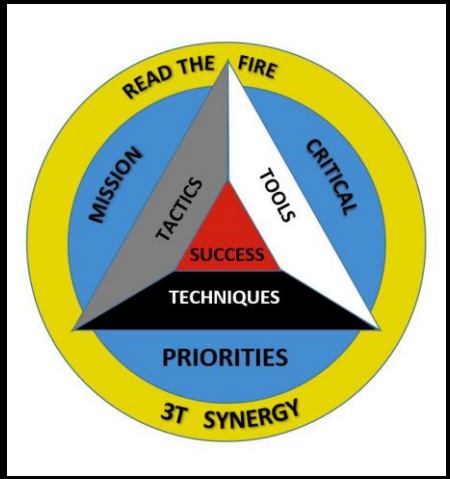


Smarter Firefighting

Beyond one Tactic, one Tool, one Technique

Shan Raffel

CFBT International

Aus-Rescue

Smart Firefighting

The Problem – Extremely High Stakes

- Immanent threat to human life
- Immanent threat to property
- Immanent threat to the environment

The Context – Extremely Limited Information and Time Frames

- Limited information prior to arrival
- Information overload on arrival – high stress
- Incomplete, flawed or confusing initial information
- Seconds to make life and death situations
- Minutes to review and adjust

Success Factors

Analyze Information (Filter the noise – Situational Awareness)

- Pre-arrival
- In route
- Arrival - rapid identification of threat and mission critical objectives

Initial Action

- Initial tasking of crew to support likely strategy and tactics

360 Information

- Develop a strategic approach to preserve life, and property

Tactical Implementation

- Tactical synergy – focused on eliminating threat to Life/Property
- Confine the incident – stop it from spreading
- Extinguish the threat – move in
- Minimize loss
- Support recovery

Barriers

Ignorance

Complacency

Arrogance

Sloth

Barriers

Understanding of Fire Behaviour

Not current, poor, or limited training quality and access

Extinguishing

Knowledge: Outdated - Flawed - Incomplete
Human elements: Fear – Ego – Bias - Laziness = 1 TTT

Decision Making Under Stress

Scientific understanding is relatively new
Underappreciation of the role of “time stress”
Overly complicated acronyms
Practical learning opportunities are limited and costly

One size fits all approach

A belief that Firefighters are stupid
Failure to appreciate the impact of context

Context Based

IDENTIFY	FOCUS	FOUNDATIONAL KNOWLEDGE
THREAT Fire Smoke Collapse Other	BE SAHF Where is it now? Where is it going? Construction, stage of development All hazards: Human – Occupancy - Energy	Fire Behaviour/Dynamics Fire Behaviour Indicators (SAHF) Contextual factors (BE) Size-up – all hazards TDMUS - Situational awareness
WHO **WHAT**	**Rescues**: Location, most threatened **Exposures**: Construction/threat/value	Fire spread – hard/soft information Building construction – wind impact
HOW	**Priorities** –Identify Strategic Objectives and Approach Alternatives – Consider all Tactical Options Choose – Best Combination and Sequence (synergy) **Take Action** – Communicate – command –review	Risk vs Benefit Strengths and weaknesses Tactical synergy ICS – Maintenance of SA

