## **A Few Words First**

Audio Connection – Please mute phone (\*6 toggle) – or your GM left-side name

All phone connections may be muted during the presentation. If so, save your comments and questions for Q&A and/or put them in the GlobalMeet chat window. Upcoming Meetings:

- Oct 26: Tutorial Design Structure Matrix, register <u>HERE</u> or on Chapter website Tyson Browning, Texas Christian University
- Nov 14: An SE Approach to Providing Photo Voltaics in Ghana Marlene Brown, Sandia Labs
- Dec ??: No Traditional December Holiday Social is Scheduled (We are lacking a social event coordinator/producer, and you didn't step up)

CSEP Courses by Certification Training International: <u>Course details</u> (with more locations and dates) Upcoming Course Schedule (somewhat nearby): 2019 Feb 11-15 | San Francisco, CA 2019 Aug 12-16 | Austin, TX Chapter SEP mentors: Ann Hodges <u>alhodge@sandia.gov</u>, Heidi Hahn <u>hahn@lanl.gov</u>

> First slide, not recorded but retained in pdf presentation. And Now - Introductions

## Enchantment Chapter Monthly Meeting



#### <u>10 October 2018 – 16:45-18:00 MT</u>

Using Enterprise Architecture for Analysis of a Complex Adaptive Organization's Risk Inducing Characteristics

Laura Salguero, Sandia National Labs, R&D Systems Engineer, Isalgue@sandia.gov

#### Abstract:

Sandia National Laboratories is an organization with a wide range of research and development activities that include nuclear, explosives, and chemical hazards. In addition, Sandia has over 2000 labs and over 40 major test facilities, such as the Thermal Test Complex, the Lightning Test Facility, and the Rocket Sled Track. In order to support safe operations, Sandia has a large Environment, Safety, and Health (ES&H) organization that provides expertise to support engineers and scientists in performing work safely. With such a diverse organization to support, the ES&H program continuously seeks opportunities to improve the services provided for Sandia by using various methods as part of their risk management strategy. One of the methods being investigated is using enterprise architecture analysis to mitigate risk inducing characteristics such as normalization of deviance, organizational drift, and problems in information flow. This talk presents a case study for how a Department of Defense Architecture Framework (DoDAF) model of the ES&H enterprise, including information technology applications, can be analyzed to understand the level of risk associated with the risk inducing characteristics discussed above. While the analysis is not complete, we provide proposed analysis methods that will be used for future research as the project progresses.

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# **Today's Presentation** Things to Think About

How can this be applied in your work environment? What did you hear that will influence your thinking? What is your take away from this presentation?





Laura Salguero has always been a methodical thinker that organizes and characterizes the world around her.

From her research background that spans diverse domains including physics, mechanical engineering, and biomedical research, Laura has developed a broad understanding of and deep interest in the world around her.

In a continuing effort to advance that understanding, she is currently in a role as an R&D systems engineer at Sandia National Labs where she is leading a cross-divisional capability to bring MBSE to more of Sandia and is applying MBSE to a wide range of systems.

#### PRESENTATION

#### Exceptional service in the national interest





#### Using Enterprise Architecture for Analysis of a Complex Adaptive Organization's Risk Inducing Characteristics Laura Salguero, Johnathon Huff, Anthony Matta, & Sue Collins





#### **Sandia National Laboratories**



Federally Funded Research and Development Center (FFRDC) with core capabilities in

- Systems engineering and integration
- Cybersecurity and risk analysis
- High Performance Computing
- Extreme environment testing at unique facilities
- Nanotechnologies and microsystems

#### **Research & Development**

- Nuclear Weapons
- Defense Systems and Assessments
- Energy and Climate
- Global Security







#### **Sandia National Laboratories**



Sandia employs approximately 13,000 employees and operates on approximately 200,000 acres of land with almost 1000 buildings.



Sandia is large and complex!

## Environment, Safety & Health (ES&H)



Sandia's policy is to perform work in a safe and environmentally responsible manner by committing to



- maintaining a safe workplace, preventing incidents, and protecting the public
- protecting the environment, conserving resources, and preventing pollution
- maintaining compliance with legal and other requirements
- striving for continual improvement

What is our optimal customer service model for protecting the environment and enabling employees to deliver mission capabilities safely?

