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**COLLABORATIVE INSTRUCTIONAL DEVELOPMENT  
ENVIRONMENT: A STAGE FOR THE AIDA**

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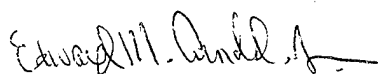
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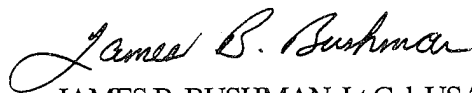
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## **PREFACE**

This research was conducted under the United States Air Force Summer Faculty/Graduate Student Research Program and was sponsored by the Air Force Office of Scientific Research, Bolling Air Force Base, Washington, D.C. under contract number F49620-90-C-0076. This research was conducted by the Department of Communication Design, California State University, Chico on behalf of the U.S. Air Force Armstrong Laboratory, Human Resources Directorate, Brooks Air Force Base. The Technical Training Research Division, Instructional Design Branch (AL/HRTC) provided management oversight for this effort.

## SUMMARY

Computer-based media production tools have matured sufficiently to enable the Air Force to readily provide very powerful curriculum development tools based on the existing Desktop III or IV. However, providing instructional designers and developers with a multimedia development workstation is not equivalent to providing them the power to use them well. While an Automated Instructional Design Advisor (AIDA) will certainly aid designers and developers in choosing appropriate media to solve instruction problems, provision of such powerful media production tools will require a commitment within the Air Force to provide technical and creative support. Only this will ensure effective, motivational media design.

An examination of matured computer-based media production technology was undertaken and a group of ISD experts was impaneled to discern which available tools hold the most promise and value for instructional design. This study presents the finding of the Delphi panel as well as considers the impact of providing such tools to designers and developers. We make the recommendation that implementation of a computer-mediated communication system be concurrent with the emplacement of computer-based media production tools to create a collaborative instructional development environment that will improve media creativity and dynamism especially with respect to computer-based training. In addition, such a system will provide for centralized archiving of reusable and repurposed media, effective formative and summative evaluation, increased collaboration between instructional designers, developers, subject-matter experts, and media production experts. Such a system should increase instructional quality, employee productivity and job satisfaction.

## **Collaborative Instructional Development Environment: A Stage for the AIDA**

### **INTRODUCTION**

The Air Force has identified a goal concomitant with the development of the Advanced Instructional Design Advisor (AIDA) to create a multi-use instructional design workstation that will provide designers/developers the power to locally produce instructional materials ranging from graphics to video to computer-based interactive training (Spector, 1990). The Collaborative Instructional Development Environment (CIDE) Workstation is a set of functional specifications for hardware, software and network communications to operate on the Air Force Desktop III (PC 80386) and IV (PC 80486). The specifications were developed from the responses of a Delphi committee asked to evaluate potential components of such a system in terms of their most common tasks and development efforts. The purpose of this research is to ascertain not only the computer-based media development tools required for effective instructional design by the Air Force, but to explore the type of collaborative support environment that will make available to instructional developers the expertise necessary to produce curriculum materials that fully exploit the power of media to motivate as well as teach.

### **DISCUSSION OF THE PROBLEM**

Well-developed, appropriate media enhances instructional quality (Johnston, 1987). However, its use and effectiveness are hampered by:

- High cost
- Inability to determine appropriate media
- Lack of production expertise
- Substantial lead time for production
- Communications problems

While an Advanced Instructional Design Advisor (AIDA) can aid in selecting the appropriate media for an instructional activity, the problems listed represent serious impediments to the instructional developer in incorporating that media into the lesson. An experienced live instructor can often compensate for problems with instructional media, but the trend toward electronic delivery of instruction demands highly effective stand-alone media that communicates and motivates (Winn, 1987). Thus, there is a pressing need to empower instructional designers/developers (IDDs) with the tools to create powerful and dynamic instructional aids both for standup instruction and for computer-based instruction and distance learning.

The software and hardware tools now exist to create a multimedia production workstation that will allow development of a wide array of instructional media from documents to animation to interactive digital video. However, it is unrealistic to believe that instructional developers, often subject matter experts in a particular area of training, will also have the skills to make the



best use of the powerful tools such a workstation will provide. Therefore, how to empower IDD's to produce and manipulate a variety of instructional media without placing on them the burden of requisite expertise in what are typically specialist areas has become a primary concern. For example, providing a graphics software package that is easy to use does not endow the user with the talent to generate visuals that are creative and powerful in their ability to facilitate the transfer of knowledge and also grab the learner's attention and hold his or her interest.

AIDA offers a partial solution. AIDA can assist an IDD in selecting an appropriate medium to accomplish specific instructional objectives. It will guide developers through many complex design decisions and help them clarify goals and directions. But AIDA will not be able to review the aesthetics of media development. It will not be able to examine a proposed media solution for clarity of purpose and execution.. Though it will be able to point out potential errors, it will not be able to answer specific questions regarding the easiest way to solve a particular communication problem; nor can AIDA provide years of media production experience to a neophyte designer.

So while AIDA provides less experienced IDD's important guidance and assistance in instructional design decisions, it cannot give comprehensive direction and evaluation in media production.. They need both the valuable guidance of AIDA and a support infrastructure for technical and creative assistance in making the best use of the increasingly complex tools at their disposal and for producing the media that will most effectively support the instructional objectives.

#### THE COLLABORATIVE INSTRUCTIONAL DEVELOPMENT ENVIRONMENT (CIDE)

The increasing demand for multimedia instructional materials has created the need for a collaborative instructional development environment that includes not only instructional design and subject matter expertise, but media development specialists as well. The addition of a communications network to the computer platform on which designers/developers will be running both AIDA and the designer-specified hardware and software for media production can create a collaborative open network for sharing expertise in mentor/apprentice relationships between developers and special interest advice conferences led by media specialists. Providing on-demand assistance should solve most media production problems and provide a logical path for the instructional developer to travel from the recommendations of the AIDA to the finished lesson material required by the instructional design.

The inherent versatility of an open network brings a number of added benefits to Air Force instructional design organizations including:

- Centralized Multimedia Education and Training Archive (META) of reusable instructional media for easy updates, adaptation and integration.

