we need detail such as Stage 1: Rebellion, and it will have eighteen pictures, etc. So, you really hammer it out with as much of the art conceived as possible and a design spec laid out for programming, specifying, for example, screen one, button one will be here, button two will be there, etc.

Do you give guidelines as the granularity of the task detail? Yes, we are kind of working through that. This is a new process for everybody but what we like; well, what I told them is make it a big enough or small enough task that you would want us to follow up on that task. If there are sub-tasks underneath some of the tasks that are really specific to programming, you don't want us calling everyday and asking this and this and this… Just have us call you three days later and ask if you finished this big task. It's kind of squishy but we expect them to be able to manage to these larger tasks. I think it could get to a point with certain types of projects where you almost have a template of sorts that you could say—with this type of project; we are going to have these deliverables. You'll have to come up with the specifics for those deliverables but they will be essentially similar to this other project. So, if we do it generic enough, it can be transferable.

I know that one of our SPDs has what they call a JavaScript library. The program is coded for other programmers and basically, it has a list of all the interactions that they have done on one side of the frame. Someone can click on it and it has samples of code and samples of how it would function on the other side of the frame. So, any programmer that wants to use, say, a crossword puzzle mastery check can click on the thing and see samples of what it will look like and then see the code that is behind it and see all of the areas where you have to change input. That could be shown to faculty members but they would have to be technically minded enough that all the JavaScripting wouldn't scare them. Or you could just create a catalog with a brief description without the technical detail. Howard, maybe you should consider a version of that to the instructional design manager. We could make a version of that just for faculty's eyes.

Steve: I think we would definitely use that as instructional designers too. It would be very useful during our pre-production meetings to help us not reinvent the wheel. But we don't want templates and pre-defined things to stifle anyone's contributions. During those meetings, we want to make sure that everyone of the team is heard. For example, our usability expert usually contributes things pertaining to his quality assurance "hat". He describes it this way: (1) quality assurance over the functional specifications. Does it work on a MAC as well as on a PC ie. Netscape which versions? (2) Usability—being concerned about information flow, the design of the application, inputs/outputs, students' expectations before and after an activity and some of the material that packages our application instructions. (3) Functionality, usability, and accessibility. "Are we building to ADA standards?" So, we have a standard list of criteria and on a given project, we use those criteria to test our work and see if it's accessible.

Finally, we also try to establish some completion dates but they are very fluid, often violated, and easily changed. Therein lies one of our problems here at CID—changing dates because priorities are changed. There are always conflicts with everyone wanting their work done right away, so how do you manage that; how do you manage the expectations? I don't know, maybe the pressure and desire to get things done and push things through results in getting things done on time. So all ten of us designers are feeling all the weight of all those instructors wanting their things done today. I at least try to be sensitive to management feeling that pressure from all ten of us—I communicate the urgency but I try not to add any pressure of my own. I try to point out to everyone the consequences of things if the schedule changes don't work out.

Howard: That is one of the purposes of the **third PMT meeting**—the Impact Review. Once we have a detailed plan in place, it comes back again to the PMT where we will prioritize it based on how much work it will be, how many people will be involved, how many students will this eventually impact. Even factors such as how powerful is this department are considered. Do we want to make them happy by doing it right away? We will sort out the priorities there and the project will begin to be worked on based on those priorities.

Alice: Certainly all of the projects are supposed to be put into the process after that third PMT meeting but sometimes we will take the output from the Pre-production meetings and go back to the PMT and say, "based on what our team has said, the amount of money that we have given is not enough." If it is not enough, then we will ask the PMT if we can get more money or do you want us to scale the project back. Personally, I think the former is probably the more responsible thing to do since we have already said that we are going to create this project. CIMA said yes to the project and we want it and now that we have actually planned it out and have realized how much it will actually cost, it doesn't change the fact that CIMA wanted it. It just may be more than was expected. So, that is my suggested approach—to try to get more money for the project. Either that or say that we are not going to give final approval or assign any money until after the pre-production meeting and we know exactly how much it is going to cost. But they don't want to do that—the directors and the CIMA committee have lots of past experience and assign what they feel is going to be enough. It is really a shot in the dark until it gets to this point (pre-production).

Howard: Well, we sometimes miss that shot but we do have some complicating factors. For example, we're kind of driven by the university President's office and one of their priorities for on-campus organizations deals with incorporating student mentoring when possible. I think that will drive what we are trying to do here for a long time even though we still have to get work done and we still have to be a serious organization. We're not only concerned with producing material; we're concerned with who produces it. We are concerned with the student employees we have. I mean, if we really were production-oriented, we wouldn't have all of these part time students. We would hire 20 or 30 fulltime people and we would just crank them. *Then you wouldn't have the mentoring and accompanying retraining problem?* Right, but here we are training and mentoring students even though some of the instructional designers and faculty members get a little bit perturbed because we don't do things like at a business. We've got students that we mentor coming with different levels of ability and different family situations, including different amounts of time as well as varying times that they can work. Also, school projects and the reality of education with tests and studies, etc., can get in the way. And that is their first priority and should be.

Some of them are here for a few months and all of them have only a few years at the most. Understanding that, you can appreciate better why we don't produce 50 courses a year and lots of CIMA projects a year. We do considerably less. That colors our approach to the ADDIE model because I think it assumes maybe 100% efficiency or near that. I don't even think the full time people are 100% efficient. So, maybe because of having student labor that we want to heavily involve in things, we might underestimate

some of the costs, contributing toward this appearance of not being a serious organization.

We haven't always done a really good job of that—some of the colleges don't like working with us. There is some political posturing going on with that as certain areas want to do this themselves anyway and don't really want to turn it over to an outside service organization. *Is that why one of the instructional designers works directly for one of the colleges?* Yes, and if you have the money to do it, then money talks. It has worked out fairly well although it is frustrating at times. That instructional designer at least reports back through our organization so the quality control on that is still about the same but they don't follow the same rubric we do in assessing what is important. What is important to them is exactly that—important only to them.

Steve: That is really important to us as instructional designers. We don't always have a sense that things are prioritized the same all across campus. For example, we CIMA projects, one thing to take into consideration is giving more weight to objects that will be used university-wide rather than, say in a single, small course. Also, I would look at the context in which the object will be used. If this is something that will be used in the classroom with some instructor mediation, I would probably say that it is not as important to be sharp or polished because the instructor can fill in the blanks for the students. Whereas if it is something that the students will view on their own, I would want it to be as tight a package as possible—as professional looking as possible. It's a matter of expectation too—something you take home on a CD you expect to be a little more professionally done.

*As you move into **the Production Phase**, how do you determine the quality of the learning objects you create?* While we would want it to look as professional as possible, there is a point where there are diminishing returns and it becomes more extravagant than needed—art for arts sake rather than art for instructions sake. I don't know that there is any set of guidelines or checklists to do that. We do rely on what we create in the I^3 document and if we make changes in our core team meetings, we try to keep the I^3 document up to date. If you don't, what happens is the programmers may be working on a different set of criteria than the artists and vice versa. *Is their work determined by what is in the I^3?* It should be and the documents that go with the I^3. *And what documents are those?* The appendices that contain the specifications and tables and illustrations. For example, when we were developing a virtual audiometer for a professor, I included a table that included the starting state of all of the buttons on the audiometer. You don't need to give that level of detail for the student's view but when the people start doing the programming and the artwork, they need to know that.

Isn't that kind of detail supposed to come out of the pre-production meeting? Well, not necessarily that level of detail. I try to anticipate what we are going to need and give it to them ahead of time. It really depends on the purpose of the art or graphic or whatever it is. For example, for a normal independent study course, you don't want to have photo quality stuff unless you absolutely have to—that you wouldn't be able to tell what it was without that high quality. But, it always has to be accurate and you can never mislabel something. But sometimes a sketch is just as good as a photo.

It is something where we will just consult with the faculty member and see what their needs and desires are. We will also consult with the art leads and artists to see what their desires are and kind of make a judgment call based on these conversations. Some of the designers take an iterative approach, doing some smaller testing of the product. For example, they give students some extra credit for trying something out and seeing how it looks.

When the art is approved by the faculty and hopefully by some student review process, it goes on to programming and they start doing their programming miracles and usually produce some kind of prototype. We will review the prototype and determine if it is operating according to specifications, that is, it has all the functionalities we envisioned. We will do some tweaking on that as we need to and eventually come up with the nearly completed project.

Howard: One of the things we are trying to implement is doing more of these prototypes and trying to use a low fidelity prototype as part of a usability test, so that before you have got the thing built and solidified, you can make any changes you need from there. This object (pointing to a screen shot of a physics course object) was initially described to us just verbally with a paragraph. Our artists translate it first to a paper sketch and say, 'this is what we think your words describe initially. Are we on board?' And if the artists are not on board, they make changes and fixes as needed. But we have found that doing that on paper as un-techno as it may be, it is just faster. So, we do this (pointing to an initial paper sketch of the screen shot he just showed me). We make descriptions of what every button does, what all of the interaction is and we march

through it with the faculty member and the instructional designer ad nauseum until we have it on paper exactly how they want it. Then, we translate that to an on-paper color version of that. Still, nothing has been programmed. This is just a mock up of what the screen will ultimately be like. We get everything esthetically the way they want it and everything like that. Then, once that is all figured out—we've got the interaction figured out here; we've got the style guide figured out here—then we spend time doing the programming.

Sometimes that programming effort is not as integrated with other aspects of our operation as it should be. I think our confined space issue is a tangible component of our production woes. *Why is that?* When I was first hired when the CID was just created, the programmers existed downstairs in the old building and the artists were upstairs in the back room. And there was no conversation between the two. When I showed up, I said, 'we are physically moving computers, folks. We are going to go programmer-artist, programmer-artist.' And some people thought I was nuts, including the artists and programmers. But I really felt strongly because of my background and where I came from that this kind of interaction was important. So, we did that.

Basically now, you have artists talking with programmers, saying 'how can I best prepare my art so that it is useful for you?' There are some preparation non-art things that the programmers would really appreciate. It would make their job much easier. And there are also some interaction considerations for the programmers that if they consulted with an artist to say 'what looks best?' But if they are down the hall or down a floor, that conversation simply doesn't take place. But if they sit right next to you, that just elevates

the quality a lot. And we had that for a while but now we are suffering from some of that displacement because we've got artists out here (pointing out to the bull pens and row of computer tables) and all of the programmers have tended to migrate back into the back room (separated from the artists location by a row of cubicles against the room's wall). But I would like them to still be mixed. So, by expanding our space a little bit, we could remix more thoroughly, and things could go faster again. It was proven before that it worked.

Also, we don't have good consultation areas; the conference room is entirely too small for our needs for core team meetings. Yet, at the same time, we don't need an entire conference room for a consultation area; a few small round tables where we could lay out some pieces of paper and show faculty some of the ideas to look at would work really well.

And we probably need consultation areas even more since we added project managers to the mix. Getting back to our discussion of the process—we get programming working on stuff. We hope the introduction of project managers into the process will help us a lot to ensure we have a reliable process for the type of prototyping we would like to first see from programming. They are also great at helping to ensure that our projects meet budget constraints and deadlines. But if the production folks miss something, it is a problem. It is not just a matter of them knowing what to do in their particular area because if they miss some of the discussions about the content and the educational objective, then they might go off in directions they shouldn't. They go off in those directions because they don't know any better. Maybe according to the rules of their craft

it is ok but according to the goals of the project, they would have done things much differently if they had known that. So, you have translation problems over and over again and then we have to retell the story so that they get the plans. But of course, some things get left out.

Could some of that rework cost be reduced if the production people actually doing the work came to the pre-production planning meetings to gain an understanding of what the learning objective is? Right, and it is almost just as important for them to know what the "no" decisions were as it is to know what the "yes" decisions were. They will either just go off in that "no" decision direction or come back and ask all the same questions that were already asked and answered! So, either way, it takes more time. Another thing if they are in the project early, they begin to invest in the project as well—they bring things to the table as well, that benefit the project. They bring experience, ideas, suggestions but they also begin to develop more of a sense of ownership but it now not just a job, a task. It becomes their job, their task, their project, along with the ID and the faculty member—it becomes ours now instead of just "here's a job to do." To sum up, the design and redesign multiple times is needed to bring the production people up to speed. Then it can move into the final stages of production. There will continue to be some iterative testing going on to improve the instructional product. Finally, we show it to the professor and if it is good, then it is supposed to go down to the QA team for a final test to make sure everything works.

