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The Development and Testing of a Fire Simulator Exercise

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OF A FIRE SIMULATOR EXERCISE

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THE DEVELOPMENT AND TESTING OF A FIRE SIMULATOR EXERCISE

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INTRODUCTION

Forest fire simulation is the realistic portrayal or synthesis of forest fire situations. Overhead projectors are used to simulate fire and smoke on a projected background scene. Sound effects and simulated radio communication help to develop the decision-making situation.

As a training media, the simulator provides many of the pressures, emotions, distractions, and inputs of a real fire. The trainee gets "involved". Problems dealt with by this technique have a much better "carry over" into real fires, than mere classroom lecture or discussion. Simulation is rapidly becoming the most important training technique in forest fire control organizations.

The fire simulator located in the Forestry building at Stephen F. Austin State University was installed for the purpose of familiarizing forestry students with this training tool and instructing them in the problems of decision making needed while fighting fires. The purpose of this study was to develop and test simulation exercises which would help to meet these general objectives.

Specific objectives to be derived from the exercises are as follows:

1.) To present students with a simulated situation

which would demonstrate the decisions required in the suppression of a fire.

2.) To reinforce classroom instruction in fire behavior and suppression, emphasizing the following:
   a. fire size up
   b. initial attack
   c. coordination of equipment and manpower
   d. priority setting
   e. dealing with emerging problems.

3.) To familiarize students with the fire simulator so that they will know its purpose, how it works, and why it is used.

Use of the fire simulator at SFASU gives the forestry students a chance to gain an insight into the complexities of fire behavior and suppression prior to actual field experience. The students should be better prepared through simulator experience to put their fire knowledge and training to use on the job by anticipating more of the problems they are likely to encounter.

Fire simulators have been used almost exclusively as training for the correction of specific problems among experienced fire control personnel; the simulator at Stephen F. Austin State University, however, is used to reinforce a classroom course on fire control and use. The exercises utilize what has been taught, and present new and stimulating decision-making situations. They present mistakes made

in the field which must be overcome, unexpected happenings due to such things as unusual weather phenomena, and as many other teaching situations as can logically be inserted.

The development of exercises was only part of the study. Training the men needed to carry out the exercise was also a challenge since some of them had no fire experience except that received in the classroom. The responsibility for a successful learning situation depends entirely upon the skill and teamwork demonstrated by all the operators and role players during the exercise. In the following pages these problems, and other unexpected stumbling blocks to simulator operation will be presented along with some solutions and critiques on each segment of the fire simulator exercise development.

LITERATURE REVIEW

Simulators had their origins in the 1930's, when sand tables and terrain models were used in fire training (Pierovich 1966). During the 1950's "red string" problems, where the fire boundary was shown by string, were used to train fire suppression crews. More sophisticated training was done with maps and aerial photographs, using progressively drawn fire perimeters with situation statements.

Then in the 1960's, oblique photographs were used with a map and situation statement to present fire suppression problems. The fire simulator as we know it today evolved about this time, through the efforts of Bert Holtby and Nolan O'Neal of the Forest Service, personnel of the Systems Development Corporation, and Hank Case of International Electric Corporation. This original simulator was called the Mark I.

Training for fire bosses was done in such basic problems as size up, ordering and assigning resources, tactics, and dealing with emerging problems. All who participated were enthusiastic about the simulators' tremendous impact, and termed it a major breakthrough in fire training (O'Neal 1963).

Four men required a day and a half to set up the Mark

I, so a more simplified version was developed, called the Mark II. Also with the Mark II phase came "charring" (blackening up burned-out areas) and improved sound effects.

More sophisticated communications equipment was still needed, and it was incorporated in the Mark III "portable" simulator. The new equipment consisted of two telephone trunks, four radio networks, along with a recording capability and a four-track sound effects system.

In 1971, the first production model fire simulator (Scott Dynamic Situation Simulator) was delivered to 76 customers, culminating 3 years of research and development work aimed at providing field units with a reasonably inexpensive, highly portable, initial attack training simulator (Ball 1971).

The United States Forest Service has cooperated with state fire control agencies and other federal and private agencies for maximum use of fire simulators. As more simulators were put into use, the training and simulation improved, and new techniques and uses have been devised. A brief historical summary of the varied uses of fire simulators follows:

In 1966 a new training technique was used at the Southern Forest Fire Laboratory to simulate prescribed fires due to the difficulty of scheduling field exercises

during favorable weather (Cooper and Smith 1968).

In 1969 fire simulation was used in conjunction with a fire finder on the Shasta-Trinity National Forest to train fire detection personnel during lookout training. In this type of fire simulation smoke is added gradually and the trainee sights and reports its azimuth, distance, size, and character, with followup reports prompted by the central dispatcher. The exercise provides the trainee an opportunity to actually practice the proper procedure of reporting a fire (Burnaugh and Kittell 1969).

In 1970 the Washington Forest Protection Association provided fire simulator training for woods and forest management personnel who lacked actual fire experience. This was the first reported simulator use for non-experienced personnel. The trainees were impressed with the need to size up a fire in its initial stages. By actually experiencing a turn in the "hot seat", each trainee gained an appreciation and understanding of why confusion often exists, particularly during the early stages of a fire (Matthews 1970).

In Florida, simulator training is aimed at initial attack on small fires when the supervision is not as experienced as that found at a big fire. These small fires are fought "by the book", a manual which features tactical charts to show fire suppression activity based upon wind

speed, relative humidity, and fuel type and condition. To aid in simulation for "by the book" suppression, Florida fire control personnel show a small close up of fuel type in the lower corner of the panoramic fire scene (Florida Division of Forestry, Fire Control Bureau 1971).

