3.10.2020

Research Spotlight Forum

Social Sciences & Decision Making

Human Factors (6671)

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About Me & The Human Factors Organization

- PhD in Aerospace Engineering from GaTech (Cognitive Engineering Center)
  - Minors in Math & Higher Education Teaching
- Currently SNL Virtual Worker in Atlanta, GA
  - On GT's campus often! Always happy to meet.

Research Areas:

- Engineering Design & Decision-Making, Multidisciplinary Decision-Making, Technology Integration, Team Science, Training & Instructional Design

Human Factors Department

- Multidisciplinary backgrounds (ME, AE, IE, CS, Psych, Neuro)
- Projects span SNL mission areas & customers (ND, TSA, NRC, DOD, DOT)

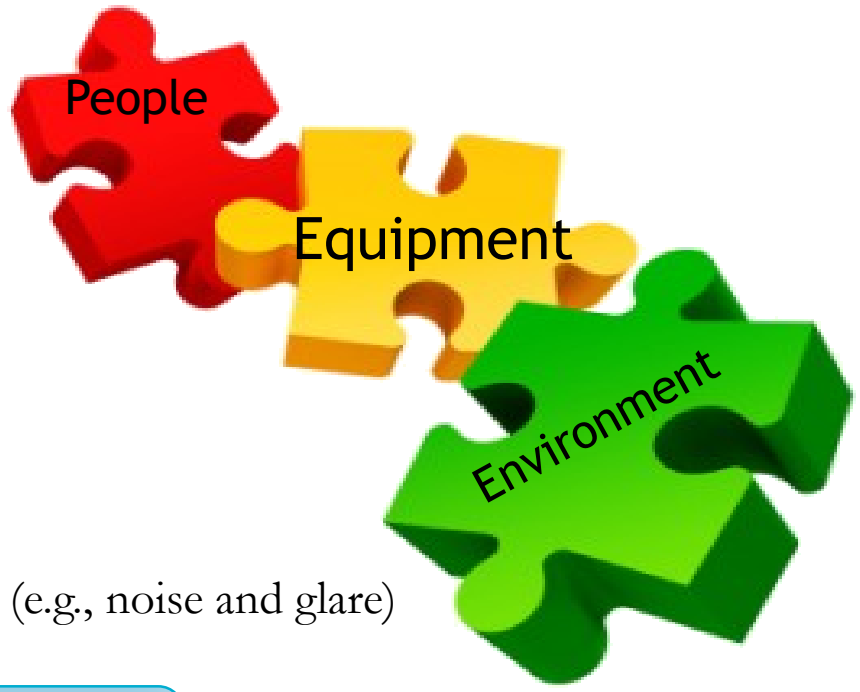
Example Methods

Observations, Surveys, Interviews, Focus Groups, Ethnography, Task Analysis, Workload Analysis, Benchmarking, Analysis of Records, User Requirements Gathering, Heuristic Evaluations, Human Reliability Analysis, Instructional Design, Experimental Design, Anthropometry, Physiological Measurements, etc

Human Factors & Systems Engineering

System is a set of interrelated components that interact in an organized fashion to achieve a common goal

- Equipment
- Environment
- People



Systems engineering is an interdisciplinary approach to enable the realization of successful systems

Human Systems Integration is an important component

- Focuses on the human element of the system
- Identifies human performance requirements for a successful system
- Identifies critical interactions between people and equipment
- Mitigates negative impacts of the environment on human performance (e.g., noise and glare)

Human Factors failures can increase design costs, decrease security and safety, and even lead to loss of life

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Research Spotlight Forum

Social Sciences & Decision Making

RAIDS: Robust, Adaptive, Integrated, Deployable Solutions

Scottie-Beth Fleming & Michelle Pang

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Motivation

National security problems are difficult to define and solve

- National security problems have many interdependencies and are often multi-causal
- Attempts to address complex national security problems often lead to unforeseen consequences and have no obvious solution
- Often, there is no clear responsibility of any one organization

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Foundational Principles for Innovative Design Solutions

Leverage Design Thinking

- Literature connects complex problem solving with design thinking practices
- Generally, the design process consists of two phases:
  1. Problem definition
  2. Problem solution

