What makes a good fire simulator?

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The team

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The challenge of understanding what makes a good fire simulator

	Interviews	Workshop 1	Workshop 2	Questionnaire
Jurisdiction				
Australian Capital Territory	2	3	1	2
New South Wales	4	4	5	17
Northern Territory	0	0	1	2
Queensland	1	3	3	8
South Australia	2	2	4	2
Tasmania	1	1	1	6
Victoria	3	6	3	22
Western Australia	1	0	2	5
National	4	7	5	3
Overseas	3	0	0	1
Total	21	26	25	67

Aims

a) Understand current practices, issues and priorities

a) Establish a set of benchmarks to guide future simulator development.

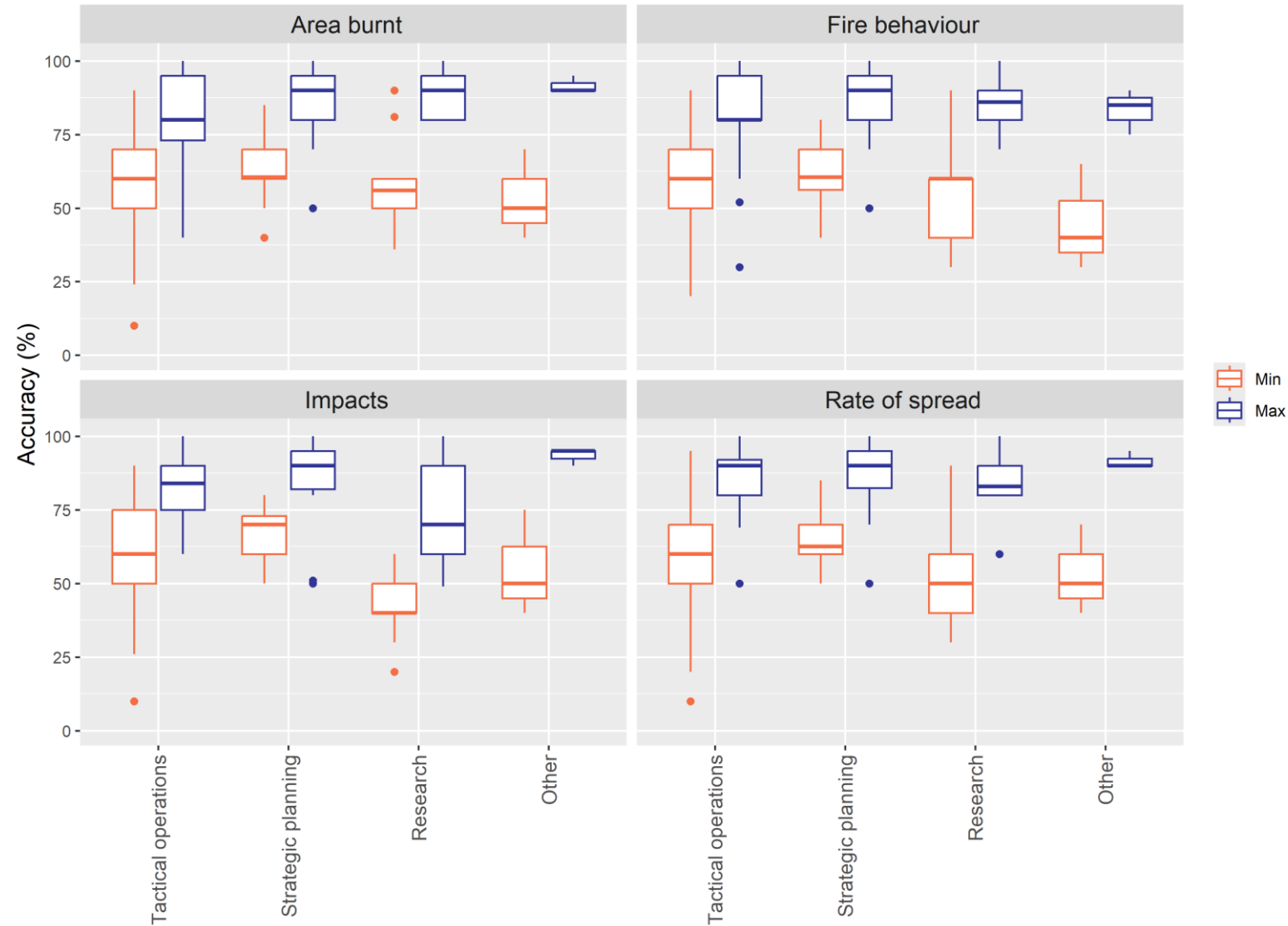Benchmarks and standards are hard to quantify

