id #17685

Children are our future: Collaborating with young SPs in paediatric simulation-based education?

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The involvement of young people as SPs is challenging to negotiate with many practical considerations & ethical challenges. Through interviews with young SPs and health professions educators, and a comprehensive review of literature, this research identified positive aspects of engaging young SPs. However, it also revealed complex challenges, not least of which is the ethical imperative to safeguard their development & wellbeing in environments where this may not be a simple undertaking.

While young people are not routinely employed as SPs, there is an increased interest in their involvement in SBE given the challenges associated with securing paediatric clinical experiences. Young SPs can make a valuable contribution, & many value their SP experiences for developing acting skills, confidence, financial gain and their ability to influence the preparation of future health professionals. However, young SPs also acknowledge some roles can impact their wellbeing in the short and longer term.

Significant harm can arise from a variety of sources including the environment, preparation & support programs, expectations of the role & the need to provide learner feedback. Although acknowledged as important by research participants, it was apparent that adherence to core ethical principles varied & this had potential to manifest as adverse outcomes for young SPs.

Practical considerations include numerous HR requirements & creating suitable environments with qualified staff to prepare, train and support young people. Consistency of role portrayal, particularly for assessment is also a barrier to involvement. The spectrum of challenges is often regarded as so cumbersome that engaging young SP is avoided.

Children & young people can be a valuable addition to SBE regardless of the considerations & challenges identified. However, the need to safeguard their wellbeing must usurp all other considerations and potential adverse effects mitigated or removed before young people are exposed to SP roles.

id #17925

TIME, PLACE, SPACE: pilot case study on the reality of simulation training during COVID-19

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COVID-19 saw a persuasive pivot to online and hybrid teaching practices, bringing new instructional challenges for teachers in the creation of authentic learning experiences. This paper details a practical response to the reality of simulation training during COVID-19.

Faced with student cohorts working remotely and locked across diverse national and international locations, we were confronted with the need to create new approaches to classroom teaching. This pilot case study documents an experiment held at UNSW in extending clinical simulation-based learning experiences across time, place and space.

The challenge presented was twofold: tackling remote distances as well as engaging two discrete cohorts, each with its own learning needs. We developed a collaborative clinical simulation model to

engage simulation design students from the faculty of ARTS, DESIGN & ARCHITECTURE and clinical simulation students from the faculty of MEDICINE & HEALTH bringing the two disciplines together and building a bridge between simulation users and simulation designers. Currently, there are no education models that combine these two differing cohorts.

The model included four phases in which the learning objectives, scenario, supporting resources and clinical simulation were designed, piloted, rated, and debriefed. Participant feedback provided an understanding of the need for synergy between users and designers for future simulation development. While technology facilitated the exchange, the socio-technical complexity proved challenging for a smoother approach to this new way of working together.

id #17947

Human impacts for educators who assume simulated patient roles

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Background and Aims

Internationally changing clinical environments, complex patient presentations, and health service funding restrictions have led to changes in the delivery of healthcare education. This has become a stimulus for educators to innovatively increase the use simulation as a teaching method.

However, evidence of psychological harm and emotional discomfort has occurred for students and voluntary or paid people during simulations. While concerning, best practice strategies are suggested to minimize risk to these cohorts. But healthcare educators also assume simulated patient roles; yet their experiences and potential risks are seldom contemplated.

This qualitative study aimed to provide an understanding of what impacts healthcare educators' experiences of assuming simulated patient roles, through the construction of a substantive grounded theory. The research questioned; How does assuming simulated patient roles impact healthcare educators?

Methods

Guided by constructivist grounded theory methodology this study gathered data via interviews from nineteen healthcare educators who assume simulated patient roles. Simultaneous data generation and analysis by coding, memo writing, storylining, flipflopping, and category development led to the construction of a theory.

Results

The theory of splitting self when assuming simulated patient roles constructed from this study composed the core category as coexisting altruistically and egoistically. Healthcare educators have an unselfish concern for the welfare of others, in this case student learning while enduring a situation that creates internal conflict but provides them with satisfaction. The main categories constructed included professional and personal responsibilities to student learning, transference and personal immersions and an internal conflict between personal needs and perceived needs of students.

Conclusion

This research offers thought provoking consideration of healthcare educators assuming simulated patient roles. The availability of the constructed theory potentially will guide the development of simulation policies, guidelines, and health professional curricula adding to the continuation of creative, innovative, energised, and ethical practice in simulation.

id #17961

"Welcome to Sonivale": a virtual community supporting authentic, contextualized learning in the Bachelor of Nursing

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The School of Nursing maintains a strategic focus on creating innovative ways of teaching and assessment that are contemporary, authentic and engaging for students with diverse learning needs, backgrounds, interests, and worldviews. To this end, case studies, experiential and simulation-based learning opportunities have been a mainstay in the nursing curriculum. Whilst these approaches go some way to developing clinical reasoning and related nursing skills and knowledge, they are often limited by their siloed use within single units; the one-off or point-in-time focus on specific health conditions and the clinical response to these (nursing activities and clinical skills); and/or minimal consideration of the broader health, social and cultural environment (community) as a key determinant of health and wellbeing.

To address these limitations, the School of Nursing has developed a virtual community, **Sonivale**, to be used within the Bachelor of Nursing (BN). This forms part of a suite of simulation activities and resources designed to bring context and realism to the learning experience. Sonivale is an online teaching application involving a fictional community with multiple intersecting and unfolding features, character stories and scenarios. Although fictional, Sonivale reflects the demographics, strengths and challenges of a typical semi-rural community in Australia. Sonivale provides contemporary, real-world perspectives for the people, places and resources that students engage with in their learning and practice (placements), supporting the BN to capitalize on the “power of context”.

This presentation will introduce Sonivale and highlight the design and pedagogical principles and considerations that informed the initial development of this virtual community, with particular emphasis on what we have achieved without a dedicated budget and within the limitations of existing learning technologies and platforms at the University of Tasmania. Our vision for the future, opportunities for multi-disciplinary collaboration and the potential use of this approach beyond nursing, will also be explored.

id #17964

Impact of classroom-based MASK-ED™ (KRS simulation) on physiotherapy student clinical performance: a randomized cluster trial

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Background:In physiotherapy, research into the benefits simulation could have in the university-setting, prior to the commencement of work-integrated learning, is expanding. MASK-ED™ simulation is one form of simulation that could be beneficial in improving clinical performance. MASK-ED™ simulation involves an educator donning a silicone mask and portraying a patient role, specifically developed to meet learning objectives.

Objective:To evaluate the effectiveness of MASK-ED™ simulation compared to role-play with peers for training pre-clinical physiotherapy students.

Methods:A single-centre, single-blind, cluster randomized (by tutorial groups) trial with concealed allocation, between group post-measures, and intention-to-treat analysis was conducted at an Australian university. Participants:144 physiotherapy students (exp n= 70, con n= 74) undertaking their neurological curricula. The experimental group was exposed to MASK-ED™ simulation in five out of a potential thirty-two tutorials (16%), the control continued with role-play with peers. The primary outcome measure was Assessment of Physiotherapy Practice scores from the students’ rehabilitation work-integrated learning clinical placement. These were compared between the experimental and control groups using Mann–Whitney U tests. Secondary outcome measures include practical and written examination scores. These were compared between groups via independent t-tests. Participant satisfaction surveys were also administered to the experimental group.

Results:One hundred thirty-two participants' (exp n=62, con n=72) results were analysed. There were no significant differences between the experimental and control groups for Assessment of Physiotherapy Practice scores (p=0.699–0.995) or across the secondary outcome measures. Participants found MASK-ED™ simulation was somewhat helpful for preparing them for clinical practice, however felt that a group setting was not as effective as a one-on-one encounter would have been.

Conclusions:MASK-ED™ simulation was no more effective than role-play with peers in preparing physiotherapy students for work-integrated learning. The influence of the design of simulation on effective learning and the number of classroom-based simulation encounters required to impact clinical performance requires further investigation.

id #18014

A Systems, Modelling & Simulation Framework for the Assurance of Maritime Autonomous Systems

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The ever-increasing introduction of Robotic and Autonomous Systems with Artificial Intelligence (RAS-AI) is driving the need for standardised approaches for their formal assurance. At present, there is no set of agreed regulatory requirements, standards, or processes applicable to the technical assurance of RAS-AI technology in a maritime context. This effectively means that it is not possible to properly certify Maritime Autonomous Systems (MAS) in a way that is consistent with the approaches applied to crewed vessels.

This presentation applies a systems, modelling and simulation lens to assurance of MAS. It opens with a look back at the challenges of safety that resulted from the innovation of flight, and the creative innovation that emerged to mitigate the safety risks to pilots and transformed aviation into perhaps the safest and most effective of societal contemporary capabilities. It will then highlight the underpinning principles that enabled this transformation and present an exaptive view in their application to the present-day challenge of MAS assurance specifically, and autonomous systems in general.

It will conclude with describing a conceptual solution for the assurance of MAS, that builds on foundational concepts from systems engineering and high-fidelity modelling and simulation, identifying core functionality, and key external and internal interfaces. Associated research initiatives and opportunities will be identified.

id #18035

Choose your own adventure. Enriching undergraduate nursing simulation using a video QR code gaming concept.

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The use of patient simulation mannikins are ubiquitous in the teaching of clinical skills to undergraduate nursing students. The use of mannikins can range from the teaching of foundational skills such as pulse assessment, to more advanced skills such as cardiopulmonary resuscitation; however, regardless of the skill being learnt or the fidelity of the mannikin being used, the teaching is often reliant on the direction of the academic staff member. Moreover, when using mannikins with a large undergraduate student nurse cohort, kinaesthetic learning is often promoted over 'soft skill' learning such as teamwork, communication and problem solving.

To create a more student-centred learning approach whilst using mannikins and to promote 'soft skill' learning, a '*choose your own adventure*' game concept was developed. Within this concept students would choose a small number of QR codes from the larger selection available, with each QR code delivering a video vignette that would provide additional information for the mannikin being cared for. Students would then use the combined video and mannikin assessment to formulate a plan of action. Due to the self-selection of QR codes, each student was afforded a different scenario and learning

experience. Not only did this concept foster self-directed learning, but due to the need to work together and analyse information, increased communication, teamwork, and problem solving were also seen.

The highlighted benefits of augmenting patient simulation mannikin learning with the use of a video QR code '*choose your own adventure*' gaming concept will form the basis of this Australasian simulation congress presentation. Whilst still in its infancy, anecdotal reports from students and staff confirm the value of this approach and the benefit to student learning. Following an increased rollout, research is planned to evaluate the benefit of and student experience with using this simulation gaming concept.

id #18044

Immersive holographic mixed reality nursing - the students experiences

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Mixed reality (MR) technology enables learners to interact with holographic virtual content, which is integrated into the physical context via the students applying head mounted displays. Research studies have made initial links to increasing clinical judgement, enthusiasm, and engagement. However, there is an absence of the students' voice and their experiences, and a dearth of research and exploration of this topic are not yet fully explored.

This qualitative hermeneutic phenomenological research design follows philosophical approach (van Manen, 2014). Data has been gathered via interviews of pre-registered nursing students internationally who have experienced Mixed Reality. van Manen's (2014), six interwoven research activities, existential methods and themes guide the analysis of the data.

Initial results focused on the themes of immersion and visualisation within clinical conditions. A further theme was, Self-reflection by students experiencing MR. This assisting in solidifying knowledge experiences while providing confidence of transferring these skills safely into the clinical environment.

This study highlights the students voice and provides beginning outcomes relating to the MR phenomenon. These findings have the potential to impact and influence change within nursing education while contributing to increased safety of our students when in the clinical environment. This research highlights the need to ensure the true essences of the MR phenomenon is discovered, promoting the voice of the student internationally.

Very few studies have focused on the experiences of the nursing students using this simulation modality, this research provides a voice of the student on an international platform.

id #18045

An applied harm minimisation game for alcohol and other drug education for high school students

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In Australia, alcohol and other drug (AOD) secondary school education is delivered within the Health and Physical Education (HPE) curriculum, yet several factors can impede traditional AOD education programs efficacy, including non-engaging and non-interactive delivery of subject material, cumbersome upskilling and/or training requirements for teachers, and implementation issues.

Online and computer-based AOD education programs targeting adolescents have demonstrated reductions in intentions to engage in AOD use, and AOD-related harm. A novel application of digital

technology in classrooms is the use of serious games for educational purposes. Serious games have shown to be effective in improving knowledge, motivation to learn, general problem-solving skills, strategic thinking, and cognitive skills, and have begun to be trialled in AOD school education settings.

This project leveraged the seven-step *systematic and iterative user-centred development framework* for the development to produce *Sideffect GamePlan*, an AOD serious game module developed for use by Australian secondary school teachers with students in Years 9 and 10. The seven-step framework included: (1) Forming an expert multidisciplinary design team, (2) Defining the problem and establishing user preferences, (3) Incorporating the evidence base, (4) Serious game design, (5) Incorporating behaviour and psychological theory, (6) Developing a logic model, and (7) User testing.

High school students, HPE teachers and parents were engaged throughout development to provide feedback on promoting engagement, acceptability and usability of the game amongst both students and teachers. Overall, participants rated game acceptability and usability favourably and would recommend the game for learning about AOD.

Sideffect GamePlan has been approved by the Australian Government Department of Health and Aged Care for national dissemination, was awarded the Research and Innovation Project of the Year at the 2022 West Australian Information Technology and Telecommunication Alliance INCITE Awards and came runner-up at the 2022 Australian Information Industry Association National iAwards (Not-for-Profit/Community Solution).

id #18053

Exploring the Capabilities of Cameo Systems Modeler to Integrate and Operate Lego Mindstorms Hardware

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Effective modeling and integration are important capabilities critical to a systems engineer. This involves breaking down complex systems into simpler parts and presenting them in a way that is less complicated to understand. To perform such tasks, systems engineers are educated to use advanced software tools and standardized modeling methods. Cameo Systems Modeler (CSM) is a systems engineering tool that enables not only systems architecture design but also more in-depth modeling and simulation. CSM's extension, Cameo Simulation Toolkit, allows debugging and validating system behavior by executing parametric models in the context of realistic mock-ups of the user interface. This paper provides an example of integration of the digital model of a weapon system created using Systems Modeling Language (SysML) with a mockup of a physical system to enable hardware-in-the-loop simulations to explore system performance and verify requirements. Specifically, the Mk 15 Phalanx Close-in Weapon System deployed on U.S. Navy cruisers and destroyers is modeled by structure and behavior diagrams in CSM and then integrated with a mockup of a physical system built using a Lego Mindstorms EV3 development kit. Lego infrared sensors receive inputs and send data to the model made in Cameo. The Cameo model reacts based on changing inputs and sends control signals to Lego motors. The paper provides a detailed integration guidance developed as part of a Master's thesis, discusses achieved functionality, and reveals certain limitations pertinent to the current capability of Cameo to make connections between the SysML model and Lego hardware. Adding a few additional functions to the EV3 library in Cameo is expected to increase the level of control of the Cameo software over the Lego hardware to allow for more realistic simulations enabling extensive parametric and trade-off studies to be conducted in safe environments away from the battlefield.

id #18059

Learning from Test Pilots: Risk Management Strategies for Testing Complex Systems

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Test pilots are responsible for testing and certification of new aircraft which can involve a significant level of risk to individuals and their companies. The risk management strategies used by the flight test profession were observed to be multi-faceted, more than the organisational policy required and

conveyed between generations through lore. Grasping the opportunity, qualitative research using survey, semi-structured interviews and thematic analysis was conducted to identify the risk management frameworks used by the flight test community, to be abstracted for use in testing complex systems in any field.

The study of volunteer participants from Australia, North America and Europe was focused on the conduct of flight test with catastrophic consequences by professional organisations inside the last 5 years. Finding that organisations mandated ISO31000 processes with a two-dimensional model of probability and consequence, the study also found that when faced with complex risk, test crews set organisational policy and industrial process aside. While the crews remained compliant with organisational risk policy, flight test culture knows these processes are not adequate for complex risk. When testing complex systems, the outputs of organisational policy are not used for anything and at that point, flight test lore comes to the fore. When testing complex systems with a sample size of zero and no prospect of surviving the first realisation of risk, Test Crews adopt a different approach. They have a risk management framework that recognises intricacy domains and when testing complex systems they implement Precautionary tools in an incremental approach – which is not a linear break-up of the task to the available time.

The findings of the study present organisations testing complex systems with an opportunity to target risk management frameworks – avoiding duplicative processes that people are inherently aware are ineffective.

id #18061

The HIVE Model: Towards an Ontological Approach to Systems Integration and Testing

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This paper introduces the HIVE Model, a new approach for systems integration engineering that emphasises the importance of T&E activities. The HIVE Model aims to overcome the limitations of the traditional SE lifecycles models, especially for complex and large-scale systems by providing a modular and scalable framework that effectively represents the multilevel nature of such systems and their subsystem interrelationships. Traditional models often fail to effectively illustrate complex systems, particularly in relation to various T&E activities. This highlights the necessity for a more advanced SE lifecycles model, specifically in terms of systems realisation. The HIVE Model is built on a modular array of hexagons and features an iterative and scalable approach, incorporating unique properties that significantly enhance the projection of representations of complex systems structures across multiple levels. In this model, iterability refers to the ability to repeat the modelling of upper layers of systems. While scalability denotes the capacity for growth into greater scale and capabilities resulting from iterability across system contexts. In the HIVE Model, each consecutive layer of hexagons represents a different level of systems and is typically linked to neighbouring hexagons and adjacent lower and upper layers. The proposed model has potentials in system integration, including test planning and execution, from two different angles. Firstly, it enables partitioning complex systems into subsystems, defining their components, and effectively illustrating interrelationships between them at a comprehensive viewpoint. Secondly, by breaking down the system into smaller, manageable subsystems, the HIVE model can identify and address integration issues, improving overall system quality by considering interrelationship across multiple levels from a modular viewpoint. In addition to introducing the HIVE Model, this paper critically reviews existing models, such as the V-Model, Waterfall-Model, compares them to the proposed model, discusses the strengths and limitation of each approach, and presents opportunities for future research.

id #18064

Upskilling Australian T&E practitioners for systems of systems test and evaluation.

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In a time of unprecedented geopolitical tension, disrupted global supply chains and technical workforce shortages, the ability to grow a sovereign and sustainable workforce of digitally enabled test & evaluation professionals has become an issue of great national importance.

Specialist test and evaluation professionals in the Australian defence sector often have deep expertise in platform-level test and evaluation. Whilst platform-level T&E skills will always be necessary, the combined effect of the digital engineering revolution with its model-based systems engineering approaches to capability development, and increased reliance on synthetic test and evaluation for system of systems testing, now necessitate senior test and evaluation professionals possess a new set of skills and knowledge.

The results of a training needs analysis which examined the role of the future test and evaluation practitioner as redefined by the digital-engineering revolution, and in the context of system of systems testing will be presented, along with insights into the investment in digital tools an infrastructure required to equip this digitally enabled workforce.

The relationship between the complementary disciplines of test and evaluation and modelling and simulation will be explored in the context of system of system test and evaluation as an enabler for joint force assurance.

The need to upskill Australian test and evaluation professionals in the areas of scientific test and analysis techniques, military experimentation, and digital engineering as indicated by the training needs analysis will be argued.

id #18077

Electromagnetic Spectrum Simulation – Spectrum Simulator for Artificial Intelligence, Machine Learning and Autonomous Systems

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In this paper we present a city-scale Radio Frequency (RF) electromagnetic Spectrum Simulator that undertakes the dual purpose of:

- creating realistic data to enable application of Machine Learning (ML), and
- testing of injecting Artificial Intelligence (AI) and autonomous systems as part of the ecosystem.

Open market simulators exist for waveform modelling (e.g. Matlab), propagation modelling (e.g. HTZ Warfare), network modelling (e.g. OpNet), agent interaction (e.g. JADE) but none of these individually or in any combination meet the above requirements or can meet the need to simulate entities with RF devices at the city scale.

Careful attention has been applied to balance scalability whilst meeting salient model isomorphism requirements. The key modelled attribute is spectrum occupancy, or what electronic engineers would call the power spectrum, across the RF continuum. Deliberate design decisions have been made to use appropriate models of devices and networks (e.g. Bluetooth and Wi-Fi) rather than detailed waveforms and protocols. Similarly, applying complexity in the right places such as verified International Telecommunication Union (ITU) specific propagation models rather than sophisticated and computationally expensive Maxwells equations or overly simplistic and inaccurate power distance models.

The Spectrum Simulator creates “patterns of life” via an agent driven framework where entities perform tasks such as driving to work, recreation and home, undertaking work, recreation and domestic activities. These behaviours drive device usage and hence spectrum patterns of life that in aggregate effect spectrum occupancy.