Generate a diverse solution set

- Diverse and innovative solution sets are obtained through divergent and convergent thinking
- Multidisciplinary teaming can be leveraged for varied perspectives

Iterate to improve solutions

- Iteration is an integral part of innovation
- Solution refinement with each iteration cycle

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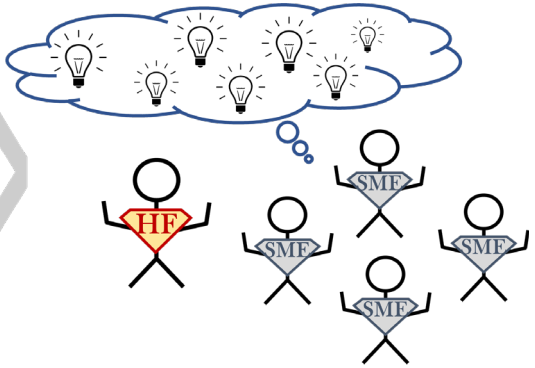
Robust, Adaptive, Integrated Deployable Solutions (RAIDS)

Process for developing innovative and flexible solutions to challenging national security problems

Methodology to approach complex, high consequence, and often urgent problems

Leverage National Security community's multidisciplinary capabilities and diverse expertise



Brings together the right people to generate innovative, diverse, and appropriate solutions

Robust, Adaptive, Integrated Deployable Solutions

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Applications

- National security challenges
  - Threat response
  - Strategic planning
  - Mission support
- Engineering challenges
  - Product design and innovation
  - Corrective actions for system failures
- Research and development
  - Identifying high impact, crosscutting research areas

Tokyo Electric Power Co., TEPCO

US Air Force

NASA

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Why Human Factors Facilitators?

Human Factors can:

- Illuminate hidden perspectives and information
- Facilitate communication across individuals and team
- Define and analyze various contexts
- Gather, define, understand, and refine requirements
- Understand work environments and contextual and situational implications

(Example) Human Factors Methods:

- Contextual Design
- Ethnography
- Task Analysis
- Process Observation
- User-Centered Design
- Surveys and Focus Groups
- Elicitation

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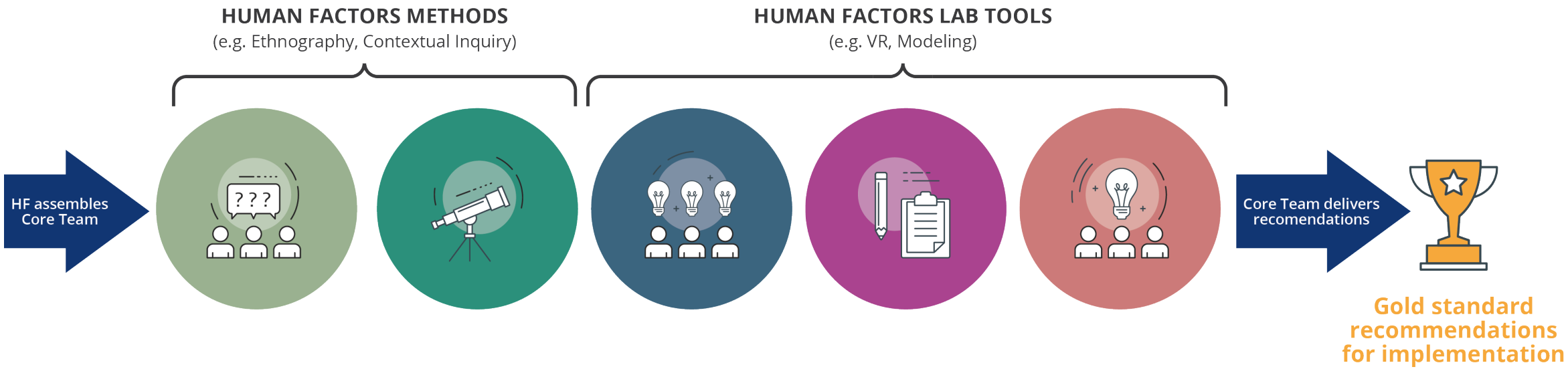
The RAIDS Process



