May 26th, 7:30 AM

The New Frontier: Preparing and Sustaining Astronauts for Long-Duration, Deep Space Missions

Timothy R. Brock
Founder & CEO The Institute 4 Worthy Performance Winter Park, FL

THE 44TH SPACE CONGRESS®

"THE JOURNEY: FURTHER EXPLORATION FOR UNIVERSAL OPPORTUNITIES"

MAY 24-26 | CAPE CANAVERAL, FLORIDA

44TH SPACE CONGRESS

MAY 2016 COCOA BEACH, FL

The New Frontier: Preparing and Sustaining Astronauts for Long-Duration, Deep Space Missions

Timothy R. Brock, PhD, CPT, CRP, ID(S&L+)

Founder & CEO

The Institute 4 Worthy Performance

Winter Park, FL

Tim@ti4wp.com

The Institute 4 Worthy Performance

Semper et cogitemus et nos excolamus!

Background

- Retired Air Force
  - Nuclear Weapons
  - ICBMs
- Retired Lockheed Martin
  - Manager, Science of Learning and Performance Improvement
  - Chief Training Systems Architect for winning Crew Exploration Vehicle proposal
- PhD, Specialization in Training and Performance Improvement
  - Dissertation – *Training NASA Astronauts for Deep Space Exploration Missions: A Research Study to Develop and Validate a Competency-Based Training Framework*

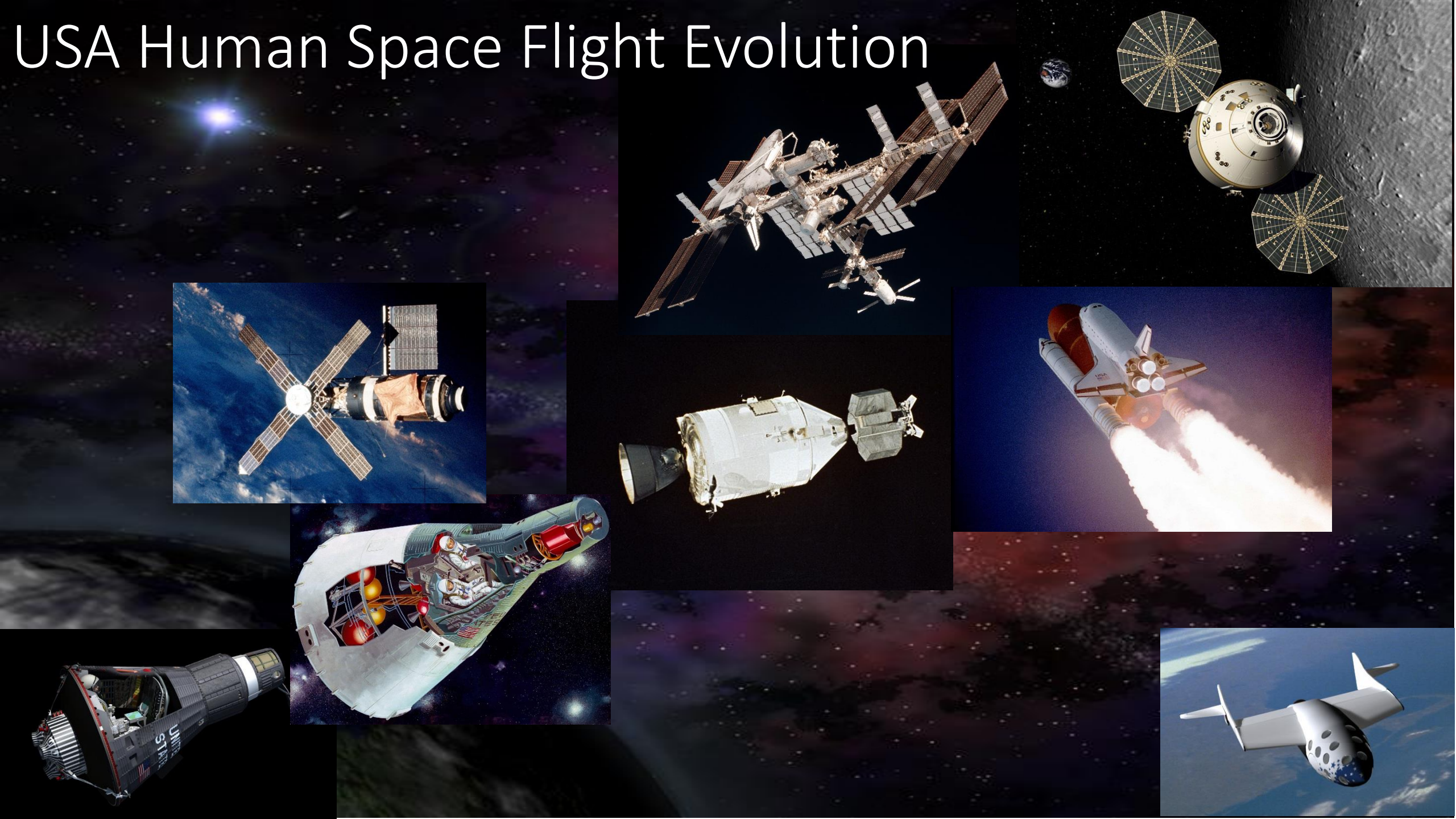
Two Visions

"We choose to go to the Moon in this decade and do the other things, not because they are easy, but because they are hard."
-John F Kennedy

New Space Exploration Vision

"This cause of exploration and discovery is not an option we choose; It is a desire written in the human heart." – President Bush

USA Human Space Flight Evolution



Frank Hughes, Retired Chief of NASA/JSF Space Flight Training (1993-1999)

- A space pioneer who started his 33 year NASA career in 1966 as a Simulator Instructor

To return to the Moon and on to Mars, we must update, economize, and shorten the space preparation process.

- Astronaut Training - Mercury – 200 training hours → ISS – 3,000 training hours
- Does not include costs of non-astronaut training

Training time growth reflects evolution of spacecraft missions and complexities

- Type 1 Spacecraft – Can return to Earth's surface
  - Repair Depot - If it breaks and we can't repair in space, we can bring it home and fix it
- Type 2 Spacecraft – Cannot return to Earth's surface
  - Complex, Expensive Logistics System - Must stockpile or transport spares/repairs as quickly as possible
- Type 3 Spacecraft – Totally autonomous – Moon and Mars missions
  - Can't easily return to Earth
  - Must include all spare parts, crew skills, consumables, etc. on board before departing Earth
  - "Houston, we have a problem" communication time delay challenge

A critical challenge is how do we reduce the time to and cost of proficiency required by today's fiscal constraints?

Human Competence Equation

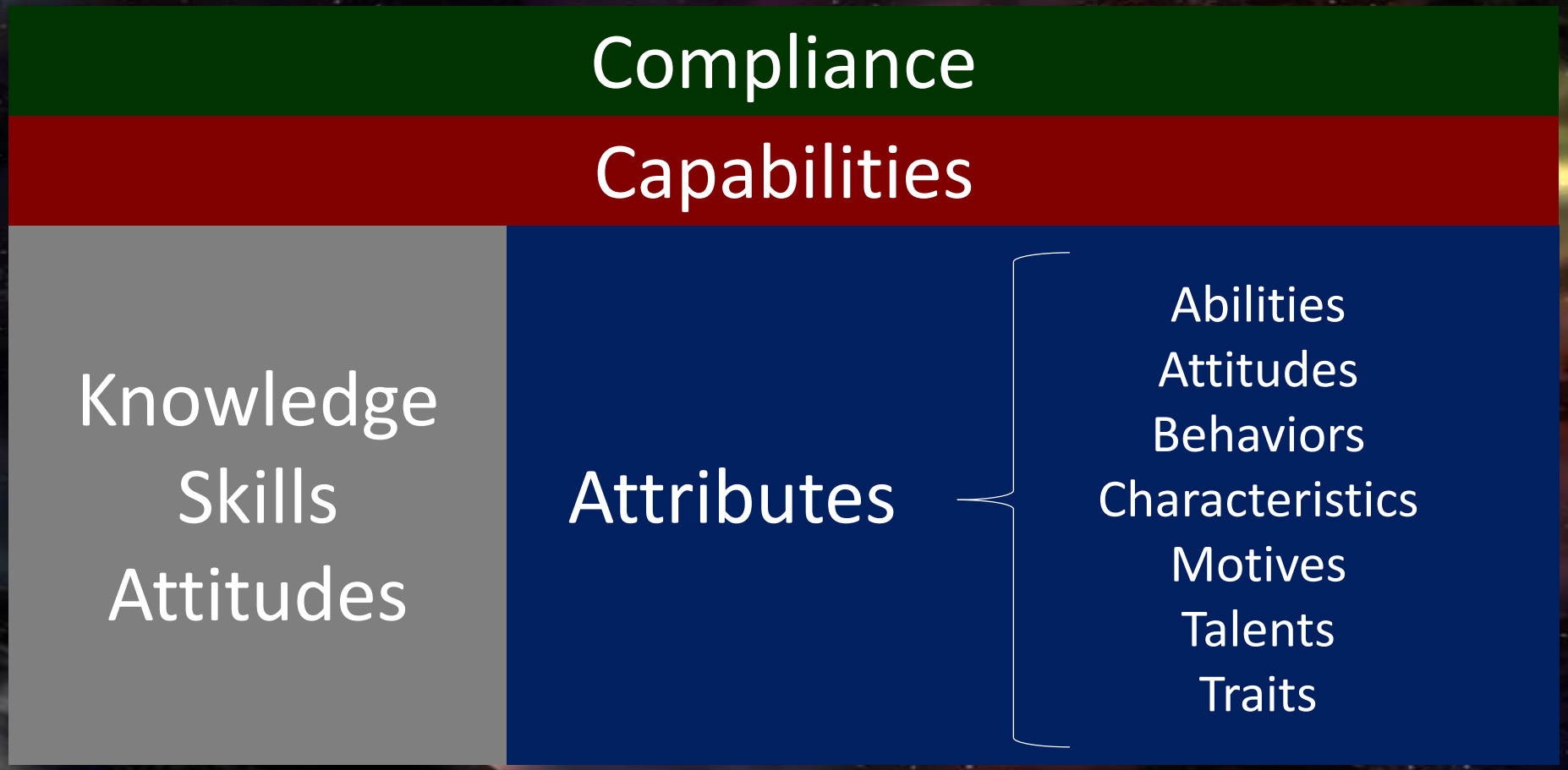
$$W = f\left(\frac{A}{B}\right)$$

Human competence is a function of worthy performance (W),
which is a function (f) of the ratio of
valuable accomplishments (A) to costly behavior (B).

