


# MODELLING THE ASSIGNMENT OF RESOURCES DURING LARGE WILDFIRES TO PROTECT ASSETS

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## Overview

- Incident Management Teams (IMTs) work in high pressure environments, having to make complex, time critical decisions. A clear need for decision support tools exist.
- Operations Research (OR) is the use of analytical techniques such as mathematical modelling to help make better decisions.
- Applications of OR to fire management have focused largely on long term planning such as the location of facilities, fleet composition and fuel management.[2] This research considers the application of OR techniques to short term decision making by IMTs fighting large wildfires.

## Aiding IMT Decision Making

- Assigning resources during large bushfires is a very complex task which is difficult to solve manually.
- Mathematical models ease the burden on IMTs, performing computations on behalf of the IMT and providing the opportunity for the IMT to explore various scenarios interactively.

## Research Questions

- What benefits can methods and tools in OR provide to IMTs?
- How may IMTs best utilise the available resources during large bushfires?
- What is the best utilisation of resources in the absence of any suppression efforts?
- What are the trade-offs that arise when assigning resources to different task, such as asset protection and active fire suppression.

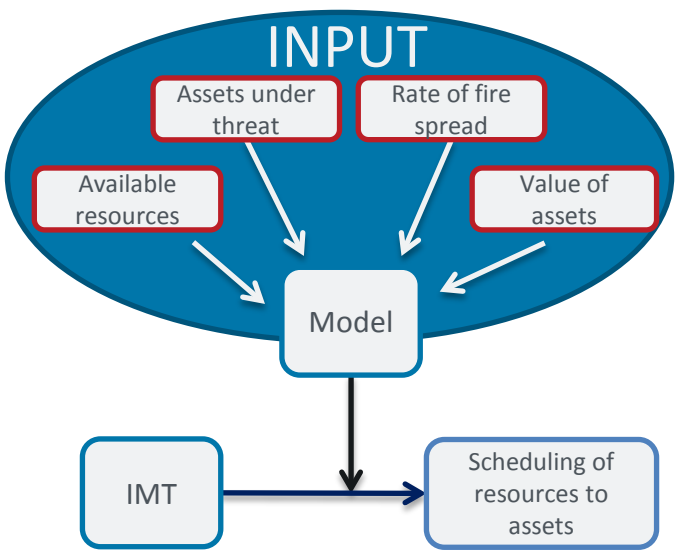


**FIGURE:** Resources are scheduled to protect various assets given factors such as value of assets, time to impact and available resources.

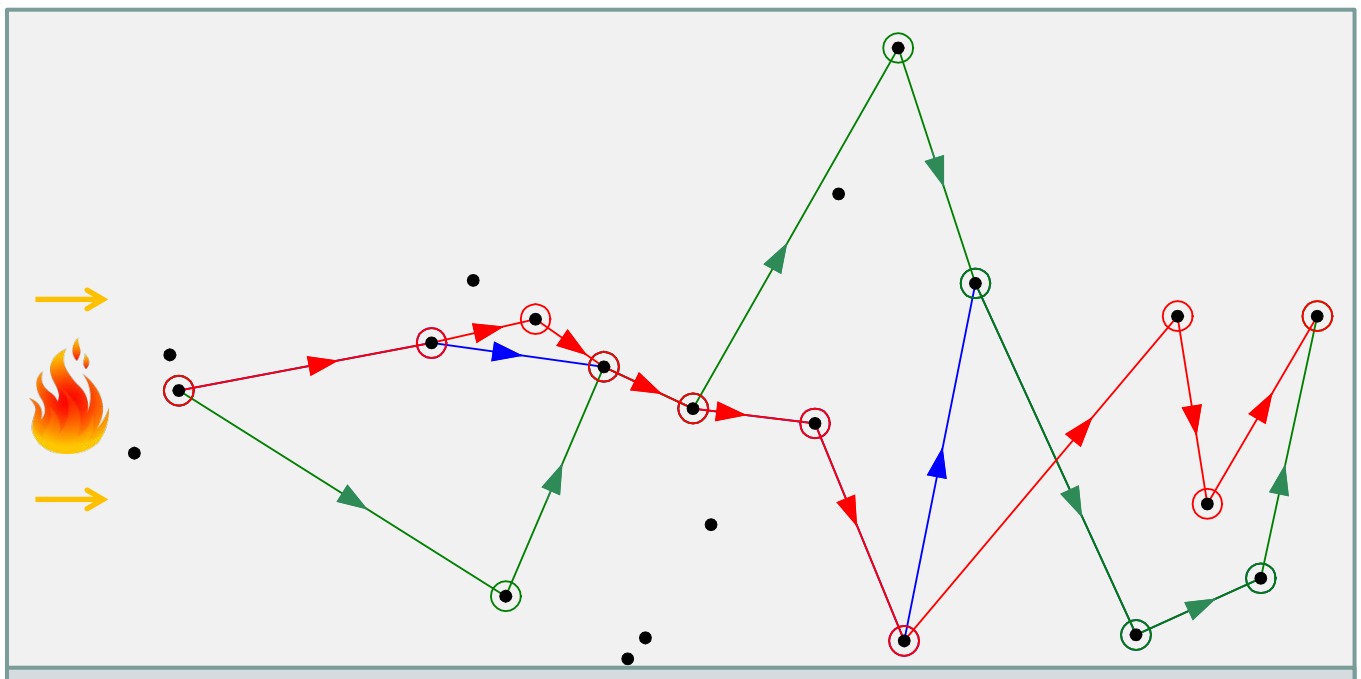

**FIGURE:** A modelling approach to scheduling resources during large bushfires. In the scenario shown a fire is sweeping through the landscape from left to right. Black dots (nodes) indicate the location of assets, each with an associated value and protection requirement. The routes of three resources indicate in blue, red and green colour lines, is the resource assignment that protects the highest total asset value.

## IMT Resource Allocation

- Previous models considered optimal strategies regarding active suppression and fire line construction.
- However, on days of extreme fire weather active suppression is not always a viable option and other actions may need to be considered.
- The IMT priorities may be summarised as follow: 1) issue warnings to enable those at risk to protect themselves, 2) protect vulnerable people, 3) protect assets the community has identified as valuable, 4) stop building-to-building fire spread in built-up areas, and 5) protect less valuable or more isolated assets. [1]
- Protecting assets bears a resemblance to the team orienteering problem with time windows found in OR literature.[3]

## Model Characteristics

- Each asset has an associated time window. Sufficient resources must arrive at the asset during the time window to ensure it is protected.
- The location and value of each asset is known.
- A fix number of resources is available to schedule.
- Each asset has its own protection requirements in terms of number of resources required.

## Future Work

- Fire authorities manage a variety of different resource types, the next model will allow for the dispatch of a variety of different types of resources.
- A trade-off exists when considering the number of crews assigned to active suppression and asset protection. The aim is to investigate the consequences of these trade-offs.

### Selected Literature

1. Killalea, D. (2009). Operational priorities: when it's out of control what do we do? Retrieved July 30, 2013, from http://www.bushfirecrc.com/blog/damien-killalea/operational-priorities-when-it%E2%80%99s-out-control-what-do-we-do

2. Minas, J. P., Hearne, J. W., & Handmer, J. W. (2012). A review of operations research methods applicable to wildfire management. *International Journal of Wildland Fire*, *21*(3), 189–196.

3. Vansteenwegen, P., Souffriau, W., & Van Oudheusden, D. (2011). The orienteering problem: A survey. *European Journal of Operational Research*, *209*(1), 1–10.

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