State forestry organizations are the most widespread users of forest fire simulators. Supplemental training for their fire control personnel is provided just prior to the fire season.

Exercises can be designed to stress and correct problems encountered in recent fires. Training of this kind is more effective because consequences are still vividly remembered from the real fire.

EQUIPMENT AND DEVELOPMENTAL PROCEDURES

The Fire Simulator

The equipment located in the fire simulator room at SFASU (Figure 1) is composed of a portable Scott "Dynamic Situation Simulator", with a custom communication and sound system.

The Scott Dynamic Situation Simulator[1] (Figure 2) encorporates 4 overhead projectors into a single unit to simulate background scene, fire, and smoke. The two projectors using duplicate transparencies for the background scene permit progressive changes in smoke and fire char by dissolving from one projector to the other, when performing the necessary scribing. The fire and smoke effects are obtained by scribing quick drying enamel paint off of glass plates so that amber or red color for fire and regular light for smoke is projected onto the background scenery on the screen. Motion, speed and direction are provided by moveable, revolving disks mounted between the lamp and scribing stage of the projectors. Fire line is simulated by scribing a broken line on an opaqued glass plate of

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[1]Detailed specifications are available from Scott-Engineering Sciences, 1400 S.W. 8th St., Pompano Beach, Florida 33060.

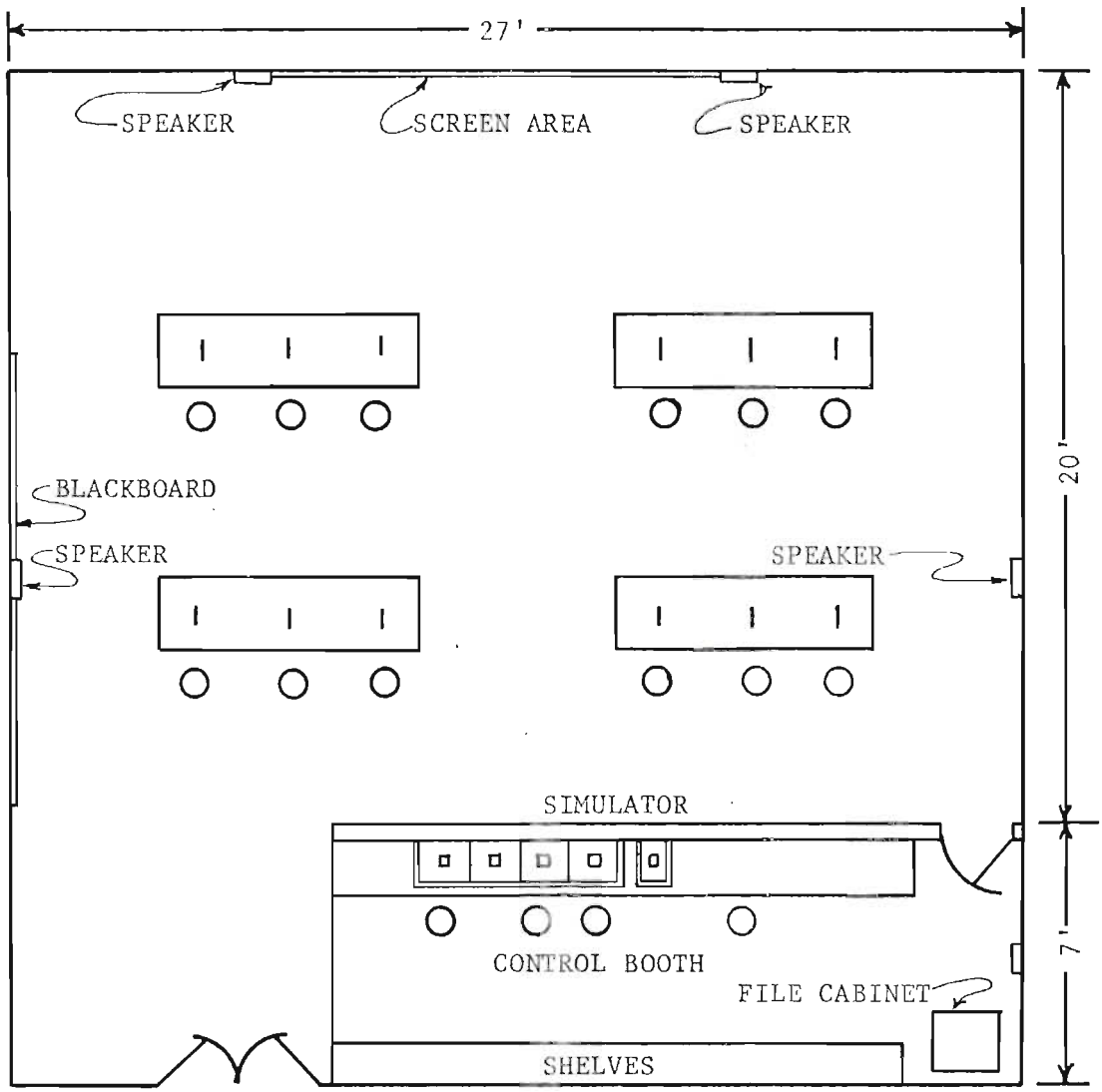

Figure 1. Interior Arrangement of Fire Simulator Room at Stephen F. Austin State University.