Key Definitions

Term	Definition
Accomplishments	The consequences (output or result) produced by behaviors.
Behaviors	The tangible acts or decisions of individuals, groups, or organizations.
Competence	A collection of knowledge, skills, abilities, or characteristics that reside in an individual needed to meet a competency standard. Competence is achieved when the individual exhibits or performs at the level of proficiency required by the competency (i.e., behaviors).
Competency	A collection of knowledge, skills, abilities and characteristics associated with a specified level of job performance required by the organization. Some define competencies from a task, result, or output perspective. *A set of behavioral markers and the ability to apply them to new situations and environments within the context of human space flight. (ISS Human Behavior & Performance Competency Model)*

Competency-Based Training Components



NASA Competency Management System

"Competencies are the common thread that tie the elements of workforce management together."

ISS Human Behavior and Performance Competencies

- Self-Care/Self-Management
- Communication
- Cross Cultural
- Teamwork and Group Living
- Leadership/Followership
- Conflict Management
- Situational Awareness
- Decision Making and Problem Solving

NASA Systems Engineering Competencies

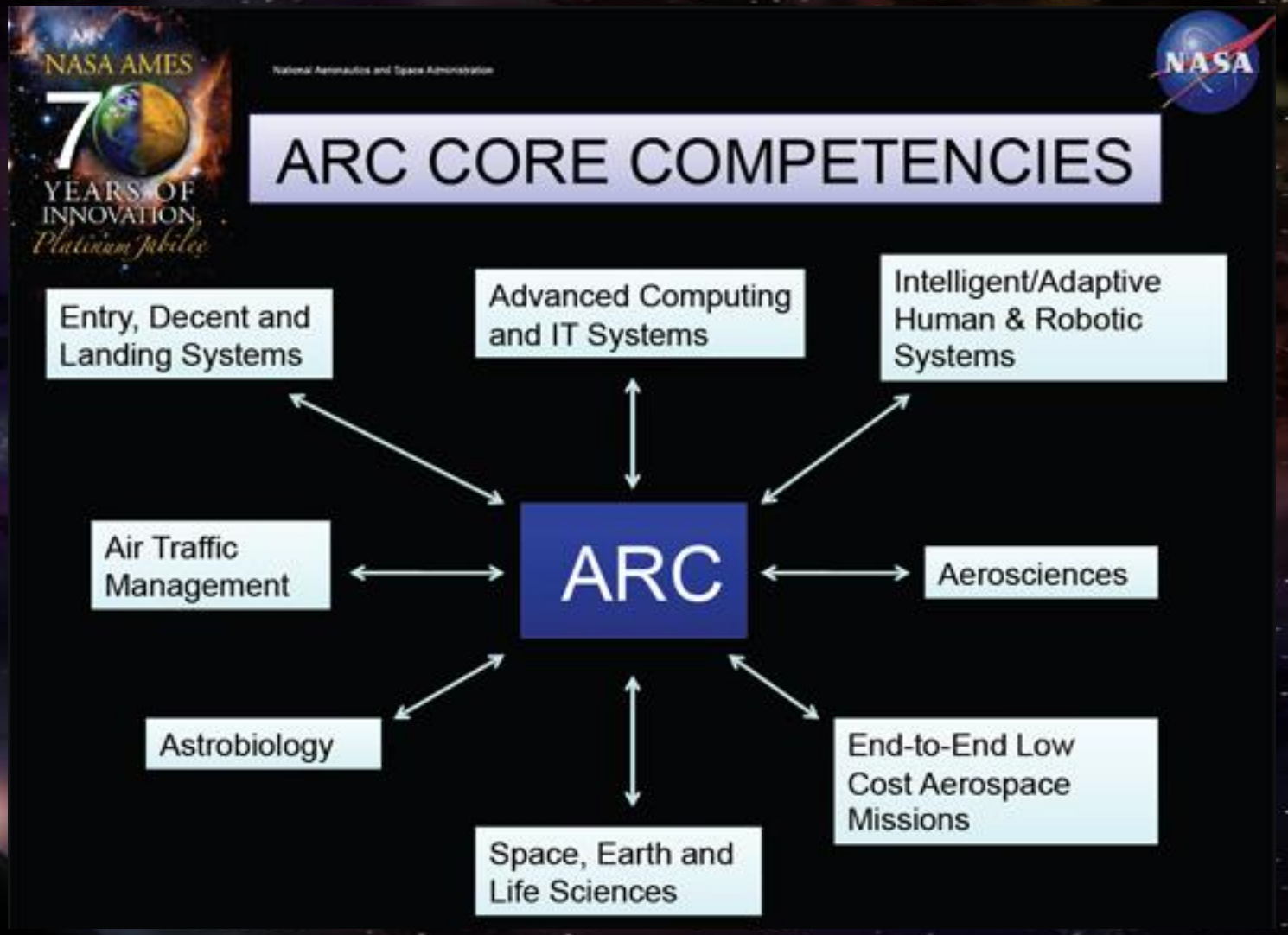
- Concepts and Architecture
- System Design
- Production, Product Transition, Operations
- Technical Management
- Project Management and Control
- NASA Internal and External Environments
- Human Capital Management
- Security, Safety, and Mission Assurance
- Professional and Leadership Development
- Knowledge Management

NASA Competency Management System

"Competencies are the common thread that tie the elements of workforce management together."

NASA Ames Research Center

8 Core Competencies



NASA Competency Management System

"Competencies are the common thread that tie the elements of workforce management together."

NASA Leadership Model

5 Dimensions

20 Competencies

(Measurable skills, knowledge, or personal characteristics)

Skills

(Abilities or proficiencies)

Behaviors

(Performance indicates proficiency within a skill)

There are different skills and behaviors at each of the five levels of leadership.

NASA Competence Alignment

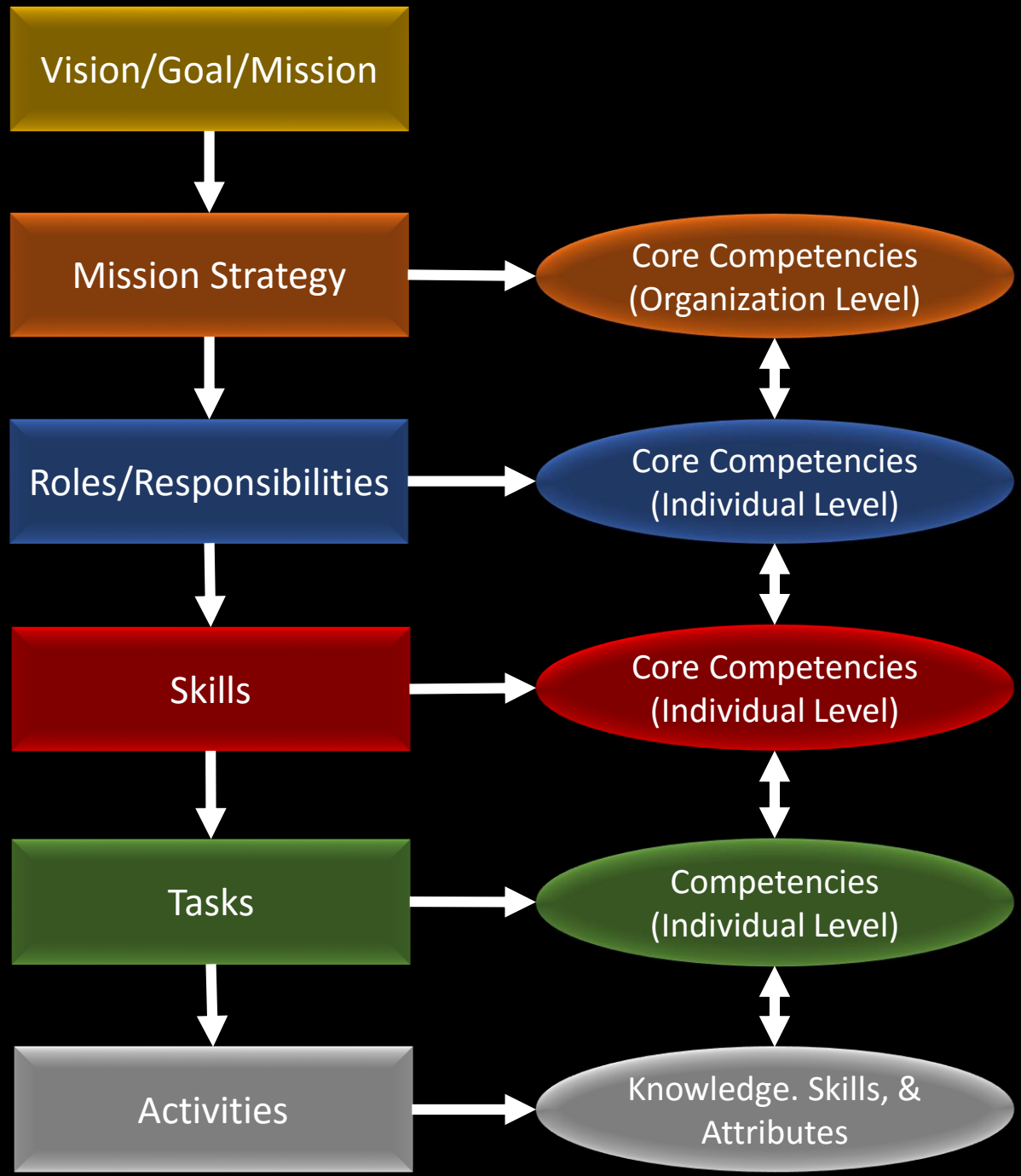
NASA uses competencies to:

Mission Alignment
- Identify Mission and Organizational Skills GAPS
- Guide staffing, retention, education and training programs
- Practice feedback and metrics on HR programs

