RETHINKING TRAINING IN THE 90’s

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Abstract: Training has become a growth industry in the last decade. A 1995 survey of US industries with 100 or more employees reported that approximately $52 billion was spent annually on training employees, while total estimates for all companies are estimated at $90 to $100 billion. As technology evolves, some experts in the architectural, engineering, and construction (AEC) industries predict that training costs will grow five-fold from current levels.

Who is receiving all this training, and why? How is training being conducted, and are there better ways to do it? Are there cost-effective ways to conduct training? These issues are critical if the AEC industry is to remain responsive and competitive in rapidly changing national and global markets.

This paper surveys recent training trends, and insights are offered about how and why the AEC industry trains employees. Considering recent technological innovations, new ideas are presented for how training could be conducted to exploit technology and deliver more relevant and economical training than is available using traditional training approaches.

Introduction

Training has become a major cost of doing business. In a 1995 survey of all US businesses with 100 or more employees, approximately $52 billion was spent on training (Training Magazine 1995) and estimates are that $90 to $100 billion was spent overall (Reinhardt 1995). Although training needs are diverse, training is still largely delivered in classroom-oriented environments where an instructor prepares and controls the learning experience. Few will question the effectiveness of this instructor-centered approach when instruction is properly designed, prepared, and delivered. However, the time has come to question whether these instructionist-centered approaches are worth the expense because of non-productivity costs associated with travel and missed work. Most importantly, we must also ask whether this should be dominant method of training in an era of rapid technological obsolescence.

New approaches should consider how training can be re-engineered to shift the focus from providing instructionist-centered training to creating task-centered learning opportunities where new skills can be acquired as they are needed in the workplace. While traditional training environments will likely remain appropriate for imparting basic skills, this paper explores a paradigm for creating and exploiting cost-effective learning opportunities in the workplace, rather than traditional training environments outside the workplace.

Current Employers And Employee Training Needs

Training is critical for any industry that must remain competitive in a technologically complex and ever-changing world. Stasiowski (1995) predicts that,

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Key words: training, instructionist-centered training, distance learning, industry trends
because of technology, many AEC employees will become obsolete within three years
without continuous training, and this will increase training costs five-fold in the near
term. High technology innovators talk of ever shortening planning horizons, and
some even warn that planning cycles greater than three years are dangerous
(Prokesch 1993).

Given the disruption that training can project on an organization, what are
the benefits of training? In addition to dealing with rapid changes in the work
environment, companies benefit from training beyond obvious improvements in
individual proficiency and competency. Proper training can also lead to more
satisfied employees, and studies indicate that training, under certain circumstances,
training can also reduce turnover (Hequet 1993).

Since the traditional employee-company contract exists in few industries,
employees have started to view training as important for job security. Formal
degrees and documented technical skills are also seen as tickets to job security, but
this has created “diploma creep” with a significant increase in the number of
advanced degrees awarded in fields such as engineering management during the late
80’s (IEEE 1990). As a result, many training resources are wasted building resumes
with certificates representing knowledge that “might be needed in the future”, rather
than delivering knowledge and skills that “are needed right now.”

What does management know or think about this dilemma? Oddly enough,
decision makers often contribute to training waste by approving and supporting
training programs without having any real idea about their purpose or productivity
value (Arthur and Womack 1995). Traditional training is simply assumed to have
some intrinsic value and is assumed to be a “cost of doing business”, even though its
benefit to business is never quantified.

Who Is Getting Trained And What Is Being Taught

Learning is a lifetime endeavor for engineers. Although managers often focus
the professional development for entry-level workers, training is essential at all skill
levels. New employee training takes place in 89% of US organizations with 100 or
more employees, while higher level management training in leadership, performance
appraisals, and interpersonal skill training is conducted in 85% of these organizations
(Training Magazine 1995).

