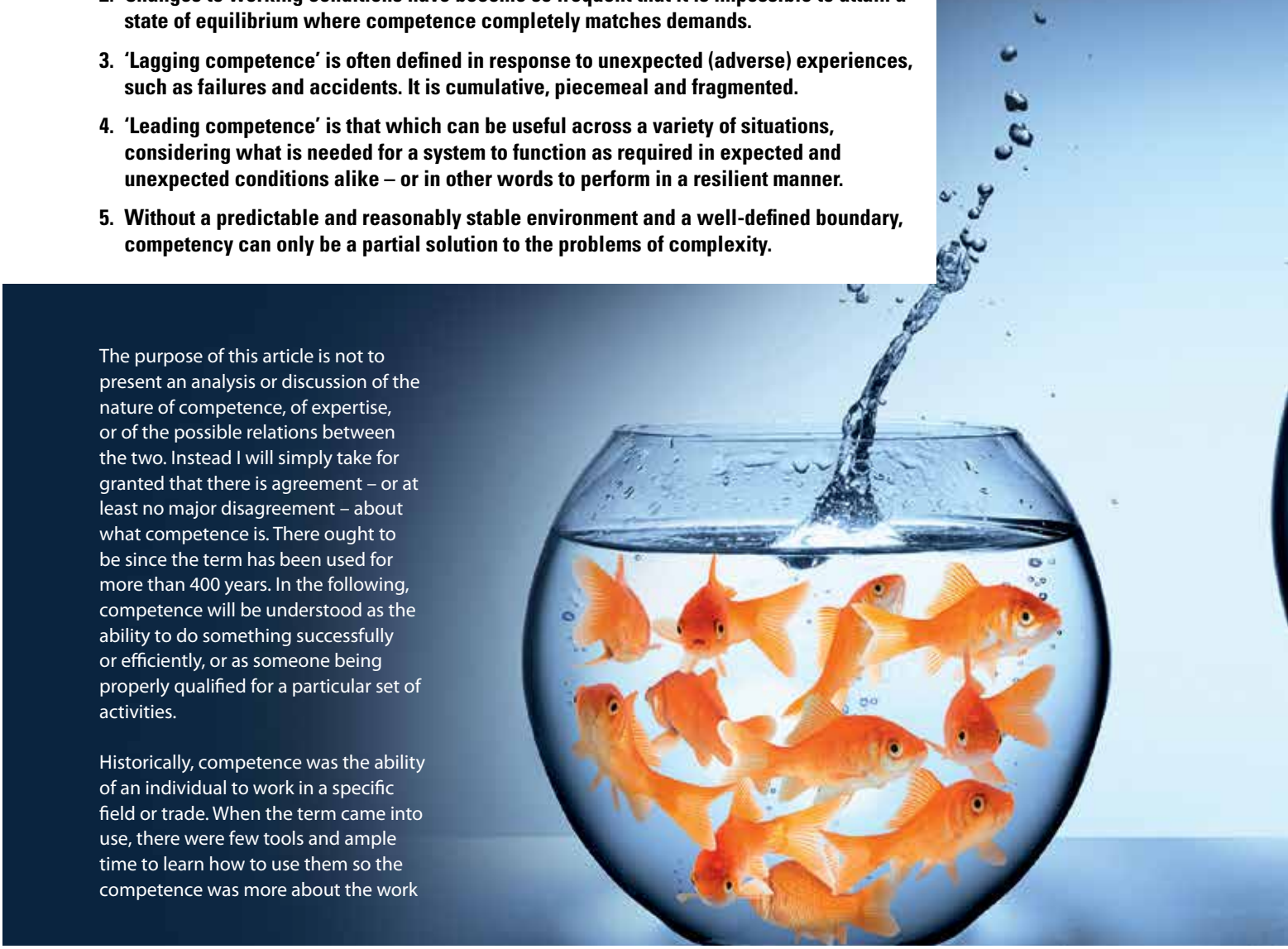
COMPETENCE
LAGGING OR LEADING?

The accelerating changes in technology and the environment of aviation place new demands on competency, such that it is becoming ever harder to prescribe specific competencies based on irregular situations. **Erik Hollnagel** makes a distinction between two kinds of competence – lagging and leading – and argues that there are limits to work-as-imagined and work-as-prescribed when it comes to competence.

KEY POINTS

1. **Work now requires the mastery of rapidly evolving and increasingly complicated technologies, with increased demands on competence both to manage the technology and how to compensate for its limitations.**
2. **Changes to working conditions have become so frequent that it is impossible to attain a state of equilibrium where competence completely matches demands.**
3. **'Lagging competence' is often defined in response to unexpected (adverse) experiences, such as failures and accidents. It is cumulative, piecemeal and fragmented.**
4. **'Leading competence' is that which can be useful across a variety of situations, considering what is needed for a system to function as required in expected and unexpected conditions alike – or in other words to perform in a resilient manner.**
5. **Without a predictable and reasonably stable environment and a well-defined boundary, competency can only be a partial solution to the problems of complexity.**



The purpose of this article is not to present an analysis or discussion of the nature of competence, of expertise, or of the possible relations between the two. Instead I will simply take for granted that there is agreement – or at least no major disagreement – about what competence is. There ought to be since the term has been used for more than 400 years. In the following, competence will be understood as the ability to do something successfully or efficiently, or as someone being properly qualified for a particular set of activities.