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Step 0: Form Team

National security problem is identified

Identify facilitators

- Human Factors (HF) experts with relevant background are identified to lead and facilitate the RAIDS Core Team

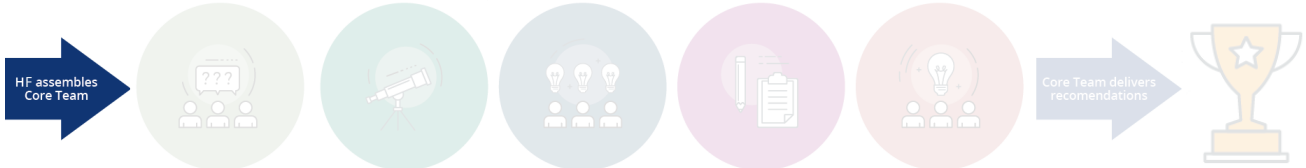
Assemble Core Team

- 3-4 experts (SMEs) are identified using recommendations, departmental organization charts, corporate repository of publication records, personal experience, etc.

Initiate process

- HF Facilitators compile relevant background information and prepare thought starters to initiate Problem Scoping

Output: Core Team of 5-6 people →
1-2 HF professionals (RAIDS Facilitators) and 3-4 focus area SMEs



Step 1: Scope

Outline Problem/Context

- Breakdown the problem/situation
- Gather available information
- Decompose critical system components
- Identify stakeholders

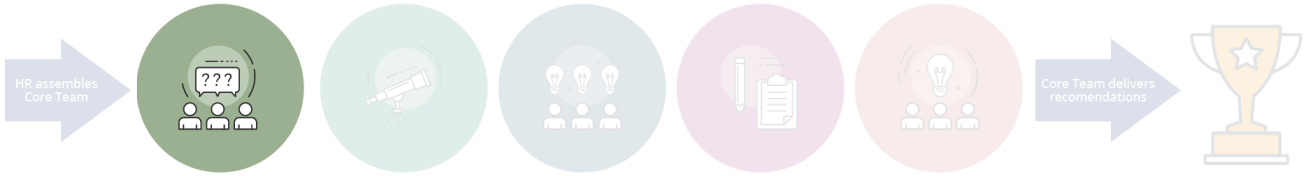
Identify critical components of problem

- Determine main priorities
- Identify risks, impact areas, trade-offs

Perform Verification

- Verify big picture overview with customer

Output: Statement of actionable impact addressing national security problem



Step 2: Observe

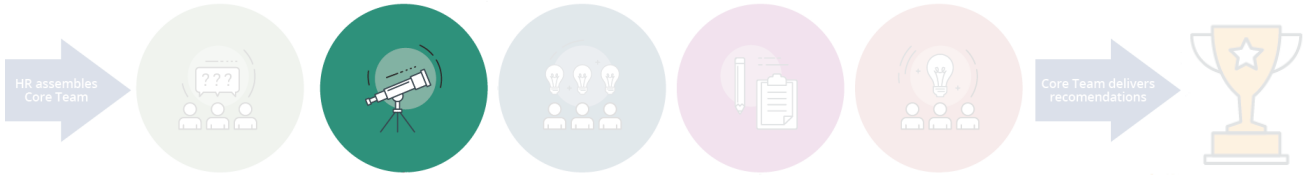
Collect additional background information

- Perform literature search and review
- Collect processed data from relevant projects
- Elicit information from stakeholders and involved parties using a variety of HF methodologies (e.g. ethnography, contextual inquiry, task analysis, surveys and focus groups, semi-structured interviews)

Distill and prioritize information

- Analyze data to highlight trends, gaps, and themes
- Prioritize key risks, impact areas, trade-offs