The Spectrum Simulator has been an essential system for the advancement of the Distributed aUtonomous Spectrum managemenT (DUST) technology that performs advanced autonomous spectrum forecasting, management, and trading; exploiting underlying technologies of AI and ML. The Spectrum Simulator has enabled the investigations, development, and testing of DUST as a precursor to graduating to the physical world.

id #18086

Simulated competency testing in computed tomography (CT) skills

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Radiation therapy (RT) students in their 4th year, work towards achieving competency in performing Computed Tomography (CT) scans for treatment planning in their final six months of training. This is primarily achieved on clinical placement in radiation therapy departments. This year in a pre-clinical workshop all students completed a simulated competency test prior to their placement via CT simulation software, authentic clinical equipment, documentation, and patient actors. All elements of acquiring an RT planning CT were assessed by this method. This gave students prior experience and confidence in gaining competence clinically on placement.

id #18087

ParaVerse - Virtual reality enhanced tactical parachute training

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This project involves a collaboration between the Edith Cowan University (ECU) Simulation & Immersive Digital Technology Group (SIDTG) and the Department of Defence, Special Operations Command (SOCOMD) with expertise contributed from Murdoch University and Curtin University. The project is co-funded by the Department of Defence and the Defence Science Centre (Department of Jobs, Tourism, Science and Innovation).

The project aims are to create an immersive virtual reality (IVR) enhanced parachute mission preparation and training tool for SOCOMD. The primary purpose of the system is to allow users to plan for and practice a descent by parachute into a self-selected area of the world by recreating a portion of the descent under canopy in IVR.

Application development sees completion of a ‘proof-of-concept’ application and initial prototype design. The user can specify a mission configuration and desired landing zone incorporating real-world surrounding topography generated from map data, as well as manipulate altitude and bearing of the parachute at canopy opening. The system creates a first-person view, visualised and displayed through an IVR headset, allowing users to control a virtual parachute from canopy opening to the point immediately prior to landing. Following the IVR experience, the system allows users to review parachute trajectory performance through video playback in first, third, birds-eye and ground point-of-views. Users can also choose to replay scenarios with prior virtual avatars depicting previous jump trajectories, allowing users to follow or consider their new approach in alignment with previous approaches live.

An application to the Department of Defence and Veteran’s Affairs Human Research Ethics Committee has been submitted to evaluate the application amongst 30 SOCOMD personnel. The goal being to ascertain the perceived viability of the prototype IVR system to contribute to and deliver parachuting education and training and mission preparedness.

id #18090

Capture, share and apply Digital Standards in the AECO-Industry by using Linked Data and AI

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In the AECO industry the same information is used over and over again. Think of every project starting with a statement of requirements full of specifications of what an asset should comply to. Or information about solutions from previous projects we look up when designing. And of course all requirements from standards that need to be verified against the design and final products as well as the contract.

Digital Standards are a solution to process requirements, easily reuse information, and share information across companies and software,.

To benefit from Digital Standards, the following steps need to be taken:

- Extracting specifications and requirements from text-based document
- Enhance structure data once and manage it in one place
- Share the information between it-applications and re-use many times

Extracting requirements and specifications from a standard can be a labor intensive task. By using a specific domain of AI called Natural Language Processing (NLP) the extraction of information is automated. Analyzing large volumes of unstructured data, creating structure and deriving meaning from this data is now easily done.

When the information is extracted, the organisation can manage the information in digital libraries. By developing libraries with a clear purpose, the data can be re-used in different ways. Resulting that the information is managed once, but is re-used many times.

To share information between different applications and organizations, the information is published in an Open Standard. With Open Standards for semantics and interoperability (e.g. Linked Data) it is feasible for companies, teams or even individuals to create, manage and publish requirement standards of their own.

Making digital standards and requirements is a challenge on its own and requires rules and agreements within communities. But software and AI help transform documents into models for more consistent management, easier distribution and more helpful applications.

id #18097

Enhance system quality using simulation-based test during the initial stages of the development process

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How often have you delivered your design to your customer only to find out that it wasn't what the customer expected? There are many industry examples of projects that failed due to miscommunication of requirements. The challenges that initial requirements are primarily specified using informal text that are easy to misinterpret, are incomplete or inconsistent.

Furthermore, studies also show that the cost of finding a bug increases over time. For example, finding a software bug while coding on your desktop PC is cheaper than finding that bug on a production hardware that's in the field. The cost of testing increases-- later the defects are found in the development cycle. We need to be able to determine as early as possible if all the requirements are implemented.

Model based design enables engineers to develop complex systems by working at a higher level of abstraction compared to implementation. The visual nature of models and state machines makes it easier to express and understand complex relationships and sequence of interactions. You can use models as executable specifications to enable early validation of requirements through system simulation, then generate documentation and production code from those models automatically. The growth in complexity of today’s systems reinforces the importance of early virtual development including system simulation for testing and evaluation.

id #18108

A Review of Model-Based System Safety Techniques for Complex Railway Systems

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In safety-critical systems, such as those used in aviation, nuclear power plants, and transportation systems, the consequences of failure can be catastrophic. As a result, ensuring that these systems are designed, developed, and operated safely is of paramount importance. By using Model Based System Engineering (MBSE), engineers can model the system's behaviour, identify potential hazards, and evaluate the effectiveness of safety measures to mitigate these hazards. Moreover, MBSE allows engineers to detect and address safety issues early in the design process, before the system is built or deployed. However, applying system safety and model-based safety engineering methods throughout the design and implementation lifecycle of complex railway systems can be challenging. The process

for designing, implementing and integrating software and hardware rail systems and sub-systems varies greatly and demands adherence to relevant standards. Moreover, limited resources, budgets, and tight delivery schedules often impede the seamless application of these methods throughout the entire lifecycle. Adopting a model-based system safety becomes more challenging when considering the geographical and demographical aspects of projects. For example, railway regulations and legislations depending on the jurisdictions impose requirements on Rail Transport Operators (RTO) and Rail Infrastructure Managers (RIM). These regulative and legislative requirements have direct impact on the Safety Management Systems (SMS) that are developed by the RTOs and RIMs and must be adhered to by projects. Hence, it is not always straightforward to apply the same safety analysis models and same level of safety analysis when delivering projects. To address these challenges, a comprehensive review and assessment of common model-based system safety techniques used in railway projects is crucial. This review takes into account projects from diverse geographical locations and railway types, including both passenger and heavy haul systems. The review discusses the advantages and disadvantages of different methods.

id #18114

Creating healthcare realities using jigsaws

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Background and Aim

The use of jigsaws as a simulation method in healthcare education offers innovation and creativity. The use of jigsaws in healthcare education is based on cooperation within groups often referred to as team learning. This is where each participant has a specific task to perform and the responsibility to relay acquired information to others.

Our aim being to explore if jigsaw puzzles are an innovative and energizing simulation method that is beneficial to developing effective teams in healthcare.

Description of the process

We have used jigsaws in multiple teaching settings, including interprofessional education, health promotion, and mass casualty simulations. After each use of jigsaws, we reflected on the experiences and gathered voluntary feedback from students. Our reflections are presented to you as an ethnodrama. An ethnodrama represents, the complexity of lived relationships in healthcare education and offers an alternative to traditional methods of research.

During the presentation we invite you to be part of a new ethnodrama. Your participation is voluntary and will not go beyond the presentation. We will invite you to come forward and participate in a simulation using jigsaws. We together will create an ethnodrama from the experience.

Implications for teaching practice

From our experiences of using jigsaws our reflective ethnodrama had three scenes. Firstly, why jigsaws. Secondly, engaging with students, and lastly, unpacking the use of jigsaws.

We look forward to your reflective ethnodrama to see if your experience is similar. We also invite discussion if using jigsaws is a simulation method.

Conclusion

The conclusion for this presentation belongs to you, the participants. We look forward to sharing our ethnodrama and creating an ethnodrama with you based on your experience of creating a healthcare reality using jigsaws.

id #18131

Western Sydney Local Health Districit Emergency Code Black response revision project

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Following ongoing incidents of violence and aggression in Western Sydney Local Health District (WSLHD) and access challenges to traditional violence prevention training, a project was commenced to overhaul Code Black training for all emergency departments. A research project exploring staff experiences of violence and aggression informed the restructure of processes and procedures surrounding Code Black management. A multidisciplinary team met regularly to review and update multiple elements of the existing Code Black processes. The restructure was implemented across four WSLHD Emergency departments over a period of eight months. The rollout utilised a combination of educational modalities including bedside teaching, electronic and written materials, traditional simulation-based learning and locally developed Virtual Reality (VR) based applications.

In this session, we showcase the education program developed to rollout the restructured response to Code Black. WSLHD in collaboration with the University of Sydney and development partners Frameless Interactive, developed a series of Virtual Reality (VR) based simulation training resources to supplement the restructured training program.

The VR program utilises a combination of passive and interactive, static and randomised 360 video and flatscreen exemplar videos to model verbal de-escalation skills, team assembly, physical and chemical restraint and post event debriefing. Additionally, a prototype VR based, Artificial Intelligence (AI) driven conversational agent was developed to train staff in verbal de-escalation skills.

Formal evaluation of the project and its outcomes is in progress. Early findings indicate the Code Black revision project was well received by staff and since its completion there has been a reduction in both the use of physical restraints and time in restraints across our district.

This project was the recipient of the Simulation Australasia Project Innovation Award 2022

id #18134

Modelling the AAR geometric coupling to expedite receiver clearances

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Air to Air Refueling (AAR) Receiver Clearances comprise a body of testing done to assure the compatibility of a unique pairing of a tanker aircraft with a receiver aircraft. The data collected in test supports a risk acceptance decision to couple the systems in flight. There are many domains that need to be assured (including aerodynamic, electrical, fuel systems, loads and dynamics), with the geometric domain being the physical coupling.

A digital model of the geometric coupling of the tanker/receiver pairing was sought to provide a tool to identify the limiting cases from tens of thousands of combinations in operational use. With two aircraft connected by a boom with its own flight controls, each with 6 degrees of freedom, it is an 18 dimensional problem in the geometric domain. Historically, flight test would use professional judgement to cut down to a few hundred test points of interest, for conduct across a number of test flights. A digital tool holds promise to expedite the conduct of testing for provision of assurance in the geometry of a coupling. Rather than testing a sample and accepting the residual risk, testing would validate the model and the model would then test every point digitally. The level of assurance would be higher, the bounds of knowledge defined, and consequent residual risk reduced. The digital approach would provide greater assurance while requiring far fewer flights – saving flight hours for the tanker and the receiver.

Modelling the AAR problem in the geometry domain in the first instance was selected as being technically challenging (non-trivial and therefore valuable) but achievable, and because it can be visualised, its value easily perceived. This presentation will report on the experience and progress of the team undertaking the development of this modelling approach to test and evaluation of an AAR capability.

id #18135

Peer Patient examinations are feasible, authentic, and predict clinical performance in physiotherapy students.

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Background: Classroom-based examinations prior to work-integrated learning need to be feasible, realistic, acceptable, and predictive. Authentic simulation-based assessments are one way that students' readiness to commence work-integrated learning is being determined.

Objective: To investigated if using *Peer Patient* simulation, where students are trained to act as patients for their peers, during examinations was a feasible and predictive alternative to traditional practical examinations.

Methods: A single-center, mixed-methods, feasibility and predictive study investigated *Peer Patient* simulation during practical examinations. The feasibility of these examinations was determined through the amount of time taken to train senior students and the consistency of their portrayal. Junior students' acceptance of the examinations and their experience were also investigated. Odds ratios were used to examine whether *Peer Patient* Examinations can predict work-integrated learning performance.

Results: 77 junior students (91%) consented to participate. Twelve senior students were trained as *Peer Patients* - they were highly consistent in their patient portrayal (4.5 out of 5, SD 0.3). The time impost on senior students for training was feasible, averaging 10 hours. Junior students rated the examinations as more acceptable than regular practical examinations. Themes that emerged included: examinations were authentic; assisted in the development of the students' professional identity; more practice time would have been beneficial. The odds of failing placement were 10.1 times higher in students who failed their *Peer Patient* Examination, than in students who passed.

Conclusions: *Peer Patient* examinations were feasible, acceptable, and predictive of future clinical performance. Students found *Peer Patient* examinations to be an authentic assessment tool that have the potential to develop their professional identity. The examinations were predictive of work-integrated learning performance which will allow academics to implement targeted remediation prior to students commencing work-integrated learning.

id #18136

Aggression and Violence De-escalation Training using Virtual Reality Technology for Frontline Emergency Department Healthcare Professionals

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Aggression and violence (A&V) towards frontline healthcare professionals (FHPs) occurs daily, placing increasing strain on Australian hospitals. Given traditional face-to-face A&V de-escalation training can be difficult to resource and lacks consistency, there is a need to explore alternative effective training solutions in early aggression identification and de-escalation techniques. Previous studies suggest immersive virtual reality (IVR) can provide comparable training experiences to live training formats, while ensuring standardisation and allowing for more flexibility in delivery. This project designed and evaluated a novel A&V de-escalation training solution for Emergency Department (ED) healthcare professionals using IVR technology.

The project comprised of four phases:

(1) Qualitative focus groups gathering the perspectives of hospital clinicians, management, and work health safety staff on appropriate learning objectives, scenarios, and perceived barriers to implementation.

(2) Formative results and feedback from an expert clinical advisory group was synthesised with corresponding literature to inform comprehensive design documentation.

(3) Education resource development through an iterative review process leveraging the expertise of the Edith Cowan University Simulation and Immersive Digital Technology Group.

(4) A pilot evaluation of the completed resource undertaken with 130 ED FHPs with representation from all three Western Australian (WA) Metropolitan Health Services. Data was collected through self-report questionnaires investigating participant confidence, task difficulty, satisfaction, and system usability. Analyses suggest significant improvements in self-reported confidence following completion of the IVR solution and high levels of resource usability among those with no prior IVR experience, with 90% of participants stating desire for further A&V training through IVR.

This pilot project provides a thorough proof-of-concept and demonstrates clear appetite amongst FHPs for further IVR A&V de-escalation training opportunities. Further evaluation of the resource with undergraduate nursing and paramedic students is currently underway, due to be completed in April 2023. The project was funded through the Department of Health, WA.

id #18137

Rubber Space Pirates: Developing Elastic Organizations

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Socio-technical complexity is the New Normal, yet the thinking required to meet it is not. Complex environments demand ELASTIC organizations: those that can adapt continuously and sustainably; achieve predictable outcomes via surprising methods; and thrive amidst high uncertainty. We need a New Normal for learning, teaching, and leading elasticity. Yet too often, organizational attempts to meet complexity are rooted in 19th-century industrial paradigms for change. Even when billed as digital "transformation," such paradigms emphasize operational efficiency, work invariance, hierarchy, and technology over the development of human dimensions. Cognitive readiness, stress inoculation, and cultural preparedness are left unaddressed as too vague, costly, or (ironically) complex. In certain configurations, commercial off-the-shelf massively-multiplayer online (MMO) games offer underutilized, widely-available scaffolding for developing organizational elasticity. They provide complex operational demands and resource constraints analogous to real-world scenarios. They encourage participants to develop skills essential to elastic organizations, including emotional investment in outcomes, iterative progress, and collaborative evolution. This developmental approach is illuminated using an MMO case study through the lens of human-systems performance consulting. The case study illustrates factors critical to developing sustainable organizational elasticity, as utilized within knowledge-work organizations across multiple industries, over 20+ years coaching, consulting, training, and leadership development experience. These factors include: high environmental complexity relative to goal complexity; a large, diverse, inclusive participant population; indirect coordination through manipulating the environment (stigmergy); and play, i.e.: experimentation to find novel strategies. Additional explorations include possible affordances from generative AI and suggestions for how MMOs may be utilized as part of a curriculum, including implications for briefing/debriefing and evaluation. In April 2022, Simulation Australasia's SimCafe hosted this topic as a webinar; this presentation proposes to share emerging developments on the topic since then. A 5-minute video preview of a related long-format presentation is online at: https://youtu.be/6pX7S8InrWA

id #18149

Revisiting large scale defence acquisition: Evolving a continuum framework to address uncertainty and acquisition responsiveness.

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This article revisits the defence acquisition model from the perspective of future-proofing to conceptualising a new framework which is responsive to uncertainty and changing operational environment. By adapting principles from Beer's VSM with software engineering concepts from DevOps and Agile. The proposed acquisition framework still seeks to address the requirements within the context of existing procurement frameworks. In a rapidly changing operating environment the speed at which innovation can be converted into deployable capability to maintain a competitive edge becomes increasingly important. With expensive assets having lifespans which can exceed 20 years, there is a

greater likelihood that naval assets may become stranded due to technological evolution, driven by competition with evolving adversarial threats. To avert the potential of stranded assets, naval acquisition should be viewed as a continuum that needs to evolve and renew at a pace that is responsive to the changing environmental circumstances. When acquisition decision making gives greater consideration to the ongoing evolution of existing assets alongside production of new assets responsiveness if improved. The article argues the importance of adopting a future-proofing mindset to reduce the cost of deploying new capability throughout the fleet rapidly, and cost effectively moving into the future.

id #18162

Validation of AI Coaching and Feedback in a Field-Tested Virtual Reality Simulation-Based Training Environment

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Developing and validating innovative solutions that train student pilots as effectively as experienced Instructor Pilots (IP) is a priority for many defense and civilian aviator training programs around the world to increase student throughput, minimize impact of IP shortages, and reduce overall training costs. Innovative training paradigms target the development of low-footprint, immersive simulators that maximize training task coverage and training effectiveness in self-paced environments when aptly paired with digital training solutions that can mimic the behaviors and evaluation heuristics of expert IPs. The current study investigated the utility of training using a Virtual Reality (VR) simulation-based training device paired to a next-generation synthetic IP providing real-time coaching and feedback, along with immersive and gamified debrief capabilities aimed to maintain student motivation and engagement. Thirty cadets from a large Indo-Pacific Asian Air Force participated in an hour-long training event practicing basic maneuvers across time. Difficulty was manipulated by alternating time of day. Maneuver performance was assessed automatically by the training system based on syllabus-based criteria. Results show significant training effects across time. Results are further discussed in terms of cadets' perceptions by experience and performance levels. A key finding shows a strong motivational effect for cadets when using the training system. This study is unique as it was filed tested in a germane operational pilot training environment and proves the viability of core aspects for next generation training solutions.

id #18175

Using Tag Team Patient Safety Simulation to prepare nursing students for an acute cardiac event.

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Early recognition and response to deterioration, can improve patient outcomes, reduce invasive interventions, and prevent adverse events, such as cardiac arrest. However, preparing nursing students for a complex situation like this can be challenging. Thus, practice through simulation is vital.

Previously, nurse academics at the University of Tasmania have used small group simulation, with students interacting with a mannikin. Anecdotal reports from academics and students suggested that this approach did not provide the realistic stressors of a deteriorating patient scenario. Students would focus on tasks, rather than addressing issues, such as, identifying the cause of deterioration, escalating for help, or assessing the outcomes of their interventions. Additionally, as students would be working independently in their group, and because of the class size, the academic was not always able to provide immediate feedback, potentially losing teaching moments.

Due to the observed learning issues with a largely student managed clinical scenario, it was decided that an alternative simulation pedagogy was required. Tag Team patient Safety Simulation (TTPSS) was therefore selected as it is designed to maximise engagement, assist with large cohorts of students, and provide a meaningful and realistic simulation. This presentation will discuss TTPSS in the context of an acute cardiac event prepared by an academic in the School of Nursing at University of Tasmania, exploring the design, development, implementation, and evaluation from students.

TTPSS has proven to be an effective approach in preparing nursing students to respond to an acute cardiac episode. Academics reported that during TTPSS, students were able to receive peer feedback, reflect and make improvements in their practice, including, critical thinking, delegation, decision making and escalating care. Additionally, 95% of students identified TTPSS as a valuable learning experience. Further research is planned to evaluate the effectiveness of TTPSS in preparing nursing students for their practice placement.

id #18179

Policy Making for Engineering Grand Challenges – a simulation-based learning strategy

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University students nearing graduation are poised between the reality of study and the real world of work. To help engineering students explore what is involved in successfully transitioning from 'being an engineering student' to 'being an engineer' a simulation-based subject was developed to replicate aspects of that transitional journey. This paper describes design principles, their application in real time and student responses to engagement with an 'as if real' experience intended to be a realistic bridging activity introducing complex interdisciplinary workplace problems into classroom settings.

while engineering appears to be a coherent and uniform discipline, students engage with engineering as diverse, fragmented specialisations (e.g. 'civil, 'chemical', 'environmental') which may seem to have little in common beyond a shared second word in their name. This is more evident in academic settings and less relevant in workplaces where the impact of such efforts as the 'Engineering Grand Challenges' (NAE, 2023) is becoming more evident.

This unit of study was developed for use with final year engineering students to focus attention on interconnections among the diversity of engineering disciplines and engender an understanding of the value of collaborative work across boundaries. Students become *'as if consultants'* to research a specified (different each year) engineering grand challenge, prepare a policy document for a real enterprise affected by the challenge, and present their report 'in role' as consultants to a panel of experts. This simulation-based framework enables students to explore life between the realities of current study and what they can expect to encounter in the real life of engineering work. Its design provides a template for action learning strategies bridging theory and practice, and is applicable as a simulation-based learning strategy across disciplines as diverse and business, accounting, engineering and education.

