

# **57th IAA Symposium on Safety, Quality and Knowledge Management in Space Activities**

Held at the 75th International Astronautical Congress  
(IAC 2024)

Milan, Italy  
14-18 October 2024

ISBN: 979-8-3313-1227-5

**Printed from e-media with permission by:**

Curran Associates, Inc.  
57 Morehouse Lane  
Red Hook, NY 12571



**Some format issues inherent in the e-media version may also appear in this print version.**

Copyright© (2024) by International Astronautical Federation  
All rights reserved.

Printed with permission by Curran Associates, Inc. (2025)

For permission requests, please contact International Astronautical Federation  
at the address below.

International Astronautical Federation  
100 Avenue de Suffren  
75015 Paris  
France

Phone: +33 1 45 67 42 60

Fax: +33 1 42 73 21 20

[www.iafastro.org](http://www.iafastro.org)

**Additional copies of this publication are available from:**

Curran Associates, Inc.  
57 Morehouse Lane  
Red Hook, NY 12571 USA  
Phone: 845-758-0400  
Fax: 845-758-2633  
Email: [curran@proceedings.com](mailto:curran@proceedings.com)  
Web: [www.proceedings.com](http://www.proceedings.com)

# TABLE OF CONTENTS

## **FOR A SUCCESSFUL SPACE PROGRAM: QUALITY AND SAFETY!**

Structural and Thermal Model Testing Campaign of a 1U CubeSat.....	1
<i>Francesco Botti, Matteo Dowell, Luca Mazzotti, Andrea Raymond, Matteo Piunti, Giulia Bianchini, Ludovico Bernasconi, Margherita Raveane, Alessandro Biella, Diego Fascendini, Eleonora Maconi, Giorgia Platano, Mariagiulia Serlini, Laura Festa, Gianni Curti, Luca Sportelli, Paola Vescovi, Andrea Malandra, Juan Bedoya, Riccardo Spinzi, Giuseppe De Luca, Luca Giuliani, Didier José Bontemps, Alexandra Negoita, Francesco Schembri</i>	
Product Assurance and Configuration Management of the European Service Module: ESA Perspective from the Development Phase to the Successful Artemis I Mission and Beyond.....	16
<i>Marco Chiaradia, Raffaele Campagnuolo</i>	
Ensuring Safety in Critical Category 'A' Flight Software Through MC/DC and Object-To-Source Traceability Verification .....	27
<i>Andoni Arregui, Fabian Schriever, Christoph Weiß, Thomas Wucher</i>	
Assessing the Sustainability of Artificial Intelligence Systems Deployed in Outer Space.....	37
<i>Meghna Ravikumar, Hargun Kaur, Christina Mai, Eesa Aamer, Emily Ha-Tchong, Dheekshitha Palanikumar, Elizabeth Xu</i>	
Designing a Space Pit for Rocket Launches: A Novel Approach .....	49
<i>Pranav Balaji, Ansh Jaipuria, Senthilkumar Sundararaj</i>	
Operational Risk Management in Student Space Missions Through FMEA-Centric Software .....	56
<i>Hunter Wodzinski, Nikolai Stefanov, Jeffery John, Red Whittaker</i>	
The Three R's of Space Travel - Resiliency, Recoverability and Redundancy: Should We Be Going to the Moon Without Established and Agreed Search & Rescue Protocols? .....	64
<i>Dharshun Sridharan</i>	
RAMS and FDIR Methods in Support to Zero Debris Approach.....	74
<i>Silvana Radu, Laura Miquel Parra, Fabrice Cosson</i>	
Survey and Analysis for LeanSat Mission Assurance Strategy .....	83
<i>Kikuko Miyata, Yoshihiro Tsuruda, Mengu Cho</i>	
In-House Structure Design for Student Cubesat Missions: Strategies, Solutions, and Lessons Learnt.....	89
<i>Juan Bedoya, Luca Mazzotti, Giuseppe De Luca, Aurora Cagnoni, Luca Giuliani, Andrea Raymond, Riccardo Spinzi, Davide Corazzi, Francesco Schembri, Adeo Felice, Emanuele Nicolo' Pizzo, Didier José Bontemps, Alexandra Negoita</i>	
SAVOIR FDIR Handbook: Insights from the Latest Update.....	101
<i>Silvana Radu, Paulo Rosa, Benedicte Girouart</i>	

## **EMERGING TRENDS OF KNOWLEDGE MANAGEMENT IN ORGANIZATIONS**

The Formulation of a Strategic Plan for an Emerging Space Agency: A Case Study on Bahrain's National Space Science Agency (NSSA) .....	112
<i>Rasha Al-Amad, Yaqoob Alqassab, Aysha Alharam, Mohamed Al-Aseeri, Amal Albinali</i>	

