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ABSTRACT

This paper focuses upon the research and development (R&D) process associated with developing automated feedback materials for the SIMulation NETworking (SIMNET) training system. This R&D process involved a partnership among instructional developers, practitioners, and researchers. Users' input has been utilized to help: (1) design the prototype feedback materials; (2) determine their instructional suitability; (3) refine the prototypes; (4) design the implementation process; (5) test the implementation process; and (6) make any final improvements to the prototypes and implementation process. The automated feedback aids (after-action reviews or AARs) produced vis-a-vis this R&D process are discussed, as well as the importance of this partnership in developing any new instructional innovations. It is suggested that such a partnership should help reverse the historical trend of use and then abandonment of new instructional innovations by giving instructors a sense of ownership and ease with using the innovation. It is concluded that a tentative framework for involving the users in the instructional R&D process has emerged from this project, although questions remain regarding both the number of users who should be included in the R&D process and the generalizability of the framework. Five figures illustrating the text are included. (Contains 26 references.) (Author/ALF)

Developing Automated Feedback Materials for A Training Simulator: An Interaction Between Users and Researchers

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ABSTRACT

This paper focuses upon the research and development (R & D) process associated with developing automated feedback materials for the SIMulation NETworking (SIMNET) training system. This R & D process involved a partnership among instructional developers, practitioners, and researchers. Users' input has been utilized to help: (a) design the prototype feedback materials; (b) determine their instructional suitability; (b) refine the prototypes; (c) design the implementation process; (d) test the implementation process; and (e) make any final improvements to the prototypes and implementation process. The feedback materials produced vis-a-vis this R & D process are discussed. Also discussed was the importance of this partnership in developing and implementing any new instructional innovations. Such a partnership should help reverse the historical trend of use and then abandonment of new instructional innovations by giving instructors a sense of ownership and ease with using the innovation.

Developing Automated Feedback Materials for a Training Simulator: An Interaction between Users and Researchers

This paper focuses upon the research and development (R & D) process associated with implementing automated feedback materials for the SIMulation NETworking (SIMNET) training system. This R & D process involved a partnership among instructional developers, practitioners, and researchers.

Need for the Partnership

A major theme in the history of instructional technology has been an initial widespread enthusiasm for an instructional innovation followed by either its limited use or eventual disuse (Cuban,1986; Shlechter,1991). Film, radio, television, and computer-based instruction were hailed by their generation of instructional developers and policy-makers as the educational panacea of their day (Cuban; Shlechter). And yet, these innovations have never been widely accepted by instructors as instructional delivery systems.

Cuban (1986) and Thomas (1987) have noted two main reasons for this historical trend. One, instructors have resisted changes which are seen as imposed solutions. Cuban, for example, has noted that educational television was developed and implemented in school districts by non-teachers without soliciting the advice or consent of the user--the teachers. two, instructors have been hesitant to employ any instructional technologies (e.g., computer-based delivery systems) which are difficult for them to use (Thomas).

Hence, instructors' sense of ownership and ease with using the product are key factors in their utilization of it.

The military has also found that these two factors underlie users' acceptance of a new system (Gray, Roberts-Gray, & Gray, 1983; Polzella, Hubbard, Brown, & McLean, 1987; Reidel, 1988; Roberts-Gray, 1983; Shlechter, Burnside, & Thomas, 1987). Shlechter et al. have reported that military instructional personnel must assume "ownership" of the newly developed instructional program; otherwise the program will never be fully utilized.

Gray et al. (1983) have noted that communications problems between training personnel and instructional developers may make a high quality product very difficult to use, a situation which widens the gap between development and utilization of instructional innovations. They have developed a framework for a partnership between instructional developers and practitioners, which has been widely used by the Army Research Institute, for implementing new instructional innovations. Their framework, however, does not deal with the developmental phases of this process. Involving users during the developmental phases would ensure their sense of "ownership" of the instructional innovation. It would correspondingly reduce the possibility of wasting precious funds on developing instructional products that are either never fully utilized or need costly fixes.

Need for SIMNET

Contemporary trainers and educators have been challenged to provide more effective training with dwindling financial resources. The Army has found, for example, that training officers in tactical skills in a field environment has become increasingly expensive. However, relatively inexpensive table exercises and board games have not faithfully reproduced the conditions inherent in field exercises (Kristiansen, 1987).