Within the AEC community, studies of entry-level engineers by Kinney and Ra
(1995) with four or less years of job experience found that managers place a high
priority on training for technical skills and communication (see Figure 1). This
compares favorably to results reported by other industries where technical training
was offered for learning personal computer applications (72%), problem solving
(57%), new equipment operation (65%), data processing/management information
systems (52%), and computer programming (54%) (Training Magazine 1995). With
the explosive growth in workplace automation, these technical training categories
are likely to continue and grow at an increased rate.

How Is Training Being Conducted

Not surprisingly, traditional classroom training, including watching videotapes,
lectures, and one-on-one instruction are the most frequently used training methods
(see Figure 2). Within the AEC community, Kinney and Ra (1995) also found
traditional training methods include mentoring, continued education, seminars, and
in-house training were the most used training methods for entry level employees. Of
course, traditional classroom training also dominates graduate MBA and Engineering
Management programs that produce advanced degrees critical for mid-level
managers to climb the corporate ladder.
Although traditional classroom techniques are frequently used in training, are these the only training delivery methods available? Figure 2 indicates that several other training methods are available today, including computer-based training, interactive video, multi-media-based training and computer conferencing. These methodologies are used much less frequently than traditional training techniques, but the time has come to consider how these methodologies can address some of the problems inherent with traditional training approaches.

What Is Wrong With Training Today

Although traditional instructional approaches are frequently used, is it really the most effective instructional method? New evidence is mounting that it may not be the best way to train a modern workforce for the following reasons:

• **traditional training environments are expensive**: While classroom environments provide insulation from interruptions, trainees are often removed from the work environment and placed in sterile classrooms. This often requires travel and non-productive time while learners participate in training.

• **traditional learning environments lack context**: Trainees who are in a classroom environment often have problems seeing how the material they are being taught can be applied in their everyday work because of a lack of work context. Also, trainees often have to learn the training material twice: once in the classroom, and then again when they return to their work settings.

• **there is too much to learn**: Engineering applications have grown considerably in complexity over the last decade. Traditional classroom environments often do little more than familiarize a learner with basic system features and functionality.

• **the technology is changing too quickly**: Frequent releases of engineering software make learning about technology-related concepts an ongoing and continuous process. By the time classes can be developed and taught, the underlying technology has often changed so much that the class is irrelevant.

• **people are intimidated**: In large groups, people are often afraid to speak out or ask questions. This “fear of looking stupid” can significantly hamper the learning process and prevent people from obtaining all they could from the learning experience. Technology allows workers to “ask questions” without a fear of looking dumb in front of others (Reinhardt 1995).

Refocusing Training For The 90’s

Within the AEC community, technological advancements and competition have transformed the industry from highly trained individual specialists to broadly trained generalists working in groups. Large AEC firms that traditionally work on strictly civil engineering tasks will work in the future on multi-disciplined projects that encompass “cradle to grave” decisions including finance, design, construction, operation, maintenance, and retirement. These large AEC firms will face increased competition in the form of lower cost operations, as well as competition from non-traditional sources, including consulting and accounting firms, offering a broader range of project and information-oriented services that outstrip those offered by the traditional AEC firms. The large companies that will prosper in the 90’s will be those with a diverse, adaptable workforce that are best able to learn new skills demanded by the marketplace, and training will be key to remaining competitive.

The small AEC firms are also evolving into broadly trained generalists. How many small AEC companies only provide one of the traditional civil engineering specialties? Training will be more critical for this sector of the AEC community.
because of the lack of diversity of employees, nature of their work, and small profit margins. Unless their training resources are used effectively, many small firms will become extinct or relegated to groups of technicians providing technical support to larger firms.

What can be done to prepare the AEC work force for challenges of the 90’s and beyond? One solution lies with the technology itself that is causing these tumultuous changes. Recent advances in multi-media technology, local area networks and video teleconferencing permit new channels of communications between workers and experts. These channels support communications that are readily accessible, less formal, less costly, and contextualized. Workers can access expertise that would normally only be found in the classroom, regardless of organization boundaries, when the need arises. But the bigger question remains: how can technology alter the basic learning processes necessary to build and maintain a skilled work force?