NAE (2023) National Academy of Engineering 14 Grand Challenges for Engineering, at http://www.engineeringchallenges.org/challenges.aspx

id #18199

Readying allied health students for the reality of placements: Perspectives and practicalities for interprofessional simulation

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Introduction: Clinical placements are a crucial part of allied health curricula, but an increasingly precious resource given the challenges of healthcare workforce shortages and workload pressures, particularly post-pandemic. Meanwhile, more university courses are enrolling more students to train the future workforce. It is therefore essential that students commence their clinical placement programs well-prepared for success to optimise the use of placement resources and avoid pressuring clinical educators. Simulation is increasingly accepted as contributing to clinical learning and provides a promising approach to readying students for the reality of clinical placements.

Methods: Combining international and interprofessional expertise, a diverse team developed a multidisciplinary, simulation-based, placement preparation week. The program was implemented for occupational therapy, physiotherapy and podiatry students prior to their first clinical placement. This study explored the experiences of both participants and providers in the program using separate focus groups with local students, international students, clinical facilitators, and simulated patients (actors). Data were inductively analysed using a reflexive thematic approach.

Results: According to the 22 participants (12 students; 10 providers), the simulation program provided an engaging learning environment and was realistic and relevant, allowing for skill transfer. The development of skills and confidence in communication was a strong outcome and high priority for the novice student population. Participants also identified topics for further assisting students' placement preparation, and differing needs for local and international students. Additionally, all participant groups emphasised the importance of adequately preparing everyone involved in the simulation program to optimise outcomes.

Conclusion: This study outlines how an interprofessional simulation program can provide a highly valuable approach to prepare allied health students for the reality of clinical placements. By considering multiple stakeholders' perspectives, the study provides diverse, comprehensive and practical considerations for designing such an interprofessional program. These findings have assisted in successfully embedding simulation in these curricula.

id #18215

Using the Endsley model to evaluate simulation-based situation awareness healthcare student training in India

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Introduction: Situation awareness (SA) training is a vital part of healthcare training, but opportunities to provide SA training are limited in some setups, especially in low and middle-income countries (LMICs). We aimed to analyse undergraduate medical and nursing students' perception of their understanding of SA through an interprofessional obstetric neonatal emergency simulation workshop (ONE-Sim),[1] in an Indian teaching hospital, and subsequently evaluate their perceived changes in SA understanding using the Endsley model.[2]

Methods: Feedback on SA before and after the ONE-Sim workshops was collected through questionnaire-based surveys. Thematic analysis was performed, with themes emerging from an inductive analysis followed by a deductive analysis using the Endsley model.

Results: One hundred and sixty medical and nursing students attended the workshops. 127 pre and 118 post workshop surveys were completed. Themes emerging from inductive analysis included environmental awareness, evolving knowledge, skill development, and applicability to practice. These aligned with the 3 levels of SA in the Endsley model in deductive analysis suggesting that participants transformed their perception, comprehension, and projection of SA after the workshop.

Conclusion: Simulation-based education enhanced SA perception in obstetric and neonatal emergencies for medical and nursing students in a LMIC setting, and the Endsley model is a feasible framework to measure learner perceived changes in SA understanding through simulation-based education.

[1]Malhotra A, Kumar A: ONE-Sim: Obstetric and Neonatal Simulation Workshop Australia. 2021. Available at: https://www.onesimeducation.com/.

[2]Endsley M. Toward a theory of situation awareness in dynamic systems. Hum Factors 1995;37(1):32–64.

id #18226

A probabilistic Testability Model

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Test and evaluation (T&E) is a critical process for assessing the performance and reliability of complex systems in a variety of domains, such as aerospace, defence, and healthcare. In many cases, T&E involves assessing the probability of a system passing or failing a specific test or set of tests. The ability to accurately model and predict these probabilities is essential for effective decision-making and risk management. This paper presents a testability model that incorporates different component requirements and their relevance to different test cases. The model then assigns probability measures to quantify the ability of each test case to verify each and every requirement. This approach leads to a matrix of testability that contains probability measures of test successes in verifying requirements. We solve the generated network of probabilities and assign test cases to maximise the probability of detecting faults using a Markov decision process (MDP) which is a fundamental component of the reinforcement learning framework. MDP is a powerful mathematical tool for modelling stochastic processes that offer a mathematical structure to represent decision-making processes where outcomes depend on both random factors and the decisions made by the decision-maker. The results show that the proposed methodology is effective in validating the model, as it can identify areas where the model deviated from the reference model and provide insight into the reasons for these deviations. This model is useful for identifying potential faults and their dependencies on testability, which can help improve the overall testability of a system. It provides a more accurate and quantitative representation of testability, which can be used to guide testing activities and optimize testing resources. Additionally, the model can help identify areas where improvements to the design or implementation of a system can be made to enhance its testability.

id #18250

Digital Data Packages: Making the Digital Thread Work

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The digital thread promises unbroken traceability from first expression of need through design, production, acceptance, operation, and upgrade. Viewed from one perspective, this provides confidence that the needs expressed have been satisfied. Viewed from another, the thread establishes provenance for each aspect of a product or system. Done right, this is all captured in an authoritative source of truth supporting the engineering enterprise during development and the greater enterprise throughout the product lifecycle.

But how do we move from promise to practice and realized potential? There are countless stakeholders operating across the engineering lifecycle, each with specific insights, perspectives, and concerns. If implemented correctly, the digital thread enables every individual to see the information they need to see when they need to see it to elicit their unique insights and make informed decisions. Done poorly, the digital thread becomes an overwhelming tangle of interconnected bits of data dispersed across distributed repositories with lightweight traceability but little coherence and even less insight.

While the enterprise needs an effective digital thread complete with traceability, provenance, and rationale, the individual practitioner does not. While the enterprise requires an authoritative source of truth, the specific team member needs access to their source information and a repository for their results. To make the digital transformation work, we must complement the unbroken thread of traceability promised by the digital thread with digital data packages for each player along the lifecycle.

A digital data package is the digitalization of yesterday's technical data package – not simply the digitization of prior content but the reconceptualization of information in the context of digital engineering. This presentation establishes the role of the digital data package, the definition of a core digital data package between architecture and design, and its derivation from / traceability to the digital thread and digital engineering.

id #18251

Overview to Quantum Computing Simulation

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2. Calculated Insight, Oviedo, FL, USA

Quantum computing offers a greater advance in computing capability than any technology in history. While development of the quantum computer remains a challenge, some of the capabilities and challenges posed by quantum computing can be discovered and addressed using quantum simulation. In this paper we discuss the hurdles to be addressed to prepare for quantum computing and how the hurdles can be addressed using quantum simulation. In the paper, we provide an introduction and overview to quantum computing, an introduction to quantum simulation and its relevance for current and future problems as well as how quantum simulation can facilitate the adoption of quantum computing.

Unlike classical computation, quantum computation is inherently probabilistic due to the need for measurement of the quantum state to determine a result. To determine (read) the output of a quantum algorithm or circuit the quantum state is measured. The interplay between the quantum computer and classical computer necessitates a hybrid architecture employing both quantum hardware and a classical computer. The design of the hybrid architecture of a quantum computer coupled with a classical computer is one area that quantum simulation can address.

The paper opens with a definition of quantum computing simulation and a discussion of the utility of quantum computing simulation and the reasons for interest in this area of computation. The paper continues with an introduction to quantum mechanics and its notation as well as a discussion of the major approaches to quantum computing along with their associated engineering, implementation, and programming challenges. The remainder of the paper delves into the questions of what quantum simulation is used for and why, the insights provided by quantum simulation, and the groups/companies performing quantum simulation. The paper concludes with a discussion of the future of quantum simulation and the questions that future quantum simulation can address.

id #18252

Assessing Methods to Increase the Value-Added Interplay Between MBSE and Detailed Design Tools

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Generic claims are often made of the benefits of more tightly coupling Systems Engineering practices with those of detailed design. In the context of the respective domains' software tools, this typically correlates to tighter coupling and integration between Model-Based Systems Engineering (MBSE) and detailed design tools such as electrical computer aided design (ECAD), mechanical CAD (MCAD), software integrated development environments (IDEs), etc. Often the problem is approached from the standpoint of simply developing point-to-point connectors or Digital Thread connections and gluttonously passing packages of data back and forth without first stopping to ask the questions of, "why are we connecting the tools?;" "what specific information do we need to answer our specific questions?;" "where is the authoritative source of truth;" and "how do we manage changes across the connected tool chain?" Digital tool-to-tool interoperability is just one factor in this complex problem. Complicating this further is that often the personnel from each engineering domain come to a project team with distinctly different backgrounds, perspectives, training, and assumptions about what the other domains and disciplines do and provide in terms of value to the team. Geographical and industry differences further complicate the problem.

This presentation will review several current approaches to system-level and detailed design tool integration and assess where there are opportunities to improve the value and efficiency of these connections so that we can evolve from simply transferring data because we can - to transporting precisely specified packets of information, no more or less, to an intended recipient so that the end consumer can ultimately gain knowledge and wisdom and apply that to making better design decisions. As customer-facing enterprises, if our singular goal and focus is to always deliver tangible, lovable products and services on time and on budget to end customers, we cannot settle for less.

id #18279

Post Training Self-Confidence as a Measure of Effectiveness in Simulation-BasedCPR Training

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Cardiopulmonary resuscitation (CPR) is a life-saving skill that requires regular training and practice. Simulation-based training has become increasingly popular due to its ability to provide realistic and engaging scenarios that enhance learning. These realistic simulations can be provided through the use of immersive technology, although in health settings, moulage based approaches are widely used. While studies have demonstrated the effectiveness of simulation-based training in improving CPR performance, few studies have explored the use of self-confidence as a measure of training efficacy.

This study aimed to compare the effectiveness of two simulation-based CPR training approaches, a standard CPR instruction based course and the same course enhanced with live simulation, using measures of self-confidence to evaluate training efficacy. A total of 37 participants were randomly assigned to either the standard or simulation group and received identical CPR training sessions. After completing the training, participants rated their self-confidence using a modified version of the student satisfaction and self-confidence learning scale (SCLS) and also evaluated the training using a modified version of the Simulation Design Scale (SDS).

The results showed that participants with no prior CPR training experience in the simulation group reported significantly higher self-confidence scores than those in the standard group ($p < .05$). These results indicate the value of simulation based training approaches at building new learner self-confidence. Additionally, the findings suggest that self-confidence can be a valuable indicator of CPR training efficacy, providing insight into potential training transfer. While training can provide the knowledge and skills required to perform a particular task, self-confidence in abilities to execute the task effectively can play a crucial role in the transfer of training to real-world performance, providing a useful indicator of training effectiveness.

id #18295

Capturing the Complexity of Ship Operability: A SysML-based Ontology and MBSE Methodology

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2. Defence, DSTG, Melbourn, VIC, Australia

Ship operability is crucial for ensuring the safe and efficient operation of ships, as well as for achieving the operational goals of the Navy. As such the development of a methodology to measure ship operability is an essential task that requires a systematic and integrated approach. In this context, Model-Based Systems Engineering (MBSE) provides a useful framework for developing a methodology for ship operability measurement. MBSE is a systematic and iterative approach that uses models to capture, analyse, and manage the complexity of systems, including ships. By using MBSE, it is possible to create a formal and structured representation of the ship's operability, which can be used to support decision-making processes related to ship design, construction, and operation. To develop an MBSE methodology for ship operability measurement, it is necessary to first create an ontology that captures the essential concepts, relationships, and constraints related to ship operability. The ontology in this work is created based on the Systems Modelling Language (SysML), which is a graphical modelling language that is widely used in MBSE. The ontology is based on the operability definition specified in DEF(AUST)5000—ADF Maritime Materiel Requirements Set. An MBSE methodology is then developed by identifying the steps and diagrams required to measure ship operability. These steps include the creation of a model for the definition of operability criteria, the identification of potential hazards and risks, and the evaluation of the ship's performance under various operating conditions.

id #18325

Why modelling in UAF falls short during below the line system development

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The aim of this presentation is to explore the challenges encountered when selecting an appropriate Systems Engineering modelling approach in support of both system of systems and system level development. The presentation will discuss the role of architecture frameworks, modelling languages, and modelling methods in this context, and examine how the Unified Architecture Framework (UAF) and the Systems Modelling Language (SysML) fit into this domain.

The presenter will also propose a characterization of the gap between enterprise modelling approaches and single system development, highlighting the key differences between these two domains and the implications for modelling. In addition, commentary will be provided on existing approaches for bridging the gap between these two worlds.

By the end of the presentation, attendees should have a better understanding of the key factors to consider when selecting a modelling approach for systems engineering activities, and be equipped with practical insights and strategies to help navigate the challenges involved.

id #18333

Empowering the future of Test & Evaluation through Digital Engineering

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The empowerment of junior Test and Evaluation engineers is critical to securing a workforce suited to an increasingly complex world. Arguably, the lion's share of T&E expertise resides in the heads of a few key senior engineers; resulting in a T&E workforce with a great deal of experience but not a great deal of diversity in thought. To empower a future T&E capability, senior engineers must pass down knowledge in an accessible way such that junior engineers from a variety of backgrounds can learn effectively. This is where the power of Digital Engineering comes into play.

A Digital Engineering approach to Test and Evaluation was trialled by Nova Systems through the development and application of a customised digital tool to evaluate Flight Simulator Training Devices (FSTDs). As FSTDs require recurrent evaluation activities to maintain currency and are dictated by a complex web of aircraft standards, they serve as an ideal case study. Powerful visual representation of traceability within the tool enables junior engineers to develop understanding of how compliance is met against multiple layers of upstream requirements. Integrated data collection processes enable junior engineers to lead test data collection and analysis for recurrent evaluation activities which have been set up previously. Historic archiving capability allows junior engineers to review engineering rationale to better understand decisions made and to think more deeply about their work.

Investing in digital engineering not only introduces greater technical rigour into T&E activities, it also introduces a data-centric approach which breaks down barriers to entry to interesting technical work for diverse groups who may otherwise not receive such opportunities. The development of our future T&E workforce by applying a digital engineering approach, along with the challenges associated with this methodology, will be discussed.

id #18343

Meeting operational realities: The benefit of using volunteer actor patients in simulation

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Background:

Experiential learning through simulation-based education can provide a safe environment for nursing students to learn the skills needed to prepare them for clinical practice. However, one of the main operational constraints of simulation is the cost. High-fidelity simulation typically requires specialised

equipment, mannequins, technology, technicians and trained facilitators, which can be costly. As an alternative, we used a medium-fidelity simulation using volunteer actor patients.

Context:

We developed a simulation-based immersive experience of real-life scenarios, which catered for 40 students per day. The simulation space used was a replica four-bedded hospital room with functioning equipment commonly used in clinical settings, such as electric beds, oxygen, call bells and observational equipment. The whole simulation activity was prepared and delivered by three experienced nursing faculty.

Objectives:

We aimed to explore the impact of adding a human dimension to a medium-fidelity simulation activity for pre-registration nursing students through the use of volunteer actor patients.

Method:

A qualitative descriptive design was employed with purposive sampling comprising final-year nursing students and volunteer actor patients who consented to participate. Data were collected from six focus groups involving 13 students and six volunteer actor patients. The transcribed data were independently coded and analysed by two researchers using thematic analysis to identify five themes.

Results:

The benefit of using volunteer actor patients in simulation were:

- Authenticity and realism
- Enhanced clinical judgement and decision-making
- Active learning and motivation
- Integration of theory and practice
- Improving clinical skills

Conclusion:

Using volunteer actor patients in simulations can bring multiple benefits, including providing a meaningful learning experience and an affordable way of delivering high-quality education to nursing students.

id #18344

Factors influencing the uptake of simulation-based education in Pacific Island low- and middle-income countries

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Introduction

The development of simulation-based education (SBE) has been previously identified as a priority by stakeholders in Pacific Island low- and middle-income countries (LMICs). Prior to the implementation of SBE programmes, contextual factors should be considered to optimise their effectiveness and avoid potential harms.[1] We aimed to address the paucity of contextual information in Pacific Island LMICs by identifying factors influencing uptake of SBE including perspectives and prior experiences of Pacific Island healthcare workers.

Methods

This mixed methods study included a survey and group interviews. Using prospective and snowball sampling, healthcare workers in the Pacific Islands were invited to participate online. Descriptive univariate statistics were generated from quantitative data, while qualitative data was analysed using reflexive thematic analysis.

Results

Survey responses of 56 healthcare workers from 12 Pacific Island countries were included. Respondents most commonly practised in Fiji (24/56) and the most frequently reported occupation was surgery (31/56). The most accessible forms of simulation included mannequins (34/67), scenarios-based simulation (31/56), and simulated patients (18/56). Perspectives on simulation were positive, with the majority (54/56) of respondents expressing interest in further SBE. Two group interviews were conducted with 16 total participants, representing seven Pacific Island countries. Themes identified included availability of simulation requirements, inertia inhibiting simulation development and structural challenges. Other themes were heterogeneity of clinician attitudes, collaboration to nurture simulation, and Pacific self-determination.

Discussion

This study revealed the complex landscape of factors influencing SBE in Pacific Island LMICs and confirmed local support for SBE programmes in this setting. Despite cited challenges inhibiting its implementation, numerous enablers of SBE are evident. These factors should be considered prior to implementation of future projects.

References:

1. McGaghie WC et al. A critical review of simulation-based medical education research: 2003–2009. Med Educ. 2010; 44(1):[50-63 pp.]. Available from: https://onlinelibrary.wiley.com/doi/abs/10.1111/j.1365-2923.2009.03547.x

id #18347

Optimisation using simulation: meeting real world demand for optimal, sustainable service delivery and decision making.

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At a time of increasing pressures for efficiency, delivering consistently high-quality simulation experiences in healthcare organisations can be challenging. Driven by organisational demand this presentation describes our experience in creating a sustainable workforce capable of delivering effective simulation activities, engaging participants, impacting clinical decision making and enhancing patient experiences.

Demonstrated impact of translational simulation activities on service delivery has led to increased demand, additionally, the global pandemic required agility and adaptability to change process and systems rapidly and training to embed new ways of working. ‘Optimisation using simulation’ tests the vision of work as imagined into real clinical practice identifying inefficiencies and errors that place our patients and work force at risk. The vision that no service is expanded, no building is designed, no equipment purchased, or any procedure is implemented without considering simulation testing first has led to a need for appropriately trained faculty.

Growth in the demand for this service in collaborating with partners and end users in the design of workflow, testing patient journeys and supporting clinical decision making has led to a need to increase organisational capability by providing training, mentorship, and support to key workforce personnel who can provide this service to health partners across the state.

Meeting this demand required increased organisational capability across disciplines and distance, a faculty development program was developed specifically for the testing of systems and process, noting that the application of simulation for process and systems testing including high risk procedure rehearsal requires a different approach to design, delivery and debriefing building on the foundations of the principles in the application of simulation for education and training. This presentation will share the

development and evaluation of a faculty development program for translational simulation and its impact on service design and clinical decision making.

id #18384

Clinician's Blind Spot: Co-designing simulation infused with lived experience to address cognitive bias in healthcare

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Introduction

The presence and consequences of cognitive bias in healthcare contributes to health disparities. Targeted education strategies to increase awareness of bias can mitigate its influence on clinical care. This four-part research project aimed to co-design, deliver and evaluate interprofessional simulation-based education (SBE) to address cognitive bias in healthcare; and establish a framework for utilising incident data and consumer and health professionals' experiences to co-design simulation scenarios. This presentation focuses on one part of this project: co-design of an interprofessional SBE experience with healthcare consumers and health professionals.

Methods

Data were collected using semi-structured interviews from consumers and staff, recruited to share experiences of cognitive bias in healthcare. In addition, a range of de-identified artefacts (letters, photos, reports) were collected to enrich the scenario storyline. Thematic analysis was used to search for patterns, congruency and meaning from interview data.

Results

Interview data from three consumers and five staff were analysed. Key themes included communication, stigma, diagnostic overshadowing and fragmented systems. Using a co-design education methodology, regular collaboration with staff, consumers and research team occurred throughout the SBE development to ensure authenticity. The SBE incorporates a clinical case infused with verbatim consumer quotes, narrative artefacts and video messages, encouraging learners to identify incidences and impact of unconscious bias on patient care.

Discussion

To our knowledge, this is the first interprofessional, co-designed SBE experience specifically addressing cognitive bias. Placing consumers at the centre of research and co-design of health professions education shifts the focus to a more humanistic dimension – the lived experiences of healthcare consumers. Creating learning opportunities deliberately co-designed with consumers challenges health professionals' perceptions of reality and supports honest dialogue whereby learners can explore their uncomfortable feelings about undesirable and/or challenging situations, investigate alternate diagnostic decision making, treatment and communication choices, and rehearse preferred therapeutic interactions and responses.

id #18388

Evaluation of online interprofessional simulation workshops for obstetric and neonatal emergencies- through COVID-19 and beyond

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Objectives: To explore medical and midwifery students' perceptions of learning, and interprofessional aspects through online simulation-based obstetric and neonatal emergency workshops held during the Coronavirus (COVID-19) pandemic.