Use cases

Tactical
Strategic
Research

Criteria

Configurability	Scale
Compatibility	Speed
Ease of use	Support
Effectiveness of software framework	Trustworthiness
Handling of inputs	Validation
Handling of outputs	Value for money
Robustness of modelling framework	Versatility

Performance benchmarks for four aspects of fire characterisation

Benchmarks for performance of simulator features

Variable	Average minimum required (range)	Average maximum required (range)
Spatial resolution	30m^2 (1-30m^2)	200m^2 (30 - 10,000m^2)
Model timestep	10 minutes (1 second - 3 hours)	60 minutes (1 minute - 24 hours)
Output speed	1 minutes (1 second - 5 hours)	15 minutes (30 seconds - 2 weeks)
Number of ensembles	1 (0 - 20,000)	50 (3 - 20 million)

Benchmarks for performance of simulator features

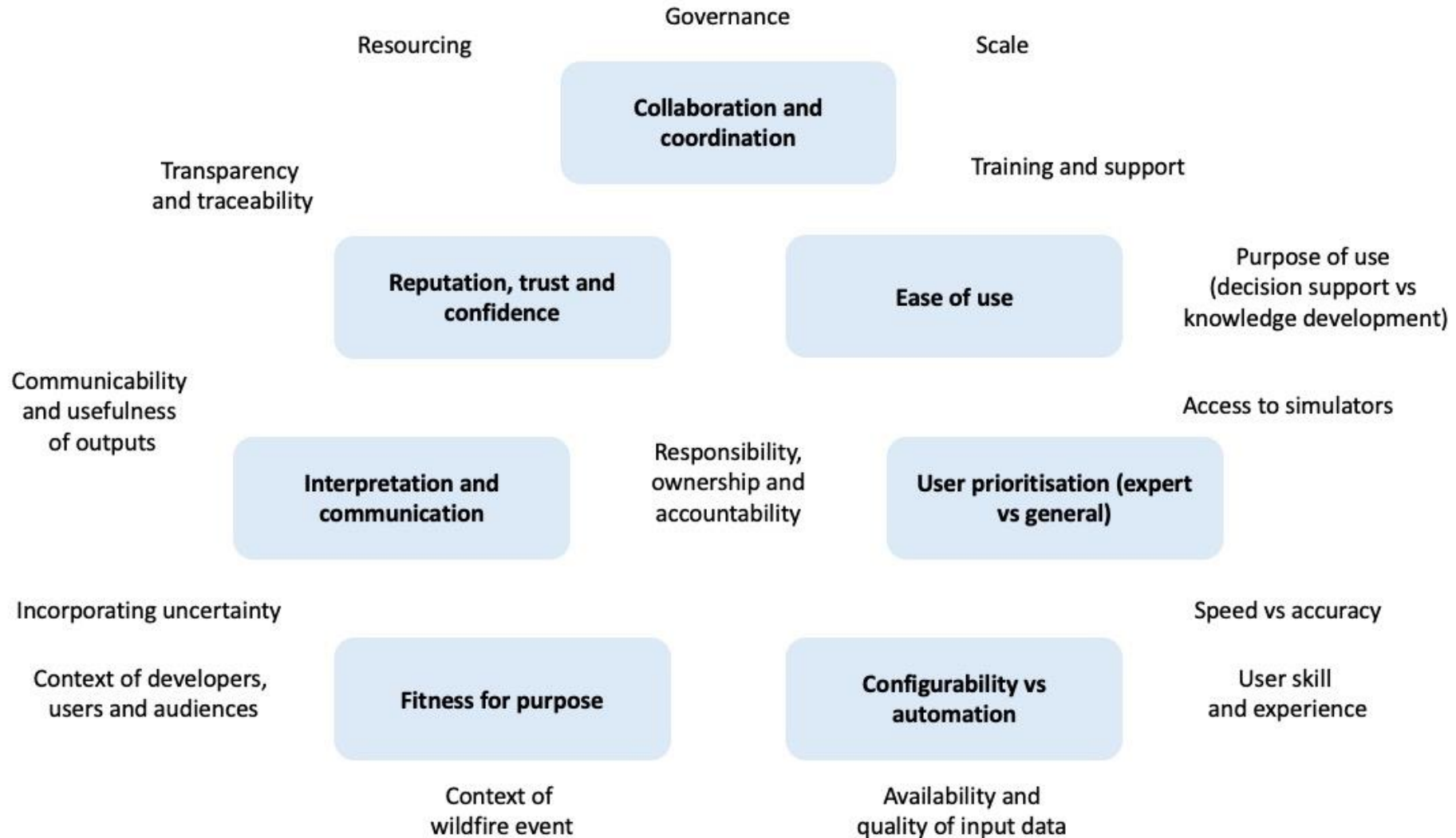| Variable	Average minimum required (range)	Average maximum required (range)
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Why benchmarks were hard to quantify:

- Context dependent

- Measurable values and trade-offs are challenging to conceptualise

- Disagreements on definitions

- Interconnectedness of criteria

The simulator 'ecosystem'

Governance

Resourcing

Scale

Collaboration and coordination

Transparency and traceability

Training and support

Reputation, trust and confidence

Ease of use

Purpose of use (decision support vs knowledge development)

Communicability and usefulness of outputs

Access to simulators

Responsibility, ownership and accountability

Interpretation and communication

User prioritisation (expert vs general)

Incorporating uncertainty

Speed vs accuracy

Context of developers, users and audiences

Fitness for purpose

Configurability vs automation

User skill and experience

Context of wildfire event

Availability and quality of input data

Guidelines for wildfire simulator development and utilisation

Drive simulator performance through improved modelling and data.

Improve usability of fire simulator software and hardware.

Adopt a comprehensive and transparent approach to validation and verification.

Maintain a cohesive approach to development and use through governance, capacity building and engagement.

Guidelines for wildfire simulator development and utilisation

Principle	Priorities	Actions to Consider
Drive simulator performance through improved modelling and data.	Expand and improve simulator capability	· Maintain a pipeline of short- and long-term improvements to models and modules.
	Improve the availability and quality of input data	· Expand and improve existing input data collection methods, including via automation where applicable.
		· Improve access and useability of input data.
		· Provide guidance on influence of input data scale and resolution on model performance.
Improve usability of fire simulator software and hardware.	Ensure user-centric design in development of simulator interfaces.	· Develop front-end user interfaces to reflect new technology and scientific knowledge.
		· Develop intuitive and efficient workflows.
		· Maintain consistency, where possible, across versions and updates.
		· Maximise user customisability (e.g. dual modes for 'general' and 'expert' users).
		· Build troubleshooting support and feedback into simulators (e.g. error prompts).
	Improve stability and usability of hardware and infrastructure	· Maintain a pipeline of short- and long-term improvements to infrastructure.
		· Provide offline and low resource (e.g. data, memory, computing power) alternatives for simulators.
	Improve interpretability and communicability of outputs	· Improve transparency and customisability of outputs.
		· Develop a standardised reporting format for outputs that includes key points such as model assumptions and uncertainty.
		· Provide training and support in interpreting simulator output for audiences.
	Provide comprehensive support for simulator users and audiences	· Ensure diverse support options are available for users and audiences
		· Agree upon whether training should be nationalised or accredited.
Adopt a comprehensive and transparent approach to validation and verification.	Establish performance standards	· Establish standards for evaluation, verification and validation of simulators, models and data.
		· Establish a mechanism for reviewing and updating standards alongside evolving technology and contexts of simulator use.
	Emphasise transparency and traceability	· Establish guidelines or expectations for documenting simulator function, simulator use processes and simulator outcomes.
		· Automatically collect data on the simulator use process when running a simulation.
	Establish outcome-oriented evaluation	· Understand the effect of simulator outputs on fire management outcomes.
		· Develop a process for reporting simulator outcomes post-event.
Maintain a cohesive approach to development and use through governance, capacity building and engagement.	Establish effective governance	· Establish a clear long-term vision for future research, development and use of simulators.
		· Develop strategies for the integration of new science, capacity building, communication, and infrastructure.
		· Reflect on whether current tools are appropriate for intended purposes or if alternatives may be better suited.
		· Consider the benefit to cost ratio of all proposed development and change
		· Engage with ethical questions, for example, around access, resourcing, responsibility, and human-computer interactions.
	Prioritise engagement	· Develop formal and informal mechanisms to engage a wide range of stakeholders at all stages of development to meet their evolving needs.
		· Reflect upon the logistics and resources needed for ongoing, long-term stakeholder engagement.
	Build capacity	· Develop strategies for capacity building tailored to user needs.

Takeaways

Measurable benchmarks may not result in fit-for-purpose simulators
- They are hard to quantify
- They risk overlooking the needs of certain users
- Are not flexible to changing user needs and evolving technology

Good simulators depend on a good simulator ecosystem

Thanks for listening