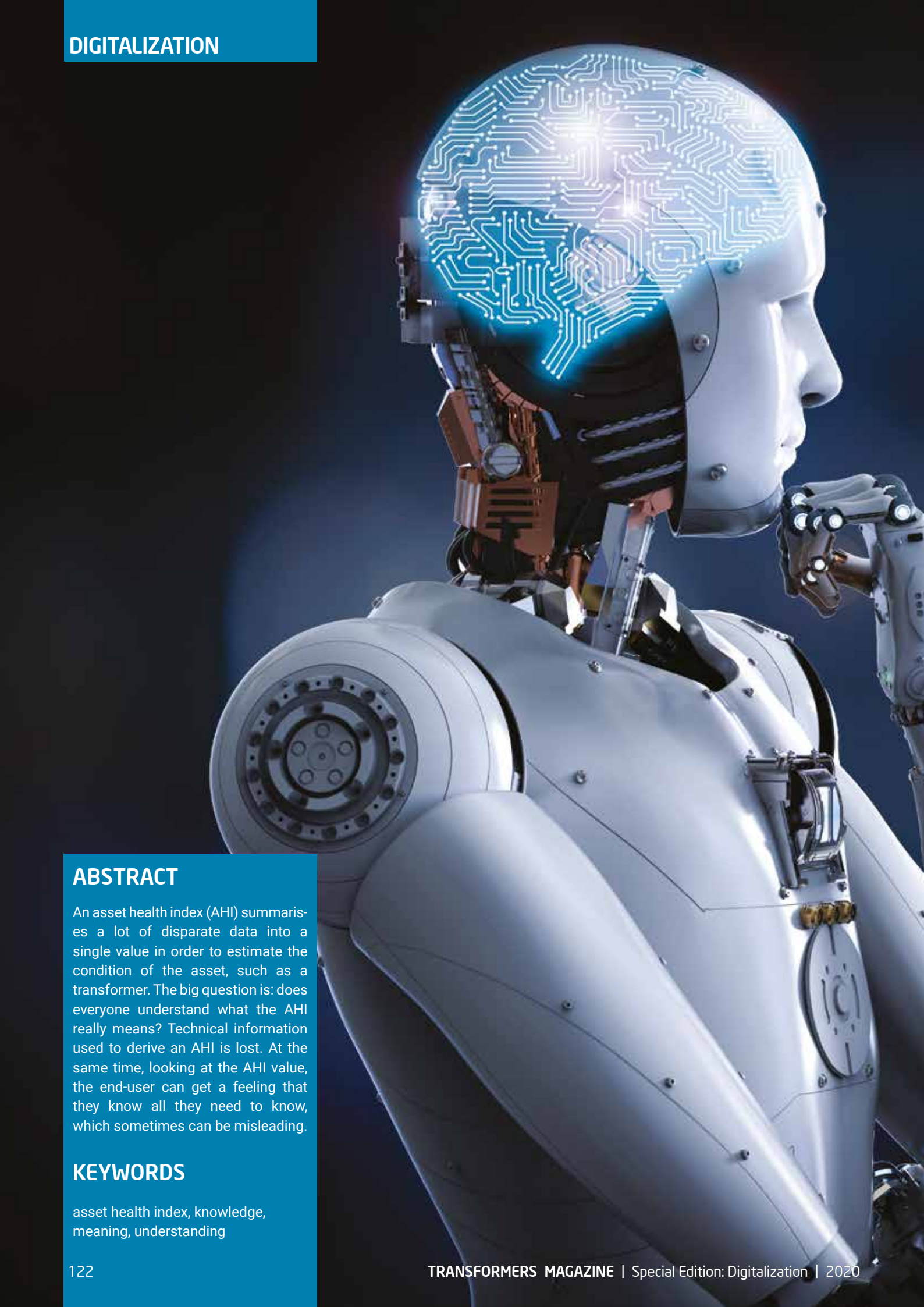

ABSTRACT

An asset health index (AHI) summarises a lot of disparate data into a single value in order to estimate the condition of the asset, such as a transformer. The big question is: does everyone understand what the AHI really means? Technical information used to derive an AHI is lost. At the same time, looking at the AHI value, the end-user can get a feeling that they know all they need to know, which sometimes can be misleading.