The Army has thus developed the high-tech SIMulation NETworking (SIMNET) training technology to provide cost-effective tactical training. SIMNET consists of the integrated use of training simulators, combat support equipment, and instructor's station. Each simulator has its own microcomputer and is connected with the other simulators by transmitting specifically formatted data packets across the computer network (Garvey & Radgowski, 1988). These data packets contain information about vehicle appearance (e.g., location, speed, and type of vehicle), vehicle status (e.g., fuel and ammo level of tank), direct fires (e.g., hits, type of target, and rounds fired) indirect fires (e.g., location and results of artillery fire) impact (results of vehicle firing), and status change (destroyed or damaged) of the vehicle.

SIMNET's effectiveness has been established (Bessemer, 1991; Brown, Pishel, & Southard, 1988; TEXCOM, 1990; Shlechter, Bessemer, & Kolosh, 1991). Shlechter et al., for example, have found that SIMNET training provides armor students with the needed practice opportunities to develop their tactical skills. Bessemer (1991) has suggested that SIMNET's effectiveness is also tied to the feedback provided by its instructors. He noted that SIMNET's effectiveness increases as improvements were made in the SIMNET instructors' after-action reviews (AARs). Improvements in these AARs may be attributed to additional SIMNET equipment. A plan view display (PVD) and stealth vehicle have been added making it easier for instructors to observe the SIMNET exercises. The PVD provides a graphic map display of portions of the battleground with icons representing vehicles. The stealth capability provides a direct view of the battleground from an invisible vehicle moving on or above the terrain.

Need for Automated Feedback (AAR) Aids

There are still several limitations with SIMNET's feedback capabilities. Current SIMNET feedback capabilities cannot quickly provide important quantitative and graphic summaries or printed reports of the students' performance. These feedback capabilities are not portable, which means that the instructors must use them in a specified area. Instructors may miss some significant aspect(s) of their students' performance as they must also participate as SIMNET players.

Easter, Kryway, Olson, Peters, Slemon, & Obermayer (1986) have suggested that an automated performance measurement (APM) system with graphi replay capabilities could help eliminate such limitations with a training system's (e.g., SIMNET) feedback capabilities. An APM system would provide students and instructors with timely and useful feedback by performing all statistical analyses in real or near-real time (Easter et al.). An APM system would also provide printed reports of this feedback and monitor every significant aspect of a unit's SIMNET performance.

It has thus been decided to develop a portable APM prototype--the Unit Performance Assessment System (UPAS)--for SIMNET training. UPAS is a microcomputer system that collects the previously discussed data packets from SIMNET and automatically organizes the derived information into a relational database (Meliza, Bessemer, Burnside, & Shlechter, in preparation). From this database, the collected information can be further manipulated into tabular and graphic summaries of unit performance that can be used as AAR aids. UPAS also has the capability to print these aids for later use.

Questions, however, remain regarding the most appropriate format(s) for these AAR aids. The educational and training literature does provide some limited guidance in developing these formats (see Downs, Johnson, & Fallesen, 1987; Garlinger, 1987; Holding, 1965; Kulhavy & Stock, 1989; Meliza, Bessemer, Burnside, & Shlechter, in preparation; Pridemore, Webb, Haygood, Stock, & Kulhavy, 1990; Scott, 1983). Kulhavy and Stock have suggested that such feedback materials must contain enough information to correct students' faulty perceptions of their performance without overwhelming them. Meliza et al. have suggested that feedback materials for collective Armor training exercises must include concrete examples of problematic unit performance for crucial mission events.

The UPAS' feedback materials must then provide concrete examples of crucial mission events without containing too much information. These feedback aids must also be relatively easy to use. And, the users (SIMNET instructional personnel) must feel a sense of ownership of the developed materials.

Research and Development Process

Research and Development Framework

A multiple-phase research and development (R & D) framework was utilized to develop the feedback materials. This R & D framework, loosely based upon Gray et al.'s (1983) implementation framework, incorporated the practical concerns of users with principles of instructional design. The first phase involved designing and developing the prototype feedback materials with some input from the users. The later phases, which have not been completed, involve the R & D team working closely with the users to refine and implement the materials.

Phase 1

This phase involved designing the automated AAR aids. This design process was based upon: (a) observations of armor tactical training conducted by the R & D team (Bessemer, 1991; Shlechter et al., 1991); (b) lessons learned regarding AARs for armor training from the National Training Center (NTC), which is the site for large-scale combined arms field exercises (McFann, Hiller, &

McCluskey, 1990); (c) conversations with SIMNET instructional personnel, including the Military Director of the Combined Arms Tactical Treaining Center (CATTC): and (d) task analyses by an R & D team member with NTC experience. The task analyses involved analyzing the fit between the prototype formats and the 600 armor mission training standards (e.g., proper orientation of vehicle and gun tube) suitable for SIMNET training (see Burnside, 1990 for a further descriptions of these standards).

