Limitations of Bayesian Networks in public risk advice

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Risk is common in public life

- ISO standards for risk assessment

- Strong interest from insurance groups

- Few quantifications of risk, most heuristic assessments

Risk

- Risk = exposure (hazard) + vulnerability

- Bayesian Networks are an ideal tool for risk management
    - Outputs are likelihoods
    - Uncertainty is captured

Risk models

- Common uses
    - Research
    - Hazard management

- Complexities, assumptions and limitations documented

- Probabilistic outputs are understood

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General public and risk

- Difficulty understanding risk models

- Probabilities an issue

- Often require a simple message

- Litigation from inappropriately applied advice is a real concern

WE SHOULD GO TO THE NORTH BEACH. SOMEONE SAID THE SOUTH BEACH HAS A 20% HIGHER RISK OF SHARK ATTACKS.

YEAH, BUT STATISTICALLY, TAKING THREE BEACH TRIPS INSTEAD OF TWO INCREASES OUR ODDS OF GETTING SHOT BY A SWIMMING DOG CARRYING A HANDGUN IN ITS MOUTH BY *50%!*

OH NO! THIS IS OUR THIRD TRIP!

REMINDER: A 50% INCREASE IN A TINY RISK IS *STILL TINY.*

Natural hazards and risk

- Australians exposed to a range of natural hazards

  Land of the Rainbow Gold
  For flood and fire and famine
  She pays us back threefold
  Dorothea Mackellar

- Exposure identified when house/land is purchased

- Individuals greater ability to reduce their vulnerability and therefore decrease risk

- Agencies use education strategies target vulnerability

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Outline

- Present an example of a BN used for public education in wildfire risk reduction

- Highlight the limitations/issues faced

- Unexpected research benefits

Fires and people

– Wildfires can result in significant losses to people and communities

- Winmalee (2013)
  - 193 homes
- Black Saturday (2009)
  - 2000 +homes, 173 people
- San Diego (2007)
  - 2200+ homes

Waldo Canyon Fire 2013
Source: Denver Post

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Role of residents

- Probability of house survival can increase 3-6 times if residents stay and defend (Blanchi et al. 2008)

- Defence risks the life of the resident(s)

- Risk to life and property ~ f(preparation)
  - McLennan et al. (2013)
  - Tibbits et al. (2008)

Fire agencies advice

- A brief history

- Post Ash-Wednesday
    - Emphasis on resident Stay and Defend

- Prior to Black Saturday
    - Prepare, Stay and Defend or Leave Early

- After Black Saturday
    - 'Catastrophic' FDR
    - More encouraged to leave early

