

# Air Force Institute of Technology

*Educating the Leaders of America's Air Force*



**U.S. AIR FORCE**

## ***Modernizing Database Architectures in Support of DDDAS***

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*Integrity - Service - Excellence*

# **Modernizing Database Architectures in Support of DDDAS**

**Dr Brent Langhals – Air Force Institute of Technology**

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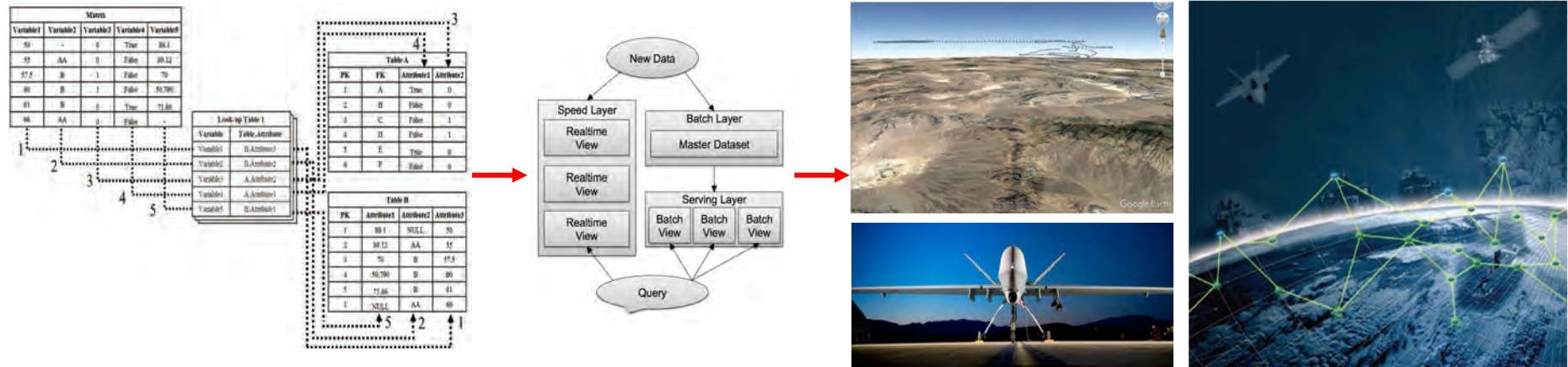
- **Summary of Effort**
  - **AF Relevance: UAS Data Storage and Retrieval -> DDDAS**
  - **AFRL Interest/Collaboration – Dr Terry Wilson (RYAR)**
- **Key Focus of Scientific Research**
  - **Modernize secure military data storage/retrieval architectures to facilitate in-stream on-demand analytics**
- **Accomplishments**
  - **Database lab and DB evaluation methodology established**
  - **Provided customized database w/ analytics S/W for 432 MXG (Creech AFB)**
- **Other performers on project**
  - **Faculty/coPIs: Dr Michael Grimaila, Dr Douglas Hodson**
  - **Students: Maj Beach (PhD), Capt Sigala (MS), Capt Kulm (MS)**

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## New S&T advances for new capabilities through the project:

- **Modeling: Indirection Methodology for ETL operations of UAS data into relational database – includes user toolkit for multiple mission analysis**
  - Solves versioning; initiates data fusion of data types/sources at intake
  - Future work -> explore uses/efficiencies of other database (NoSQL types)
- **Algorithms: Automate ETL through indirect mapping algorithm – matching global variables to software/platform version**
- **Tech Transfer: AFIT SMS Processor (ASP) and Reaper Analysis Toolkit (RAT)**

