Discussion

Measuring judgements to improve performance
D. Blockley and P. Godfrey, Civil Engineering, **158**, No. 3, August 2005

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At the beginning of the section entitled 'Total subjectivity is rare', the stated aim is to find 'the distinction between a subjective opinion, an expert judgement and objective evidence'. This is important because the way in which a problem is tackled depends on the type of information available, and this is really the crux of the paper.

An attempt is made to achieve this distinction using Popper's theory of objective knowledge. However, it is not successful because all products of the human mind lie in world 3, the 'objective world', including theories, books, works of art, social institutions and ethical values, as well as the aforementioned subjective opinions, expert judgements and objective evidence. Therefore, no distinction can be made using this model. The problem is that the 'objective world 3' includes many things that are not objective and so this model does nothing to solve the problem.

It is suggested that rather than applying Popper's theory of objective knowledge, the solution of complex engineering problems involving a mixture of hard and soft issues would benefit more from a consideration of Popper's theory of scientific method as described in *The Logic of Scientific Discovery*.[8] In this work, Popper creates a clear demarcation between empirical science and metaphysical ideas. He says: 'We must distinguish between, on the one hand, our subjective experiences or our feelings of conviction, which can never justify any statement and, on the other hand, the objective logical relations subsisting among the various systems of scientific statements, and within each of them.'

In the method, the definition of the terms 'objective' and 'subjective' are clear and easy to apply. Popper uses a definition similar to Kant, who said: 'If something is valid, for anybody in possession of his reason, then its grounds are objective and sufficient.' In Popper's terminology, a statement is 'objective' if it can be inter-subjectively tested and hence justified. For example a theory is only 'objective' or 'scientific' if it is capable of being falsified by testing. The criterion 'capable of being falsified by testing' is introduced by Popper because verification, although improving confidence in its use, will never prove the theory (this is known as Hume's problem of induction). Therefore, scientific theories can only ever be tentative conjectures, which may one day be refuted. In addition, Kant applied the word 'subjective' to our feelings of conviction, which cannot be justified in an empirical sense.

From this starting point, the definition of hard and soft systems would make more sense. Hard systems are objective and soft systems are at least partially subjective.

Engineering, when dealing with hard systems as defined above, may be considered to be science. Thomas Kuhn defined a scientific community (as against an artistic community for example) by its unique behaviour.[9] Kuhn's work was largely based on observation and therefore was sociological and inductive in nature, which did not endear him to Popper,[10] even though their work could be seen as complementary in many respects. Kuhn observed that a scientific community concerned with a particular field, when not in a state of crisis, is in possession of a single paradigm. This means that solutions to the problems of that field must 'satisfy the well-defined community of the scientist's professional compeers'. Those who work with a different paradigm are by definition practising outside of science. In non-scientific fields (of which philosophy is one) there are always competing schools with their own paradigms (for example Aristotelians and Platonists), each of which questions the very foundation of the others. Therefore, engineering, when dealing with soft systems, is not science and is more akin to philosophy or sociology in that there is no single accepted method or theory to apply. A variety of methods to deal with soft systems are ably described in the paper by Blockley and Godfrey.

Throughout the paper the implication is that so-called 'professional judgements' are of value and are in some sense pseudo-objective and to some extent inter-subjective. In a previous

paper, Professor Blockley goes further when he says, 'Professional engineering judgements are not subjective and arbitrary. Total subjectivity is rare – rational judgements are shared inter-subjective evaluations that are indeed partly personal but they are considered decisions or sensible opinions expressed by experienced engineers from rich experience.'[11] However, there is much danger in blindly accepting opinions just because the person expressing them is experienced or (if you are lucky) will take responsibility for them. If professional judgements are to some extent inter-subjective, then it should be possible to defend them. In conventional scientific method, it is normal to demand that if someone gives their opinion, they should also be able to explain the rational arguments or the previous experiences that lead to their opinion. The question that follows from this is, to what extent are professional judgements objective, because if they were completely objective, they would surely cease to be 'judgements'? Conversely, if they were completely subjective, they would then surely be worthless?

In the same section is the statement, 'Engineers are not necessarily concerned with the truth of a theory or model; they are more concerned with their responsibility to act on the basis of a theory or model…that they have taken precautions that can be reasonably expected to take [*sic*] against being wrong.' Ignoring the fact that many engineers would disagree with this narrow definition of their role, Kuhn's model of scientific development indicates that for a solution to be acceptable, it must not be in conflict with the current paradigm. In other words, solutions must be consistent with current engineering practice in the profession in order to be defensible. If current best practice is found to be lacking, then it must be updated. This is echoed by the requirement in the ICE's *Code of Professional Conduct* for members to proactively develop professional knowledge and keep up to date with current best practice.

In conclusion, Popper's scientific method may be used to better identify what parts of a problem may be solved in an objective manner and what parts may only be solved in a subjective manner. It is in the engineer's best interest to strive to be objective at all times—that is to make decisions that can be backed up by logical argument and hence, in the words of Kuhn, 'satisfy the well-defined community of his/her professional compeers'.

Authors' reply

Unfortunately Mr Jones misses the point of the paper in two respects. First, we value engineering judgement and think it so important that we want to help make it as rigorous as we can—Mr Jones apparently does not. Second, he interprets Popper's ideas too strictly. Recent developments in neuroscience allow us to extend Popper's ideas in waya of which we think he would approve were he still alive. We will now reply in more detail to these two issues in turn.