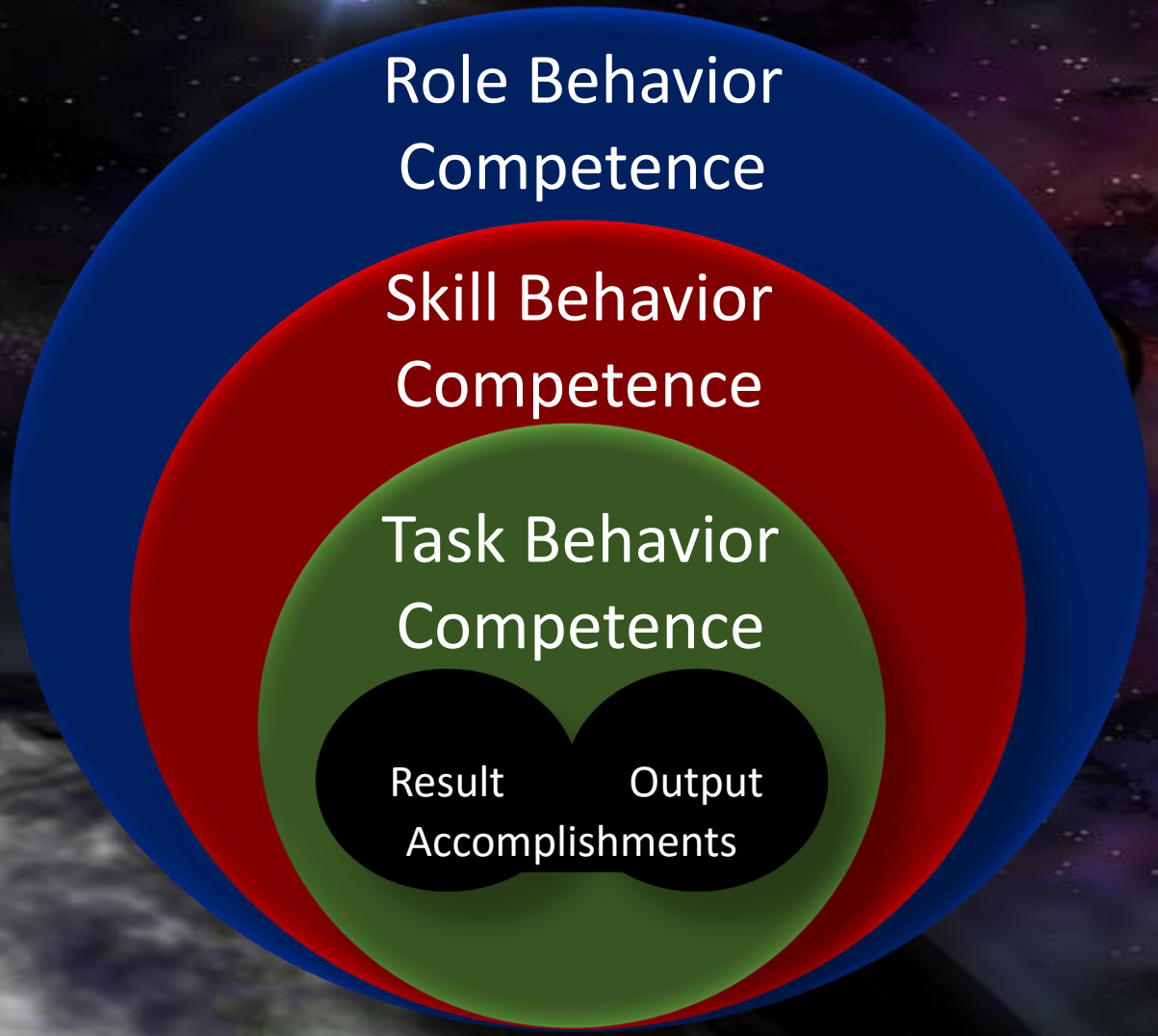
Find and Sustain Expertise
- Develop employees
- Plan careers
- Rapidly locate expertise

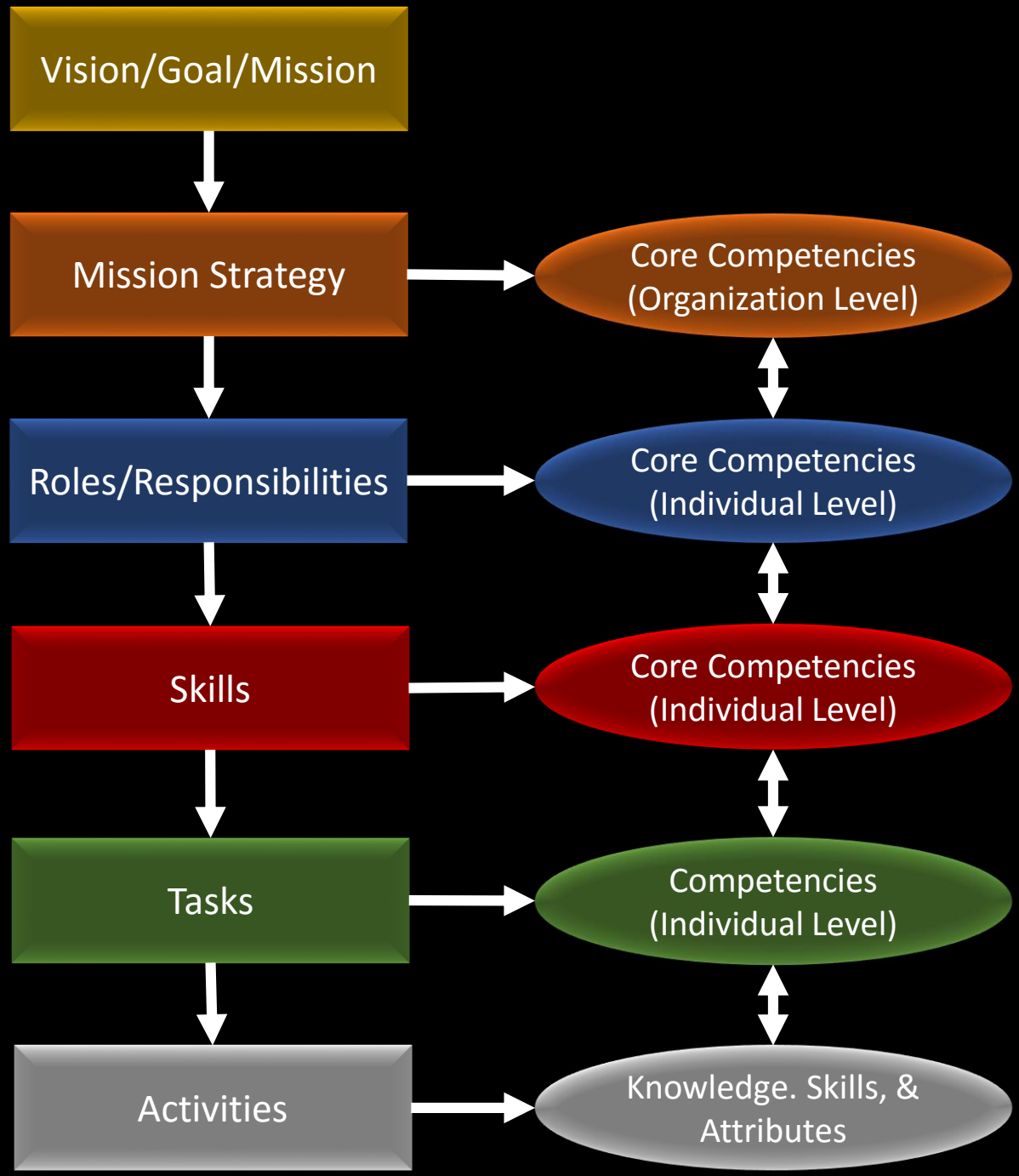
Work within Professional Communities
- Tie to federal communities
- Succession planning

Senior Leaders:
Can we accomplish our mission with our workforce?



Human Competence Chain





Hale's Competence Assessment Levels

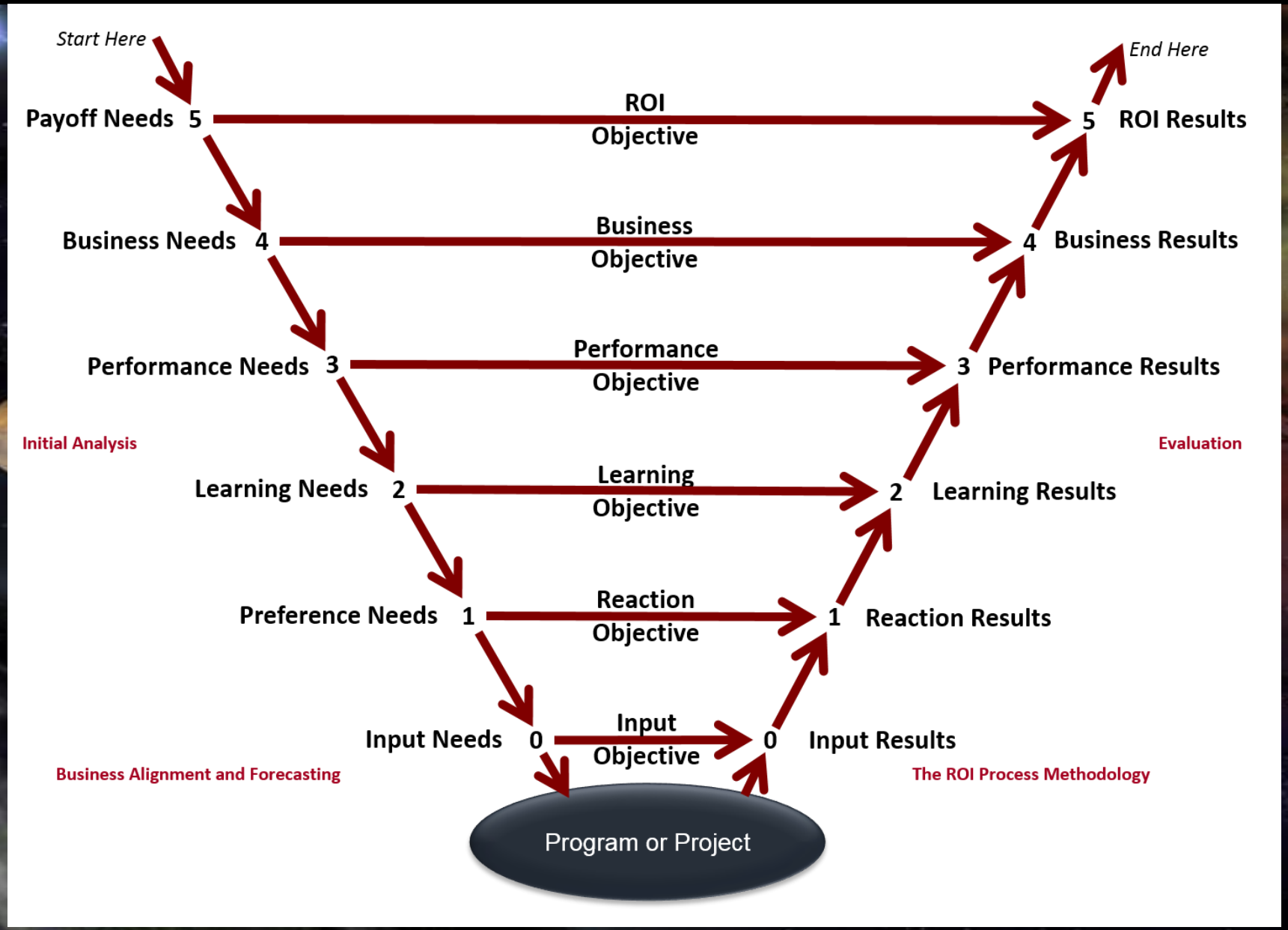
Knowledge-Based	Performance-Based
Can demonstrate knowledge of terms, rules, principles, concepts, and procedures. ***- terms, facts***	Can apply terms, rules, principles, concepts, and procedures under controlled conditions, such as in simulation. ***- controlled environment***
Skill-Based	**Proficiency-Based**
Can apply terms, rules, principles, concepts, and procedures in the abstract, such as a scenario questions or case study. ***- application, comprehension, analysis***	Can apply terms, rules, principles, concepts, and procedures consistently under real work conditions. ***- uncontrolled environment***