Steve: Even when it is ready for that final test, I insist on reviewing everything before it goes for that final check just to make sure that what ends up on the screen is

what at least I had in mind. I try to put myself in the position of a student who knows nothing about the course or the courseware. I just ask myself, "Do I have all the instructions I need to make this work?" And we also have the benefit of student employees who are pretty vocal. So, as soon as they start doing artwork or coding, as they get trained, we tell them that if anything here doesn't make sense, since you are a student and you think this is stupid, please come and talk to us. That way, we can help other students out there who will really take the course.

I hope all of the student employees get trained that way because one of the things that is a little different here is that we have a team of programmers but they don't necessarily always work with me. They are assigned in a rotating pool so that if a project comes up, they can say, "These two are not busy so they can go work on that." So, I might be working with them on this one but next time I might be working with two others. I don't have the kind of close working relationship I have had at other places. So, what I try to do is when I am putting something into our process, I try to find out who it is assigned to and go visit with them about it. And when it is done, I make sure I look at the work.

That reminds me of something with one of our projects. We had a meeting about a handful of really significant issues but while we were working through those significant issues, the faculty would make small requests to change this text; change that color. Well, sure, no problem. But when you added all those little changes up at the end that was another significant piece of work. So, maybe following a change control process takes a lot of time but maybe in the long run, following it would save time.

Alice: With faculty feedback, we try to have feature locks and a change control process that, in theory, should inform the faculty of the consequences of change, in terms of time and resources. In theory, it sounds great to minimize that but in practice it doesn't work as well for our instructional designers. Particularly because a lot of the changes they deal with are so small in effort that it is more effort to go through the change control process than it is just to do them. So, we kind of get a reputation that we will just do the changes but when a bigger change comes along, the faculty expect us to do that change too, just like we have done all their small changes. And when we back off a little bit, trying to enforce some change control process, they feel some frustration there.

Steve: Sometimes they also feel frustration because our processes are so slow—I know I feel that same frustration. Sometimes our process is so slow that I think we occasionally underutilize our resources. The process of trying to find those underutilized resources tends to focus on managers and others pushing things down but to me, I want to find out where these underutilized resources are from which I can pull. Every time there is underutilized resource, I go for it. I pull it in and try to use it. So, we need to work on the process of better utilizing those underutilized resources.

I also think there are a lot of things that I do with some of my projects that can be better handled by another designer. I can learn but in the process, there may be some slack. Other designers may be underutilized in one area with their projects and they have some time. For example, I have five manuscripts that need to be worked through and that is not where my expertise stands. Somehow, I don't think we do that well—using our resources in the best possible way. We have a process and are married to the process and

because of that, we don't know about available resources. How can we know if an IDA (Instructional Design Assistant) is underutilized or if a designer has available time? But, I understand that we are growing and evolving so that aspect of my job is exciting because I keep learning.

Howard: Our SPDs are generally responsible for keeping our artists and programmers busy. One of the things we try to do in a weekly SPD meeting is review workload. The meeting lasts about two hours, in which we go over every single project from a project level and ask, 'how is it going?' 'Do you have what you need?' 'Do you have the people that you need?' 'What is the deadline?' 'Are we late for something?' 'What can we do to help move the project forward?' We go back through the list of everybody who is working on all the projects from a people standpoint. "How is 'Becky' doing? Is she getting you the work that she wasn't getting you before?" That kind of stuff… And we do people swapping if necessary. "I'm done on this project now. I've got three artists who have nothing to do." "Great, I can use them over here." That kind of arrangement happens weekly, so no artist or programmer goes undiscussed more than a week.

Alice: Keeping all of the artists and programmers busy is good, as long as they are doing meaningful work on projects. We need to track all of that work so we have a couple of assistants who look at the hours each person puts in and keep track of that on a weekly basis. There is an issue—what if it ends up taking longer than we've allocated? If we have found that it is taking longer, then usually, we will get back with management and directors and say that this project has been underestimated and give a new estimate

about how long it is going to take. "Do you want to pull the plug on it, allocate more money to it, or do you want to cut back on the scope?" Or are we just going to do as much as we can with what we have and say, "Well, there it is." Some of the questions that you can ask up front are, "what is most important to you—quality or basic functionality?" Maybe I should back up a little bit. After we have created a work breakdown structure and project plan, we get fairly good estimates about how much the project is going to cost. We'll look at that and compare it with how much the project has been allocated or awarded. If those numbers match up pretty well, then we will go ahead with the project. If there is a pretty big discrepancy, then we have got to figure something out and that is another one of those management decisions. So, hopefully, we can see those scope/time/money issues before we get toward the end.

Steve: Even with those SPD meetings and the project managers helping, there are still problems with resource balancing and priorities. And prioritization is one of the biggest problems with resources. We recently had all the work on my CIMA projects come to a screeching halt when one of the high profile projects needed to be worked on and finished up. They told us that they were going to allocate all of the resources for that and so everything else was on hold temporarily.

Howard: I think the priority list is the key. It is the Rosetta Stone of CID. The concept of a priority list has been a hard sell for some in CID, in that, if we have twelve instructional designers, on average, you would think that in the first twelve prioritized projects, each one of them would be represented. But it isn't so because a particular designer's first priority might only be number 45 on the CID priority list. And so it is

frustrating, obviously, for them that we are not working on their projects. So, it is difficult for them to go back and tell the professor, 'you're not important.' I don't know how to fix that but we need a CID-wide priority list. What are we building because we don't have resources to immediately produce every priority project simultaneously we have to pick and choose, and I don't know the best way to do that picking and choosing.

We have got some scoring anchors that determine the priority but if you happen to be the odd man out, like this project with priority number 55, you are going to get frustrated. And so the tendency is, if they are not going to work on my project, I will hire some IDAs who know PhotoShop or Flash and we'll do it kind of under the table among ourselves. I can't fault them for that but it screws us up because when it does become a priority, we then have to do a reverse engineer on the work that they have already done. Now we have to start programming on top of what they have already programmed and it is very slow and it's very frustrating. So, it is better if they will just hold their horses and stop until we can get them to be a priority. Then we will have fifteen people we can descend on it and get it done surprisingly fast. I don't know what the fix is there but that would be one thing that would help.

Another issue in programming is that we have just one programming SPD who is over all of the projects that require multimedia programming. One person. And each of those projects has quirks about them that require that person's unique expertise. We use student programmers who are at various levels of expertise. We advance the more senior students into positions of authority on those projects where they become the lead program designers on those projects. For the most part, they answer the questions and figure out

the math, and organize the other programmers on the projects and all that kind of stuff. And that has helped but the problem is, in our pool of programming we have just eight people who can fill those lead roles—just eight. So, that limits us to eight simultaneous projects obviously, or nine if you count the programming SPD having his own. But he is still consulting on those eight projects so he is stretched a little thin.

Is that why you are hiring a new SPD for programming? Yes, another person who can supplement that and hopefully we'll be able to expand that into another eight projects. But that will be down the road as younger programmers develop into more senior programmers. But that is exactly why we are hiring another SPD. But that will only reach sixteen simultaneous projects. So, it is really difficult to get any faster than that. There is a limit to how many your brain can simultaneously manage as they are marching down the programming path. It takes time and you just reach a point of saturation. And we're there—so that's why we are hiring this new SPD.

Steve: We don't have that problem fixed yet so we still have these fire drill routines. And we still need to move on with our projects. When we can move forward, we usually hold weekly core team meetings to make sure our project people are making the right progress. I used to call all of those meetings but now our project manager does it. And that has been a really great move. *Why?* Well, it just takes a lot of the burden off of me. Most of what I did before was managing the projects. I would call all of the meetings, try to arrange everybody's schedule—you know the faculty members are not on Outlook so you can't get their schedules. So you have to communicate with them and they have to remember to read their email and send it back to you with a time that they

can meet. And of course, it doesn't match anyone else's time. So, you just go back and forth, trying to get these meetings together. And then you try to make assignments and make sure that everybody is working on their assignments and if they don't, then you have to remind them. It's just a lot of hassle that really doesn't have a whole lot to do with instructional design.

That makes me want to ask—isn't there some systematic way so that someone with a project being worked on at CID can look at the status of their project? We wanted to do something so that our clients could track projects on the CID website but that has not come to fruition yet. So, I decided to do my own project web page because I really want the deans, chairs and instructors I work with to have access to the project information. And they need that without having to feel like they have to contact me or my IDA or get a hold of anybody but that they can just click on a link and enter the codes that I give them to access the projects. Also, the instructors and the dean and chair can look at the documentation needed for the CIMA proposal. So, if they are really curious, they can go there and see.

It really helps to keep the faculty involved in the development process because we don't always think of everything. I got a call from one of the SPDs, for example, as we were doing a virtual audiometer. His question was "does the red side of the earphone go on the right ear or on the left ear?" That wasn't in the documentation so we had go back to the professor who would really know. So, as you get into this, there are reasons that you have to go back to the professor and ask for clarification. Also, you need to tell them and show them what you are doing and ask them if it looks good. But one of the

drawbacks of keeping the professors involved is the sort of creep that comes when they say, "Yes, that looks great. In fact, we'd really like to have this. What do you think about that?" And the next thing you know, we are doing lots more than we planned.

Alice: That's where the project management process and more attention to the documentation can help out. With good I^3 documentation, if that feature creep started, we could say, "now you approved only this in this document so we're not going to do anymore." But if the faculty member still asked for more, I could ask if they were willing to sacrifice some of the scope to add this or spend more money on it or have it take more time. Generally, that will cause someone to stop, think, and usually say ok. That approach has always worked for me and I usually start with the time factor—this is going to be late if we do that. Are you ok with that? And they would usually back off the request. *So, you would always take it back to the documentation for the instruction?* Yes, we need our instructional designers to nail that in the documentation so we can point back to that as well as use the project management matrix of time, money, and scope. We can do that as long as the documentation was done before we got to the point of the revisions.

The lack of good documentation is even worse when more than one department is involved with the project. I'm managing one combined department project where there are two professors from two separate departments. It is pretty hard to get them together to provide the amount of feedback we would like. It is also not always easy to get them to agree among themselves. That is another reason to ensure that we show them the object for feedback because that gives them a chance to make sure they are in agreement. What

we don't want to do is provide them with something that one says is great and the other says, 'I wish we had done it another way.'

What else do you do as a project manager to keep these projects on track? Work with our PCs (project coordinators)—they become our legs and arms. They check daily with the members of the team to make sure that things get done. *How many projects will a PC have?* They will have anywhere from five to eight, depending on the size of the projects. On a weekly basis, they will update the MS Project file and track what has been charged to the project. So, we oversee that and make sure that they are following up with that. Since these are students, we sometimes have to take that role during finals or big papers or such.

Steve: Working together with the project managers, we usually stay on top of things but sometimes things aren't caught until we do some Quality Assurance (QA) testing during **the post-production phase**. Some other things that have popped up during our QA testing have been things like the delivery speed of our products. Some people we tested with didn't like the time that one of the learning objects took to load, so I had one of my IDAs create a low speed version that we will use for the Independent Study course. It has all the main learning objects and images but we got rid of all the graphics that took so long to load. We try to do a lot of the QA testing that technically should be post-production during the production phase so that we can make changes. If it is an Independent Study course, that testing involves being sent to professional editors; then it goes through the Independent Study QA process, however they do that; making sure that they have all the objects that they need, including their piece about the instructor, how to

succeed in this course, etc. For a CIMA project, it will go through Quality Assurance here in CID. We will also do usability testing, although if the product is solely intended for an instructor to use we probably won't conduct a usability test because the instructor has been with us the whole time, and he has given plenty of input as to how he wants it to work. Then we will make any changes or modifications as have become necessary through the QA process. *When it is through the production phase, is there any sort of final verification test that usability testing and evaluation do?*

Howard: We will do the final testing to make sure that we hit all the functionality and all the specifications and that we have fixed all the glaring errors before we release it and mass produce it in its final form. Also, there are accessibility issues that addressed all through the process—QA will take care of that as they are doing the user testing. Our quality assurance experts are trained to look at it from a very tight quality assurance viewpoint. This is a new set of eyes that is not familiar with what the system is supposed to do in the first place. They will run it under Explorer and under Netscape and push every button and follow every path. They read everything and might catch typos but, at this final check stage, they don't look at it from a content point of view. On some Independent Study courses, there will be a second QA check where they hire somebody to come in and take the course or they may grab one of their student employees, give them the course book, the text book, and the CD; ask them to read everything, answer every question, try every activity, do the assignments, and see if there is anything left out or if it is confusing. While Independent Study would like to do that for all of its courses, there is a time and resource problem. So, sometimes they do it and sometimes they don't.