2018 ANZ International Wildland Deployment to the USA

Short Notice- Jetlag - Information Overload - High Stakes

Vegetation - Altitude - Climatic Challenges - Culture - Procedures - 80/20

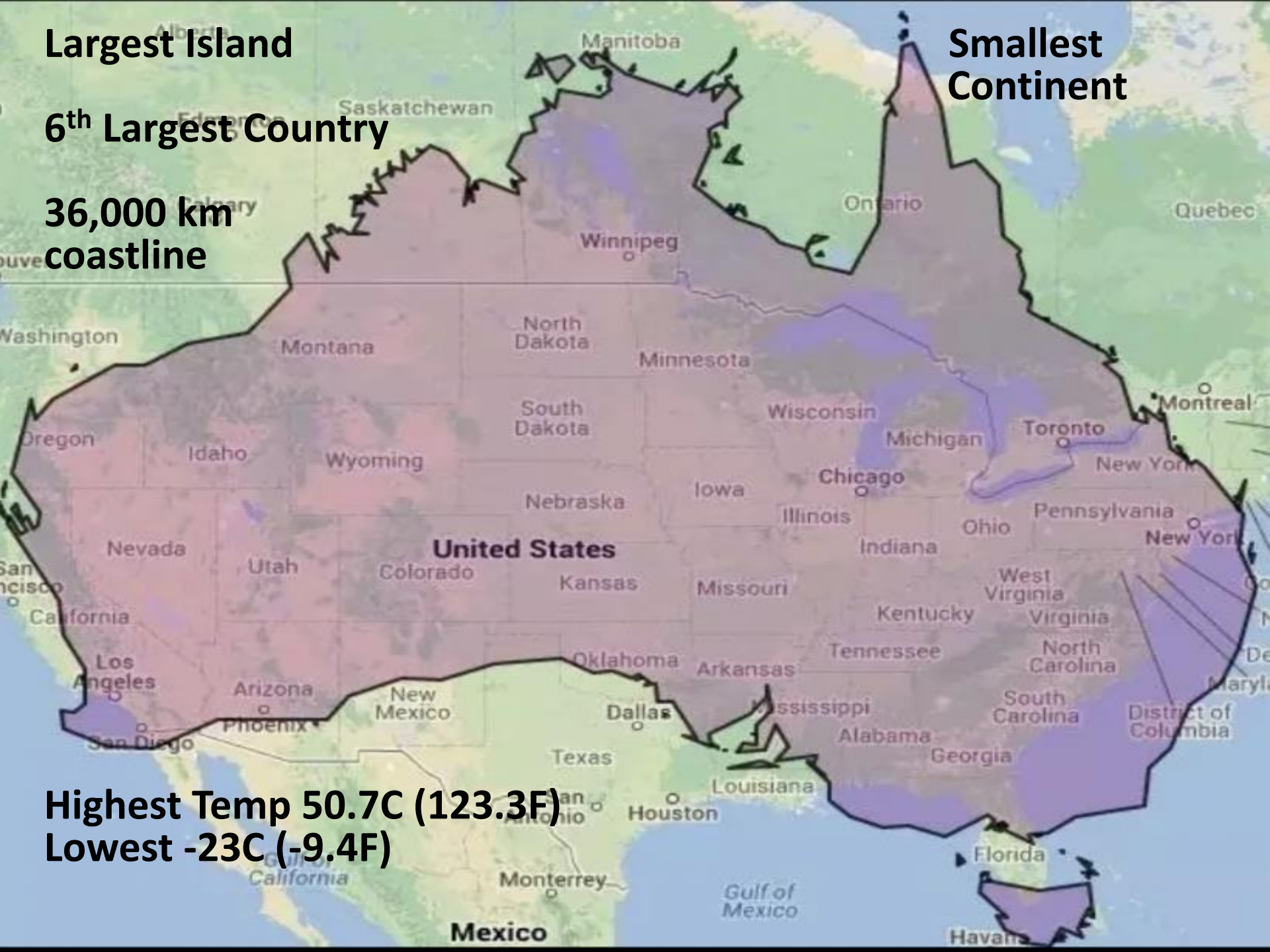
Dangerous and Unfamiliar Wildlife

Diverse Colleagues

Interesting People

Growth

My Primary Context – in a few pictures


Largest Island
6th Largest Country
36,000 km coastline
Smallest Continent
Highest Temp 50.7C (123.3F)
Lowest -23C (-9.4F)
Manitoba
Saskatchewan
Ontario
Quebec
Winnipeg
Washington
Montana
North Dakota
Minnesota
Oregon
Idaho
Wyoming
South Dakota
Wisconsin
Michigan
Toronto
Montreal
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Gulf of California
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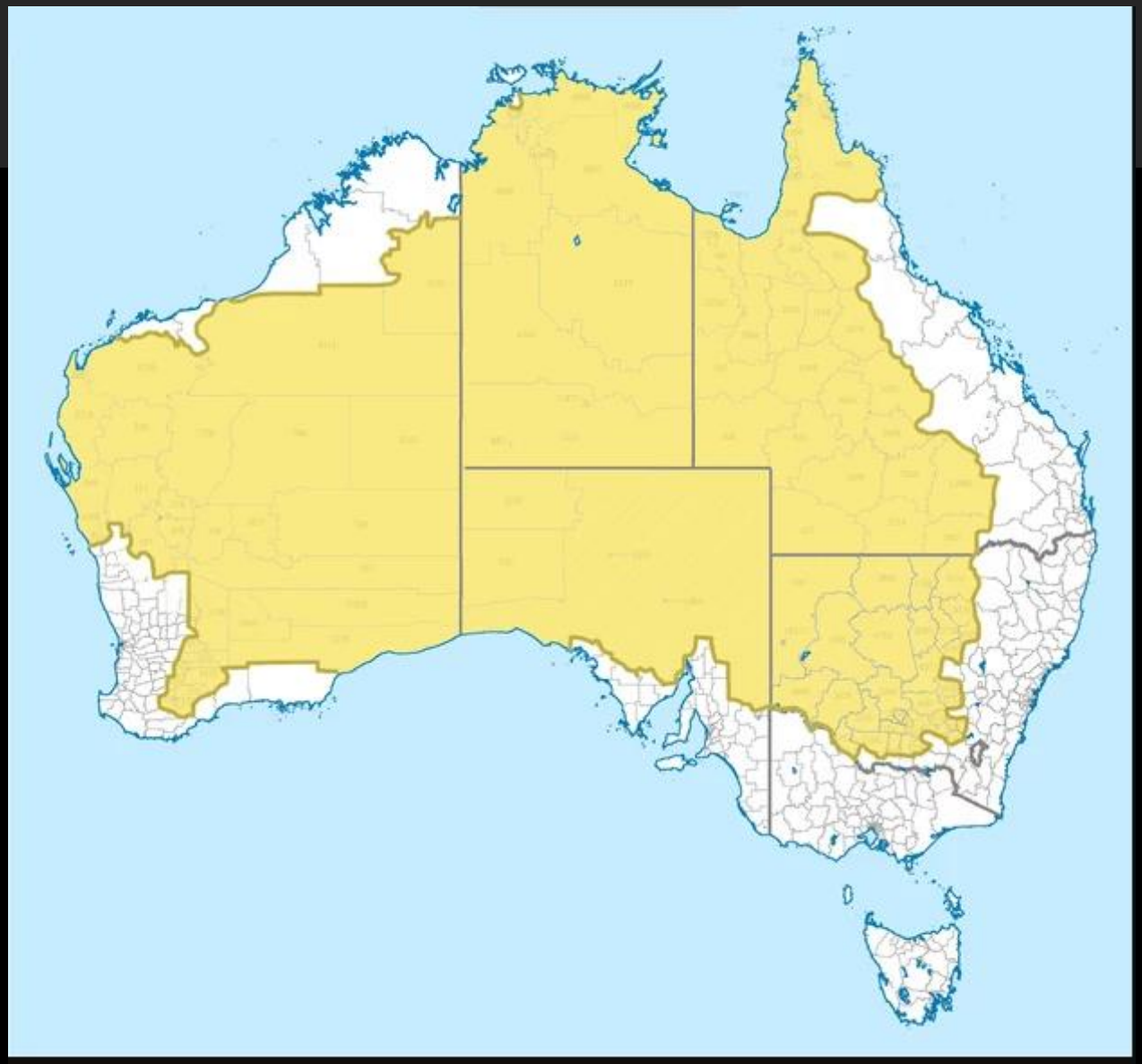


My Context
Queensland – "The Sunshine State"

1,9 million km2 (5x Japan, 7x Great Britain, 2.5x Texas)

6,973km of Coastline

Population 6 million

Sub tropical - Tropical - Desert

Queensland - Risk Profile

3rd largest Fire Service in the world by area

2400 Permanent Firefighters
2200 Auxiliary Firefighters

242 Urban Fire Stations

1409 Rural Brigades

over 70,000 calls per year

Do You React, or Think, Under Stress?