Agency advice

- Generalised checklist

- Partial adoption

- Difficult to adapt to specific circumstances

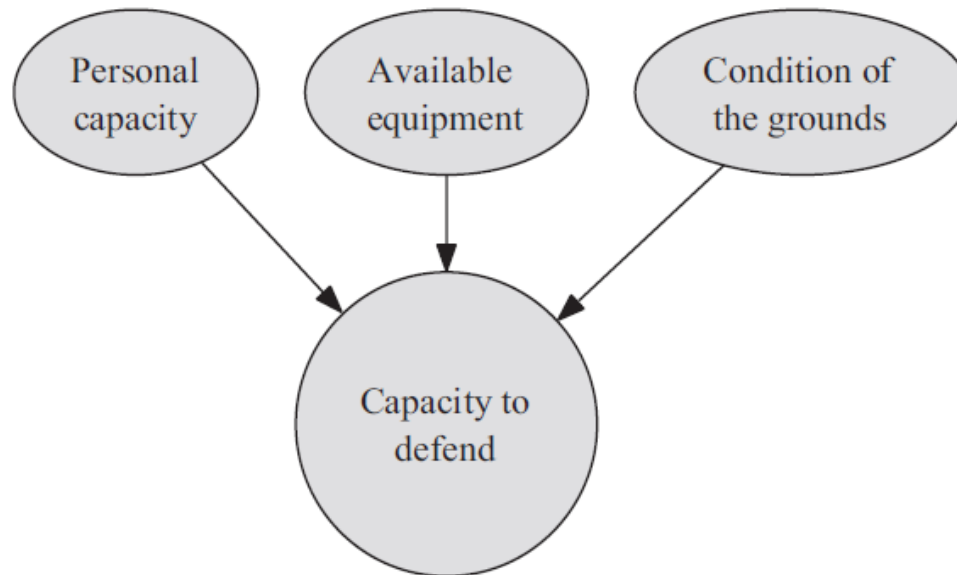- Mental aspects poorly considered

A new tool

- NSW RFS approach UOW to prepare a new tool to define whether it is safe to stay and defend

- Replace an existing "7 question" tool

- Specifically asked for a BN

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Preparedness

Data needs

- What does it mean to be prepared?

- What is the probability of **safely attempting** to defend under varying levels of preparation?

- Approaches:
  - Research expert workshop
  - Online practitioners survey
  - Online resident surveys
  - Interviews residents

Workshop

- Aim: to elicit definitions and probabilities

- Outcome: Fail

- Definitions raised a key question

- Preparedness for what?

Defining adequate means of residents to prepare property for protection from wildfire

T.D. Penman [a,*], C. Eriksen [a,b], R. Blanchi [c], M. Chladil [d], A.M. Gill [e], K. Haynes [f], J. Leonard [c], J. McLennan [g], R.A. Bradstock [a]

Prepared to exposure

RHF ~ Distance, Vege type, Fire weather, Slope

Exposure

Capacity to defend

Prepared to exposure

Flame zone

Radiant Heat zone

Ember zone
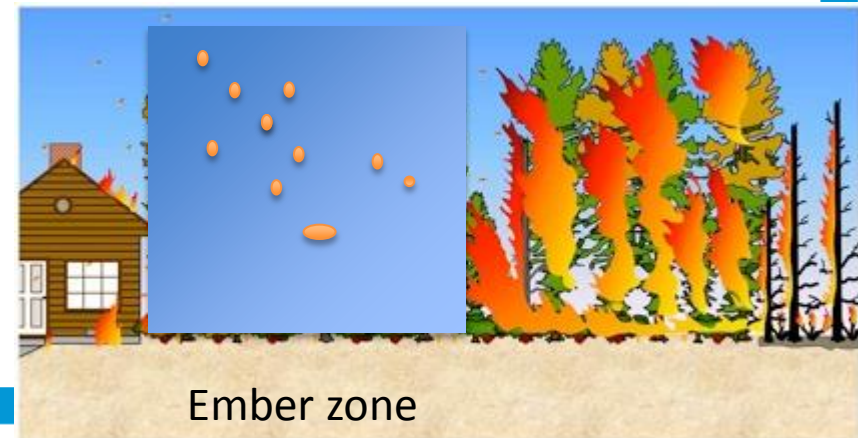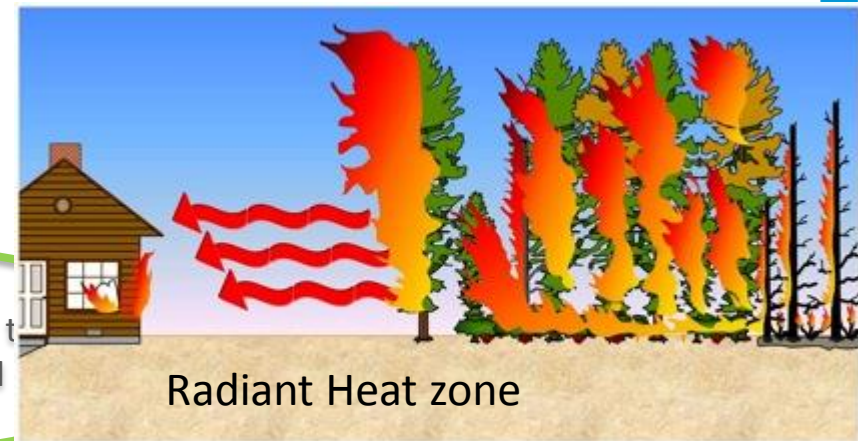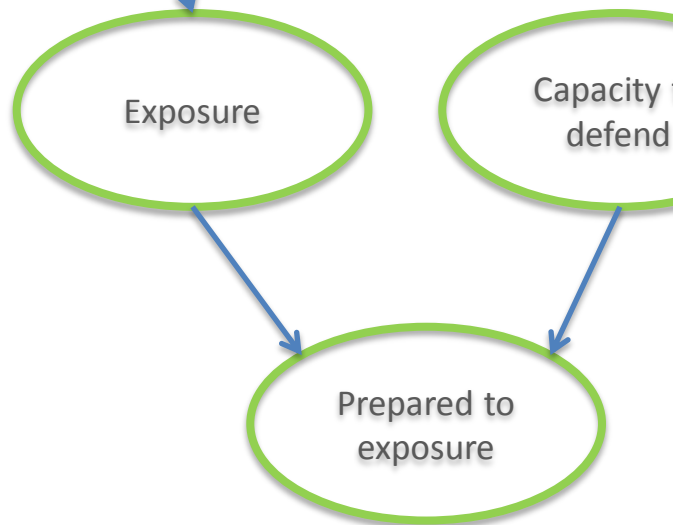
Sub-models

