- **Success in the face of uncertainty: human resilience and the accident risk bow-tie**

Linda Bellamy, White Queen BV, The Netherlands

Abstract

The research addresses success rather than failure and the topics of resilience, improving management of safety and whether resilience concepts can be integrated into classical bow-tie approaches. The Dutch institute RIVM has an interest in scenario-based methods using their bow-tie structured accident analysis tool Storybuilder™[1], [2], [3]. The bow-tie is a linear model with a focus on the negative, the already occurred accidents. The aim is that resilience modelling will be a mirror of this in being proactive rather than reactive in the face of unanticipated scenarios. The research aims to unite the strong points of both failure and success, focusing on the mental models of people delivering success in handling uncertainty.

A consortium of experts, known as the Resilience Success Consortium, will carry out the work. The consortium consists of the following persons and organisations:

- Dr Linda J. Bellamy, White Queen BV, the Netherlands – Coordinator, assistance with mental modelling, some interviewing (process industry)

- Anne van Galen MSc, Consultant, France – Interviewing and development of show cases

- Dr Ioannis Papazoglou & Dr Olga Aneziris, NCSR Demokritos, Greece – Modelling barrier successes in the bow-tie

- Ir. Hans Baksteen, Rondas Safety Consultancy BV, the Netherlands – Hands-on Storybuilding of positive cases and lessons learned from accidents

- Dr Nijs-Jan Duijm & Dr Kirsten Jorgensen, DTU Department of Management Engineering, Denmark – Assist with formalisation of success modelling within the bow-tie and with practical implementation strategies.

- Arthur Dijkstra, Pilot (Captain B777), management system modeller – Expert reviewer role on intermediate & final products and interviewee.

A resilience questionnaire, focused on how people mentally model the changing risk environment, will be developed for interviewing people who have to deal with high risk control problems. This evaluation will start with mountain climbing and tactical military training where there is proven success in the face of uncertainty and be followed up by interviews concerning management of major hazard (petro)chemical installations and dangerous maintenance tasks. The result will be information on the mental characteristics of people that manage high risk environments resiliently, and how this interfaces with the organisational context, providing inspiring case studies in this regard across sectors, which will help determine what organisations should do to stimulate resilience within their own human capital.

The mental modelling work will be incorporated in the publically available Storybuilder™ bow-tie tool. Structural and reliability modelling will be done to see how the bow-tie, a well-known risk management tool, can be improved for incorporating the resilience factor such that qualitative and quantitative bow-tie outputs will encompass the success

factor rather than failure. The model already contains safety barrier failure modes which have been developed around a human-technical model. This research will concentrate on the currently undeveloped success modes. The model will finally be filled with a demonstration set of accident scenarios to show how negative events can be translated into a showcase of positive lessons.

The outcomes will benefit current users of bow-tie modelling by providing lessons learned on resilience which will be offered to sector organisations of participating businesses as well as organised learning opportunities provided through a website, webinars and a workshop.