The primal response is to "react", in a routine manner, without thinking. Robotically using the default tactic, with the "weapon of choice", and the favorite technique. Moth candle. 1 x Tactic/Tool/Technique

Do You React, or Think, Under Stress?

The trained response is “think”, size-up, recognise and predict. Identify the strategic outcome, use the best combination of tactical options, select the most applicable tools and use the most efficient techniques.

Training the Mind

"On the fireground, it is not possible to tear a complicated situation into definite parts but it is possible to train the mind in the habit of surveying and analyzing a complicated situation in a ***systematic manner****."*

Lloyd Layman

Challenges to Thinking

Critical time frames. Seconds and minutes, not hours or days.

High Stakes. Human Life: Victims, yourself and crew.

Limited information. Often incomplete and/or incorrect.

Observation Pressure. Radio word back – youtube generation.

Limited Resources.

Extremely Hostile Operating Environment.

A lack of relevant realistic training.

Critical Decisions and Time Stress

Time Stress	Decision Making Time	Information Available	Stakes	Accountability
First On Scene STRATEGIC TACTICAL TASK	Seconds for initial plan. A few Minutes for review/ adjustment.	Rapid size-up of BE SAHF. Limited Hard Information. Unreliable Soft info. Bystander information. Any "Local knowledge".	Life Property Environment	Extremely high for OIC and crews. They are often the primary focus of investigations. Measured in lives lost and Thousands of Dollars
Senior Support Arrival POLITICAL STRAGETIC TACTICAL	Several Minutes to review initial actions. 10's of mins for adjustments. Hours to review 2ndry actions.	Handover from OIC. Access to electronic data. Information from "word back". Support staff.	Subsequent Loss of: Life Property Environment	High for actions and decisions made after their assumption of control (command).
CEO/CO Involvement POLITICAL STRATEGIC	Hours to review all actions. Hours- days for adjustments. Weeks/months to deal with fallout.	Significant resources. Extensive expert advice. Political and Legal advice.	Economic. Environment.	Quality of training and guidance provided to "first on scene". Loss of job/position if found that critical issues were not actioned.
Investigation team POLITICAL LEGAL	Weeks Months Years	Unlimited access to all available information.	Professional credibility. Political implications.	**Information can be cross examined and historically reviewed.**

First on Scene

No time for written aids.

Initial strategy and tactics must be developed and managed in short term memory.

A unique situation that very few ever experience. Even less people experience it on a regular basis.

"True genius resides in the capacity for evaluation of uncertain, hazardous, and conflicting information."
Sir Winston Churchill

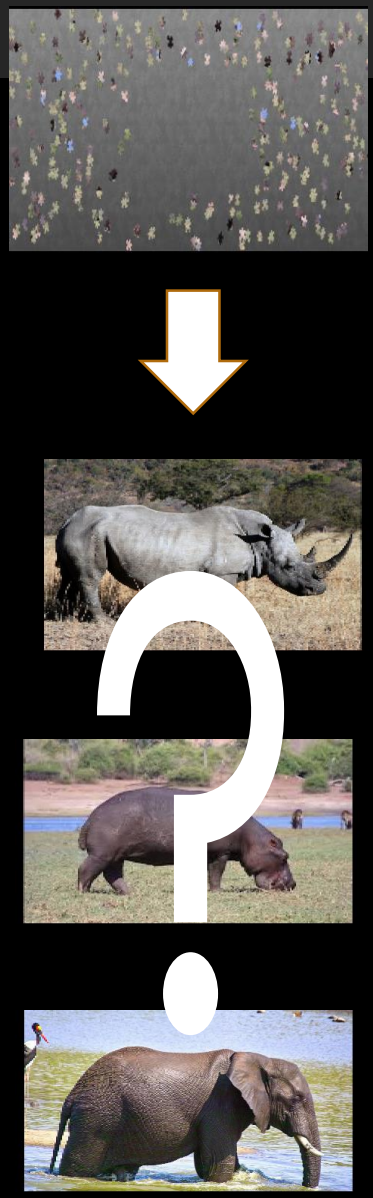
First Arriving Challenge

Like being given 300 pieces of a 1000 piece jigsaw puzzle and told to identify the object in a few minutes.

Some of the pieces are scattered on A to D sides.

Some are inside the structure.

But you will never have all of the pieces.



Time + Limited Experience = Hindsight Bias

Decisions made by first responders, in very limited time frames, with very high stakes, and very limited information; will be judged by people with long time frames, low stakes, and significant information.

Their judgement could be impacted by:
- Limited or “dated” experience.
Agendas.

Spoiler Alert!!!!!!!!
Miracle on the Hudson.

Strategic Decision Making

Strategic Values – Rescues and Exposures
Information Gathering - BE SAHF
Priorities – Alternatives – Chose – Take Action

Situational Awareness

Size-up

Identify threats to the Mission Critical Assets.
Filter Hard and Soft Information.
Utilise “Stored knowledge” (training + experience) and local knowledge.
Prioritise the most valuable assets.

Predict

How will the threat impact the Mission Critical Assets if I do nothing.

Interdict

Determine the best Strategic approach.
Consider the tactical Alternatives (options).
Choose the most applicable combination of Tactics, Tools, and Techniques.
Take Action. Communicate – Delegate (sectorise), Control and Review.

Strategy Vs Tactics

Strategy

"An overall approach that is based on the objective of minimizing the loss of life, property and environment."

Tactics

"The deployment of firefighters using the most effective combination tools and techniques to safely and efficiently achieve the strategic objective.

