



Australian Government
Department of Defence
Defence Science and
Technology Organisation

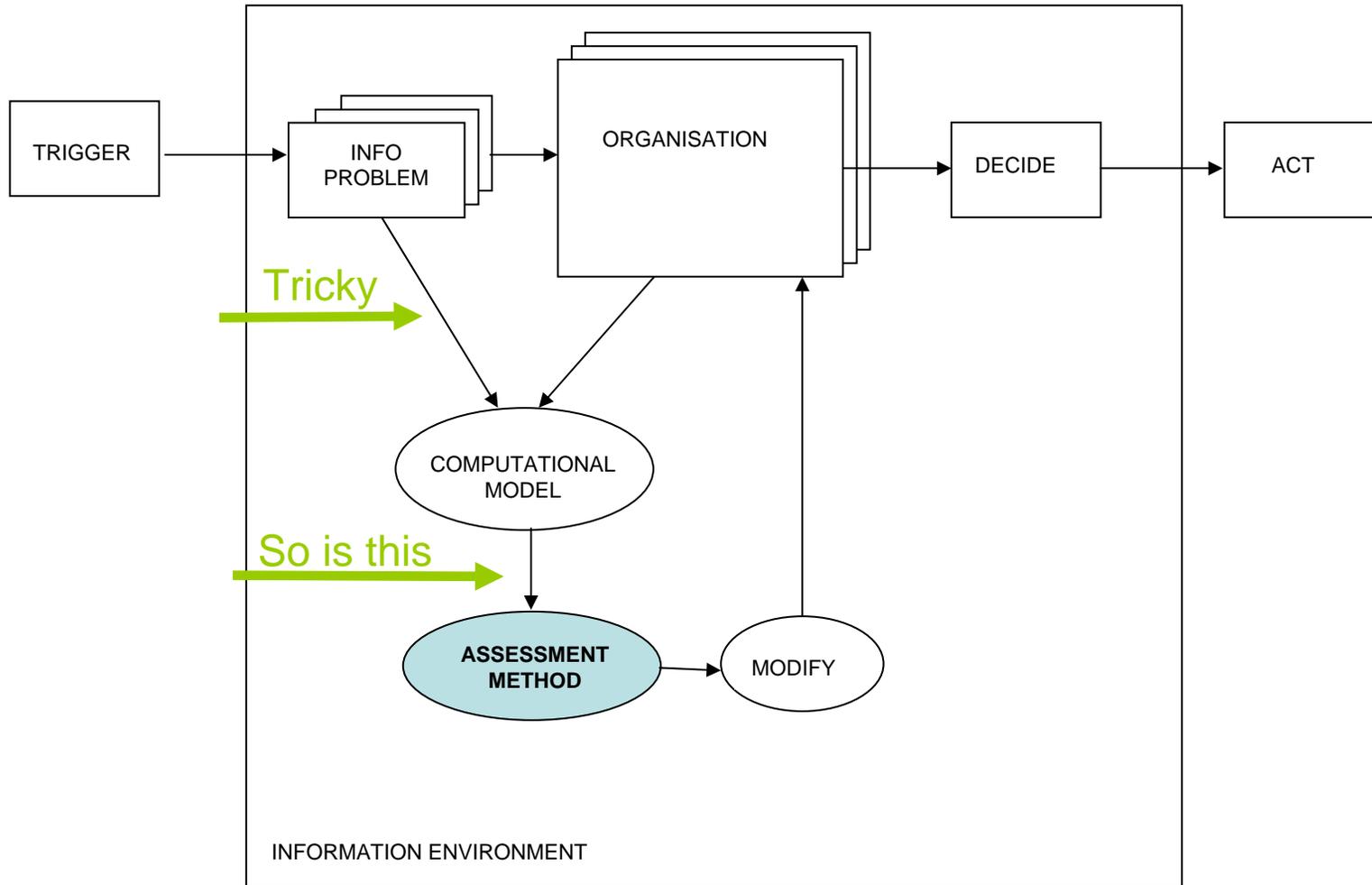
Computability Issues of Efficiency & Effectiveness of Organisational Models

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Context



On the Shoulders of Giants



Alan Turing 1936 proved that:

Halting Theorem There is no universal method (or program) that can tell if another program with a given input will halt for all program-input pairs.

H. G. Rice 1953 that generalised the Halting Theorem:

Rices Theorem There is no universal method (or program) that determines any non-trivial functional behaviour of computer programs.

An example of a functional question for which Rices Theorem applies is “does a computer program with input 1 produce any outputs?” A non-functional question for which Rices Theorem does not apply is one that refers to the operation of the computer program such as “does a computer program with input 0 produce an output within 1000 steps?”

Results

Theorem 1 There is no universal method or program to determine whether an organisational model is “efficient”. (proof uses Halting Theorem)

Theorem 2 There is no universal method or program to determine whether an organisational model is “effective”. (proof follows directly from Rices Theorem).

Theorem 3 Any method A designed to be a universal performance indicator will fail according to the bound

$$fail_A(n) \geq \alpha_A \sqrt{N}$$

Variety

Collection of Organisations & Info Problems	Assessment Power (with respect to any fixed non-trivial organisational property)
<p>Finite (cf The Known)</p> <p><i>-Legitimate best practice</i> <i>-Standard Operating Procedures</i></p> <p>Sense-Categorise-Respond</p>	<p>Completely and accurately known given sufficient time</p> <p><i>12 Times Table</i></p>
<p>Infinite-Bounded Variety (cf Knowable)</p> <p><i>Analytical/reductionist</i> <i>-Scenario planning</i> <i>-Systems thinking</i></p> <p>Sense-Analyse-Respond</p>	<p>Can always successfully assess within certain bounds. However the gap between lower and upper bounds is almost always significant.</p> <p><i>Multiplication, Scheduling</i> <i>Sorting, Routing,.....</i></p>
<p>Infinite – Unbounded Variety (cf Complex)</p> <p><i>Retrospective coherence</i> <i>-Pattern management</i> <i>-Perspective filters</i></p> <p>Probe-Sense-Respond</p>	<p>Any assessment method must fail for some pairs of Organisation/Info problem pairs.</p> <p><i>Halting Problem</i> <i>Polynomial-solvability</i> <i>Effectiveness & Efficiency</i></p> <p><i>fail – $A(n) \stackrel{?}{\geq} \alpha_A \sqrt{N}$</i></p>

Tricky →

Alignment with Practice



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NATO COBP for C ²	Our Results
“No single measure or methodology exists that satisfactorily assesses the overall effectiveness of C ² ”	Nor could there ever be one that is complete for all situations (Theorems 1 and 2)
“If done well measures of C ² effectiveness will be scenario independent so one can compare C ² effectiveness across a range of missions and circumstances”	The extent to which a method may be scenario independent relates to the quantity <i>fail_A(n)</i> (Theorem 3)