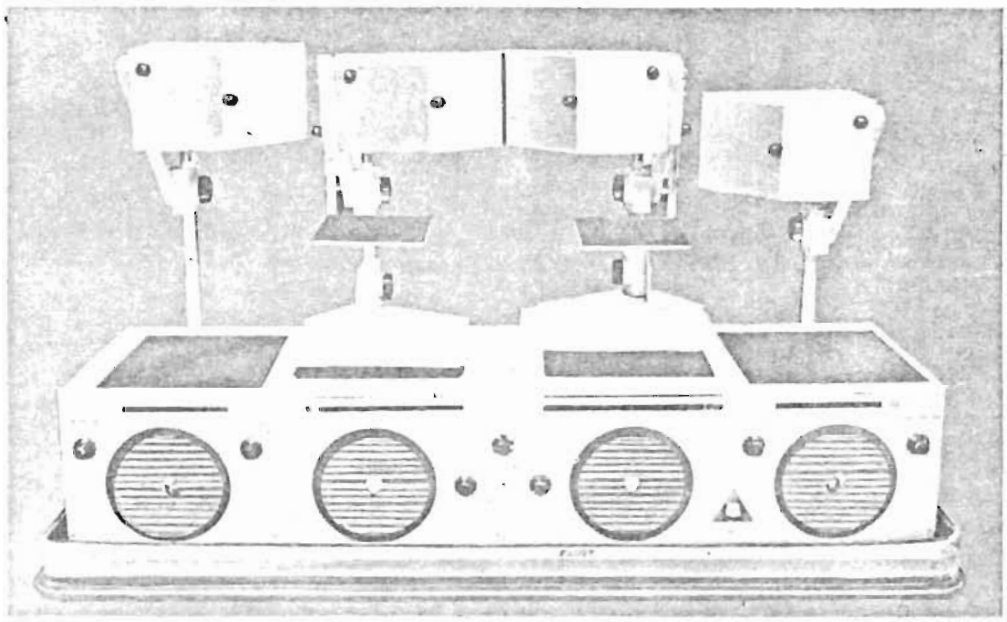

Figure 2. The Scott Dynamic Situation Simulator (Scott-Engineering Sciences Photo).

another overhead projector.

The custom communication and sound effects system provides for public address, stereo sound effects, monaural sound effects, and instructor to student or student to instructor telephone communication simultaneously. Sound effects are provided by two tape recorders: (1) a Sony Model TC 330, which provides sound transfer between reel-to-reel and cassette tape, recording from an external source onto either reel-to-reel or cassette tape, and playback from reel-to-reel or cassette into six wall-mounted Davis Model 28W8 special purpose 8" dual-voice-coil speakers, and (2) a Hitachi Model TRW-240 cassette tape, 2-track monaural recorder, which features battery operation to record the sound effects in the field, or a 120 volt AC converter for indoor operation. The recordings are artificially converted into stereo sound effects on the Sony recorder. During the simulation exercise both recorders are operated, with fire sound effects from the Hitachi, and equipment sound effects from each channel of the Sony. This provides three different simultaneous sound effects by adjusting volume controls, with additional sound effects available by changing cassettes during the exercise.

Microphone and earphone receptacles and telephones are located at the 12 trainee positions and 3 instructor positions. The microphones are used for simulated radio com-

munication over the public address system during exercises. Instructors may ring all student phones simultaneously or individual student phones to monitor student comprehension. Amplified conversations can be tape recorded, if desired, for later reference in debriefing sessions.

Also located in the fire simulator room, but not used in these simulation exercises, in an Osborne Fire Finder, a Raytheon Communicator System (300 series), and a dispatcher's wall-mounted map.[2]

Operation and Use of the Simulator

Fire simulators are complex and contain a great deal of sophisticated hardware. Familiarization with the operation and use of the equipment was essential in the beginning. Published articles on the development, use, and adaptations of simulators as well as equipment manuals were studied.

It was necessary to gain skill in actually using the equipment. Mr. Ken Burton of the Texas Forest Service, Lufkin, Texas and Mr. James Moore, Division of State and Private Forestry, United States Forest Service, Atlanta, Georgia gave advice and training in the early stages of

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[2]See Reeves, Hershel C. and Don A. Clymer. The fire simulator room at Stephen F. Austin State University. Unpubl. manuscript accepted for publication as Fire Control Note, 1972.

this project. Both of these men have had much practical experience in producing fire simulation exercises. The student personnel trained to operate the simulator at this time were Kirk Wynns, Jerome Behr, and Don Clymer.

The Development of Exercise I

Exercise I started off with a search for a slide suitable for a background scene. Mr. Ken Burton, Texas Forest Service, provided about 150 slides from which one was selected for use in producing 5-inch x 7-inch exact duplicate transparencies.

Several sound effects were recorded from U. S. Forest Service tapes provided by Mr. James Moore, U. S. Forest Service, State and Private Forestry, Atlanta, Georgia. Additional sound effects have been recorded in the field. During the process of transferring the sound effects it was learned that the monaural sounds could be artifically transferred into stereo sound effects. The Forest Service tapes had airplane passes in monaural sound. By manipulating the volume controls during the transfer recording, the airplane could be made to pass from left to right, or right to left. This added a very effective dimension to the sound effects.

The actual exercise development began with a study of the color slide chosen for the background scene. Specific

objectives to be accomplished were discussed so that a logical program could be evolved. The nature of the fire, under specified burning conditions, and resources available for suppression activities were indicated so that the correct sequence of decisions, possible incorrect actions, and feedback methods could be decided. The preparation of a practice script, which incorporated the known pertinent information, was necessary before "dry runs" of the simulator exercise could be made.

The principal objective stressed in the first simulator exercise was initial attack at the head of the fire, in which rate of fire spread and endangered high value property were emphasized.

Situation Briefing[3]

A detection airplane reports a fire of unknown origin along Rt. 23 in East Texas that is spreading north into a wooded area. The fire is one acre in size. It is a mild day in March, and drought conditions are prevailing. Temperature is 80°F, relative humidity is 30 percent, winds are from the southwest at 12 mph, and the spread index is 35.