Dreyfus Model of Skills Acquisition

	Novice	Advanced Beginner	Competent	Proficient	Expert
Recollection	Non-Situational	**Situational**	**Situational**	**Situational**	**Situational**
Recognition	Decomposed	Decomposed	**Holistic**	**Holistic**	**Holistic**
Decision	Analytical	Analytical	Analytical	**Intuitive**	**Intuitive**
Awareness	Monitoring	Monitoring	Monitoring	Monitoring	**Absorbed**
	Needs close supervision or instruction	Able to do some simpler tasks without supervision	Able to do most tasks using own judgment	Takes responsibility for work, coaches others	Takes responsibility beyond existing standards, creates own interpretations

Model measures skill, not the person.

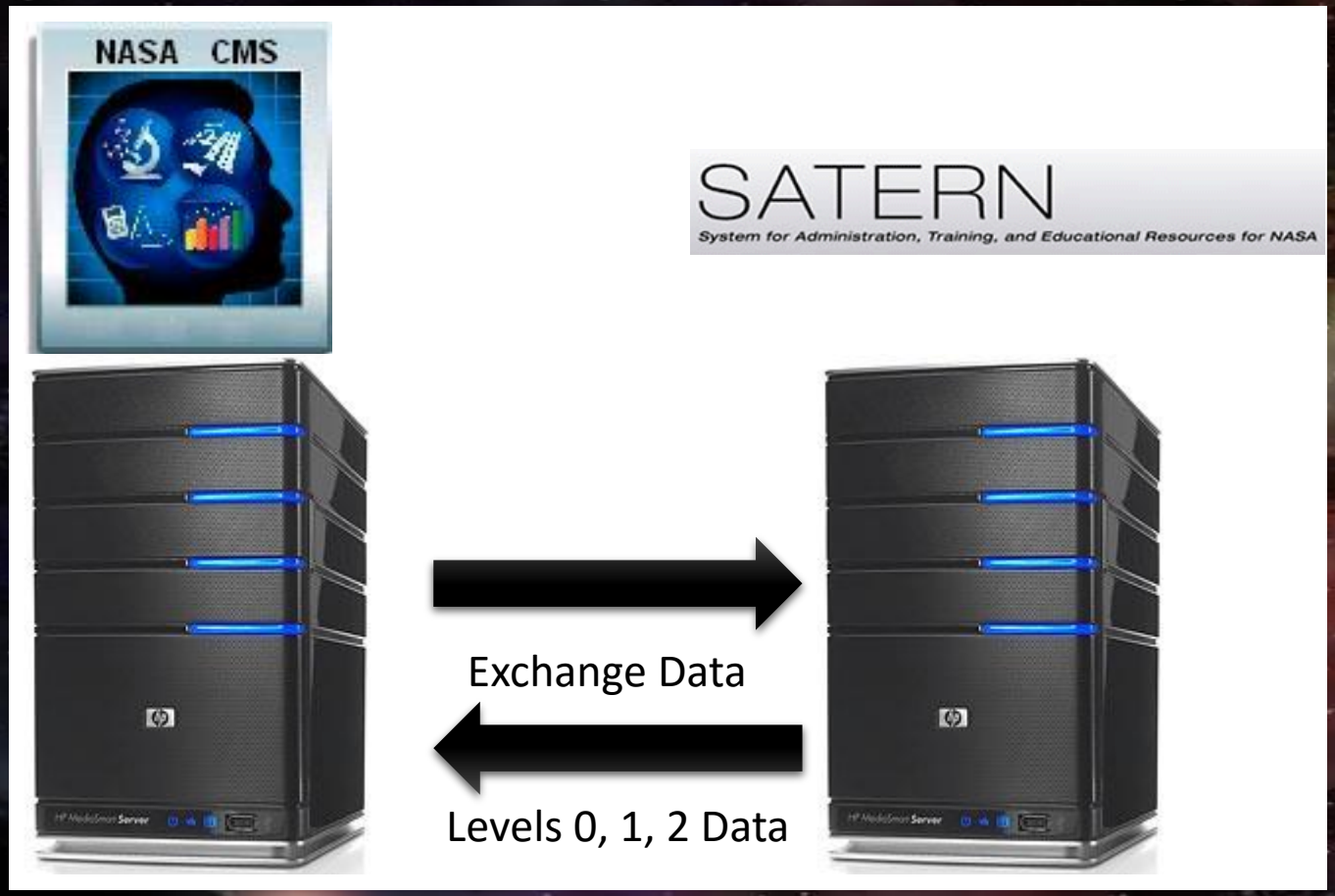
Phillips Value Alignment Model



NASA CMS and LMS Integration

Workforce Competency Domains
110

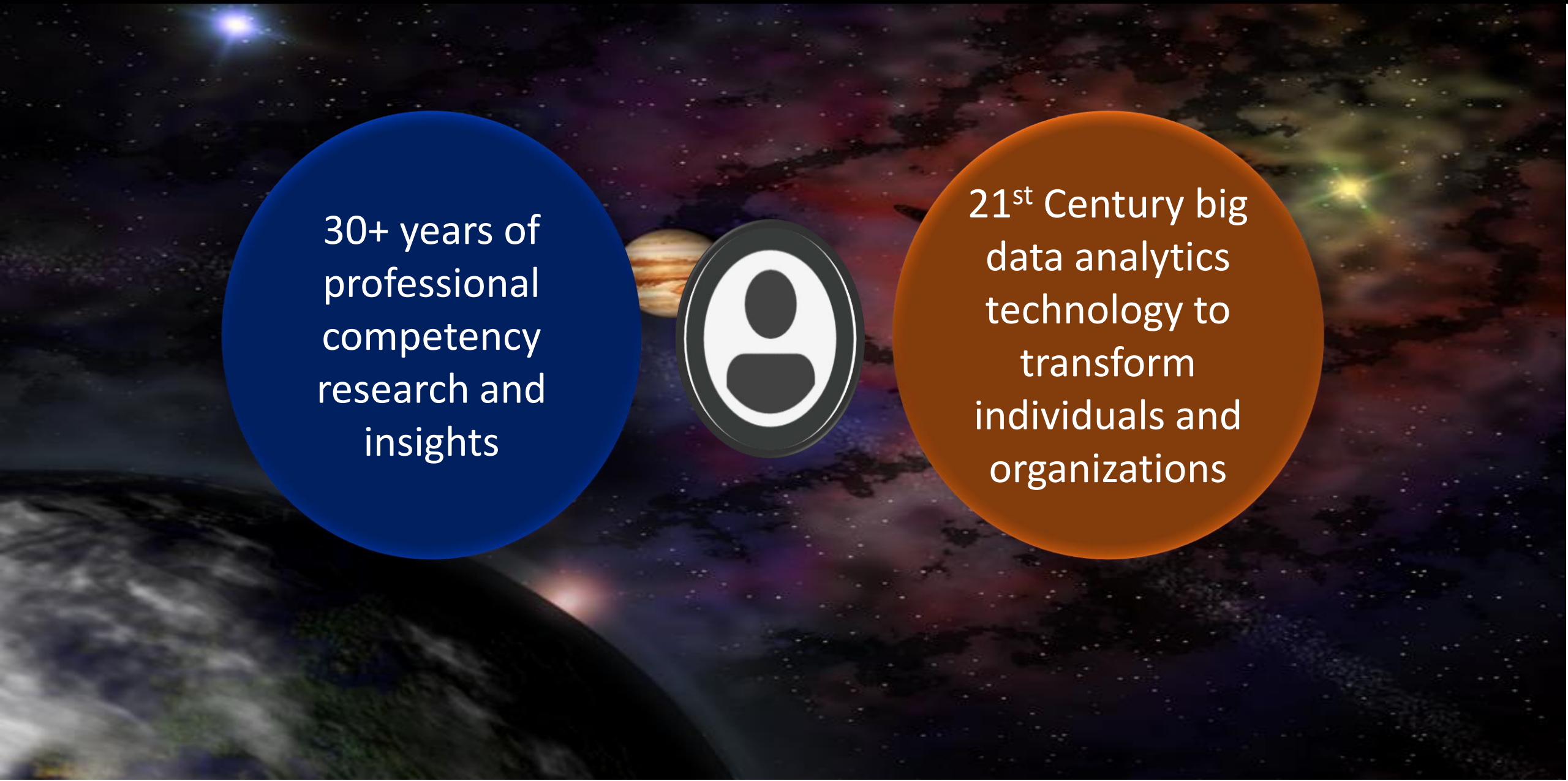
Employees
~17,000



Aligns
Courses &
Conferences

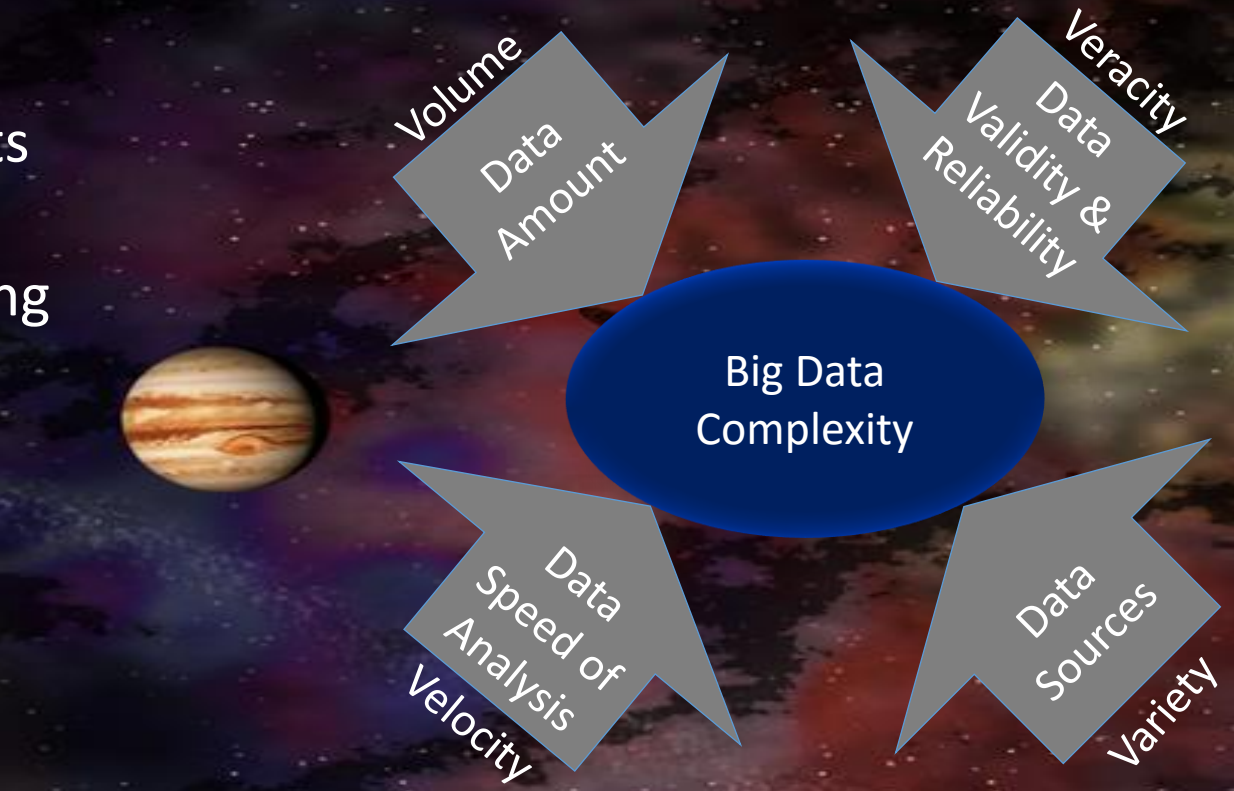
Tracks
Courses &
Conferences

Learning Analytics to Competence Analytics



What is big data?

Big data is a term for data sets that are so large or complex that traditional data processing applications are inadequate. (Wikipedia)



Accuracy in big data may lead to **more confident decision making**, and better decisions can result **in greater operational efficiency, cost reduction and reduced risk**. (Wikipedia)

What is analytics?

"…the discovery and communication of meaningful patterns in data" that "often favors data visualization to communicate insight."

Wikepedia

In term of human capital, "analytics on human capital investments is a way to improve those returns, on both the individual and the organizational level."

Pease, Byerly, & Fitz-enz (2013). *Human Capital Analytics: How to Harness the Potential of Your Organization's Greatest Asset*

