

Section A		
<b>Institution:</b> Durham University		
<b>Unit of Assessment:</b> 30 – Philosophy		
<b>Title:</b> Improving Decision-Making Procedures in the UK Ministry of Defence and other Government Departments		
<b>Period when the underpinning research was undertaken:</b> Between 2014 and 2020		
<b>Details of staff conducting the underpinning research from the submitting unit:</b>		
<b>Name(s):</b> Julian Reiss	<b>Role(s) (e.g. job title):</b> Professor of Philosophy	<b>Period(s) employed by submitting HEI:</b> 1 October 2012 – 30 September 2019
<b>Period when the claimed impact occurred:</b> Between February 2016 and July 2020		
<b>Is this case study continued from a case study submitted in 2014?</b> N		
<b>Section B</b>		
<b>1. Summary of the impact</b>		
<p>Julian Reiss's work on evidence has shaped the so-called 'Evidence Framework Approach' (EFA), a decision tool used by the Ministry of Defence (MoD). The EFA describes practical ways to use evidence and improve its analytical quality to support procurement and other decisions made by the MoD. The EFA is currently being incorporated into the Analytical Quality Assurance (Aqua) Book which is used widely within the United Kingdom government. Further, Reiss's work on mechanisms has changed thinking about models within the Inter-Departmental Working Group on Quality Assurance of Analytical Models whose reports develop 'best practice guidelines' of quality assurance (QA) of analytical models that inform government policy.</p>		
<b>2. Underpinning research</b>		
<p>The research underpinning this case study is a philosophical theory of scientific evidence, the Pragmatist Theory of Evidence, developed by Reiss in a series of papers [R1], [R2], [R4], [R5] and a book [R3]. It has two main original features. First, the evidential relationship (i.e., the relationship between hypothesis and evidence) is conceived as <i>material</i> rather than <i>formal</i>. Compare: 'If it is raining, the streets will be wet. It is raining. Therefore, the streets will be wet.' which is a formally valid inference (i.e., valid because the statements have a certain logical form), with 'It is raining. Therefore, the streets will be wet', which is materially valid (i.e., valid due to the terms that appear in the statements). Almost all existing theories of evidence regard the evidential relationship as formal. In Carl Hempel's hypothetico-deductive (HD) theory of confirmation, for instance, any statement E is evidence for a hypothesis H as long as H logically implies E. Second, a variety of contextual elements such as background knowledge as well as methodological, ethical, and conceptual norms help to determine the extent to which a piece of evidence supports or decreases the support of a hypothesis. These are important innovations because standard accounts cannot explain important cases of evidential reasoning in the sciences see [R5]. Practical relevance is thus one of the theory's major strengths.</p> <p>Relevant specifically for the impact case study is that the theory distinguishes two central concepts of evidence: support and warrant. Any piece of information relevant to the assessment of a hypothesis counts as its support. A suspect's fingerprint on the murder weapon supports the hypothesis that the suspect is guilty, but on its own it doesn't prove anything. The aggregation of all available items of support produces an assessment of the</p>		

warrant of a hypothesis. Only when all relevant support has been examined and combined, the hypothesis of the suspect's guilt can be said to be warranted. Further, the theory assumes that a hypothesis cannot be warranted, not even minimally, unless alternative accounts of the support have been eliminated. In this respect, the theory is somewhat Popperian in character.

Another of the theory's main features is a characterisation of different grades of warrant (from strongest to weakest: proof, strong, moderate, weak warrant), ordered by the number and strength of eliminated alternatives. The theory is meant to serve as an alternative to more mainstream theories of evidence and confirmation such as Bayesian Confirmation Theory, the HD theory, the error-statistical approach and Peter Achinstein's explanationist approach. Reiss's characterisation of different grades of evidence is one of the main building blocks of the so-called Evidence Framework Approach (EFA), a guidebook for decision making widely used within the Defence Science and Technology Laboratory (Dstl).

A second strand of research that has informed practice at Dstl and the Inter-Departmental Working Group on Quality Assurance of Analytical Models is Reiss's work on causality, especially on causal mechanisms (see for instance [R3]). Mechanisms are often assumed to be 'additive' in that they make stable contributions to outcomes independently of the background against which they operate. Reiss challenges this assumption and argues that, at least in the sciences that examine complex phenomena, mechanisms should be expected to operate interactively, that is, their contribution changes with the background. Another widely shared assumption, that mechanisms are stable under interventions, is also challenged in this work.