KEYWORDS

asset health index, knowledge, meaning, understanding

An asset health index (AHI) summarises asset, condition, and operational data so that it may be used in financial and operational planning

Think of a number...

1. Introduction

An asset health index (AHI) is a means to summarise a lot of disparate data into a single value to address a specific question: Does the asset need maintenance, for example, and if so, when? This short discussion will not go into the details of generating an AHI but will focus on what happens next (1).

So, the big question is: does everyone understand what the AHI really means?

AHIs are commonly used to rank assets for prioritisation of maintenance, replacement, or other intervention. There is a lot of work that goes on to reduce all relevant and available data to an AHI which covers the 4 key aspects of an AHI (2):

- Calibration, so that the timescales for action of similar indices are common
- Monotonicity, so that worse indices are always associated with a more urgent timescale
- Auditable, so we can see which data was important in a specific index being generated
- Justifiable, so that if we have to spend money, we have a good reason as to why – we can see the failure modes identified and what they imply

Basically, the AHI summarises asset, condition, and operational data so that it may be used in financial and operational planning, as shown in Fig. 1.

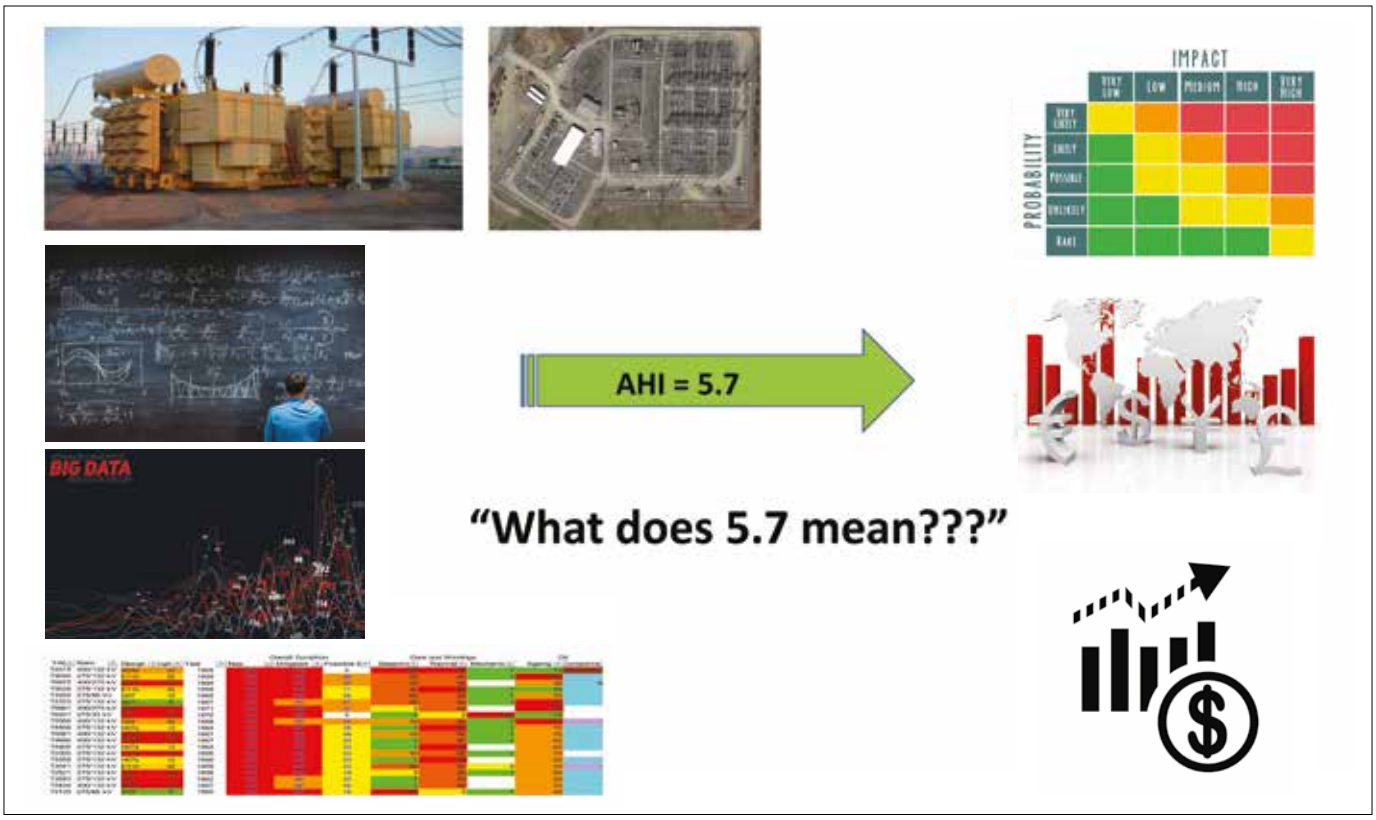

Figure 1. What does an AHI of 5.7 mean?

The answer to the question "What does 5.7 mean?" is definitely not simple

The answer to the question "What does 5.7 mean?" is not a simple one: What would be a 'good' AHI value, or a 'bad' one? What are the actions associated with that AHI? What are the timescales? What was the root cause data which yielded this score? How accurate is the analysis? And with what precision?

Whoever generated the AHI should have some understanding of all these questions – the AHI is a result of a technical evaluation of varied and imprecise data. What about the people using the AHI in analyses for planning? They usually understand numbers, spreadsheets, and equations – but rarely do they understand the actual assets themselves. The consequence, described as the Dunning-Kruger effect (3), is an overestimation of ability in a particular field of study based on limited knowledge, as shown in Fig. 2.