The following prototype AAR aids were designed: Battle Flow, Battle Scorecard, Battle Snapshot, Exercise Time Line, and Plan View Display (PVD). The following descriptions of these materials have been based upon information presented in the SIMNET UPAS User's Guide and accompanying technical report (Meliza, Tan, White, Gross, & McMeel, in preparation; 1992; Meliza et al., in preparation).

The Exercise Timeline and Battle Scorecard provide, respectively, graphic and tabular overviews of the soldiers' performance. As shown in Figure 1, the Battle Scorecard presents quantitative information regarding the number of hits, kills, and misses per side. Such information could provide the unit with a picture of the mission's success. The Military Director of the CATTC was instrumental in the development of this AAR aid. He wanted a summary table of the unit's firing abilities that was analogous to those tables used at the NTC. The Exercise Timeline provides information regarding the temporal occurrences for crucial mission events, e.g., first friendly fire (Figure 2). Bessemer (personal communication, March 23, 1992) has observed that a time-related overview of activities is needed for any successful tactical AAR. The Exercise Timeline can also help the instructor to more effectively use the other feedback aids. This instructional feature can, for example, help the SIMNET instructor choose the most appropriate activities to be replayed by the PVD.

Insert Figures 1-2 about here

As shown in Figures 3-5, the PVD, Battle Flowchart and Battle Snapshot provide graphic representations of activities over the SIMNET terrain. These instructional features contain major terrain features along with icons representing different vehicles and grid coordinates. The PVD replays either the entire exercise or segments of the exercises. The Battle Flowchart provides a line trace of the unit's movements across time increments, and the Battle Snapshot displays the unit's position for salient moments of the exercise.

Insert Figures 3-5 here

The task analyses indicated that forty percent of the sampled Mission Training Program standards would be addressed vis-a-vis the different prototype aids. And, each of these aids would make a unique contribution to addressing these standards (Meliza et al., in preparation; Meliza, Bessemer et al., in preparation). The Battle Snapshot, for example, would provide the best picture of vehicle orientation.

Phase 2

In this phase the instructional suitability of these different prototypes was assessed. Five SIMNET instructors were shown paper representations of the Battle Scorecard, Battle Flow, Battle Snapshots, Exercise Timeline prototypes and a partially implemented PVD. They were then interviewed for thirty minutes regarding these materials.

These instructors were two senior noncommissioned officers and three officers from the Command and Staff Division of the Armor School. Their primary responsibilities involved training Lieutenants in the segment of the Armor Officer Basic Course (AOB) dealing with tactics, which included three days in the SIMNET environment and ten days in the field. These instructors had also used SIMNET for other training courses at Fort Knox, such as the Pre-Command Course for Majors and Lt. Colonels.

All of these SIMNET instructors indicated that the Battle Flow, Battle Snapshot and Exercise Timeline materials were desirable feedback aids. Modifications in these feedback aids, however, were needed in order for the instructors to use them. The Battle Flow Chart, for example, needed the terrain features found in the PVD. They also requested the ability to quickly transform the different feedback- ids into overhead transparencies, which would allow the aids to be viewed by the entire platoon.

They also indicated that the Battle Scorecard would be used to prepare their AARs. Modifications were also requested for this instructional feature. They wanted, for example, the Battle Scorecard to contain information about hits and kills for specific tanks in their platoon vis-a-vis enemy tanks. Again, they wanted the ability to quickly transform this material into an overhead transparency.

They claimed that the PVD would rarely be used. These officers felt that the PVD would be too small for their use. However, this belief might change when the instructors view a fully implemented UPAS.

Based upon these interviews some changes were made to the different prototypes. For example, terrain features were added to the Battle Snapshot and Battle Flow. Contract requirements have prohibited the possibility of making some other requested changes. The PVD, for example, cannot be made any larger nor can UPAS produce transparencies. However, a printer is attached to the system; instructors can then use a copy machine available in the SIMNET complex to produce the needed transparencies.

Phase 3

Phase 3 has involved working closely with the users in order to make any needed refinements or additions to the UPAS package.

The selected users for this phase were two military members of the CATTC staff and two military instructors for the AOB course.

The CATTC personnel, who were noncommissioned officers, spent approximately an hour viewing UPAS's different features. While viewing this system, they were interviewed about the usefulness and possible problems with the different aids. These interviews were loosely structured so that a variety of training concerns could be discussed with these soldiers.

