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1   I n t r o d u c t i o n

Global competition demands that all companies are in a continual state of improvement. An integral part of this process is TRAINING, which refers to the transfer of knowledge from more skilled to less skilled. Training is typically needed under the following circumstances:

- o   New or modified system under development.

- o   New hires or users new to the system.

- o   Enhancement of user performance (Productivity, Quality etc)

Steve Woloz Associates, a licensed trainer with Emploi Quebec, fully endorses and subscribes to the Human Factors Training Approach as outlined in the Instructional System Development (ISD) as outlined by the Federal Transport Aviation Association (FTAA).

Steve Woloz approach is to begin with a generic approach and then customize the actual training program to the client's specific requirements. Actual experience has shown us that in addition to traditional training manuals, the use of multimedia is an indispensable training tool. As an example, please see the attached video clip. On the following pages we will summarize the Human Factors Training Approach. *1

*1: Actual text taken from website : http://www.hf.faa.gov/webtraining/Training/Training1.htm

STEVE WOLOZ ET ASSOCIÉS INC.,   UNE SYNERGIE D'ENERGIE, D'EXPERTISE, ET D'EXPERIENCE
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2   I S D   I n t r o d u c t i o n

Although there are many approaches to training, this module will present the concepts of Instructional Systems Development (ISD). ISD, originally developed under the auspices of the Department of Defense, is widely used not only by the military, but also by corporations and Federal agencies. ISD is particularly well suited for complex systems training development, as it is derived from the Systems Engineering process of which Human Factors forms a part. ISD is characterized by its logical, structured approach and emphasis on trainee job performance. The goal of ISD is to increase the effectiveness and cost-efficiency of training by:

- Developing instruction based on job performance requirements,

- Eliminating irrelevant skills and knowledge instruction from courses, and

  Ensuring trainees acquire the skills, knowledge, and attitudes to do the job

3   F i v e   P h a s e s

The ISD process consists of five phases. The analysis phase defines what needs to be trained. Next, an instructional design is crafted to meet this need. Only after the design is complete are the instructional materials developed. During development, individual and group tryouts of the materials are conducted. Results are iteratively fed back into design and development. Evaluation is a central feature of ISD and is performed in each phase. The phases are:

- **Phase 1: Analysis -** Determine if training is the appropriate solution; if so, define training requirements.

- **Phase 2: Design -** Define objectives, design the training program, and select training methods and media.

- **Phase 3: Development -** Develop all training materials in accordance with design. Conduct pilot training classes. Refine course, as necessary.

- **Phase 4: Implementation -** Implement training, evaluate, and refine.

- **Phase 5: Evaluation -** Performed during development, during implementation, immediately after training, and six months or more after training.
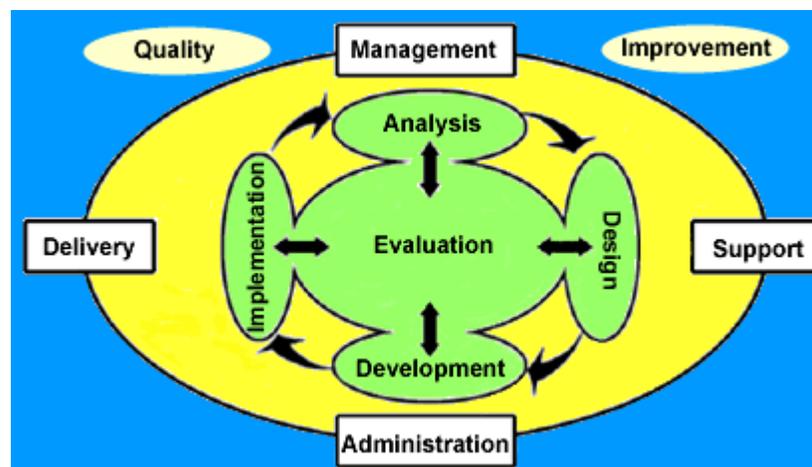
4   P h a s e   1   -   A n a l y s i s