Methods: This qualitative study was conducted at Monash University, Australia. Data were obtained from six separate online Obstetric Neonatal Emergency Simulation (ONE-Sim) workshops held between May 2020 and August 2021. A total of 385 students attended the workshops, and were invited to participate in the study by completing an online survey two-three weeks following the workshops. Of the attendees, 144 students completed the survey (95 medical, 45 midwifery), equating to a response rate of 37%. Survey responses were downloaded from the online survey platform and separated into medical and midwifery responses. Thematic analysis of data was conducted by two researchers using a coding framework, resulting in development of themes and subthemes.

Results: Main themes identified included adaptability, connectivism, preparedness for practice, experiential learning, learning through modelling and dynamics of online interaction. Students reported that online workshop was a useful alternative method to experience simulation-based learning, increase their readiness for clinical practice and foster positive interprofessional relationships. Consistent with existing literature evaluating similar in-person programs, midwifery students were most interested in interprofessional interaction (predominant theme: dynamics of online interaction), whilst medical students were more concerned with developing clinical skills (predominant themes: learning through modelling, experiential learning).

Conclusions: Beyond the pandemic, online learning may be a useful and convenient way of delivering interprofessional simulation-based education, such as in remote areas and as an adjunct to in-person teaching. Future studies should evaluate the impact of online learning with a mixed methods study and in comparison, to in-person programs.

id #18411

The Defence Simulation Analytical Service – A Real World Application of the Data Fabric

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There is perhaps no better reason to define and understand the practicalities and benefits of bridging reality and simulation than the need to make better decisions. This is particularly important in the military context where decision superiority is vital.

This paper will examine today's defence technology and its progress toward achieving "decision advantage" across domains by utilising a ***data fabric*** in support of multi domain command and control. Maintaining decision advantage is increasingly complex: Defence is still operating under a decades old staff process that conducts manual analysis and evaluation of courses of action, it lacks the ability to display information in real-time, siloed tools make it difficult to provision and access modelling and data and workflow inefficiencies emerge from the challenges of fusing large amounts of open and closed source data.

Whilst the technology has matured year on year and the focus today is about extracting the most value from the data, at the speed of the mission, it all boils down to one point. Defence suffers from a lack of intelligent information provided at the speed commanders need.

A modern data architecture ensures data is accessible to relevant data users within their unique workflows. Data fabric is an architectural approach that simplifies data access in an organization and facilitates self-service data consumption. Teams can use this architecture to automate data discovery, governance, and consumption, through integrated end-to-end data management and governance capabilities. They can then use data services to augment real data with synthetic data in modelling and simulation tools to evaluate courses of actions.

The combination of a data fabric, analytics and AI, and modelling and simulation in the Defence Simulation Analytical Service (DSaS) offers trusted decision making at the speed of relevance.

id #18424

In-situ simulation - Informing decision making and promoting collaboration in merging 2 specialties.

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Aim

To simulate clinical scenarios to inform functionality and working processes of a merging environment.

Background

The envisaged model of care in 2020 when the new Christchurch Hospital officially opened was for all children to be cared for in Children's Emergency Care (CEC) regardless of entry pathway. Due to resourcing and funding this was delayed, and children continued to be cared for in an environment proposed to be Adult only. Part of CEC was opened in 2020 with the already established Children's Acute Assessment Unit. In September 2022 the model of care changed with the merging of two areas to become Children's Emergency Care. The understanding of different ways of working requires collaboration, to establish best practice and best outcomes for children and Whanau.

Intervention

We implemented interdepartmental insitu scenarios designed to test environment functionality and processes, enabling discussion with end users, who provided constructive feedback. The consecutive feedback enabled further testing and built a clearer picture of functionality and education required.

Outcomes

The simulations informed decision-making around changes to the environment, processes and systems. The use of simulation allowed two very different areas the chance to have their voices heard and negotiate a collaborative model that benefits the child and family moving forward.

id #18430

Pioneering the Australian Academic electronic medical records (AAeMR) prototype: affordability, accessibility, and accountability.

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Background:

Globally, the healthcare industry's adoption of advanced technology has impacted nursing education and highlighted the need for undergraduate nursing programs to incorporate digital technology literacy within their curricula. The limited integration of electronic medical records (eMR) into undergraduate nursing programs in Australia is one example of the widening gap between theory and practice. There has been minimal contemporary Australian research examining the experience, perceptions, and culture of nurse-patient interactions when using eMR and how considerations of affordability, accessibility, and accountability impact on this integration.

Objectives:

This research examined the impact of using the Australian academic electronic medical records (AAeMR) prototype in an undergraduate nursing simulated learning environment (SLE) with a specific focus on third year student perspectives. A secondary focus was to explore Registered Nurses' (RN) perspectives of the simulated program and their cultural work practices when utilising eMR in the clinical setting.

Methods:

The AAeMR prototype was used in an undergraduate nursing third-year subject within one regional university. Students practiced providing care using a workstation on wheels housing realistic simulated patient medical records and the AAeMR. RNs were invited to visit the campus to view the SLE and the AAeMR in use.

Design and Analysis:

After ethics approval and written consent, a purposive sample of third year nursing students (n=12) and Registered Nurses (n=9) participated in their respective focus groups that were recorded and then transcribed. Thematic analysis was conducted on all focus group contributions and emerging themes were identified.

Impact:

Findings contribute to the understanding of how the delivery of patient-centered care is impacted by digital technology and provide a foundation to develop this innovative AAeMR program. Key recommendations from this research address the concepts of affordability, accessibility, and accountability as they relate to best practices in simulated teaching and learning using eMR at the bedside.

id #18432

There is more to Model Based System Engineering (MBSE) than just picking a tool!

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There is significant hype about MBSE within the Systems Engineering community. However, MBSE is often misunderstood and thrown around as a buzzword. Tool vendors may declare that by using their product you are performing MBSE. Whilst this may be a valid claim, you will probably not do it well or efficiently. This is because each tool has a limited capacity to perform all that MBSE entails. Most tools marketed as supporting MBSE, support SysML modelling well but struggle with requirements and verification aspects of MBSE. This is particularly problematic with increasing scale and complexity.

MBSE is not all about tools or a radical new way of designing complex systems or a panacea to all your problems and in fact it could introduce more problems if you go into it blindly.

So what is it? This presentation will explore that MBSE is simply performing many Systems Engineering activities that have done in the past but in a manner that ensures the outputs are captured in a consistent, verifiable way. It ensures that there is a single source of truth of data and it can queried and presented it in multiple ways that help a reader understand and communicate the system.

Underpinning robust MBSE is a data metamodel combined with defined methadology and training and tools to support MBSE. This presentation will discuss how a metamodel, clear methodology, training and an integrated tool environment offer the best chance of success using MBSE and help avoid some pitfalls.

id #18442

What's in a name? Is finding Modelling & Simulation data only the first step?

Kevin A J Wood[1]

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Defence forces need to prepare for a wide range of activities, supported by training that reflects the complexity of operations. Training, augmented by Simulation, enables defence forces to train using realistic, complex and repeatable training scenarios. Simulation is a highly data-centric activity that requires uniting of disparate collections of simulation assets and managing their interactions. This produces a complex simulation data context and a need for supporting, coordinating and planning data sets to meet training outcomes, a significant issue for organisations such as the Australian Defence Force, who want to maximise the reuse of a significant investment in data.

Management of simulation data is partially covered by a series of studies undertaken by NATO Modelling and Simulation (M&S) Group (NMSG) and Simulation Interoperability Standards Organization (SISO). These studies develop architectures and standards to support the Modelling and Simulation as a Service (MSaaS) paradigm. Support for the federation of simulation data registries across geographical and geopolitical borders is seen as key to enabling the discoverability of reusable assets. While recommendations for a Technical Reference Architecture and Governance policies exist, there is no agreed implementation method for a metadata model to support asset discovery.

Even if a discoverable asset can be found, its name is simply a label to distinguish it from another. Without rich metadata describing the capability, credibility and interoperability of the asset, how do we readily determine whether the data will interoperate with other elements of a training scenario?

This paper analyses the work carried out by NMSG and SISO for the standardisation of data discovery and metadata schema content and discusses how an innovative approach of utilising Simulation Interoperability Readiness Levels (SIRL) as part of the metadata schema could further reduce the time and effort for uniting the disparate collection of models and data in a training exercise.

id #18443

Simulation in a safe space: ethical considerations of training medical students in a rural context

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2. MDRS College of Medicine and Public Health, Flinders University, Renmark, SA, Australia

The Flinders University Doctor of Medicine Rural Stream (MDRS) provides medical students with an immersive teaching and learning experience in rural South Australian communities. Integrated learning includes a significant number of high-fidelity simulations. It is the MDRS program that provides the context of this presentation. The focus is embedded in the ethical considerations of the repeatability and reliability of simulation in a rural context.

Interprofessional Educators (IPEs) are experienced emergency nurses who teach into the clinical curriculum of the MDRS. Their role includes writing, reviewing, and delivering clinical simulations based on real life clinical experiences. The simulations are designed to capture essential clinical skills which are developed over time through repeated exposure and real time feedback. They focus on core clinical and technical skills together with communication, teamwork and understanding the complexity of the clinical working environment. Evaluation of this program has shown consistently positive results. Small group learning in a simulated environment has increased student confidence and clinical preparedness.

Blending the use of simulated patients, clinical team members, state of the art patient simulators and task trainers underpinned by real life scenarios has increased the clinical safety of medical students who participate in the program. Similarly, the involvement of clinicians who students work alongside in their placement locations, enables ongoing learning and feedback together with opportunities to fine tune simulation to meet any identified learning gaps.

Preparing medical students for the complexity of rural clinical practice through reliable, assessment-based simulation not only meets the Australian Medical Council Standards, but it is also an ethical obligation to the communities and health services that students learn in. This presentation will describe the diversity and reliability of the simulation program, discuss the wins and challenges and share the learnings of this immersive approach to medical education in a rural context.

id #18450

Thermal Analysis of a Rocket-Scramjet-Rocket Space Launch System over a Payload-Optimised Trajectory

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4. University of Southern Queensland, Toowomba, Queensland, Australia

The small satellite industry is expanding rapidly, driving a need for dedicated and cost-effective small satellite launchers that may be achieved via the introduction of reusability. One possibility for accomplishing reusability in a small launch system is the inclusion of high-speed airbreathing propulsion systems, namely ramjet or scramjet engines.

One of the primary technical challenges to overcome in high-speed airbreathing systems of any type is the high thermal loading produced by hypersonic flight in-atmosphere. Thermal protection system design is a major focus for current development, and conceptual studies into the missions and designs of these types of vehicles can help inform design decisions and assess feasibility for future operational vehicles.

This work uses vehicle simulation and applies optimal control to explore the capabilities of a partially-airbreathing space launch system. In particular, thermal analysis is included into the simulation of optimal trajectories, via a 1-D heat analysis, to indicate the heat transfer and temperature at various point on the vehicle. The combination of optimised trajectory simulation and thermal analysis is used to explore the design of the thermal protection system of the vehicle and its sensitivity to various critical manoeuvres. In addition the possibility of limiting the trajectory using heat transfer over the vehicle body is explored.

It is found that modification of passive thermal protection system properties produces only small effects on the maximum temperatures observed internally within the vehicle, and that active protection is required to produce significant cooling results. An investigation of thermally limiting the trajectory of the vehicle find that there is only minimal performance degradation to a certain cutoff point, past which the operation of the vehicle degrades significantly due to sub-optimal manoeuvres. These findings can be used to inform future design decisions and the direction of future studies.

id #18460

Bridging Reality and Simulation with Digital Twins

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A Digital Twin is literally a bridge between reality and simulation, although there is a lot of confusion about what the term actually means.

Digital twin technology has received significant attention from industry and academia since the term's inception in 1991. In the decades since, digital twins have been developed and implemented in diverse applications across many and varied industries. However, several challenges remain for firms seeking to develop digital twin-based solutions. These challenges range from a lack of clarity on fundamental definitions of digital twin and how they create value to gaps in academic research, both conceptual and technical, the variety of standards-based frameworks that can be used, as well as gaps in those standards.

Notwithstanding the above-mentioned issues, Digital Twins, and their related technical frameworks, have a lot to offer across a wide range of applications. For example, Digital Twins are a potential solution to the complexities of developing modern military platforms and capabilities, especially as Artificial Intelligence begins to be incorporated. In particular, from an operational perspective, the Operational Test and Evaluation phase stands to benefit enormously from Digital Twin frameworks and technologies.

A Digital Twin is not simply a model or simulation of a system, but simulation and modelling plays a fundamental role in enabling a Digital Twin to fulfil it's purpose. In this domain, many of the same issues and caveats apply – the need to choose appropriate levels of fidelity, the need to validate models and simulations as being fit for purpose.

This paper discusses the current state of Digital Twins from a modelling and simulation perspective, identifies key issues to be considered when developing, acquiring or using a Digital Twin, and provides a number of case studies where Digital Twins have been used to enhance outcomes.

id #18462

An optimisation approach for the positioning of entities in a land combat simulation

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COMBATXXI is a land combat simulation environment used to perform comparative analysis of operational effectiveness using force on force modelling. This is done by creating complex military scenarios and running simulation experiments with existing or novel systems, tactics and force structures. The positioning of entities within COMBATXXI can impact simulation runs, and if not accounted for could affect the outcome of the simulation study.

In military planning, commanders provide general positions for units to occupy, however the finer terrain reasoning is left to vehicle crews and teams to make an assessment on the exact location which is most appropriate for the task. This research aims to provide an approximation for that terrain reasoning within COMBATXXI, placing entities within a nearby area that provides a refinement of the position suggested by a combat plan.

We utilise mission specific observation probabilities, mobility and cover to quantify the suitability of a position. A differential evolution algorithm is used to quickly find improved positions. The effectiveness of this approach is assessed by simulating existing scenarios with the new optimised positions and through feedback from military subject matter experts.

Applying this approach led to entities performing better with higher kill rates and higher survivability in the simulation. An unintended benefit is an improved understanding of the COMBATXXI scenario by scenario developers. An interactive visualisation of the objective function allows developers to make their own assessments of the suitability of a location. This is expected to reduce the time it takes scenario developers to create new scenarios and position the entities. The outcome is a blended method where users can add their own knowledge of positioning onto the calculated values for improved and realistic scenario development.

id #18466

Adaptive Learning Modes for Virtual Reality Training in Medical Education

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The market for off-the-shelf Virtual Reality (VR) solutions for training is growing exponentially with the improved functionality, lower costs and higher availability of both hardware and software, however the solutions are often bespoke or non-adaptable to meet the needs of different operational scenarios and the variable learning needs of users. Adaptive learning modes in VR will provide personalized learning experiences. They have several advantages, including the ability to provide customized learning experiences, reduce training time and cost, and improve learner engagement and retention. However, there are also challenges to overcome, such as the need for reliable data collection and analysis, and the development of effective algorithms for personalized learning.

This paper will present the results of a scoping review of the literature that discusses the breadth and extent of the body of knowledge around adaptive or personalised learning in Virtual Reality. The scoping review highlighted that there have been few empirical studies regarding the applications of different modes of learning and tailored feedback to users. There is a tendency in the research to focus on the fidelity of the VR experience, with less coupling of training design, learning outcomes, and learner abilities to VR environments. For procedural training of medical students this is important as simulations should not only provide an appropriate representation of the task, but also consider what and how the student learns. Previous studies have discussed extensively the benefits of practice and muscle memory in terms of motor skill retention, however the cognitive aspects such as decision-making, awareness of risk, and error identification/recovery are equally as important for learning clinical skills. A systems network diagram of the themes was developed to show the hierarchies and

interactions between the key attributes and areas of the literature with a view to providing a framework for future research agendas.

id #18468

Whose reality do we simulate? Critical reflections on the ethics of disability representation in simulation

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When simulations are developed and portrayed by outsiders to the community being represented, the ethics of representation need to be considered. Frequently simulations used in healthcare professional skills training are conceptualised and portrayed by people with no lived experience of disability themselves. If incorporated at all, lived experience may be considered via expert consultation at the case development stage. The simulation quality is subsequently judged more on authenticity to expert clinical experience than to people with lived experience. When we design simulation and judge its quality this way, are we considering whose reality we simulate? Are we sufficiently critical about representation in simulation?

In this presentation we apply a critical perspective to identify subtle ways in which the inclusion of lived experience in simulation scenario design and implementation influences what is represented, and how, in the training of novice healthcare professional students. To do so, we review the data from 14 semi-structured, in-depth, phenomenological interviews into the experience of portraying a live scenario in a simulation program. The simulation program was similar in each case, but some participants were representing a scenario they were provided, while others were supported to either create a character based on their family or work experiences, and others to develop a scenario based on their own lived experiences.

Drawing on these data, we identify subtle but important differences in the representations of disability as well as participant motivations, needs and experiences in the programs. There are no one-size-fits-all solutions, but we challenge the traditional clinical lens and prioritisation of authenticity from the perspective of the clinical experience. We highlight ethical and practical implications for the scheduling and administration of simulation programs, the development of simulation scenarios, the briefing and debriefing of all participants (learners, facilitators, role players), and the future of technology-enhanced simulation in healthcare.

id #18494

Why Simulation and Systems Engineers Make Good Mentors and Why That's Increasingly Important for Executives

Richard Hodge[1]

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Executives mentor emerging leaders to extend their experience into different functional areas. It’s often a planned, traditional process curating and sharing organisational expertise piece by piece.

With a continuous drive for growth, executives now face demands for higher environmental and social governance, where they are increasingly liable for the consequences of their decisions on society and the planet. They face a system-of-systems problem needing systems frameworks to engage with increasing complexity.

This systems expertise is often lacking in many non-technical executives.

Simulation and systems engineers work comfortably in conditions where complexity is present. We develop a ‘third eye’ enabling us to see a bigger picture beyond content, to ask hard questions, develop and integrate concepts that better address contextual complexities.

These are the foundations of good mentors for today’s challenges: ultimately building capacity in systemic approaches, guiding leaders to use models that improve transparency and communication for

better time-sensitive and safety-critical decision-making across an enterprise. Business schools don't teach management the things we take for granted.

This presentation offers perspectives on:

- How simulation and systems engineers are suited to developing themselves into an executive mentoring role to guide systemic improvement and how this is different from traditional mentoring.
- Professional development required to increase knowledge of several systems frameworks and their application to strategy execution, operations, and governance.
- The importance of meeting executives where they are and guiding them to explore what they don't know, educate them, listen to those with systems experience, experiment to remove ambiguity, to evolve directions and actions that make progress.

The presentation aims to open a conversation on the role simulation and systems engineers may take in mentoring leaders to engage with complexity and not shy away from the grand challenges we face together.

id #18503

An approach for tender evaluation using MBSE

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Model-Based Systems Engineering (MBSE) is used as good practice in designing systems. When done well, it maintains a view of the overall system purpose while defining the necessary interactions and integrations of the designed solution. MBSE considers dimensions of physical architecture, logical behaviour, requirements, parametrics, and verification & validation. MBSE approaches have also been applied "above the line" – to the definition of systems requirements – through capability analysis, particularly in Australian defence and transport industries.

Some efforts have been made in the past to define an overall acquisition approach using MBSE. The aim of this is to use the rich model content developed in Model-Based Capability Design (MBCD) to support tendering and acquisition – crossing from "above the line" to "below the line". However, these approaches have practical shortcomings in two observed areas: (1) In the need to restrict access to full model detail – from both acquirer and supplier; and (2) In the cost of time and money needed to require tender submissions to be provided using a particular modelling approach and toolset.

This presentation outlines a proposed approach that may help meet the above aim in tender evaluation without necessitating any changes to the tendering process, or sharing of full model content. The focus here is on using the technology available in our MBSE tools to build content on tendered systems solution options within the MBCD models. The approach highlights traceability from problem to proposed solution, and parametrics to help analyse quantitative aspects. A combination of MBSE tool aspects contribute to this approach:

- Import of data into models via simple integrations (such as Microsoft Excel)
- Basic object-oriented principles of inheritance between system elements
- Parameter binding and constraint analysis
- Diagramming and tabular outputs from the model as part of reporting for decision making

id #18505

A Network View to Optimising Technical and Organisational Management

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The One Defence Capability System (ODCS) is a Defence wide integrated materiel system that provides authoritative information for the strategic development and management of Defence Capability. In support of this, the ODCS provides the strategic business processes, required documentation and decision support tools that will justify Defence Capability decisions. The OCDS

touches those aspects that are fundamental across any Project or Product lifecycle. The use of the ODCS exists to help ensure that defence capability decisions are optimised by the projects leadership team and carried through to meet the strategic Defence objectives.

This research paper explores the use of network analysis to identify the complex relationships and important groups throughout that impact the lifecycle of a typical ARMY project. A simulation model has been created by Systra in which the personnel groups and project phases have been broken down into nodes (vertices), with edges (links) representing the relationship between them. Nodes can represent physical items or spaces, people (social), or even abstract thoughts.

