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| Table Topic: Digital Threads |
| 1. Based on the following references, how would you succinctly define what a Digital Thread is? What are the strengths of each definition that need to be included in the updated definition? What other attributes should be included?    * 1. A digital thread is an extensible and configurable analytical framework that seamlessly expedites the controlled interplay of technical data, software, information, and knowledge in the digital engineering ecosystem, based on the established requirements, architectures, formats, and rules for building digital models [[DoDI 5000.97 Digital Engineering](https://www.esd.whs.mil/Portals/54/Documents/DD/issuances/dodi/500097p.PDF?ver=bePIqKXaLUTK_Iu5iTNREw%3D%3D)].      2. A digital thread consists of a collection of linked authoritative digital information pertaining to a process, product, or system, whose consistency is actively managed throughout the life cycle. This enables accessibility, traceability, currency, applicability, and credibility of information, thus facilitating the capture, communication, and use and reuse of knowledge to efficiently inform decisions that realize value [AIAA, [Digital Thread: Definition, Value, and Reference Model](https://www.aiaa.org/resources/digital-thread-white-paper)]      3. A digital thread provides a communication framework that allows a connected data flow and integrated view of the asset’s data throughout its lifecycle across traditionally siloed functional perspectives [[Bukley and Birk, Leveraging Digital Engineering for Space Guardians and Space Explorers, Aerospace Corp., Dec 2021.](https://csps.aerospace.org/sites/default/files/2021-12/Bukley_LeveragingDigital_20211207.pdf)]   Strengths:   * Bi-Directional Communication * Definition that includes the external environment * Any definitions that expands/goes beyond engineering, considers a broader environment * Exist across a platform’s life cycle * Virtual representation at the CURRENT STATE of a system * Active management of consistency * Authoritative * Detailed, explains purpose   Weaknesses:   * Definition that doesn’t include the external environment/context * Interoperability * Not a picture/diagram * Model consistency * Not audience independent definition “digital thread emoji” * Lack of platform capability for ASOT * Lots of jargon, or having to say “digital” to describe digital   Missing:   * Does the thread just pass data between models or can there be data transformation * Needs to more strongly incentivize cross-silo (full enterprise) scope * Context (provenance) / metadata * Digital thread must be considered in context with * Value/outcome * Consistency management * Who owns the digital thread * Seamlessness * Credibility * Does a digital thread support the entire lifecycle from concept through disposal? * Collection of linked authoritative data * Linkage across orgs / supply chain (protective IP and security)   Conclusion: The whole table agreed that among the 3 provided options, the AIAA definition is the most complete and accurate, although there was still room for improvement provided in the “missing” recommendations. Regardless, the entire table wanted to move on from further defining a Digital Thread.   1. What are the Digital Threads (e.g., from supplier system to Gov't dashboard) necessary to realize an incremental and/or continuous Systems Engineering Technical Reviews (SETRs) process?  * What are the models and/or data types included?   + Models     - Industry:       1. Large Language Models.       2. Material Models.       3. Mission Models.       4. System Models (MBSE).       5. Process Models.       6. Factory Models: 3D (ergonomic, process, etc.).       7. 3D Solid Models (MBD).     - Government:       1. Constructive Model at multiple fidelities. (Executable models for simulations, training, etc)       2. Model of Performance       3. Model of Nominal Behavior       4. Threat Models     - Academia:       1. Descriptive Models.       2. Physics-based, data-driven models (e.g., machine learning, AI).       3. Discrete Event Models   + Data Types     - Industry:       1. Telemetry Data       2. Reliability metrics (and other –ilities)       3. Cost of program at SETR.       4. Model accuracy metrics.       5. SWaP (Size, Weight, and Power).       6. Accuracy.       7. 3D point clouds from inspection (3D geometry scans).       8. Test data.       9. Simulation (physics-based).     - Government:       1. Test data from Modeling & simulation       2. Test Data from operational test & tactics development.     - Academia:       1. Requirements       2. Test data       3. Simulation data. * What are the sources and sinks?   + Source     - Fleet data.     - Calibration data.     - Physical characteristic measurements.     - Material response data.     - Test data.     - Decision points (context provenance).     - Suppliers   + Sinks     - Root Cause Analysis (RCA).     - Emergent decision reviews (contradiction vs. assumption, discovery vs. unknown).     - Maintenance, operators, regulators.     - V&V (Verification & Validation): * What are the challenges that exist to enabling these Digital Threads?   + Lack of definable “Purpose” for each digital thread. Decisions we use the digital thread for should be driving the type of models, fidelity, data types, data rates, data storage and start there. Example: “What questions must be answered to make a SETR decision, then work backwards from there”   + Various schedules for development mean maturity will vary, leading to risk in compliance.   + Configuration Management   + Need to understand schedule compliance in addition to technical compliance.   + Understanding model fidelity as related to requirement compliance.   + Model assumptions may be inaccurate based on operational data—requires model calibration.   + Data-sharing restrictions, IP rights when sharing across different organizations.   + Cultural change resistance: doing things "the way they've always been done."     - Also, learning to trust the output of data-driven models as much, and more, than we currently trust sitting in a room for 2 weeks going over PowerPoint slides.   + Data integrity and access control.   + Closed vendor ecosystems.   + Data uncertainty.   + Need industry standard models, styles, etc (sysML, Step 242)   + Need data (or process?) that validates a model against the standards/regulations   + Need to be able to prove that the model(s) you’re working from is the Authoritative Source of Truth   + Need to be able to see a clear link between DMM and value added to the program/decisions * What technical approaches are (or would be) effective at enabling these Digital Threads?   + LLMs for consistency and consolidation/translation   + Metadata specification guidelines   + Decision provenance   + Agentic knowledge steward   + Common Data framework   + Start with 'Pain Points'.   + Define 'SETR Dashboard'.   + Incentivize cross-silo integration. * What metrics could be used to evaluate the effectiveness of Digital Threads in the SETR process?   + Operational Performance in conformance to the requirement (expectation)   + Faster closure of issues   + Reduction in time to access (and review) any part of the ASOT   + De-duplication of effort   + Ability for the Digital processes to “steer the program”   + Frequency of twinning   + Packet loss rate   + Storage Capacity   + Transmission Efficiency   Question 2 Summarized Outputs:   1. Technical Approaches:    1. "Start with 'Pain Points'."    2. "Define 'SETR Dashboard'."    3. "Read AIAA position paper for OT."    4. Incentivize cross-silo integration. 2. Challenges:    1. "We don't know what we need for the dashboard (ask for everything)."    2. "Data sharing, transparency, provenance (ASOT)."    3. "Standard models, formats, etc." 3. Metrics:    1. "Reduction in time to review any portion of the ASOT."    2. "Ability of OT to steer program direction." 4. Next Steps:    1. "How to incentivize cross-silo integration."    2. "Pick a few 'biggest pain points' (digital strands) and solve them." |