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[3]A situation briefing generally describes the location of the fire, resources available for suppression efforts, and general conditions under which the fire occurs. The briefing is presented to trainees prior to the actual simulation.

Normal exercise time:	45 minutes
Briefing	5 minutes
Simulator	15 minutes
Debriefing	15 minutes
Tour of Simulator	10 minutes

Background Scene. A view is shown of a wooded area north of Rt. 23 in East Texas (Figure 3) with 2 houses and a pine plantation in the center of the picture about 400 yards from the road. The road embankments are high and very steep.

Resources Available.

Role		Radio I. D.
Dispatcher	-	Mooneyville
Fire Boss	-	Fire Boss
Plow Unit	-	Unit #1
Detection plane	-	Patrol #1

The fire boss arrives 1/2 hour after the fire is reported. He has one 3-man tractor crew due to arrive on the scene in 5 minutes. An observation plane on routine patrol is available.

Practice Script

Due to the fact that the students operating the simulator have had little or no fire experience the following script was prepared to help in the practice of the exercise

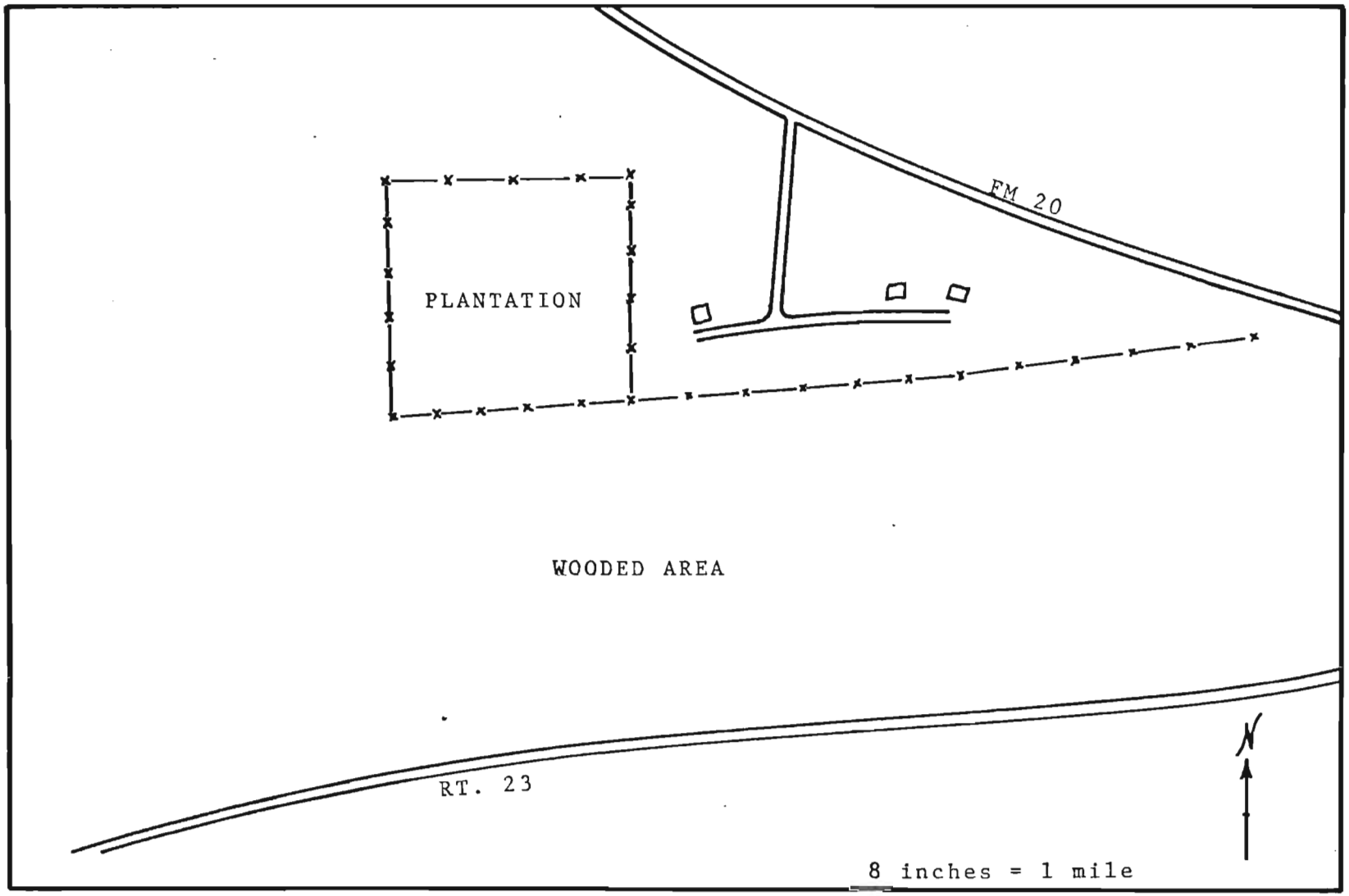

Figure 3. Orientation Map of Fire Area in East Texas for Exercise I.

and prevent confusion until the operators became familiar with the proper sequence of events. As practice progressed, "ad libbing" was encouraged and once the fire boss broke free from the script, the objectives, and desired sequence of decisions (Table 1) determined the conversation and radio communication.

Table 1. Correct Sequence of Decisions, Possible Incorrect Actions, and Feedback for Exercise I.