360^0 Assessment Types

- Personality
- Style
- Values
- Technical Knowledge
- Strengths
- **Behaviors**

Action Oriented

Patterns

Observable

Measurable

Consequential

Accomplishments

Competency Development Big Data Analytics New Capabilities

Evaluate Professional Role Competencies

- All levels of the organization
- Not personality, style, values, knowledge, strengths
- Behaviors that are observable and measurable

Analyze data to generate new insights

- Real-time 360^0 behavioral data
- Action-oriented, patterns
- Robust, scalable dashboards & analysis reports

Create professional develop plans

- Based on on-going quantified needs
- Accountable “moving the needle” metrics
- All levels of the organization

Competency Development Big Data Analytics New Capabilities

Ongoing and targeted role competency focus

Evaluate four key professional behavioral competencies

- *May also add to or replace with own competency model*

Real-Time, Comprehensive 360⁰ Perspective

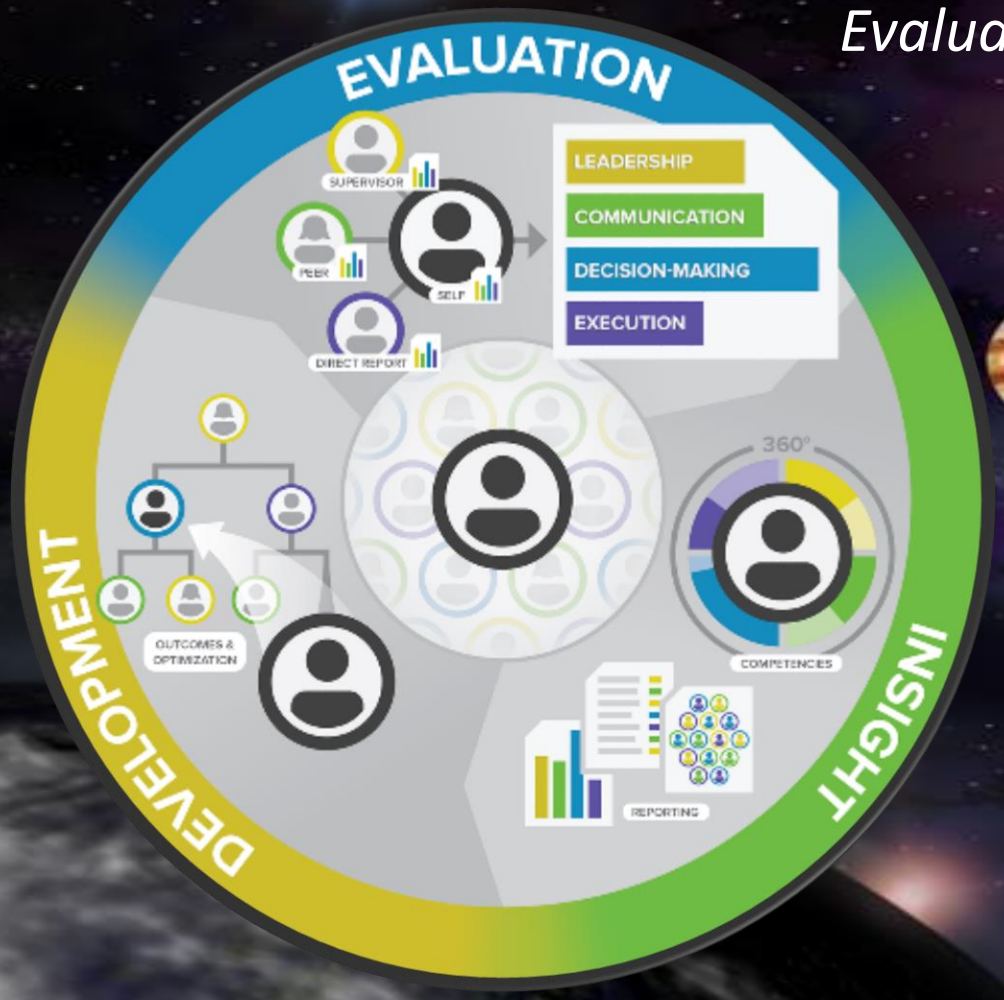
Robust Professional Competency Analysis Reporting

- *Enterprise*
- *Team*
- *Individual*
- *All levels in between*

Customize/Target Needs-Driven Professional Development

Accountable for Performance Outcomes and Results

Competency Development Big Data Analytics



Evaluate four key professional behavioral competencies.

Assess using a revised Dreyfus Skills Development Scale

Novice
- Minimal knowledge and use of behavior.

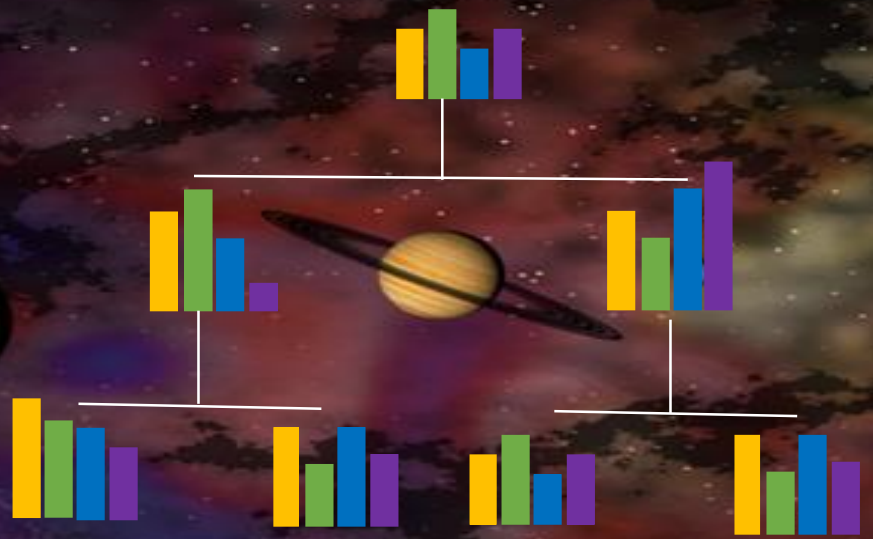
Advanced Beginner
- Some knowledge and use of behavior.

Competent
- Acceptable knowledge and use of behavior.

Proficient
- Above average knowledge and use of behavior.

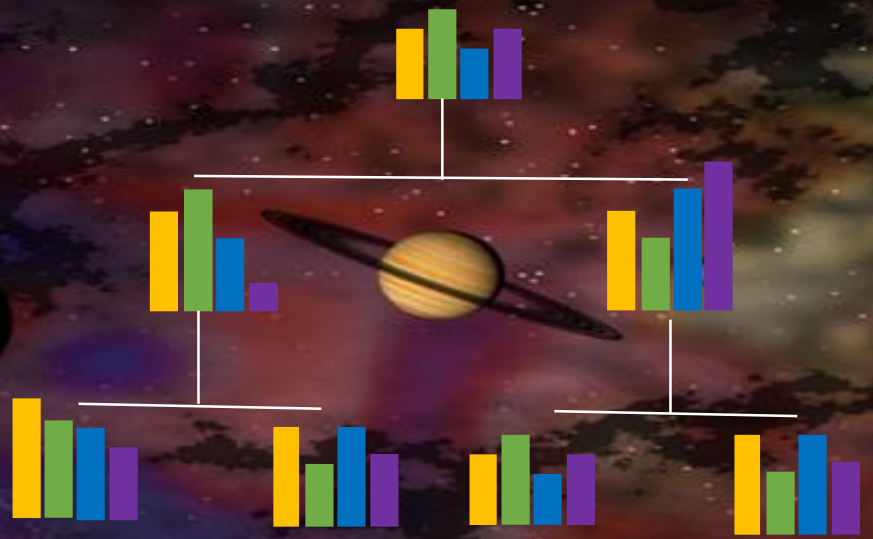
Expert
- Comprehensive knowledge and use of behavior.