The analysis phase of ISD consists of a three-step, front end analysis (FEA). This initiating phase forms the foundation of a training program. Human Factors skills are especially applicable at this point. The FEA should be conducted as part of, or in parallel, with the Human Factors tasks performed as part of Systems Engineering during system development. If Human Factors engineering has been applied to develop easy-to-use, human-to-system interfaces and procedures, then training will be easy-to-design, develop, and conduct.
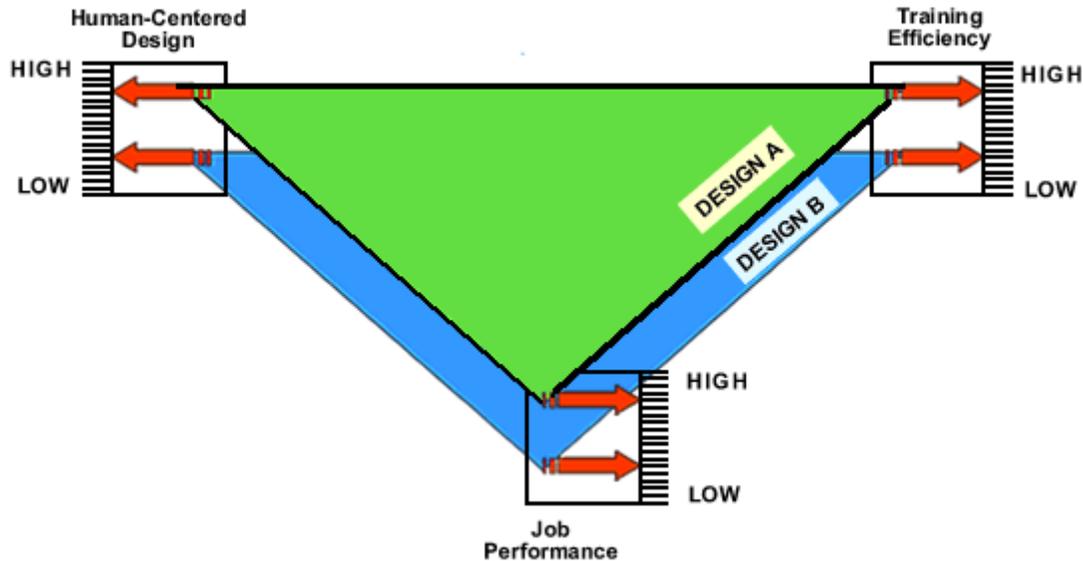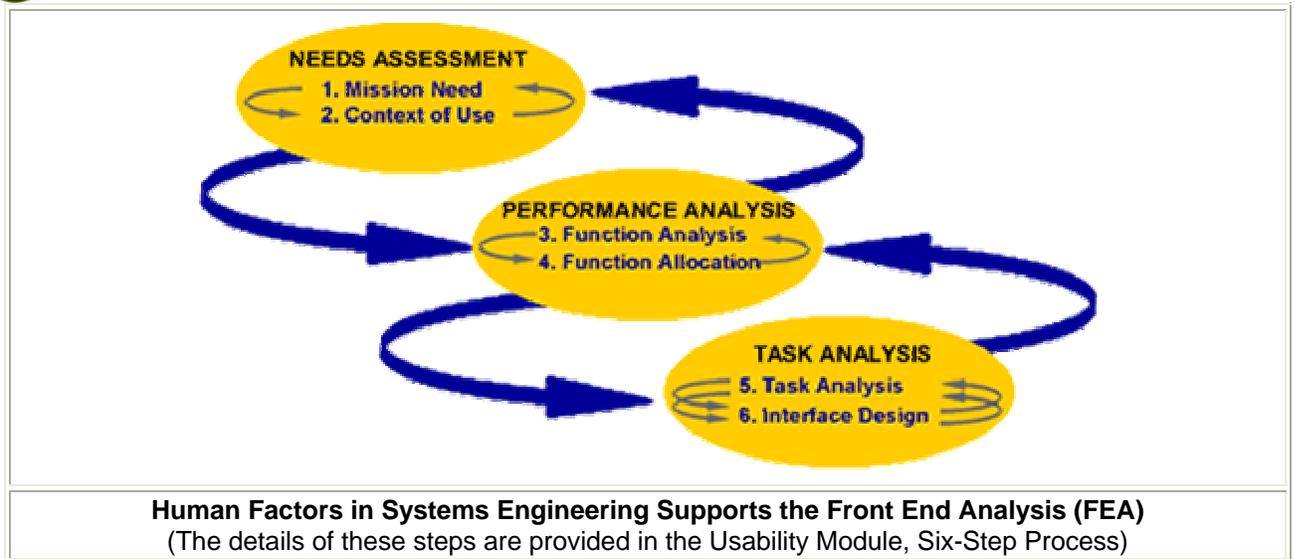

"Design A" has a higher Human-Centered Design content than "Design B" and yields greater training efficiency and higher job performance

Phase 1 of the ISD approach is broken down into a three step front end analysis (FEA). The FEA defines training needs and job performance requirements; determines if training is the solution; and identifies what is to be trained. The FEA steps closely parallel the Human Factors activities within the Systems Engineering process. Information from these analyses can be applied to the FEA. Completion of the three FEA steps is required before instructional design or development activities are begun.

