



**NATIONAL
ACADEMIES** *Sciences
Engineering
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The Future of Digital Twinning: Technological Challenges and Implications for National Security

A Virtual Unclassified Colloquium

February 15, 2023

11am – 4pm ET

Intelligence Community Studies Board

About This Colloquium

Under the sponsorship of ODNI, Academies staff conduct semi-annual colloquia as part of an on-going series. Each colloquium covers a major topic of interest to the intelligence community and hosts leading experts from government, private industry, and academia to participate in presentations and panel discussions. Digital Twins are transforming how knowledge is generated and used. A Digital Twin is a set of virtual information constructs that fully describes a potential or actual physical object, process, or system. They are used in products, systems, and processes before and after their development, creating a means for determining the feasibility of production and modes of failure. Developments in computing power, artificial intelligence, and big data are enabling replication of large complex systems with greater fidelity and predictive power. This includes the replication of social systems and cities, such as the Virtual Singapore project, to support urban planning, public safety, and enhanced security measures. The purpose for this one-day unclassified colloquium is to hear from practitioner experts who are working with Digital Twins to identify the future prospects for Digital Twin applications.

The goal of the colloquium is to understand where and how Digital Twins are used today, perspectives for their future use and potential national security implications. The format for this colloquium is a one-day session, open to the public, via Zoom Webinar, in which industry experts will discuss the current state and future prospects of Digital Twins. Colloquium presenters will address topics such as the applications of Digital Twins to the fields of behavioral anticipation, predictive analytics, advanced modeling and simulation, critical infrastructure systems, societal and city management, military systems, and cyber security.

About The Intelligence Community Studies Board

The National Academies of Sciences, Engineering and Medicine have been called upon by government agencies and the U.S. Congress to provide objective, science-based advice on important issues affecting the nation for more than 150 years. The U.S. military turns to us for independent advice on topics related to research, development, and application of science and technology in support of military matters. We provide a level of independence, quality, and visibility that cannot be matched by other scientific advisory boards. Our board members are widely recognized industry, academic, and former military experts that serve without compensation and are formally appointed by the President of the National Academy of Sciences.

The Intelligence Community Studies Board (ICSB) provides both classified and unclassified forums to convene leading technical and intelligence experts to evaluate scientific and technology approaches to facilitate threat-informed acquisition decisions.

For more information on the ICSB including our projects and member biographies please visit our website at www.nationalacademies.org/ICSB

Colloquium Project Summary

The Future of Digital Twinning: Technological Challenges and Implications for National Security

Digital Twins are transforming how knowledge is generated and used. A Digital Twin is a set of virtual information constructs that fully describes a potential or actual physical object, process, or system. They are used in products, systems, and processes before and after their development, creating a means for determining the feasibility of production and modes of failure. Developments in computing power, artificial intelligence, and big data are enabling replication of large complex systems with greater fidelity and predictive power. This includes the replication of social systems and cities, such as the Virtual Singapore project, to support urban planning, public safety, and enhanced security measures.

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Connection Information

NATIONAL ACADEMIES Sciences
Engineering
Medicine

The Future of Digital Twinning: Technological Challenges and Implications for National Security

February 15, 2023

11:00 AM – 4:00 PM ET

- | | |
|---------------|---|
| 11:00 – 11:05 | Introduction and Administrative Announcements
Ms. Nia Johnson ICSB Program Officer |
| 11:05 – 11:15 | Welcome Remarks
Mr. Dan Flynn Office of the Director of National Intelligence |
| 11:15 – 12:15 | Keynote:
Dr. Michael Grieves Digital Twin Institute |
| 12:15 – 01:00 | Digital Twin Critical Infrastructure Management and Operations in Orange County, California
Mr. Michael LaFontaine and Dr. Kostas Alexandridis Orange County Public Works |
| 01:00 – 01:45 | Digital Twins in Aerospace Engineering
Dr. Karen E. Willcox University of Texas at Austin |
| 01:45 – 02:00 | Break |
| 02:00 – 02:45 | The Calculus of Cyber Warfare As Influenced by the Art of Digital Twin
Mr. Dave Shaw Intuitus |
| 02:45 – 03:30 | Technical and Regulatory Aspects of Digital Twin Application in Nuclear Energy Facilities |

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Connection Information

Dr. Vaibhav Yadav | Idaho National Laboratory

03:30 – 04:00 **Panel Discussion**

Moderator: Dr. Adrian Wolfberg | ICSB Senior Program
Officer

04:00 **Closing Remarks and Adjourn**

Speaker Biographies



Sponsor: Dan Flynn

Office of the Director of National Intelligence

Dan Flynn was selected to be the first Director of the IC Net Assessments Division in August 2018. In this position, Mr. Flynn is responsible for developing forecasts and comparative assessments to identify emerging challenges and opportunities for US intelligence capabilities.

