Harnessing the Risk-Related Data Supply Chain: An Information Architecture Approach to Enriching Human System Research and Operations Knowledge

Lynn E. Buquo and Kathy A. Johnson-Throop, Ph.D.
Information Architecture

• What is it?
  – A representation of the enterprise built using systematic rational methods. The architecture contains a representation of the current state as well as a design of the desired (target) state that operates more effectively and efficiently. The target state is designed to facilitate the movement of data and information to the right people at the right time to get their work done.

• How is it built?
  – Identify the data/information and the people and systems generating or consuming that data/information
  – Identify the business processes
    • are they defined, documented, ad hoc, a combination
  – Determine the target state

• How is it used?
  – Determine a transition strategy (priorities and specific tasks) to move from the current state to the target state
Current Information Architecture

- Multiple projects generating data
  - Operational
  - Research
- Multiple systems storing data
- Few connections between the systems
- Inefficient access to data/information
- Incomplete knowledge of data/information available
Current & Target State: Human System Risk Business Process

- **Risk**
  - Information (Analyses)
  - Gaps

- **Research**
  - Operational Data
  - Products

- **Analysis**
- **Operations**
• By mapping the risk-related data flow from raw data to useable information and knowledge (think of it as a data supply chain), the Human Research Program (HRP) and Space Life Science Directorate (SLSD) are building an information architecture plan to leverage their existing, and often shared, IT infrastructure.
Target Information Architecture: Some Key Aspects

- Single place to go for evidence
  - Can be a distributed system underneath

- Risk representation tool that fully represents the richness of the risks and enables problem solving about the risks
  - Many risks have relationships among them.
    - E.g. inadequate nutrition can be a contributing factor to many other risks
  - Some risks share mitigation strategies

- It is important to understand how people and systems in the enterprise participate in multiple tasks and activities

Get the Right Information to the Right Place at the Right Time!
Single place to go for evidence

- Creation of an Evidence Base Working Group and Executive Committee to handle all data requests for data derived from personally identifiable data in our systems (both research and clinical data)

- Data systems inventory – identify all types of data in SLSD and HRP systems
Activities Derived from Key Aspects

Risk representation tool

- RMAT – Risk Management Analysis Tool
  - Enter all risks into a database tool to capture current risk representation
  - Explore richer representation format that can capture the relationships between components of the risk representation

```
<table>
<thead>
<tr>
<th>RISK FACTOR OF INADEQUATE NUTRITION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Element: Human Health Countermeasures</td>
</tr>
<tr>
<td>Lunar Criticality: Controlled</td>
</tr>
<tr>
<td>Mars Criticality: Unacceptable</td>
</tr>
</tbody>
</table>

Expand All Sections

- Risk Statement
  - Given that adequate nutrition is a key factor in all physiological functions, and that spaceflight has been shown to alter many physiological functions in humans, and that countermeasures for individual systems may alter nutritional status, there is a possibility that inadequate nutrition will compromise crew health, including endurance, muscle mass and strength, immune function, bone mass and strength, cardiovascular performance, gastrointestinal function, endocrine function, and ocular, psychological and physical health, and ability to mitigate oxidative damage.

- Context
- Operational Relevance
- Mitigation Strategy
- Gaps (8)
  - N1: Are nutrients in food stable during space flight?
  - N2: What is the adequate dose range of vitamin D supplementation?
  - N3: How do nutritional status/nutrition requirements change during spaceflight?
  - N8: What are the interactions of exercise and nutrition in altered weight bearing environments that mitigate muscle loss?
  - N14: What integrated nutritional, exercise and/or pharmaceutical countermeasures can be used to mitigate bone loss?
  - N6: What impact does flight have on oxidative damage?
  - N15: Can nutrition/nutrients mitigate O2/radiation risks?
  - N4: Do countermeasures impact nutrition?

- Related Risks (7)
```
Activities Derived from Key Aspects

Understand People and Systems Relationships

- Organizational Relationships documentation
- Functional review of Systems
Summary

An Information Architecture facilitates the understanding and, hence, harnessing of the human system risk-related data supply chain which enhances the ability to securely collect, integrate, and share data assets that improve human system research and operations.
BACKUP MATERIAL
HRP-SLSD: Organizational View

• HRP and SLSD have a unique organizational construct that adds a layer of complexity to the challenge of building an information architecture plan.
  – Organizational symbiosis at least at the Johnson Space Center
    • HRP program management and support are organizationally embedded in SLSD at the Johnson Space Center
    • Key individuals are both SLSD managers/discipline experts as well as HRP element managers.
    • SLSD employees are funded by and work on HRP-funded efforts, but live within an SLSD organizational reporting structure
    • IT systems and dependency on the kinds of data are entwined
      – This is particularly strong in the area of human system risk-related data/information
The complexity of the organizational construct is compounded by the complexity of the applications that support both organizations.

We literally took a physical inventory of the applications used to support HRP, SLSD, and those that were shared.

- We laid it out by abstracting the business process to the highest level:
  - HRP = Research
  - SLSD = In-flight and ground-based operations
  - M&A = Both organizations have systems that support management and administration
We, then talked through the primary lines of business that fall out of the research and operations areas.

Still keeping it at a high level, we identified 4 primary lines of business:

- Risk Management (both organizations do this)
- Research Management (primarily HRP, but SLSD does it in support of HRP)
- Human System Management (primarily SLSD: in-flight medical care, flight medicine clinic, JSC clinic)
- Innovation. Major SLSD goal this year is to make this more foundational to the organization

With these 3 elements better understood, we have a notional representation of our IT infrastructure baseline.
Notional Architecture Representation

Lines of Business:
- Risk Management
- Research Management
- Human System Management
- Innovation

Research (HRP):
- LSDA
- GAD
- TSC
- BCPR (legacy)
- HRR
- ISS MP (ISS Reusable Website)
- HTSF (EMR link possible)
- EBDB (NEED)
- ISS Pg Tool Kit (Data push)
- Bed Rest Study

Research & Ops (HRP & SLS):
- RMAT
- S/P Private Medical
- Compusense (Tasting)
- IMM
- Nutrition OLIMS
- WAFAL LIMS
- SRAG/SRDL
- LADTAG
- Anthro
- FS Training Management
- GRAF
- Sample Tracking STIS
- LSAT

Ground Apps:
- Console Schedule
- Call Down (DB)
- EMR
- PACS
- HITT

Inflight Apps:
- CDCA
- CQEP
- FFQ
- AREAS
- MMR
- ARED/TZ
- CCDB
- SAFLT

Operational (SLS):
- Hazmat
- Space Med Lib
- SK/SD/SF website
- HIS Hygiene

Management and Administration:
- INSPIRES NSSC
- u: SMO/PI
- u: LSDA HRP Mgmt Legislators PI
- NSBRI Portal
- Task book (AGCV) & HRP $s
- Sk PUBS
- HSI
- Wind Chill (PPMI)
- e-room (GRC)
- HRP Websites int/Ext
- USRA

Research & Ops (HRP & SLS):
- ITA
- S/P IRD
- DAA
- BPS
- Back ups ISL
- PBMA
- Click commerce (CHPS) [SISL]
- DOC LIB
- BCD
- CPHS
- IRMA AKA IRMA
- Web Docs
- License Server (mgmt)
- ICH LIMS (SD)
- SARS
- Microb Review Board
- Temp monitoring system
- Safety Chem (tracking)
- Secure share (PGP)