Our Evaluator is always trying to get us to appreciate the value of usability in improving technology and media instructions. He recently wrote a paper and one of his claims was that increasing the level of usability early on saves money, significant amounts of money. And, I think we found that already. We haven't done a specific study to measure that, but I feel that we're making improvements. Our effort early on is creating a better product without requiring us to go back and make the changes that we have had to make in the past. So, we've reduced those time frames to make those fixes by bringing users in early on.

The way we have evaluation set up is we combine testing, quality assurance, usability, and accessibility—that kind of evaluation—and we what we are calling implementation evaluation. There is kind of an overlapping Venn diagram that includes quality assurance—making sure something works, making sure that it is usable, that people understand how to navigate it—and this overlaps with implementation. So, that's the general philosophy that we have, is that evaluation doesn't start when the thing ends; it starts when the thing begins. So, the idea then is that when the I^3 documents are produced, our evaluator will write a little statement about how we intend to evaluate the effectiveness of the thing being produced.

And that is a summative statement or a process statement? It's a process statement. We'll intervene at the stage when an artifact of the program is created, then we'll show it to three or four students and we'll get feedback, etc. At this stage we'll do this and at that stage we'll do that. So, the idea is that we will work with the production team throughout to give as much feedback to them as possible.

We also have heuristics that we know for certain things. For example, accessibility heuristics—we know that certain ways of ordering the texts and certain kinds of contrasts—those kinds of things, are easier to use for people with physical disabilities. Law dictates some of those so they are not only heuristics. But there are also some design heuristics that we are trying to adhere to. Our Quality Assurance Specialist knows a lot about working with these issues so he will often participate in the design team meetings and take notes and give feedback and be involved. What I have encouraged him to do is to keep a file for each of the projects so that we have information. We have developed a requirements list and test the final product against some of these requirements. Requirements are what we hope they can do and the features that we want it to have.

And that requirements list, are you developing that in conjunction with the faculty member and instructional designer? Yes, exactly. As you know, they start with objectives and the requirements come from those but change over time as they decide if something is absolutely central to what we are doing. We try to help them with that decision and give them that sort of feedback. What we are trying to build is a feeling that they are open to change and we respond to that.

Alice: One of the problems I have noticed with our QA process is that we understand what we are doing and student users may not know they are actually supposed to push the button the way we expect them to. I have a brand new computer and most of our testers have them as well. Our oldest machine here is probably about three years old. Our testers do a good job of testing with all of the OSs and a bunch of different

configurations so they can try to emulate what is out there with the students but they can't duplicate their old machines.

Another issue with testing is that after we have the project all set up and we do everything, between production and post-production, there is still a lot of gray area between the two. Where does production start and QA start? There is also a lot of QA that goes at the end but you also want to have it right at the beginning with a low fidelity test. We try to put both aspects of that into the project plan. Plus, we try to make sure to pass stuff back to the faculty member as much as possible for review. What is not really shown on the CID Project Lifecycle flowchart is evaluation that usually comes in after a semester of being used. And it is really only in that type of evaluation where we get any idea if the students have learned anything from what we create.

Steve: When we get all the QA testing done, we try to finish up the documentation. That is something of a challenge because we have been given a certain amount of money just to create the object or course but there is no money set aside to catalog it, or assign metatags which would provide searchability. Is there some "metadata tax" that we could slap on the budget? Even if the only metadata on the object were a title for it, at least you could search on that. We are waiting for a product called Telescope to be the tool that would facilitate this function. We, in production, don't have an entity called "the metadata team" so someone will need to do that. And I don't know how they would be funded and where they would sit in the center's organization. Logically, the person to input all those metatags would need to be someone familiar with the objects, and familiar with them to the extant they understand the potential uses for

them in related and unrelated fields of study. They would need to be content experts or at least "content aficionados". Clearly this is not the job for artists or programmers, nor is it the job for IDAs. More likely faculty Research Assistants should do this additional work.

Howard: There is another issue that affects the QA process— they have a lot of projects where the faculty or ID say that it is good enough—we've just got to get it out of here. So, it may not go through QA as much as it should. Plus we have to worry about creative works here on campus, taking the stuff and selling it outside of campus, so there are licensing issues. So, this week I am meeting with others here on campus to determine what it means to be completed and who has to be in on the check-off list to say that it is completed and we have taken care of our end. There is still some question that even here at CID who needs to be in on what steps. I am more of a production person—I always have been. But we are dealing with a lot of academics and even people here in our department come from that kind of independence, which is that nothing is ever done—we're going to continue to work on it. But we've got to find where that line is because we can't give faculty continuing update options on the projects, with faculty saying, "This isn't quite right so go ahead and fix that." We have far too many projects that are in the "all but completed but not really" phase.

Steve: But we do have projects we get finished. And then we will have **the close-out phase** of the process where we deliver the product to the instructor(s) and formally close out the project with the project manager. They will compare budgets to actual and perform other work to closeout the project. Then, hopefully, our evaluator will be able to do a summative evaluation—did it work? That is a little hard because the new CID

Project Lifecycle doesn't technically have summative evaluation in it. Plus we don't have a budget built in for evaluation. So, we put it out into the world and they find a bug in it—then what do we do? We don't do version 2 because we don't have the money to do that. With our Independent Study and General Education courses, we do have feedback set up with the last thing students do being to fill out the "how do I feel about" survey. We do get those back but again, since we don't necessarily view it as our course—it is really the professor's course, so for the evaluation part, we can do corrections, we can solve problems that might stop a student from proceeding but it's not pushing for a new version.

At the end of every Independent Study course there is a survey sent to each student—I believe this is still a voluntary survey but we do get survey results from these. It is the standard Independent Study survey. Unfortunately, it isn't really designed to address the objectives of the course specifically. Some of the instructors do ask for feedback from the students, say in the last lesson and that feedback is sent directly to the instructor. The instructional designers do get copies of these evaluation sheets from Independent Study. There is an opportunity for open-ended comments and some of these are fairly thoughtful and interesting but some are not. So, there is some attempt made to evaluate the course, however, it could be stronger and more course-specific.

Howard: I would like to clarify some if I could. The reason evaluation is not a part of the Close-out process is that we have gone through the University project management training and we determined that this process is a "project." It is pretty closely tied to *project* management and evaluation is a *product* or *portfolio* management

issue. It doesn't mean that we don't do evaluation. The only evaluation that is considered in this process is formative evaluation or it occurs before this model or it occurs after this model. It doesn't occur in this model.

And the 'before this model' evaluation is "do we even want to talk about this?" Or "Gee, the last time we did something like this, we really screwed this part of it up. Let's make sure we don't do that again." This side of evaluation (pointing to the right of Close out) is where our Evaluator gives a survey to all the students who took that class and finds out, say, that they really hate Unit 3 or that the teacher should behave differently or whatever. So, our process model departs from the classic definition of ADDIE because there is no summative evaluation part of this. That is outside the scope of this model.

It is also very hard to do level three or four evaluation because learning is a tricky concept—what do you mean by 'learned?' Doing well on a test? Having a more positive attitude about the subject? Motivation? So, operationalizing that isn't an easy thing to do. And looking 5 years down the road at learning is just not possible most of the time in this environment.

I know we are getting close to our time here but I want to add one more thing. I really think, regardless of what you may hear from other people, we actually have a lot better handle on projects and on our capacity than we have ever had. It is not going perfect but if you become too much of just a widget shop where you are just controlling your resources very, very rigidly, you lose a lot of the R&D and "take a chance" on some things occasionally. And so I think we need to keep this kind of flexibility but still

convey to our clientele, both the university administration and to departments and Deans what we can and can't do. And that we will deliver on time when we say that we will. Unfortunately, for about the last two years, we really haven't put any kind of end date on when we will get projects done because we didn't have a deadline. But now, I think we are starting to hold to deadlines and can say that we will be able to get to that project here and get it done so that it can have an impact on some students.

One final question—is there anything in this entire process that assigns to one particular person the ultimate responsibility to get the project done on time and on budget?

Alice: Nothing on here (referring to the CID Project Lifecycle flowchart) says that and as you can see from the accountability indicators here, both PM and ID have accountability as various points. *Here at the end, you have ID and PM as a shared responsibility for the closeout. Who has ultimate accountability for getting it done on time?* Project management. IDs have a vested interest in it—there is kind of a shared interest but I think the primary onus lies on the project managers to get it done. *Ok, that would be the book answer but each organization is different. What I am asking is "in your experience with this stuff in your job, who gets the credit, who gets the blame, who feels the pressure to get it done on time?* Well, I would say that IDs and PMs kind of share that because they start at the beginning of the process making promises and building up hope with the department so I'm sure they feel a vested interest in it. We're interested in making sure that this timeline is followed and ultimately, making sure that

the department is happy. So, I think it is accurate to say, ID and PM. But ownership of these phases, 5, 6, and 7—that is definitely us.

But I would say that really defining overall ownership of projects is a problem. I think between the instructional designers and the project managers some confusion about who really is the owner of the final product. *Well, look at this (the CID Project Lifecycle). Right here at the very end, it says both of you. So, who is it?* Exactly, and I think it is something that needs to be clear. I think there might be an issue of roles here—who is in charge of what? I think that anytime you try to change an organization around, you get some of this. And when you compare the project managers who are new around here with the instructional designers, well, quite honestly, they are impressive people with a lot of skill and accomplishment. They are Ph.D.s and doctoral students and such and we are just out of college. And we are going to go up to them and saying, "I need this from you by Friday." They don't give that impression to me at all but it's sort of awkward. I'm just trying to do my job here you know.

Howard: Our project managers have been doing a great job but part of the problem is a capacity issue. There are too many projects for the project managers to function at the detail level like they should to properly manage their projects. So the designers are still behaving as project managers and they don't know where their work begins and where the PM's work should take over. In theory, this line should be pretty cleanly separated but because of this workload issue, a lot of the designers consider Project Managers sort of as administrative assistants, not really Project managers.

So, they feel it is their responsibility to make sure those things get tracked and not the PM? Right, this is really a capacity issue—the PMs, of which we have two, are too overloaded to be able to effectively track details of the 100 projects they have to manage. They use their PCs and together, they try but they don't know what is going on with all of their projects. Especially the task lists—they may know in general what is going on with their projects but they have no idea that, say, yesterday, three artists didn't finish what they were supposed to. So the designers say to themselves—if the PM is not going to follow up with the artists, I'm going to.

Once we get the capacity issue solved, maybe it would become clearer that designers taking over PM duties may be an organizational issue but we won't know that until the capacity issue is addressed. The problem in our shop is that instructional designers don't do just production. They do consultation and there is no project management involved in consultation and we are trying to recast our designers for the most part as consultants, and oh, by the way, they do production instead of the other way around. It is difficult to do that when the production we do pays the bills even though we are funded so that we don't charge back for the consulting. So as long as the university president continues to see that as a priority and we can demonstrate results that help out the university, then we'll continue to provide consulting.

Steve: I would like to add that we as instructional designers are experts in content and liaison with the faculty and communication but we need an independent third legislative body, so to speak, to mediate some of that tug of war. The project managers are that "disinterested third party" that says, 'I know it is not beautiful but it is due on

June 1st,' or 'I know it doesn't have all the content but it is due on June 1st—we need to get the content.' So, they speak scope, schedule, and resource rather than creativity or content-related issues.

Thank you very much for your time. When this research is finished, I will send you all copies if you would like.

