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Title: A Survey on Interoperability Measurement

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Abstract

A Survey on Interoperability Measurement

For at least ten years, both government and industry have actively explored research on interoperability with the goal of creating a straightforward way of measuring, reporting, then improving the interoperability of a complex network of people, equipment, processes and organizations. Researchers have created models, proposed measures, described levels, postulated scorecards, and listed a variety of qualitative factors in support of an interoperability measure. Within extant interoperability research, the authors have identified over a dozen definitions of interoperability, over two dozen types of interoperability, numerous interoperability attributes and aspects, three foundational interoperability models, and nearly a dozen interoperability measures. At least four research groups are the centers-of-gravity for interoperability measurement research. This survey paper summarizes and focuses the current body of knowledge on interoperability measurement and identifies areas where further research is needed.

Outline of the Paper

    - Conceptual Interoperability (Carney, 2004, p. 18)
    - Enterprise Interoperability within Supply Chain Frame (Blanc, 2005, p. 3)
  - Definitions
    - Who defined it and when?
      - Poppel, 1987
      - Heiler, 1995
      - Amanowicz, 1996
      - Curts, 1999
      - JCS, 2000
      - Clark, 2001
      - Fewell, 2003
      - Levine X 5, 2003
      - Kasunic, 2004
      - Carney, 2004
      - Blanc X 2, 2005
    - Analysis of Definitions
      - Groupings (Types and Categories)
  - Models
    - Levels of Information System Interoperability (LISI)
    - Organizational Interoperability Model (OIM)
    - Levels of Conceptual Interoperability Model - LCIM
  - Measures
    - Attributes
      - Procedures (C4ISR, 1998, p. 2-9)
      - Applications (C4ISR, 1998, p. 2-12)
      - Infrastructure (C4ISR, 1998, p. 2-13)
      - Data (C4ISR, 1998, p. 2-14)
      - Preparedness (Clark, 2001, p. 9)
      - Understanding (Clark, 2001, p. 9)
      - Command Style (Clark, 2001, p. 9)
      - Ethos (Clark, 2001, p. 9)
    - Aspects
      - Organisational Structure Interoperability (Clark, 2001, p. 2)
      - Procedures Interoperability (Clark, 2001, p. 2)
      - Training Interoperability (Clark, 2001, p. 2)
      - Organisational Interoperability (Clark, 2001, p. 2)
      - Doctrinal Interoperability (Clark, 2001, p. 2)
      - Cultural Interoperability (Clark, 2001, p. 2)
      - Planned (technological) (Clothier, 1996, 1997), (Clark, 2001, p. 2)
      - Flexible (extemporaneous) (Clothier, 1996, 1997), (Clark, 2001, p. 2)
    - Levels
    - Scores
    - Scorecards
    - Quality Factors
- Architecture Impact
- Mathematics of interoperability measurement
  - Graph Theory
  - Operations Research (Optimization) Theory
  - Complexity Theory
- Research gaps and the edge of the research—What needs to be looked at next?
- Conclusion

References

Author Bios

Thomas Ford is the first resident Systems Engineering PhD student at the Air Force Institute of Technology. Prior to becoming a student, Major Ford helped formulate Air Force architecture policy and guidance at the Air Staff. Before serving on the Air Staff, he was Deputy Chief of Joint STARS production and oversaw the production and delivery of two aircraft. This paper contains the initial results of his dissertation literature search on combining interoperability measurement, network optimization and architectural design.

John Colombi is an Assistant Professor of Electrical Engineering at the Air Force Institute of Technology. He teaches graduate courses and leads sponsored research in support of the Systems Engineering program. Before joining the faculty, Dr. Colombi led various Air Force C4ISR systems integration activities including the C2 Constellation. At Hanscom AFB, he also served as Chief of Systems Engineer for U.S. AWACS. He has served at NSA developing information security and ran communications networking research at the Air Force Research Laboratory.

Scott Graham is an Assistant Professor of Computer Engineering at the Air Force Institute of Technology. He teaches graduate courses in computer networking and leads sponsored research in the area of mobile military networks. Prior to joining the faculty, Dr. Graham conducted software evaluation at the Air Force Operational Test and Evaluation Center and led testing of the Combat Talon II Mission Rehearsal Device at the Aeronautical Systems Centers Training Systems Product Group.

David Jacques is an Assistant Professor of Aeronautical Engineering and joined the faculty of the Air Force Institute of Technology in the summer of 1999. Prior military assignments included tactical missile intelligence analysis, ballistic missile test and evaluation, and research and development for advanced munition concepts. He twice received AF level recognition for his work; in 1998 for Outstanding Contributions to USAF Research and Development, and in 2002 as an Air Force Outstanding Science and Engineering Educator. In the winter of 2002-2003, LtCol Jacques led the activation team for the new AF Center for Systems Engineering initiated by then Secretary of the Air Force Dr. James Roche. In December of 2003, LtCol Jacques retired from active duty and accepted a position as a civilian faculty at AFIT. In addition to teaching and research, Dr. Jacques now chairs the graduate Systems Engineering program, and heads up the Education and Training Division for the Air Force Center for Systems Engineering. Dr. Jacques' research interests include multi-objective or constrained optimal design, and cooperative behavior and control of autonomous vehicles. Dr. Jacques holds a BS in Mechanical Engineering from Lehigh University, and MS and PhD degrees in Aeronautical Engineering from AFIT. He is an active member of the International Council of Systems Engineering (INCOSE) and has been selected as a 2006 Associate Fellow of the American Institute of Aeronautics and Astronautics (AIAA).