Logging Machinery used in Wildland Fire Suppression

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Abstract

Catastrophic wildfires are now a common occurrence in the west. To battle these blazes, logging machines are used for constructing firelines (earthmoving), timber removal, and water transport. The research at Oregon State University is defining the issues at stake with three focus points: equipment, policy, and training. Standard and modified logging machines are used in multi-employer work arrangements for wildfire suppression scenarios and tactics. Wildfire suppression is a complicated system to comprehend, and the study identifies the pertinent issues, provides a problem definition, and identifies research needs to advance firefighting efficiency.

Introduction

Devastating fires have become a common occurrence in the western United States and Canada during recent years. Large fuel breaks have been the only effective way to stop some of these catastrophic wildfires, and without these interruptions, the fires commonly burn until the weather changes or the fuels simply run out. Trends in fire suppression equipment technology show little change over the last fifty years and logging equipment offers new potentials.

Increases in mechanization occurred in logging for two main reasons: to increase safety and efficiency. This justification can be logically extended to fire suppression. Bulldozers have long been the sole piece of heavy equipment used for firefighting; however, there has been success using logging machinery for various firefighting tasks.

The main goal of this scoping research is to improve the efficiency of wildland fire suppression through documentation of potentials and defining problems and related issues. Fire managers in the public and private sectors as well as the specialized operators of machines from the private sectors need to better understand how the new equipment can contribute to wildfire suppression. Three main focus points have been selected: the equipment, safety policies, and training requirements.

Equipment

Logging machinery has been used successfully on large and small wildfires occurring on both public and private lands. Tasks performed during Initial and Extended Attack scenarios include direct and indirect tactics, water delivery, mop-up, rehabilitation, and hazard reduction.
The ongoing logging operations were likely the first scenarios where logging equipment was deployed to fight fires. Accidental fires can be started from sparks or friction of moving tracks, blades, saws, and other parts—especially in the dry season. Thus, most logging crews are required by law to make special preparations for these emergencies. In addition to having a plan of action and assigned duties, many crews also keep a water supply and firefighting tools nearby. The heavy equipment suppresses the wildfire by digging lines and removing fuels. Furthermore, older machines are occasionally modified specifically for fire suppression purposes.

In southern Oregon, one logging contractor built “skidgines” to accompany feller-bunchers. The name skidgine is derived by combining a log skidder with a fire engine. These skidders were retired from logging but still had some value. Equipped with a 500 gallon water tank, pump, and hose the machines were parked near the operation and could be quickly driven to small fires that might occur from sparks caused by debris and the continuously spinning “hot saw” of the feller-buncher (Wampler 2003).

Contracts
Logging machines have also been used by wildfire contractors as money-making firefighting tools on agency fires. Federal contracting has increased dramatically, especially in wildland firefighting. As a result, many in the private sector have become employees of the government contractors. These contract workers consist of both logging personnel who lack work (especially during the fire season) and newcomers looking to make a career in forest activities.

On agency managed fires, both standard and modified machines have been used in contract firefighting. Interagency contracts have been built to serve two levels—regional and national—with the range of deployment depending on the type of contract used. An Emergency Equipment Rental Agreement (EERA) must accompany these contracts (Kuehn 2003). Pay rates and equipment classifications are provided with these contracts. However, determining pay rates can be complicated. Many rates are negotiable due to the unclear agency classification of equipment and the wide range of innovative machines available.

Modifications
Many machine modifications have been documented in addition to water tanks, water cannons, pumps, and hoses. Calcium chloride has been used to enhance rubber-tired machine stability when operating on steep ground. Chains are used to decrease the direct heat exposure to the tires, and on some machines, can also reduce site rehabilitation needs by decreasing ground pressure. To provide a necessary level of safety and performance, machines carrying large water tanks have also been equipped with additional braking systems on the rear axle and stronger driveshafts.

Because many modified machines have not been properly designed to handle the fire conditions they will encounter, more assessments are needed on how capabilities are altered when machines perform tasks different than those for which they were originally designed. For example, a skidder will behave differently when carrying a full water tank than it would when dragging logs partially supported by the ground.
Safety
Operator safety has also been a reason for modifying machines. Pull-down fire screens are used on some machines to provide burnover protection. In contrast, some expensive logging machines are factory equipped with on-board fire extinguishing systems that use chemicals toxic to humans. Many other modifications are in consideration—some more sophisticated than others.