By performing methods known in network analysis as “centrality analyses” we can identify the most important nodes/phases (resources and phases) in the projects capability network. From this investigation, the network can be modelled as a series of linear equations using graph analysis. The important aspect of this analysis is the introduction of alternatives and defining uncertainty. With the inclusion of constraints, it will then allow optimisation. This can be used to architect communications, resources or technical lines with the project’s stakeholders and project team. This provides a view into the decision-making process when management or technical alternatives are presented.

id #18512

Measuring Mastery Through Real-Time Cognitive Load and Performance

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Mastery of a skill is a key goal for many learners in simulation-based training tasks, however its measurement is often challenging. While traditional training environments focus on outcomes, they often do not provide insight into the changes in cognitive load that underlie the development of mastery. Synthetic training environments and serious games provide the opportunity to measure cognitive load and performance in real-time. In this paper, we propose a novel approach for measuring mastery using real-time cognitive load and performance data.

In this work, we demonstrate the temporal impact that different challenges, environment conditions and tasks have on player performance and cognitive load in a complex 3D driving serious game. These results are then related to the concept of mastery, and how its development is reflected in changes in both cognitive load and performance. The experiment conducted in this research also validates a novel in-game version of the detection response task (DRT) establishing a cost-effective method for measuring cognitive load in real-time that can be used to capture the attainment of task mastery.

We conducted a study with 31 participants using the 3D driving serious game. Participants completed three identical circuits in the driving game, with different zones of varying challenge difficulty. The cognitive load and performance measures were used to rate the difficulty of each type of challenge, including the primary task (driving) as well as additional tasks such as counting vehicles, following directions, or judging distance. Performance was measured through a normalized zone difficulty score that accounted for variability in specific driving section lengths. The results from the experiments showed the development of mastery through increases in performance scores with associated decreases in cognitive load. Interestingly, the results also made it evident when specific tasks remained challenging, and thus mastery was not achieved.

id #18516

Enabling the Warfighters by incorporating Modelling and Simulation into Federated Mission Networking

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Modelling and Simulation (M&S) supports both military training and Operational Analysis mainly in standalone applications. There is now a desire by warfighters to utilise M&S for decision support (Course of Action Analysis (COAA) and Wargaming) and in Mission Rehearsal. NATO, because of the challenges for achieving interoperability in Afghanistan, instigated Federated Mission Networking (FMN), aimed at NATO nations and partners achieving “Day Zero” interoperability. FMN is delivered through a spiral development process, each having a specification that nations commit to implementing.

A requirement for M&S to support FMN was included for Spiral 5 for Mission Rehearsal (now been moved into Spiral 6 and to include Collective Training). NATO as part of its Digital Transformation also has a need to conduct COAA and Wargaming using M&S. Participation in FMN by the NATO Modelling and Simulation Group (NMSG) is important to achieve this and to that end, a Specialist Team (MSG-193) was set up. MSG-193 had been committed for one year, with the intent of establishing a longer follow-on activity if the role proved productive. This was the case and MSG-201 was established.

NMSG is well equipped to help specifying M&S in FMN using Command and Control and Simulation Interoperation standard (NATO STANAG (4856 Ed 01)), Modelling and Simulation as a Service (MSaaS), Correlated Dynamic Synthetic Environments (DSE) for Distributed Simulation, and Cyber-Electronic Warfare (CyEW). The established STANAG High Level Architecture (HLA) and the NATO Education and Training Network (NETN) are also appropriate for use in the FMN context.

This paper will explain the processes required to develop both the Procedural and Service Instructions that underpin FMN, the work of NMSG 201 and the lessons identified from participation in Coalition Warrior Interoperability eXercise (CWIX) 2022 and 2023 to validate the M&S standards in the context of FMN.

id #18525

Tales of Tails, Cobras, Cats and Models

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Systems Engineering is a **transdisciplinary** and **integrative** approach to enable the successful realization, use, and retirement of engineered systems, using **systems principles and concepts**, and scientific, technological, and management methods" (INCOSE). This introductory presentation, broadly structured into three parts, will focus on some of these "***systems principles and concepts***" that underpin the understanding of systems and the engineering of systems, enabling the efficient and effective transformation of complex concepts into safe, secure, and sustainable capabilities. Part 1 is a motivational introduction on the importance ("***why***") of systems thinking through a series of real-life systems stories and of systems archetypes. Part 2 shifts focus onto "***what"*** is systems thinking, leveraging the Iceberg metaphor as a system thinking tool, introducing systems principles and modelling and simulation as foundational enabling pillars and highlighting two key questions that underpin the quality of engineered systems ("did we build the system right?", and "did we build the right system?"]. Part 3 elaborates on the "***how***" of systems thinking from two key "model" perspectives – "***systems architectural/framework***" models for understand systems structures, and a "***systems dynamic/process***" models for understanding systems behaviours, and in so doing, to enable the understanding and transformation of complex concepts into tangible, safe, secure, and sustainable capabilities. The overarching objective of this presentation is to highlight the fundamental importance of systemic thinking, modelling and simulation in helping deal with complexity and in ensuring ethical, safe and resilient outcomes for society, over short-term quick-fixes that always result in unintended negative consequences.

id #18532

The State of EVs in Australia - a Systems Perspective

Thomas Manley[1]

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After a long development lead time, Electric Vehicles (EV) are now transforming the automobile industry, as demand for, and supply of, EVs takes off. Traditional automakers are struggling to catch the start-ups, as they try to make the transition from Internal Combustion Engines (ICE) to EVs.

EVs are not just greener cars. They are computers on wheels; a totally new form of transport that includes new technology such as regenerative braking, the structural battery pack, and increasingly, autonomous driving capabilities.

Yet they are also a system vastly broader than the car itself that includes charging networks, home battery storage, home solar, mobile apps, over-the-air updates and more. At the same time, they have

the potential to cause significantly disruption to many industries like dealerships, services stations and perhaps even car parks, taxis and food delivery services.

Taking a systems approach, this presentation will explore the state of EVs in Australia (as compared with markets around the world), the automobile system of the future, and what this means for society along with the implications for disruption.

Thomas Manley contributed to Engineers Australia's submission on the government's National EV Strategy and was a panellist on EA's recent webinar "Engineers Australia's national electric vehicle strategy". He is SESA's Technical Director, a Certified Systems Engineering Professional (CSEP) and a Chartered Engineer.

id #18538

Communications Network Primer for Systems Engineers

Thomas Manley[1]

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As systems become more interconnected, they are becoming more complex in nature. At the same time, society is becoming increasingly dependent on Communications Networks ("CNs"). Some examples include the need for the financial sector to operate continuously and without interruption, for transportation systems to distribute people and goods around the world, for emergency services to respond reliably and with urgency, for power generation centres to reliably transport electricity, and even for militaries to succeed on the battlespace. These examples are all considered examples of Critical Infrastructure (CI), defined as those systems which are vital for society to function. US Presidential Policy Directive/PPD-21 - Critical Infrastructure Security and Resilience identified "*energy and communications systems as uniquely critical due to the enabling functions they provide across all critical infrastructure sectors*".

The Information and Communication Technology (ICT) working group (previously Telecommunications WG) believes that a communications network primer would greatly aid entry level and experienced SEs by empowering them with enough information to understand how to apply the systems engineering body of knowledge (SeBOK) to systems where the System of Interest (SOI) includes, or relies upon, CNs, and to know when to engage the right subject matter experts.

This presentation will introduce the Primer titled "A Systems Engineer's Guide to Communications Networks: Modelling Networks as Systems". It will be of benefit to all those involved in utilising CNs, not just those who deliver CNs. It would be of most benefit to those involved with ICT projects in Defence, rail signalling/communications and those acquiring communications technologies for first responders.

Thomas Manley is Co-Chair of the INCOSE ICT Working Group and Team Lead for the primer project.

id #18560

The future of scenario-based simulation training for law enforcement in the AI driven world

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Scenario-based simulation training (SBST) is a widely adopted concept to train and prepare law enforcement officers in crisis and incident management. In this increasingly volatile, uncertain, complex and ambiguous society, it is even more crucial for officers to be exposed to multiple scenarios, both in terms of complexity and severity, prior to and even during the course of deployment.

SBST technology has taken various forms and has developed dramatically across the years. From digital wargames that were direct conversions from paper wargames, to platforms that support interactivity between officers and teams within a simulated environment, SBST has come a long way from its early years. With advanced computing, SBST has advanced, both in breadth and depth. Depth – where different technological platforms support the training of different tactical skills with a high level of accuracy, and breadth – where virtual environments allow different teams, at different levels of the

organisation, to train together. In addition to watching a scenario unfold through video clips, officers now experience a high level of fidelity by interacting within virtual reality, augmented reality, and even spaces within the multiverse.

The use of AI is not a new concept in law enforcement. Today, agencies depend very much on AI for policing crimes through analysing large amounts of data. However, the adoption of AI within training systems, especially in the context of training complex decision-making skills, remains far and few. It is therefore timely for us to think about how we could incorporate AI into our training simulation systems to prepare officers for even more complex and ever-changing societal landscape.

This presentation aims to first map the development of SBST – different modalities and platforms that were adopted over the years. Thereafter, it will discuss and ideate how AI could further enhance and transform law enforcement training.

id #18561

Navigating complexities, training need to simulation solution - placing the stakeholder at the centre

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One of the acknowledged challenges for organizations is navigating the journey from a training need to a simulation-based educationally sound product. Building on the ADELIS model for establishing educational fidelity in simulation-based learning activities, this paper focuses on the role of transferring the organizational training need to a simulation-based learning activity. At the centre of the process is 'What are the questions that need to be asked and answered to ensure the activity design meets the learning needs?' Irrespective of the profession, a systematic approach to designing simulation-based learning activities is essential to ensure the activities deliver the appropriate opportunities for learning, transfer of learning to the reality of the workplace and demonstrate efficacy of the learning experience. Equally, important is to engage the stakeholder in the design process from beginning to end product, the process discussed in this paper offers a template for educational designers, stakeholders, and simulation product manufacturers to engage collaboratively to deliver fit for purpose learning experiences

id #18613

Systems Engineering, Ethics and Autonomous Machines in the Battlespace: An Electronic Warfare Perspective

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The modern battlespace is a complex environment comprising many interacting systems-of-systems (SOS), human and machine, that cooperate and clash across the spectrum of time-spans, and across the spectrum of physical effect. Systems modelling and simulation play important roles in the exploration of the properties in a battlespace environment. As this is a broad issue to tackle and the battlespace is extremely complex and complicated, the analysis concentrates on the electronic warfare (EW) component of force protection and force projection. The ethics considerations of autonomous weaponised robotic machines operating in the battlespace is an area where state actors are developing guidelines which have tended to lag behind the technological development and capabilities of these AI-enabled systems.

In this paper, the systems engineering principles are applied to the analysis of the attendant ethics which might apply to autonomous systems in the battlespace, to guide potential actions, whether under human authority or solely independent of human authority. Also, there is no replacement for direct knowledge of the battlespace when considering the technology that is continuously evolving and being applied in this space. This current research draws on information provided by Australian soldiers as a key source of guidance for the views expressed in this paper, which is a key difference between reality and simulation. The strength of the systems engineering approach is that it provides a framework for defining the stakeholders and it highlights the influences from the many sectors that are relevant, together with identifying a number of questions for further consideration and discussion.

id #18614

Defence T&E Strategy

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ABSTRACT

The Defence Test and Evaluation Strategy Australia's rapidly changing strategic environment requires the Australian Defence Force to field increasingly complex capabilities over the coming decades. Advances in technology are changing the nature of the systems, and systems-of-systems that are subject to test and evaluation to assure their fitness-for-purpose. Individual platform testing follows a well-established systems engineering process, but technologies like machine–learning require the development of new test techniques. New technologies also enable novel, more efficient test methods. The growing complexity of integrated force packages also drives a need to improve T&E of systems-of-systems at the Joint Force Level. To meet Defences contemporary T&E needs, the Defence Test and Evaluation Strategy was released on 24Aug21. The Strategy aims to deliver a modern, networked, T&E capability that underpins risk-based capability decisions and is actively supported by a strong, sovereign base. The Strategy will be implemented by 2030 over three "Horizons" designed to understand the current state of the Australian T&E Enterprise before modernising and enhancing it through improved use technology and the development of a more cohesive, coordinated Defence T&E Enterprise. This briefing will provide insights into the completed activities under Horizon 1 and the implementation plan of the Defence T&E Strategy for Horizon 2. Will invite discussion on challenges and opportunities presented by new and emerging technologies as well as visions of what the future Australian Defence T&E Enterprise should be by 2030.

Keywords: Test and Evaluation, Strategy, Implementation, Enterprise, Plan

id #18617

Testing Smarter using Design of Experiments

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The systems that Defence test continue to increase in complexity and as such the requirement to "test smarter" has never been greater. Design of Experiments (DoE) is a testing methodology that aims to maximise the knowledge of the performance of a system under test by identifying the significant input factors and developing the most efficient way to gain an understanding of the relationship between these input factors and the system response. DoE provides optimal insight for minimal cost. It moves us from "I think" towards "I know". DoE is applicable to testing physical systems and systems represented through modelling and simulation.

This presentation will provide an overview of DoE and detail the benefits of employing DoE over traditional testing methodologies such as one-factor-at-a-time testing. A fictional modelling and simulation example of designing an uncrewed aerial vehicle for surveillance will demonstrate how DoE optimally covers the test design space, characterises system performance and quantifies the level of confidence in our conclusions.

Keywords: Test and Evaluation, Design, Experiments, Methodology, Autonomous Systems.

id #18619

Testing of Robotic and Autonomous Systems - When the Rubber Hits the Road (or Water)

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This presentation will discuss some of the challenges encountered and lessons learned from various developmental and operational test activities for uncrewed ground and sub-surface systems.

Emerging and disruptive technology, such as uncrewed robotics and autonomous systems (RAS) have many challenges and opportunities during the systems engineering process, particularly in test and evaluation. RAS have been slowly developing over many years, though recently augmented with other emerging technology such as digital twins, model based systems engineering, artificial intelligence, etc – machine learning robotics are considers a recent technology. As the systems have evolved and developed, so have the challenges associated with conducting a safe and effective test and evaluation program.

This presentation will cover the flurry of recent discussions around actual challenges and opportunities in regard to Test and Evaluation (T&E) considerations and examples of drones or unmanned aerial vehicles, unmanned ground vehicles and robotics and autonomous systems within maritime environments.

These T&E challenges and opportunities highlight the need to consider new methods of T&E for Robotics and Autonomous Systems (RAS) in the various environment to encourage high trust and assurance of robots and uncrewed systems.

Submitted as part of engineering a sustainable world UN SDG number 9 – Industry, Innovation and Infrastructure.

Keywords: Systems Engineering, Test and Evaluation (T&E), uncrewed, unmanned, robotics and autonomous systems (RAS), challenges, UN SDG 9

id #18631

MBSE and PLE as combined key enablers for agile systems "family" engineering

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This presentation showcases the integration of agile development, Model-Based Systems Engineering (MBSE), and Product Line Engineering (PLE), along with a real-world industrial example. While MBSE shares principles with Agile methodology, PLE's feature-based approach brings additional benefits such as reuse and variability development to agile systems engineering. The presentation demonstrates an agile development workflow that combines MBSE and PLE, enhancing development efficiency, collaboration, and time-to-market.

The presentation will cover an industrial example that shows an agile development workflow that combines both MBSE and PLE to improve development efficiency and reuse, collaboration, and shorten time-to-market. The example will show how new features and requirements can be integrated to existing variable and common legacy assets and catalysed into development items that are assigned to the different systems engineers. The systems engineers can then develop the family models and validate & verify them through simulation for the new features of the system family.

Attendees will leave the presentation with a clear understanding of the advantages of using agile development with MBSE and PLE against a traditional single-project-oriented and waterfall approach, as well as insights on how to apply this approach with the support of dedicated commercial tools.

id #18636

Navy Modelling and Simulation

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Navy Modelling and Simulation

The Royal Australian Navy (RAN) robotics, autonomous systems and artificial intelligence (RAS-AI) Strategy 2040 is to modernise its maritime capabilities with emerging technologies such as robotics and autonomous systems, modelling and simulation and synthetic environments.

In connection to the original statement, the application of self-learning robotic in the maritime environment used for Defence, has expanded the number of opportunities and applications with the information era and explosion of data analysis. Model based engineering, digital twin, virtual training and simulation, data analysis and manipulation are some of the cross emerging themes being targeted by RAS and indeed targeted by RASAI Strategy.

This presentation will provide an overview of Navy Modelling and Simulation Strategy, synthetic environments and the interfaces with systems engineering, test and evaluation.

CMDR Richard Austin is the Deputy Director Navy Modelling and Simulation in Warfare Innovation Navy, Navy Capability Division. CMDR Austin has presented previously as part of panel at SETE22 and Test and Evaluation Community of Practise on Emerging Technologies – the challenge of testing them.

Keywords: Modelling and Simulation, Test and Evaluation,

id #18015

Systems 101 - An Introductory Tutorial on Systems Thinking, Modelling & Simulation and Engineering Systems

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Systems Engineering is a “transdisciplinary and integrative approach” that uses “systems principles and concepts”, to enable the definition and realisation of complex capabilities (INCOSE). This introductory tutorial will focus on some of these "transdisciplinary systems principles and concepts” that underpin the efficient and effective engineering of systems. It is broadly structured to be delivered in six parts, sandwiched between a motivational introduction and a concluding session summary and discussion.

Part 1 focuses on the "Why, What and How" of systems thinking. Part 2 introduces key M&S concepts of abstraction and fidelity and the associated systems concepts of interoperability and emergence. Part 3 then applies these concepts to outline a mental-model framework, introducing two key concepts that underpin the engineering of systems and the foundational role systems engineers play in the translation of complex concepts into tangible, safe, secure and sustainable capabilities. Part 4 builds on previous concepts to introduce "systems models" and introduces a first-principles perspective to systems engineering life-cycles. Part 5 focuses in on contextualising verification and validation as a core spanning stream across systems engineering life-cycles. Part 6 is an introduction to complexity - building on the concepts from previous parts and introduces the Cynefin framework as one means of understanding and dealing with complexity.

Breakouts and discussion sessions (and breaks!) are embedded through the tutorial, to allow for interaction, discussion, engagement and networking. The last breakout session will focus inward, to draft an “elevator pitch” to communicate the central and critical role systems engineers play in the transformation of complex concepts into tangible critical capabilities in an ever evolving and interconnected socio-technical context for a safer, secure and sustainable future. Depending on interest and time-permitting, we will conclude with applying the concepts covered in the tutorial, to consider the question “are we living in a simulation?”.

id #18213

Addressing a human *Weak Point* in implementing simulation strategies

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A frequently identified Weak Point in simulation concerns the capabilities of the people who manage learning in simulation-based contexts. Do your simulation strategies address this issue? What do you know about characteristics and capabilities indicating the presence (or absence) of these skills? And what exactly – or even imprecisely – are they? Are they the same for all conditions? What ethical issues are involved? Are there models to guide actions? Are these models the same for all conditions and circumstances?

In different contexts the simulation manager is called umpire, educator, clinical specialist, coach, technician or facilitator. Whatever the title is used the required skills are similar - and their quality contributes a great deal to the success or failure of simulation based activity. When large amounts of money are paid for technical components of a simulation, how much time and money should be invested in ensuring that those managing the learning are properly equipped to use it efficiently and effectively?

This interactive workshop is for anyone making decisions about employing simulation-based learning for decision support and/or skills and knowledge development. It uses a number of short exercises to help participants explore questions relevant to their own contexts. While it cannot make anyone an instant expert on facilitation, participants will be more confident about recognising good and poor performance and taking appropriate actions for aligning people management skills with the technical complexities involved in managing the learning in all kinds of simulations.

By participation in this workshop you will

- Appreciate the importance of incorporating quality facilitation skills into simulation-based learning
- Recognise quality facilitation skills in action
- Identify deficits in facilitating simulation-based learning
- Understand the causes of gaps in facilitation capability
- Have guidelines for choosing and implementing appropriate improvement actions
- Be confident in advocating for, and supporting ethically based quality facilitation

id #18300

Essentials of Model-Based Systems Engineering (MBSE)

Daniel Spencer[1]

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Taking a systems approach helps to deal with the increasing complexity of products, capabilities, and the environments in which they are operated. Model-Based Systems Engineering (MBSE) can be an effective aid in managing and communicating technical information for today's projects. Many organisations will have had exposure to MBSE, but the transformation is far from complete. To be successful, some key foundational concepts need to be addressed.

Some myths and misconceptions exist around evaluating and deploying MBSE:

"This will just add another software tool"

"Modelling and simulation is too complex for our project"

"Our client only expects us to deliver a set of documents"

"I'm creating all of the diagrams, so we're already doing enough"

This half-day session covers the most important aspects that engineers and organisations need to consider when rolling out MBSE or refining existing MBSE approaches. Through discussions of the fundamental concepts, the focus is maintained on the true deliverables – the system itself and overall project success.