Table 1 summarizes an alternative paradigm to address training needs of our future work force. This model assumes that workers will have access to multi-media capable workstations and are interconnected via high speed local and wide area networks. These networks will providing access to libraries of useful applications, historical case studies, and electronic learning environments stored on high capacity media. Such an environment delivers a rich training environment right to the learners desktop and allows workers to leverage existing institutional resources during both training and routine job performance.

This new model assumes that organizations can identify subject matter experts and provide technology that provides electronic access to these experts while working. Rather than learning from a single instructor, groups of experts could act as consultants and review projects, offering advice, suggestions and subject matter expertise to less experienced engineers. The workplace would serve as the classroom, and learners would work with teams of experienced mentors and experts who provide guidance and advice as the learner solves real world problems arising in the workplace. The basic hardware and software necessary to support this vision exists today, but what is principally needed is a shift in how organizations conduct training, and ultimately, how organizations work.

As an example, Table 2 contrasts the old and new model for the training needs of new civil engineers (see Figure 1) based upon the Kinney and Ra survey. Since most larger consulting firms conduct formal training for new employees, this type of training was also added to the list.

This vision can also benefit from near-term future technology improvements, including task-oriented context-sensitive help systems, intelligent tutorial systems, on-demand digital video systems, and point-to-point video and speech capabilities over local area networks. Although advanced technology is necessary for creating this training vision, it should be viewed only as a facilitator of change. Most importantly, there must be a fundamental shift in the focus of training from providing traditional classroom based instruction to creating task-centered learning activities in the workplace by providing both access to powerful tools and experts that have demonstrated success in using these tools.

For the past decade, educators and researchers have espoused the virtues of computer based education and training (CBET) in the workplace, but this potential has yet to be realized. The AEC industry is, however, starting to embrace information technology beyond e-mail and computer-aided drafting. Some of the more interesting views include virtual civil engineering libraries, multi-media textbooks and journals, and even an interactive learning center for civil engineers at Georgia Institute of Technology (Austin 1995).
Some Open Questions

This paradigm offers new ideas for conducting non-traditional training, but some difficult questions still must be addressed. How can we measure learning that occurs in the workplace? Under the current system, a seminar or college course offers tangible proof that training occurred; but, how do we create credentials from less formal training activities? Are credentials from formal training experiences even important? From a litigation perspective, can we prove that engineers and scientists have the skills to properly analyze and solve problems? As the AEC industry continues to evolve towards broadly trained generalists, will there be a loss of critical technical skills and expertise? Most importantly, will this be in the best interest of the public?

Conclusions

Some issues surrounding training are more economic than pedagogical and a reflection of the current state of the AEC industry. The traditional employee-company relationship is changing, placing undue emphasis on formal training certificates for employment security and litigation purposes, rather than because it is the best way to learn. At the same time, organizational re-engineering, mergers, and down-sizing all make training compulsory in order to remain competitive in a global market economy. In short, training in the 90s is being conducted for a host of reasons that did not exist 10 years ago, but the competitive economic climate of industry requires that training must be conducted more effectively.

Technology exists today to create and exploit individual learning opportunities using means that are cheaper and more effective than traditional instructionist-oriented teaching, however, some difficult questions still exist. What training is really necessary, and what is the best way to conduct it? How can we create opportunities in the workplace to conduct training, and how to measure its success? When training does take place in the workplace, how can we recognize and reward it so that employees benefit as much as they would have if they had received expensive classroom based training? These are all issues that must be addressed if a new training paradigm is to succeed.
Appendix I. References


