# U.S. ARMY RESEARCH, DEVELOPMENT AND ENGINEERING COMMAND

An Update From The SISO Exploration of Next Generation Technology Application to Modeling and Simulation (ENGTAM) Standing Study Group

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# AGENDA

- Problem Statement

- ENGTAM Study Group (SG)

- Literature Search

- Dependency on Use Cases

- Evolution into Standing Study Group (SSG)

- Value to Modeling & Simulation (M&S) Domain

- ENGTAM Technology Adoption Model

- ENGTAM Presentations

- Path Forward

# PROBLEM STATEMENT

- There are countless emerging and evolving technologies useful to the M&S Community of Practice (CoP)
- Technologies are developed by anyone, for any purpose, anywhere in the world
- The wide array of globally developed options can be a barrier to adoption
- How do consumers make an informed decision when selecting a new technology for their requirements?
- Rapid progress in commercial technology solutions generates the need for the M&S CoP to examine what paradigms are becoming more ubiquitous and can be used in the next generation of M&S technologies
- Acknowledging there is no single body, source, or person that knows all of what is required throughout the M&S industry, a venue to support a diverse membership was sought

# ENGTAM STUDY GROUP (SG)

- Simulation Interoperability Standards Organization (SISO) ENGTAM SG was created in December 2015

- Initial concept for the SG was inspired by the goal of thinking forward with respect to Science and Technology (S&T)

- SISO SG permits maximum participation for this exchange of ideas and information and does not require membership or affiliation in any organization

- Meets telephonically monthly to discuss technologies, technology adoption, use cases and the best direction forward regarding how the M&S CoPs can remain knowledgeable

- Large participant base with lively discussion about the topics at hand
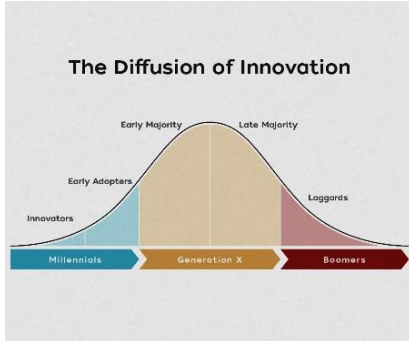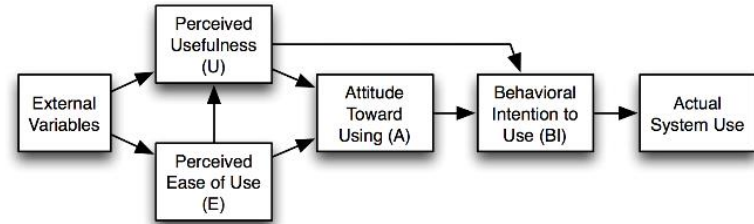
# LITERATURE SEARCH

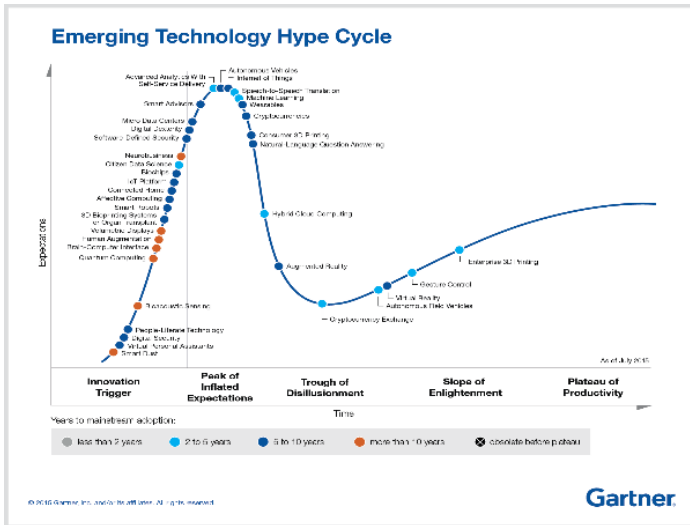A literature search was conducted for technology adoption standardization efforts across many sources.
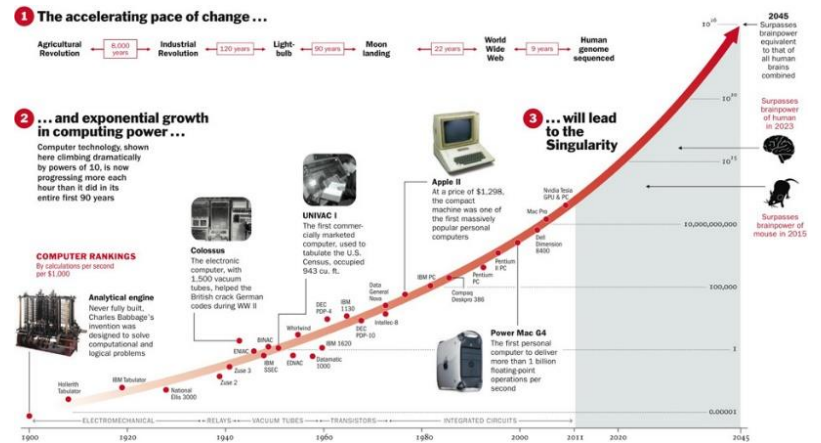
# TECHNOLOGY ADOPTION RESEARCH