Mr Jones says 'there is much danger in blindly accepting opinions just because the person expressing them is experienced or (if you are lucky) will take responsibility for them.' The authors would agree that no-one should 'blindly' accept opinion—the whole point of any measuring process of judgement is to test them in a way entirely consistent with Popper's approach. One of the messages of the paper is that, if used appropriately, the measuring process can generate discussion and argument to test opinion as ingeniously as it is possible to do with the time and resources available in a particular situation and context. Mr Jones is also incorrect to say that we interpret the role of the engineers narrowly by emphasising the taking of responsibility—we are simply saying that strict truth is unavailable and engineers must make decisions that work—so they make models that they judge to be dependable for a decision in other words which they can justify if required to do so—there is no question of any 'blind' acceptance.

In the paper, Popper's three-world model is used to help make some simple distinctions. Clearly it can be criticised—it is a model to help us understand. If we were to take it any deeper as a vehicle for understanding we could argue that both worlds 2 and 3 are part of world 1—actual reality. By this view our brains are physical objects in world 1 with emergent properties of 'mindness' or 'self' or subjectivity which allow us to contemplate the nature of ourselves. If we do not consider religious or mystical interpretations of mind or self and we take the view expressed by neuroscientists such as Llinas[12] that cognition is an empirical problem not a

philosophical one, then the 'self' is a set of dynamic complex patterns in the brain. By a similar argument all world 3 knowledge has to physically exist on paper or electronically (remember that much of the early writing of the Greek philosophers was lost) as world 1 objects.

We consider that Mr Jones's interpretation of Popper is, for the modern thinker, too restrictive. We argue that subjective experience has an objective reality in that neuroscientists can see brain patterns when they perform brain scans. Of course we are not suggesting that they are anywhere near any practical measurements of engineering judgements using brain scans—we are simply stating that judgement exists in an objective way. So although we cannot measure the brain patterns in any dependable way for our purpose here we can, however, get a glimpse of the effect of these patterns expressed as our behaviour. We do this through measurements of preference choices and we do it to help make our judgements more rigorous. That is why we emphasise the purpose of measurement. The measurement results are testable and falsifiable—but not in the simple clear way Mr Jones requires—they are less dependable than traditional physical measurements but none the less can be and are very important and useful—it is the way any practical professional work is done.

We should not forget that where we are concerned with measuring something in the future we have to use people's judgement. It is essential that we do it as dependably as we can.

References

8. Popper K. R. *The Logic of Scientific Discovery*. Routledge Classics, London, 2002 (first published in German in 1935, first published in English in 1959).
9. Kuhn T. S. *The Structure of Scientific Revolutions*, 3rd edition. University of Chicago Press, Chicago, IL, 1996 (first published in 1962).
10. Sardar Z. *Thomas Kuhn and the Science Wars*. Icon Books, Cambridge, 2000.
11. Blockley D. Do ethics matter? *The Structural Engineer*, 5th April 2005, 27–31.
12. Llinas R. R. *I of the Vortex: from Neurons to Self*. MIT Press, Cambridge, MA, 2002.

Author's reply to Ben Thatham

With regard to capacity factor, I am mystified by the optimism claimed for future capacity factor. Unfortunately, this seems to be more a matter of faith than of fact. In the following table, I show what has been published.

Year	1999	2000	2001	2002	2003
Ofgem capacity factor (%)				25.7	24.6
DTI capacity factor (%)	28.2	28.2	26.4	29.9	24.1

The top row shows the capacity factors for the data published by Ofgem for the last two years. These are at variance with the DTI's own figure for 2002 but agree closely with the DTI's figure for 2003.

I also query why the nation as well as the industry does not publish the actual performance of the publicly funded wind capacity in an open, timely and transparent manner as is the practice in Denmark.

The figures collected so far are for onshore wind and one is permitted to presume that many of the better sites are 'used up'. In budgeting something as important as the country's future electricity supply, it would be prudent to stick to known facts. These suggest that on-shore capacity factor should be budgeted around 25%. It is possible though not yet proven that offshore capacity, overall, may be over 30%.

With regard to the displacement of conventional capacity by wind capacity, I show that Denmark's wind capacity, amounting to roughly 60% of peak demand does not contribute one kW of firm capacity – in the sense that it clearly cannot be called upon to deliver any power when the wind is not blowing.

The German experience (discussed in my second paper, which is due to be published in *Civil Engineering* in November 2005) confirms that even in a 'wind system' built on a much larger land area, a very large wind capacity does not supply any firm capacity.

I am mystified by claims, often made by non-technical advisers to the present UK Government, that somehow the wind system in UK will 'behave better and more reliably' in the UK than it does in Denmark or Germany – where wind capacity replaces no firm capacity at all.

With regard to absolute technical limits of UK wind capacity, I do not wish to be rude but I find such a self-evidently foolish remark (by the writers of The Sustainable Energy Commission) does not deserve a reply.

Finally, with regard to the costs and benefits of wind, it is genuinely hard to comment, even briefly on this woofly, diffuse and inconclusive chapter. I regret simply not having the time to do so.

Reference

3. International Energy Agency. *Key World Energy Statistics*. IEA, Paris, 2004