Roles, Effects, and Ramifications of In-Person Interactions in a Digital Team.....	125
<i>Federica Bonfitto, Gaetan Fayon, Alessandra Gallucci, Mihaela-Bianca Iorga, Federico Nigro, Nishanth Pushparaj, Yusuf Alqattan, Deboshri Sadhukhan, Lucas Rümmler, Nicolas Soulard</i>	
Knowledge Continuity in Space Organizations: Adaptive Strategies for Successful Intergenerational Knowledge Sharing .....	140
<i>Andrew Murphy, Yaqoob Alqassab, Chia Tian-Bearne Chen, Omar Laamoumi, Matthew McKay, Natasha Nogueira, Isi Casas Del Valle Pacheco, Masaru Saijo, Maura Sordello, Miriana Valentino</i>	
Knowledge Mapping as an Anticipation Tool to Enhance CNES Skills and Promote Innovation .....	158
<i>Estelle Cavan, Yoann Foulonneau, Daniel Galarreta</i>	
Pythia - An LLM-Driven Automated Platform that Uses Established Consensus-Building Techniques to Capture and Synthesise the Wisdom of a Panel of Renowned Authorities on Space Engineering. ....	166
<i>Shaun Kenyon, Sheila Gough Kenyon, Callum McColl</i>	
Leveraging an Integrated Data Platform to Support Satellite Constellation Tradespace Analysis .....	178
<i>Joe Gregory, Lucy Hoag, Alisha Zute, Mike Marmar, Barry Jones, Alejandro Salado, Visalakshi Iyer, Brett Cope</i>	
Knowledge Engineering and Augmented Human Intelligence. an Application to the Sustainable Use of Space.....	193
<i>Daniel Galarreta, Sylvain Michel, Vincent Holley</i>	
Ontology-Driven Model Based System Engineering for Automating the Design of Satellites .....	202
<i>Sindre Herstad</i>	
Knowledge Representation and Model-Based Systems Engineering for Space Data Standards and Fundamentals.....	210
<i>Robert Rovetto</i>	
Project Knowledge Management Framework Under Thai Space Consortium.....	223
<i>Phongsakorn Meemak, Pennapa Boonrueng, Songphon Munkongsujarit</i>	

## **PREDICTION, TESTING, MEASUREMENT AND EFFECTS OF SPACE ENVIRONMENT ON SPACE MISSIONS**

The Correlation of Radiation Simulations with In-Orbit Data from the GreenCube MEO CubeSat Mission .....	231
<i>Michela Boscia, Silvia Mari, Marta Del Bianco, Lorenzo Frezza, Gabriele Mascetti, Gabriele Impresario, Rita Carpentiero, Fabio Santoni</i>	
Thermal Resilience Test Method and Strategy for Solar Cells Space Qualification.....	238
<i>Marco Rosa, Reynel Josué Galindo Rosales, Hirokazu Masui, Mengu Cho</i>	
Single Event Effect Testing Using Medical Synchrotron .....	246
<i>Martin Eizinger, Wolfgang Treberspurg, Bernhard Seifert, Johanna Fries, Albert Hirtl</i>	
Experimental Approach of Molecular Contamination for SOLAR-C EUVST's Candidate Materials .....	256
<i>Hiroaki Okuma, Atsushi Fujii, Fumitaka Urayama, Kazuya Shinoda, Hirohisa Hara, Riyo Yamanaka, Eiji Miyazaki, Yugo Kimoto, Toshifumi Shimizu</i>	
Characterization of Organic Contamination Footprint from Moon, Mars and Ocean World Landing Systems for Robotic and Crewed Missions .....	260
<i>Carlos Soares, William Hoey, John Alred, Paul Boeder</i>	

## **CYBERSECURITY IN SPACE SYSTEMS, RISKS AND COUNTERMEASURES**

Encrypted Collision Probability for Secure Satellite Conjunction Analysis.....	268
<i>Jihoon Suh, Michael Hibbard, Kaoru Teranishi, Takashi Tanaka, Moriba Jah, Maruthi Akella</i>	
Advancing Cybersecurity for Satellite Communications in the Quantum Computing Era .....	281
<i>Jens Freymuth, Philipp Wüstenberg, José Manuel Diez, Thee Vanichangkul, Enrico Stoll, Philipp Kampermann, Siegfried Voigt</i>	
Developing a CCSDS Compliant Platform to Reliably Secure Current and Future Space Data Links .....	287
<i>Louis Masson, Mickael Bonjour, Laurent Thoeny, Sylvain Willy</i>	
Mitigating Stealth Attacks Via Game-Theoretic Switching in Multi Spacecraft Systems.....	295
<i>James Ragan, Joshua Ibrahim, Soon-Jo Chung, Fred Hadaegh</i>	
Cyber Insurance for Cybersecurity in Space Systems. Building Efficient Risk Management Ecosystem.....	310
<i>Katarzyna Malinowska, Michal Szwajewski</i>	
Cyber Range and Digital Twin Technologies for Space Resiliency and Security .....	322
<i>Antonio Carlo, Nebile Pelin Manti, Bintang Alam Semesta Wisran Am, Andrés Edl, Paola Breda</i>	
Deep Learning in Space: Advancing Exploration and Safeguarding Against Cyber Threats .....	333
<i>May Almousa</i>	
The Use of AI in the Detection of Cyber Intrusions in Orbital Systems .....	348
<i>Anna Barraqué, Julien Airaud</i>	
The Role of Localized Communities of Interest in Standardizing Coordinated Responses to Space Cybersecurity Threats.....	359
<i>Nick Tsamis, Harvey Reed, Ruth Stilwell</i>	
Proposal of Cyber Incident Response Strategies in Space Networks for Security Enhancement.....	373
<i>Frank Raul Quintana Quispe, Juan Rodolfo Alvarez Huarhua, Avid Roman-Gonzalez</i>	