Prior to his current assignment, Mr. Flynn was the Director of the Global Security Program for the National Intelligence Council's (NIC's) Strategic Futures Group. In this position, he led national-level assessments of long-term and crosscutting military-security issues for senior US policymakers and defense officials.

Prior to joining the NIC, Mr. Flynn served in multiple positions at CIA as an analyst and manager responsible for assessments of foreign weapons, technologies, and military innovations. He was a member of CIA's Senior Analytic Service (SAS) and former Chairman of the SAS Council.

From 2004 to 2005, Mr. Flynn served as a senior staff member for The President's Commission on the Intelligence Capabilities of the United States Regarding Weapons of Mass Destruction. His duties included leading the Commission's research on the capabilities of the IC to support future US military operations, perform strategic assessments, and conduct scientific and technical analysis.

Mr. Flynn is a "Distinguished Graduate" of the National War College earning an M.S. in National Security Strategy. He also earned a B.S. in Aerospace Engineering from Boston University. Mr. Flynn is an ODNI "Plank Holder."

Speaker Biographies



Keynote Speaker: Dr. Michael Grieves

Digital Twin Institute

Dr. Michael Grieves is an internationally renowned expert in Product Lifecycle Management (PLM) and originated the concept of the Digital Twin. His focus is on virtual product development, engineering, systems engineering, and complex systems, manufacturing, especially additive manufacturing, and operational sustainment. Dr. Grieves wrote the seminal books on PLM, “Product Lifecycle Management” and “Virtually Perfect: Driving Innovative and Lean Products through PLM.” He has consulted and/or done research at some of the top global organizations, including NASA, Boeing, Newport News Shipbuilding, and General Motors.

Speaker Biographies



Dr. Kostas Alexandridis, PhD GISP

Orange County Public Works

Dr. Kostas Alexandridis, GISP, is a GIS Analyst/ Spatial Complex Systems Scientist with the County of Orange, OC Survey Geospatial Applications in Santa Ana, California. He holds a PhD in Natural Resource Policy from Purdue University and BS/MS degrees in Agricultural Engineering/Agricultural Economics and Rural Sociology from Aristotle University of Thessaloniki in Greece. His work involves programming, modeling and simulation for Digital Twin models, advanced geoAI and spatially explicit Machine Learning (ML), and complex geospatial and geoscientific analysis and simulation. From 2009-2018, Dr. Alexandridis served in multiple joint positions at the University of the Virgin Islands, in the US Caribbean. Specifically, as a Research Assistant Professor of Marine and Environmental Science with a joint appointment as an Assistant Professor of Computer and Computational Sciences, College of Science and Mathematics, UVI (2010-2018).

He also served in academic administrative positions as the Director of the Center for Marine and Environmental Studies at UVI (2012-2013), and the founder and Director of the Institute for Geocomputational Analysis and Statistics (GeoCAS) at UVI (2013-2018). He also held an adjunct position with the University of South Florida (2012-2018). From 2006 to 2009, Dr. Alexandridis served as a senior research scientist with the Commonwealth Scientific and Industrial Research Organization (CSIRO) in Northern Queensland, Australia. Dr. Alexandridis is a certified Geographic Information Systems Professional (GISP No. 51820), has published extensively in the areas of complex information sciences, semantic network analysis, self-organizing systems, complex Spatial sciences, social-ecological systems, and computational social sciences.

More information about Kostas in his LinkedIn Profile:
<https://www.linkedin.com/in/ktalexan/>

Speaker Biographies



Michael LaFontaine, PLS, PMP, MBA

Orange County Public Works

Michael LaFontaine, is a Deputy County Surveyor with Orange County Public Works (OCPW) located in their Orange, CA satellite office. His team is responsible for providing geospatial field and mapping/modeling services for the County's diverse portfolio of facilities which include flood channels, roadways, an airport, harbors, dams, basins, and buildings. Michael is a Professional Land Surveyor with over 16 years of public and private sector experience in the survey profession. He has both field and office experience and is revered as a tech evangelist in the profession. He holds a Masters in Business Administration from University of California, Irvine and an AS of Survey/Mapping from Santiago Canyon College. Michael has served as the President of the Orange County Chapter of the California Land Surveyors Association (CLSA) in 2018, and a Director for CLSA from 2014-2016. Michael is a lifelong learner and firm believer that geospatial professionals are well positioned to play an integral role in the Digital Twin space. Outside of his professional life, Michael is an avid surfer and world traveler. He thoroughly enjoys spending time with his 6 year old daughter, Sophia, his wife, Diana, and their new Bernedoodle puppy, Bailey.