Shelter in place

House construction standard

Exposure
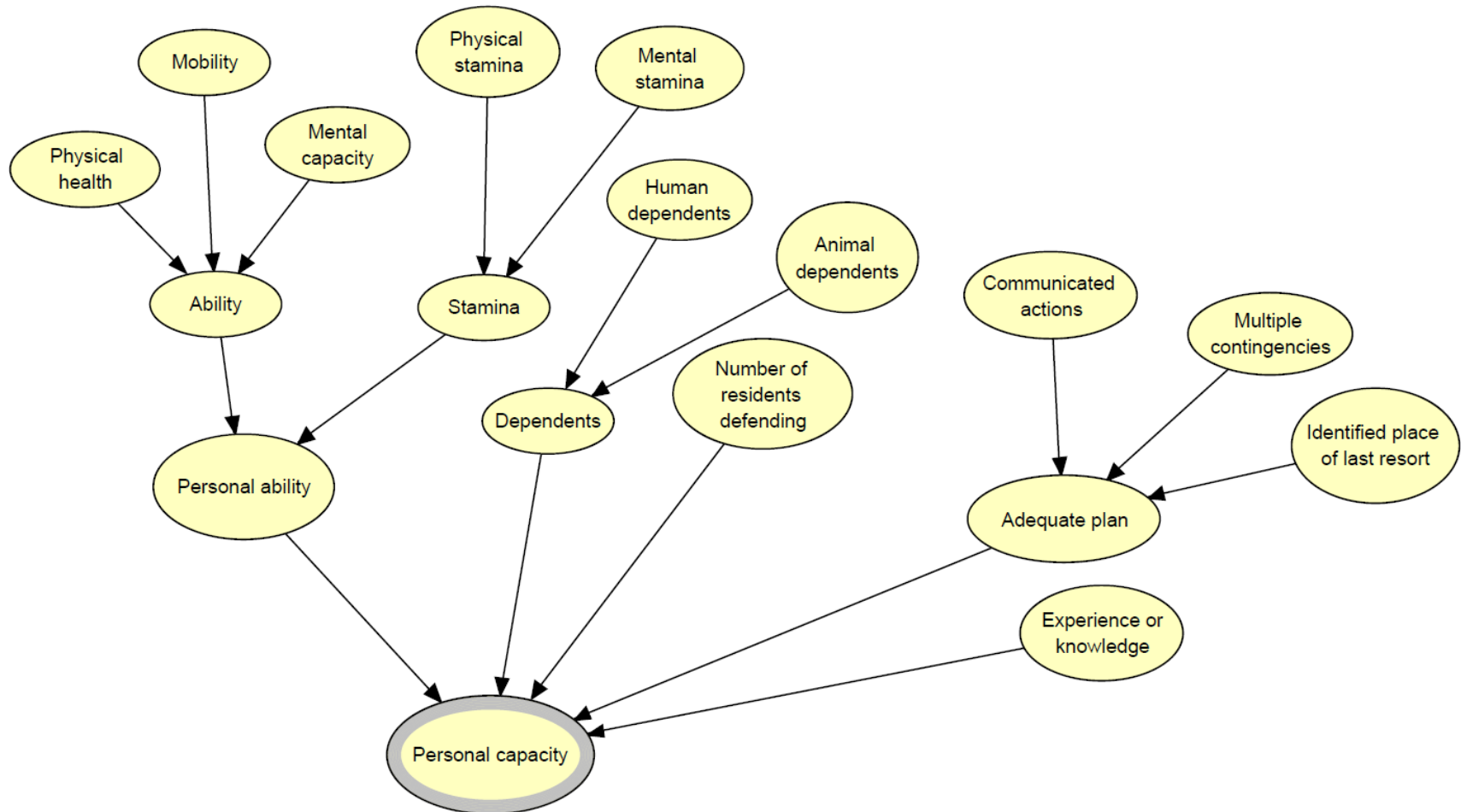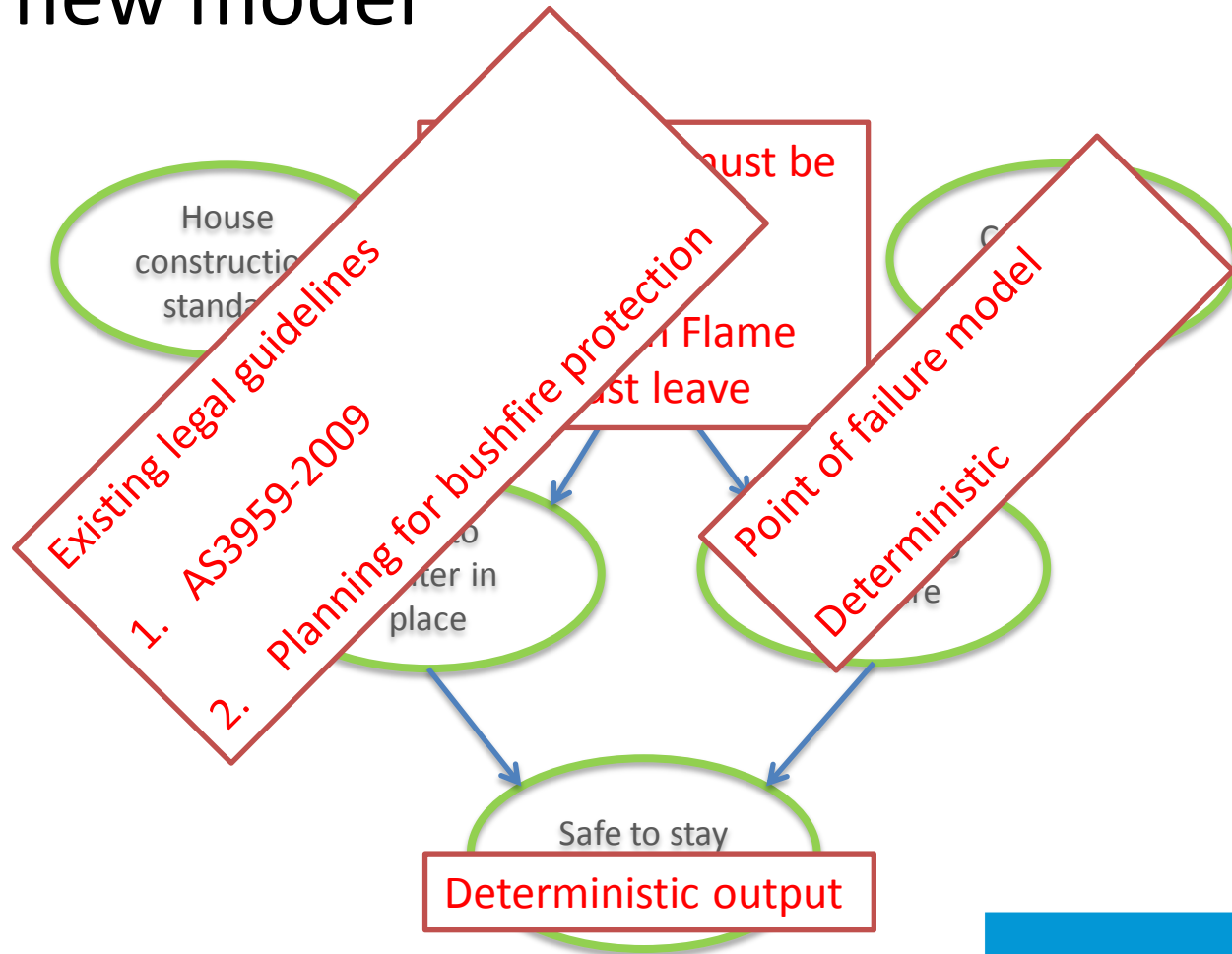