Strategic Values

Strategic approaches are based on core values or objectives.

Preservation of **Life**

Preservation of **Property**

Preservation of the **Environment**

LPE

Critical Information Gathering

Limited time + Information overload + high stakes = Red Mist – Fog of War

Sorting the relevant information (the wheat) from the "noise" (chaff)

Focus on

HARD INFORMATION – Facts

SOFT INFORMATION – Probabilities

Hard Information

Visible victims, or reliable witness statements.

Clear or known information regarding the Building.

Location of utilities.

Wind direction and velocity.

Location and colour of current smoke discharge.

Air flow indicators from exhaust openings.

Heat indicators.

Visible flame.

Soft Information

Building factors such as:

- Information from a neighbour
- Local knowledge of neighbourhood or occupancy
- Objects such as children's toys, disability aids, cars, overfilled letter box
- Open/closed doors or windows (away or at home?)

Many Smoke/Air indicators must be considered as soft until the 360 is completed.

More Than One Way

Coal Was Wealth

Construction
Occupancy
Area
Life Hazard

Water
Auxiliary Systems
Street Conditions

Weather
Exposures
Apparatus & Personnel
Location
Time
Hazards

More Than One Way

SLICE -RS

Size-up.

Locate the fire.

Identify and control flow path.

Cool the space from safest location.

Extinguish the fire.

Supplementing these are Rescue and Salvage.

Purpose? – Initial Word Back

Initial Arrival Word Back Prompt

APE OAA

Arrival: Confirm exact address
Picture: Brief description of situation (threat)
Exposures: Number and construction

Occupants: Confirmed or likely rescues required
Action: Strategic mode – Tactics – Tools in use
Assistance: Additional resources

Do a 360 (secondary survey)

Follow-up Message

HAULETO

Height: of building
Area: how big is the area of fire involvement
Use: occupancy type
Location: where is the fire? ABCD - Level
Equipment: in use now - what we will need
Time: how long will it take to control
Occupants: Current status - accounted for/not unaccounted for

Layman – RECEO

RESCUES	Number Location
EXPOSURES	Number Construction Type
CONFINE	Cut off spread Compartmentation
EXTINGUISH	Type of media Size/capacity/number Position
OVERHAUL	Minimise loss Hot spots Environment Recovery

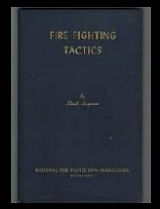
BE SAHF – Locate - Changes

Determine the Strategic Approach
External Transitional Internal

PRIORITIES	Who and/or What
ALTERNATIVES	Consider all options
CHOOSE	Available resources
TAKE ACTION	

Communicate: Strategic objective and approach
Command: Who, What, Where and How
Coordinate: Monitor, support and encourage
Reassess: Observe, listen to advice, make changes

Additional resources
Re-evaluate



Fire Fighting Tactics, Lloyd Layman, 1953 NFPA

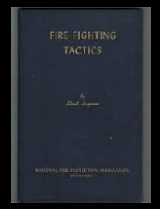
I. Determine the Strategy

RESCUES	Number Location
EXPOSURES	Number Construction Type
CONFINE	Cut off spread Compartmentation
EXTINGUISH	Type of media Size/capacity/number Position
OVERHAUL	Minimise loss Hot spots Environment Recovery

PRIORITIES	Threat and Value
ALTERNATIVES	Resources and Time
CHOOSE	Risk Vs Benefit

External
Transitional
Internal

Situational Awareness
Think – don't react
Consider all options



Fire Fighting Tactics, Lloyd Layman, 1953 NFPA

Strategic Focus - NOT Sequence of Action!

Rescue (preservation of life) is always the first priority. This does NOT mean it is always the first action. There are many situations where strategically placed initial hose lines are the best way to preserve life and facilitate Rescue. At times it may be appropriate to take immediate rescue action without fire attack.

If there are no Rescues required, the next focus in on Exposures (property at threat)

Value
Life (firefighters included) is more valuable than property.
High reward (lives that can be saved) justifies a higher level of risk.

No Value – No Risk
Lives and property that are already lost have no strategic value.
Moderate risk may be taken in situations where there is a small chance of saving lives or valuable property.
If there are no chances of saving life or property, then the risk taken must be very low.

Improve or Glorify?

It is normal to re-examine and try to improve the work of a visionary. As long as the motive is not “self glorification”

Broad examination considered:
Rescue: defend people, find people, extricate, life, people, innocents
Exposures: property, assets,
Confine: partition, intercept, block, trap
Extinguish: snuff out, finish, gone, killed, quenched, mitigate, stuffed,
Overhaul: ablate, end, finish up, get better, help,

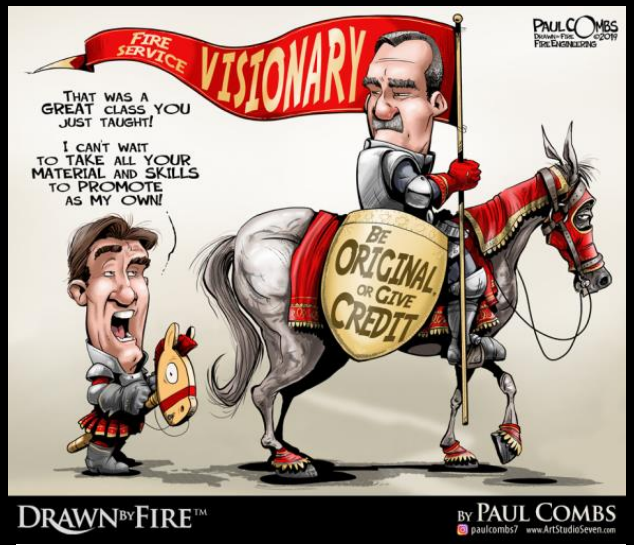
LEPER

PETME

LICME

FATTE

After many hours I concluded the Chief Layman’s model was the best☺



Initial Size Up - 360

Identify the threat:

BE SAHF + Hard and Soft information

Who is threatened:

Rescues

Greatest threat

What is threatened:

Exposures

Most threatened?