Despite having precautionary features, machine manufacturers may recommend evacuating the machine in a burnover situation because of flammable fluids, pressurized systems, and other possible dangers. Most manufacturers do not recognize firefighting as a designed use for the machine—even if it is performing the actual task for which it was designed but operating in a fire setting (e.g., a skidder skidding logs or a feller-buncher felling trees on a fireline). Only a limited number of logging equipment manufacturers advertise their machines for use in fire suppression.

Stability
To help analyze stability of an existing machine or machine design, a computer model is being constructed to assess machines modified with rectangular box-shaped water tanks. The model will include uphill, downhill, and side slope calculations. For this analysis, stability is defined as the ratio of restoring to overturning moments:

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\text{stability} = \frac{\sum \text{moments}_{\text{restoring}}}{\sum \text{moments}_{\text{overturning}}}
\]

The model is written in Visual Studio 7.0, and features an easy-to-use interface (Figure 1). The heuristic takes user inputs to first determine the center of gravity of the fluid in the tank and then calculates the overall machine stability. Because any ratio grater than 1 is computed to be stable, comparisons to machines involved with past accidents are being used to help determine an appropriate safety factor.

One such accident documented by the Forest Engineering Research Institute of Canada (FERIC) demonstrated how a modified skidder overturned on a 35% slope. The machine originally was driving uphill, then stalled, rolled backwards down the slope, and eventually overturned. Luckily, the operator was not killed; however, it was labeled as a serious “near miss” accident. In addition to its location dangerously high on the rear axle, the water tank also blocked the vision of the operator and prevented precautionary actions such as backing up the hill. Future incidents like this can be avoided by assessing the machine during the design stage and before operation.
Manufacturers
A questionnaire has been distributed to the Society of Automotive Engineers (SAE) Forest Machinery sub-committee. This group consists of representatives from several logging machine and attachment manufacturers. The questionnaire attempts to gather knowledge from machine experts regarding the firefighting uses of machines. Although still in the works, questionnaires have been returned and there are some early findings. Liability is a major issue, and the manufacturers do not currently recognize firefighting as a designed use of the machine. Company warranties would be voided when the equipment is used for wildland fire suppression. There are also discrepancies in the correct procedure to be followed in a burnover situation. Questions about engine performance, tire and track vulnerability, operator protection, and other issues are still outstanding but will influence how machines are used in wildland firefighting.

Policies and Training
At the heart of the issues are the federal, state, agency, and company policies and regulations that dictate specific procedures to be followed. The Oregon Occupational Safety and Health Administration (OR-OSHA) has had regulations covering wildland firefighters since 1988. All forest activities workers who may be called upon to fight wildfires in Oregon must receive the minimum basic training as stated in the safety code (OR-OSHA 2003). This applies to both logging crews and professional contract firefighters. For fires resulting from logging operations, Oregon Revised Statutes (ORS) require logging contractors to provide a “reasonable effort” in suppressing fires occurring on the operation (ORS-477). Often this requirement is the justification for modifying older equipment to have at hand for fire emergencies.
Various other issues surface when private employees become involved with a government agency for firefighting. Firefighting for the agency requires more documented training, knowledge of fire behavior, and integrating into the Incident Command Structure (ICS). In order to coordinate fire suppression, government standards often required of private workers to maintain a level of safety across the complex fire organization. This may create confusion about responsibilities among those involved in the multi-employer work arrangement.

The Initial Attack situation is an emergency allowing agency management to bypass lengthy training and safety requirements to immediately utilize loggers as suppression resources. However, after a certain time—often the end of the first shift or beginning of Extended Attack—the logger is then required to meet the agency standards. This will involve additional personal protective equipment (PPE) such as Nomex™ clothing and fire shelters. More demanding training standards must also be met. The actual requirements depend on the agency with jurisdiction on the fire. Rationally resolving conflicting requirements will determine whether the fire is extinguished or grows out of control.

Incorporating loggers and logging equipment for fighting wildland fires is slowly taking place within the government. The “Big Iron” project, in the Northern Rockies Region of the US Forest Service, has provided an inventory of machines including their rates and uses (Steele et al. 2003). There is also progress towards including the logging machinery and potential uses in fire suppression tactics courses. In addition, specific criteria have allowed better inspection of equipment offered for federal fire suppression contracts in the Northern Rockies Region.

Conclusion

Society needs more sophisticated tools and systems for suppressing both large and small wildfires. Recent trends indicate logging machinery potentials are becoming recognized to increase safety and efficiency. The government and private sectors are slowly learning how to work together, but more progress is needed to increase understanding and knowledge between the groups. Wildland fire suppression is a complicated system to comprehend. The study attempts to identify the pertinent issues, provide a problem definition, and identify research needs for advancing efficiency.

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