BU STUDENTSHIPS 2022

PROJECT DESCRIPTION

PROJECT TITLE
Automated Risk Management
PROJECT SUMMARY
Between the climate crisis, political tension and other rising threats, the era of cascading risk across and between enterprises is here to stay. To survive in this new era, governments and businesses will need the capability to identify early indicators ahead of risk events, and to act proactively to mitigate those risks before they become disruptions. Today, enabling these capabilities will require a risk management program that blends data science, automation and Artificial Intelligence (AI). While risk management is extensively used across many fields, most processes and implementations are largely manually based, which places a high cognitive burden upon a risk manager, particularly in complex and highly dynamic environments. Complexity arises because of the many factors that can influence a decision and the uncertainty of the external environment (Cleland-Huang 2016). An entirely automated process is often inappropriate because human risk appetite changes with context (Flemisch et al. 2012). While risk is often interpreted as being related to avoidance or the prevention of unwanted outcomes (International Organization for Standardization 2018), it is also important to consider risk in relation to opportunities so as to maximise achieving positive outcomes and not miss taking opportunities as they arise. Fundamentally, risk management is about balancing positive and negative outcomes, which is challenging in dynamic, complex situations where humans rapidly run out of cognitive capacity to make timely and effective decisions. This project will consider different approaches to automation (e.g. rules-based, expert systems, recommender systems, machine learning), and assess the role they could play in risk management systems. It will also consider how risk appetite can be elucidated from an operator and used to modify and automated processes in real-time. A key outcome from the project will be to understand/demonstrate what the appropriate level of automation/cognition is for risk management systems, and how it can be achieved. A novel aspect of this research is the automation of risk management when risk appetite, risk tolerance, and risk thresholds are constantly changing, as occurs in fast-paced military operations. Many systems exist as part of a system of systems, and so do not entirely operate in isolation. Where a number of these independent systems collaborating to achieve a new combined purpose operate manual and automated risk management processes, there may be unwanted interactions and emergent behaviours that may be unaccounted for and undesirable (Boardman and Sauser 2006). Thus, later stages of this project will consider automated risk management in a system of systems enterprise risk management context, which is another novel aspect of this research.

The objectives of this project are:

1. Investigate existing automated risk management solutions through systematic literature review and analysis of best practices from industries such as defence, healthcare, finance, transport and utilities.

2. Identify automation improvements that can be made to different phases of the real-time risk management process with the appropriate level of automation/cognition that can be embedded into the risk management systems.

3. Determine the applicability of the automated risk management in Systems of Systems and Cyber Physical Systems, and identify an approach to automate the co-ordination and collaboration across constituent systems.

4. Develop an evidence-based approach, supported by a prototype toolkit to enhance risk management through automation by considering different approaches to automation (e.g. rules-based, expert systems, recommender systems, machine learning).

5. Validate the approach through application to existing case studies and subject matter expert feedback.

6. Derive a set of guidelines and recommendations for the exploitation and dissemination of the automated risk management in an enterprise risk management context.

The project will be based around a number of use cases to ensure relevance of the research and to enable technology transition. Potential examples of management systems include: electromagnetic operations management, security management, and radio spectrum management. Research outcomes will demonstrate automated risk management in a real-world relevant application where such technology has not previously been demonstrated.

ACADEMIC IMPACT

Risk management of a large, complex enterprise, especially in highly dynamic and uncertain environments, is a significant research challenge. This project goes beyond existing research to consider the socio-technical aspects of automated risk management, where the role of the human remains important (Boy 2017), but where technology can better manage the cognitive burden placed upon humans managing risk.

The PhD research work is timely and innovative dealing with important research questions. There are at least four types of academic impact that will be achieved through this project:

1. Scientific output should be published in high-impact journals and conferences;

2. Networking: the candidate will collaborate with researchers from BU and The Defence Science and Technology Laboratory (Dstl);

3. Prototype: the project will deliver an automated risk management demonstration in a relevant application;

4. Research roadmap: in collaboration with the sponsor, the project will identify future R&D activities required to transition the research into deployed systems.

