An Interview with Adam Hepworth: An Operations Research Systems Analyst

Samuel Cox (SC): How does a Transport officer end up an Operations Research Systems Analyst (ORSA)? Is your career replicable for others who share your interests, or are you a one-off?
Adam Hepworth (AH): I've held a lifelong affinity for Science, Technology, Engineering and Mathematics (STEM), and was fortunate to be sponsored by the Australian Army to do one of the top Master of Science in Operations Research programs in the world at the United States Naval Postgraduate School (NPS) in Monterey, California. I completed 41 coursework subjects and a 15-month research thesis in my two years studying there.

So, yes, it's replicable and the ORSA stream is available to those in Army who have the interest. Eight people from Army have gone through the program over the past 20 years, and while you might expect people with the necessary skillsets to be found in RAEME (the Royal Corps of Australian Electrical and Mechanical Engineers) and Engineers (Royal Australian Engineers), the reality is we've had Medical, Infantry and Transport personnel complete the program too.

The ORSA stream doesn't select for people with a specific corps skillset, but those with the right academic skills; an undergraduate and/or graduate level background in mathematics, computer science or engineering. That's currently not a prevalent skillset within Army, and our recruiting is targeting people with highly quantitative STEM degrees.

It's important that we have a diverse range of personnel studying to be ORSA's so that we don't have a bias for one perspective that then skews how we use certain methods, models and tools in our work for Army.

I think of myself as corps agnostic. While I'm not personally suited to becoming a Transport Officer Commanding (OC), the ORSA skillset I now have can be applied across all of the staff functions. ORSA's never work in isolation; we are the technical experts that partner with domain experts. We can go from working on, for example, a personnel or training problem, to information warfare, to building an evaluation framework for assessing Australia's military strategy.

SC: What is an Operations Research Systems Analyst? As a professional quantitative analyst, what do you within the Australian Army?
AH: We're a senior leader decision support tool. Like any Staff Officer within a headquarters, we provide advice that empowers our senior leaders to make better decisions. We try and distil all of the relevant information that exists in order to find the 'critical path' or 'true signal' so that senior leaders can make the best decision possible for the future Army. We reduce the noise.

SC: That's how [Lieutenant Colonel Robin Smith describes the role of Artificial Intelligence](#) (AI); reducing the noise in order to provide a senior leader with the clearest information needed to make better decisions.

AH: That's correct, but the difference between my role and AI is that I also design the AI. At NPS my research thesis explored Multi-Armed Bandit Reinforcement Learning. That's a type of AI system that you can employ to maximise the reward and understanding for a problem in which we trade–off exploration and exploitation.

I applied this idea to military intelligence, where we only have a finite number of analysts that can search through all the sources and their associated documents. We want to intelligently discard sources that may not be relevant for a certain context. The AI system I developed at NPS augments and supports an analyst using a multi-arm bandit approach.

A multi-arm bandit is best understood through this analogy: imagine there's a number of slot machines before you and you want to determine which is the 'best' (giving the greatest pay-off over time). A multi-arm bandit can help you find a way to explore those slot machines while spending as little money as possible, trying to make sure that you find the slot machine which gives you the best return.

There are three main areas within Operations Research that assist with decision making that we use: stochastic modelling, data science, and mathematical programming.

Stochastic modelling includes areas such as probability modelling and queuing theory. We're trying to look at problems in terms of systems and defining the uncertainty within that system in order to better understand system dynamics. Data science refers to both farming and mining large data sets in order to find key causal information and predictors to support decision making. Lastly, mathematical programming optimises a system (like airline schedule routing, crew work-rest ratios, etc.) from a mathematical perspective.

In the last six months of study at NPS, you apply everything you've studied to various military contexts, which is where Army gets its value out of sending you to study there. We studied combat modelling, campaign analysis, operations analysis and analytical wargaming. For example, I did work during this period for the United States Pacific Fleet. We used shipping data, essentially GPS tracks of shipping routes, to inform where the Pacific Fleet should place different sensors, platforms and effectors throughout the region to achieve optimal influence results.

Our potential adversaries are working as hard, potentially even harder, as we are on problems like this. If we're not dedicating assets and resources to this field, then we're going to start a future conflict already behind.

SC: What sort of projects are you undertaking at the Land Warfare Laboratory?
AH: As I briefly mentioned earlier, we recently helped frame the way Australia's military strategy could be assessed and evaluated. We used a systems-thinking approach to enable us to really deeply understand the problem and its root causes.

SC: Is that work more like creating a framework like the Military Appreciation Process (MAP) which is designed to help someone uncover and address what the real problem is, or more like an After Action Review (AAR) which wants to assess and evaluate something after it occurred?

AH: It's actually a combination of both. We're asking, 'are we doing things right?' and 'are we doing the right things?'. So, if you turned the MAP and an AAR into math and code, then that's one of the services that the Land Warfare Laboratory provides. Another project centres on information warfare. It's one of Army's forward-leaning projects at the moment where we're designing the evaluation framework and analytical plan.

SC: Information warfare can be both offensive and defensive. Which is the Australian Army doing?

AH: Army is scoping the problem at the moment; we do have a unit and people (primarily from the Intelligence and Signals corps) on the task. Army is looking to understand what the spectrum of possible options are to determine where priorities lie and what future capability could look like. It could be a combination of both.

SC: We teach our junior leaders about 'the art and science of tactics'. Am I correct in thinking that the role of an ORSA nests firmly within the 'science of tactics'?

AH: Spot on. We're not trying to replace commanders in the field who are employing the 'art of tactics'; there's a harmony between both our roles. We're either operating at the very low level to understand what the best capability for a commander is, or we're at the extremely high level considering a concept of operations for a campaign or theatre of war. We can help ensure that when tasks are given to a commander, they are the right tasks.

SC: You're currently undertaking a Doctor of Philosophy in Computer Science with a focus on autonomous agent trust and swarm intelligence. What are some key points from your research?

AH: I'm trying to understand if we can identify the decisional change points of an adversary commander through the observation of spatiotemporal data. I want to determine when an enemy commander has made a new decision that's beyond the sensor range of individual friendly callsigns.

SC: What do you think is the most important issue facing Army right now?

AH: I think we could invest more in the space and information domains in order to keep up with the rate of technological change in those areas being driven by potential adversaries, as well as research and science communities.

Adam Hepworth is the Senior Operations Research Systems Analyst working in the Land Warfare Laboratory at Army Headquarters. Adam is one of two qualified and experienced Operations Research Systems Analysts in the Australian Army, employed in role. He is a graduate of the Naval Postgraduate School Operations Research program and is presently studying a Doctor of Philosophy in Computer Science, part-time through the University of New South Wales.

For more on Major Adam Hepworth's work and research, watch this interview with a local TV show conducted during his posting to the United States and connect with him on LinkedIn. His research thesis from the United States Naval Postgraduate School is available here.

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