Rogers' Bell Curve and the Diffusion of Innovation
(Hackett, Jason, http://bit.ly/2bajZL6)



Technology Acceptance Model – Davis,
Bagozzi & Warshaw, http://bit.ly/1OBQHRL



Hype Cycle – Pemberton Levy, Heather,
http://gtnr.it/1MNRe1i



Moore's Law is Progressing (source:
Humans Win, Lose or Draw?,
http://bit.ly/2aOsDvu)

# USE CASES

- The SG began searching for the latest and greatest technology for new starts as well as finding <u>better ways to do our current mission</u>

- The realm of technology that could possibly help M&S is tremendous; to <u>narrow our focus</u>, use cases were required

- To our knowledge, there is no single body, source, or person that knows <u>all of what is required throughout the M&S industry</u>

- Discovering, understanding, acquiring, and applying new technologies would be greatly enriched if one knew what the functional objectives are and how those functions are currently being accomplished

> We were unsuccessful in getting any broad and widely shareable use cases we could use to baseline our search

# STANDING STUDY GROUP (SSG) EVOLUTION

- Building on SG work, SSG formed September 2017 to focus on technology adoption, not just the technologies themselves

- Explore the latest industry technology trends and available solutions

- Consider other architecture quality and management requirements such as risk, cost, and long term sustainability, among others

- Assist the M&S CoP to stay informed of recent technology advancements and understand their impacts to our current and future implementations

- Examine, document and recommend best practices / standards for discovering and adopting technology into organizations

# ENGTAM VALUE TO M&S CoP

- Help modernize the M&S domain:
  - Recommend technologies for further exploration
  - Gather information on technologies that show potential to support M&S
  - Address issues pertaining to the adoption of a specific technology
- Highlight areas for potential standardization
  - Develop detailed technology adoption best practices
  - Add overlays to the technology adoption steps specific to type of organization and project
- Collaborate on best practices and lessons learned in a variety of areas
  - NATO S&T Panels have each created "Technology Watch" as a permanent activity
  - SISO Cloud-Based Modelling & Simulation SG

# ENGTAM TECHNOLOGY ADOPTION MODEL

- The ENGTAM SSG is moving forward towards developing best practices for technology discovery/evaluation/adoption. We will be discussing our current progress, which has evolved into the following steps:
  - Current State
  - Tech Exploration
  - Tech Evaluation
  - Tech Adoption
  - Tech Management

# TECHNOLOGY ADOPTION MODEL CATEGORIES OF ACTIVITIES

## Five Steps / Categories of Activities

| Step | Current State | Exploration | Evaluation | Adoption | Management |
|---|---|---|---|---|---|
| Activities | • Organization goals<br>• Organization strategy<br>• Organization capabilities<br>• Organization needs / weakness<br>• Use Cases<br>• Systems Views | • Identify capability areas<br>• Identify technical areas<br>• Plan, staff and schedule exploration activities<br>• On-going monitoring | • Systems engineering for how technology will integrate (technical and process)<br>• Testing (component and system)<br>• Pricing (full life cycle)<br>• Scheduling | • Backup Existing Solutions / Data<br>• Partial / Full Replacement Strategy<br>• Training<br>• Installation<br>• Integration<br>• Data Migration<br>• Process Adjustments | • Maintenance<br>• Upgrades<br>• Process Refinement<br>• Integration Adjustments |

# TECHNOLOGY ADOPTION MODEL STEP1: CURRENT STATE

- Influenced by the struggle to broadly apply technologies we were discovering to M&S projects and organizations

- Finding new technology is great, but knowing what is valuable to YOU is based on what you DO, HOW you do it, and WHERE you're going

- Should not drive the discovery of new technology, so discovery can be done with open mind

- Will help focus evaluation of technology for what would be useful

# TECHNOLOGY ADOPTION MODEL STEP 2: EXPLORATION

- Find what technology exists and what will exist soon that can help the organization

- Starts with learning, but consistently staying abreast of the industry(ies) is just as important

- Lengthy process that should be staffed, scheduled, and monitored -- it is more than just reading articles

- Iterative exploration will be valuable given how fast technology changes

# TECHNOLOGY ADOPTION MODEL STEP 3: EVALUATION

- Assess technology based on organization's goals, how it would interoperate with other systems, robustness, pricing, availability, etc.