The result is that the technical information used to derive an AHI is 'lost' as the 'end user' feels they know all they need to know as they understand the number, if not the asset. After all, anyone can see that 5.7 is bigger than 4 and therefore must be more likely to fail or need attention. The Dunning-Kruger effect has been found in many industries and applications. What we need to do is be prepared for it and to respond to it.

How? By ensuring that an AHI has a degree of precision associated with it: a confidence interval which addresses both the accuracy and precision of both the condition evaluation and the timescale for action. This is a part of the communication process between the production of an AHI and its use: the AHI is an estimate based on knowledge, experience, and standards. It is not 'perfect'.

We often hear that an AHI is just for indication, that there are categories to group 'similar' assets: all those needing attention in about 2-5 years, or those deemed to be likely to last at least 15 years. In fact, the use of categories to group assets, often in support of a risk matrix, can be a cause of further obfuscation, based on human nature which sees everything within a category as being more similar to those things outside, and vice versa (4, 5). So, we need to be aware of this 'just an indicator' generalisation as it can be misleading.

To be effective in managing assets, the communication between the technical folks and the financial folks has to be clear and meaningful, with an understanding on both sides as to the limitations on the generation of an AHI and its application. A good AHI promotes communication, being based on calibrated, monotonic, auditable, and justifiable analyses.

Some things to DO:

- DO use data to identify where an asset is on each failure mode timescale and use this to estimate the probability of failure – using standard / guideline diagnostics where available – to give clarity and justification
- DO build the health index around consistent and calibrated timescales to retain a sense of urgency
- DO try to include a sense of precision around the data and the index

