The Disclosure Milieu in the Space Operations Community: An ISOW 2022 Review

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Abstract
Managers/presenters who are also researchers and engineers often become emotionally and intellectually attached to their work and actively monitor how their ideas diffuse and extend to others. Consequently, managers from originating firms tend to observe the innovation efforts of recipient firms represented by co-presenters and registered attendees. Conference presentations occur within a well-defined physical and social setting, known as the "disclosure milieu" This paper aims to explore how Next Generation Space Operations engaged ISOW 2022 disclosure milieu and determine by extension if the industry leader NASA is in alignment.
Keywords: knowledge sharing, knowledge spillover, disclosure milieu

Introduction
In the field of space operations and in the broader field of aerospace industry, research moves extremely quickly. Progress is driven by a combination of extreme interest on the one hand and broad applicability on the other. For this reason, conference proceedings are a primary method of scientific communication. The technical scope of Improving Space Operations Workshop 2022 encompassed a number of peer-reviewed journals, including those of other professional societies. There are many knowledge-sharing options for ISOW presenters when the relevant topics presented reach an appropriate level of significance, maturity, and scientific merit [1]. However, conferences typically bring together a large number of companies to the same location for a series of presentations to an interested (registered) audience. As a result of this co-location, conference presentations occur within a well-defined physical and social setting, known as the "disclosure milieu" [2]. Each conference setting creates a disclosure milieu that determines the composition of the audience and the extent of the interactions among managers/ presenters and the audience in the same place and time as disclosures (i.e. knowledge sharing) are made.

Managers/presenters who are also researchers and engineers often become emotionally and intellectually attached to their work and actively monitor how their ideas diffuse and extend to others. Consequently, managers from originating firms tend to observe the innovation efforts of recipient firms represented in the roles of co-presenters and registered attendees. Indeed, originating firms and their inventors often track the innovative efforts of other organizations—including those that fail—through social networks, technical publications, conferences, patent filings, and reverse-engineering efforts [3]. These channels facilitate both the flow of knowledge from originators to recipients and the flow of knowledge back to originators once recipients have combined the spillover with other knowledge.

A disclosure milieu influences the ability of attendees to revise their beliefs about a topic (or conference theme); hence, the market reaction to the conference. On the other hand, presenters for a disclosure (i.e. knowledge-sharing) affect its information content due to attendee differences in investors' private information, consensus in beliefs, and ability to interpret disclosures [4]. The disclosure milieu heightens these potential audience effects by bringing together participants with private information to the same location and facilitating information transfers through explicit discussions with managers and other participating presenters. Therefore, information signals obtained from stakeholders in both attendance and presentation modes develop higher-order belief formation and assessment of nonverbal cues before, during, and after the conference [4].

Purpose
In showing how the commercial sector of aerospace industry is unified to provide next generation space operations (NGSO), the aim here, is to explore how Next Generation Space Operations engaged ISOW 2022 disclosure milieu and to determine by extension if the industry leader NASA is in alignment.

Method
Presentations were summarized from Improving Space Operations Workshop 2022. Assessment of NSGO presentations were analyzed for key content themes that matched NGSO technical papers published between January 01, 2022 and June 30, 2022, and retrieved from NASA Technical Reports Server (NTRS). The NTRS search engine query "next generation space operations" retrieved the best matches during the queried dates. Retrieved papers and reports were edited for specificity, then matched to ISOW 2022 presentations.

Results and Discussion

Total number of ISOW 2022 presentations = 15
Total number of retrieved NTRS papers = 65
Total number of retrieved NTRS papers (Post-editing) = 26
Total number of ISOW 2022/ NTRS matches = 16