- Ability to search local and remote archives for appropriate existing media.
- Organizational gateway for send/receive faxing and E-mail.
- Centralized electronic media publishing.
- Automated document flow for formative and summative evaluation.
- Improved task management and group coordination.

This study will address the following questions pertinent to a collaborative instructional development environment:

1. Is electronic collaboration effective?
2. What are the instructional media needs of Air Force instructional developers and how are they currently being met?
3. Can a collaborative instructional development environment be created with current commercial-off-the-shelf technology?

### ASSUMPTIONS

The first assumption is that electronic media provide effective enhancement to instructional strategies in terms of improved cognition, information organization and integration, and learner motivation has been generally accepted since the 1968 research of Chu and Schramm (1979). Therefore, this study does not address the use of electronic media in improving the effectiveness of instruction. The term "effective" implies a judgment relative to a standard. This has customarily meant comparison of some electronic medium relative to face-to-face instruction without electronic media. "Medium" is defined by the American Heritage Dictionary as an agency, such as a person, object or quality, by means of which something is accomplished, conveyed or transferred. The electronic media are simply carriers of information for presentation to the learner. The potential of a medium for transfer of knowledge and skills has more to do with how the information is packaged and accessed by the learner than it does with the characteristics of the medium itself (Johnston, 1987).

Information encoded as print differs very little whether it is presented by video, CRT or in a handout. The spoken word may be carried by the instructor's voice in person, on audio tape or by video. The assumption is made that learning does occur with electronic media and that the way the information is packaged, accessed and presented can have great effect on the learning process. Given this assumption, the problem becomes how to provide the tools and the expertise to permit the instructional developer to have choices in the selection of an appropriate medium and the most effective packaging of that instruction for optimal learning. An important consideration in the design and development process is the "mindware," a term coined by Salomon (1985) that refers to the mindset a learner brings to the instructional process. It includes the learner's propensities and associations with media. Main (1992) has attempted to systematize these motivational factors by generating a model of instructional design which

integrates the affective domain into the curriculum development process. Although empirical data is sparse, the attractiveness of electronic media is evident in the amount of leisure time spent with television and electronic games by both children and adults. Though there is some ongoing discussion in the literature over how much and what types of media are appropriate to various tasks (see Friedman, Polson & Spector, 1991), we will not attempt to explore these issues here since they are more the province of an AIDA, SME's and IDD's than they are dependent on a CIDE.

The very strength of a collaborative instructional development environment is the versatility to produce any and all types of media as deemed suitable to a particular task by the cadre of professionals employed for ISD. Whether the media need is a published document, graphic slide, computer-based animation, or edited videotape, the personal computer has matured sufficiently as a platform to produce professional quality products. We state here that the PC is sufficiently robust to simultaneously support a panoply of media production tools, an AIDA, and a collaborative network to form electronic work groups.

Electronic work groups as discussed here are the result of computer-mediated communication (CMC). Analog communication networks are not considered because of their relatively high cost when used for media exchange. Computer-based communication systems range from simple electronic mail to voice mail, interactive chat forums, desktop video conferencing, document transfer and shared screen editing. Basic CMC systems have gained enormous popularity over the last 10 years as exemplified by the rise in usage of public network services such as MCI Mail, Prodigy and America On-Line, and the worldwide research collaboration taking place on InterNet, NSFnet and Bitnet. For millions of people, checking their e-mail messages or logging into an interactive chat conference has become a daily ritual. InterNet, a consortium of universities and research institutions, expects to have more than 2 million participants by 1995 (*Communications Week*, July 6, 1992, p. 1).

These services are active collaborative communities. Over one thousand special interest forums on the InterNet, for example, allow asynchronous discussion of social, technological and scholarly issues ranging from animal psychology to quantum physics. The participants represent a huge knowledge base. By actively sharing information they multiply their individual skills and abilities.

### IS ELECTRONIC COLLABORATION EFFECTIVE?

The literature on collaborative work is rich with examples of increased employee productivity. Though one study of Air Force cadets found that highly competitive people perform best when given individual rewards (Porter, Bird, & Wunder, 1990), the majority of researchers have reported improvement in performance on complex tasks by collaborative groups

(Bassin, 1988; Blaye, Light, Joiner, & Sheldon 1991; Johnson, Maruyama, Johnson, Nelson & Skon, 1981; Katz, Kochan & Weber, 1985). In their excellent literature review, Tjosvold and Tsao (1989) state:

Considerable research, including field experiments, indicate that people in cooperation compared to those in competition exchange resources, assist each other, and manage conflicts constructively so that they are all successful (p. 189).

Citing the findings of Johnson et al. (1981) they continue, "as they work cooperatively, employees explore issues and make successful decisions, and are more productive especially on complex tasks that benefit from sharing information" (p. 189).

According to Bassin (1988), "It's not the gifted individuals who make peak performance possible as much as the dynamics of belief, collaboration and support" (p. 64). Bassin believes cooperative work groups are effective because of the resources of individual members, diversity of ideas, emotional support, mutual motivation and increased job satisfaction. He feels that isolated employees are at a fundamental disadvantage, unable to grasp how their work output fits into the overall performance of the organization. Collaborative teams solve these problems. According to Tjosvold et al. (1989):

In cooperation, people believe their goals are positively linked; one's goal attainment helps others reach their goals. Alternatively, mistrust, individual tasks, and win/lose rewards induce competition. Competitors believe their goals are negatively correlated so that one's goal attainment makes it more difficult for others to attain their goals (p. 189).

Finally, members of cooperative work groups report increased job satisfaction and organizational loyalty (Andrews and Jones, 1983; Bassin, 1988; Finholt, Sproull & Kiesler, 1990; Sproull & Kiesler, 1986; Tjosvold, Johnson et al., 1981; Tjosvold et al., 1989). A reduced sense of isolation, greater understanding of organizational objectives, emotional support and social interaction all seem to play important roles. Sproull and Keisler (1986) point out that cooperative work groups often use electronic mail to provide a productive outlet for natural desires for sociability and organizational attachment. "People like to be sociable at work. A technology that makes it easy to be sociable--be it a water fountain, coffee pot, telephone, or EMS [electronic messaging system]--will be used for sociability" (p. 1151). Likewise, Tjosvold, et al. (1983) suggest that cooperative interaction strengthens morale, commitment to the organization and productivity. The positive experiences of working together lead employees to believe they have gained a great deal from the employer; and teamwork binds them to each other and to the organization.

