Safety-Critical Systems: Open Assessment 2006-2007

Training Tools for Resilience Engineering

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1 Introduction

Resilience engineering is a relatively new concept. It is controversial because, although it describes important and familiar ideas, it remains to be seen whether or not it can support the design and maintenance of safety-critical systems. The primary text on the topic is by Hollnagel, Woods and Leveson [1] although there are other overview papers on the web. Locating and assessing these additional resources is part of the exercise. The principle ideas in resilience engineering stem from the recognition that failure does not always stem from malfunctions or poor design. Instead, many adverse events stem from the network of interactions and adaptations that are often necessary for complex systems to be useful in the 'real world'. Individuals and organizations must continually adapt their behavior to current conditions. With limited time, finite psychological and physiological resources and partial tool support, there adaptations are seldom ideal and hence accidents may occur. Other ideas in the area are extrapolations from the concept of resilience in ecological systems, where for example particular cultures may be more or less adaptable in the face of external shocks such as changes in climate or land use.

2 Tool Development

Your task in the open assessment is to develop a training tool that will help users to understand the key concepts and ideas in resilience engineering as they apply to healthcare systems. The tool should be carefully targeted at engineers, clinicians or managers. You can focus on any aspect of healthcare, including primary facilities or hospitals. If you decide to focus on engineers, you can assume that the users have some idea of the basic concepts in safety-critical systems design. However, it is likely that this group of users will only heard of the term 'resilience engineering' and will know nothing of how it might apply to the healthcare industries. Conversely, if you choose clinicians or managers then you will have to alter your assumptions to reflect their possible lack of prior knowledge about the engineering of safety critical systems. However, these users may know more about the application and management of complex systems than the engineers mentioned above,

The training tool must be designed to support a limited number of learning outcomes. In other words, you have to consider what someone might gain from using the system. For example, you might develop a system for engineers that help them to consider the impact of resilience engineering on the way they handle the lifecycle of complex systems. Conversely, you might develop a training tool for clinicians that illustrates the trade-offs that arise when medical devices are not used in the way that they were originally intended. A training tool for managers might help them to understand the measures and processes that might be used to assess changes in the underlying 'safety' of a healthcare institution compared to other organizations in terms of their 'resilience' to changing technology or healthcare practices.

3 Evaluation

It is important that you evaluate your resilience engineering training tool. One means of doing this would be to ask a number of different users to try it out. For instance, one group might be asked to use your tool while another is given a paper introduction to the same topics. However, this raises important methodological concerns. Firstly, how would you insure that both groups have the same level of expertise and background knowledge so that any comparisons are fair? Secondly, how would you go about assessing the impact of the training? Simply asking questions about the ideas behind resilience engineering does not ensure that users will be able to apply those concepts to support the development or maintenance of safety-critical systems. Please consult with me before conducting your evaluation so that I can provide advice in

answering some of these questions. You should also consult the course handbook and associated web pages that cover the ethical guidelines for user testing.

4 Transferable Skills

This exercise will provide a first-hand introduction to the concepts associated with resilience engineering. This is a relatively new approach and it is attracting a considerable amount of commercial and academic interest. The development of tool support will also provide some understanding of the problems that can arise when developing Computer Assisted Learning (CAL) systems. These tools are being widely deployed in a range of industries. Hence many of the skills provided by this assessed exercise are in very scarce supply.

5 Assessment Criteria and Submission Details

This exercise is degree assessed. It contributes 30% to the total marks associated with this course. The body of the report should not exceed fifteen A4 pages. The report must be printed out and must be submitted in a secure binder. It must include:

- A title page containing your contact details (email etc);
- A table of contents and appropriate page numbers;
- A section on the tool that you developed.
- A section on the evaluation method that you used.
- A results sections.
- Conclusions.

In addition to the fifteen pages in the body of the report, you may also include appendices. These should contain the listing of any code used during the study together with suitable acknowledgements for the source of code that has been borrowed from other programmers.

The report should be handed in at the start of the lecture on Thursday 30th November 2005. Extensions will only be granted in exceptional circumstances and they should be requested as soon as possible. Extensions for equipment failures may be granted provided that you let me know as soon as they occur so that I can have them fixed as soon as possible. Please make sure that you keep back-up copies of all of your work and include a plagiarism statement using the standard ‘pink form’. The following marking scheme will be applied:

- 15 for the method;
- 10 for the results;
- 15 for the conclusion;
- 10 for the technical documentation.

All solutions must be the work of the individual submitting the exercise and the usual plagiarism form must be attached to all solutions. All questions about this exercise should be addressed to Chris Johnson.

References

[1] Erik Hollnagel, David D. Woods and Nancy Leveson, Resilience Engineering: Concepts and Precepts, Ashgate Publishing, Aldershot, UK, 2006. ISBN 0 7546 4641 6.