Correct Sequence of Decisions	Possible Incorrect Actions	Feedback Methods
1. Quickly size up fire.	Fail to properly size up fire.	None until item 3.
2. Asks Dispatcher for weather and available equipment.	Fails to ask for weather and available equipment.	Dispatcher tells him the weather report is available.
3. Report location and size of fire, and fuel type.	Fail to give complete report.	Dispatcher asks for more information on fire.
4. Determine rate of spread and relative danger to	Fail to ascertain rate of spread. (Continued)	Dispatcher asks for rate of

Table 1. (Continued)

Correct Sequence of Decisions	Possible Incorrect Actions	Feedback Methods
houses and plantation.		spread.
5. Select proper place to unload and attack fire.	(a) Stop on Rt. 23 and try to climb embankment. (b) Attack fire flanks instead.	(a) Tractor operator says embankment is too high. (b) Increase simulated smoke and fire.

Exercise Begins

Fire boss - Reports arriving at a vantage point near fire. Asks for weather report and available equipment.

Mooneyville - Present temp. 80°F, SW Wind at 12 mph, Humidity 30 percent, Spread index of 35. } Weather

One plow unit due to arrive on scene in 5 minutes; observation plane available also. } Equipment

Ask condition of fire.

Fire boss - Fire appears to be about an acre in size and is about 50 ft. N of Rt. 23 on high embankment. Fire spreading toward Northeast. Fuel is light hardwood and pine litter. Requests observation plane fly over for a closer look.

Mooneyville - Instructs plane (Patrol #1) to scout fire 3 miles west of Cripple Creek.

Patrol #1 - How long do you want me to stay in the area of the fire?

Mooneyville - Until the fire boss tells you everything is under control.

Plow Unit #1 - I'm on Route 23 approaching the fire from

the west. Where do you want me to start plowing?

Fire boss - Unload on road side away from fire and walk your unit in toward the head of the fire so you can tie in to the road.

Plow Unit #1 - Road embankment too steep. Asks for another route into the fire.

Fire boss - Head east on State Rte. 23 and take FM 20 north for about 1/4 mile. Should see a farm lane heading in north of the fire.

Patrol #1 - I am over the fire. It's spreading toward the Northeast and looks to be about two acres in size. I don't see any spot fires, but there are some houses ahead of the fire.

Fire boss - How fast does fire appear to be spreading?

Patrol #1 - It's moving pretty good. I'd estimate a chain and a half in the last 10 minutes.

Plow Unit #1 - I'm at the end of the lane near a farm house.

Fire boss - Unload and secure your truck then walk your plow down toward the fire in a SW direction for about 100 yards. Start your line to the east and swing south along the east flank of the fire.

Plow Unit #1 - Repeat instructions - after a lapse of time report your position near the fire.

Fire boss - Can you handle the job okay?

Unit #1 - I think we can take care of it okay.

Fire boss - O.K. Backfire your line as you go. After you reach the road double back and plow out the west flank.

Mooneyville - How's the fire. Estimated time plow unit free.

Fire boss - Fire is approximately two acres and spreading toward NE. Plow unit should be through in about 2 hours.

Unit #1 - We have reached the road and tied into it. We're checking line now as we go back around fire.

Fire boss - 10-4.

End of Exercise

Problems and Solutions in the Simulation of Exercise I

At this stage of the project the solving of equipment problems left little time to strive for a good exercise. The enlarged transparencies had not been received from the printer, so for this first exercise a slide projector was used for the background scene.

The sound effects were very poor - the sound had so much static over the speakers as to be almost unrecognizable and totally unrealistic. The problem was finally traced to amplifiers with insufficient power in the custom communications system. Although voice was amplified well, the sound effects were distorted. The recorders were wired straight to the speaker inputs - in effect using the recorders' amplifiers - and this created excellent sound qualities and solved the problem.

An additional overhead projector for simulating fire line was obtained. This projector could not be operated because the wall receptacles were wired to dimmer switches, and others had no power. The electricians labored a week to rewire the incorrectly wired receptacles.

The overhead projectors have interlock switches to shut off the lamp if the stage is lifted. On two of the overheads, these interlock switches were inoperative and

as a result, the lamps shut off during long practice sessions. Short exercises have so far prevented shut-down during exercise presentations.

The control room has large glass windows from 3 feet upwards, and the equipment can be seen from the trainee area. During the exercise presentation, the trainees were fascinated and distracted by the equipment and personnel, so the windows were covered up to eye level. It is hoped this will help the trainees' concentration and interest.

The original microphones were not palm type field microphones, but studio stalk type (Figure 4). These microphones were not convenient to use, were omnidirectional, and due to equipment noise in the control room were prone to disturbing feedback. Three palm type field microphones were obtained to correct the noise feedback and to provide more realism in the communications aspect of simulation.

Debriefing

In the debriefing for Exercise I the students' initial reactions to the simulator and the exercise itself were obtained. The exercise was then reviewed, decisions made by the fire boss were discussed, and the students were asked what they thought were correct decisions. The correct action was then discussed and explained. Any suggestions or questions pertaining to the exercise were discussed and

Figure 4. Omnidirectional studio stalk type microphone (left), and palm type field microphone (right).

ideas for improvement were encouraged. After the debriefing a tour of the simulator was made, and its operation explained to the students. All questions about the exercise or the simulator were answered as well as possible.

Critique of Exercise I

The first practical application of the fire simulator was not a total success. However, it did provide valuable experience for the simulator crew since the large number of students in the fire studies class (Fall, 1971) had to be divided into two groups. Repetition of the exercise permitted the opportunity to gain confidence in scribing and "ad libbing" during the exercise.

The projection screen area of the wall was originally painted an off-white which was not satisfactory for optimum light reception. This was repainted a stark-white on which colors, and especially the smoke, stand out brighter.

A sketch map for identifying roads of the fire area was needed so that trainees could determine the locations of equipment from radio conversations.

