What is it?

A real time map centric collaboration, analytics and resource management system for multi-tiered organisations.

- Before | during | after planned & unplanned events
- Cloud or own server
- Mobile friendly | field data collection
- Command | Control | Coordination
- All hazards

Benefits and problems addressed

1. Improves situational awareness and command, control and coordination at, and between, all hierarchical levels.
2. Improves fire fighter safety as information is communicated in real-time.
3. Reduces the time required to prepare and distribute Incident Action Plans and burn plans and ensures they are always up to date (plans can be automatically generated).
4. Saves time on reporting by automatically generating statistics on the implementation of prevention plans as a by-product of the operational use of the system.
5. Improves accountability through automatic time/user stamping and message acknowledgements.
6. Ensures tasks are completed on time.
7. Enables people and resources to be managed more efficiently and ensures compliance with organizational training and fatigue management policies.
8. Ensures continuous improvement through automatically learning from the past and local knowledge.
9. Improves integration between disparate systems and functionality.
10. Improves coordination between multiple simultaneous competing events.
11. Breaks down silos between different parts of the organization and different types of events by sharing information and ensures agency interoperability.
12. Addresses many recommendations from multiple inquiries into disaster scale fires.

Who are we?

3 founders with 20+ years experience:

- Dylan - Subject matter expert in emergency management
- Martin - Software engineering and user interface design
- Sonja - Business, project management and graphic design

- 3 full stack developers with collectively 50 years experience
- 2 developers Masters in cybernetics
- Australian (Canberra based)

Major concepts

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Advantages

- Device and operating system agnostic
- No software to install (even off-line)
- No training for most users
- Configurable without programming
- Tightly integrated
- Multi-purpose
- Automatically learns
- Can be integrated with existing systems

Summary

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Burnology | Unite is a highly configurable cloud based, mobile friendly, real time, map-centric, communication, command, information and resource management system for use by multi-tiered organisations (Figures 1, 2 and 3). The system unites people, places and processes.

The system allows geographically separated teams/people (e.g. field based fire fighters and office based incident managers) to collaborate in real time.

It can also be described as:

- an artificial intelligence powered geospatial system - the first in the world,
- a real time collaborative web based GIS,
- a command, control and coordination system,
- a data collection system for real time data analytics,
- a framework for real time data integration and sharing, and
- an incident management system.

Figure 1 Typical structure and information flows (orange arrows) in emergency incidents the system is designed to manage. Although a simple concept, this has been patented by Burnology, as no existing spatial systems have been designed to manage all these information flows.
Figure 2 High level structure and function of the system.

Figure 3 Main functionality of the system.
Templates are configured by administrators in end-use agencies (without programming) for different events (e.g. bushfire, flood). In-use, the system behaves in accordance with configuration allowing flexibility between situations but ensuring consistency in how situations of the same type are managed (Figures 4, 5, 6 and 7).

Templates are used to control spatial and non-spatial functionality and how data entered is re-used and integrated within and between templates.

**Figure 4** Relationship between configuration and in-use in the system.

**Figure 5** Example of configuring the spatial aspects of a template.

**Figure 6** Example of configuring an auto-filled form using the systems’ drag and drop interface. Auto-filled forms are configured as part of configuring templates.
Configuration versus in-use

The use of templates also ensures that, for most users, the system can be made easy to use with most of the complexity hidden in the configuration of the template.

Figure 7 Examples of different templates illustrating the flexibility of the system.
At the lowest hierarchical level, the primary user interface is a shared map (Figures 8 and 9) that all users can view and make changes to, with those changes visible to all users in real time (3-7 seconds).

End use agencies may configure point, line and polygon feature types and rules governing their behaviour used in shared maps.

The location of all resources is automatically tracked and shown on the shared map on all devices in real time. In addition to geospatial data, messages, tasks and photos may be transferred between users via shared maps (Figure 10).

**Figure 8** Example screenshot of a shared map on a mobile device.

**Figure 9** Example screenshot of a shared map on a desktop computer. All changes made on this map by any user are visible to all users of the map in real time.

**Note:** The hideable legend to the right of the map provides summary statistics for the data on the map while the feature pop up enables one feature type to be changed to another (Backburn - Planned to Backburn - Complete) at the press of a button.
Shared maps

Figure 10
Not only can configurable point, line and polygon features be transferred between users via the shared map, photos may also be transferred such that a photo taken by one user may be viewed by all other users on desktop or mobile devices in real time.