It is generally felt that members of a cooperative work group benefit from the strengths of the talented individuals of whom it is comprised (Bassin, 1988). Technical expertise and design experience more readily cross the organizational lines in an ad hoc cooperative group, providing just-in-time support for mission-critical objectives (Finholt, et al., 1990). Employees participate in organizational goals and enjoy increased productivity and greater job satisfaction. But traditional methods of forming and maintaining ad hoc work groups such as face-to-face meetings may cost an organization a great deal in terms of travel, time to distribute materials, and time required to meet and to schedule more meetings, especially amongst geographically remote participants (Finholt et al., 1990).

The literature provides sufficient evidence that electronic collaboration is effective. There is a note of caution. Changing communication patterns and protocols also changes organizational culture. These issues are not addressed in this paper but considerable empirical evidence is available and should be examined before establishing capabilities (see for example Dubrovsky, Kiesler & Sethna, 1991; Lea & Spears, 1991; Smilowitz, Compton & Flint, 1989; Sproull et al., 1986).

#### WHAT ARE THE INSTRUCTIONAL MEDIA NEEDS OF AIR FORCE IDD'S AND HOW ARE THEY NOW BEING MET?

A Delphi group of expert Air Force IDD's was used to determine the instructional media needs of the Air Force and what tools would most enrich the collaborative instructional development environment.

The methodology for this study involved a review of state-of-the-art technologies in the field of personal computers and desktop workstations, media production tools and communication software. The evaluation was limited to commercial-off-the-shelf applications or products being beta tested for commercial release. An examination of the trade publications in personal computing, desktop publishing, digital photography, graphic design, video production and communication networking was used to establish a taxonomy of available products and services that appeared to have value for instructional development. A trip was made to the InfoMart in Dallas to see some of the candidate technologies demonstrated.

The information from the technology review was used to generate a list of 42 product categories divided into three areas of instructional design/development: 1) Instructional materials development, 2) Management, and 3) Collaboration. To provide a rational method for evaluating the importance of the functions represented by these product categories, a combination of the Delphi methodology and the Kepner-Tregoe rational decision model (1965) was used.

The Kepner-Tregoe rational decision model uses the technique of determining what are the essential outcomes and what are the desirable outcomes for any decision situation. It is widely used in the evaluation of competing systems because it provides a quantifiable method for comparing products with a variety of disparate features. The "must" category of features must be met by all candidate systems or they are dropped from further consideration. Those features deemed desirable but not essential are labeled "wants" and are assigned weights (usually by a panel of users). The evaluation is made by experts who test the system's ability on each item.

For our panel of experts we elected to use Air Force IDD's from a number of organizations that would reflect a variety of instructional development needs from standup courses to computer-based technical training. We opted for this approach over using consultants or academics because of the importance of user involvement in system design.

Systems development theory (Boar, 1984; Conner, 1985; Kling, 1991) and practical field experience (Kyng, 1991; Perin, 1991) both indicate that potential users of a system must be involved during the early stages of design. Kyng (1991) advocates a doctrine of "mutual learning" where designers teach users about the technological possibilities while users instruct designers in the task specifics of their work. Perin (1991) discusses the problems created when systems are mandated for unwilling users. Computer systems that extend the abilities of subordinates, and especially those that may create informal social fields among them, may threaten managers. "The challenge is to create computer support that acknowledges, if not incorporates these realities, rather than presuming the technology will by itself reform or obliterate them" (p. 81).

Therefore, while expert consultants might easily specify an extremely competent design system in terms of the prevalent ISD models and perceived needs of IDD's, there is no certainty that such a system will be readily adopted by Air Force IDD's. For these reasons, we assembled a Delphi panel of experienced users to assist in developing the functional design requirements for the CIDE. We were assisted in identifying expert IDD's by Lt. Sheila Robinson (HQ ATC/TTDD) and by Maj. Richard O'Neal (HQ ATC/XPCR) at Randolph Air Force Base.

Delphi is a technique developed by the RAND Corporation to be used in technical forecasting or to achieve consensus among a group of experts without undue influence (halo effect) by prestigious individuals (Tersine & Riggs, 1976). For this study, a Delphi group of 10 experienced Air Force IDD's was selected. Their combined experience totals 108 years in curriculum development. The participants are expert practitioners rather than a representative sample of Air Force instructional developers. A survey by Walsh, Yee, Grozier, Gibson and Young (1992) of 256 Air Force personnel involved in developing computer-based instruction (CBI) found the average experience of the IDD's to be just 20 months. Participants were

selected for this panel because of their knowledge and experience with Air Force instructional design and development, not because they represented typical IDD's.

Eight members of the panel of experts were male and two were female. Seven were civilian employees of the Air Force and three were career military personnel. The level of sophistication of the group was quite high. One participant was a manager of an instructional development group. Although not involved in the actual design of instruction at this time, he had more than 7 years of prior experience in training development. He was included because his managerial responsibilities included the design and development of all types of instruction from traditional classroom to CBI. Eight of the members were experienced in designing and developing CBI and three of them did this exclusively. Five panel members were involved with the design of standup training using static media aids and six develop dynamic media for their instructional programs. Seven of the designers had at least some experience in multimedia CBI development. This level of expertise and experience in the field made this group well qualified to offer expert evaluations concerning the functional requirements and desired features for a collaborative workstation to improve both the productivity and quality of Air Force instructional design and development.

#### INSTRUMENTATION AND EVALUATION

A structured questionnaire was distributed to the panelists in which they were asked to specify the percentages of instruction created using different types of media both within their organization and Air Force-wide. We then asked them to tell us how much instruction using each type of media they thought would be most appropriate for use by their organization and the Air Force.