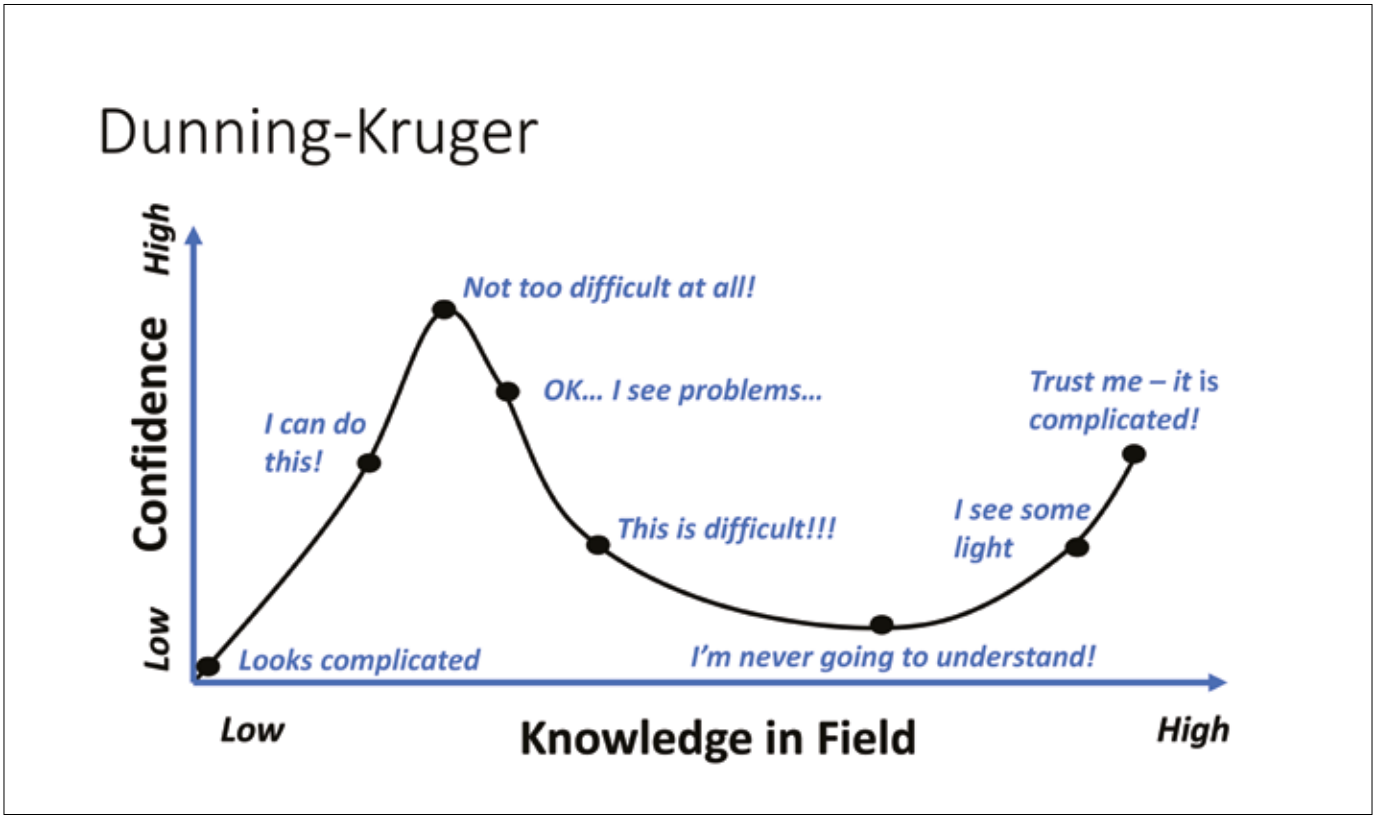

Figure 2. The Dunning-Kruger Effect

- DO publish the details of the process of index development to all stakeholders
- DO sanity check the final indices to make sure they reflect reality as it would be very questionable to have a set of indices which mean 20 % of assets need replacing in a year, if historical failure rates are at ~ 1 %

And some things which are 'DO NOT':

- DO NOT go straight from data to an index as it loses indication of failure modes and timescales
- DO NOT use weighted systems which lose or dilute any sense of urgency
- DO NOT assume the 'users' understand the precision of the index as we are dealing with timescales and probabilities and imprecise data
- DO NOT assume the 'users' understand the physical nature assets: transformers are complicated!

Above all – keep the communication going between the technical and the financial folks!

The AHI is an estimate of the transformer asset condition based on knowledge, experience, and standards but it is not perfect

Bibliography

[1] S. Rhoads, J. White et al., *Developing and Using Justifiable Asset Health Indices for Tactical and Strategic Risk Management*, CIGRÉ, Paris, France, 2018

[2] *Condition Assessment of Power Transformers*, CIGRÉ Technical Brochure 761, March 2019

[3] J. Kruger, D. Dunning, *Unskilled and Unaware of It*, Journal of Personality and Social Psychology. 77 (6): 1121–1134, 1999

[4] R. Sapolsky, *Introduction to Human Behavioural Biology*, Stanford University, 2011, https://www.youtube.com/watch?v=NNnIGh9g6fA

[5] P. Thomas et al., *The Risk of Using Risk Matrices*, Society of Petroleum Engineers Annual Conference, New Orleans, USA, 2014

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