Other changes decided on were a more complicated plot that required more decisions, and a better flow of conversation. Although the role players had undergone several practice sessions before they simulated Exercise I they were reluctant to deviate from the simple, prepared script during the performance. Improvisation during an exercise

is essential to a good simulation problem, so more practice in "ad libbing" during dry runs was considered a necessity. In addition, another person was needed to work on the fire line projector and serve as a role player.

The Development of Exercise II

Several changes decided on during and after Exercise I were incorporated into Exercise II. The objectives and script were expanded. This provided for an increase in equipment which permitted more decision-making situations.

Robert Bloom, Texas Forest Service, Lufkin, Texas was responsible for several decision-making situations incorporated into Exercise II. Mr. Bloom explained the operations and problems he had encountered on a large fire where he had directed suppression efforts the previous summer.

Objectives

The objectives of Exercise II were: (1) to quickly and correctly size up the fire, (2) establish correct points of initial attack, (3) recognize the need for additional suppression units, (4) coordinate available resources, and (5) improvise in the field.

Situation Briefing

A detection airplane reports a fire of unknown origin in heavy logging slash along FM 39 in East Texas. The fire

is one acre in size. Drought conditions are prevailing with no rain recorded in the last 22 days. Temperature is 80°F, relative humidity is 30 percent, winds are from the south at 5 mph, gusting to 20 mph, and the spread index is 42.

Normal exercise time:	55 minutes
Briefing	5 minutes
Simulator	25 minutes
Debriefing	15 minutes
Tour of Simulator	10 minutes

Background Scene. A view is shown of a wooded area adjacent to FM 39 between FM 16 and FM 10 (Figure 5). South of FM 39 is a slash area, a pine plantation and a house. North of the road is forest and a farm house.

Resources Available.

Role		Radio I.D.
Dispatcher	-	Central
Fire boss	-	200
Official forestry unit	-	201
Official forestry unit	-	202
Industrial company unit	-	C-51
Aerial detection plane	-	AP-20

The fire boss arrives 1/2 hour after the fire is reported. He has one 3-man tractor crew due to arrive on the

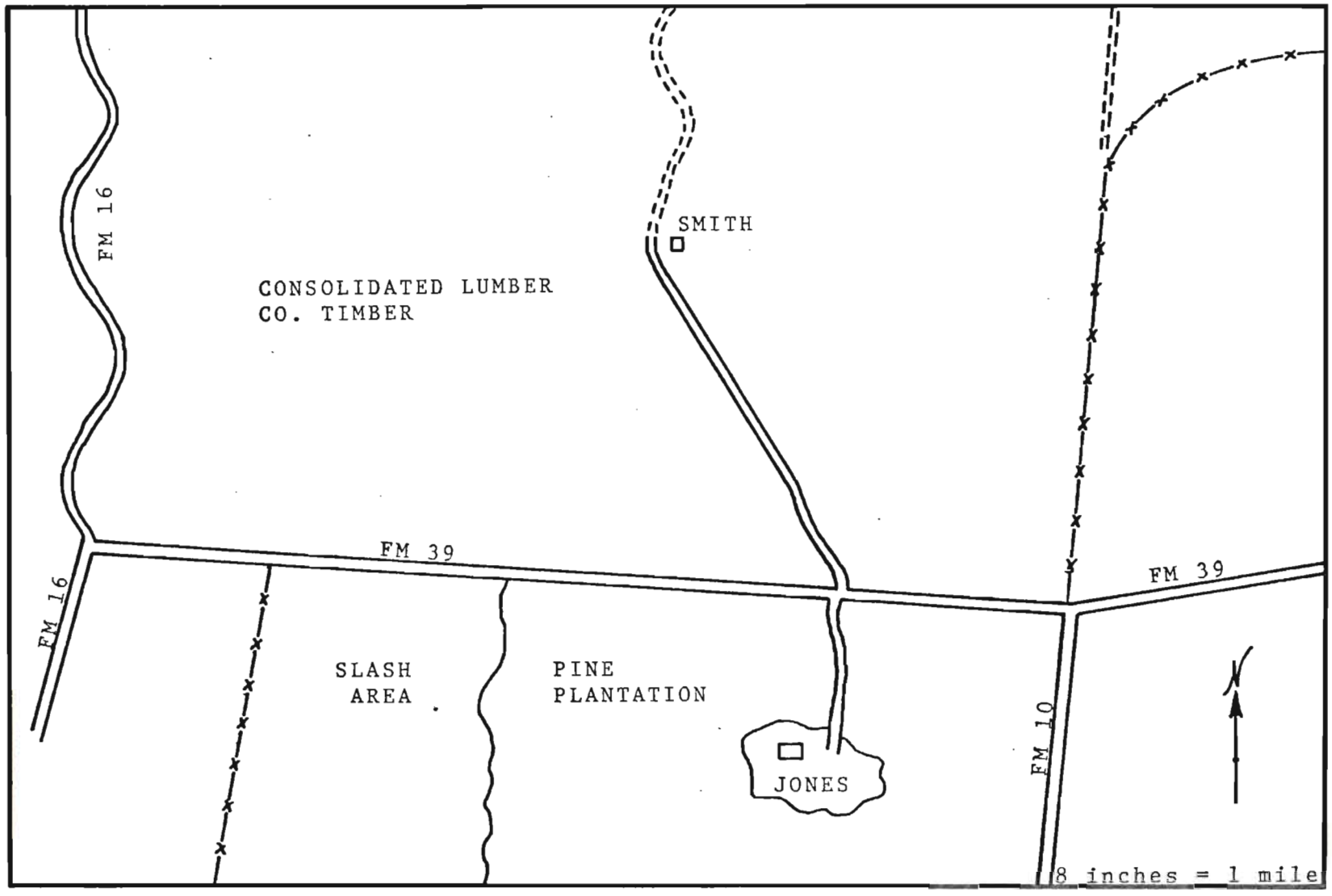

Figure 5. Orientation Map of Fire Area in East Texas for Exercise II.

scene in 5 minutes; another unit is available and could be on the scene in 15 minutes. An observation plane and an industrial unit are only minutes away. One of the 3-man tractor crews has both a radio on the tractor and a Handie-Talkie.