They were presented with the list of 42 candidate technologies developed from the trade journals, literature review and vendor presentations. They were told their expertise was being solicited to assist in determining the design features of a collaborative instructional development workstation. They were asked to evaluate each technology category to determine if they felt it was essential (a "must") to quality curriculum development. If the technology was judged not to be essential, the panelists were asked to place a value on its worth (0=valueless to 20=nearly essential) to an instructional developer.

Finally, they were asked about media they can and cannot presently develop in-house and their collaborative relationships with other designers and subject matter experts.

We sought to answer five basic questions that bear directly on the functional specifications of the CIDE:

- What types of instructional media are presently being developed?

- What types of instructional media would IDD's prefer to develop if they had more resources?
- By whom is various media now developed (IDD's, non-training agencies, contractors)?
- What kind of collaboration is necessary to the development of effective media for instruction?
- What technologies are perceived as essential to IDD's; which are desirable, and which are unnecessary?

The data gathered was averaged and used to rank order potential technologies that could be included in the CIDE. Using the Kepner-Tregoe (1965) decisioning system, we were able to determine which technologies constitute the necessities of the system and which the niceties. Using this "rational" decisioning system helps forestall the desire to add every available technology under the assumption that if we provide it to designers they will learn to want it and use it-- the "Field of Dreams" approach.

### THE TECHNOLOGIES

Our only constraint (self-imposed) was that all software and hardware technologies specified for the design of the CIDE should be compatible with the Air Force Desktop III and IV. Our intent in this was not only to reduce eventual development costs and to work with a computing platform that has already been approved and implemented by the Air Force, but also to ensure compatibility with the Advanced Instructional Design Advisor being developed for Air Force ISD (Hickey, Spector & Muraida, 1992).

Technological feasibility was determined through review of computer trade publications and an on-site visit to Dallas' InfoMart. While specific software and hardware selections will require further study and additional input from potential users, there will be a discussion below of critical technologies that match the user requirements determined by the Delphi panel. The research and development paradigm is to establish a rational ordering of functional requirements and assess the status of commercial-off-the-shelf (COTS) tools available to meet those requirements.

### FINDINGS

Our hypothesis is that Air Force IDD's are probably designing more standup instruction and more instruction with static media than they would prefer. If true, we suspect it was because of an inability to design more dynamic curriculum materials stemming from a variety of reasons ranging from lack of skills to lack of equipment to insufficient time. To test this theory, we asked the Delphi panel for their best estimate of the quantities of instructional media of various



types being produced by them, their organizations, and their best estimate of the media types used Air Force-wide. Summaries of their responses are contained in Figures 1-8.

As we postulated, individual Air Force IDD's generally feel they are developing more instruction without media, or instruction that is dominated by static media than they would prefer (Figure 1). The mean portion of curriculum hours developed as standup instruction with no media was estimated by our panel to be 40 percent within their own organizations and 32 percent overall for the Air Force. They believed a more suitable amount of this type of instruction would be about 25 percent.

The participants also indicated they would prefer to see less instruction supported by static media such as slides, overhead transparencies, etc. (Figure 2). They estimated instruction with static media accounted for almost 50 percent of the hours of instruction produced in their organization and nearly 60 percent Air Force-wide. Their preference was that approximately one-third of the instructional hours be standup instruction supported by static media.

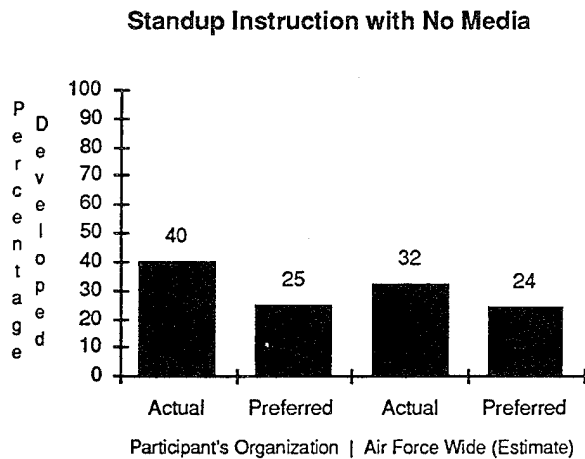


Figure 1

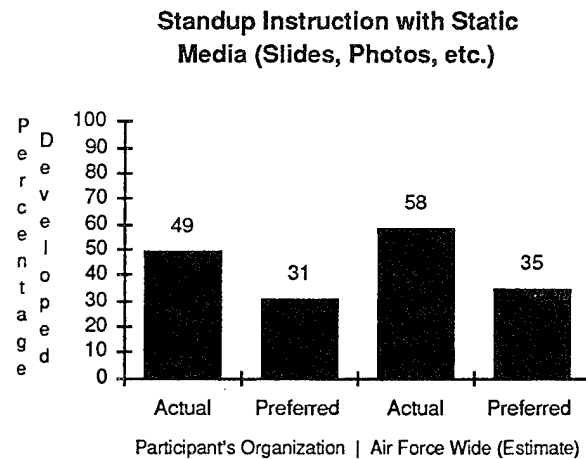


Figure 2

The use of dynamic media for instruction shows an opposite result, i.e., the participants would like to use dynamic media more than it is being used now (Figure 3). Participants would like to increase their organization's use of dynamic media from 30 to nearly 40 percent of instruction designed, and would like to see it account for one-third of total Air Force instruction.