The AOB instructors, who were Captains, also viewed the UPAS device for approximately an hour. They were then asked to rate the usability of the different instructional features from not useable to indispensable on a scale developed by Polzella & Hubbard (1986). They were also asked to; (a) rate the amount of information (too much/too little/right amount of information) contained in the feature, (b)indicate any enhancements needed to make UPAS more usable, and (c) provide reasons for their answers to the different questions.

These users had the same opinions regarding the Battle Snapshot, Battle Flow, and PVD. They felt that these features needed a better method for identifying each tank. The AOB instructors wanted these features to include the vehicle's bumper number, which is used by the Stealth Tank, to identify each tank. Better methods for identifying each tank are now being developed.

Divergent viewpoints were expressed regarding the usability of the Battle Scorecard and Exercise Timeline. These AOB instructors liked the Exercise Timeline, but felt that the Battle Scorecard was worthless. The reason for the latter opinion was that the AOB course does not emphasize gunnery skills. The SIMNET training personnel liked the Battle Scorecard but felt that the Exercise Timeline was too hard to read.

It could be that these divergent opinions represent differences in requirements for different armor training circumstances, but they could also represent the idiosyncratic views of a few users. Further research is now being conducted to provide clearer insights into the reasons for these divergent opinions, as several more instructors will soon be completing the questionnaire regarding the displays.

Phase 4

This phase will involve determining the most appropriate strategies for implementing UPAS into the different training programs which use SIMNET. This phase will be accomplished by an R & D staff member, CATTC staff member and an AOB instructor working closely together to devise a standardized set of written guidelines for accomplishing the above mentioned goal.

Phase 5

This phase will consist of piloting the prototype AAR aids under actual training conditions. An AOB class and an operational armor unit will participate in this pilot study. Data will be collected regarding any problems that the instructors had in using UPAS and on the instructors' and students' attitudes toward the different instructional features. These pilot data will thus determine if any additional refinements are needed to make UPAS a usable product.

Conclusions and Recommendations

This investigation has further demonstrated the value of researchers and instructional developers interacting with practitioners when developing a new instructional device/system. Areas of agreement among the different partners have provided the R & D team with added confidence that the most appropriate feedback materials are being developed; while areas of disagreement suggest that either the feedback materials need to be changed or further research is needed to determine the appropriate feedback materials.

This partnership has served several other functions. One, it has increased the likelihood that UPAS will be successfully implemented into the context of current SIMNET training by giving the instructional personnel a sense of ownership of its implementation and by developing guidelines to overcome possible problems with operating this model of UPAS. Two, future models of UPAS will include those technological fixes requested by the users that could not be incorporated into the current system.

A tentative framework for involving the users in the instructional R & D process has also emerged from this project. This framework consists of employing users' input to help: (a) design the prototypes; (b) determine their instructional suitability; (b) refine the prototypes; (c) design the implementation process; (d) test the implementation process; (e) make any final improvements to the prototypes or implementation process; and (f) provide guidance for the R & D of the next generation of this APM.

Many issues, however, need to be resolved regarding this framework. It might have been a mistake to design the initial prototypes without more fully consulting with the users. Providing the users with a more active role during the design phase might have reduced the problems that the users had with this device. Conversely, a user did note that he could only judge the value of an instructional feature vis-a-vis an actual training condition. Another user claimed that he had to play with the UPAS device before understanding and evaluating it. Questions thus remain regarding the level of user participation for the different developmental phases.

Questions also remain about the number of users who should be included in the R & D process. Sampling the opinions of too many users may complicate this process as each user may have his/her own instructional concerns. Not sampling enough users, however, may produce an instructional product which is not widely used.

Questions finally remain regarding the generalizabilty of this tentative framework to other educational and training situations. Perhaps, the development of each new instructional product represents a unique situation with a unique set of concerns. At least, this paper has provided instructional developers/researchers with some guidance in order to develop their own particular framework.

Finally, this project is developing usable automated feedback-aids for making SIMNET-type training more effective. This is an important development in the evolution of such advanced training systems. These systems have either not included automated feedback aids or have included feedback aids that are generally not very usable (Easter al., 1986; T. Downey of the Boeing Corporation, personal communication, November, 1991). For example, Easter et al. found that only two advanced instructional systems for training jet-fighter crews have APMs with remote graphic capabilities.

In closing, this paper has both theoretical and practical implications for instructional developers and researchers. These authors have discussed the development of a prototype set of automated feedback materials to be used with emerging training simulators. We have also discussed the partnership among instructional developers, researchers, and users in this R & D process. And, we believe that a productive partnership among these different professionals would reverse the previously discussed historical trend of use and then abandonment of new instructional innovations.