Multi-tiered & data re-use

The system is designed for use in multi-tiered organisations. Data input at each hierarchical level is re-presented to support decision making at other levels.

For example, at higher hierarchical levels, configurable statistics are automatically extracted from multiple shared maps and presented in configurable tabular dashboards, charts and maps (Figures 11, 12 and 13).

Figure 11
Example of a dashboard, which can be used to provide situational awareness over several maps simultaneously.
Auto-filled forms are forms that can be configured to be auto-populated by data entered on maps, the resource management module and tasks module.

This enables text and statistics based plans, such as Incident Action Plans (IAPs), and other reports, such reports on the implementation of fire prevention plans, to be automatically generated (Figures 14 and 15). This includes the ability of first responders to quickly and easily generate an in-field IAP that is visible to all other first responders and office based staff in real time.
Multi-tiered & data re-use

A person in the field implementing a fire prevention plan changes a proposed area of slashing to a completed area of slashing on their mobile phone.

Map in the field

Map in the office

The change made to the map in the field is visible to those in the office in real time.

Dashboard in the office

Autofilled form in the office

Statistics in the dashboard on the implementation of the fire prevention plan are automatically updated in real time. These statistics can be configured by end use agencies without programming using a drag and drop interface.

Figure 14 Example of how data entered in the field on the implementation of a fire prevention plan can be reused to automatically generate statistics on the implementation of that plan.

Statistics in the autofilled form on the implementation of the fire prevention plan are automatically updated in real time. These statistics can be configured by end use agencies without programming using a drag and drop interface.

Figure 15 Example of how an administrator in an end use agency can configure the system to re-use data entered via shared maps, the resource management module and tasks module to create an automatically populated Incident Action Plan.
The system includes a comprehensive resource management module that provides functionality for day to day rostering as well as in emergency incidents and from the individual to the whole of incident level (Figure 16). The resource management module enables:

- Individual users to enter their own availability and the availability of resources (Figure 17).
- Users to be rostered to roles and vehicles for day to day work accounting for individual availability, competency requirements and fatigue management (Figure 17).
- The building of organisational structures to manage events and the population of those structures for current and future shifts accounting for individual availability, the role the user has been rostered to in the day to day roster, user competencies and fatigue management – this includes both planned (e.g. prescribed burns) and unplanned (e.g. wildfires) events (Figure 18).

As with the rest of the system, administrators in end use agencies may configure the resource management module to meet their agencies’ policies and needs (Figure 19). In this way the system automatically ensures compliance with agency resource management policies.

**Figure 16** An overview of the various components in the resource management module.
Rostering

Figure 17 The user interfaces of the availability and rostering functionality of the resource management module.

Note: Colours used in rostering and availability are configurable - they don’t have to be as bright as illustrated.

Figure 18 Right: The desktop user interface which may be used to build an organisational structure and populate it by dragging and dropping people and resources. In the case of a prescribed burn plan, the organisational structure may be populated by ‘required’ resources indicating the number and type of resources required to implement the burn. When weather conditions are suitable to undertake the burn, the required resources may be replaced by resources that are actually available at the time. In this way, maximum advantage can be taken of the resources available for prescribed burning. The colour of resources automatically changes as people are allocated to the resource with green indicating that the required number of available and suitably trained staff have been allocated.

Left: As a resource plan is built on the desktop site, the resourcing information available on mobile devices is automatically updated in real time. If a resource plan is built on a mobile device, the resource plan on the desktop site, and all other mobile devices, will be updated in real time.
Resource Management

Figure 19  Example of configuring the resource management module. The interface used to define maximum permitted shift patterns. Notice different maximum permitted shift patterns may be defined for each shift and IMT versus operational roles. The system uses this information to exclude staff who do not meet the agency fatigue policy from the list of available staff in the resource planning page (Figure 18).

Data logging & accountability

All data added, deleted or modified in the system is automatically logged (data collection as a by-product of management) (Figure 20).

The system includes the ability to send messages, including red flag messages, where users may respond yes or no using a “thumbs up” or “thumbs down” icon. The sender of these messages may view a tally of replies to these messages providing accountability of who has viewed the message and how they have replied (Figure 21).