Competency Development Big Data Analytics



Measure not just workplace skills, but also behavioral attributes.

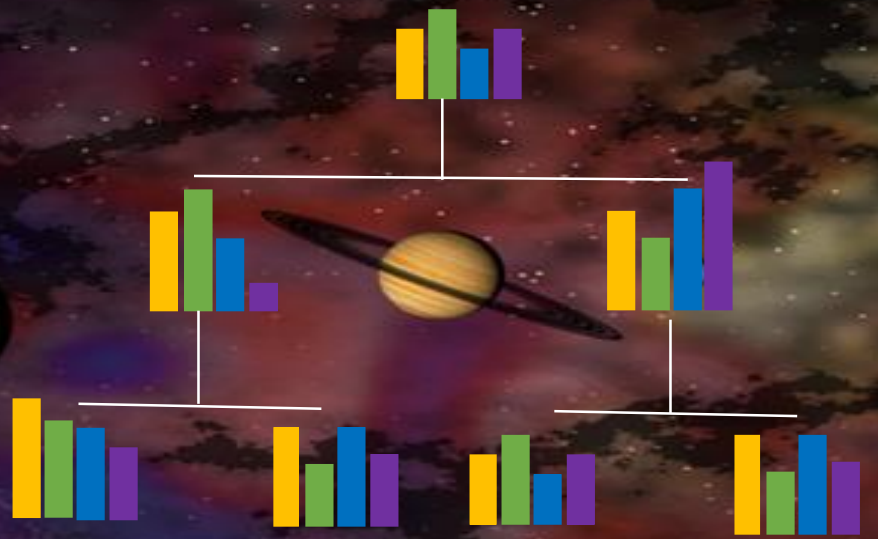
Competency Development Big Data Analytics



Diagnose Gaps in Professional Competencies

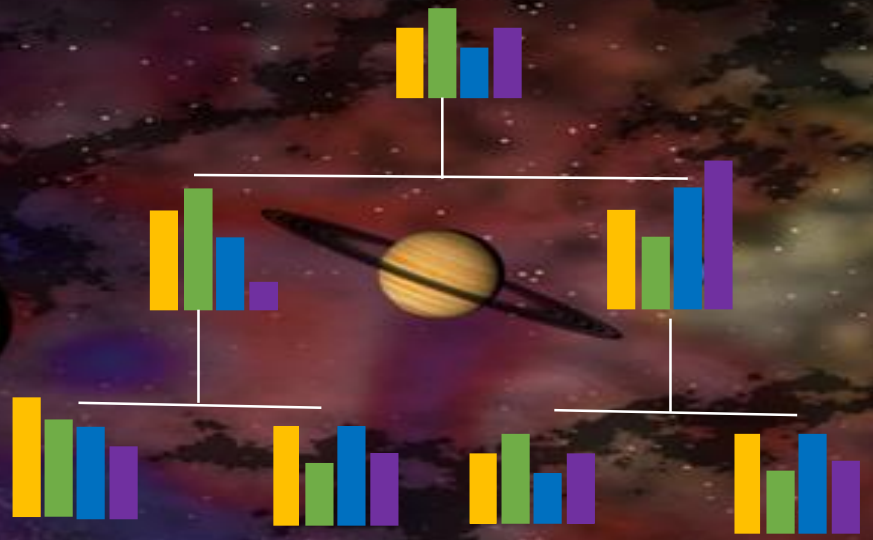
Discover talent strengths and vulnerabilities

Competency Development Big Data Analytics



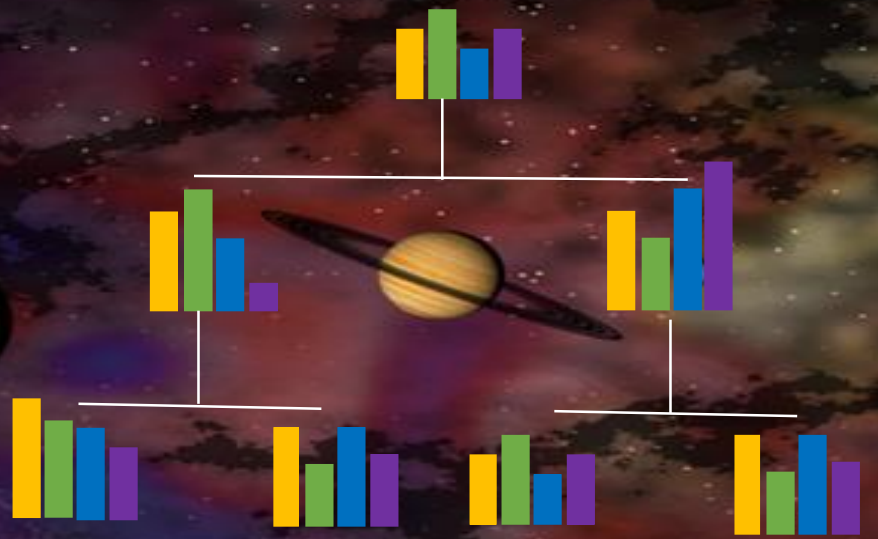
Realize insights for ongoing professional role development to practice at top of license/profession

Competency Development Big Data Analytics



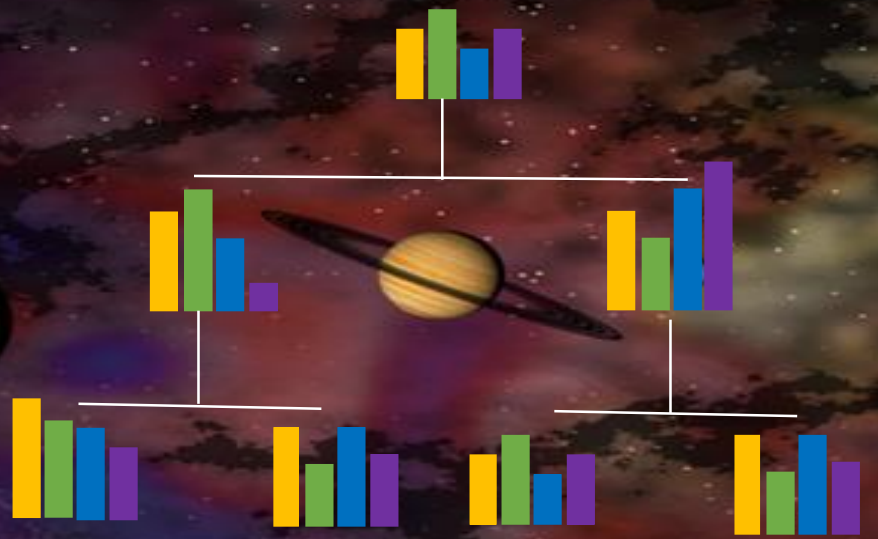
Tailor professional role development to meet real needs that matter

Competency Development Big Data Analytics



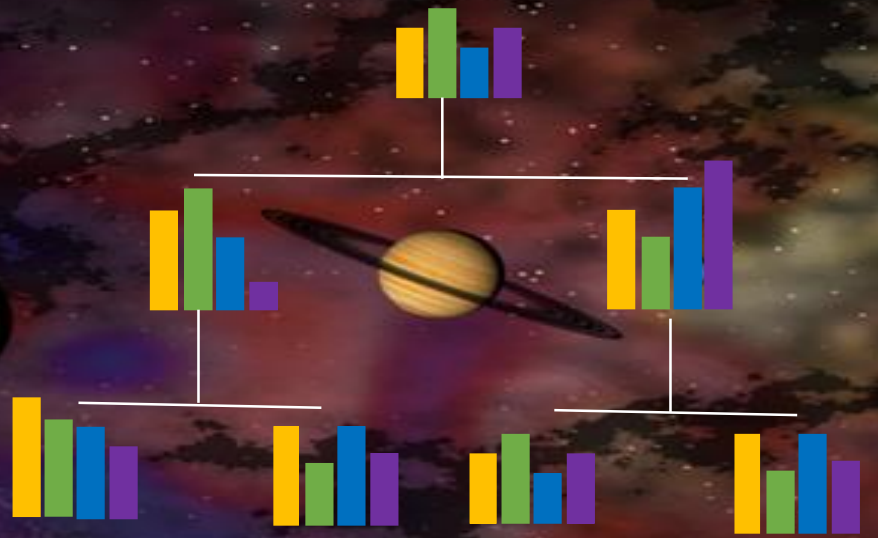
Optimize teams for maximum impact and workforce ROI

Competency Development Big Data Analytics



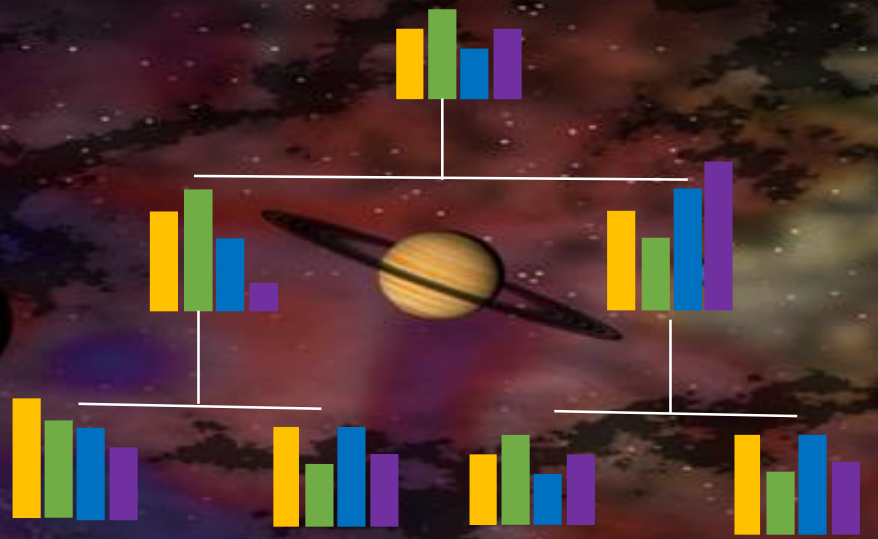
Avoid costly resourcing (training, mentor/coach, promotion, assignment, etc.) mistakes