NTRS Papers	NTRS Subject Categories or KeyTerms	ISOW 2022 Presentations	ISOW 2022 Key Terms
Space Communications Responsive to Events Across Missions (SCREAM): An Investigation of Network Solutions for Transient Science Space Systems	Space Communications, Spacecraft Communications, Command and Tracking	Mission Operations Assistant - Leveling Up Mission Support Staff	Ground Station, Satellite telemetry
Key Components of the Next Generation Solar Physics Mission (NGSPM)		Dr. Timothy Livengood,Research Scientist, NASA GSFC, University of Maryland, College Park, MD	Submillimeter Solar Observation Lunar Volatiles Experiment (SSOLVE)
Microbial Life in Space	space radiation, stress, International Space Station, microbial life microbiome	Dr. Tobias Neiderweiser, Researcher, Bioserve Space Technologies, University of Colorado	ISS Science Experiments
Moon to Mars (M2M) Habitation Considerations: A Snap Shot As of January 2022	Habitat, Habitation, Artemis, Surface Habitat, Transit Habitat, Mars Habitat, Habitation, Artemis, Surface Habitat, Transit Habitat, Mars	Horseshoe Orbit for Propulsion-Free Exploration of Phobos	
Integrating Mission Timelines and Procedures to Enhance Situational Awareness in Human Spaceflight Operations	User experience, Usability, Self-scheduling, Timeline, Procedure execution, Situational awareness, Space exploration	Mission Operations Assistant - Leveling Up Mission Support Staff	Ground Station Satellite telemetry
Pair Production Detectors for Gamma-ray Astrophysics	Gamma rays, High-energy astrophysics, Active galactic nuclei, Pulsars, Gamma-ray bursts, Gamma-ray telescopes, Pair production	Dr. Tobias Neiderweiser, Researcher, Bioserve Space Technologies, University of Colorado	ISS Science Experiments
Draft LunaNet Interoperability Specification	Space Communications, Spacecraft Communications, Command and Tracking	Mission Operations Assistant - Leveling Up Mission Support Staff	Ground Station Satellite telemetry
A High-fidelity Performance and Sensitivity Analysis of X-ray Pulsar Navigation in Near-Earth and Cislunar Orbits	Spacecraft Instrumentation and Astrionics		
NASA Orbital Debris Engineering Model		Method & Apparatus forRemoving Orbital Space Debris from Near Earth Orbit Using Solar	Platform for Redirecting &

(ORDEM) 3.1 Model Process		Wind: (PRRISM)	Removing Inert Space Material (PRRISM)
NASA Orbital Debris Engineering Model (ORDEM) 3.1: Model Verification and Validation		Method and Apparatus for Removing Orbital Space Debris from Near Earth Orbit Using the 2 Solar Wind: Platform for Redirecting and Removing Inert Space Material (PRRISM)	Platform for Redirecting and Removing Inert Space Material (PRRISM)
An Overall Assessment of JPSS-3 VIIRS Radiometric Performance Based on Pre-Launch Testing	Earth Resources and Remote Sensing	Dr. Adam London, Founder and Chief Technical Officer, Astra	Startup: Launch Vehicle Svcs
NASA Passive Thermal Control Engineering Guidebook	thermal analysis, passive thermal, best practices		
Nuclear Power Concepts and Development Strategies for High-Power Electric Propulsion Missions to Mar	Spacecraft Propulsion and Power; Lunar and Planetary Science and Exploration		
Development of Advanced Manufacturing Approaches for Single-Piece Launch Vehicle Structures	integrally stiffened cylinder (ISC), single-piece manufacturing, near-net shape, flow forming advanced manufacturing, fuselage, launch vehicle, seamless barrel		
COMPASS Final Report: 2008 International Lunar Network (ILN)	Spacecraft Design, Testing and Performance; Lunar and Planetary Science and Exploration; Radioisotope Power Systems; Lunar Lander; Design Reference Mission		
Revisiting the Solar Research Cybe-rinfrastructure Needs: A White Paper of Findings and Recommendations	SMD, Heliophysics	Dr. Helene Bachatene, Vice-President, System Key Technologies Chief Technical Officer Thales (France	Digitizing Space Operations, Edge Computing
NASA's Armstrong Flight Research Center: Research, Technology, and Engineering Report 2021			
Reference Surface Activities for Crewed Mars Mission Systems and Utilization	Lunar and Planetary Science and Exploration		