**Standup Instruction with Dynamic Media (Slide-Tape, Video etc.)**

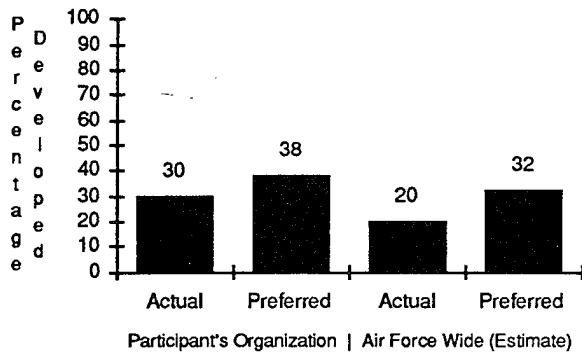


Figure 3

**Instruction with Student Handouts and/or Workbooks**

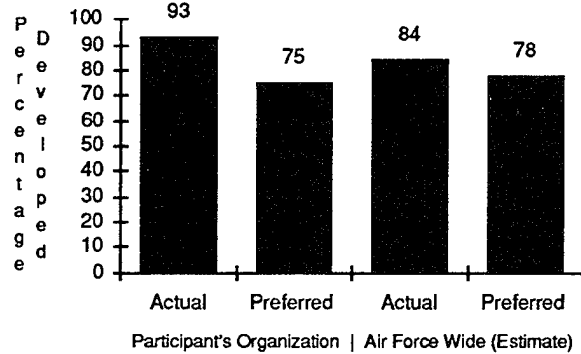


Figure 4

As we suspected, print-based media is still the most widely used medium (Figure 4). More than 90 percent of instructional hours are supported by some printed materials in the form of student handouts and workbooks. The effective penetration of desktop publishing and familiarity of nearly all instructional designers with paper-based production certainly facilitates its ubiquity. Nevertheless, panelists felt that the amount could be reduced somewhat without damage to the instructional process.

**Curriculum Presented as Computer-Based Instruction**

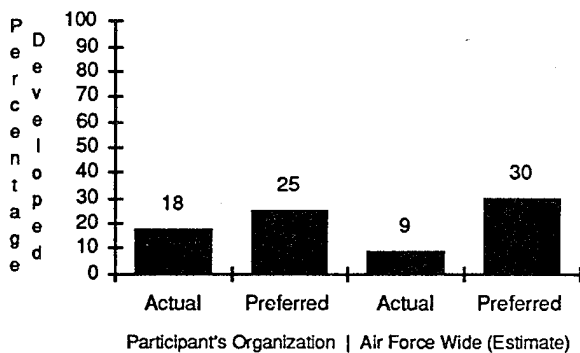


Figure 5

**Computer-Based Instruction with Multimedia Presentation**

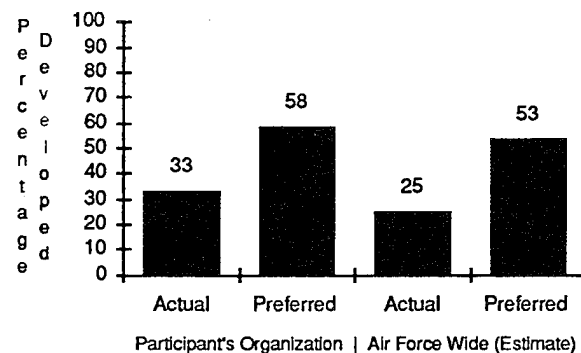


Figure 6

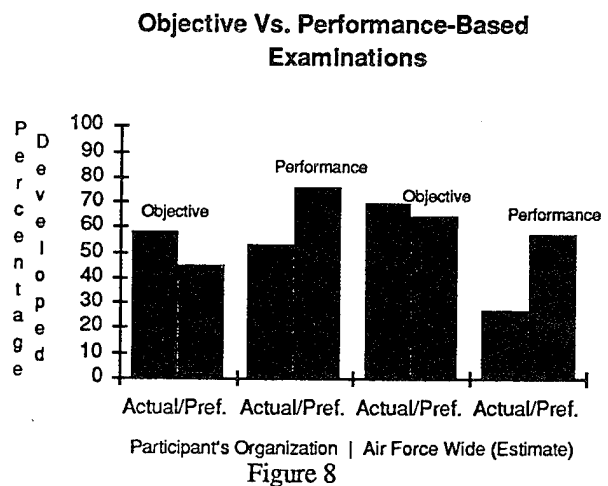
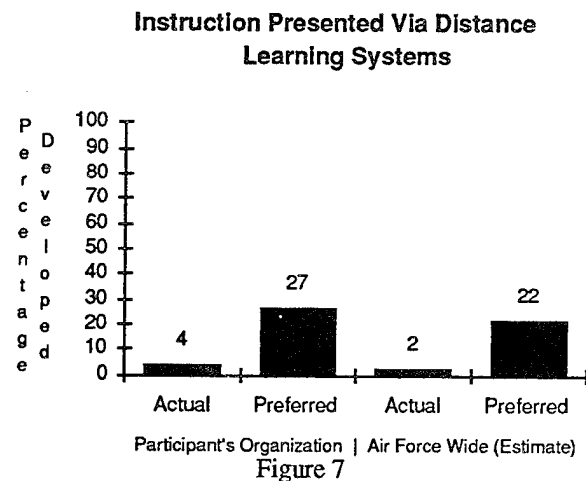
While the percentage of instruction presently developed for computer-based delivery is low (18 percent within our panelist's organizations and less than 10 percent estimated Air Force-wide), most participants would like to see CBI use increased greatly (Figure 5). Although one panelist charged exclusively with CBI development feels that CBI should only account for 10 percent of all instruction, other participants felt the amount of CBI desired should be nearly one-third of Air Force-wide instruction.

Every respondent wants to see more multimedia CBI developed for Air Force instruction (Figure 6). At present, one-third of all CBI being developed within participants' organizations consists of dynamic multimedia, along with an estimated 25 percent of such CBI Air Force-wide.

But panelists believe that the amount should be pushed above 50 percent, that is, more than half of all computer-based instruction should be multimedia. This suggests a clear need for interactive dynamic multimedia. However, as participant comments allude, many of the tools required to develop motivational multimedia are presently unavailable in the field.

Air Force IDD's also indicate an interest in developing more instruction for distance learning applications (Figure 7). By their estimate a scant two percent of Air Force instruction now constitutes distance learning. However, they believe as much as 27 percent of their instruction has distance learning applications, and see a potential for 22 percent of total Air Force instruction to be delivered remotely.

Finally, panelists felt that too great an emphasis is now placed on objective examinations. They show a clear preference for developing performance-based evaluations both within their own organizations and Air Force-wide (Figure 8). The data suggests most of the experts want performance-based evaluations to supplement rather than totally replace objective exams. Given the nature of many of the tasks for which Air Force IDD's develop instructional systems, it seems likely that objective measures may often be insufficient. Many skills-based tasks can only be effectively evaluated by proficient performance. Objective exams are generally easier to develop, administer and evaluate than performance-based tests, suggesting that IDD's may benefit from tools that help them develop more innovative evaluation measures.