### 3. References to the research

[R1] Reiss, Julian (2019), "Against External Validity", *Synthese* **196**: 3103-3121; <https://doi.org/10.1007/s11229-018-1796-6>

[R2] Reiss, Julian (2016), "Suppes' Probabilistic Theory of Causality and Causal Inference in Econometrics", *Journal of Economic Methodology* **23**(3): 289-304; <https://doi.org/10.1080/1350178X.2016.1189127>

[R3] Reiss, Julian (2015a), *Causation, Evidence, and Inference*, New York (NY): Routledge

[R4] Reiss, Julian (2015b), "A Pragmatist Theory of Evidence", *Philosophy of Science* **82**(3): 341-62; <https://doi.org/10.1086/681643>

[R5] Reiss, Julian (2014), "What's Wrong With Our Theories of Evidence?", *Theoria* **29**(2): 283-306; <http://dx.doi.org/10.1387/theoria.10782>

#### Evidence of the Quality of Research:

[R1], [R2], [R4] and [R5] are published in high-quality refereed journals. [R3] is published as part of a prestigious book series, *Routledge Studies in the Philosophy of Science*, by an international academic publisher. [R4] has been submitted in REF2.

[R1] was supported by the European Research Council, for the project 'Knowledge for Use' (Grant agreement No. 667526 K4U; budget EUR2,092,125 for 2015 to 2020).

### 4. Details of the impact

#### 4.1. Introduction

In February 2016, members of Durham University's Centre for Humanities Engaging Science and Society (CHESS) were contacted by members of the Defence Science and Technology Laboratory (Dstl) of the UK Ministry of the Defence (MoD), based in Fareham. Dstl's stated purpose is 'to maximise the impact of science and technology for the defence and security of the United Kingdom' by creating, aggregating and interpreting scientific evidence to support logistic, tactical and strategic decisions of the MoD. Members of Dstl sought input from philosophy of science about the nature of evidential reasoning, causality and causal

inference, as well as modelling and simulation. Since then, the two groups have communicated regularly and held 5 mutual visits and workshops, two in Fareham and three in Durham.

Dstl used work done at CHES in creating the Evidence Framework Approach (EFA). This is an approach to decision-making and quality-assurance used widely within the MoD to help determine and assess both policy and procurement (as explained in 4.3-4.5 below). It is also an approach that is being used more generally, outside of the context of defence, within Treasury-based government documents (4.5 below). Impact has been made at three different levels: influencing the way the policy makers think, influencing the policies themselves, and influencing the decisions made using the policy.

#### **4.2. Influencing the way policy makers think**

According to the Principal Analyst in the Defence Science and Technology Laboratory (Dstl), Reiss's work has played an important role in shaping his thought, and thought within the Inter-Departmental Working Group on Quality Assurance of Analytical Models more generally:

"Your work has become highly influential in how I think about Analytical Quality in my role as the Dstl representative on the Inter-Departmental Working Group on Quality Assurance of Analytical Models. Your work informs both my own research and the shaping I provide to the research of others in my work as a Principal Analyst within the Defence Science and Technology Laboratory (Dstl)" [E1].

Several specific aspects of Reiss's thought have been particularly influential. One of these concerns Reiss's work on mechanisms (e.g. [R3]). In particular, [E1] cites the role of Reiss's ideas concerning *additive mechanisms*, *interactive factors* and *structure-altering mechanisms* as changing the practice of modelling complex phenomena in this Working Group. In addition to Reiss's work on mechanisms, [E1] also cites the importance of Reiss's work on *warrant* – in particular [R3] - in influencing the thought of the Principal Analyst within Dstl and the subsequent thought of the Working Group:

"For me, your conceptualisation of the *Warrant* of the work conducted (Reiss 2015) has been the missing piece of the jigsaw in my research leading to a key update to my understanding."

#### **4.3. Influencing policies**

The influence of Reiss's research on policy-makers and their thought has translated into influence on policy itself primarily via its role in the Evidence Framework Approach (EFA). The Evidence Framework Approach - [E2], [E3] - is outlined in an official MoD document of the same name [E3]. It has been introduced as a new decision-making policy and is considered one aspect of a best-practice approach to analytical quality assurance within the Defence and Security Analysis Division, of which Dstl is a part [E5].