Highest value.

Strategic Objective

Rescues

Priorities
Who is at the greatest risk?
Possibility of non-confirmed entrapments.

Alternatives (to the first thought or “routine)
Extinguish/confine
Internal rescue – stairs, doors, windows.
External – ladders/platforms.

Choose
Risk Vs Benefit.
Current resources and responding resources.

Take action
Communicate – Command – Coordinate - Reassess

Develop Strategic Objective

Exposures (Construction type - Value)

Priorities
Most at risk
Most valuable

Alternatives
Focus on primary fire first?
Focus on most valuable exposure first?
Handlines – Fixed Monitors – Aerial Appliances?

Choose
Consider Risk Vs Benefit!
Available resources?
Time?

Take action
Communicate – Command – Coordinate - Reassess

Strategic Approaches - Simplified

1. External
2. Transitional
3. Internal

Strategic Approach - External

1. External

The size-up indicates that it is not possible to take internal actions due to stage of fire development, and/or, the risk benefit analysis indicates it is not viable.

Deployment of resources from external positions.

Strategic Approach - Transitional

2. Transitional

Initial deployment of resources from an external position with the objective of reducing the initial threat to allow for a transition to Internal Operations.

Very high risk because the situation is considered marginal. Progression to internal entry can only be justified if there is a high potential benefit (saving savable lives).

Reduce the fire intensity.
Divert or confine fire/smoke.
Assess the result and make rapid entry if viable.

Strategic Approach - Internal

3. Internal

Send crews into the structure (Kill Zone) to effect rescue, confinement and fire extinction. (Not necessarily in this order).

High risk. Conditions that justified the initial risk can change suddenly.

Manage the “Kill Zone”. Focus on extinguishing or at least confining the fire. Buffer Zone – Safe Zone.

Tactical Considerations for Internal

Firefighters move into, and through a smoke (fuel) laden atmosphere to reach their objective (Rescue, Confine, or Extinguish).

Smoke is fuel. It can ignite rapidly.

The window of opportunity will be very narrow unless the fire can be cooled, denied air, or separated from occupants.

Gas cooling alone will NOT stop fire progression, only delay it. Consider current stage of fire development, size/geometry of kill zone, and travel distance.

2. Develop the Tactical Plan

Based on Strategic Approach
External Transitional Internal

RESCUES	Number Location
EXPOSURES	Number Construction Type
CONFINE	Cut off spread Compartmentation
EXTINGUISH	Type of media Size/capacity/number Position
OVERHAUL	Minimise loss Hot spots Environment Recovery

PRIORITIES	Who and/or What
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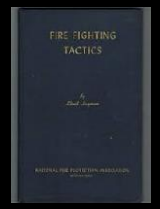


Fire Fighting Tactics, Lloyd Layman, 1953 NFPA

Develop the Tactical Plan

Developed in the context the strategy.
External – Transitional - Internal

Rescues
Exposures

Priorities – Who is at greatest risk? What exposures have the highest priority (value).

Alternatives – How can they be protected? Generate all available options.

Choose – Best **combination** of Tactics/Tools/Techniques.

Take Action – Communicate – Command - Co-ordinate – Re-assess.

Tactical Implementation

Confine – Remove or Separate the mission critical assets from the current and anticipated threat.

Extinguish – Deploy the best combination of tools and techniques to eliminate the threat.

Overhaul – Minimise loss, aid recovery.

Priorities
Alternatives
Choose
Take Action

Tactical Synergy

Thinking beyond one Tactic, one Tool, one Technique
Fast Water
Air Flow Management
Combine Water and Air Flow Management

Aus-Rescue

Beyond Favourite to Appropriate

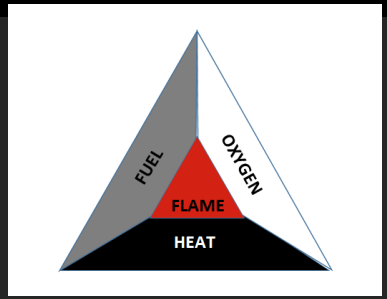
Unbiased

Informed

Strategic

Outcome focused:
Tactical options and sequence.
Tool selection based on relative strengths.
Techniques maximise the effectiveness of tool.

Tactical Synergy



The HEAT side of the fire triangle is generally removed by cooling the burning surfaces.

The OXYGEN side is influenced by anti-ventilation.

FUEL supply may be limited by
making use of available compartmentation possibilities
placing hose lines deny progress to adjacent fuel
removing accumulated unburnt fuel (smoke)

The critical point is that maxim efficiency is achieved when 2 or more sides of the triangle are impacted.

Principles of Tactical Synergy

1. Fast Water

Strategic placement of first lines (not “moth to candle”).
What is burning is already lost!
Speed of Attack or Weight of Attack?

2. Air Flow Management

Identify current inlets feeding the fire, and exhaust paths.
limit/confine/divert/cool/remove.

3. Synergise Tactics/Tools/Techniques

Combine Fast Water and Air Flow Management.
Cut off/Separate/Remove

Fast Water – Position for Life

“This practice allows you to first get a hose-line between salvable victims and the fire (assuming the line was taken into the structure in the most appropriate avenue, placing it between the fire and salvable people). Hopefully this will keep the situation from getting worse’.

Deputy Chief (Toledo OH) John 'Skip' Coleman

Fast Water – Stop or Slow Spread

'we should always remember that the best way to accomplish the rescue objective is to take the danger away from the victims or put out the fire. Even if the fire is not immediately controlled or extinguished, a quick attack can slow the spread of the fire and buy other firefighters additional time to take the victims away from the danger'.