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Figure Captions

BATTLE SCORECARD

DIRECT FIRE WEAPON SYSTEM SUMMARY

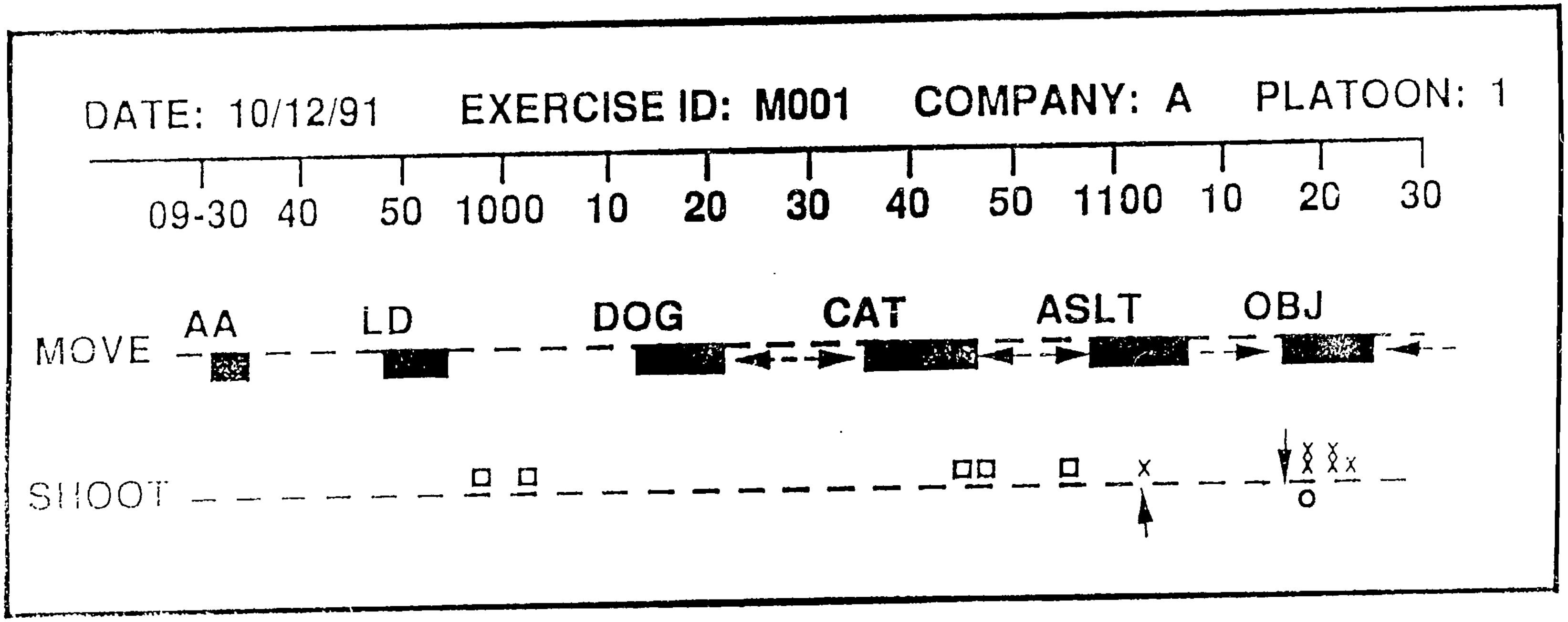
SIDE	FIRING WEAPON	FIRING AMMO	SHOTS	MBT_H	MBT_K	IFV_H	IFV_K	OTH_H	OTH_K	TOT_H	TOT_K
B	US M1	US M392A2 - 105mm/KP	95	4	4	0	1	0	0	4	5
		US M456A1 - 105mm/SCP	87	0	0	6	5	0	0	6	5
Total			182	4	4	6	6	0	0	10	10

SIDE	FIRING WEAPON	FIRING AMMO	SHOTS	MBT_H	MBT_K	IFV_H	IFV_K	OTH_H	OTH_K	TOT_H	TOT_K
B	US M2	US M791 - 25mm	197	2	0	1	3	0	0	3	3
Total			197	2	0	1	3	0	0	3	3

SIDE	FIRING WEAPON	FIRING AMMO	SHOTS	MBT_H	MBT_K	IFV_H	IFV_K	OTH_H	OTH_K	TOT_H	TOT_K
R	USSR T72M	US M392A2 - 105mm/KP	1	0	1	0	0	0	0	0	1
		US M456A1 - 105mm/SCP	1	0	0	0	0	0	0	0	0
Total			2	0	1	0	0	0	0	0	1