Output: Set of priorities to address and risks associated



Step 3: Ideate

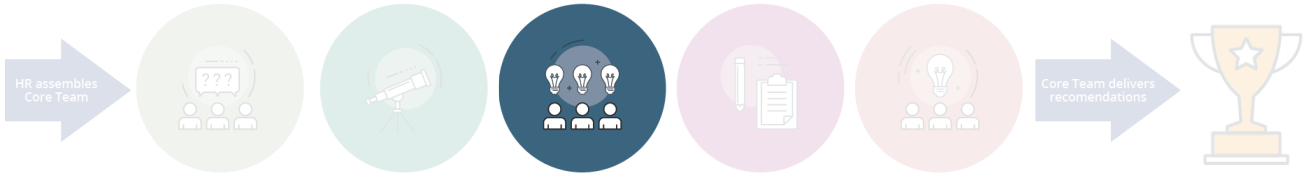
Decompose high-level problem into focus areas for ideation

- Define problem statement(s) for ideation activities addressing previously identified priorities

Generate a large number of potential solutions via brainstorming activity

- Mindmapping
- Reverse Brainstorming
- Developing Personas
- Gallery Method, Brainwriting
- Gap Filling
- TIPS/TRIZ
- Rapid Prototyping
- Card Sorting
- etc.

Output: Many ideas to address opportunities in solution space



Step 4: Validate

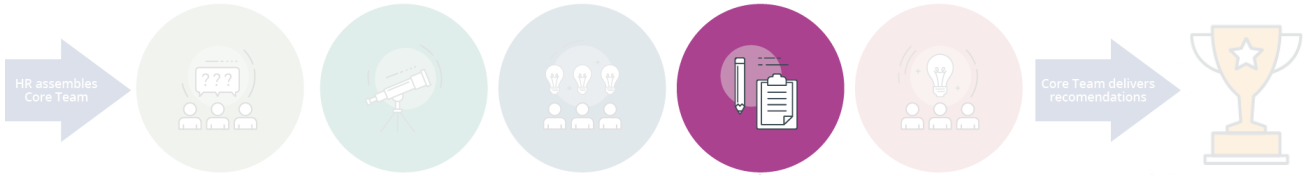
Down-select ideas generated in previous step

- Group or sort ideas based on themes or solution approaches
- Eliminate infeasible concepts
- Compare ideas with supplemental information (e.g. historical, policy, S&T, feasibility, cost)
- Prototype or model (where applicable)

Solicit input/feedback from (non-Core) SMEs

- Verify logistical details of implementation (where applicable)
- Validate concepts considering risks, priorities, impact

Output: A focused set of solutions/recommendations



Step 5: Converge

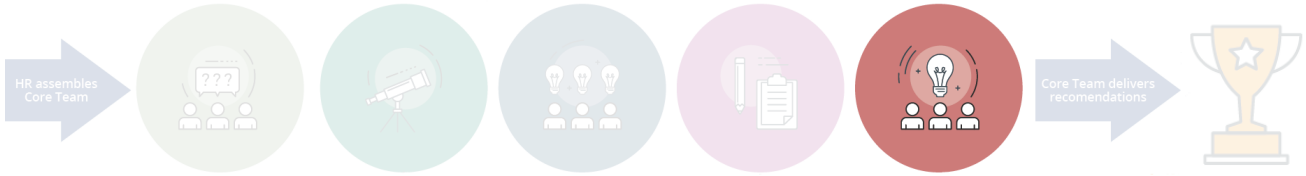
Assess ideas based on critical components of problem

- Rate ideas based on risks, impact areas and trade-offs (i.e. decision criteria), generated in Step 1
  - Implement an idea selection method (e.g. decision-matrix, Pugh chart, dot voting, affinity diagram, T-chart)

Perform final down-selection to top recommendations

	Criterion A	Criterion B	Criterion C	Total Benefit
Solution 1				
Solution 2	Criteria Weights			
Solution 3				

Output: Top recommended solutions which can be further assessed and implemented by on-the-ground team