The session is delivered in a tutorial format, and includes:

- Background in systems concepts and Systems Engineering

- Myths, misconceptions, and essential characteristics of MBSE
- Example of an MBSE metamodel
- Processes
- Modelling examples in Requirements, Physical Architecture, Behaviour, Verification
- Overview of the various diagram types covering each modelling area

The session is equally valuable for:

- Engineers who implement MBSE approaches, or who have an interest in understanding more about MBSE
- Managers and decision makers responsible for systems engineering efforts
- Other stakeholders and project representatives that want to know what questions should be asked when evaluating MBSE approaches
- People who have interest in the information that underpins the wider digital engineering thread throughout the engineering lifecycle

id #18485

Applying Systems Engineering Concepts in a Learning Framework for Better Modelling Design

Richard Hodge[1]

1. Hodge Nominees Australia P/L, Sunbury, VICTORIA, Australia

Senior executives face pressures consistently to prioritise short-term operational needs over the long-term benefits for their enterprise. Culture shifts adversely, risk accumulates and they don't have time to learn systems engineering or modelling basics, much less apply them.

How then can simulation and systems engineers engage with non-engineering stakeholders and executives in ways that apply some basic foundations of systems engineering while setting a solid foundation for the development of simulation and modelling for better business outcomes?

In this tutorial, Dr. Hodge will layer insights from a range of sources to create a simple framework that guides enquiry with executives to co-create a foundation and narrative for modelling within a systems framework. He draws together insights and practice from:

- The Divided Brain by Iain McGilchrist to design for a human brain, not a machine
- The 4MAT® Model by Bernice McCarthy, as a basis for ongoing learning
- The Systems Engineering 'Egg Diagram' from DSMC 1998, and its alignment with the 4MAT® Model
- Four simple modelling techniques drawn in conversation to explore the 'Why' – 'What' – 'How' – 'If' elements (used by Thought Leaders Global)
- A process for addressing these in a particular order, respectful of the need to achieve connectedness before co-creation can begin.

Dr. Hodge applies this process regularly when mentoring thought leaders around the world. This session is designed as both tutorial and workshop as attendees take time to apply insights and modelling tools to a challenge within their own work context.

Attendees will learn and practice applying concepts in this framework so they leave with insights they can apply immediately in their workplace. The concepts are recursive to apply at any level to improve buy-in to an evolving narrative and foundation for better modelling and business outcomes for both executives and simulation and systems engineers.

id #17990

How to create an AIRWAY FIRE simulation without burning a hole in your pocket!

Pamela Chia[1]**, Michelle Leanne Lim**[2]**, Shin Yuet Chong**[2]

1. KK Women's and Children's Hospital, Singapore, SINGAPORE

2. Singapore General Hospital, Singapore

Airway fires are rare but have catastrophic consequences. As clinical exposure to airway fires is unlikely, simulation-mediated deliberate practice will give team members the opportunity to hone their response. We report a low-cost and sustainable method to conduct an airway fire simulation. As part of the National Airway Programme, 50 participants from emergency medicine, anaesthesia and intensive care participated in our airway fire simulation scenario. Participants played the roles of surgeon, anaesthetists, scrub and anaesthesia nurses. The scenario was a patient with a known difficult airway undergoing a tonsillectomy. While diathermy is being applied, ‘smoke’ is seen emanating from airway. Participants are expected to pour saline into the mouth to extinguish the presumed airway fire, remove the ‘burning’ endotracheal tube and reintubate the patient. To simulate smoke coming from the airway, the authors used the Laedral Delxus Airway task trainer, detached the oesophagus and connected a nebuliser filled with water mixed with ashes to the oesophageal outlet. The nebuliser was connected to a flowmeter on a hidden oxygen cylinder. When the flowmeter is turned on, mist resembling smoke will waft up through the mouth, simulating an airway fire. Vital signs were displayed on a laptop using Laedral LLEAP software. The high-fidelity manikin has become the preferred teaching modality in crisis scenarios due to its realistic features. However, it may not be suitable for an airway fire scenario due to concerns about water damage to sensitive electronic circuits.

The advantages of using our setup are:

1) its low cost, easy setup and relative portability

2) no risk of water damage to expensive manikins

3) no naked flame that can pose as a hazard to participants

We share this effective, affordable, accessible training tool to encourage other simulation faculty worldwide to use it in their airway crisis management training programmes.

id #18518

"I'll lead, I'll scribe." - Gender and Role Participation in Team Simulation Training.

Kristin Boyle[2, 1], Kate Mccloskey[2, 3], Janet Mcleod[4], Julian Stella[1]

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3. Paediatrics , University Hospital Geelong , Geelong , Victoria , Australia

4. School of Medicine , Deakin University , Geelong , Victoria , Australia

Introduction: Students at a regional postgraduate medical school participate in a number of team based simulated clinical scenarios as part of their medical education. Role allocation is usually done in an informal and collective manner, where students can either volunteer for or "offer" to others the various leadership and followership roles, with a collective understanding that roles will be rotated through the group. Researchers involved in facilitating simulation observed that within mixed gender groups, there appeared to be a bias towards male representation in leadership roles. The question arose: Is gender inadvertently influencing the educational experience we are delivering to medical students?

Methods:The study utilised an explanatory sequential mixed methods design, with collection of both qualitative and quantitative data. Data collection commenced in 2019, but was halted for logistical reasons during the COVID pandemic. A pre-survey was completed by all consenting students, with collections of basic demographic data and previous occupational and simulation training experience. All group simulation sessions in the 2020 academic year were video taped and reviewed by researchers, with students identified, coded, then matched to their demographic data. A qualitative content analyisis was also performed, looking at leadership statements and behaviors. In addition, a focus group was conducted with a small group of volunteer students, exploring themes such as different styles of leadership, and factors influencing comfort with leadship.

Results and conclusion: Preliminary analysis suggests there may be a small but statistically significant relationship between gender and role participation in team simulation training. Focus group content analysis revealed various potential reasons for this, such as fear of poor performance, future career aspirations, and placing higher value on the education experience of the leadership role.

Complete results and conclusion will be available early June.

id #18083

A Simulated Clinic to Build Interprofessional and Authentic Learning Opportunities for shaping future practice

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Background

Simulation based learning provides an opportunity to increase students' clinical readiness prior to workplace placement. Cross disciplinary learning allows facilitation of interprofessional competency building and improved student appreciation of other health professions (1). With this in mind an authentic learning scenario was planned incorporating two disciplines, nuclear medicine and radiation therapy. This presentation outlines the approach to facilitating an interdisciplinary mock simulated clinic, where experiences were mapped to common professional capabilities.

Content

The clinic aim was to replicate physical elements of a nuclear medicine or radiation therapy department. This resemblance to the real-life scenario is critical to learning.

All students were allocated roles of both the health care professional and patient. The patient was encouraged to ask questions to the clinician about the procedure to better understand the other modality.

Patient presentations were varied and included limited mobility, communication challenges and varying levels of cooperation. Short appointment times with unexpected events built in, encouraged development of quick recall, teamwork and problem solving.

A student de-brief using real time polling enabled incorporation of student opinions into future mock clinics. They indicated a preference for more information prior to the clinic to better prepare themselves. Although this feeling of unpreparedness was intended to mimic placement, in future clinics expectations of students will be addressed.

Conclusion

The mock clinic was a valuable experience for staff and students. A goal to embed authentic assessment through the mock clinic exercise will be explored with future iterations.

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id #18102

Novice Learners' Perspective on Obstetric Airway Crisis Decision-Making Training using Virtual Reality Simulation

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2. Duke-NUS Medical School, Singapore

Background: Current training for managing the obstetric difficult airway crisis are inadequate, as real-life opportunities are rare. Conduct of more frequent simulation training sessions is needed but is resource intensive. Virtual reality (VR) simulation training has been increasingly used recently, potentially complementing existing simulation curricula.

Methods: In this pilot qualitative study, a VR simulation scenario of the obstetric airway crisis was designed, testing decision-making. Novice learners rotating through obstetric anesthesia were

recruited. Individual interviews were conducted pre-VR to assess learning needs and post-VR to assess perspectives on using the VR teaching tool. The Interviews were transcribed and thematically analyzed.

Results: 21 residents were recruited. Three pre-VR themes identified were gaps in the current curriculum, confidence in managing obstetric difficult airway crises, and recognition that simulation is resource intensive. 2 post-VR themes identified were VR helping in learning decision-making under stress and areas of improvement for the VR tool.

Conclusion: We identified the advantages of VR simulation and its potential as an intervention to address gaps in our curriculum. Areas of improvement were identified for more effective future implementation.

id #18386

Exploring whether simulated Pre-Internships programs improve the value of subsequent medical student clinical rotations.

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Background:

Pre-internship is traditionally a rotation done at the end of the medical student curriculum to support work readiness prior to internship. Deakin University include a structured simulation program (PRINT) as part of this pre-internship, which rotates students weekly through different simulated wards as simulated interns, with increasing complexity of both medical situations and number of patients to prioritise and escalate. During 2021/22 with changes to the curriculum during COVID, the timing of PRINT changed to be any rotation during final year medicine which led to unexpected feedback regarding its utility earlier in the final year.

Whilst current literature has identified a clear correlation between undertaking pre-internship clinical programs in medical students' final year and an improved ability to transition into an intern role the following year (Australian Medical Council & Medical Board of Australia, 2021). At present there is insufficient research examining the impacts the timing these programs delivery have on students' confidence, ability to achieve subsequent learning outcomes and enhancements in student preparedness for internship following graduation.

Hypothesis:

Simulated pre-internships not only prepare medical students for their intern year – but can also ensure that students learn more and have increased confidence and ability to develop their learning in their subsequent clinical rotations.

Aim:

To investigate whether simulated pre-internships improve the value of subsequent clinical rotations.

Methods:

Research will be undertaken using mixed methods with a combination of quantitative questionnaires for medical students both pre and post their print rotation, as well as several focus groups with the medical students.

Results:

Results pending but will be available by the time of presentation.

Conclusion:

Conclusions will look at the student experience on their subsequent rotation and the influence that PRINT has on their ability to participate in their clinical rotation.

id #18530

Evaluation of interprofessional online debrief discussion of Obstetric and Neonatal Simulation

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Objective

To evaluate how medical and midwifery students perceived the online interprofessional simulation-based workshops in achieving the desired learning outcomes in the education of obstetric and neonatal emergencies.

Methods

This qualitative study was conducted at Monash University, Australia following a social constructivist view[1]. Data were collected from 18 video recordings of the discussion conducted during online Obstetric and Neonatal Emergency Simulation (ONE-Sim) workshops from August 2020 to October 2021. All participants attended the live virtual scenario-based workshop with simulated emergencies followed by a discussion on key learning points with both medical and midwifery students and co-facilitators. Learning outcomes of the workshop were behavioural skills like teamwork, communication, and clinical procedural basic obstetric and neonatal emergency skills. A total of 290 (250 medical, 40 midwifery) students participated in the study. Student responses were collated from transcriptions of video recordings of the workshop.

Results

Students reported that the workshops were effective in demonstrating good interprofessional communication and team dynamics, increased their exposure to obstetric/neonatal emergencies, allowed the application of theoretical knowledge, and permitted them to receive constructive feedback. Most students described the positive impact of online simulation-based education (SBE); however, the perceived downside was the inability to replace hands-on experiential learning. Predominant themes were (1) communication, (2) clinical experience, (3) clinical reasoning, (4) preparedness for clinical emergencies, (5) observational learning, and the relevance of online simulation.

Conclusion

Online, simulation-based training is a convenient and effective way of teaching obstetric and neonatal emergencies. It allows for a safe learning environment, prioritises patient safety, and builds clinical decision-making skills in an interprofessional environment. More studies are needed, to compare the effectiveness of online simulation-based training to in-person practice.

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id #17957

THE THREE SHIFT SIMULATION PROJECT, INTERPROFESSIONAL COMMUNICATION FOR THE SAKE OF PATIENT SAFETY.

Kerry Reid-Searl[1], Danny Sidwell[1], Larissa Smart[1], Melanie Greenwood[1], Pieter VanDam[1], Catherine Teare[1]

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Background

A common factor contributing to patient harm is ineffective communication between health care professionals. Many undergraduate nursing programs teach students to identify signs of early patient deterioration and communicate concerns via a phone to medical officers using simulation. These simulations rarely involve the physical presence of medical students where direct communication can occur. This led a university in Tasmania, Australia, to design The Three-Shift interdisciplinary simulation.

Aim

The aim of this presentation is to showcase the design, development, and evaluation of the Three Shift Simulation.

Discussion

The Three Shift Simulation involved nursing, medical and pharmacy students working together across three different shifts collaboratively whilst caring for a deteriorating patient. Throughout each shift students would communicate with each other and respond to the unfolding patient situation. To guide educators through the simulation, a tool kit was developed to enable replication of the simulation and ease in delivery. The tool kit would include a user guide, rules of engagement, handouts on the significance of the simulation, and guides for each learner playing different roles including cue cards. Following ethical clearance, the simulation was evaluated by willing participants who completed a survey post the simulation. Results indicated that the simulation helped participants *develop their clinical reasoning skills*, *clinical decision-making abilities*, *recognize patient deterioration early* and *practice communicating with other healthcare professionals.*

Conclusion

Three shift simulation is a simulation designed to promote interprofessional communication. The tool kit enables the replication of the simulation across multiple campuses and potentially to other nursing programmes.

id #18243

Techniques for improving countermeasure models for synthetic environments

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Technology advances in long-range Integrated Air Defence Systems with wide electromagnetic (EM) spectrum coverage significantly affects the likelihood of mission success of airborne operations. The development of new countermeasures (CM) against modern threat systems using current test and evaluation approaches is based on results from field trials with surrogate threat simulators and can have extended CM deployment turnaround times. Given the pace of threat development in the 21st century, such turnaround times are too slow to ensure mission effectiveness. In addition, the CM techniques are generally threat dependent and any minor changes to a threat may defeat the new CMs. In light of this, the NATO Air Force Armaments Group Subgroup 2 has identified that future CM development and validation must begin in synthetic environments (SE) to provide fast, agile and threat-agnostic CMs. Using SEs expedites the CM development cycle by reducing trials and data processing time, and allows for testing of more exotic scenarios and threat variations.

We are developing physics-based models of mission relevant CM characteristics in the electro-optic domain. Training our physics-based models with trial and laboratory data yields statistical environmental parameter distributions that can be used to generate CM behaviour predictions for scenarios that represent untested real world conditions. Validated models can be integrated into a SE to create mission relevant scenarios. We have developed successful models predicting both intensity and trajectory of airborne pyrotechnic CM, with root-mean-square deviations down to a few percent of radiance for linear burn models, and 0.5 m for our six-degrees-of-freedom trajectory model. Presented is a description of the philosophy and techniques for achieving predictive capabilities, and what advances need to be made in data acquisition for better outcomes.

id #18425

Content analysis of publicly available online advertisements for simulation professional roles across the four sectors.

Janiece Roche[1]

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While the professional knowledge required to work efficiently and effectively within simulation and modelling is changing constantly, and increasing exponentially, what is not yet available is a coherent framework linking skills (capabilities) and knowledge requirements across sectors. (Lu, 2019; Sagar, 2014).

There is a clear and increasing gap in regard to the availability of appropriately qualified staff (Blackmore & Allitt, 2021). As yet it is unclear whether the skills and knowledge expected of a simulation workforce are common across industries and disciplines and whether such knowledge and skills are transferable. Therefore, to envisage the simulation workforce there is a need to understand the scope of knowledge and skills required for use by simulation professionals within and across sectors.

This study is required because there is a chronic shortage of simulation professionals within the Australian workforce (Blackmore & Allitt, 2021; Okraski, 2014).

This paper aims to:

- Identify the range of simulation professional roles within and across the healthcare, defence, engineering and aviation sectors
- Map essential skills and knowledge in those simulation roles
- Identify core or common skills and knowledge across simulation roles

The report follows a study 1 using document analysis, a social research method which involves classifying textual material into manageable data (Weber, 1990) through processes such as document selection, data collection, categorisation of content and analysis (Altheide, 2011). This report deepens the understanding of the perceptions of the simulation professional role.

id #18452

The impact of video demonstrations and video-captured OSCEs to assess and develop clinical competency

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Background: Simulations share commonalities with OSCE's in that learners are observed performing a clinical skill, or participating in a clinical scenario. Both simulations and OSCEs aim to develop and assess a learner's clinical competency. The impact of observational anxiety on a learner's performance is a known challenge of simulations and OSCE's. In the Health Assessment and Advanced Nursing Practice paper at Otago University, the educators have observed that during the laboratory sessions, the advanced practice nurses (APN's) seemed intently focused on how to pass the final OSCE rather than the acquisition of physical examination skills to inform their clinical decision-making. Covid-19 presented an opportunity to consider how we use simulation or OSCE's to teach and assess a nurse's competence in physical examination. One strategy was to video the lecturer performing the OSCE and using a video-captured OSCE to assess competence.

Aim: To understand the impact of a video demonstration and video-captured OSCE to develop and assess APN's competence in physical examination.

Methods: A qualitative descriptive design utilising semi-structured interviews with four APN students and one examiner who were involved in the video-captured OSCE and demonstration. Data was analysed using a thematic analysis.

Findings: There were opportunities and challenges for the students and examiner when using a video demonstration and video-captured OSCE to develop and assess competence. The traditional OSCE might not be the problem but rather the teaching and learning approach. Using a behaviourist approach to practice clinical skills before a simulation may enhance a student's performance and decrease anxiety.

Conclusion: The pandemic serves as a reminder that out of crisis, new opportunities emerge when educators question traditional teaching methods and assessments, and collectively problem solve.

id #18016

Panel - Systems Thinking, M&S, Foundational Enabling Pillars for an Ethical and Resilient Society

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Panel Members to be confirmed from SimAust, SESA and ITEA.

The intent of this panel session is to catalyze discussion across Systems, M&S and T&E through the sharing of personal insights into contemporary societal challenges such as the COVID pandemic, the digital revolution and the rapid adoption of AI/ML based technologies, towards a better, more ethical, safe and secure society.

We live in an ever-evolving socio-technological context of ever-increasing interconnectivity and resulting complexity. Every "system" (be it social, environmental, commercial, political, technological, biological or hybrid) is increasingly an integration of multiple interdependent sub-systems (social, environmental, commercial, political, technological, biological or hybrid), and exists within an environment that itself is comprised of multiple interdependent systems, all in varying states of evolution. Each system is subjected to continual stimulus from its environment and responds with behaviours that are a function of its inherent architecture, its heritage, and temporal influences.

So while our intentions when creating new systems (or of modifying existing ones) is (almost always) driven by a need for a greater good, the ever increasing complexity of the evolving interdependent operational context, is continually increasing the risk of unintended outcomes from unforeseen interactions and emergent behaviours. The impact of these unintended consequences can be significant, especially with regards to personal safety, security, and ethical considerations of users of the system, of others that may interact with it/them, and eventually that of humanity.

So are we doomed to eventual self-destruction in an ironic (technology driven) twist to the Fermi paradox, or is there opportunity (or more so, a fundamental need), to lift our approaches to engineering and use of contemporary systems so as to minimise unintended outcomes and our survival as a species?

id #18076

Systems Engineering Workforce Readiness for the Future

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2. INCOSE, SanDiego, Cal, USA

3. Australian National University, Canberra

Science, Engineering and in particular Systems Engineering (SE) progress is often a result of the integration of multi-disciplinary contributions. The speed of technology changes, the increasing access to knowledge, and the greater interconnectedness and interoperability requires the education and training of Systems Engineers to evolve to address these challenges. Currently, there is a shortage of experienced Systems Engineers and a growing need for such competencies. As such, a number of guiding principles have been identified in a white paper titled "Building the SE Workforce of the Future", a complement to the INCOSE SE Vision 2035 (incose.org/sevision), authored by Heinz Stoewer and David Nichols.

The guiding principles for SE workforce readiness for the future include applying a broad systems approach and global cooperation to help transform our world to one we wish to live and pass to our children; practicing SE in many tiers of an enterprise to ensure product functionality and market success; embracing digital and cyber-physical transformations coupled with technology advances; addressing the increasing criticality and diversity of SE tools, particularly across different generations of incompatible tools while embracing modelling and simulation, virtualisation and digital twins; and greater diversity in SE roles requiring SE education curriculum to also focus on SE specialisations; to name a few. Building this skilled SE workforces will require continuing education through formal education, increasing the use of capstone projects, workplace training and on-the-job training.

This panel will discuss future readiness of the SE workforce, and the usefulness of these guiding principles to help influence the curriculum of educational institutions, and the continuing professional development pathway for Systems Engineers. Panellists will come from academia, industry and government. Discussions and outcomes will be shared with the authors of the white paper for further consideration and application.

id #18082

How can industry, academia, and defence collaboratively build a sovereign test and evaluation workforce?

Tim Grabert[1, 2], **Kristen Raby**[1, 3], **Malcolm Tutty**[4, 5], **Mahmoud Efatmaneshnik**[6]

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4. RAAF, Canberra

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6. UNISA, Adelaide, Australia

The ability to raise and sustain a workforce of Australian test and evaluation professionals who have the skills, knowledge, and experience to test the types of disruptive technologies needed to ensure our national survival has become issue of national importance. Recent government announcements regarding workforce generation as result of AUKUS is testimony of this.

Furthermore, the types of competencies needed by test and evaluation practitioners is also rapidly changing as a result of the digital engineering revolution. The US Department of Defence Digital Transformation strategy of 2018 states that "digital engineering has empowered a paradigm shift from the traditional design-build-test methodology to a model-analyse-build methodology".