SIDE	FIRING WEAPON	FIRING AMMO	SHOTS	MBT_H	MBT_K	IFV_H	IFV_K	OTH_H	OTH_K	TOT_H	TOT_K
R	USSR_BMP2	US M791 - 25mm	155	3	0	0	0	0	0	3	0
Total			155	3	0	0	0	0	0	3	0
Overall total			536	9	5	7	9	0	0	16	14

SIMNET EXERCISE TIMELINE



LEGEND:

TIME BETWEEN FIRST AND LAST VEHICLE CROSSING THE CONTROL MEASURE

TIME DURING WHICH NO VEHICLE MOVED

ARTILLERY FIRE NEAR UNIT

FIRST ENEMY FIRE RECEIVED

FIRST FRIENDLY FIRE DELIVERED

X ENEMY VEHICLE DESTROYED

O FRIENDLY VEHICLE DESTROYED

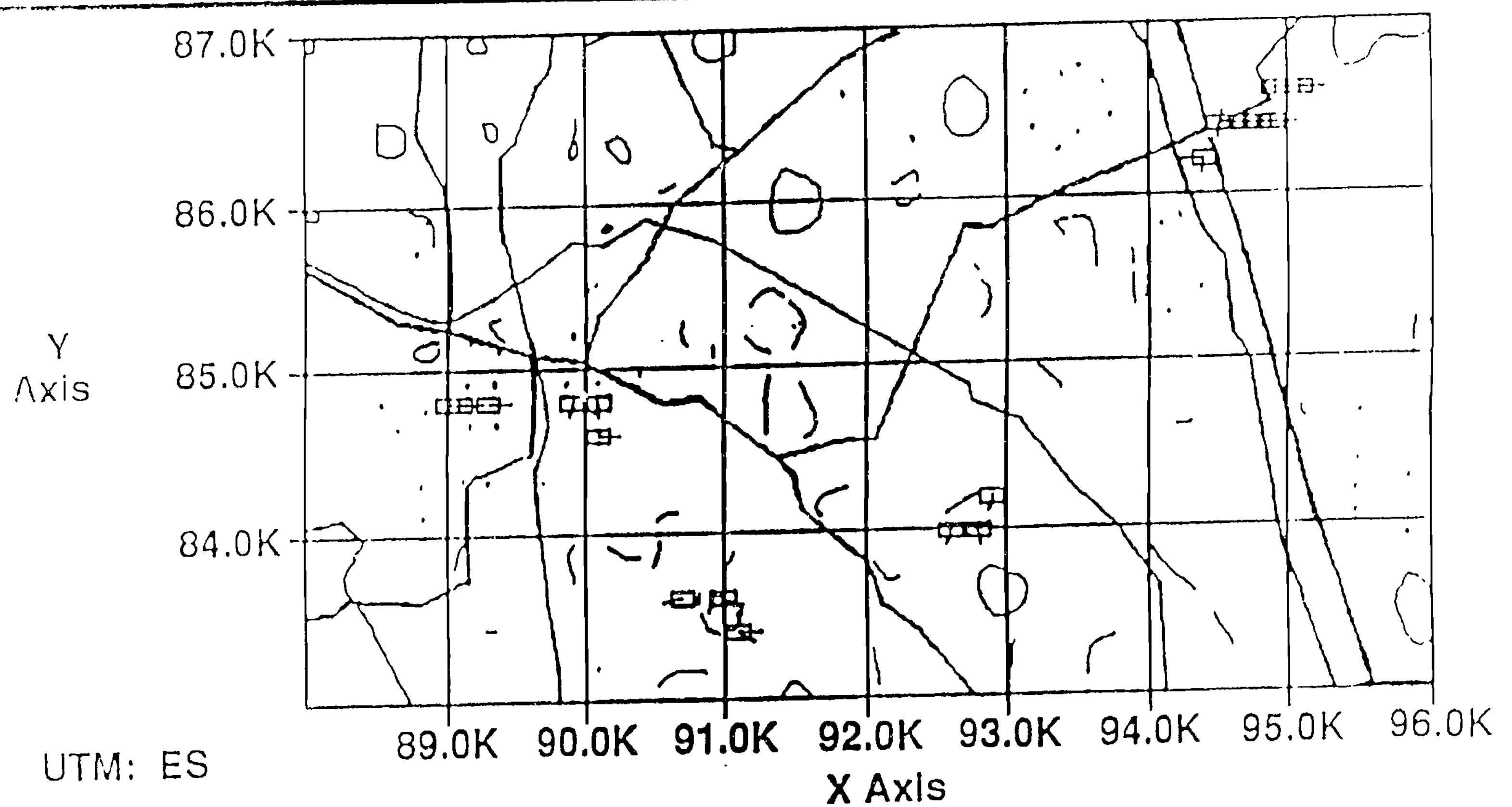
0708

PLAN VIEW