TABLE 1. Comparison of Old and New Training Models

<table>
<thead>
<tr>
<th>Issue</th>
<th>Old Training model</th>
<th>New Training Model</th>
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</thead>
<tbody>
<tr>
<td>competency credentials</td>
<td>formal degrees and training certificates</td>
<td>demonstrated skills with technical tools in the workplace</td>
</tr>
<tr>
<td>training environments</td>
<td>isolated, formal classroom environments</td>
<td>decentralized workplace-centered activities and projects where project managers can electronically conduct meetings, collaborate, and work on multi-disciplined projects</td>
</tr>
<tr>
<td>pedagogical paradigm</td>
<td>learning by objectives established by a teacher in order to master a fixed curricula</td>
<td>learner controlled, contextualized “just in time” learning opportunities</td>
</tr>
<tr>
<td>motivation for learning</td>
<td>learning because “you might need it later”</td>
<td>locating new information because “you need it now”</td>
</tr>
<tr>
<td>instructor role</td>
<td>the instructor controls the learning experience and provides expertise about theoretical issues in the classroom</td>
<td>groups of recognized experts provide guidance and expertise about work-centered questions in the workplace</td>
</tr>
</tbody>
</table>
### TABLE 2. Contrast of Traditional and New Model for the Training Needs for New Civil Engineers

<table>
<thead>
<tr>
<th>Skill Competency</th>
<th>Old Model</th>
<th>New Model</th>
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<tbody>
<tr>
<td>engineering and technical fundamentals</td>
<td>graduate degrees and short courses</td>
<td>laser disc based instructional programs; networks of cataloged work examples; intelligent tutoring technology</td>
</tr>
<tr>
<td>communications skills</td>
<td>seminars and short courses</td>
<td>ad hoc meetings and briefings using point-to-point video teleconferencing, electronic circulation and presentation of projects to recognized experts who critique both the quality of work and communication skills</td>
</tr>
<tr>
<td>computer software proficiency</td>
<td>short courses, continuing education, and video tapes</td>
<td>on-line help that is electronically linked to in-house MIS experts, recognized application experts, and/or software publisher support staff</td>
</tr>
<tr>
<td>training on plans, specifications, and estimates; construction practice, and project management</td>
<td>short courses continuing education one-on-one instruction</td>
<td>access to powerful software tools that allow engineering practitioners to capture assumptions and perform robust project management tasks that can be dynamically modified</td>
</tr>
<tr>
<td>consulting business</td>
<td>short courses continuing education</td>
<td>electronic access to subject matter experts and real life case studies from past projects</td>
</tr>
<tr>
<td>new employee training</td>
<td>fixed period rotations through several offices</td>
<td>electronic access to libraries of ongoing projects and group communications; electronic read-only access to historical project archives and templates</td>
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</tbody>
</table>
Eng&Tech Fundamentals
Communications
Computer-Aided Design/Drafting
Computer Software Proficiency
Plans Specifications and Estimates Assembly
Construction Practice
Project Management
Consulting Business

FIG. 1. Manager’s priority for training entry level civil engineers (from Kinney and Ra 1995)

**FIG. 2. Instructional methods for training (from Training Magazine 1995)**

<table>
<thead>
<tr>
<th>Instructional Method</th>
<th>Percent of Organizations Using These Methods</th>
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<tbody>
<tr>
<td>Videotapes</td>
<td>90%</td>
</tr>
<tr>
<td>Lectures</td>
<td>80%</td>
</tr>
<tr>
<td>One-on-One Instruction</td>
<td>60%</td>
</tr>
<tr>
<td>Role plays</td>
<td>60%</td>
</tr>
<tr>
<td>Games/Simulation</td>
<td>50%</td>
</tr>
<tr>
<td>Case Studies</td>
<td>50%</td>
</tr>
<tr>
<td>Computer-Based Training</td>
<td>40%</td>
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<tr>
<td>Audiotapes</td>
<td>40%</td>
</tr>
<tr>
<td>Films</td>
<td>40%</td>
</tr>
<tr>
<td>Non-Computerized Self Study</td>
<td>40%</td>
</tr>
<tr>
<td>Self Assessment Techniques</td>
<td>40%</td>
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<tr>
<td>Interactive Video</td>
<td>30%</td>
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<tr>
<td>Video Teleconferencing</td>
<td>30%</td>
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<tr>
<td>Multimedia</td>
<td>20%</td>
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<tr>
<td>CD-ROM</td>
<td>20%</td>
</tr>
<tr>
<td>Computer Conferencing</td>
<td>10%</td>
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