This research will have cross-disciplinary academic impact. For example, colleagues from the BU Psychology Department will be involved when addressing the challenges centred on the high cognitive burden place upon risk managers, and the benefits of introducing automation.

Previous collaborations (e.g. two matched funded PhDs) with Dstl contributed to an impact case study for UoA11, and it is envisaged that the current PhD proposal will contribute to a future impact case study for the next REF.

SOCIETAL IMPACT

Many real-world situations, including military operations, are dynamic, uncertain, and highly complex. Risk management in such situations needs to operate at the speed of environmental changes, which can only be achieved with automated risk management. In a Defence context, effective risk management helps commanders make better informed decisions, which saves lives. The technology offers benefits to other sectors (such as healthcare, finance, transport, utilities, cyber security, and others), including:

- Operating efficiency: Automated risk management enables businesses to work more efficiently by streamlining workflows and replacing error-prone manual processes with accurate automated ones. This reduces cycle times and lowers staffing costs.

- Optimal use of labour: With relief from the burden of mundane tasks, risk managers can instead focus their time and energy on value-added, mission-critical priorities. Not only does this boost morale and aid employee retention, it can also positively impact the bottom line.

- Increased productivity: By combining risk management with machine learning and cognitive technologies to create intelligent operations, automated risk management accelerates productivity.

- Better customer experience: Because automation reduces cycle time when compared to paper-based manual processes, the entire risk management process can be completed more quickly and accurately. As a result, businesses deliver a better customer experience and reduce customer churn.

PGR DEVELOPMENT OPPORTUNITIES

This project offers a very interesting learning and training opportunity for the candidate. Different subjects are involved in the project such as risk management, systems engineering, human-machine interaction, machine learning, cyber security, etc. Issues like project planning and management will also be part of the learning process. The candidate will be exposed to the academic and industrial environments, having access to periodic secondments at Dstl (subject to security clearance). Dstl will support the student in understanding different applications of the technology developed, and will facilitate meetings with users of the technologies to help understand future applications.

While at BU, the candidate will receive research-based training. At Dstl, he/she will become familiar with research and development in the industrial setting, and will be given insights into the exploitation of the results of this project. The candidate will gain various skills, especially scientific skills, employability skills, and industrial experience from

interacting with the industrial partners. Moreover, the candidate will have the opportunity to interact with local and international researchers. Last but not least, he/she will be expected to attend international conferences to present the research findings conducted during the project. Huseyin Dogan

BU has various MSc programmes, including MSc in Data Science an AI, and MSc in Cyber Security and Human Factors. The candidate will have the opportunity to gain some applicable teaching and marking experience within the bounds permitted by the terms of the studentship.

The candidate will also have the opportunity to collaborate with the Defence BattleLab in Dorset to use their facilities and have access to expertise for test cases and running experimentations. There will be a secondment opportunity at the BattleLab due to existing collaborations between BU, Dstl, and BattleLab.

References

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Cleland-Huang, J., 2016. Stakeholders on the prowl. *IEEE Software*, 33 (2), 29-31.

Flemisch, F., Heesen, M., Hesse, T., Kelsch, J., Schieben, A. and Beller, J., 2012. Towards a dynamic balance between humans and automation: authority, ability, responsibility and control in shared and cooperative control situations. *Cognition, Technology & Work*, 14 (1), 3-18.

International Organization for Standardization, 2018. ISO31000: 2018 Risk management-Principles and guidelines. *International Organization for Standardization*, Geneva, Switzerland.