TIME: 1020

NEXT EVENT: CROSS LD

EVENT TIME: 1000



<F1> chg Viewport. <F2> chg **Scale.** **<F3>** chg Time. <F4> Printer Select.
<F5> Print. <F6> Next Event. **<F7> Refresh** Screen.
<Eso> Return to Previous **Display.** **<Arrow keys>** chg Viewport by units(s)

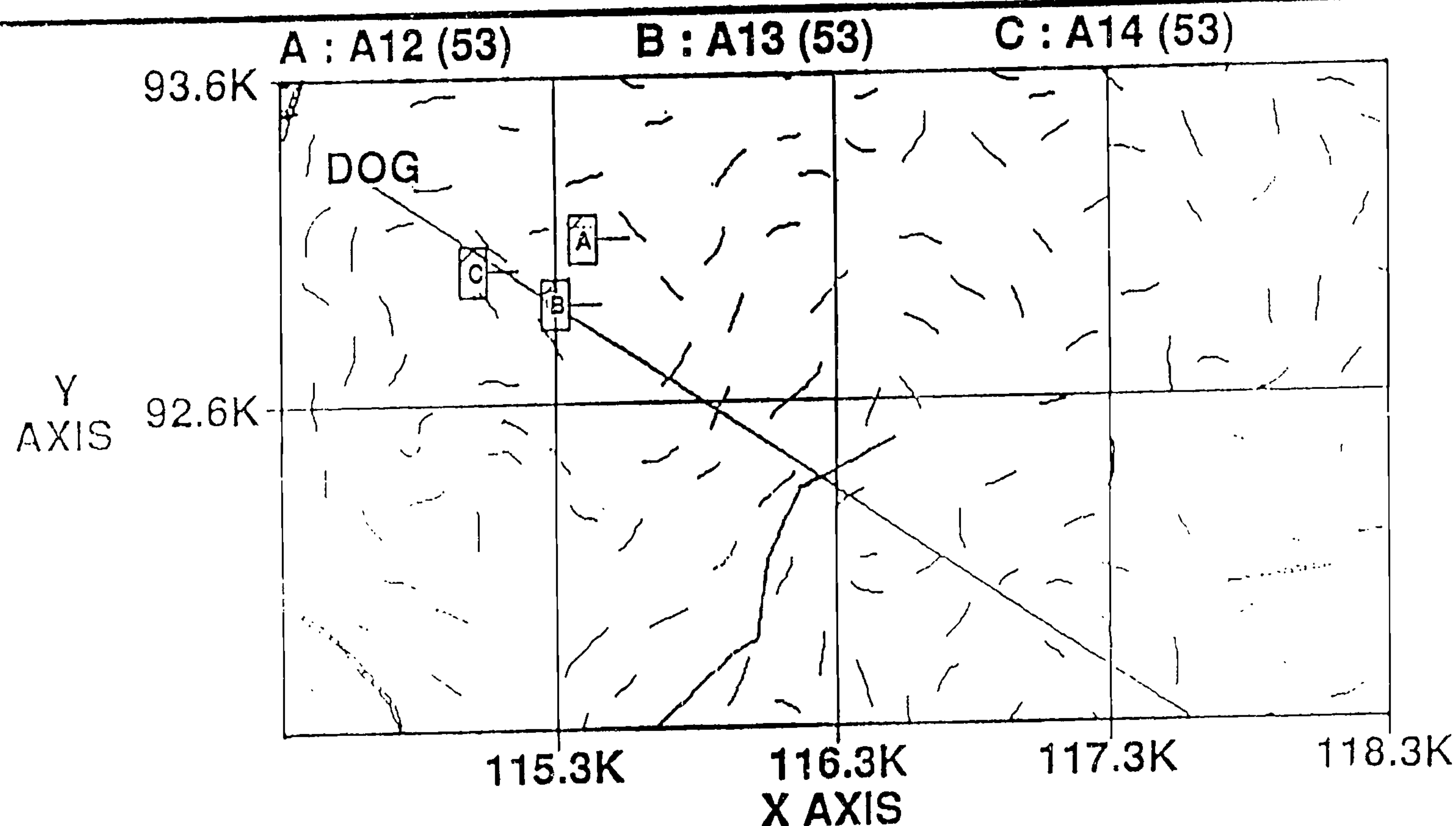
0704

BATTLE SNAPSHOT

DATE: 91-8-21
EXERCISE ID: 001

COMPANY: A

TIME: 1658
PLATOON: 1



<F1> chg Origin. <F2> chg Scale. <F3> Enter Time. <F4> Printer Setup.
<5> Print. <F6> chg Company/Platoon. <Esc> to return to Previous Displ