Historically, competence was the ability of an individual to work in a specific field or trade. When the term came into use, there were few tools and ample time to learn how to use them so the competence was more about the work

than the tools. Working conditions were also very stable in the sense that changes – due to new tools or methods, for instance – were few and far between. Competence could therefore be acquired in a natural manner and was not the problem that it is today.

All this came to an end around the middle of the 20th century when computers and information technology radically changed the nature of work. To make a long story short, work required the mastery of rapidly evolving and increasingly complicated technologies and the role of competence therefore became more conspicuous. Since work no longer could be done without the use of technology, one consequence was that demands on competence grew to include both how to manage the technology and how to compensate for its limitations. Another consequence was that changes to working conditions became so frequent that it became impossible to attain a state of equilibrium where competence completely matched demands.

Defining competence as the ability to do something successfully means that it must refer to a description of what it is that needs to be done. The basis for competence used to be the codified work experience such as that required for apprentices to become journeymen and finally master craftsmen. But today, competence must also include knowledge about how work systems and technological artefacts have been designed and are intended to function. This can be seen as a combination of Work-as-Imagined (WAI) and Work-as-Prescribed (WAP).

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WAI comprises a specification of the skills and competence that are needed to ensure that the system can accomplish its purpose – that it will work as intended. WAI is both how we imagine others do, or should do, their work and how we imagine what work will be in the future. WAP is the formalisation or specification of work as it is found in, e.g., regulations, procedures, standards, and job descriptions. In the world of today, the basis for competence is therefore a combination of collective experiences and anticipated needs. In view of the ever growing importance of safety, reliability, and productivity, competence must now also include the ability to recover from potentially harmful or dangerous situations – as well as to avoid getting into them in the first place.

Lagging competence

Competence should in principle cover the whole range of possible situations from the trivial to the non-trivial. In a discussion of resilience engineering, Westrum (2006) proposed a distinction between three types of threats based on how expected – or unexpected – they were: regular threats, irregular threats, and unexampled events. The two first categories, but not the third, make sense in relation to work situations and competence.

Regular situations happen so often that most people in an organisation have experienced them, directly or indirectly. It is therefore possible to specify the competence that is needed to manage them and to carry out work in a satisfactory manner. While competence initially can be based on WAI/WAP, unexpected situations or conditions will occur sooner or later. They can be due to improvements and redesign – such as new technology – but more importantly also due to malfunctions, failures, or even accidents. Indeed, an almost universal response to failures and accidents is to analyse them in order to identify the competence that would have prevented them. In that way the competence increases, but retroactively: it is lagging. Competence is furthermore cumulative and based on unexpected (adverse) experiences, hence piecemeal and fragmented. The advantage is that the associated costs can be justified because they refer to something that has happened – although the probability that it may happen again is rather low, which detracts from the value. The disadvantage is that lagging competence only increases the curriculum, since new cases are simply added to the existing ones rather than being seen in a larger context.

Leading competence

Although some part of competence must be lagging, it would clearly be interesting and useful if competence also could be leading. That would among other things mean that there would be fewer situations where a lack of competence could lead to losses. The downside is that preparing competence ahead of time, without knowing for certain whether it will ever be needed, is costly both in terms of establishing it and in terms of maintaining and verifying it.

Yet leading competence is essential for irregular situations since they, by definition, happen rarely. Irregular situations are so infrequent that an organisation may never have encountered them, hence has no experience to refer to, although people may know about them from the general lore or shared war stories. Since irregular situations go beyond the design base there is little help to be found in WAI and WAP either. Although each irregular situation by itself may be imaginable, their number is so large that it is impossible to think of, let alone establish, specific competence. Even if the required competence could be specified, it will not be cost-effective to prepare and maintain it. An alternative solution is to consider the generic competence that can be useful across a variety of situations.

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One way is to rely on risk assessment and a risk matrix to specify what is needed to compensate for the most serious cases. A complementary and more constructive approach is to consider what is needed for a system to function as required in expected and unexpected conditions alike – or in other words to perform in a resilient manner. This can be called the requisite competence, in analogy with the concept of requisite variety as used by control engineering and cybernetics. The requisite competence could, for instance, be derived from the set of cognitive and interpersonal skills that are the focus of CRM – such as communication, decision making, and leadership. It could include the abilities to handle time stress and uncertainty, to guard against well-known fallacies in judgement and decision making, etc.

This can, however, not be done without explicitly considering how competence depends on the boundaries of the system. The demands on competence change as the boundaries expand horizontally, vertically, and temporally. The attractiveness of routines and standardisation, and therefore of WAP, is that these make it possible to define the required competence – at least as long as the situation can be controlled and stable working conditions can be maintained. Competence cannot be prescribed, assessed, or verified unless there is a well-defined boundary and unless the environment is reasonably stable and predictable. Yet an understanding of competence, lagging as well as leading, must accept that working environments today – and actually since the early 1980s – are characterised by tightly coupled functions that defy linear cause-consequence reasoning about how they should be managed. A failure to recognise that will lead to unreasonable and unacceptable limitations and constraints on system performance in terms of safety, productivity, sustainability, stakeholder interests and customer satisfaction. Competence is a challenge, but it is not a silver bullet.

References

Westrum, R. (2006). A typology of resilience situations. In: E. Hollnagel, D. D. Woods and N. Leveson (eds). Resilience engineering: concepts and precepts. Aldershot, UK: Ashgate.

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