SUPERVISORY TEAM	
First Supervisor	Huseyin Dogan
Additional Supervisors	Duncan Ki-Aries, Nan Jiang, Chris Williams
Recent publications by supervisors relevant to this project	Ki-Aries, D., Faily, S., Dogan, H. and Williams, C., 2021. System of Systems End-to-End Information Security Risk Assessment with OASoSIS (SUBMITTED). *Computers and Security*. M'manga, A., Faily, S., McAlaney, J., Williams, C., Kadobayashi, Y. and Miyamoto, D., 2019. A normative decision-making model for cyber security. *Information and Computer Security*, 26 (5), 636-646. Fan, B., Ma, J., Jiang, N., Dogan, H. and Ali, R., 2019. A Rule Based Reasoning System for Initiating Passive ADAS Warnings Without Driving Distraction Through an Ontological Approach. In: *SMC 2018: IEEE International Conference on Systems, Man, and Cybernetics* 7-10 October 2018 Miyazaki, Japan. , 3511-3517. Ki-Aries, D., Faily, S., Dogan, H. and Williams, C., 2018. Assessing system of systems security risk and requirements with oasosis. *Proceedings - 2018 5th International Workshop on Evolving Security and Privacy Requirements Engineering, ESPRE 2018*, 14-20.

	Ki-Aries, D., Faily, S., Dogan, H. and Williams, C., 2018. System of Systems Characterisation assisting Security Risk Assessment. In: *IEEE 13th System of Systems Engineering Conference* 19 June-22 April 2018 Paris, France. IEEE. M'manga, A., Faily, S., McAlaney, J. and Williams, C., 2018. Rationalising Decision Making about Risk: A Normative Approach. Proceedings of *the Twelfth International Symposium on Human Aspects of Information Security & Assurance (HAISA 2018)*, 263-271. M'manga, A., Faily, S., McAlaney, J. and Williams, C., 2017. Folk Risk Analysis: Factors Influencing Security Analysts' Interpretation of Risk. In*: 3rd Workshop on Security Information Workers* 12-14 July 2017 Santa Clara, USA. *Proceedings of the 3rd Workshop on Security Information Workers* Usenix Association. Ki-Aries, D., Dogan, H., Faily, S., Whittington, P. and Williams, C., 2017. From requirements to operation: Components for risk assessment in a pervasive system of systems. *Proceedings - 2017 IEEE 25th International Requirements Engineering Conference Workshops, REW 2017*, 83-89. Ki-Aries, D., Faily, S., Dogan, H. and Williams, C., 2017. Re-framing "The AMN": A Case Study Eliciting and Modelling a System of Systems using the Afghan Mission Network,. In: *Proceedings of the 11th IEEE International Conference on Research* *Challenges in Information Science* 10-12 May 2017 Brighton, UK.

INFORMAL ENQUIRIES
Please contact the lead supervisor on the following email for informal enquiries: hdogan@bournemouth.ac.uk
ELIGIBILITY CRITERIA
The BU PhD and MRes Studentships are open to UK, EU and International students. Candidates for a PhD Studentship should demonstrate outstanding qualities and be motivated to complete a PhD in 4 years and must demonstrate: • outstanding academic potential as measured normally by either a 1st class honours degree (or equivalent Grade Point Average (GPA) or a Master's degree with distinction or equivalent • an IELTS (Academic) score of 6.5 minimum (with a minimum 6.0 in each component, or equivalent) for candidates for whom English is not their first language and this must be evidenced at point of application. Candidates for an MRes Studentship should demonstrate outstanding qualities and be motivated to complete a MRes in 18 months and must demonstrate: • outstanding academic potential as measured normally by an upper second class honours degree (or equivalent Grade Point Average (GPA) • an IELTS (Academic) score of 6.5 minimum (with a minimum 6.0 in each component, or equivalent) for candidates for whom English is not their first language and this must be evidenced at point of application.
ADDITIONAL ELIGIBILITY CRITERIA

HOW TO APPLY

Please complete the online application form by **31 January 2023**

Further information on the application process can be found at: www.bournemouth.ac.uk/studentships