Safe to shelter in place
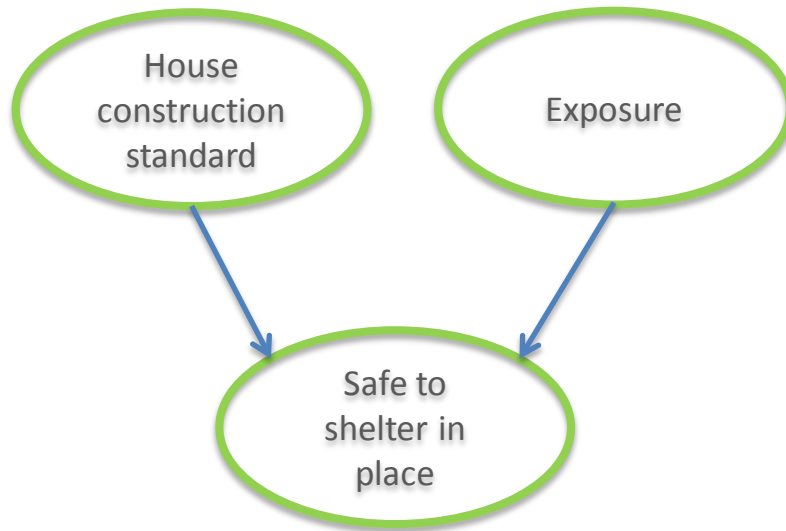
Australian Standards AS 3959
Construction of buildings in bushfire-prone areas