This specialist panel will explore the following difficult questions within the context of generating a sovereign, sustainable workforce of test and evaluation professionals:

What is the role of the T&E Practitioner in the digital engineering age?

What competencies do T&E practitioners need to remain relevant?

How can stakeholders within the Australian defence sector which includes industry, academia, and Defence work together to get the most out of this small but strategically important technical workforce?

How can industry stakeholders work together to build the T&E practitioner workforce of tomorrow? Where will the people come from?

id #18118

Systems Modelling and Simulation Approaches in Healthcare - Breaking down Complexity

Andrew Madry[1], **Jawahar Bhalla**[2], **Chris Browne**[3], **Grace Kennedy**[4]

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2. JB Engineering Systems, Sydney, NSW, Australia

3. Australian National University, Canberra, Australia

4. University of Wollongong, Wollongong, NSW, Australia

This Panel explores combining systems thinking/systems engineering (SE) approaches with modelling and simulation (M&S) to improve healthcare for Australia. Systems thinking is a holistic approach to problem-solving that emphasizes the interconnectedness of all parts of a system, and how changes in one part can impact the whole. The Australian healthcare system is complex and multifaceted, with many different stakeholders and factors at play. By applying systems thinking, healthcare professionals can better understand the underlying causes of issues and design more effective and sustainable solutions.

Modelling and Simulation of complex scenarios can inform decisions, remaining cognizant of the limitations of any model.

This panel will provide a discussion between practitioners from both communities (SE and M&S). The panel will be followed up with a workshop during ASC, hosted by the Healthcare Working Group of the Systems Engineering Society of Australia (SESA). This will allow for more in depth discussion.

Systems thinking has the potential to be a powerful tool for improving healthcare in Australia, by promoting a more comprehensive and integrated understanding of the healthcare system and its underlying dynamics. By taking a systems thinking approach, backed up with realistic M&S, healthcare

professionals can identify opportunities for innovation and improvement, and work towards building a more effective, efficient, and equitable healthcare system for all Australians.

id #17855

Exploring the Potential of 3D Printing: Printing Part-Task Trainers, Replacement Parts & Molds

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The West Moreton Health (WMH) 3D printing initiative was established with the aim of enhancing medical & nursing training through the use of 3D printing technology.

The initiative has been highly successful in creating part task trainers, replacement parts and molds using 3D printing technology. These part task trainers include surgical airway trainers, intraosseous insertion trainers, suturing practice model molds, umbilical venous catheterisation molds, peripheral intravenous cannulation part task trainers and more. These trainers provide medical professionals with a realistic and hands-on approach to learning and perfecting their skills. They allow practitioners to practice the procedures repeatedly until they have mastered them before performing them on real patients.

One of the most significant advantages of the WMH 3D printing initiative is the cost-effectiveness of the part task trainers. The use of 3D printing technology has significantly reduced the cost of creating part task trainers, allowing for more trainers to be produced at a fraction of the cost of traditional manufacturing methods. This has allowed the organization to expand its training offerings and reach more medical professionals. The models created in just 12 months would have cost over $40, 000 to purchase from commercial vendors.

In conclusion, the West Moreton Health 3D printing initiative has been highly successful in enhancing medical training through the creation of highly accurate and cost-effective part task trainers. The use of 3D printing technology and silicone polymers has provided professionals with a realistic and hands-on approach to learning, enabling them to master procedures before performing them on real patients. This model presents exciting opportunities for low resource health systems in other countries to increase availability of training models at a drastically lower cost compared to current commercial options. This initiative is a testament to the benefits of embracing new technologies in healthcare.

id #17966

AV simulations as a strategy to raise awareness of diversity in pain assessment

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Appropriate management of pain requires nuanced assessment and consideration of multiple factors. The meanings of pain for patients and extent of self-report are influenced by cultural beliefs, prior experiences, fear and ability to adequately communicate. Clinician beliefs and anticipation of 'expected' levels of pain and relief required are similarly influenced by professional and personal experiences and beliefs. The cultural diversity of health consumers and the health workforce adds further complexity in achieving accurate pain assessment and subsequent management. The co-design of contemporary audio-visual (AV) simulations featuring scenarios of culturally diverse patients were evaluated for feasibility, acceptability and impact with nursing students. These resources can be used in multiple ways for example as preparation for simulations or clinical practice experiences. The broader context of interprofessional interactions, clarity and timeliness of communications and team decisions can extend application of these resources. This workshop will step through the key elements and benefits of co-design and ways in which AV simulations can be used to enhance engagement in learning and reflection about clinical practice.

id #18072

Eight Aspects of Agile Systems Engineering

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Agile Systems Engineering (SE) is a principle-based method for designing, building, sustaining, and evolving purpose-fulfilling creations when knowledge is uncertain and operational environments are dynamic. Principles are abstractions for what needs to be accomplished and why, without constraints or directions on how. How those abstractions manifest operationally depends upon the engineering context. The challenge of working across multi-domains in SE adds a layer of complexity to agility in comparison to implementing an agile approach in a single-domain such as Software Engineering.

This workshop will outline the eight aspects (principles) of Agile SE – Featured-based product line architectures; Iterative incremental development; Attentive situational awareness; Attentive decision making; Common-mission teaming; Shared knowledge management; Continual integration and testing; Operations concepts. Each aspect will be discussed in smaller groups to identify the challenges and pain points faced by industry(ies) in implementing an agile approach in SE. Likewise, possible guidance criteria will be identified.

The outcomes from this workshop will be collated and analysed, and then forwarded as input to the International Council on SE (INCOSE) Agile SE working group who are authoring a guidance document on Agile SE over the next eighteen months, to be published in late 2024. This guidance document will complement the Agile SE Primer which will be published by the same working group in 2023.

The workshop leader, Kerry Lunney, is a member of this working group and a co-author of both the Agile SE Primer and the Agile SE Guidance Document.

id #18416

Using Systems Thinking to Explore the Challenges in Healthcare Systems.

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1. University of Wollongong, Gwynneville, NSW, Australia

2. University of Canberra, Canberra, ACT

3. JB Engineering Systems, Sydney

4. Madry Technologies, Sydney

The recent years under pandemic have highlighted the sensitivity of our healthcare systems to adverse conditions leading to questions around the decisions around ongoing resilience. A healthcare system can be considered from different levels or boundaries from the micro-level interactions between individuals through to meso-level, organisational interactions, and up to the macro-level system of systems involving multiple organisations and wider government policies (and at levels of decomposition in between). Many of the decisions made during this period focussed on model representations and simulations to project the behaviour of these systems on a shorter-term basis on near term real-time data. Systems Thinking (ST) can be described as a discipline for examining wholes, interrelationships, and patterns utilising tools and techniques. As we now digest the decisions made, in hindsight, the application of ST approaches can now yield important insights into the lessons learnt.

This interactive workshop will guide attendees in exploring the contemporary challenges in Healthcare Systems using ST. The purpose of the workshop is three-fold: 1) to introduce attendees to a set of pragmatic ST principles/archetypes, 2) to identify the current challenges in healthcare systems and 3) to identify the opportunities for ST approaches to support decision making, intervention and change against those challenges. No previous experience in ST or healthcare expertise is required to participate, all perspectives are welcome. In fostering these discussions, the outputs of the workshop will be a set of contemporary challenges and potential activities that will be used to drive the overall efforts of the Systems Engineering Society of Australia's (SESA's) Healthcare Working Group.

id #18428

Understanding simulation professional skills and knowledge across Healthcare, Engineering, Defence and Aviation

Janiece M Roche[1]
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The aim of this workshop is to:

- Consult industry experts to deepen an understanding of skills and knowledge against the outcomes of the document analysis which identified advertised jobs do not reflect or outline the core skills and knowledge required to work in simulation.
- Identify, from a multi-industry perspective, a range of strategies for developing and communicating about transfer of the knowledge and skills of simulation professionals in order to address workforce staffing issues

The design of the workshop is to:

- Provide context to the simulation professional role and report of a document analysis of the current status skills and knowledge required in job advertisements in the industries of Healthcare, Engineering, Defence and Aviation
- Gain permission from prior to attendance or the session for participants to be involved in group work
- To form 4 focus groups of up to 6 persons from each of the representative sectors, as a part of an exploratory research method to facilitate discussion to gain in-depth understanding of skills and knowledge required from professionals working within simulation(Morgan, 1997; O.Nyumba et al., 2018).
- There will be trained facilitation in this workshop with ethics approval.

This method offers a platform for differing paradigms and views and is unique research to inform the simulation community (Krueger & Casey, 2015)
The outcomes of this workshop will be published as a part of a post doctorate study.

id #18438

Why games are a fast way to develop knowledge of Human Factors

Marcus Watson

Introduction

The workshop will explore how games can be used to introduce behaviors of effective teams and explore debriefing methods appropriate for all types of simulation.

Background

Many people feel uncomfortable discussing the non-technical aspects of their work. Games provide a unique opportunity to break the ice and introduce how failures in situations-awareness, communication, leadership and collaboration can produce poor outcomes without bringing a participant's clinical skills into question. Since the game requires no technical expertise, it provides an effective method to get the participants to focus on human behavior. The game provides an opportunity to engage large groups through participation and debriefing.

Method

The workshop will include:

- An introduction to Human Factors,
- Participants will play the Trade Game and debrief,
- The outcomes of the games will be used to illustrate strategies participants could have used to improve their teamwork.

The Trade Game is designed to demonstrate how people behave when under pressure and faced with uncertainty. The Trade Game works as a physical and mental arousal activity that can be used to explore the following issues:

- Human Behaviour,
- Leadership, and Teamwork
- Decision-Making in Complex Situations
- Workload and Meta-Cognition
- Educational Design and Debriefing Techniques

Participants will have access to an electronic copy of the game after they play.

Workshop size

The workshop is designed for 15-40 participants. Its duration is normally 90 minutes; however, it can be played anywhere between 1-4 hours.

id #18483

A T&E Code of Practice and the nexus between simulation and reality

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2. UNSW, Canberra, ACT, Australia

The International Test & Evaluation Associations (ITEA – see Home - ITEA - testing, education | International Test and Evaluation Association) Southern Cross Chapter held a Panel/Workshop at the SETE 2022 Symposia focused on the potential and need for the development of an T&E Code of Practice to complement the Systems Engineering Society of Australia / International Council on Systems Engineering (INCOSE) Systems Engineering Body of Knowledge (SEBOK) using a Model-Based Systems Engineering and T&E approach or MBSETE.

ITEA proposes to leverage it's Certified T&E Professional (CTEP – see Certification Process Overview (itea.org)) and INCOSE SEBOK material to underpin key principles. Australian Defence representatives also advised that in addition to the Defence T&E Manual they had recently started work on an Australian defence guidebook for "monitoring extensive ICT/IS projects (through T&E)".

Based on the SETE 2022 Panel/Workshop, ITEA have agreed to develop a T&E Code of Practice that would be suitable for many engineering and scientific disciplines including aerospace, cyber, defence, modelling, simulation, Intelligent and Autonomous Systems and disruptive technologies. Collaboration with SESA and INCOSE is strongly supported by ITEA.

The 2023 SETE panel and workshop will identify and confirm the over-arching principles of T&E and the priorities for discipline development, group them, and then prepare a brief for voting by the wider ITEA and INCOSE memberships before further development to improve the nexus between simulation and reality.

id #17934

Competency-based Systems Engineering Certification implementing AS/NZS ISO/IEC 24773-3:2022

Ray Hentzschel[1]

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This paper describes the application of Competency-based Systems Engineering Certification in Australia through a program known as Chartered Australian Systems Engineer (CASE). This program implements the requirements of *ISO/IEC 24773-3:2021 Software and systems engineering — Certification of software and systems engineering professionals — Part 3: Systems engineering* adopted in 2022 by Standards Australia.

The content of the standard is outlined, demonstrating a tight nexus with CSEP, and the INCOSE Systems Engineering Competency Framework. The paper describes the application of this standard through a Mutual Recognition Agreement with Engineers Australia to accredit certified systems engineers to chartered status.

The paper concludes by describing the Professionalization ecosystem that the certification pillar supports, and how the growing INCOSE resources can be applied to professionalization of Australian Systems Engineers.

id #17960

Between reality and simulation using Mask-Ed™ despite Covid-19 restrictions

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Aim: To reflect on the experiences of using Mask-Ed™ (KRS Simulation) as an on-line teaching method through an ethnodrama.

Context: The onset of the COVID-19 pandemic toppled education delivery worldwide. Higher education, and in particular, nursing education, was no exception. The pandemic required nurse educators to shift from traditional face-to-face learning environments to remote and virtual interactions. The experienced challenges between reality and simulation offered new ways of working together internationally. One simulation modality used by multiple tertiary institutions internationally was Mask-Ed™. Mask-Ed is a highly realistic simulation technique. The simulation modality involves an informed and trained Mask-Ed educator donning silicone props to transform into a character as a simulated patient.

Research Design: Ethnodrama represents, the complexity of lived relationships in education and offers an alternative to traditional methods of research. This ethnodrama was created by educators as they united globally to continue delivering nursing education to learners using the simulation modality of Mask-Ed.

Results: The use of Mask-Ed via on-line formats required caution and thorough preparation for the educators and their learners. The educators considered that through their Mask-Ed characters they were able to offer empathy, caring, and compassion, through genuine human connections developed between them, their Mask-Ed characters, and their learners.

Significance & Implications: The reflection encapsulated in this ethnodrama highlight the educators' experiences and their perceived versatility of Mask-Ed as a simulation modality as a practical innovative solution to create new ways of working together. The realism of Mask-Ed potentially offers opportunities for expanding the use of this across multiple delivery modes.

id #18165

Virtual Reality Analgesia for managing post-Laparoscopic gynaecological pain (VIRAL)

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Laparoscopy (key-hole surgery) is a commonly employed technique in gynaecological surgery. Existing research surrounding post-operative pain in women undergoing laparoscopic surgery is sparse and conflicting. It has been demonstrated that in the acute post-operative period, ~46% of patients post-laparoscopy were in severe pain and required significantly greater amounts of analgesia such as opioids, compared to patients undergoing laparotomy (open surgery). Given opioids have several widely acknowledged shortcomings (eg. adverse side effects, delayed ambulation and the potential for dependence), it is vital that alternative and adjunct pain management strategies are developed to bridge the current clinical gap, particularly, post-laparoscopy.

Virtual Reality (VR) is an emerging digital technology platform which can help address the shortcomings of current post-operative pain management. VR allows for users to be immersed in and interact with a three-dimensional virtual environment through multisensorial stimulation. Though the mechanism of action is uncertain, early research is indicating that this immersive capability helps direct attention away from the pain source. A systematic review by the project team has demonstrated clinical efficacy of VR in pain reduction whilst also being well tolerated by patients.

This prompted the design of a pilot study to evaluate the efficacy of VR in the context of post-operative gynaecological laparoscopy. The pilot demonstrated the potential of VR to facilitate analgesia in a small sample size. However, this may not be generalisable to a larger population. As a result, a phase 3, randomised controlled trial was designed to further investigate the effectiveness of VR analgesia on pain scores and opiate demand post-laparoscopy. If similar findings to the pilot are observed, this trial will lead to considerable benefits to the healthcare system through reduced post-operative pain, greater patient satisfaction, and decreased requirement and expenditure for opiate analgesia.

Word count: 288/300 words

id #18202

Project COMS; the Collaborative Online Multidisciplinary Simulation

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Background

In today's complex healthcare landscape, interprofessional education is essential for developing a collaborative workforce. This type of education allows students from different professions to learn together, leading to a better understanding of each other's and one's own roles and contributions. The World Health Organisation recommend incorporating simulation-based education and interprofessional learning experiences in health professional training. This study aims to develop and evaluate an online, interdisciplinary simulated patient experience for health professional students, focusing professional identity formation.

Methods

An online pilot program will bring together students from Medicine, Nursing and Allied Health professions across five institutions in Australia. The design supports rural and regional students not co-located with other health disciplines to access quality interprofessional learning opportunities. Students will be supported to work through clinical vignette cases with professional actors portraying simulated patients. The students will work together to present, via video, an interdisciplinary management plan for their assigned patient case.

To ensure the quality and authenticity of patient case scenarios, an expert clinician reference group will be consulted. Questionnaires will be used to evaluate the program's feasibility, acceptability, and impact on professional identity formation. To gain a more in-depth understanding of the experience and professional identity formation, participants will be invited to participate in focus groups, to provide rich triangulated data that incorporates multiple perspectives and help to identify areas for program improvement.

Outcomes

The project deliverables include an interdisciplinary simulation program with accompanying tasks, objectives, marking rubrics, and patient cases with corresponding vignettes. We will present the findings of the projects' feasibility, acceptability, implementation, and practicality, along with measures of professional identity and focus group themes.

This study will contribute to the development and evidence of interprofessional education and provide valuable insights into the effectiveness of an online, interdisciplinary simulated patient experience for health professional students.

id #18393

Defence update to the Capability Definition Documentation (CDD) Guide

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Defence has recently updated the Capability Definition Documentation (CDD) Guide, along with the corresponding Operational Concept Document (OCD) Procedure.

The CDD suite collectively includes the OCD, the Function & Performance Specification (FPS) and the Test & Evaluation Master Plan (TEMP), though the CDD guide focuses mainly on the OCD. There are many drivers for change at present, including: an increased focus on "speed to capability"; the rise of Model Based Systems Engineering (MBSE); a renewed focus on Enterprise Architecture; as well as a new focus on systems of systems engineering at the portfolio level (referred to broadly as Mission Engineering). These drivers of change have resulted in a need to update the OCD content and the process through which that content is captured. An end to end technical thread (needs --> requirements --> design) will be stitched through the capability lifecycle encompassing: the OCD; the artefacts that come before / inform it; and the artefacts that follow / are influenced by it.

This presentation will be of interest to anyone involved in defining capability within Defence, as well as those involved in the end to end capability acquisition process (One Defence Capability System (ODCS)). This includes people working in the Strategic Centre, for Capability Managers, for the Delivery Groups (e.g. CASG, NSSG, CIOG etc), and in industry. It is particularly relevant to people developing or consuming artefacts such as the OCD.

It may also be of interest to people outside Defence who are involved in similar activities.

Adnan Munshi is the Deputy Chief Systems Engineer within CASG, and Thomas Manley is an experienced Systems Engineer, and the author of the latest version of the CDD Guide.

id #18510

V&V and T&E in Defence – What's the Difference?

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Verification and Validation (V&V), and Test and Evaluation (T&E) are different, but interrelated processes. V&V covers key activities within the CASG Systems Engineering processes, and T&E is a process that provides essential support for capability decision-making. Both are critical to the efficient and effective development, delivery and management of Defence Capability.

Integrated V&V and T&E activities are conducted across all phases of the One Defence Capability System (ODCS), with the following characteristics and relationships:

- V&V Processes contribute to the definition of T&E Objectives; and
- The Objective Quality Evidence (OQE) generated by T&E supports the V&V process

However:

- Not all T&E Activity is conducted in support of V&V objectives; and
- T&E is not the only source of OQE in support of V&V Objectives.

The Capability Acquisition and Sustainment Group (CASG) of the Department of Defence has recently revised V&V Policies and Guidance, to better explain the relationship between V&V and T&E, and to align V&V with the One Defence Capability System (ODCS), including the Defence T&E Policy and Procedures framework.

This purpose of this presentation is to outline the recent changes to CASG Policy and Guidance, and to explain how this can improve capability development, innovation and efficiency.

The presentation be of interest to anyone involved in the definition, delivery and support of Defence Capability. This includes people working in Integrated Force Design, Capability Managers, Delivery Groups (e.g. CASG, NSSG, CIOG etc.), and Defence Industry. It is particularly relevant to people planning or conducting V&V and T&E in support of Defence Capability.

It may also be of interest to people outside Defence who are involved in similar activities.

id #18595

The Practicalities of a Marine Synthetic Environment for Supporting Test & Evaluation

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Modelling and simulation underpin complex systems design. It is a prerequisite for conducting technology development, incorporating innovation and developing autonomous systems. In the marine domain, monitoring solutions are increasing in complexity; integrating artificial intelligence, emerging decision support, autonomous navigation and multi-vessel sensing to achieve mission objectives within an evolving maritime regulatory environment.

Yet, the systems development lifecycle must also accelerate to maintain pace with technology in order to maintain a competitive advantage. Facilitating an accelerated development cycle requires the ability to rapidly design, build and test, which leads to the requirement for instrumented test ranges underpinned by a marine synthetic environment. This combination leads to a fusion of virtual and real system performance measurements to rapidly inform system level models and design decisions.