Appendix C: CID External Reviews

There are three external evaluations that relate somewhat to the inspection/evaluation process used at CID. The first is an evaluation of eleven on-campus courses developed by CID. The second is an exploration of the instructional development process at CID. The third is an examination of the "value stream" in the CID development process. These external evaluations and their recommendations are summarized.

Evaluation of BYU Semester Online Courses

This evaluation was directed by Dr. David Williams, an academician noted for his educational evaluation skills. The following are excerpts from the report that focus on inspection/evaluation costs:

Technical modifications and additions of new technologies always involve adjustments that take time to implement. Therefore, a system of formative evaluation should be built into the course development process and representatives of all the stakeholders involved should have input and participate in refining the technical processes involved.

Find the right balance in use of various multimedia and make sure multimedia use is essential instructionally and not just there to impress.

Explore ways to appropriately address cost/benefit issues and build their analyses into an ongoing evaluation effort for each course and across courses to inform departments and the entire university.

Plan ahead and build relationships so the instructors have the actual opportunity to collaborate with CID designers to instructionally design the courses they teach in accordance with their philosophies and intents.

Continue to solicit student feedback as part of the instructional development process. Often, they have insightful ideas about how to fix problems. Asking for their input also makes them feel like they are valued within the course and works to win their loyalty.

Continue to ascertain what students need and want and what their reactions are to Semester Online courses since they are some of the most important stakeholders in this whole effort.

Instructional Development Process Redesign At the BYU Center for Instructional Design

Larry Seawright, the dissertation author, did this instructional design process review. The following is an excerpt from the report recommendations that deal with inspection/evaluation costs and processes:

Recommendations:

- Continue to use the university ESDD approach while still integrating rapid prototyping and continuous process improvement into the instructional design process

- Involve students more in determining at an early stage whether the multimedia items make a difference by the following specific recommendations:
    - Introduce earlier student input that could promote the production of improved courses, especially as the number of courses being designed by CID increases
    - Develop a Test/Usability Lab
    - Use the lab to assess the components identified by Jegede, Fraser, and Curtin (1995) as key to understanding student satisfaction, including interactivity, task orientation, technological support, and ergonomics
    - Use the lab for the establishment of a series of assessments designed to obtain student learning outcome information about the various objects and lessons being considered for inclusion in the course
    - Pilot test learning objects and major lesson modules with groups of students from the on-campus course
    - Formalize the particular methodologies employed to gain information about student satisfaction with learning objects and lessons by means of a checklist or other comparable standardization tool
    - Use the following basic evaluation questions:
        - Has the target student population been identified with sufficient clarity so that a prospective testing student can be reliably identified as a member of the target population?
        - Given a suitable context, does the student believe the learning object will result in the desired learning outcome? This assumes first, that

the student is successfully able to understand what the learning outcome ought to be and second, that the student understands how the learning object leads to that learning outcome.

        - Is the evaluation of the learning object or lesson being done in a timely manner so as to allow for sufficient revision, including major revisions, if necessary?
        - Have the stakeholder values been addressed to the degree that the evaluator understands when the evaluand is "good enough" (and does the student understand when it is good enough)?
    - Use a talk-aloud protocol with clarifying questions that could be asked by CID employees conducting the interview, probing reaction level (Kirkpatrick, 1994) answers (I like this, I don't like that) to understand why the particular reaction was generated
    - Keep documentation regarding the changes made during student review
    - Use item analysis information not only to judge the items themselves, but also to judge the instruction or learning objects designed to facilitate the learning of the objective measured by the item
- If the student review data shows that less learning is occurring due to multimedia objects relative to the amount available in the course, then consideration should be given to simpler graphics that are more easily maintained or customized
- Develop an automated feedback processing structure, setting thresholds for action to deal with the exceptions or decreases in processes effectiveness and efficiency

- Implement some sort of version control so that information stored on computer systems can be tracked back to original versions
- Build the process of obtaining student satisfaction information into the IQueue system at the phases recommended in the Student Review Milestone section of this paper

Research Findings: Brigham Young University Center for Instructional Design

Craig Woll, a doctoral student at Utah State University, did this mapping of the "value stream" at CID. Again, the portion excerpted focuses on inspection/evaluation costs.

It is also important to clarify the production paths that different products will take. Each product has it's own value stream and each product value stream needs to be mapped carefully to identify the value and the waste and eliminate the waste. Some of the possible production value streams could be the CIMA value stream, the GE Courses Value Stream, and the IS Courses Value stream. It is also plausible that there may be further division within each of these value streams as different project types are categorized.

The project queue that is heavily populated with loosely prioritized projects needs to be changed to become a first in first out (FIFO) system or a priority based system or some sort of hybrid of the two. There should be an immediate impact from this change on the production efficiency within the CID.

The developers of the instructional media could be provided guidance on the use of some simple templates and reusable learning objects. These templates and learning objects could be shared across the development team. There would need to be systematic

tracking method put into place to measure improvements made in the templates and the learning objects. This should lead to improved productivity among the developers.

There is often difficulty in finding meeting room space for the project development teams to meet in. They are limited in number of rooms within the CID and to leave means a loss in travel time. It would be useful to increase meeting room space so that the work can be expedited within the facility.

The final recommendation would be the implementation of a method of continual incremental improvement. This may be a monthly or semiannual activity to go through the value stream mapping technique to identify waste and means of removing the waste. This will lead to consistently improved production processes and continually declining production cycle times.

Exceptions Noted Between Dissertation Research and Three External Reviews

One item from the Semester Online Evaluation by Dr. Williams was not addressed:

> Plan ahead and build relationships so the instructors have the actual opportunity to collaborate with CID designers to instructionally design the courses they teach in accordance with their philosophies and intents.

A close connection between faculty member instructors and the instructional designers was noted during the interview process. However, no actual discussions took place during the interviews regarding plans to increase the opportunity for faculty

members to collaborate with CID designers to instructionally design the courses they teach in accordance with their philosophies and intents.

The instructional development process redesign done by the author listed several recommendations not implemented by CID. A test/usability lab was recommended but not implemented although many of the associated recommendations have been. Usability and other kinds of testing were frequently discussed and is reflected in the conversation. The addition of a Student Review Milestone was also recommended but has not been formalized in the CID Project Lifecycle or any other documentation. From the interviews, it was apparent that student reviews do occur but seem to be ad hoc and were often not performed at all.

The value stream research done by Craig Woll makes a recommendation for:

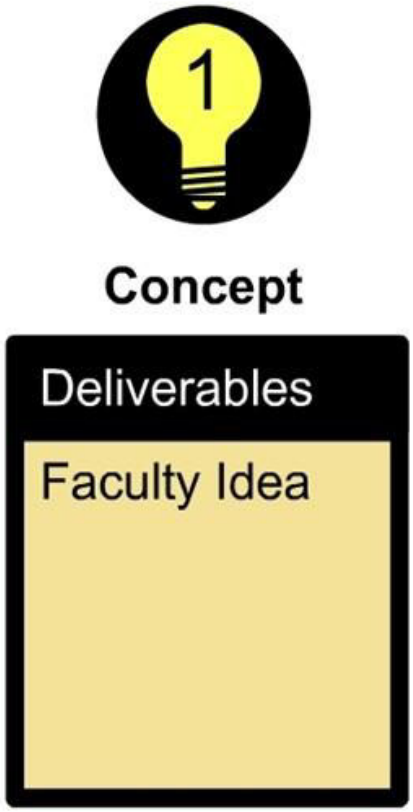
> the implementation of a method of continual incremental improvement. This may be a monthly or semiannual activity to go through the value stream mapping technique to identify waste and means of removing the waste. This will lead to consistently improved production processes and continually declining production cycle times.

This recommendation is touched on slightly with a discussion about continual improvement of the I^3 document that forms the foundation of much of the CID process. However, no specific mention of a continual process improvement process was made during the course of the interviews. In general, the data source triangulation shows that much of the interview conversation is supported by previous studies.

Appendix D: CID Project Lifecycle Phase Details

Phase One: Concept

CID Project Lifecycle



Who:

- *Subject Matter Expert*
- *Instructional Designer*

What:

CIMA
- *Communication between the subject matter expert (SME) and the instructional designer (ID).*
- *Basic idea of what the SME wants to accomplish.*

IS Paper
- *Communication between the department chair and the ID about development needs in their independent study program.*

IS Web
- *Communication between ID and [redacted] about the feasibility of doing a web course.*

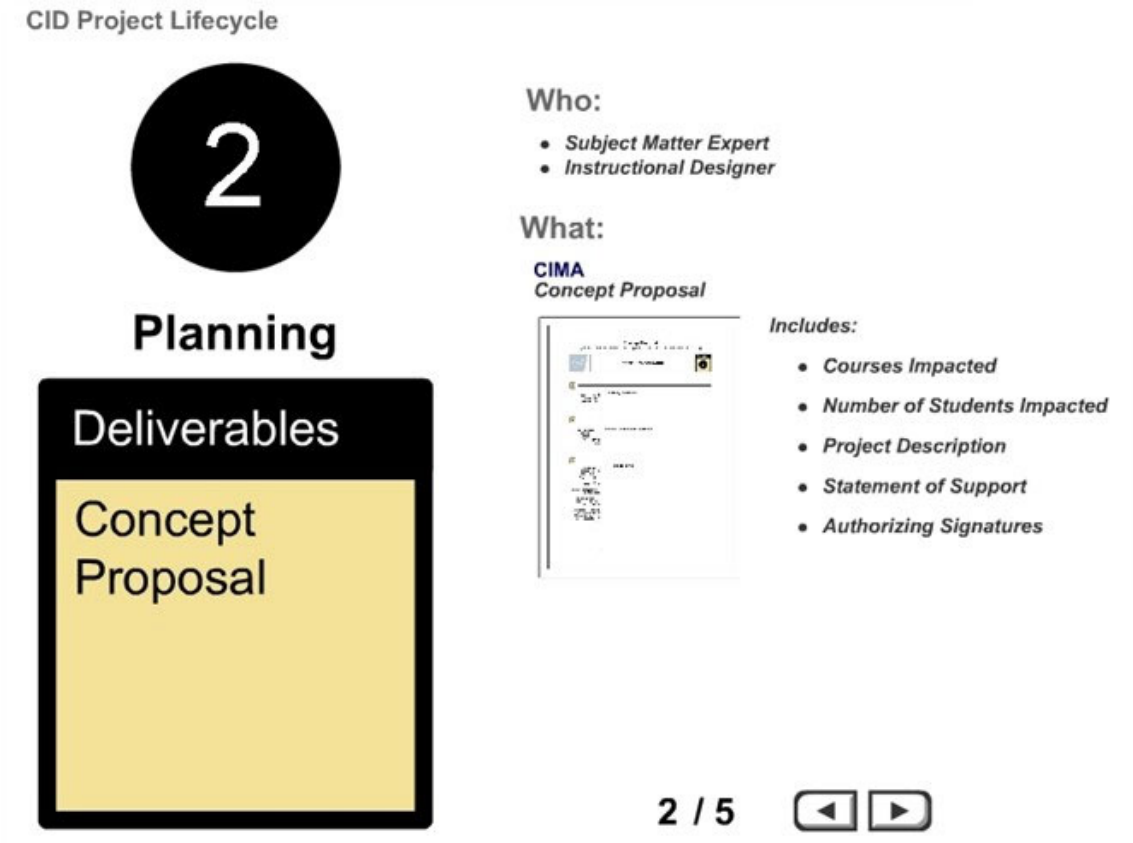
Why:

- *Necessary for the CID Project Lifecycle to begin; I think, therefore I build.*

How:

- *Establish good working relationship prior to initiating new projects.*
- *Understand the needs of the department.*
- *Remember CID funding criteria when talking about the concepts.*

Phase Two: Planning



What:

IS

Justification Form

BYU CENTRE FOR INSTRUCTIONAL DESIGN

MOA JUSTIFICATION FORM

DESIGNER:	COURSE TITLE:
COURSE NAME:	DATE:
FACULTY NAME:	DEPARTMENT CHAIR:
MOA AMOUNT:	ESTIMATED COMPLETION DATE:
CURRENT IS ENROLLMENTS (ANNUAL):	CURRENT CAMPUS ENROLLMENTS (ANNUAL):