Competency Development Big Data Analytics



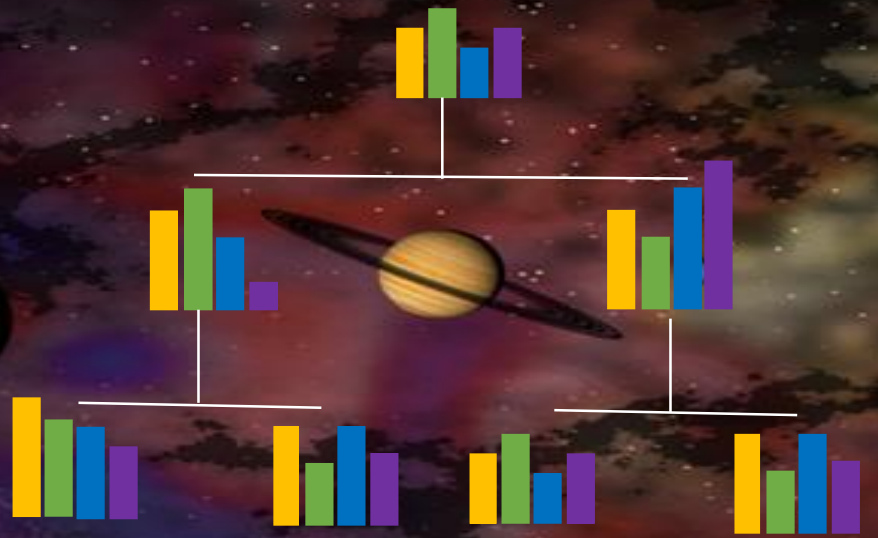
Improve consistency of competence and reduce variation in practice.

Competency Development Big Data Analytics



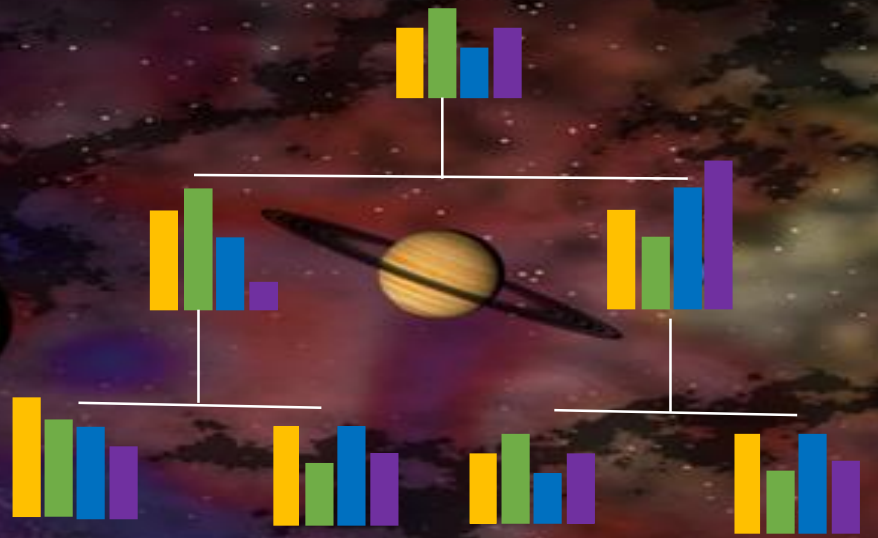
Increase productivity, satisfaction, and reduce errors.

Competency Development Big Data Analytics



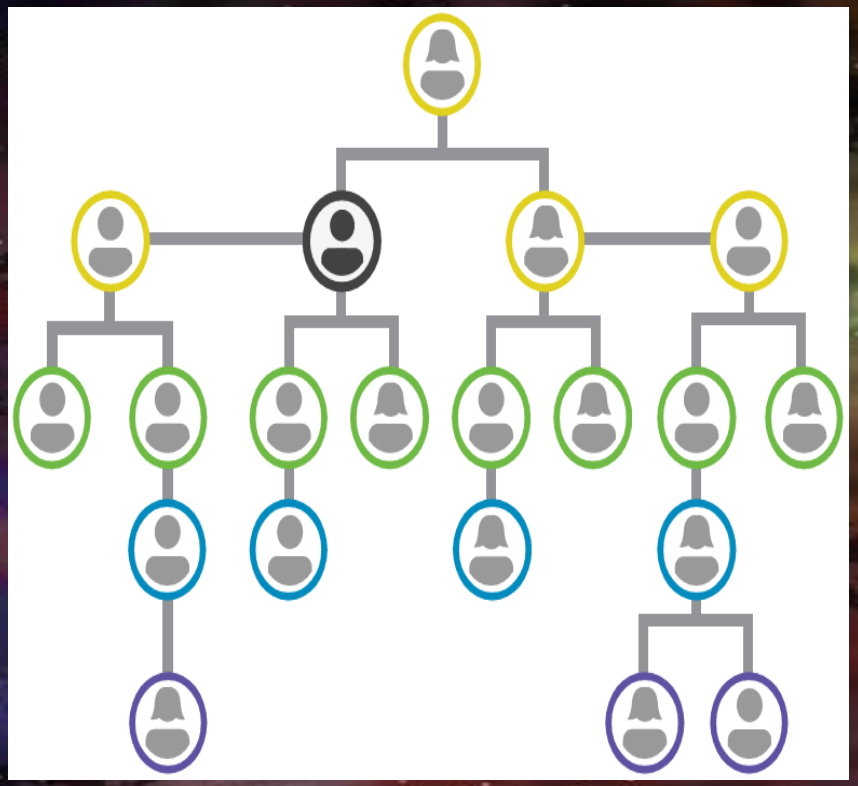
Identify undiscovered leaders and effectively promote from within

Competency Development Big Data Analytics



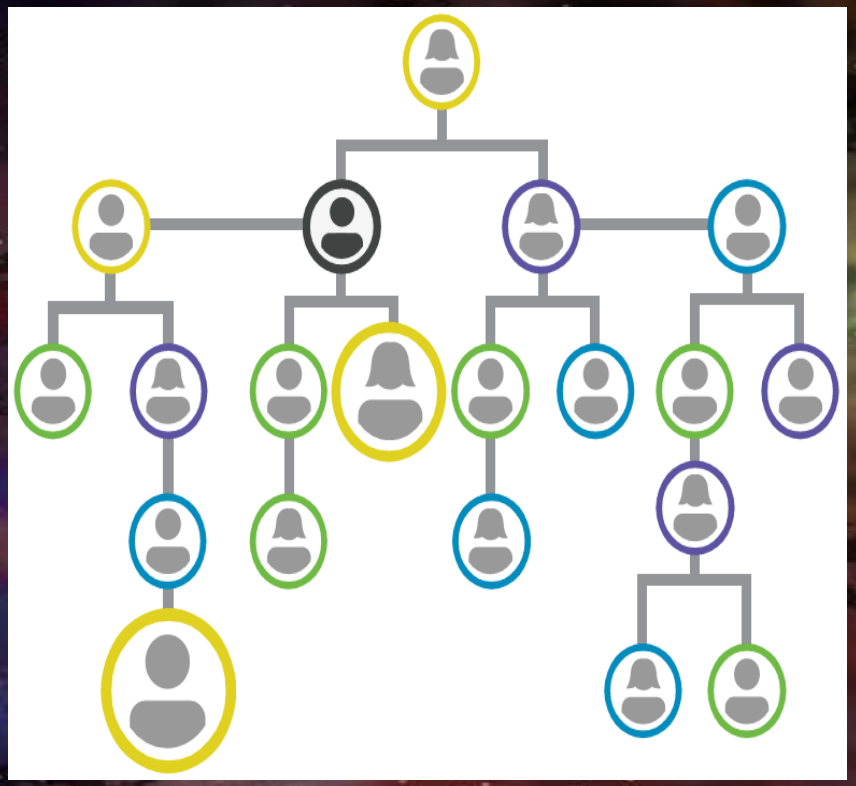
Reduce costly turnover and also increase retention and employee engagement

Competency Development Big Data Analytics



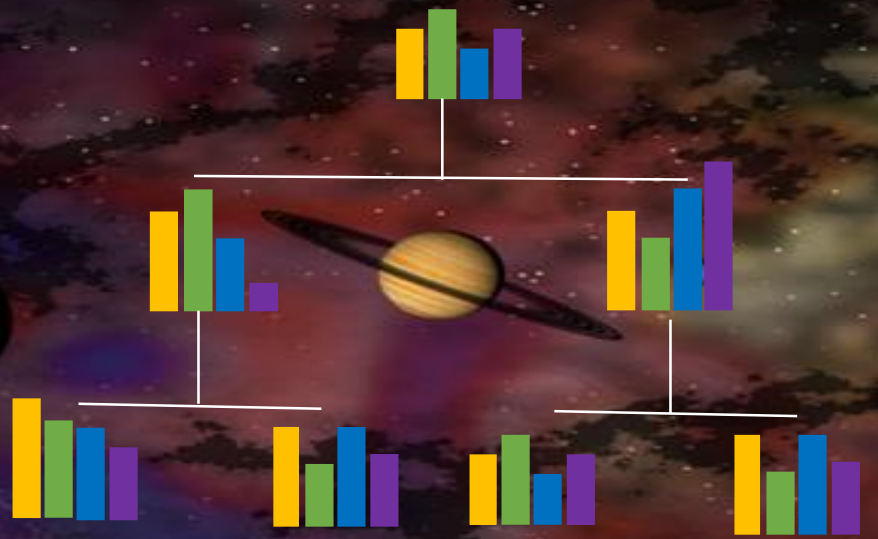
Optimize your organization's structure and performance.