Two aspects of Reiss's work on warrant have been used directly within the construction of the EFA: the distinction between the two concepts of evidence, support and warrant; and the definition of four grades of warrant: proof, strong, moderate, and weak warrant. This is clearest in their use in the construction of The Evidence Profile Table. This central element of the EFA is a specific tool for assessing and evaluating evidence requirements. It is, according to the Senior Principal Analyst of the Wargaming Team in the Simulation and Numerical Methods Group of the Defence and Security Analysis Division:

"Used when communicating the findings of research conducted within my department (Defence and Security Analysis Division) as a means of communicating uncertainty and as part of a judgement concerning an often asked question "How much evidence is enough?" to inform decisions." [E4]

The Evidence Profile Table makes direct use of Reiss's work on the four grades of warrant by integrating the 'grades of evidential strength' (or warrant) defined by his pragmatist theory of evidence ([E4]).

As one of the core tools of the EFA – see for instance p.i of the Executive Summary of the Evidence Framework Approach Technical Report [E3] – the Evidence Profile Table, and therefore Reiss's research, has had a significant impact on policy-making within the MoD and at the highest levels of government both in the United Kingdom and overseas. This is explained by the Senior Principal Analyst of the Wargaming Team in the Simulation and Numerical Methods Group of the Defence and Security Analysis Division, citing the role of 'statements of warrant' as provided by the EFA, in informing officials and policy-makers:

"Statements of warrant routinely accompany conclusions from analysis and these have been viewed and briefed to senior UK MOD officials, including the UK MODs Chief Scientific Advisor. More widely, the international defence analysis community has assessed the utility of the Evidence Framework Approach with analysis organisations in the United States of America, Australia, Norway, Sweden and the Netherlands seeing the value of the approach." [E4]

#### **4.4. Influencing government decisions**

Through its influence on the EFA and the EFA's importance in policy-making, Reiss's research has directly affected a large number of multi-million pound procurement decisions within the MoD. According to the Principal Analyst in the Defence Science and Technology Laboratory:

"The number of projects that have actively used the EFA is in the order of a dozen or so ... these projects include evidence assessments for multi-million pound procurements." [E5]. The influence that Reiss's research on warrant has had on the EFA, and so on government decision-making, will be significantly expanded by the adoption of the EFA by the army. The aim is to better understand "force development analysis and experimentation" [E4]:

"The Army is soon to publish a new analytical handbook that will include the EFA so it will influence hundreds of desk officers and their view of evidence. In addition there are key departments within Army headquarters that routinely use the language of the EFA, in particular warrant." [E5]

The EFA, as used by the army, will include the Evidence Profile Table and the distinction between evidential support and warrant as developed by Reiss [E4].

The Principal Analyst in the Defence Science and Technology Laboratory further cites the influence of the EFA – and of the concept of warrant in particular as it appears in the EFA – on diverse decision-making bodies including: the MoD Scrutiny Committee ("that oversees major procurements" [E5]) and analytical colleagues abroad, including a United States of America naval centre team concerned with the use of the EFA to support war-gaming activities.

#### **4.5. Widening the impact**

The EFA is projected to have significant impact outside of the context of defence. It is presently being integrated into a future version of the highly influential Analytical Quality Assurance (Aqua) Book (as explained in [E3]). The Aqua Book is a Treasury Department owned book to which the UK MoD contributes, and is an advisory document governing decision making across government, and not merely within the MoD. The reach of Reiss's work will therefore extend widely across government departments. This is explained in [E4]. "Outside of the UK MOD the Evidence Framework Approach will be incorporated into a future version of the Analytical Quality Assurance (Aqua) Book and associated detailed guidance.

The initial version of the Aqua Book was put in place to provide guidance on analytical quality assurance following the MacPherson Review and is a Treasury Department owned book to which the UK MOD contributed (see reference 1 for details). The Aqua Book is designed to provide guidance across United Kingdom Government departments and inclusion of the Evidence Framework Approach within a revised version will enable wider Government departments to access the thinking.” [E4]

## **5. Sources to corroborate the impact**

[E1] Testimonial from Principal Analyst in the Defence Science and Technology Laboratory, February 2019.

[E2] CHES working paper ‘A Technical Overview of the Evidence Framework Approach: Practical Ways of Thinking about Evidence’ by Senior Principal Analyst of the Wargaming Team in the Simulation and Numerical Methods Group of the Defence and Security Analysis Division.

[E3] Technical Report ‘The Evidence Framework Approach’, internal DSTL document.

[E4] Testimonial from Senior Principal Analyst of the Wargaming Team in the Simulation and Numerical Methods Group of the Defence and Security Analysis Division, March 2018.

[E5] Testimonial from Principal Analyst in the Defence Science and Technology Laboratory, February 2020.