☐ NEW ☐ REVISION ☐ BUY OUT ☐ WEB ONLY ☐ OTHER

☐ GE ☐ MAJOR REQ. ☐ BGS COURSE ☐ BOTTLENECK COURSE (EXPLAIN)

JUSTIFICATION:

How:

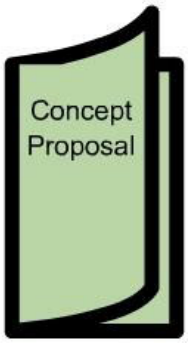
- ***Fill out the forms completely.***
- ***Answer all the questions and requirements as specifically as possible.***
- ***It is better to say too much than not enough.***

Why:

- ***The Concept Proposal helps the Priority Management Team (PMT) to determine project usefulness and validity.***
- ***PMT will determine an I3 Development Budget based on the contents of the Concept Proposal.***

CID Project Lifecycle

Sponsor
Validation



Concept Review

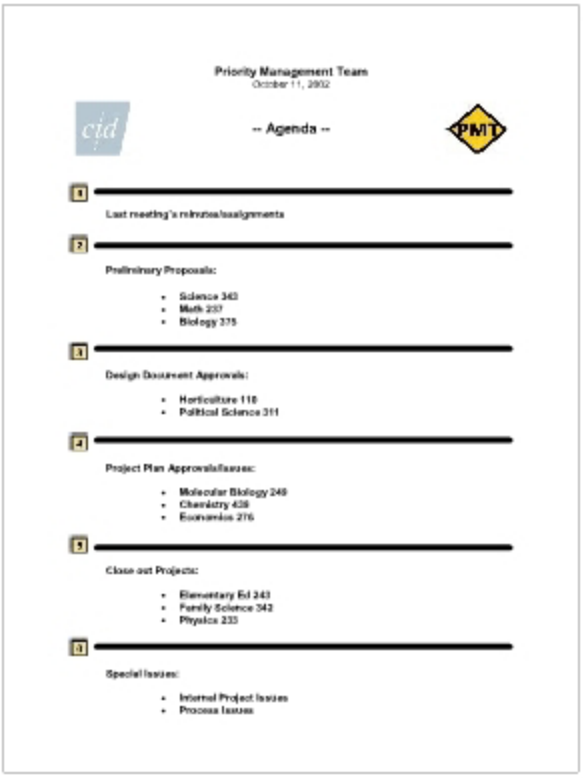
Who:

- [redacted]
- [redacted]
- [redacted]
- [redacted]

2 / 4

What:

- ***PMT Agenda***



Priority Management Team
October 11, 2002

cid

-- Agenda --

PMT

1. Last meeting's minutes/assignments
2. Preliminary Proposals:
   - Science 343
   - Math 237
   - Biology 375
3. Design Document Approvals:
   - Horticulture 118
   - Political Science 311
4. Project Plan Approvals/issues:
   - Molecular Biology 249
   - Chemistry 438
   - Economics 276
5. Close out Projects:
   - Elementary Ed 243
   - Family Science 342
   - Physics 233
6. Special Issues:
   - Internal Project Issues
   - Process Issues

How:

PMT uses the rubric of CID strategic objectives to determine priorities. CID's objectives are as follows:

- *Extend blessings of learning to more students*
- *Provide a mentored work environment*
- *Develop and refine standards and promote the adoption of standardized tools and processes (includes R&D)*
- *Return ownership to academic units*
- *Create efficiencies in teaching and learning*
- *Be a leader in the development of instructional materials*
- *Make Friends*
- *Project Readiness*

Phase Three: Resourcing

CID Project Lifecycle

3

Resourcing

Deliverables

Project Number
Design Budget
Sourcing Docs

Who:

- [redacted]
- *Project Manager*
- *Project Coordinator*

What:

CIMA & IS Web
- *Assign and open a project number in IQ and Dashboard*
- *Assign an I3 Development Budget*
- *PC tracks hours for I3 development*

IS Paper
- *All of the above*
- *MOA is cut and circulated*
- *First payment is made to department*

Why:

- *Enable orderly tracking of tasks*
- *Control costs*

Phase Four: Design

What:

CIMA
- *Complete the I3 document form.*

IS Paper
- *Work with the SME to make sure the project is being built to course standards.*
- *Review course lessons.*

IS Web
- *Work with the SME to compile a complete list of media and interactions.*
- *Review course lessons.*

Why:

- *Helps CIMA understand the scope and objectives of projects.*
- *Remember Covey's 2nd Habit: "Begin with the End in Mind." Before anything can be managed and produced (3rd Habit--"Put First Things First"), it must have clear objectives.*

How:

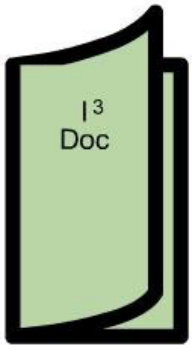
CIMA
- *The ID and SME drive the creation of the I3.*
- *The I3 needs enough representative content for CIMA to understand the scope and objectives of the project.*
- [redacted] *may be used to sketch I3 concepts.*

IS Paper
- *Remember to thoroughly review the course lessons so you can catch errors early.*

IS Web
- *Remember to create an electronic version of the manuscript marked up with everything that the ID wants in the web course.*

CID Project Lifecycle

Sponsor Validation



Who:

- [redacted]
- [redacted]
- [redacted]
- [redacted]

Scope Review

2 / 4

What:

- *PMT reviews the I3 document.*

CIMA

- *PMT sends the I3 on to CIMA for their review and approval.*
- *Upon approval by CIMA, the ID creates the Pre-Production Packet (PPP) with the SME.*
- *After the ID completes the PPP, PMT will assign resources to the project when they become available.*

IS Web & Paper

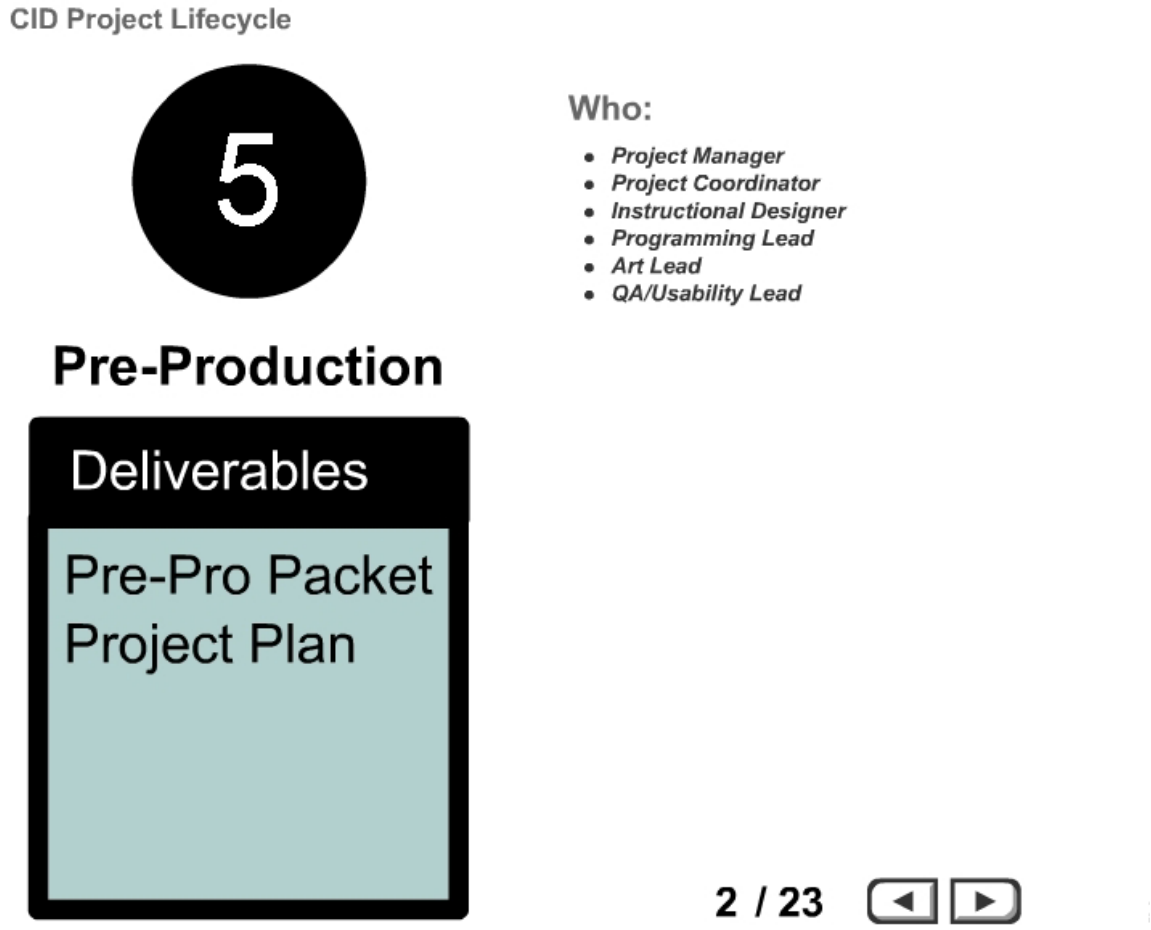
- *PMT reviews the completed manuscript, which is then sent on to Pre-Production.*

How:

PMT uses the rubric of CID strategic objectives to determine priorities. CID's objectives are as follows:

- *Extend blessings of learning to more students*
- *Provide a mentored work environment*
- *Develop and refine standards and promote the adoption of standardized tools and processes (includes R&D)*
- *Return ownership to academic units*
- *Create efficiencies in teaching and learning*
- *Be a leader in the development of instructional materials*
- *Make Friends*
- *Project Readiness*

Phase Five: Pre-Production



What:

CIMA

PRE-PRODUCTION PACKET

- *Details, details, details. The PPP defines all the fine details of the project that will enable the core team members to do their work.*
- *Some of the details include: Site maps, screenshots, functional specifications, video scripts, and all other necessary content for determining scope and tasks.*
- [redacted] *and* [redacted] *are available for sketching screens and concepts.*
- [redacted] *can assist with creating video scripts.*

PPP REVIEW

- *ID walks the core team through the PPP.*
- *Core team reviews the PPP, providing different perspectives and suggestions until the the documentation is thoroughly understood by all.*

PROJECT PLAN

- *After completing the PPP review, the core team members return to their functional teams and identify specific tasks to complete the project.*
- *All tasks from the functional teams are brought together and synthesized into a single project plan.*

What:

IS PAPER

PRE-PRODUCTION PACKET

- *Complete manuscript, grading information, list of all artwork necessary for print production, and a plan for any supplemental materials that need to be produced (CDs, etc.).*

PPP REVIEW

- *ID walks the core team through the PPP.*
- *Core team reviews the PPP, providing different perspectives and suggestions until the the documentation is thoroughly understood by all.*

PROJECT PLAN

- *After completing the PPP review, the core team members return to their functional teams and identify specific tasks to complete the project.*
- *All tasks from the functional teams are brought together and synthesized into a single project plan.*

What:

IS WEB

PRE-PRODUCTION PACKET

- *Complete electronic manuscript marked up for web production, grading information, list of all artwork, web links, and video necessary for web production, and a plan for any supplemental materials that need to be produced (CDs, etc.).*

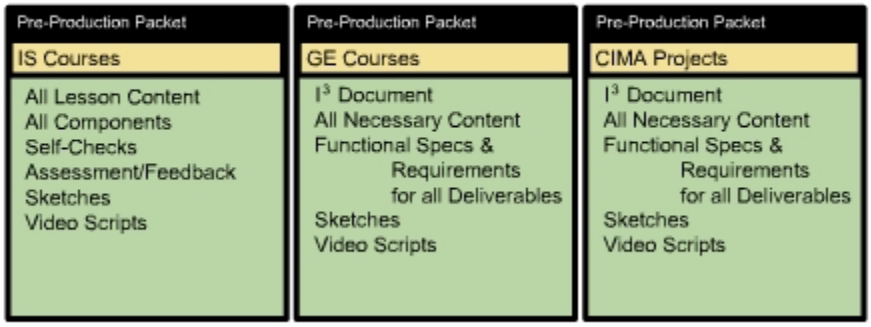
PPP REVIEW

- *Same as IS Paper.*

PROJECT PLAN

- *Same as IS Paper.*

What:



How and Why:

- ***Ensures that projects will continue to move forward regardless of changes in the project core team.***
- ***Eliminates "moving target" projects.***
- ***Keeps developers and artists happy... and sane.***
- ***There are two creations: mental and physical. Before anything can be physically created, it must first be mentally created.***
- ***Saves money through increased efficiency.***
- ***Value team member's observations and questions--everyone's perspective strengthens the project.***
- ***Remember the old adage: "An ounce of prevention is worth a pound of cure."***
- ***Don't get caught up in "look and feel" (visual design) issues. Final design will come in Step 6: Production.***
- ***The ID and IDA are responsible for keeping the PPP updated and available electronically for all team members throughout the PPP review.***

CID Project Lifecycle

Resource Validation

PMT

Project Plan

Impact Review

Who:

- [redacted]
- [redacted] *(How does he hold that pose for so long without moving??)*
- [redacted]
- [redacted]

2 / 4

What:

- *PMT reviews project plans that indicate funding needs beyond the scope of the allotted budget.*
- *Projects are either scaled-back or given more money to fund production.*

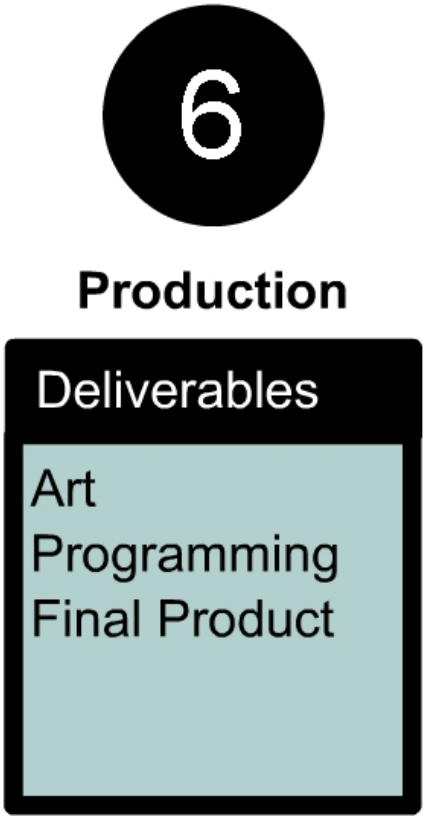
How:

PMT uses the rubric of CID strategic objectives to determine priorities. CID's objectives are as follows:

- *Extend blessings of learning to more students*
- *Provide a mentored work environment*
- *Develop and refine standards and promote the adoption of standardized tools and processes (includes R&D)*
- *Return ownership to academic units*
- *Create efficiencies in teaching and learning*
- *Be a leader in the development of instructional materials*
- *Make Friends*
- *Project Readiness*

Phase Six: Production

CID Project Lifecycle



Who:

- *Project Manager*
- *Project Coordinator*
- *Instructional Designer*
- *Programming Lead*
- *Art Lead*
- *QA/Usability Lead*

What:

- *Product Development*
- *Implementation of Project Plan*
- *Art Production*
- *Programming*
- *Usability Testing*

Why:

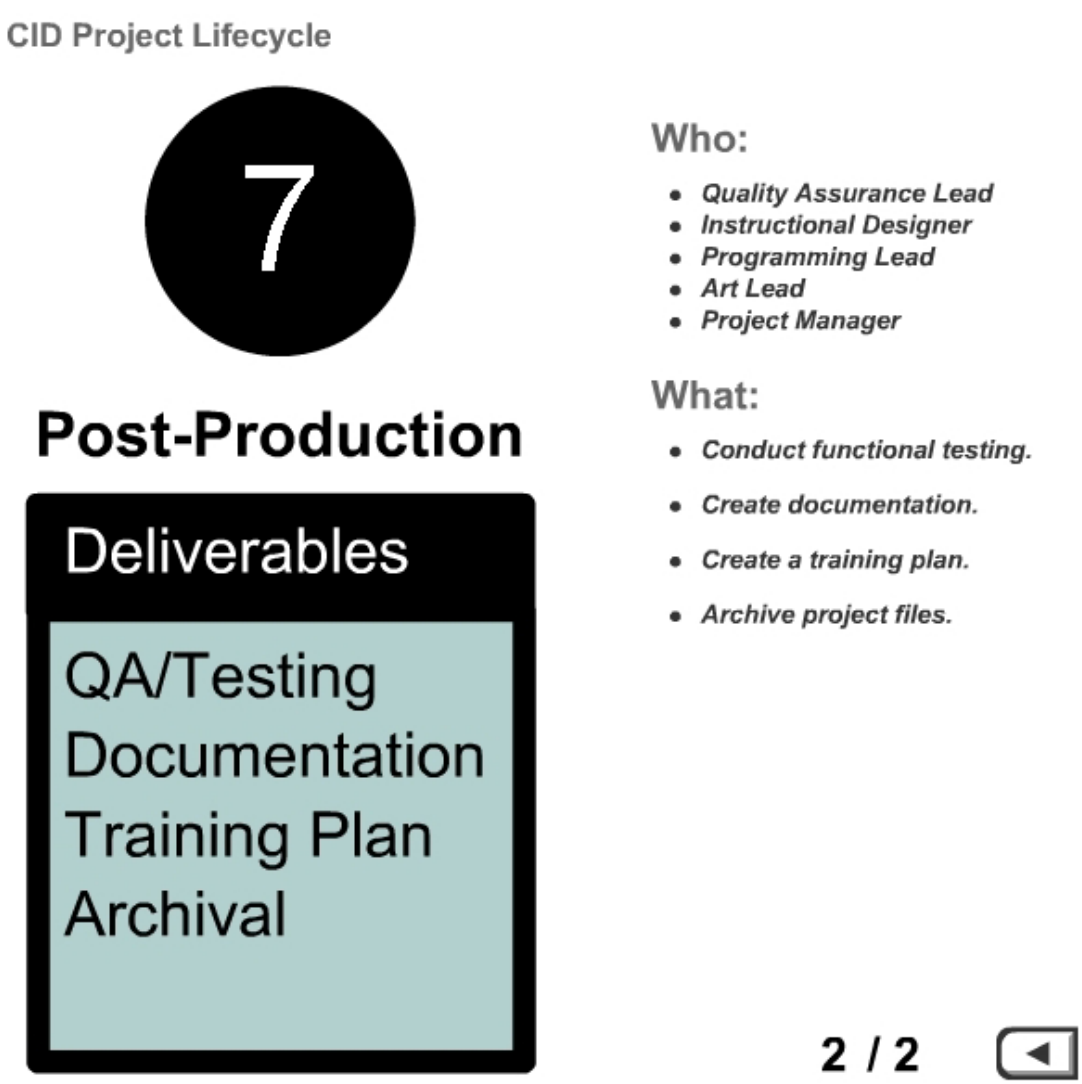
- *So we stay in business, i.e., so we complete projects*

How:

- *Follow the project plan*
- *Do tasks and fill out status reports from PCs*
- *Keep faculty abreast of developments*

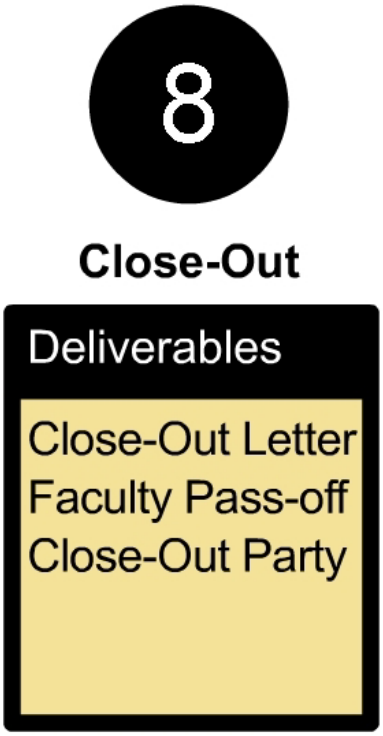
5 / 5

Phase Seven: Post-Production



Phase :

CID Project Lifecycle



Who:

- *Project Manager*
- *Instructional Designer*
- *Core Team*

What:

- *Send a formal close-out letter to the SME and core team.*
- *Give the final product to the SME.*
- *Celebrate the hard work of the team by having a close-out party.*

How:

- *The close-out party doesn't need to be anything fancy or expensive--it could be as simple as donuts for the team. The important thing is to just acknowledge the work that has been completed.*
- *When passing the project on to the SME, discuss future project concepts in the department.*

2 / 3

How:

CIMA

- *Obtain final written sign-off from the professor.*
- *Notify the professor by letter or email that the project is finished.*
- *All deliverables are transmitted with the letter.*
- *ID may walk through the deliverables and provide any product training or orientation.*
- *Complete a close-out form for the internal team.*

IS Paper

- *The ID hand-delivers the paper manual, exams, and a close-out form letter to the chair and professor.*
- *Discuss next steps with chair/professor regarding web development and invite their involvement.*

IS Web

- *Send a letter or email to chair/professor telling them what we did to web-enhance the paper course. Provide the course's URL and password.*

Appendix E: CID Documentation

The following CID process documents are contained in the Appendix: I³ Design Document.doc, I³ Coversheet.doc, Concept Proposal.doc, team-roster.xls, Status Report Template.doc, Project Plan Template.mpp, template closeout letter.doc, PMT Agenda.doc, closeout questions.doc, Programming Development.pdf, CIDProjectLifecycle.pdf, PMT Scoring Model Revision.doc, and PMT Agenda 11-20-02.doc.

I3 Documentation

Information, Instruction and Interaction Design

-- Insert Project Name --

Provide a brief overview (25 words or less) of the course challenges for which this project is being proposed.

Course Challenges:

List in broad, general terms the instructional objectives of the lessons or sub-object components included in your project.

While the goal here is brevity, you may attach additional pages if necessary.

Attach drawings or sketches of objects with explanatory notations for clarity if necessary.

Instructional Objectives:

3

For each Instructional Objective listed in [2] above, list a brief strategy for accomplishing each objective.

You may wish to include instructional content (or a description of relative content), activities, etc.

Instructional Objective Strategies:

4

For each Instructional Objective listed in [2] above, provide an assessment plan to capture success data.

Instructional Objective Assessment Plan:

5

List or attach a sufficiently detailed description of the content to be portrayed or developed in your proposed project.

Include actual content as a sample where appropriate.

Include a diagram of informational structure and flow.

Provide a description of the proposed interaction. This may be easier to accomplish visually as a storyboard, thumbnail sketches, etc.

Content:

6

List or attach an Implementation Plan for your project.

This should include:

A description of how the faculty will use the product

A description of the scope of the proposed implementation (for instance, all sections or just some?)

List the hosting needs for this project. Remember, only a brief summary is necessary at this stage, i.e. whether the product is to reside on a departmentally-sponsored server, support requirements, etc.

Implementation Plan:

7

List or attach a sufficiently detailed description of the functional requirements required for the project's success.

Brief descriptions, quick sketches or low-fidelity PowerPoint drawings of basic screen layouts and information architecture are all that are required at this early stage.

Please include:

General database development requirements

Multimedia and interaction development requirements

Platform requirements (PC vs. Mac, IE vs. Netscape, etc.)

Delivery requirements (Web, CD, etc.)

System Architecture Blueprint. This document is created from the information provided by steps 1-7

Functional Requirements:

Sample I3 Coversheet

I[3] Documentation
Information, Instruction and Interaction Design

-- A Course 220
--

Designer:_____

Project Manager:_____

Check in date: _____

Review Date: _____

Approved ☐ yes ☐ no _____
Associate Director Instructional Design

Comments:

Check in date _____

Review Date_____ _____

Approved ☐ yes ☐ no _____
Associate Director Media Production

Comments:

Project Concept Proposal

to be considered for production in cooperation with the Center for Instructional Design

-- Insert Project Name --

1

List the course(s) impacted by the proposed project.

Course(s) Impacted:

2

List the number of Students impacted by the successful completion of this project.

Number of Students Impacted:

3

Provide a brief description (1-2 paragraphs) of the proposed project.