You can find more about Michael in his LinkedIn Profile:

<https://www.linkedin.com/in/michael-lafontaine-pls-pmp-mba-488b262a/>

Speaker Biographies



Dave Shaw

Intuitus Corporation

David is a highly experienced and successful entrepreneur, currently serving in several senior leadership positions, most notably, Founder and CEO of a global cybersecurity corporation, CBA Inc. and Intuitus Corp since 2004. He currently also serves as the CISO and Senior Risk Manager for several companies. Previously, he has served as Global Managing Director of Business Intelligence and Security Consulting for Kroll Associates and as Principal/Partner for Arthur Andersen Worldwide Consulting, serving as Managing Director for Global Aerospace and Defense and Business Intelligence. David has previously led three technology firms.

In addition to his CEO job at Intuitus, he is also the Founder and Chairman of a non-profit corporation and serving as the Chairman for Bentley Kantor International USA for a Smart City project in Ghana and expansions to other sites in West Africa and the USA as well as the Intuitus Corporation of Ghana.

David earned a Bachelor of Arts from the University of Puget Sound, a Master of Arts in Public Administration and Executive Development from Ball State University, and a Master's Degree in Business Management & Strategy (Summa Cum Laud) from the Naval War College of Command and Staff in Newport, Rhode Island. David was a United States Air Force jet fighter instructor pilot, a seasoned combat pilot, a highly experienced flight and industrial safety engineer, and a decorated senior USAF Officer (Retired). During his career he graduated from USC Viterbi School of Engineering in Aviation Safety and Security Management and amassed four years of graduate and professional education in aeronautical/aerospace science.

He held leadership positions in the Digital Business Marketplace Catalyst under the TM Forum as well as Co-Chairs three Digital Twin Consortium Working Groups. Throughout his career paths, David has authored many articles and other publications as well as co-authored a university level textbook.

Speaker Biographies



Dr. Karen Willcox [NAE]

Oden Institute for Computational Engineering and Sciences,
University of Texas at Austin

Karen E. Willcox is Director of the Oden Institute for Computational Engineering and Sciences, Associate Vice President for Research, and Professor of Aerospace Engineering and Engineering Mechanics at the University of Texas at Austin. She is also External Professor at the Santa Fe Institute. At UT, she holds the W. A. “Tex” Moncrief, Jr. Chair in Simulation-Based Engineering and Sciences and the Peter O’Donnell, Jr. Centennial Chair in Computing Systems. Before joining the Oden Institute in 2018, she spent 17 years as a professor at the Massachusetts Institute of Technology, where she served as the founding Co-Director of the MIT Center for Computational Engineering and the Associate Head of the MIT Department of Aeronautics and Astronautics. Prior to joining the MIT faculty, she worked at Boeing Phantom Works with the Blended-Wing-Body aircraft design group. She is a Fellow of the Society for Industrial and Applied Mathematics (SIAM), a Fellow of the American Institute of Aeronautics and Astronautics (AIAA), and in 2017 was appointed Member of the New Zealand Order of Merit (MNZM) for services to aerospace engineering and education. In 2022 she was elected to the National Academy of Engineering (NAE).

Speaker Biographies



Dr. Vaibhav Yadav

Idaho National Laboratory

Dr. Yadav is a senior scientist at Idaho National Laboratory with extensive research experience in the areas of risk, reliability, safety, security, and regulations of nuclear power plants. He has been leading and managing several research and development projects sponsored by a variety of agencies such as the US Department of Energy, US Nuclear Regulatory Commission, US Department of State, and others. Dr. Yadav has been leading a pioneering effort focused on regulatory aspects of digital twin application for nuclear facilities which has resulted in several high-impact publications in this novel area. He is currently serving as a member of the Physical and Cyber Security Subcommittee of the ANS/ASME Joint Committee on Nuclear Risk Management; the ANS Human Factors, Instrumentation & Controls Division; and the ANS Nuclear Installations Safety Division.