The steps are:

- **Step 1: Needs Assessment -** defines training need.

- **Step 2: Performance Analysis -** determines if training is the solution.

- **Step 3: Task Analysis** - identifies what is to be trained in detail.

Human Factors in Systems Engineering Supports the Front End Analysis (FEA)
(The details of these steps are provided in the Usability Module, Six-Step Process)

4.1   FEA - Step 1: Needs Assessment

The first question addressed in the FEA needs assessment is:

- **Why is training needed?**

  o   Training is needed for a new system under development.

  o   Training is needed for new hires or users new to the system.

  o   Training is needed when the human-to-system interface and tasks have been modified due to upgrade/retro-fit to an existing system.

  o   Training is needed to improve user performance.

Initial Training - At least some training for new hires or users new to the system is usually required. Exceptions are when users come to the new job/position with all the necessary skills, knowledges, and abilities to perform. Even in this case, some orientation training will be required for new hires, as well as for workers assuming jobs within a different part of the organization.

New Interface or Tasks - With a different interface and tasks, it is highly likely that a training program will be needed. The extent of this program will depend on the difference between skills and knowledges required for the new or modified system and those already possessed by the users.

Performance Remediation - When training is needed to improve user performance on an existing system for which training has already been provided, a more detailed analysis is required to determine if "training" is indeed the answer to the performance problem. A performance assessment, Step 2 of the FEA, is in order.

4.2   FEA - Step 2: Performance Assessment

The performance assessment answers the question:

- **Is training needed to improve performance?** Other factors may be causing or contributing to the perceived human performance decrement. Among these factors are: poor design of interfaces, tasks, or job; ambiguous or improper procedures; improperly functioning equipment; work overload; inadequate environmental or working conditions; lack of feedback; or other influences internal or external to the work unit.

A Human Factors system assessment to isolate the cause of the performance decrement will determine whether or not training is the solution or part of the solution. Training should NEVER be used to circumvent poor human-to-system interface design.

4.3   FEA - Step 3: Task Analysis

The results of a thorough Task Analysis are essential to effective training course development. A Task Analysis determines:

- **What is to be trained?** - Training content, tasks and sub-tasks are identified. Task duration, frequency, and priority are estimated. Tasks/subtasks are sequenced and interrelationships defined. Further analyses identify cueing events, actions, or information needed for task initiation, continuance, or termination. Performance accuracy and success probability are assigned for each task/subtask. Possible user and maintainer errors are identified for each task/subtask, and the likely outcome of these errors defined. This includes effects on the system, its components, and other functions and tasks. Next, critical tasks/subtasks are identified, that is, those tasks/subtasks considered critical to protecting personnel and system safety. These, in turn, are analyzed for error and failure results.

The Human Factors task analysis performed during system development or modification is an excellent source of this information. Ideally, the training developers and trainers should be part of the multi-disciplinary design team that takes part in the human-centered design process. This joint participation enables the training developer to obtain a thorough understanding of the human-to-system interface, display/control interfaces, and task procedures. The team, in turn, gains the trainer's knowledge of the task difficulty levels and potential suggestions for simplification. When the needs assessment, performance analysis, and task analysis have been completed the design phase can proceed.

5   Phase 2 - Design

The design phase builds on the data and information generated during the analysis phase. It is now time to:

- Develop learning objectives for each task.

- Identify and list the learning steps required to perform each task.

- Develop the performance measures to show task/subtask mastery.

- Develop the prerequisite behaviors required prior to training entry.

- Select training media and instructional strategies.

- Define the structure and sequence of instructional materials.

- Assess existing training materials, if any, for applicability and re-use.

Based on the results of the FEA, learning objectives are defined for each task/ subtask. For each of these, test strategies and test items are developed to assess learning. Learning objectives must be

clearly written and objectively measurable. Learning objectives are used to design exercise and practice sessions and for test item development. In the design phase, instructional methods and media are selected and instructional strategies identified. An implementation plan is developed and the training information management system is specified.

6   Phase 3 - Development

In the development phase, the information from the analysis and design phases are used to develop the training materials and prepare for course implementation. Activities in this phase include:

- Develop, complete, review, and produce all lesson materials, interactive courseware, videotapes, slides, viewgraphs, and/or simulators or other training devices.

- Develop, complete, and produce student and instructor manuals and/or materials.

- Conduct formative evaluation of instruction and materials by internal review.

- Conduct individual and small-group course try-outs as additional formative evaluation and validation.

- Conduct operational, field tryouts of the complete system for summative evaluation and collection of additional validation data.