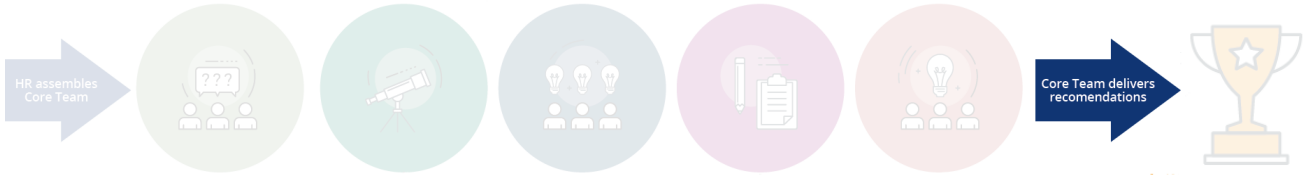
Step 6: Deliver

Deliver solutions/recommendations

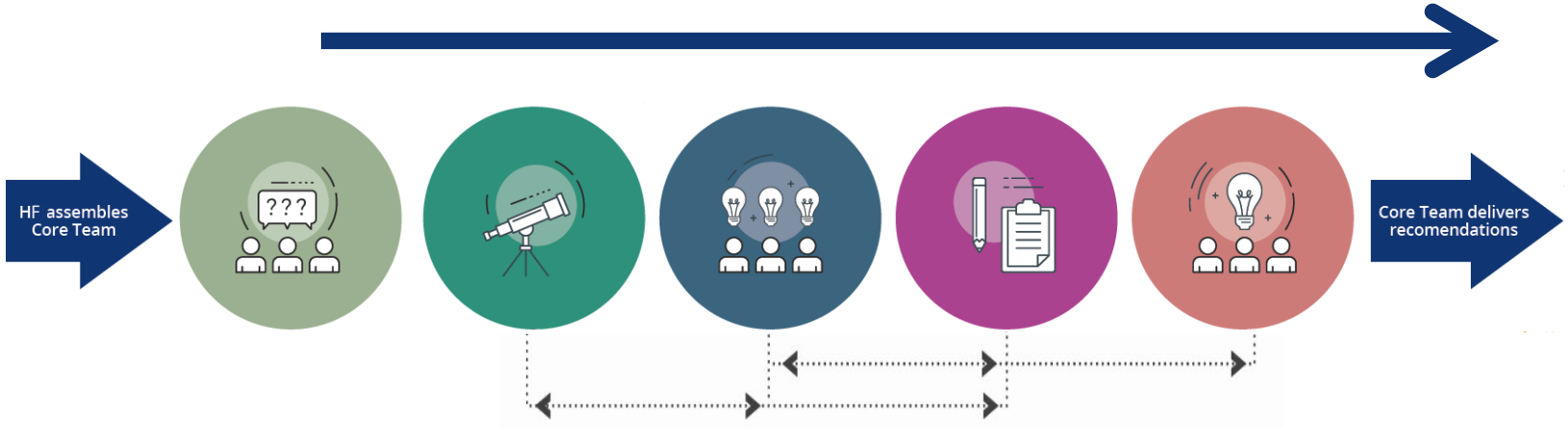
- Generate a presentation, memo (quicklook and/or complete), white paper, or other document to present the solutions and reasoning to the customer
- Provide information on problem scope and main priorities

Support deployment or continued work as needed

Output: Provide requesting customer with finalized deliverable containing top recommended solutions determined by RAIDS Core Team



Process Flexibility



- Timing for each step is not rigid
- Iteration is embedded throughout the RAIDS process and utilized as needed
- Iteration is expected, but not prescriptive
- Allows for refinement with each iterative cycle
  - Better understanding of problem space
  - Refinement of ideas
  - Enhanced framing of solution space

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Fast RAIDS

- For urgent problems requiring short solution turnaround
- Flexible process can be completed rapidly without compromising ability to utilize divergent and convergent thinking
  - Iteration periods can still occur but may be reduced
  - Less extensive research, analysis, and validation process
- Output produces actionable solutions, delivered to customer quickly

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Conclusions

Robust, Adaptive, Integrated Deployable Solutions (RAIDS)
Process for developing innovative and flexible solutions to challenging national security problems

- Build upon Design Thinking principles
- Leverage multidisciplinary expertise
- Generate a diverse solution set
- Iterate to improve solutions, honing in on impact and relevance
- Output produces actionable solutions to complex national security challenges, delivered to customer quickly

Robust, Adaptive, Integrated Deployable Solutions

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