Practice Script

The following script was prepared to assist the simulation team in becoming familiar with the proper sequence of the exercise. The script was more detailed than that for Exercise I in order to encourage more casual conversation during the exercise. "Ad libbing" from the script was more natural as the role player became familiar with the exercise. The correct sequence of decisions (Table 2) served as a guide for preparation of the script.

Table 2. Correct Sequence of Decisions, Possible Incorrect Actions, and Feedback for Exercise II.

Correct Sequence of Decisions	Possible Incorrect Actions	Feedback Methods
1. Quickly size up fire.	Fail to properly size up fire.	None until item 3.
2. Ask dispatcher for weather and available equipment.	Fail to ask for weather and available equipment.	Dispatcher calls fire boss and tells him the weather report is available.
3. Report location and size of fire, and fuel type.	Fail to give complete report.	Dispatcher calls fire boss and states ranger wants to know situation.

(Continued)

Table 2. (Continued)

Correct Sequence of Decisions	Possible Incorrect Actions	Feedback Methods
4. Select correct place of initial attack.	Attack flank instead of head along the road.	Fire spots across road.
5. Determine need for additional reinforcements.	Fail to call for additional units.	Dispatcher calls fire boss and states ranger wants to know what resources are on fire.
6. Solve communication problem. Give 201's Handie-Talkie to C-51.	Fail to tell 201 to give C-51 the Handie-Talkie.	C-51 never reports in.

(Continued)

Table 2. (Continued)

Correct Sequence of Decisions	Possible Incorrect Actions	Feedback Methods
7. Coordinate units to provide for double fire line to stop fire.	Fail to coordinate units.	Dispatcher calls fire boss and states ranger wants to know how the units are being used.

Exercise Begins

200 - Central, I have arrived at a vantage point near the fire. What is the weather report and what equipment do we have available?

Central - 200, The present temperature is 80°F, wind is from the south at 5 mph, gusting to 20 mph. The humidity is 30 percent, and spread index is about 42. One plow unit is due to arrive on the scene in 5 minutes. A second unit is available for dispatch and could be on the scene in 15 minutes; an observation plane is also available. What is the condition of the fire?

200 - Central, The fire appears to be about an acre in size, and is burning in some logging slash. Would you please send the plane over for a closer look? The fire is heading toward Consolidated Lumber Company's land across the road. Have you informed them of the fire? Do they have a crew nearby, if I might need one?

Central - AP-20, Proceed to fire west of intersection of FM 39 and FM 10.

PAUSE ----

201 - 200, I'm on FM 16 approaching the intersection with FM 29. Where do you want me to start plowing?

200 - 201, Turn right on FM 39 and start backfiring from the road across the head of the fire. Plow south and keep the fire out of that plantation.

PAUSE ----

AP-20 - 200, I am over the fire.

200 - AP-20, How does the fire look from up there?

AP-20 - 200, The fire is a little over 1 acre and burning hot. The wind is mostly from the south, but shifting towards southwest slightly.

201 - 200, We have backfired from the road and I'm starting to plow along the flank next to the plantation. A whirlwind has just moved across the road from the fire area.

AP-20 - 200, I see a spot about 50 feet north of the road. That slash is really burning hot. It looks like a blow-over occurred when the back-fire met the main head.

201 - 200, Shall I finish plowing the flank and then go catch those spots?

200 - No, 201. Stay on there until everything is under control. I'll give you a call if we have to pull you off that burn.

200 - Central, Please send the additional unit. Our fire has gotten away from us. Are there any Consolidated Lumber Company units around?

Central - 200, They have a work crew about a mile north of you and they can get to the fire area in a few minutes. They don't have a radio on the tractor though.

200 - Yes Central, please send them. Tell them to pick up a Handie-Talkie from 201's truck.

AP-20 - 200, Those spots are spreading pretty fast. Someone from 201 had better go move their truck. It's parked about 100' west of the fire on the side of the road. If those spots spread much more, the truck could catch on fire.

200 - 201, Send Joe to move your truck back toward FM 16. Is your Handie-Talkie in the truck?

201 - 10-4.

200 - Good 201. Have Joe wait near the intersection for the unit from Consolidated and give them the Handie-Talkie.

PAUSE ----

C-51 - 200, We're at the intersection of FM 16 and FM 39. We have the Handie-Talkie from 201. Where can we help out?

200 - C-51, Go out FM 39 until you reach the gravel road leading up to the Smith place. Go up about 1/4 mile, tie into the road and start putting in line towards the west. Better leave your truck

in a good location.

201 - 200, We've plowed the fire out except for the left flank along the field. We ought to be at the road pretty soon.

AP-20 - 200, That slash fire still looks hot from up here. The fire north of the road is about an acre in size. It doesn't seem to be as hot as the slash, but is moving right along. I think 201's line on the plantation side is breaking out a little.

200 - 201, Have your men catch those breakouts on the eastern flank. Make sure that fire doesn't get into the plantation.

202 - 200, We're at the intersection of FM 10 and FM 39.

200 - 202, Go west on FM 39 until you come to the road to Robert Smith's farm. Go north on that road until you reach the Smith place. About 1/4 mile up the road you should see 201's vehicle and his line tied into the road. See if the Smiths are home and warn them about the fire. Leave your truck at their house. Then, come back down some distance and put in another line about a chain from C-51's line. Burn that strip out and stay in that area to make sure the fire doesn't spot again.