- Revise courseware as a result of validation and evaluation activities.

The last steps in this phase are to revise and finalize the implementation plan and to ensure all instruction materials are ready for training implementation.

7   Phase 4 - Implementation

Upon completion of the analysis, design, and development phases, it is time to implement the "whole" system with actual trainees. The instructional system is "fielded" under "real world" conditions. Data from training classes are used to further evaluate the instructional system. Operational evaluations provide validation data and feedback on modifications for improvement.

The evaluation performed after training has been completed should be designed to measure the effectiveness of the instructional program and answer:

- **Did the trainees master the learning objectives?** - This is assessed by test scores during training, at the end of training, or a combination thereof.

- **How well are trainees performing on the job?** - This is assessed by taking performance measurements on the job. Ideally, measurements should be taken immediately after training and after six months on the job.

- **Can the training be improved?** - The ISD process stresses continuing feedback and improvement to the training program.

8 Phase 5 - Evaluation

The ISD process stresses evaluation and improvement throughout the life cycle of the operating system for which the training was developed. This is accomplished by training evaluation and iterative feedback for instructional program improvement. Trainee on-the-job performance is measured periodically to quantify the positive training transfer and measure instructional program success. A critical element of the evaluation phase is development of appropriate metrics to support this post training evaluation process. Three evaluation categories support the ISD model.

- **Formative Evaluation** - Consists of the process and product evaluation performed during the analysis and design phases. It also encompasses the development phase validations including individual and small group try-outs, but excluding the final summative evaluation/validation.

- **Summative Evaluation** - Consists of operational tryouts that are conducted as the last development phase validation of the instructional program.

- **Operational Evaluation** - Consists of the operational system evaluations that are performed both internally (in classes) and externally (on the job) on a periodic basis during the implementation phase

The ISD final evaluation phase measures and quantifies the amount of training transfer. Metrics used for this purpose include:

- **Training Transfer** - Percentage of skills successfully transferred to the job.

- **Prior Knowledge** - Percentage of skills that trainees possessed prior to training.

- **Retention** - Percentage of skills presented in training that the trainee cannot perform six months after training.

A training program has been effective when the knowledge, skills, and abilities (or attitudes) targeted for improvement or change are evidenced by the employee on the job on a sustained basis.

The Five Phase ISD Process Targets Job Performance
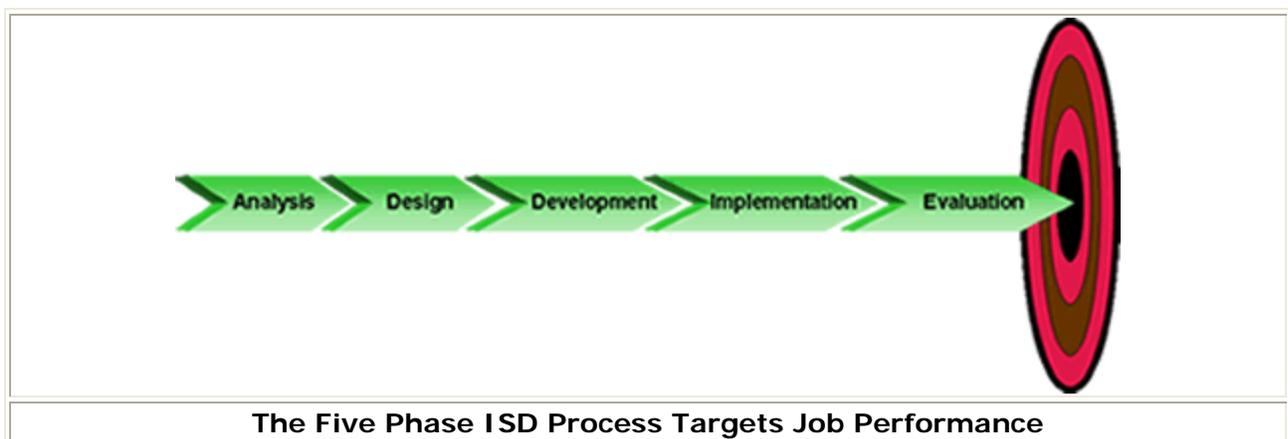
9   Training Aids & Media

There are many forms of aids and media used in training. Some, such as chalk boards, flip charts, overhead transparencies and viewgraphs, have been in use for many years to augment classroom, lecture style training. Using computers as a media with which to aid instruction began in the 1960s with Plato (Programmed Logic for Automatic Teaching Operations). Plato was the precursor for today's computer use in education and training and the platform for much early research in computer-based learning.

As computer technology has evolved, yielding more power at reduced cost, it has increasingly been applied in training and education.