Please include:

Instructional Problem *or Challenge*

Broad strategy *for addressing the Problem or Challenge*

List existing materials *or products this project will leverage, upgrade, complement or replace.*

Project Description:

4

Provide a statement of support for this project from the sponsoring department.

Please include:

*The **Projected Benefits** to the sponsoring department that the proposed project will strive to provide.*

Statement of Support:

5

Names and Signatures authorizing this project for submission to the CID Priority Management Team and for project Sponsor Validation must be included.

*A list of **Faculty Members** involved in this project (if known).*

Authorizing Signatures:

Team Roster Document

<Insert Project Name> Team Roster

Name	Role	Phone	E-mail
	Sponsor		
	Instructional Designer		
	Project Manager		
	Project Coordinator		
	Art Lead		
	MultiMedia Lead		
	Faculty Representative		
	QA/Testing		
	Video Lead		
	Server Side Lead		
	HTML Lead		

Status Report Template

Copy and paste the following information in the body of an e-mail and request the owner to fill in the blanks.

Project Name:
Task Owner:
Report Due Date:

WBS Code and Task Name:
Baseline Start Date:
Actual Start Date:
Baseline Finish Date:
Is this task complete?
Will the task finish on time?
Why?
Would you like the Project Manager to contact you?

Project Close-out Template

<Project Name> Close-out

Date:

From: Project Manager

To: Project Team Members (list by name)
Relevant Managers (list by name)
Others (as appropriate)

On <Date> the <Name of Project> Project was completed and delivered to the faculty. For your review, the final version of the product is archived on the S: Drive at .

As part of our close-out process, the project team has reviewed our design and development efforts and come up with a few suggestions for future improvement. You will find a project close-out review report attached to this e-mail. If you have any questions, or would like to discuss any of the findings, please let me know.

Thank you for your contributions to the <Project Name> Project. Your efforts helped make this project a success. It's been a pleasure working with each one of you.

Sincerely,

Project Manager
Project Name

Attachments

(cc: All involved departments' heads, list by name)

Sample PMT Agenda

Priority Management Team

--November 20, 2002--

-- Agenda --

1

Last meeting's minutes/assignments

- **Opening Prayer**
- **Effectiveness of future PMT Meetings-**

2

Concept Proposals:

-

3

Design Document Approvals:

- **Psych 341-**
- **Library Update-**
- **Stat 221 Mentored Online Labs-**

4

Project Plan Approvals/Issues:

- **B-**
- **Chem. 105-Resource allocation now and next semester-**
- **MCom 321-**

5

Close out Projects:

- **History 341-**
- **Link Disclaimer Project-**

6

Special Issues:

- **XML/Avaltus-**
- **Faculty Fellowship II-**
- **Auditory Functions-will we really have resources available again in January?**
- **Stat 221 Discuss IDer's email-**
- **Testing Report Functionality Items-**
- **Evaluator's IS Evaluation Project-**
- **QA on CIMA projects-**
- **Fellowship Resource Request-3-D Molecules for Professor -**

Closeout meeting questions

1. Define budget closure activities and timelines
2. What were the successes?
    a. What worked well?
    b. Brainstorm areas of learning
        i. Project management
        ii. Product management
        iii. Development
        iv. Testing
        v. QA
        vi. Communications
        vii. Vendor Relations
        viii. Operations
        ix. Support
        x. Documentation
        xi. Training
    c. Success criteria and how they were met
        i. What were our goals for this project?
        ii. Where our goals met?
        iii. What are the desired results of this project?
        iv. Are they measurable?
        v. Did the project have clear completion criteria?
            - Was it clear what defined a completion day?

- Where the deliverables along the way clearly defined?

vi. Was it known by the team ahead of time?

a. Description of any processes newly implemented

i. Product Management

- Was there clear sponsorship?
- Where they available to the team?

ii. Project Management

- Planning, conceptual design, detailed design, etc.
- Team membership
    - Was the correct team chosen?
    -
- Flexibility Matrix
- Is/Is not
- Review schedule baseline accomplishments
- Was this project tracked at a sufficient level?
- Did we have too many meetings? Not enough?
- Description on any justifications for completion date changes

vii. Change Management

- Was change managed properly?
- What influenced change the most?

viii. Review techniques used for handling customer expectations

- Who was impacted?

- Who needed to be interacted with during the project?

ix. Communications

- Did we communicate project details well?
    - Operations
    - Support
    - Reports/TIMs/etc.
- Vendor Relations

x. Conflict Management

- Were issues escalated correctly?
- Quickly?

xi. Was knowledge increased?

- Was there a learning curve
- How about when new team members were added?

3. Description of the Areas of improvement
    a. What were the challenges?
    b. What did not work well?
    c. What would you do to improve the next project?
    d. *Review above issues in a negative light*
4. Description of the Lessons-learned
5. Brainstorm of how to incorporate key learning's into processes
6. Description of the documentation completion criteria
    a. Training & user documentation
        i. Is there an easier or steeper learning curve?

b. Maintenance & support documentation

i. Has the overall documentation improved because of this project?

7. Description of the technical accomplishments

a. How does the technology meet the needs of the users?

b. If we could do it all over again would we do it differently?

c. What productivity and efficiencies were gained?

d. Would we have done this without the IP phone project?

e. Would we have done things differently?

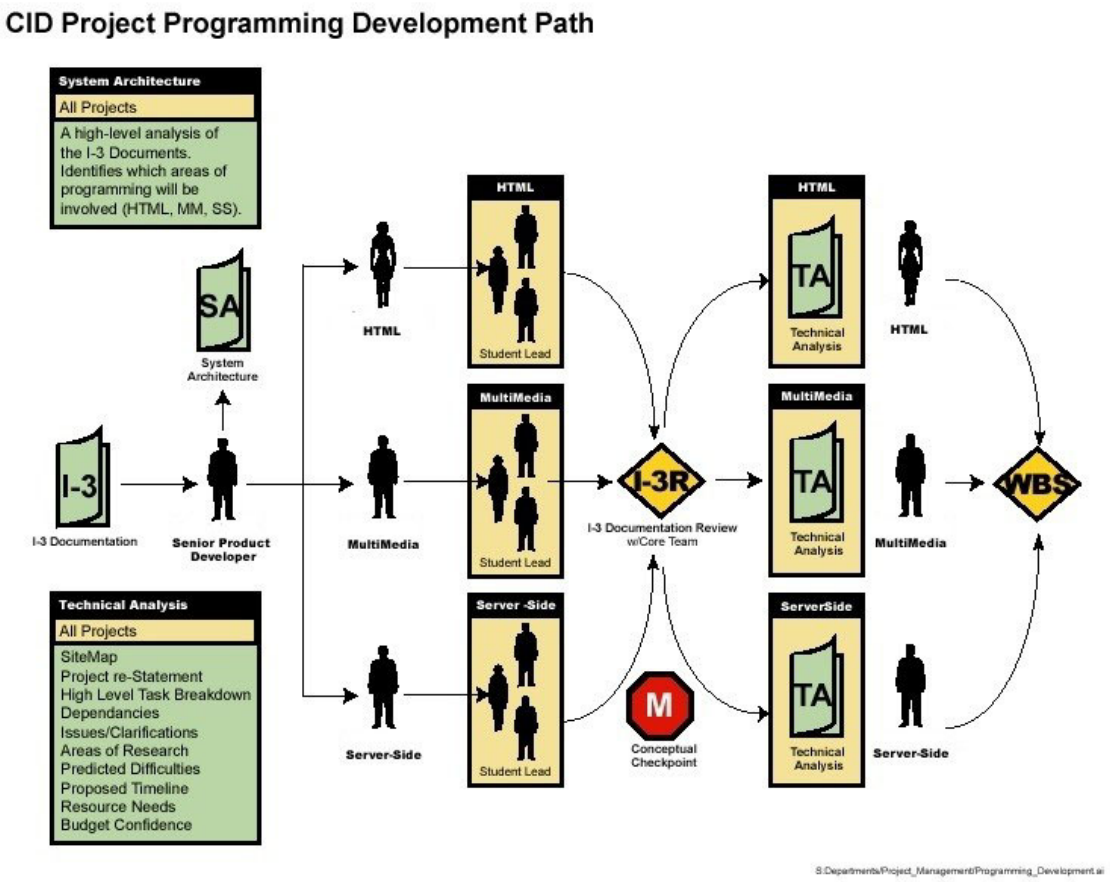
8. Review transfer of responsibilities (support, operations, etc.)

a. What was the release plan process for this project?

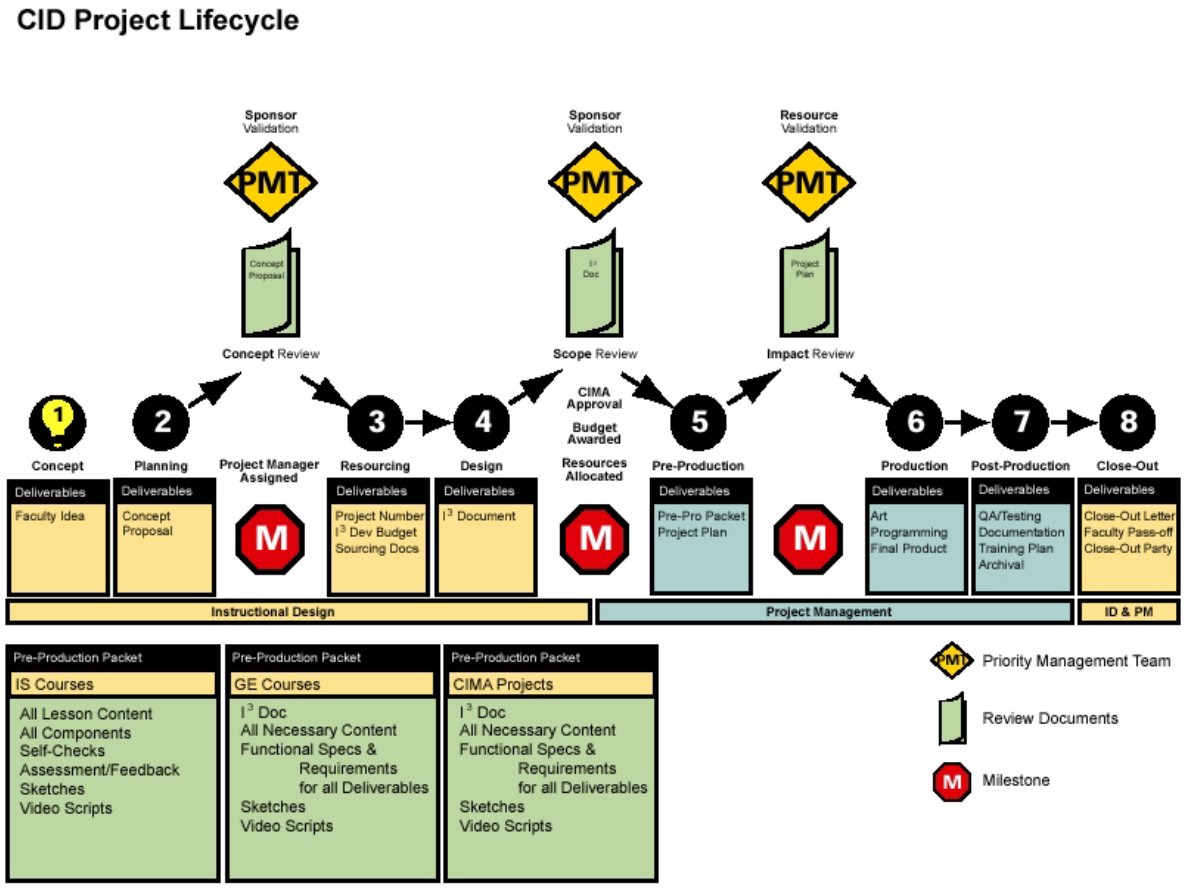
b. Was it followed well?