In summary, the experienced Delphi panel would like to develop less standup instruction that is unsupported by media or has only static media. Although they would like to reduce their reliance on traditional text-oriented student handouts and workbooks, they still want print

support for three-fourths of their instruction. They would like to increase the use of dynamic media as a support for standup instruction and they would like to increase CBI and in particular the use of CBI that includes multimedia presentation. They would also like to increase the amount of courses offered through distance learning systems and they would like to implement more performance-based evaluations.

#### MEDIA PRODUCTION METHODS

Most of our Delphi panelists (seven of nine responding) contract the final development of graphics. Reasons cited for this range from not violating a base-negotiated contract by developing graphics in-house, to a respondent who cites excessive time and effort spent to produce non-professional looking graphics. Only two of nine IDD's report they develop their own final graphics. Two report they are starting to develop more internally. One of those cited slow turnaround by contractors.

All respondents' organizations contract for printing services, though six of nine provide camera-ready copy, indicating the penetration of desktop publishing. One panelist reports that their organization is beginning to desktop publish and hope to soon provide camera-ready copy; one panelist reports that contractor turnaround is, "not very fast." Two panelists report that printing services are handled by contractors, but do not specify who provides camera-ready copy.

Five of seven respondents use on-base contractors for all photography. Two of seven provide their own photos. Similarly, five of nine respondents use on-base contractors for all video footage, while two of nine produce their own internally. Of these two respondents, one is tasked with CBI development, the other is a manager whose organization develops primarily textual media and team training. Two of nine share the task of video development with contractors. Three of seven respondents contract for slide/tape program production, two produce in-house and two report no slide/tape productions. Three of eight panelists report audio production is provided by on-base contract while two develop in-house. Three panelists state audio production services are not available (even though computer-based audio production tools are highly developed and inexpensive).

#### ESSENTIAL AND DESIRED DEVELOPMENT TOOLS

Respondents were asked to determine with a yes or no vote whether a variety of computer-based media development tools were essential to ISD. Where they voted no, they were asked to determine the usefulness of the tool for ISD on a scale of 0-20. Each "yes" vote is valued at 30 points, while each "no" vote is valued at its given weight. These data are totaled, divided by 30 and used to create the Kepner-Tregoe decision tree shown in Figure 9. Tools that receive 60 percent of possible points (180 points of the 300 points possible) are considered to be essential to ISD and, therefore, to the CIDE workstation; those totaling 50 percent (or 150 points) are

Kepner-Tregoe Decisioning Tree:  
The Value of Media Production Technologies  
for Instructional Development in Percentages

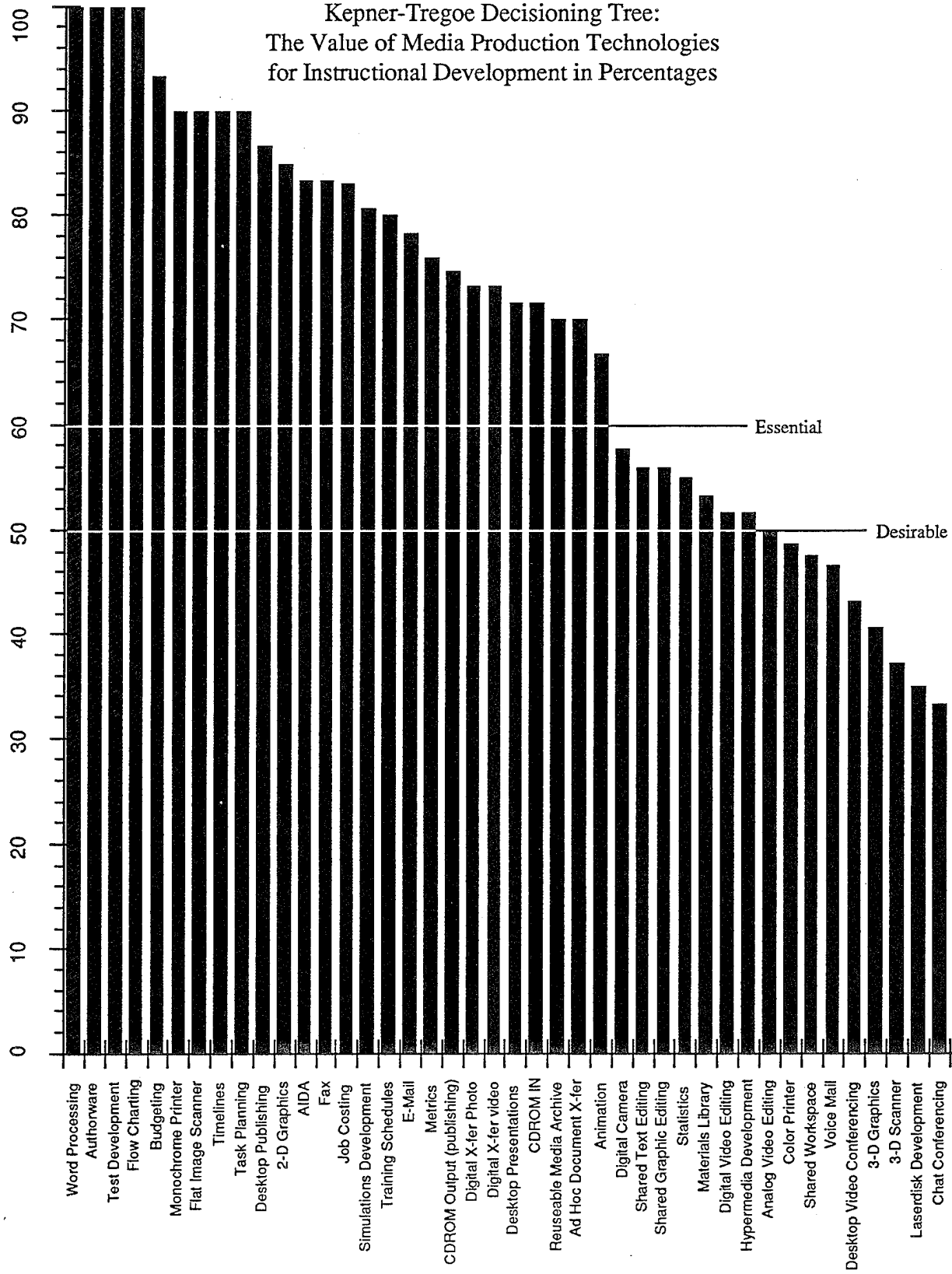


Figure 9

deemed highly desirable; others below 50 percent are considered useful in proportion to their weights. Note that no tool received a weight below 30 percent (90 points), and at least two panelists considered any given tool absolutely essential (yes votes). Thus, all of these tools should probably be available as add-on features to the workstation to support the task needs of particular designers.