0/07

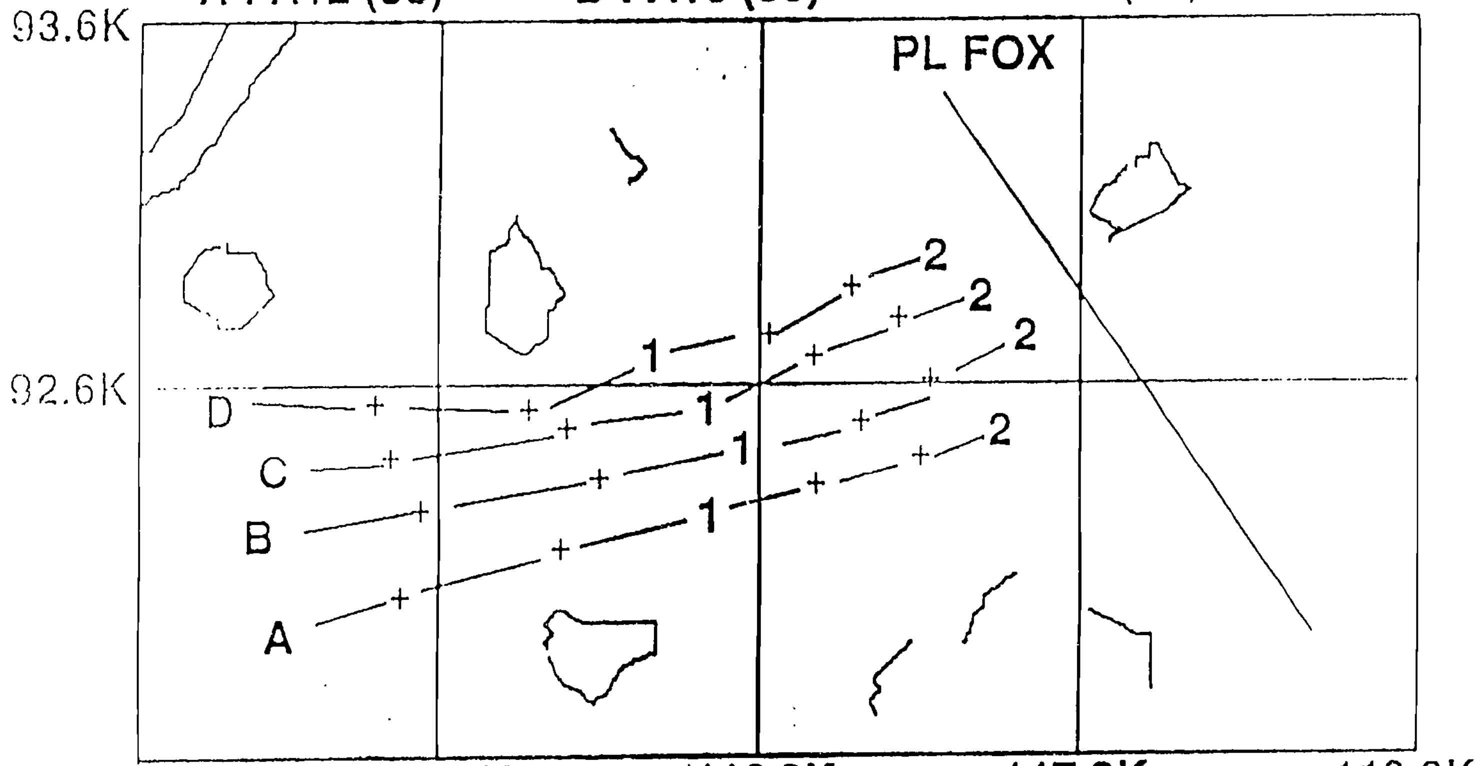
BATTLE FLOWS

DATE: 91-8-21
EXERCISE ID: 001

START TIME: 1650
COMPANY: A

FINAL TIME: 1708
PLATOON: 1

A : A12 (53) B : A13 (53) C : A14 (53) D:



0706

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