9. Reward and recognition

CID Programming Development PDF



CID Project Lifecycle PDF



PMT Scoring Model

	Strategic Objectives		G.E. Criteria	G.E. Scoring Anchors		I.S. Criteria	I.S. Scoring Anchors		CIMA Criteria	CIMA Scoring Anchors
1	Extend blessings of learning to more students		1. Increases potential enrollment 2. # of students served	4 = reaches a large (1000+) student population 2 = reaches a smaller (<1000) student population ↑= extends the audience beyond the current audience base		1. Increases potential enrollment 2. # of students served 3. LDS audience vs. audience beyond LDS	4 = reaches a large (100+) student population 3 = reaches a smaller (50 -99) student population 2 = reaches a small (<50) student population ↑= extends the audience beyond the current audience base		1. # of students served 2. LDS audience vs. audience beyond LDS	4 = reaches a large (500+) student population 3 = reaches a smaller (250 -499) student population 2 = reaches a small (<250) student population ↑= extends the audience beyond the current audience base
2	Provide a mentored work environment		Involves students	5 = Increases the students' experience and marketability 3 = Increases the student's experience or marketability 1 = Does not increase student's experienced or marketability ↑ = <larger> number of students ↓ = <fewer> number of students		Involves students			Involves students	

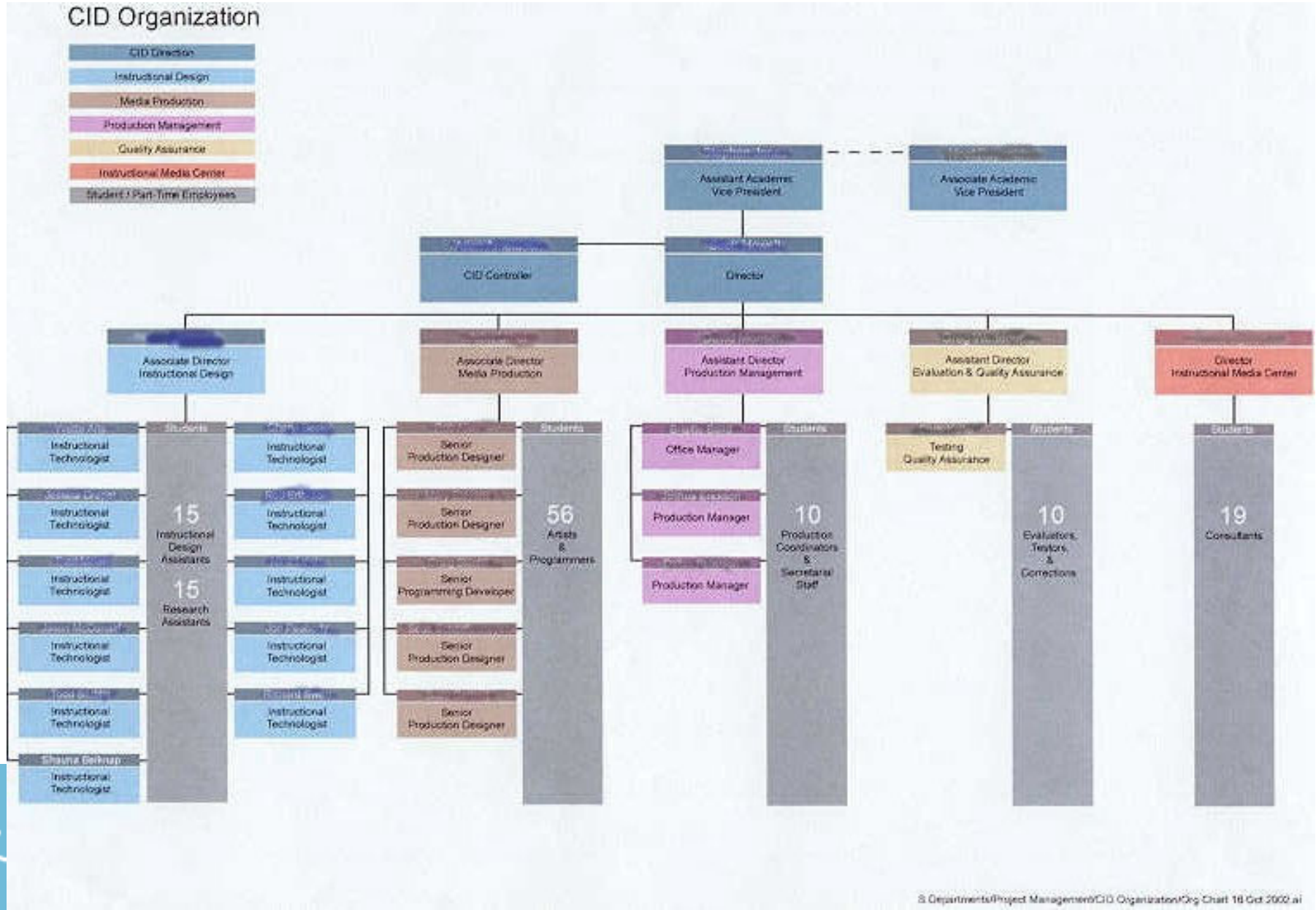
3	Develop and refine standards and promote the adoption of standardized tools and processes (includes R&D)		1. Results in new institutional models for teaching and learning 2. Enables faculty to teach in a distributed environment	5 = Promotes institutional models in T&L **and** is an R&D effort 3 = Promotes institutional models in T&L **or** is an R&D effort 1 = Neither		2. Results in new institutional models for teaching and learning 3. Enables faculty to teach in a distributed environment	5 = Promotes institutional models in T&L 3 = Promotes institutional models in T&L **and** is an R&D effort 1 = R&D with no promotion of institutional model		1. Results in new institutional models for teaching and learning 2. Enables faculty to teach in a distributed environment	5 = Promotes institutional models in T&L **and** is an R&D effort 3 = Promotes institutional models in T&L **or** is an R&D effort 1 = Neither

4	Return ownership to academic units		1. Enables faculty to teach in a distributed environment 2. Academic Unit Sponsorship with evidence that this project supports the unit's strategic objectives	5 = Enables the faculty's ability to teach in a DL environment **and** there is evidence that the project directly supports an Academic Unit's strategic goals with accepted sponsorship by the Dean/Chair 3 = There is evidence that the project directly supports an Academic Unit's strategic goals with accepted sponsorship by the Dean/Chair, but it does not clearly enable the faculty's ability to teach in a DL environment 1 = There is inadequate evidence of strategic support and the Dean/Chair has not accepted sponsorship		1. Enables faculty to teach in a distributed environment 2. Academic Unit Sponsorship with evidence that this project supports the unit's strategic objectives	5 = Enables the faculty's ability to teach in a DL environment **and** there is evidence that the project directly supports an Academic Unit's strategic goals with accepted sponsorship by the Dean/Chair 3 = There is evidence that the project directly supports an Academic Unit's strategic goals with accepted sponsorship by the Dean/Chair, but it does not clearly enable the faculty's ability to teach in a DL environment 1 = There is inadequate evidence of strategic support and the Dean/Chair has not accepted sponsorship		1. Enables faculty to teach in a distributed environment 2. Academic Unit Sponsorship with evidence that this project supports the unit's strategic objectives	5 = Enables the faculty's ability to teach in a DL environment **and** there is evidence that the project directly supports an Academic Unit's strategic goals with accepted sponsorship by the Dean/Chair 3 = There is evidence that the project directly supports an Academic Unit's strategic goals with accepted sponsorship by the Dean/Chair, but it does not clearly enable the faculty's ability to teach in a DL environment 1 = There is inadequate evidence of strategic support and the Dean/Chair has not accepted sponsorship

5	Create efficiencies in teaching and learning		Saves space and instructional time, and increases student efficiency	4 = Saves instructional time **and** increases student efficiency 2 = Saves minimal instructional time **or** increases student efficiency ↑ = saves space ↓ = does not save space		N/A	5 = Revision of an existing course 3 = A new course		Saves space and instructional time, and increases student efficiency	4 = Saves instructional time **and** increases student efficiency 2 = Saves minimal instructional time **or** increases student efficiency ↑ = saves space ↓ = does not save space
6	Be a leader in the development of instructional materials		Does it have the potential to be a standout in aesthetics, pedagogy, and technology	5 = Has the potential to standout in aesthetics, pedagogy, and technology 3 = Any two 1 = Any one		Does it have the potential to be a standout in aesthetics, pedagogy, and technology	5 = Has the potential to standout in aesthetics, pedagogy, and technology 3 = Any two 1 = Any one		Does it have the potential to be a standout in aesthetics, pedagogy, and technology	5 = Has the potential to standout in aesthetics, pedagogy, and technology 3 = Any two 1 = Any one

7	Make Friends		Level of Initiation (Anything other than a "2" invites the PMT to promote the project above others)	5 = President Bateman/Alan Wilkins, on behalf of external or internal project initiators 4 = Stephen Jones/Noel Reynolds, on behalf of external or internal project initiators 3 = Scott Howell on behalf of external or internal project initiators 2 = Default score			5 = President Bateman/Alan Wilkins, on behalf of external or internal project initiators 4 = Stephen Jones/Noel Reynolds, on behalf of external or internal project initiators 3 = Scott Howell on behalf of external or internal project initiators 2 = Default score			5 = President Bateman/Alan Wilkins, on behalf of external or internal project initiators 4 = Stephen Jones/Noel Reynolds, on behalf of external or internal project initiators 3 = Scott Howell on behalf of external or internal project initiators 2 = Default score
8	Project Readiness		Is the project ready to be worked on	N/A		N/A	5 = Contributes to BGS, GE, or major **and** there exists a mismatch of curriculum 3 = Contributes to BGS, GE, or major **or** there exists a mismatch of curriculum ↑= Impending Obsolescence			

CID Organization Chart



Appendix F: Dissertation Author Qualifications

This research is a result of the author's desire to expand his personal understanding of how evaluation, instructional design, and business practices are related. This unusual combination of interests has developed from my experiences. These experiences include twenty years in the information technology industry in various capacities, including systems engineer, project manager, and manager. Many of the tasks performed in those roles involved some sort of evaluation (usually called consulting in business), a function that was enjoyable and personally and professionally rewarding.

Several years ago, a break occurred in my business career when a Leave of Absence was taken to accompany my spouse to Belarus where she was a Fulbright Teaching Fellow. While there, I had the opportunity to teach HTML and Internet classes at her university. This rewarding experience led me to pursue a Ph.D. in Instructional Technology in the hope that we might have the opportunity sometime to receive joint Fulbright Fellowships.

My initial objective in my doctoral education was to become an instructional design expert. However, during my first year of graduate study, I had two classes in evaluation and realized this aspect of our department's program was more in line with my interests and abilities. I still wanted to become an instructional design expert though so my focus shifted to evaluation of instructional design practices. One of my positions in business was as director of project management for a relatively large training industry company in which the instructional design model used for learning object development was the ADDIE (Analysis, Design, Develop, Implement, Evaluate) model. With this practical experience in the use of ADDIE, years of business-related evaluative

experience, and now some formal training in instructional design and evaluation, I felt qualified to begin the process of better understanding how ADDIE is currently used in the instructional design field.

To gain this better understanding of ADDIE and its usage in the instructional design field, I decided to pursue a qualitative study of ADDIE. As with any study, personal biases play a role in the results. My business background manifests itself throughout this dissertation and has colored my observations. Additionally, I often discussed this dissertation research my spouse who teaches business at a highly ranked business school and does research in quality management issues. Our discussions about quality and especially service quality have also colored my observations. Indeed, some of her on-going research forms the foundation of service quality principles that are discussed in this dissertation.

Borg and Gall (1989) indicate that the type of qualitative research I have undertaken was much more difficult to do well than quantitative research because the data collected are usually subjective and the main measurement tool for collecting data is the investigator. Consequently in order to collect qualitative research data effectively, extensive training and practice in the methods are needed. As mentioned, I have had considerable experience in evaluating business situations. During the course of my Ph.D. program, I gained additional training and experience. I took additional evaluation and naturalistic inquiry classes and read much on these subjects. I was the project manager for a team evaluating course management tools for use at the university. I performed a yearlong evaluation of the development practices used by the university's public broadcasting station as they developed a half-season television series and associated Web

site and Internet-based courses. During my Ph.D. program, I have also consulted with several large firms to help them define their education and training infrastructures.

Hopefully, these experiences and the education and training I have received during my studies will help make this dissertation research more effective and useful for the reader.

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