Clearly Air Force instructional designers and developers would like to be producing more dynamic and motivational media for standup instruction, computer-based instruction and for distance learning applications. A variety of reasons for the present lack of media are suggested in the panelists' comments on their organizations' current arrangements for final media production.

One respondent states that the existing base-negotiated graphics contract legally prevents them from developing graphics in-house. One is simply lacking sufficient equipment. Three others cite training and poor final quality of in-house work due to "seldom used but technically difficult skills." Four of the respondents bemoan long turnaround time for most contracted media, while three others cite low quality in contractor-developed media due to poor communication or insufficient familiarity with the subject matter. Despite these problems, all parties indicated the need to use more dynamic and motivational instructional media.

The literature cited earlier suggests that many of these problems could be remedied by the installation of a collaborative network. Creativity and expertise hurdles can be surmounted by special interest groups and just-in-time technical support. Communications problems with contractors can be circumvented with more timely collaborative sessions. With the appropriate tools, more preparatory development work can take place in-house even if prior agreements stipulate that contractors must produce final media. And with the right tools, designers will have the freedom to explore more creative, dynamic and motivational media solutions to instructional problems.

From the Kepner-Tregoe decisioning tree it is fairly obvious that IDD's themselves recognize this. Of course there was unanimous agreement for word processors, author ware, flowcharts and test development tools-- the staples of the trade. But not surprisingly, there was extremely strong interest in desktop publishing, two-dimensional graphics, image scanners, simulations development, digital and analog video editing, video and photography transfer, and CD-ROM input and publishing. These are tools to create a media-rich instructional environment. They are not simple to use, requiring technical proficiency and creativity, but IDD's understand their value to the development of highly motivational, dynamic media.

The data indicate, as well, that they understand the value of collaboration with peers and specialists to quality ISD. Every respondent reported routine collaboration with a subject matter expert. Four participants agreed with the panelist who stated, "[it is]...impossible to develop any kind of quality training without an SME." In addition, four of nine cite frequent collaboration with other IDD's for ideas and evaluation; five of nine report collaboration with graphics specialists; and three of nine report contact with technical experts and media specialists: "without this link, our product would not get out."

Presently, the bulk of this collaboration is conducted face-to-face or over the telephone. Where media production and graphic design specialists are concerned, considerably more work is conducted face-to-face than by any other method. Yet, most of these experts cite time and communication factors as primary impediments to more extensive use of motivational media. Clearly a well-implemented collaborative network that connects IDD's, SME's and media production specialists--including contractors--would solve most of the aforementioned problems, streamline collaborative processes by eliminating many face-to-face meetings, and encourage the creative development of more effective, dynamic and motivational media.

Finally, the experience of the Navy cited by Cantor (1988) suggests that centralized archival of reusable, adaptable media would save time and money, while encouraging IDD's to make use of the best stock media available. This type of networked archive would make media produced by the most highly skilled and talented producers readily available to IDD's throughout the Air Force's widely distributed ISD agencies.

#### CAN A COLLABORATIVE INSTRUCTIONAL DESIGN ENVIRONMENT BE CREATED WITH CURRENT COMMERCIAL-OFF-THE-SHELF TECHNOLOGY?

The answer to this questions is a qualified yes. Every item on the list of 42 functions identified as essential or desirable for at least some IDD's is available right now. The open architecture and communication networking capabilities are present. What cannot be answered by this study is what integration software, degree of data interchange standards and communication data speeds are necessary and available for implementation of every function. To answer this question definitively will require additional study, prototype development and beta testing which is strongly recommended. A beta test would create a field laboratory environment that could be useful in answering a variety of research questions regarding process and task procedures for optimal use of the collaborative instructional development environment. Therefore, the constraining factors for such a system require further research and are more related more to software and user interface issues than to hardware and software capabilities.

## SUMMARY

As indicated throughout the study, the mere provision of development tools to IDD's does not empower them individually to design efficiently or effectively. Instructional Systems Design (ISD) is a complex task requiring variously the input of IDD's, SME's, graphic designers, video production specialists, technical writers and CBI programmers. While increased attention to the user interface has created a generation of media production software much more friendly to the average user, true mastery of any such tool is the result of both practice with the software and a thorough understanding of the knowledge domain to be represented and the traditions and techniques native to the media being developed. The proliferation of desktop publishing provides an illustrative example. While user-friendly programs like PageMaker<sup>(TM)</sup> and Ventura Publisher<sup>(TM)</sup> brought computer-based publishing to everyone, they did not communicate the traditions of the typographer's art. As a result, the average quality of typeset materials now varies a great deal. For expert typesetters, the software tools were a productivity boon, allowing them to create high-quality typeset pages more quickly and less expensively than ever before. However, in the hands of the non-typesetter, they allowed only the quick production of readable but inelegant pages devoid of ligatures, gendered quotes, and properly kerned letter pairs. To quote Bob Krejci, "There is no one-person authoring tool that can produce the kind of product that an experienced staff of designers, subject matter experts, artists, and programmers can develop... There is no 'Van Gogh in a spray can' product" (1992).