Mission Incredible: A Titan Sample Return Using In-Situ Propellants	Titan Sample Return, Cryogenic propellants, Inflatable Cryogenic Tanks, Radioisotope Power System, Dynamic Radioisotope Power System, Liquid Oxygen,Liquid Methane		
Space Communications Responsive to Events Across Missions (SCREAM): An Investigation of Network Solutions for Transient Science Space Systems	Space Communications, Spacecraft Communications, Command and Tracking	Mission Operations Assistant - Leveling Up Mission Support Staff	Ground Station, Satellite telemetry
Key Components of the Next Generation Solar Physics Mission (NGSPM)		Dr. Timothy Livengood,Research Scientist, NASA GSFC, University of Maryland, College Park, MD	Submillimeter Solar Observation Lunar Volatiles Experiment (SSOLVE)
Microbial Life in Space	space radiation, stress, International Space Station, microbial life microbiome	Dr. Tobias Neiderweiser, Researcher, Bioserve Space Technologies University of Colorado	ISS Science Experiments
Moon to Mars (M2M) Habitation Considerations: A Snap Shot As of January 2022	Habitat, Habitation, Artemis, Surface Habitat, Transit Habitat, Mars Habitat, Habitation, Artemis, Surface Habitat, Transit Habitat, Mars	Horseshoe Orbit for Propulsion-Free Exploration of Phobos	
Integrating Mission Timelines and Procedures to Enhance Situational Awareness in Human Spaceflight Operations	User experience, Usability, Self-scheduling, Timeline, Procedure execution, Situational awareness, Space exploration	Mission Operations Assistant - Leveling Up Mission Support Staff	Grond Stations Satellite telemetry
Pair Production Detectors for Gamma-ray Astrophysics	Gamma rays, High-energy astrophysics, Active galactic nuclei, Pulsars, Gamma-ray bursts, Gamma-ray telescopes, Pair production	Dr. Tobias Neiderweiser, Researcher, Bioserve Space Technologies, University of Colorado	ISS Science Experiments

Of the 26 NTRS papers retrieved for best-matched NGSO query, 58 % related to ISOW 2022 topical presentations. However, less than half (47%) ISOW 2022 was included in the matches, and most multiple NTRS matches.

ISOW 2022 Presentations	**No. of NTRSMatches**
Mission Operations Assistant - Leveling Up Mission Support Staff (Ground station – satellite telemetry)	5
ISS Science(Microbiology) Experiments (Bioserve Space Technologies, University of Colorado)	4
Horseshoe Orbit for Propulsion-Free Exploration of Phobos	2
Submillimeter Solar Observation Lunar Volatiles Experiment (SSOLVE)	2
Platform for Redirecting & Removing Inert Space Material (PRRISM)	2

Digitizing Space Operations, Edge Computing	1
Space Startup: Launch Vehicle Services	1

The highest number of ISOW 2022/NGSO matches were mission ground stations and ISS microbiology experiments, suggesting that a gap between successful historical milestones of Apollo and ISS and future milestones for a prospective ARTEMIS Program. Demographics were not reviewed in the study, admittedly a limitation in the findings. Interestingly, space startups and digitization of space operations with most minimal matches reflect the former as a current trend and the latter an ESA/ Thales focus on NGSO. As early as 1983, several digitized subsystems were described as means of supporting expanding mission requirements and reducing operations and maintenance costs for satellite ground telemetry, tracking and control stations [5]. During the Apollo era, antennas at all three DSN Deep Space Communications Complexes (DSCCs) at Goldstone, Canberra, and Madrid were used. Digital systems replaced analog systems, network monitor and control was computerized at the tracking stations and central control centers, and mission control was centralized. Digitization – leading to remote control centers – and increasingly unified operations continued the trend toward network efficiencies and the beginnings of automation of DSN operations [6].

Conference presentations mitigate visibility issues for different firms and their projects. An increase in a firm's following after the presentation indicates the information potential of conference presentations [7]. Of the 8 non-matched ISOW 2022 presentations, three related to space weather impacting space operations. Post-editing 103 NTRS papers retrieved from NTRS search engine query "space weather", for the same publication period January 01-June 30, 2022, 18 specifically related to space (Data not shown). Considering three ISOW 2022 matches to 18 NTRS related technical papers suggests a hidden disclosure milieu for a NGSO forum. Therefore, any innovative upgrades to space operations might result from a knowledge spillover not defined or recognized in ISOW 2022.

Conclusion

Conferences organize local disclosure milieu of managers/ presenters with other stakeholders in attendance. thus creating a market reaction. Higher-order belief formation and assessment of nonverbal cues from a conference suggest a baseline from which information signals made the difference. Showing 58% topical match between NTRS and ISOW 2022 indicates such a NGSO baseline. When considering a hidden NGSO baseline provided by 3:18 match between ISOW 2022 presentations and NTRS papers retrieved from non-NGSO query "space weather", knowledge spillover becomes a distinct possibility; hence, formation of a higher-order belief.

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