R Hiraki - Assistant Chief Seattle WA

Fast Water – Remove the Threat

'Unless you can effectively do several things at the same time (on the initial response) - PUT THE FIRE OUT (first)'.

John Mittendorf - Retired Los Angeles Fire Chief

Fast Water – Blaina Fire Wales

"Worst of all, both experts said, was the delay in getting water on the fire. Had crews gone to the right spot and applied water at once, the fire would have been manageable, they said. Instead, firefighters concentrated on evacuation.

"If you don't put water on the fire, you're going to lose control," ...

"That's what they did. They lost control.“
Coroners report

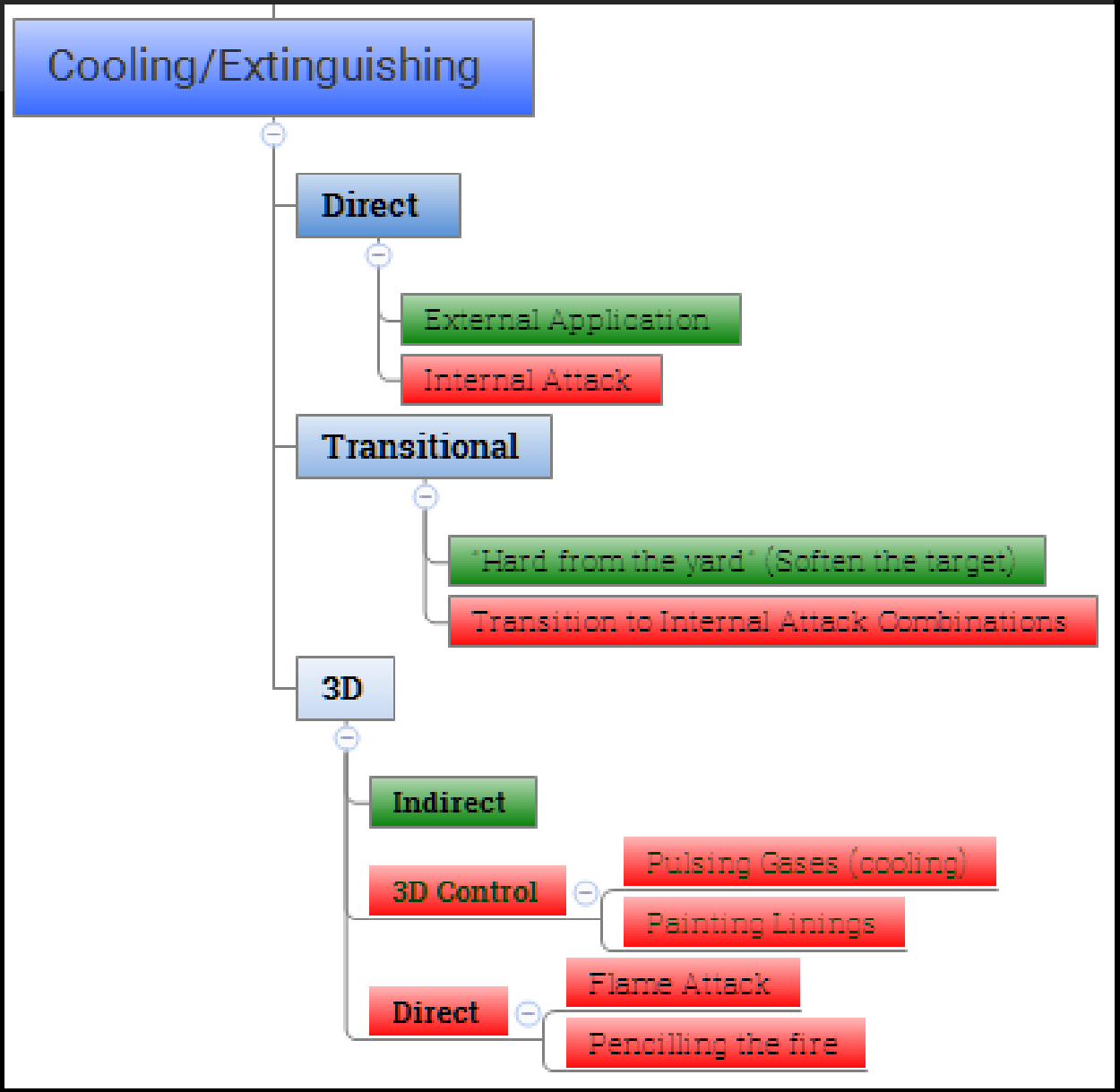
Cooling/Extinguishing Tactics

1. Direct application involves the projection of the extinguishing media directly onto burning surfaces. May be applied externally or internally.

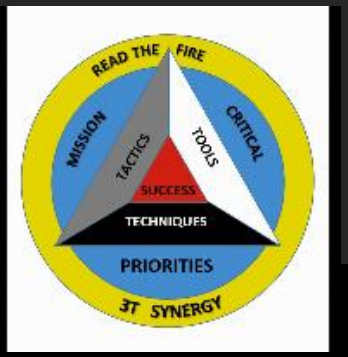
2. Transitional Attack involves initial external application of the extinguishing media with the objective of “softening the target” or “resetting” the fire to improve the conditions prior to an internal attack.

3. 3D Techniques may be used to assist internal teams to progress though a “kill zone” to gain control of the fire and improve the chances of saving entrapped occupants and thus allow , and .

Tactical Synergy Mind Map



Air Flow Management



The traditional approach to ventilation was to “vent early, vent often”. This became less effective as petrochemical based synthetic materials began to be used in every area of the built environment.

External application of water prior to entry was considered “poor firemanship”.

Modern research suggests delaying ventilation until hose lines are in place.

In November 2009, Underwriters Laboratories conducted a side by side comparison of two simulated living room fires. The purpose was to gain knowledge on the difference between modern and legacy furnishings. The rooms measured 12 ft by 12 ft with an 8ft ceiling and had an 8 ft wide by 7 ft tall opening on the front wall. Both rooms contained similar amounts of like furnishings.