This is not to suggest that there is not merit in providing IDD's with the wide variety of tools required to develop affective instructional media. On the contrary, while questions remain as to the amount and design of potent media for various instructional objectives and within specific domains of knowledge, there is no doubt that visual and auditory media can be an appropriate and highly effective means of organizing and presenting some information (Gildea, Miller & Wurtenberg, 1990). Analysis of specific appropriate forms and applications of graphics have been begun with respect to the development of an Automated Instructional Design Advisor (Friedman, et al., 1991). While an AIDA may well include guidance towards appropriate applications and designs for graphic instructional media, the goal of a development workstation should be to provide robust fully-featured design tools. Whether a screw or nail is appropriate is the decision of the carpenter and architect. A good toolbox contains both driver and hammer. For example, the graphic design and imaging segments of the PC market have matured sufficiently that there are a variety of extremely competent software packages presently available for the development of fine art (e.g., Fractal Design Painter), line art (e.g., Corel Draw, Adobe Illustrator), CAD (e.g., AutoCad, Eazy Cad), solid model rendering (e.g., AutoCad, Renderman) and photo image processing (e.g., Image-In, Photo Finish). While the Air Force may choose to standardize on one or more of these packages, the CIDE workstation will be designed to accommodate one or all of them in ad hoc arrangements to support the task at hand. However,



any such integration of new tools requires an equal commitment to technical and creative support services to aid in the transfer of sufficient expertise to make the tools useful. The creation of ad hoc collaborative work groups can address the problem of providing technical development assistance to less experienced IDD's and those without sufficient expertise in development of specific types of media. Simultaneously, collaboration should improve worker efficiency and job satisfaction as well as creating a community of expertise and a professional growth environment for the motivated IDD.

The superimposition of a collaborative open network on the instructional development environment will permit ad hoc working arrangements for mentor/apprentice relationships, creative and technical consulting support and multiple problem solving perspectives for individual IDD's as well as bringing other benefits to improve both ISD and IDD performance. A collaborative open network among instructional developers may include technologies as commonplace as fax, e-mail and voice mail or those as esoteric as ISDN-based digital document transfer and two-way video conferencing. Fundamentally, it constitutes the creation of open communication channels that engender the formation of ad hoc work groups and technical interest forums, allow the transfer of documents and resource materials, and provide an easily accessed, non-threatening means to seek technical help and creative assistance.

Building an open network will allow both synchronous (live chat forums or video conferences) and asynchronous (E-mail, fax) communications amongst IDD's. But perhaps just as valuable, it will enable document transfer for evaluation purposes, scheduling and coordination, and sharing of valuable resources such as adaptable existing media and a centralized archive for some materials. Perez (1992) in an exploration of traits of the expert training developer discovered that senior designers developing instruction through a team approach, "...developed formal conventions and guidelines to insure the uniform execution of the instructional design" (p. 13). CMC can support this kind of control and coordination as well as increasing efficiency in the group design process. Cantor (1988) reported that an automated curriculum design environment developed for the Navy that included archiving of boilerplate text and graphics as a shared resource reduced time spent on repetitive work by allowing incorporation and adaptation of existing materials. He cited an aggregate reduction in ISD time-on-task from between 45 and 66 percent.

The study by Walsh et al. (1992) of Air Force CBT developers reinforces the value a collaborative instructional development environment could provide. They found 78 percent of CBI development team members were inexperienced in CBI design and development. More than one in four of the development team members felt the team's activities were not well coordinated and that communication between team members was unclear and ineffective.

A formal job/task analysis was not performed in one of every three CBI development efforts. About one in four CBI instructional developers relied on previous course materials or analyses. Forty percent used learning objectives modified from previous lessons. Only one-half of developers indicated a media analysis was performed as part of the CBI design process, and when an analysis was performed a subject matter expert was used over two-thirds of the time. Of the 253 CBI designers surveyed, not one indicated a media specialist was involved in the media analysis process. Of development team members, just over ten percent were described as media experts and they were all graphic artists. For the CBI projects, 95 percent contained some graphic components (icons, charts, tables, diagrams, maps, equipment, human figures, even animation); 48 percent had audio content (bells, beeps, tunes as rewards, signals, music, engines and verbal commands, questions, etc.); and 45 percent included some still or motion video (for identification of equipment, body parts, panels, etc., procedures and interpersonal and communication skills). The most commonly cited reasons for not using multimedia were lack of capability, not enough time and not being trained for development. There was no mention at all of interactive media applications.

Walsh's survey of practicing computer-based instructional developers strongly indicates that Air Force CBI development could benefit substantially from the availability of a collaborative instructional development environment as outlined in this study. The data from the Delphi group indicates non-CBI instructional development needs a similar capability.

Providing computer-based media development tools in a collaborative environment should streamline many work processes and stimulate interactive evaluation of instructional components. Tessmer and Wedman (1992) discovered that the most common reason cited by professional IDD's for skipping an ISD activity was not lack of money or experience but lack of time. They state, "A means of 'cutting corners while controlling risk' in ID/D [ISD] project[s] needs to be developed" (p. 16). We believe the CIDE can assist in cutting those corners.

## CONCLUSIONS

The Air Force should explore implementation of a collaborative instructional development environment workstation. All the technologies involved are readily available in COTS packages. Many of the individual media development technologies such as flat bed scanning, graphic design, desktop publishing, author ware and laser printing are already in place in some ISD organizations. Issues to be resolved include:

- 1) the bandwidth and best method for ad hoc networking and multi-network management (e.g., simple ethernet, ISDN, FDDI, ATM, SNMP, etc.);
- 2) whether members of the collaborative community can benefit from broadband communications technologies such as desktop video teleconferencing, voice mail and groupware (shared graphic and text editing);

- 3) what kinds of materials should be centrally stored in a Multimedia Education and Training Archive (META) and whether those archives should be maintained within each ISD organization or by on-base visual information (VI) agencies such as Combat Camera, or both.
- 4) strategies for perusing, indexing and previewing contents of the META, including Boolean search techniques and indexed multimedia information retrieval.
- 5) determining any potential adverse consequences of installing a CMC network and developing strategies to offset them.

With the development of AIDA, the firm adoption of a standardized computer platform, and the maturation of computer-based media production tools ranging from graphic design to desktop digital video editing, the time is ripe for implementation of an instructional development environment with standard tools, central archiving, and a collaborative network for exchange of creative and technical support, reusable media, and formative evaluation. Changes to organizational culture, while predictable, will remain minor and manageable. In reality they will most likely contribute to increased employee satisfaction and organizational loyalty. Without question, such a system will contribute to the development of more effective, motivational instruction.

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