- Develop a detailed systems engineering process to understand how the technology would be integrated in and used by an organization and/or external users

- Pricing should consider entire lifecycle of technology (licenses, training, maintenance, staffing, and even removal)

# TECHNOLOGY ADOPTION MODEL STEP 4: ADOPTION

- Consideration for both internal (e.g. staff) and external (e.g. paying customers) users
- Integration with existing systems should be evaluated at a high level systems view in addition to detailed protocol levels
- Training, process updates, backups, scheduled down time, etc. should all be considered and carefully planned
- Potentially a phased approach

# TECHNOLOGY ADOPTION MODEL STEP 5: MANAGEMENT

- Includes maintaining, upgrading and improving the technology

- Dissemination of updates as desired and available

- Data migration and management

- Process improvements

- Technology will never stop changing / improving, so there should be plans for periodic reviews

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# SELECT TECHNOLOGY AREAS

- **Technology Areas examined by SG:**
  - Wearables
  - Streaming
  - Advanced Hardware
  - Cloud Services
  - Data Sharing
- **Technology Areas examined by SSG :**
  - Artificial Intelligence
  - Big Data
  - Data Analysis
  - Database Technologies
  - Gaming
  - Internet of Things
  - Nanotech

# SELECT PRESENTATIONS TO ENGTAM CONSTITUENCY

- TRADOC G2 Operational Environment Enterprise Big Data presentation to ENGTAM

- Cloud Computing Use Cases and Resources by Google

- Commercial Off-The-Shelf Technology (COTS) Emerging Technology Evaluation & Exploitation (CETEE) Project by the Defence Science and Technology Laboratory (DSTL) in the United Kingdom (UK)

- Applied Machine Learning for Cyber Security by IBM

- Enabling M&S in the Internet of Things (IOT) Landscape by ANSYS, Inc.

- Operationalizing Big Data by the US Army Tank Automotive Research, Development and Engineering Center (TARDEC)

# ENGTAM PATH FORWARD

- ENGTAM SSG will continue operating through 2020, exploring the latest technology and how it can be applied to the M&S CoP

- The ENGTAM SSG meets once a month on the first Tuesday of the month at 10:00 AM ET

- For more information and to join the SSG, please visit:

  https://www.sisostds.org/StandardsActivities/StudyGroups/ENGTAMSG.aspx

# Questions/Comments?

Chris McGroarty & Christopher J. Metevier, United States Army Simulation and Training Technology Center

Scott Gallant, Effective Applications Corporation

Joe McDonnell, Dynamic Animation Systems, Inc.

Lana McGlynn, McGlynn Consulting Group

# BIG DATA DEFINITION

- Large and complex data sets
  - Modern systems generate more data than ever before
  - Unstructured nature of data makes processing more difficult
  - Faster paced operations means an increased velocity of data

- Quicker and more insightful data analysis

- Algorithms and techniques for handling Big data
  - Capturing
  - Curation
  - Data reduction
  - Discovering relationships within the data
  - Storage capacity
  - Security
  - Transfer
  - Querying
  - Visualization

Big Data

| Volume |
| Variety |
| Variability |
| Veracity |
| Velocity |
| Many V's |
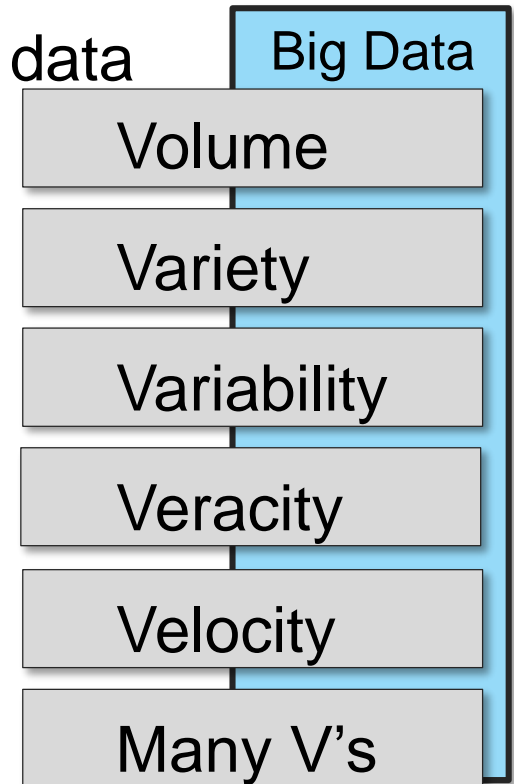
# ARTIFICIAL INTELLIGENCE DEFINITION

- Artificial Intelligence is a popular term but characterizes a vast amount of research fields.
  - Neural Networks
  - Robotics
  - Machine Learning
  - Expert Systems
  - Image Processing
  - Speech Processing
  - Natural Language Processing
  - Planning
  - Evolutionary Computation
  - Vision

Application to M&S / Operations Research
- Behavior implementation and examination
- Game theory / strategic planning
- Artificial creativity
- Decision Making
  - Convergent Optimization
  - Tree Search
  - Neural Networks

# CLOUD COMPUTING DEFINITION

- Cloud services and technologies built to work within the cloud make is easier to:
  - Use large scale M&S without requiring highly burdensome (expensive, hard to maintain, space consuming, etc.) infrastructure.
  - Utilize cloud services for big data collection, reduction, and analysis.

- The popular cloud providers have services already setup and ready to use for many big data functions:
  - Storage
  - Large data processing
  - Warehousing
  - Workflow orchestration
  - Searching
  - Structured query services
  - Analytics

https://aws.amazon.com/big-data/
https://cloud.google.com/solutions/big-data/
https://azure.microsoft.com/Big_Data/Analytics