The system includes the ability to allocate and track tasks including identifying tasks that are overdue or have not been accepted (Figure 21).

Figure 20. Example of data that has been automatically logged associated with a map feature.
In the field, following construction, a planned helipad identified in a fire prevention plan is changed to complete.

In the field photos and other evidence of the construction of the helipad is attached to the completed helipad map feature.

The number at the bottom right of the completed helipad map feature indicates that there are attachments to the map feature. These attachments may be stored with the map feature indefinitely.

Photos and other documents may be attached to map features. This may be used to provide and store evidence related to the implementation of activities in a fire prevention plan (Figure 22).
The system continues to store data even without internet reception and without downloading any software (including apps) onto individual devices. Upon returning to an on-line area, the data stored on the individual device and server automatically resynchronises. The data transmitted by the system has been optimised so it can be used in low bandwidth environments - up to 25,000 new map features can be captured and stored off-line.

The ability of the system to work off-line on any device without installing software makes it possible for a person temporarily working with your agency to log into the system and start recording data, even off-line, in a matter of minutes. This significantly enhances agency interoperability.

It also makes it possible to record data during normal day to day work or training activities (e.g. the location of water points) which is then automatically and instantly available in the event of an incident in the area. In this way, the system significantly enhances access to local knowledge in incident management.

Artificial Intelligence

All map features added to the system are stored in a knowledge base. Configurable rules control how these features are subsequently re-used (Figure 24). These rules give the system artificial intelligence (Figures 25) so that:

- Local knowledge is automatically available in subsequent emergencies.
- Prevention related data is automatically available in subsequent emergencies.
- Data collected during one emergency is automatically available in future emergencies.
- Data collected for one purpose can be used for another purpose.

Configurable rules govern how data entered on each specific purpose map is used in the knowledge base.

These relationships and rules give the system artificial intelligence such that it appears to 'learn' over time.
Artificial Intelligence

Figure 25 Simple example of how the system ‘learns’ over time.

First fire

The threatened properties plotted during the first fire are added to the knowledge base.

Second fire

The threatened properties plotted during the first fire and added to the knowledge base are automatically made visible on maps created for a second fire in the area.

If the system has been configured to include an automatically generated IAP, as the system learns over time, the IAP is increasingly pre-populated with intelligence learnt during past incidents and other events in the area (Figure 26).

The safety section of the automatically generated IAP for the third fire automatically lists the contaminated site and vertical mine shaft discovered during previous fires as specific safety issues.

Figure 26 Automatically generated IAPs are increasingly pre-populated with intelligence learnt during past fires with each successive fire.
The system can also be used to share data, in real time, between different entities e.g. different emergency management agencies (Figure 27).

**Figure 27**
Example of how the system could be configured to enable interoperability between different emergency management agencies who are working together on a particular emergency incident.

It is planned to significantly enhance the systems’ artificial intelligence functionality in the future, particularly the development of Burnology owned predictive geospatial artificial intelligence algorithms which will allow the prediction of spatial phenomena (e.g. fire behaviour) based on experiential data collected as a by-product of the operational use of the system.

**Integration**

All modules and functionality in the system is integrated meaning that a change in one part of the system causes a related and appropriate change in another part of the system (Figures 28 and 29). It is this integration between seemingly unrelated functionality that creates a lot of the systems versatility and power. The system also integrates:

- data collection, data analysis and intelligence, planning and operations,
- local knowledge, planned events and unplanned events,
- past, present and future (before, during and after an event),
- office staff (desktop/laptop) and field staff (mobile),
- two or more projects,
- two or more organisations,
- workers, managers and executives, and
- organisations and their stakeholders.
Integration

Figure 28 The various modules and functionality in the system is fully integrated meaning that any change to data in one part of the system automatically causes an appropriate corresponding change to data in other parts of the system. In this way the various modules in the system may be viewed as a series of interlocking cogs where rotating one cog results in all other related cogs also rotating. This is opposed to many other systems where, while all modules may be accessed through a single interface or login, rotating one cog does not result in related cogs also being rotated.

Figure 29 Simple example of integration between different system modules. As resources and the people allocated to them are allocated to different sectors and divisions on the resource planning page (Figure 18). These people are automatically allocated to appropriate sector and division groups in the messaging system. In this way, a message can be sent to all members of a user specified sector (e.g. advising them of assembly instructions for the following day) at the press of a single button.