PAUSE ----

201 - 200, A fellow named Jones who owns the plantation has showed up and is helping. We've got the line on the eastern flank pretty secure.

200 - 201, Check the whole perimeter once more. Make sure the fire hasn't jumped anywhere.

200 - AP-20, How's the slash area look?

AP-20 - 200, It seems under control. There's still a lot of smoke, but most of the stuff looks like it's burned out. I don't see any other spots in the area.

200 - C-51, A unit is putting in an extra line north of your line. They will stay up there to check for spotting. You can plow out that left flank down to the road.

PAUSE ----

201 - 200, We checked out the line and it's secure. The fire is in good shape.

200 - 201, Okay, good. Start plowing north on the eastern flank of the fire on the other side of the road. C-51 should be down at the road soon and they can check your line there for spot-overs.

202 - 200, We talked to Smith, and he and his boys have hooked up garden hoses to protect the house.

Smith and his other 5 boys are going along our line watching for spots. There shouldn't be any problem here now.

AP-20 - 200, The fire head has run into the backfire and really flared up, but the lines are holding. The fellows appear to have the fire under control.

End of Exercise

Improvement Changes for Exercise II

For Exercise II the screen area was greatly improved through the use of stark-white paint. Other improvements included a sketch map, distributed to trainees, which identified the road system in the fire area, and a blackboard mounted on a wall in the simulator room (Figure 1) that contained a list of the available equipment and their radio call numbers. These changes reduced confusion and enabled the trainees to follow the action of the more complicated exercise.

Debriefing

The debriefing for Exercise II followed the same pattern as used for Exercise I. The students' initial reactions to the simulator and the exercise itself were obtained. The exercise was then reviewed and the decisions made by the fire boss were discussed and justified. Suggestions or questions pertaining to the exercise were encouraged prior to a tour of the simulator and an explanation of its operation.

Critique of Exercise II

The simulation of Exercise II for groups of students and faculty was more satisfactory and rewarding than previous presentations. The simulation crew was more experienced as a result of work on the previous exercise and

the several dry runs of Exercise II over a period of 6 months prior to the final presentations. The fire studies class for the Spring semester of 1972 had to be divided into two groups, due to the large number of students. An additional presentation was performed for interested faculty and staff and advanced students who had not been exposed to the simulator. The presentations provided invaluable experience for the individuals who worked in the simulation.

Due to the increased number of decision-making situations and roles required for Exercise II, an additional person was trained to handle the fire line scribing and to play a role. "Mac" Schultz, a senior forestry student, performed this function quite well.

SUMMARY AND CONCLUSIONS

This project has been successful in that the results indicate mature, interested students, under proper supervision, can develop and perfect a fire simulator exercise, and become skilled enough in the operation of the equipment so as to enact the simulation satisfactorily.

Major objectives of this study have been met as follows:

(1) The students were presented with a fire simulation situation in which they could see the decisions required in the suppression of a fire.

(2) During the fire simulation exercise, classroom instruction on fire behavior and suppression was reinforced.

(3) Students were briefed on the mechanics, operations, and capabilities of the fire simulator.

Time has been, and still is, the most restricting element of the simulator presentations. The difficulty of recruiting students with sufficient blocks of time and professional interest to work with the simulator soon became apparent. Fire control organizations which have undergone considerable experience in fire simulation are well aware of and have made provision for the large blocks

of time needed for the perfection and application of fire simulation problems. Students who are recruited for work on the simulator will have to schedule their classes so that two or three mornings or afternoons each week are free for practice.

Suggestions made by students and faculty during debriefing sessions stressed the use of other available teaching techniques, such as the Raytheon Communicator system. Experience gained from this project indicates that innovative work with the simulator requires excessive time when inexperienced fire fighting personnel are used in the operation. A reappraisal of the objectives for which the simulator will be used is needed before simulator research on new techniques or innovations is attempted.

Since no remuneration was available, the students worked either for the personal experience or for academic credit. High quality instructional use of the fire simulator will largely depend upon inducements for the recruitment of capable students or upon participation by more faculty members.

A perpetual problem will be the turn-over in advanced students who have received the necessary instruction that would permit them to simulate realistically. Careful selection of students who plan to continue in school can help to minimize this problem.

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AN ABSTRACT OF A THESIS

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ABSTRACT

A forest fire simulation exercise was developed for the purpose of supplementing forest fire instruction, presenting students with decision-making situations encountered on forest fires, and introducing them to the fire simulator at Stephen F. Austin State University. The final exercise was developed after preliminary work and development of a more simple exercise. The problems with equipment, recruitment of simulator personnel, and the development and execution of the simulator exercises are discussed. Scheduling adequate time for practice, and providing adequate personnel training were found to be the major obstacles in simulator use. Future fire simulator use at SFA will be dependent upon finding solutions to these problems.

VITA

Don A. Clymer was born in Doylestown, Pennsylvania, on June 8, 1945, the third son of E. Ellsworth and Adelaide Clymer. After graduation from Palisades High School, Kintnersville, Pennsylvania, in 1963, he entered the Pennsylvania State University in Mont Alto, Pennsylvania, from which he received an Associate Degree in Forest Technology on June 6, 1966. In June, 1969, he entered the U.S. Army and served in the Army Engineers in Neu Ulm, Germany, being released from active duty May, 1968. He entered Stephen F. Austin State University in September, 1969. After receiving the Bachelor of Science degree in Forestry on May 13, 1971, he entered the Graduate School at Stephen F. Austin State University, where he completed the 30-hour Master of Science in Forestry degree. He is married to the former Linda L. Wilson. They have one daughter, Joy, age 2, and one son, Brad, age 3 months.

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