# Letter to the editors

## ON THE ORIGINS OF THE SKILLS, RULES, AND KNOWLEDGE FRAMEWORK: A BRIEF COMMENT ON DOUGHERTY (1990)

The purpose of this note is to establish the historical origins of the skills, rules, and knowledge (SRK) framework of human behavior, which over the past decade or so has become a 'market standard' in the systems reliability community.[1,2] Typically, SRK has been associated with Jens Rasmussen, whether it be through the publication of his 1983 article in *IEEE Transactions on Systems, Man, and Cybernetics*[3] or of his more recent monograph.[4] In an interesting article published in a recent issue of this journal, however, Dougherty[5] has stated that Rasmussen was not the first to document and name the three levels of behaviour. On page 297 of this article he states: 'Hollnagel, E., in A framework for the description of operator behaviour, RISØ-N-35-79, RISØ National Laboratory, Electronics Department, Roskilde, Denmark, 1979, was the first to name and characterize these three behavior kinds. He called the third category "goal-based" rather than Rasmussen's "knowledge-based", which may be a preferable choice, since there have been arguments over the fact that all behavior is cognitive, i.e., knowledge-based'. Could it be that the well known SRK framework has been incorrectly attributed to Rasmussen all this time?

The SRK framework, and other influential ideas, were developed by a cross-disciplinary research group in the Electronics Department of Risø National Laboratory in Roskilde, Denmark. At that time, the members of this research team included Jens Rasmussen, Len Goodstein, Erik Hollnagel, and Morten Lind. Rasmussen was the conceptual leader of the group,[6] but as in any other dynamic research environment, the ideas emerged from the many discussions that took place among the group members. Thus, one single person cannot lay *independent* claim to the 'invention' of the SRK framework. The only fact that can be established with some degree of certainty is when, and by whom, these ideas were first presented.

A detailed examination of the sequence of papers first discussing the SRK framework suggests that

Dougherty's[5] claim is unfounded. The Hollnagel report[7] cited by Dougherty was published in November of 1979. Earlier that same year, Rasmussen had drawn a figure of what can now be easily recognized as the SRK hierarchy, in preparation for a meeting of the Nordic NKA/KRU project on control-room design for nuclear power plants of which Risø was a participant. This unpublished drawing, dated February 2, 1979, seems to be the first document depicting the SRK framework. In June of 1979, Rasmussen wrote two internal reports, both of which included a description of the SRK distinction.[8,9] These seem to be the first papers documenting the SRK framework. However, both of these reports, as well as the Hollnagel paper cited by Dougherty,[5] were internal reports which have a more limited distribution than the well-known Risø green technical reports. The first time that the SRK framework appeared in print in a form widely available to the scientific community was in November of 1979, with the publication of a seminal Risø technical report by Rasmussen.[10] For the sake of completeness, it is worthwhile adding that the SRK framework was also first presented in book-chapter and journal-article forms by Rasmussen.[11,12]

This historical excursion also provides an opportunity to establish the origin of the labels now associated with the three levels of cognitive control. In a paper reviewing the development of SRK, Sanderson and Harwood[2] placed the date for the emergence of the SRK labels to somewhere between 1976 and 1979. The documents reviewed above allow one to narrow this window down even further. In the hand-drawn figure, dated 2 February 1979, the SRK levels were labeled as target control, rule control, and goal control, respectively. In one of the internal reports published by Rasmussen in June of 1979,[8] there is another hand-drawn figure of the SRK hierarchy, dated 15 May 1979. In this diagram, the SRK levels are referred to as automated, rule control, and goal control, respectively. Interestingly, the same internal report also contains a hand-written table, dated 30 May 1979, with the skill-based, rule-based, and knowledge-based labels that were ultimately adopted for the framework. This evidence suggests that an early version of the now famous three-level block diagram was developed at least three months before the final labels were actually attached to those

levels. Furthermore, the evidence also indicates that the choice of labels for the SRK framework was made some time between 15 May and 30 May 1979. As Dougherty[5] points out, the choice of labels may not have been a felicitous one, but given the framework's widespread acceptance, the point is now a moot one.

The documents reviewed above reveal that it was Rasmussen and not Hollnagel who was the first to name and characterize the three levels in the SRK framework. This historical correction is not meant to detract from the main point of Dougherty's[5] article. The question of how to proceed with the second generation of human reliability analysis (HRA) methods is of fundamental importance to the discipline of cognitive engineering. Undoubtedly, these future HRA models will be influenced by the contributions of Jens Rasmussen and his colleagues at Risø.

## ACKNOWLEDGEMENTS

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