However, sustaining a marine synthetic environment for the purposes of technology maturation is expensive. On top of the hardware, software and scaling solutions, it requires maintenance, a support team, iterative development, integration support for users and a managed user interface. Marine technology maturation and assurance is a niche field with a limited market sector to sustain a marine synthetic environment. On the other hand, a marine synthetic environment has significant multi-use potential, from replaying coral health observation transects with high resolution photogrammetry overlays, to understanding safety implications during mission planning, to facilitating semi-real training in a virtual world. These additional use cases expand the economic potential and consequently sustainability of establishing and maintaining a marine synthetic environment for technology maturation. In this presentation, I will discuss some of the practical considerations in establishing a marine synthetic environment and associated ecosystem for technology maturation.

id #18616

Defence High Performance Computing

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Defence High Performance Computing

Supercomputers are vital for modern defence. High Performance Computing plays a vital role in the design, development or analysis of modern systems and national security systems. At a fundamental level, supercomputing involves the utilisation of very large numbers of compute processors, working in parallel, across very large data sets to solve highly complex problems. Supercomputing is mainly used for predictive modelling of the real world.

To meet Defences contemporary needs, a high performance computing capability, was launched on 12 Aug 22. Government has invested approximately $200m in the establishment of a secure, centralised supercomputer to support advance research development, modelling and experimentation across Defence and National Security. This capability is open for use by researchers, Defence, Industry and Academia alike. This facility has been future proofed to enable the installation and operation of further supercomputers as the business case arises for more technology use.

Supercomputing has come a long way since the first supercomputers used for signal intelligence cryptography or cracking of codes in 1984 by CRAY computer, which ran at 400 million calculations per second, slower than the speed of a modern iPhone. Since that time, we have seen supercomputing speeds increase by over 10 billion times.

This briefing will provide insights into the Defence High Performance Computing capabilities. This briefing will provide an overview of supercomputering and showcasing real applications.

Keywords: Emerging Technology, Supercomputing, high performance computing, Defence

id #18620

Development of an Australian Guidebook for Monitoring Extensive ICT and IS Projects

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Significant Information and Communication Technology (ICT) and Information Systems (IS) projects within Defence involve substantially different challenges and expertise compared to projects for weapon systems. For example, most ICT and IS professionals are educated and experienced in modern agile project management methodologies. In Defence, most software and cyber-worthiness assessments and testing are rapidly evolving due to the rate of technological advancement and the advanced persistent threat.

Large ICT and IS projects have unique frailties and up to one in six can failure substantially. Software intensive systems and interconnectivity within Defence mean that these difficulties can impact National security capability.

There is contemporary research and industry practices, particularly in the United States, to improve monitoring of ICT and IS projects. From these reports seven sets of principles are offered for Defence projects as best practice in monitoring and testing ICT and IS capabilities. These principles cover agile approaches, resilience metrics, test coverage for system-of-systems phenomena, balanced testing, minimum viable product to ‘test for success’, evergreen approaches, cybersecurity and international accreditation for the necessary testing competencies. Each set of principles has an extensive justification and explanation section, including diagrams and implementation guidance.

The guide covers many unique terms and best practices for assuring a balance in ICT/IS projects between usability, integration, performance in congestion (stress), and performance when contested (cybersecurity).

Based upon the Government’s sovereign industrial capability priorities for test and evaluation (2020), Defence has been challenged to improve its test infrastructure for sovereign innovation, awareness, and adaptability. These principles are offered as the most efficient and rigorous contemporary approaches in monitoring ICT and IS projects for services and groups to strive to use. The principles

and explanation sections may help project leaders, chief engineers and test principals quickly refer projects to best practice without the need for repeating justification.

id #19236

Modelable and Measurable Responsible AI

Kate Devitt[1]

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On the 16 Feb 2023 at the Responsible AI in the Military Domain (REAIM) Summit, The Hague, the Australian Minister for Foreign Affairs, HON Penny Wong, stated that *Australia recognises the vital importance of ensuring AI technologies are developed and used responsibly in a civilian and military context*. What does it mean for AI to be developed responsibly? This talk will provide practical best-practise steps to design, build, test and deploy AI responsibly. Particularly to help industry facilitate faster communication with Defence about the ethical and legal risks for their AI technologies. Drawing on the public consultation draft of the Responsible AI in Defence (RAID) Toolkit (Trusted Autonomous Systems), this presentation offers a uniquely Australian focus while aligning with international best practice, including two recent releases from the United States in the form of the United States Department of Defense Directive 3000.09 Autonomy in Weapons Systems 10 Year Update and National Institute of Standards and Technology (NIST) AI Risk Management Framework. The Toolkit adapts the OECD Classification of AI Systems Framework, making it suitable in consideration of ethical and legal risk in the military domain and incorporates Australia's legal obligations under international humanitarian law including Australia's commitment to Article 36 reviews of all new weapons, means and methods of warfare. The presentation will provide an overview of responsible AI suitable to different stages of the Defence acquisition process including how to model CONOPS with human-AI teams to demonstrate how identified risks can be managed and mitigated in simulated test environments. One of the key features of the Toolkit is that there are measurable elements, so that a test protocol can be developed and deployed within system testing.

id #18030

Exploring the design, development and deployment considerations for the use of VR in clinical education

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In this session Nathan Moore and Martin Brown will discuss the research and journey of exploring the use of Virtual Reality (VR) for Clinical Education. For the past four years a collaborative team from WSLHD, The University of Sydney and developer's Frameless interactive have been designing, developing, and deploying VR based applications to support clinician and undergraduate education. The modules developed have targeted identified areas of clinical need including Advanced Life Support, Code Black management, Verbal De-escalation skills, Clinical communication and more. These modules are in varying levels of development and deployment through proof of concept to commercially available products and the theoretical and practical steps required to navigate this journey will be explored.

Whilst there is currently significant hype and attention surrounding VR and associated technologies, in this session a practical and realistic approach will be taken to identify and address some of the strengths/weaknesses and challenges/opportunities for the scalable use of VR in the complex healthcare system.

Learning outcomes for this session include;

- Understand VR/AR/MR as a technology in the context of clinical education.
- Understand the educational theories supporting the use of VR in education.
- Identify key design considerations for the development of VR applications.

- Understand potential use cases for VR in clinical education utilising different VR based approaches.
- Identify key considerations for the practical deployment of VR in clinical education.
- Experience a variety of bespoke built VR applications designed to support clinical education.

id #18352

A tutorial in the design of experiments for testing a system of systems

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The emerging discipline of *Digital Mission Engineering* with its focus on experimentation has reinvigorated the international T&E community's interest in the design and analysis of experiments.

The challenge of testing systems of systems where 'black box' approaches and synthetic environments become necessary due to the practical shortcomings of classical operational test & evaluation techniques is also driving the renewed interest in experimentation.

The aim of the *mission engineering methodology* is to discover meaningful relationships between mission inputs and end effects. The role of the *mission engineering practitioner* is to design analytical experiments to measure and compare the baseline approach to completing a mission with alternative cases.

A well-designed experiment which follows the mission engineering methodology can be effective in explaining the relational attributes of a system of systems in the context of mission success or failure.

This tutorial will provide tuition and demonstrations of the following:

- Statistical concepts underpinning the design of experiments such as the ANOVA identity and regression.
- Data visualisation techniques useful for identifying experimental factors requiring further investigation.
- The process of designing an experiment for a system of systems including the selection of factors and levels to minimise experimental noise.
- Demonstrations of how experiments can be conducted in a modern digital mission engineering physics-based environment in order to identify an efficient matrix of test points for live system testing.
- The difference between designed experiments where randomisation can be controlled, and observational studies that utilise historical data sets.

Experimental designs useful for the following scenarios will be explored:

- Characterising model performance across an operational envelope.
- Screening to identify key factors affecting system performance.
- Optimising factor values for performance.
- Comparing two or more systems in an objective fashion.

id #18169

Heart rate responses in critical care trainees during intubation: comparison between simulated and clinical environments

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Objective

This study aimed to compare the heart rate response to stress during airway intubations in clinical practice and a simulated environment.

Methods

Twenty-five critical care registrars participated in the study over a 3-month period. Heart rate data during intubations was recorded by a FitBit® Charge 2 worn by each participant during their clinical practice and during a single simulated airway management scenario. The heart rate range was calculated by subtracting the baseline working heart rate (BWHR) from the maximum functional heart rate (MFHR). For each airway intubation performed, participants recorded an airway diary entry. Data from intubations performed in the clinical environment was compared to data from a simulated environment. Heart rate changes were observed in two ways: percentage rise (median) across the 20-minute intubation period and; percentage rise at point of intubation (median).

Results

Eighteen critical care registrars completed the study, mean age 31.8 years (*SD*=2.015, *95% CI*=30.85-32.71). Throughout the 20-minute peri-intubation recording period there was no significant difference in the median change in heart rates between the clinical (14.72%) and simulation (15.96%) environment (p=0.149). At the point of intubation there was no significant difference in the median change in heart rate between the clinical (16.03%) and the simulation (25.65%) environment groups (p=0.054).

Conclusion

In this small population of critical care trainees, a simulation scenario induced a comparable heart rate response to the clinical environment during intubation. This provides evidence that simulation scenarios are able to induce a comparable physiological stress response to the clinical environment and thus facilitates effective teaching of a high-risk procedure in a safe manner.

id #18350

Simulation-based education for teaching aggression management to acute health care staff: a systematic review.

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Background: Behavioural emergencies involving aggression are increasing in acute care hospitals worldwide. Acute care staff report a lack of training and confidence in aggression prevention and management. Simulation-based education (SBE) is gaining acceptance for teaching clinical aggression management skills. The aim of this study was to systematically review the effectiveness of SBE for teaching aggression management skills for health professionals working in acute health care settings.

Methods: A study protocol was prepared in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analysis Protocols (PRISMA-P), registered (PROSPERO CRD42020151002), and published. Comprehensive searches were conducted in PubMed, MEDLINE, PsycINFO, CINAHL and The Cochrane Library. Two reviewers independently screened all records, extracted data and assessed risk of bias. Primary outcomes included patient outcomes, quality of care, and adverse effects. Secondary outcomes included workplace resource use, healthcare provider related outcomes, knowledge (de-escalation techniques), performance, attitudes, and satisfaction. A narrative synthesis of included studies was performed because substantial variation of interventions and outcome measures precluded meta-analyses.

Results: Nineteen studies were included with 1771 participants, 1566 (88%) acute care hospital staff and 205 (12%) undergraduate university students. Sixteen studies combined SBE with at least one other training modality. Three studies were RCTs and 16 were pre-/post-test design. All studies were deemed to be high/critical or serious risk of bias. Three studies collected primary outcome data, all using different methods and with inconsistent findings. Sixteen studies assessed performance in the test situation, six studies provided objective ratings of performance and ten self-report data. Eighteen reported objective or subjective improvements in secondary outcomes.

Conclusions: Acute health care staff who completed SBE on managing clinical aggression showed statistically significant improvements in knowledge and self-reported confidence. However, there is a lack of evidence about the magnitude of these improvements and impact on patient outcomes.

id #18092

Identifying Necessary Features for Effective Scenario-Based Simulation Training: A Study on Optimal Learning

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The ever-increasing complexity of real-world incidents demands officers to be well-prepared to respond dynamically. To address this, innovative approaches have been employed to simulate these scenarios to train officers on command, control, and coordination skills. Home Team Academy (Singapore) leverages simulation training to go beyond conventional training methods to prepare officers for incident management of unprecedented incidents.

To craft complex and timely simulation scenarios for training, a structured scenario design could ensure the relevance of simulation exercises and alignment to training objectives. However, there is a lack of research on the features of a scenario-based simulation training that could allow officers to maximise the training takeaways and learn how to manage real-life incidents.

The research study aims to address the gap by identifying the necessary features of scenario-based simulation training and determining their importance for optimal transfer of learning, while considering how officers perceive and interact with the simulation scenario.

Through a questionnaire, the study provides insight into officers' perspectives of the importance of psychological, contextual, physiological, physical features and stressors of simulation scenarios. It also identifies when and how learning takes place during scenario-based simulation training.

From the research findings, the features perceived to be important and the extent to which it was observed during the simulation scenario were identified. The identified features could be incorporated in future simulation scenarios to optimise the effectiveness of training.

In an increasingly complex operating landscape, a robust list of features for a simulation scenario design could further enforce simulation training as a training methodology in the area of homeland security and emergency services. Understanding human and learning dimensions of these features could lead to the development of effective simulation scenarios, thereby enhancing the transfer of learning to real-life situations and ensuring officers are adequately equipped for the demands of their roles.

id #18351

Improving Radiation Therapy student readiness for placement through authentic digital resources for simulated clinics

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Clinical placement is an important part of Radiation Therapy training, where students consolidate learning from theory courses and apply their practical skills. However, it can be challenging for students to make the transition from university studies to the first clinical placement, and student anxieties around this can compromise their learning.

A pilot program at the University of South Australia introduced a simulated clinic to second year students before their first placement. The simulation replicates the workflow and time pressure of the real-world clinical environment and was successful in helping to bridge the gap between theory and placement.

This presentation will discuss the results of a project to improve the authenticity of the simulated clinic. New digital resources were co-created in consultation with industry partners around Australia, to reflect the techniques and experiences that second year students can expect to see on their clinical placement. Surveys with students and clinicians pre- and post-intervention assessed the effect of the simulation on the students' readiness for placement.

id #18496

Cybersecurity Risk in Healthcare

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Human error and the vulnerability of clinical devices are perceived as the foremost cybersecurity risks in the critical infrastructure sector of Healthcare; this limited view, however, overlooks the Building Services that maintain the environment within a facility. Operational Technology not only increases the number of entry points for a hacker but is especially vulnerable as the protocols implemented were never designed to securely connect to the Internet.

The paper opens with an outline of internet-connected facilities in healthcare such as operating theatres, laboratories, pharmacies, sterile stores and imaging equipment all of which have stringent environmental requirements. To achieve these conditions, chilled water and ventilation must function within set tolerances; any divergence could significantly impact a hospital due to cancelled surgeries or diagnostic procedures, an MRI quench or the need to dispose of sterile products. An investigation of internet-connected building service controllers associated with Healthcare facilities follows. It was found that several devices, key to the control of temperature and humidity within a hospital, had known vulnerabilities. This affirmed the proposition that Building Services pose a cybersecurity risk to Healthcare. The paper moves on to focussing on the cyber-attack process – vulnerabilities, threats, risks and impacts – of the systems required to maintain the environment within these specialised rooms. The paper concludes with a number of recommendations to minimise the disruption a cyber-attack targeting the chilled water or ventilation systems covering construction contracts, procurement, design and documentation.

id #18519

Toward Immersive Analytics Techniques for Multiple-Run Rocket Simulation

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RocketPy is an open-source Python library that provides a range of tools for simulating the trajectory of rockets. This work presents a novel approach for visualizing simulated rocket trajectory data using virtual reality (VR). VR provides many affordances that support visual analytical tasks are not available on traditional desktop displays, including space-to-think, direct manipulation, and stereoscopy. By leveraging the affordances of VR, we are able to simultaneous visualise multiple trajectories within a single visualisation, thus providing an analyst with alterative view of the simulation and the independent variables.

Our system takes the output generated by RocketPy and converts it into a format that can be visualized in VR. The trajectory data is then rendered in a 3D virtual environment, allowing users to directly interact with it using VR controllers. The system provides a range of features, including the ability to change the viewing angle, zoom in and out, and pause the simulation at any point.

We believe that our system provides a powerful tool for analyzing simulated rocket trajectory data, allowing researchers and engineers to gain insights that may not be possible using traditional 2D visualizations. Additionally, the immersive nature of VR may help to improve user engagement and understanding, potentially leading to more effective use of simulation data in rocket design and analysis. This approach could have significant implications for the field of rocket design in general and simulation visualisation.

id #18073

FUSE (Future of Systems Engineering) Panel - Foundations for Realising Systems Engineering Vision 2035

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Systems Engineering (SE) Vision 2035 asserts the imperative for formal theoretical foundations with a stronger scientific and mathematical grounding based on advanced practices, heuristics, systems observable phenomena, and formal ontologies. Current SE foundations are derived from application experience and are codified in the SE Body of Knowledge (SEBoK), various process standards such as ISO/IEC/IEEE 15288 *System Life Cycle Processes*, and handbooks, such as the INCOSE *Systems Engineering Handbook*; these are supported and taught by higher education, certification bodies, and professional societies. Best practice SE, validated by decades of experience, is to model systems using the input-process-output (I-P-O) paradigm supported by a relationship model. Do the I-P-O paradigm and relationship model remain fit for purpose at the scale, interconnectivity, and non-deterministic phenomena of complex, non-hierarchical, networked 21st Century systems? Are there other suitable approaches? The SE Vision 2035 is silent on the phenomena of emergence, the occurrence of unanticipated negative and positive changes of system behaviours. Emergence occurs from the interplay of the system(s) of interest (SoI) within the ecosystem of which the SoI is a part. The SoI influences the ecosystem, and through interactions with external systems, the "assumedly" unchanging context, and human actors. Unforeseen interactions result in changed behaviours that morph the SoI and its ecosystem, including the context and human behaviours. We find evidence of such morphing of the SoI and its context in both natural and human-engineered systems. Phenomena include uncertainty of multiple affects/effects and outcomes with attributes including inherent inertia and learning with delays. That said, it is necessary to probabilistically model the SoI and ecosystem both spatially and temporally. Does the I-P-O paradigm and relationship model or other approaches extend to account for emergence? The outcome of this session will stimulate and infuse the Future of Systems Engineering (FUSE) foundations stream to realize the vision.

id #18535

Panel: Managing the Transition to EVs and AVs to Avoid Disruption and Pain

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Electric Vehicles (EV) are transforming the automobile industry, as the supply of (and demand for) EVs takes off. Similarly, Artificial Intelligence (AI) promises to revolutionise car ownership and ride-sharing business models with robotaxi/delivery services underpinned by Autonomous Vehicle technology. For instance, Tesla (a car company) is now considered a leader in AI.

Like all new technology, the adoption of EVs is following an S-curve and Australia has recently reached the tipping point, with battery EV sales reaching 6% in Q1 2023 (up from 2% in 2021) and 19% in ACT alone. In NZ, EV sales increased rapidly from 6% in 2021 to 18% in 2022.

Additionally, EVs are expanding into the air domain, with the widespread adoption of drones and the indigenous development of the E22Spark, a fully electric 2-passenger fixed wing aircraft, developed right here in South Australia by Bader Aero.

Challenges include:

- charging networks that are not keeping pace with the growth of EVs;
- increasing demand for electricity caused by electrification;
- the regulation of new industries such as drone technology; and
- the (unknown) effect that autonomous vehicles (including drones) may soon have, such as the impact to taxi and ride-sharing services.

This panel will explore this disruption, ways to minimise disruption (both to industries as well as to society) and the role of modelling and simulation in making sense of it all.
Panellists include:

- Domenic Hill (Chief Engineer at Bader Aero, the company developing the 2-passenger fixed wing electric aircraft E22Spark)
- Scott Elaurant (Director and Principal, Six Cats Consulting)
- Prof Nicholas Holyoak (Lecturer in Infrastructure Engineering, Flinders University, PhD in Transport Systems) TBC

Moderated by Thomas Manley (Technical Director of SESA)

id #18618

Panel - Defence Test and Evaluation Principals

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Defence Test and Evaluation

Test and Evaluation informs Government and Defence of the overall capability. The geo-strategic environment and technology is impacting Australia's capable military systems. Compounded with rapid advances in technology has seen an increase in capabilities and networked systems that deliver effects across the five warfighting domains for a modern joint force.

Test and Evaluation in Defence is applied effectively at the project and program level. During this panel hear from some of the T&E Principals on their group and service activities, and the vision for Test and Evaluation across Defence to support a risk-based capability decisions and is actively supported by a strong sovereign basis.

Discussion around the challenges of a Defence level coordination and prioritisation of T&E facilities, test ranges, resources and equipment for a collaborated T&E capability. The scale of recapitalisation of Defence capability has placed increased pressure and competition on Australia small, highly skilled T&E workforce. Additionally to meet the demands of the joint force, Defence must embrace verification and validation of emerging technologies and the requirement of new approaches to T&E, which includes artificial intelligence, data analytics, robotics and synthetic representations.

Keywords: Defence, Test and Evaluation, challenges, workforce, governance, balance.

id #18487

Lethal Autonomy is the new reality

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Over the last few decades, defence communication and information systems have been increasing the complexity and interconnectedness of systems that has pervaded society more broadly throughout the Information Age. Even more than society in the broad, Western Departments of Defence (DoDs) have sought to attain information dominance at the same time as it struggles with lethal autonomy. The result has been a large number of complex systems, system-of-systems and families-of-system-of-systems in both the physical, human and information domains. How should we address fully Lethal Autonomous Weapon Systems (LAWS) as Network-Enabled Weapons (NEW), directed energy and cyber warfare become more attractive and where does human control of LAWS sit with responsible use of artificial intelligence and ensuring information assurance?

This Tutorial and Workshop examines the Australian perspective and the System of Controls and Advanced Control Directives being proposed to address the implications of LAWS and NEWs for human decision making in their employment. Given the complex systems and key assurance initiatives being pursued systematically by the US, UK and Australian DoD initiatives to effect these more integrated, interoperable and information-assured (I3A) capabilities, while also ensuring these capabilities remain resilient to the new cyber threats using ethically-aligned approaches to experimentation, test & evaluation and employment.

The Workshop participants will be challenged as to their thinking and will directly contribute to the discourse on what Australia's doctrine should be and how best to articulate that.