Both rooms were ignited by placing a lit stick candle on the right side of the sofa. The fires were allowed to grow until flashover.

AFM - History of Anti-Ventilation

In the mid 1970's Fire Engineer Krister Giselsson, and Stockholm Firefighter Mats Rosander, noticed that the new style of heavy insulation, combined with the ever increasing use of petrochemical based plastics in the built environment, was changing fire development.

They developed new tactical approaches, tools and techniques that were considered very controversial. It took a decade before their theoretical and tactical approaches were adopted in Sweden.

It was another decade before other progressive fire departments took notice.

And a few more decades before science caught up!

Air Flow Management

'It is most dangerous for any persons who happen to be in other rooms of the house, particularly those above and at the back, into which, after a front window has been cut through (broken), it is probable, if not almost certain, that the fire will penetrate before the firemen can reach them...'

Sir Eyre Massey Shaw 1868

Air Flow Management - Limit

'The men of the fire brigade were taught to prevent, as much as possible, the access of air to the burning materials.

What the open door of the ash-pit is to the furnace of a steam-boiler the open street door is to the house on fire. In both cases the door gives vital air to the flames.'

...the door should be kept shut while the water is being brought, and the air excluded as much as possible, as the fire burns exactly in proportion to the quantity of air which it receives.

James Braidwood Superintendent,
London Fire Brigade
Fire Prevention and Fire Extinction 1866

Historical Footnote (Nerds Only)

Braidwood's comment that *"the fire burns exactly in proportion to the quantity of air which it receives"* was well ahead it is time! This extract from http://en.termwiki.com/EN/Thorntons_Rule_(1917) shows that Braidwood was over 50 years ahead of the best "scientific theory"and well over 100 years ahead scientific techniques that could validate his statement!

"Thorntons Rule (1917)
This rule states that the amount of heat released during the consumption of a given quantity of oxygen is relatively constant for most combustibles. In other words, each kilogram of oxygen used in the combustion of common organic materials results in release of 13.1 MJ of energy. This means that the heat released per unit of oxygen consumed is about the same for wood or plastic. In a ventilation-controlled fire, where the amount of air entering through openings in a room governs the fire, the heat release rate in the room cannot exceed what the available air supply will support.

Air supply may limit the heat release rate in the compartment but that unburned gases (those that could not burn in the room) can burn outside of the compartment.

In the late 1970s, fire researcher C. Huggett at the National Institute of Standards and Technology (NIST) verified Thornton's Rule using the oxygen consumption calorimetry technique, developed at NIST in the early 1970s. In "Estimation of Rate of Heat Release by Means of Oxygen Consumption Measurements," Huggett shows how much energy was released per gram of oxygen for common combustibles. Where Thornton was only able to estimate the energy release based on the oxidation of carbon-carbon and carbon-hydrogen bonds, Huggett, with modern technology, was able to make actual measurements. Huggett simply verified Thornton's earlier observation, which is the reason it is known today as Thornton's Rule".
http://en.termwiki.com/EN/Thorntons_Rule_(1917)

Ventilation Essentials

To anticipate the impact of ventilation, you need to identify the fire location, the inlet flow paths to the fire, and the exhaust flow paths.

Do not make openings unless you understand how it will impact the fire development and direction of spread.

The fire will progress in the direction of the exhaust flow paths.

Ventilation Essentials

Restricting air supply will limit the HRR – but, lower the neutral plane and visibility.

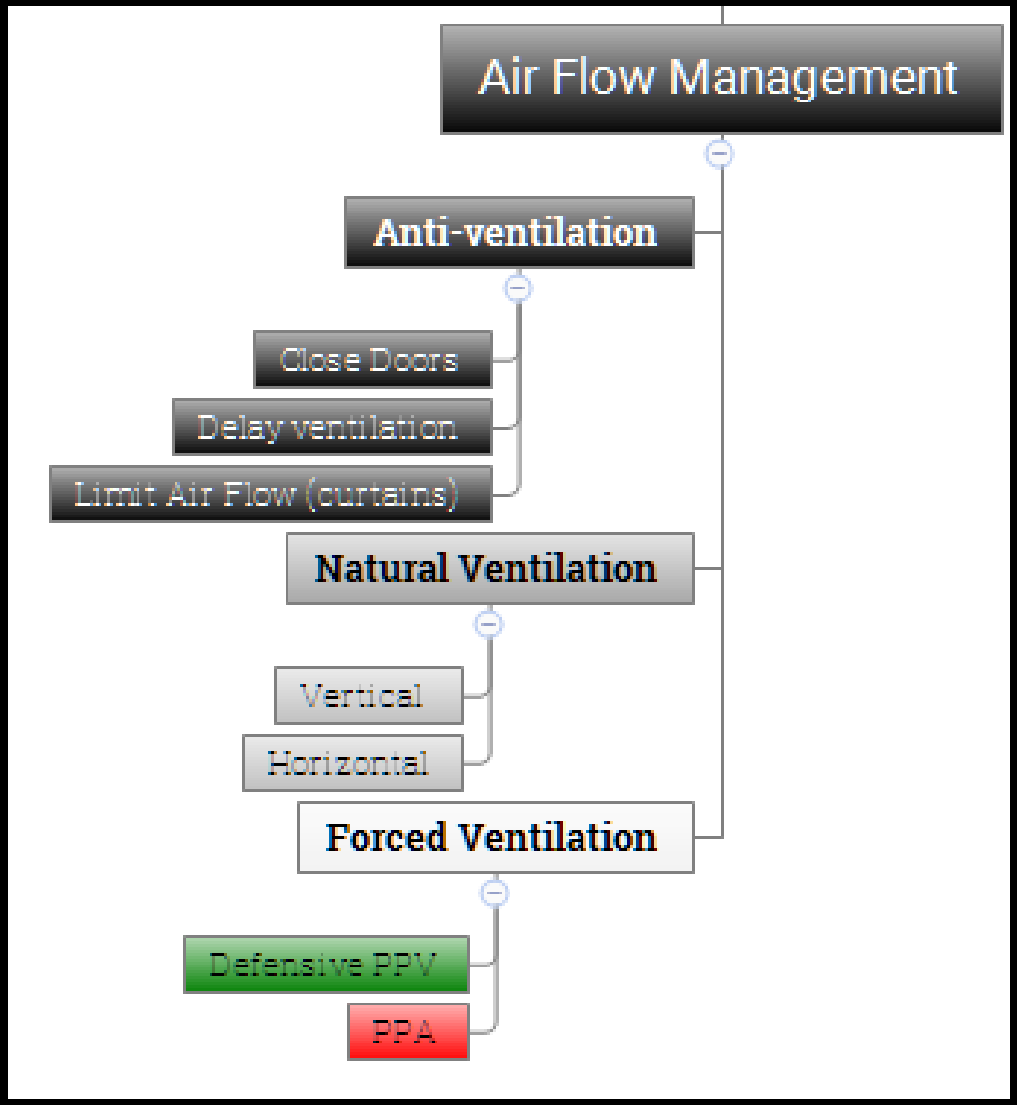
Cool before you vent if possible.