## **INTERACTIVE PRESENTATIONS - 57TH IAA SYMPOSIUM ON SAFETY, QUALITY AND KNOWLEDGE MANAGEMENT IN SPACE ACTIVITIES**

An Innovative Approach to Developing Fuel Cells for Space Applications Using the Six Sigma DMAIC Framework. ....	381
<i>Douglas Miranda Rodrigues, Aneirson Francisco Da Silva, Messias Borges Silva, Isaiás De Oliveira, Geilson Loureiro</i>	
Advanced Comms Agent Switcher for Lunar Base Camp Via SiwöNet (acasnet).....	396
<i>Deykel Ramirez, Melanie Espinoza, Keilyn Carrillo, Juliana Morales Alvarado, Daniela Duran Arias, Nicolle Gamboa Mena, Amanda Calderon, Mileyca Oporta, Facundo Mendoza-Solano, Oscar Castillo Brenes, Sofia Vega, Daniela Muñoz</i>	
Navigating Sustainability in the Space Industry: Key Principles for Future Missions.....	401
<i>Ishita Sharma, Kangsan Kim</i>	
RACCOON OS: A Secure Open-Source Operating System for Satellites .....	412
<i>José Manuel Diez, Philipp Wüstenberg, Jens Freymuth, Thee Vanichangkul, Enrico Stoll, Philipp Kampermann, Siegfried Voigt</i>	

Stakeholders' Framework, a Successful Outcome and Risk Perception Factors to Define Risk Tolerability Limits for Long-Term Mars Colonies, Design and Operation. ....	418
<i>Szymon Matkowski</i>	
Leveraging Machine Learning Algorithms and Open-Source Spatial Datasets for Land Use and Land Cover Change in the Nam Ngum River Basin (NNRB), Lao PDR .....	438
<i>Sackdavong Mangkhaseum, Akitoshi Hanazawa</i>	
Centralizing Codes and Knowledge for Streamlined Integration in the Space Sector: A Framework for Universal Access to Space and Effective Knowledge Management .....	451
<i>Muneera Almalki</i>	
Implementing the Corporate Environmental Sustainability Scheme for the European Union Space Programme Agency .....	455
<i>Maximilian Bauernfeind, Christina Giannopapa, Spyridon Metallinos, Stefano Iannitti, Eleni Panagakou</i>	
A Machine Learning-Ready Data Processing Tool for Near Real-Time Forecasting .....	460
<i>Maher Dayeh, Michael Starkey, Subhamoy Chatterjee, Kimberly Moreland</i>	
"RSH: Advanced Protective Headgear for Radiation Monitoring and User Safety" .....	463
<i>Ilaha Isgandarova</i>	
Intelligent Health Management Platform for Aerospace Electronic Systems.....	466
<i>Yuanhong Mao, Zhong Ma, Liang Yang, Xi Liu, Pengchao He, Ning Wang, Bo Chai</i>	
Space Weather Forecasting by Using Artificial Intelligence .....	474
<i>Büsra Simsek, Said Semih Karadogan, Uzay Tugcular, Mehmet Fatih Engin, Bugra Aydin, Kemal Usanmaz</i>	
Interactive Crater Exploration Rover (ICER) with Bionic Camera for Acute Perception and Visualization with Predictive Control.....	479
<i>Keilyn Carrillo, Amanda Calderon, Daniela Duran Arias, Deykel Ramirez, Juliana Morales Alvarado, Melanie Espinoza, Nicolle Gamboa Mena, Sofia Vega, Mileyca Oporta, Daniela Muñoz, Oscar Castillo Brenes, Daniela Muñoz, Sofia Vega</i>	
Factors Affecting Spacecraft In-Orbit Anomalies Causing Insurance Losses .....	483
<i>David Todd, Simon Feast, Derek Goddard, Chris Hart</i>	
Revolutionizing Satellite Hardware Reliability Through Innovative Design Paradigms .....	491
<i>Naman Vaidya</i>	
Management System in Space .....	499
<i>Fatima Hasanova</i>	
Quantum Technologies for Safe Space Communication .....	502
<i>Nigar Safarova, Shamil Mamedov, Ulvi Movsum-Zada</i>	

### **LATE BREAKING ABSTRACTS (LBA)**

Space Incident Investigation in Brazil: Boosting Alcantara Spaceport's Commercial Viabilit .....	516
<i>Marcelo Kamchen, Rafael Coelho, William Silva, Patrick Christian Melo</i>	

### **Author Index**