The new model

Reflections

- Was it necessary?
  - Directly no, but the process has paid off

- Was it premature?
  - Maybe, but forced valuable new areas of research
  - Visionary by the agency

- What benefit will the agency have for using the method?
  - Scientific basis for the advice supported by published research
  - Framework to build upon
  - Long term development of the model
  - Additional fields of research

Other research outputs

- Practitioners online survey highlighted an issue about messaging

- In-depth interviews ongoing analysis

- Online resident surveys goldmine!

What drives people to prepare?

- Research predominantly social realm

- Qualitative definitions of preparedness

- Univariate analyses dominate literature

- Interrelatedness of factors rarely addressed

Driver of preparation

- Definitions allowed us to calculate "cost to prepare"

- 2012/13 fire season

- 650 responses – primarily NSW, SA and Tasmania

- Examine the role of key drivers presented in the literature

- Learnt relationships in BN using PC algorithm

Resulting model

Property type
Perceptions of area

Past experience
Future actions

Va...
com...

Cost to
prepare

Key outputs

- Improved understanding the relationships between the primary drivers of preparation for wildfire

- Legacy of Prepare, Stay and Defend or Leave early still exists

- Agencies can vary education campaigns to improve uptake
  - E.g., urban vs interface vs rural

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Conclusions

- BN approach is valuable for risk management and research, but caution is needed for public information

- Legal issues may limit the application of these methods

- Tangential research is often valuable and interesting!

Acknowledgements

Workshop participants

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