It is better to open rather than break.

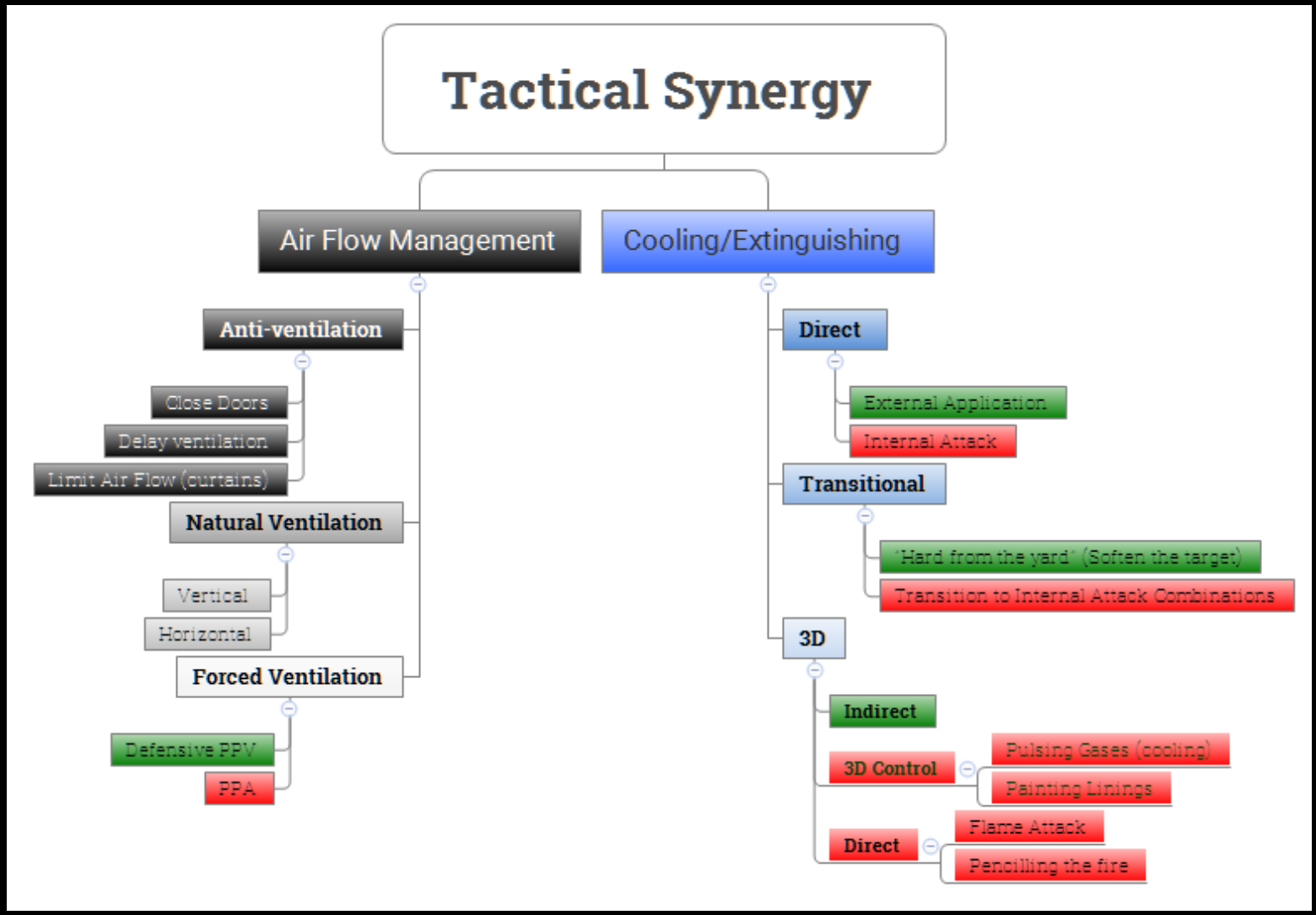
Have hose lines in place to deal with the anticipated fire progression.

Being in the Exhaust Flow Path has the potential to "Ruin your Day"

Air Flow Management Tactics



Tactical Synergy



How to be Smarter

Never stop learning all you can about fire and how to dominate it! “Stay hungry” for new knowledge.

Keep an open mind.

Learn about the human factors that impact decision making under stress.

Seek synthetic learning opportunities.

But most of all…….

How to be Smarter

Understand that
"Ego's eat brains." Alan Brunicini

Remember that
"We make a living by what we get, but we make a life by what we give." Sir Winston Churchill.

So
Stay humble! Seek to be the best servant.
Arrogance and pride are the natural enemies of growth and enlightenment.