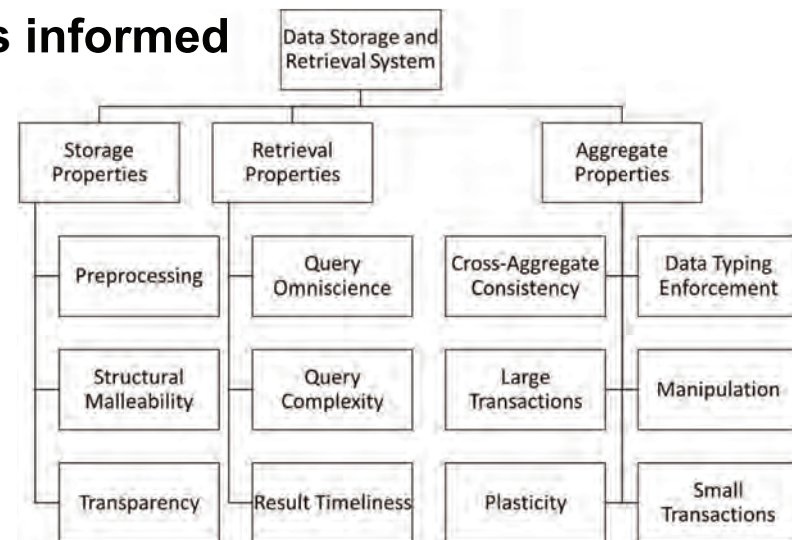
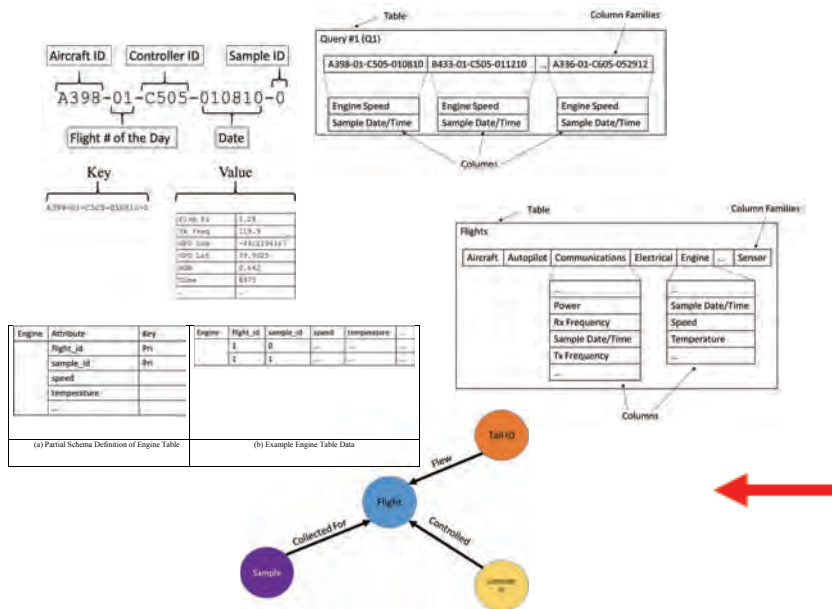


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## New S&T advances for new capabilities through the project:

- **Modeling: Criteria/Methodology for Evaluating NoSQL and Relational Databases for DDDAS applications (simulated)**
  - Working with UAS data (historical and AFIT UAS Lab)
- **Algorithms: Lab testable, user requirements informed**
- **Systems Software: AHP Toolkit**



	CAC	DTE	LAT	SAT	M	Pla	Pre	QC	QO	RT	SM	T
KV	0.048	0.057	0.194	0.416	0.027	0.033	0.180	0.039	0.415	0.496	0.347	0.034
Doc	0.048	0.116	0.327	0.123	0.243	0.302	0.232	0.135	0.083	0.196	0.347	0.280
Col	0.048	0.031	0.327	0.073	0.243	0.302	0.080	0.039	0.415	0.055	0.089	0.126
Graph	0.429	0.233	0.076	0.186	0.243	0.302	0.466	0.326	0.050	0.105	0.184	0.280
Rel	0.429	0.562	0.076	0.203	0.243	0.062	0.042	0.461	0.038	0.149	0.033	0.280

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- **Accomplishments**
  - **Established database evaluation lab**
  - **Created and delivered automated data storage and analysis toolset to Creech AFB**
    - **First operational use by maintainers deployed to Afghanistan in 2018**
  - **Graduated 1 PhD (September) 1 MS (March)**
  - **Added 1 PhD and 2 MS students to project team**
  - **1 journal accepted (1 in review)**
  - **3 conference presentations**

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## • Publications/Presentations

- "A Methodology for Evaluating Log Data Storage and Retrieval System" - Dissertation submitted by Major Ryan Engle, September 2018.
- Engle, R., Langhals, B. T., Grimaila, M. R., Hodson, D. (2018) "Evaluation Criteria for Selecting NoSQL Databases in a Single Box Environment" *International Journal of Database Management Systems*, August 2018, Volume 10, No 4.
- Engle, R.\*, Langhals, B. T., Grimaila, M. R., Hodson, D., "The Case for NoSQL on a Single Desktop." Proceedings of the 17<sup>th</sup> International Conference on Information and Knowledge Engineering, Las Vegas, NV, July 2018.
- Beach, P. M.\*, Mills, R. F., Burfeind, B. C., Langhals, B.T., Mailloux, L.O., "A STAMP-Based Approach to Developing Quantifiable Measures of Resilience." Proceedings of the 16th International Conference on Embedded Systems, Cyber-physical, Las Vegas, NV, July 2018.
- Engle, R.\*, Langhals, B. T., Grimaila, M. R., Hodson, D., "Facilitating UAS Log Data Analysis Using Open Source Tools." Proceedings of the 43<sup>rd</sup> Dayton-Cincinnati Aerospace Sciences Symposium, Dayton, OH, February 27, 2018.



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- **Coordination/Synergy**
  - **Coordinating work with MISP IV efforts with AFRL/RYPAR (Terry Wilson)**
    - **Looking to extend toolsets to all operating locations, possibly online**
  - **Engaged with AFLCMC (Mr Estes) on parallel data logger work**
- **Exposure/Use by other groups**
  - **Analysis toolkit used by MQ-9 maintainers and engineers in forward deployed locations as well as at Creech AFB**