## **Risk Inducing Characteristics**



- Normalization of Deviance
  - Structural secrecy and the local pockets can contribute to this
- Organizational Drift
  - lowest levels of the organization may slowly loosen standards over time
  - challenges when working across organizational boundaries because of varying standards.
- Problems in Information Flow and Communication
  - limited knowledge of tasks across work areas
  - Hierarchy, location, and physical and social distance are factors

#### How can we determine our risk?



## **Enterprise Architecture Development**



A coherent whole of principles, methods, and models that are used in the design and realization of an enterprise's organizational structure, business processes, IT systems, and physical infrastructure\*

- Provides the insight needed to balance requirements
- Facilitates the translation from corporate strategy to daily operations\*



Enterprise architectures are used for detailed analysis

Case studies of how these architectures are developed to create approaches to determine systemic organizational weakness are rarely published

http://maxpixel.freegreatpicture.com/Straking-Hands-Handshake-Office-Business-Businessmen-875694

It is an application of a **systems engineering** system architecture where the system of interest is the enterprise.

## **Model Based Systems Engineering**

MBSE (Model Based Systems Engineering) is the formalized application of modeling to support system requirements, design, analysis, and verification and validation activities beginning in the conceptual design phase and continuing throughout development and later life cycle phases\*

- An MBSE approach was used to comprehensively capture and facilitate the integration of ES&H's strategic goals and Information Technology (IT) strategy
- The complex system was decomposed into layers that can be analyzed at each level and considered in context
- Using an MBSE tool to manage this information, we can track changes in one area and determine system impact





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Sandia National

## **Model Based Systems Engineering**





and validation actions (V&V actions) in the course of the assembly. - SEBOK

\*\*Source: SEBOK, ISO

requirements ISO/IEC/IEEE 26702 (ISO 2007).

## **DoDAF Architecture Development**



- Step 1: Determine the intended use of the architecture
- Step 2: Determine the scope of the architecture
- **Step 3:** Determine the data required to support the architecture development effort
- Step 4: Collect, organize, correlate, and store architectural data
- Step 5: Conduct analysis in support of the architecture efforts
- Step 6: Present results based on decision maker needs (this step is not within scope)





- Sandia National Laboratories
- IT tools tend to link to an individual program as opposed to the department node
  - There are connections between these programs and departments that exist in the procedures they use to do work
    - This layer of procedures exists beneath the program areas of a department and includes the lines of communication

It is within this layer that the term 'local' can be more specifically defined and local risks can be analyzed

#### **Normalization of Deviance**





An organization with a strong functional alignment could be at higher risk of structural secrecy

Addressing structural secrecy requires looking at how program areas interact with each other to maintain high safety standards

A future state could be examined using a social network analysis tool such as this

This visualization was done using Gephi.

## **Organizational Drift**



- Redundant IT tools may be identified, potentially indicating a local pocket
- The diagram indicates that some IT tools map to multiple entities
- In our analysis of the meta-data for each of the IT tools, we captured both tools that need to be retired and tools that have redundant capabilities
- ES&H can use this identification of tools to reduce the number supported by software engineers, thus expending resources on as few tools as possible



## **Information Flow & Communication**





#### **Immediate Benefits**



- **Visual representation:** Provided a clear visual representation of the organization's complexity and a broad scope of internal interfaces.
- Active dialogue and critical thinking: The diagrams inspired considerable discussion on mission direction. Staff and management identified additional analysis that they would like to perform using the enterprise architecture.
- Corporate Partnerships
- **IT tool management repository:** Created the opportunity for a new management method for the IT tools portfolio.



# Even in the uncompleted state, the development of the enterprise architecture so far has generated benefits

#### **Conclusions & Future Work**



- Systems engineering and large-scale systemic thinking can be applied to an ES&H risk management approach through the analysis of an enterprise architecture
- This approach allows for a structured identification of interfaces and functional analyses before the optimal implementation solution is selected for an ES&H need
- This method allows for integration with other groups to ensure a comprehensive risk management approach to identified risk factors
- It encourages the integration of concept and physical systems such as IT tools that can share information and optimize human-computer interaction

#### **Future Work**

Complete the examination of the views that contribute to the analysis of the three key safety risk areas in complex ES&H organizations

Expand the architecture development and analysis methods to include all of Sandia

This will result in developing reference safety architectures for organizational views that can be compared between organizations

## **Questions?**

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> Look in GlobalMeet chat box for cut & paste link. Or use cell phone to capture this QR Code:



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The library page at: <u>www.incose.org/enchantment</u>.

Recording will be there in the library tomorrow.