Competency Development Big Data Analytics



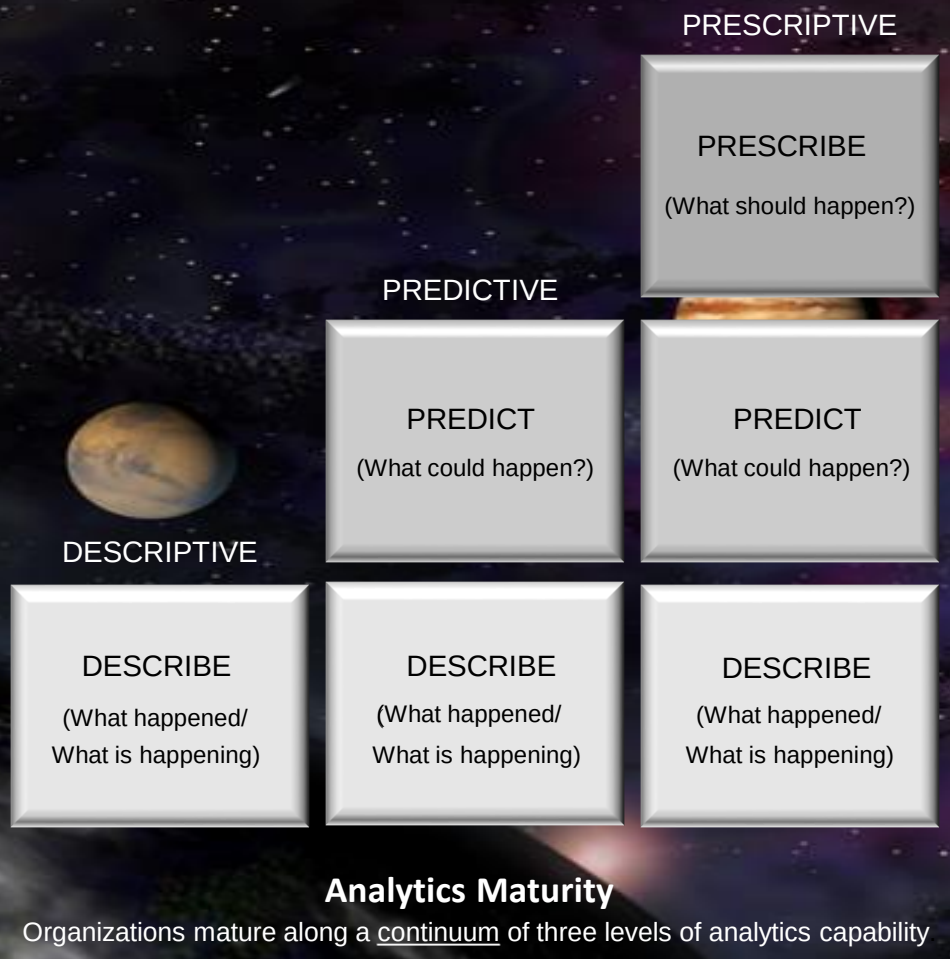
Optimize your organization's structure and performance.

Competency Development Big Data Analytics



Develop descriptive, predictive, & prescriptive analytics for professional development programs.

Competency Development Big Data Analytics



- Helps answer, what is the best course of action?
- Decision-makers use data to predict multiple scenario consequences of actions or non-actions
- Requires a predictive model along with actionable data and a feedback system that tracks the outcome produced by the action taken

- Next step in data reduction
- Forecasts what might happen in the future
- Gives decision-makers insights on what they can do
- Take data to predict what data you do not have
- Helps optimize and prescribe future investments

- Simplest
- 80% of business analytics
- Breaks big data down for human consumption
- Summarizes what happened
- Focus is on past and today

Analytics Maturity

Organizations mature along a continuum of three levels of analytics capability

Source: Fitz-enz, J., Phillips, P., and Ray, R. (2014). *Human Capital Analytics @ Work, Volume 1. The Conference Board, Research Report R-1556-14-R.*

Two Visions

"We choose to go to the Moon in this decade and do the other things, not because they are easy, but because they are hard."
-John F Kennedy

New Space Exploration Vision

"This cause of exploration and discovery is not an option we choose; It is a desire written in the human heart." – President Bush

THE 44TH SPACE CONGRESS®

"THE JOURNEY: FURTHER EXPLORATION FOR UNIVERSAL OPPORTUNITIES"

MAY 24-26 | CAPE CANAVERAL, FLORIDA

44TH SPACE CONGRESS

MAY 2016 COCOA BEACH, FL

The New Frontier: Preparing and Sustaining Astronauts for Long-Duration, Deep Space Missions

Timothy R. Brock, PhD, CPT, CRP, ID(S&L+)

Founder & CEO

The Institute 4 Worthy Performance

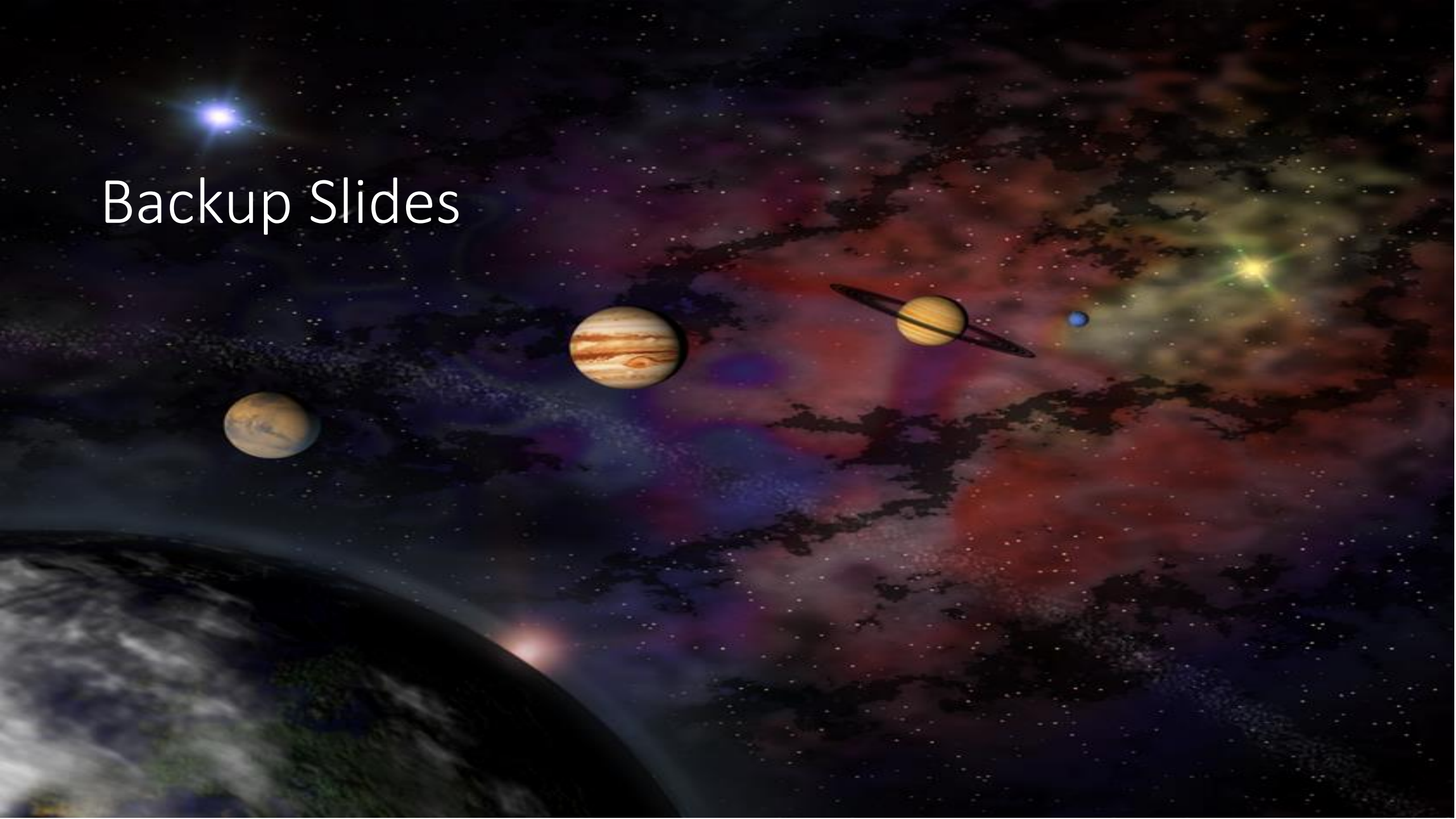
Winter Park, FL

Tim@ti4wp.com

The Institute 4 Worthy Performance

Semper et cogitemus et nos excolamus!

Backup Slides



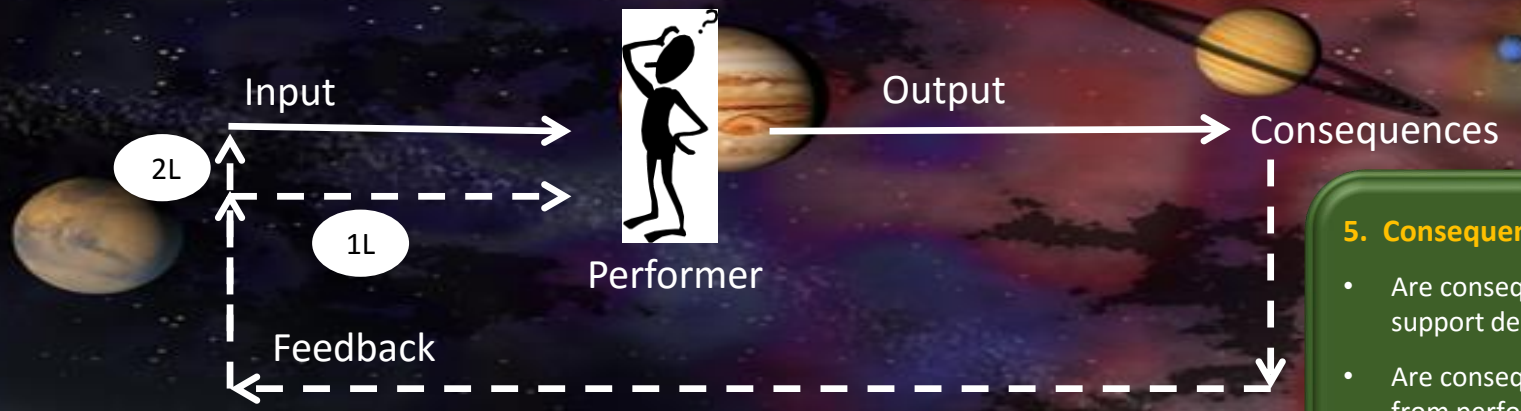
Double-Loop Human Performance System

2. Task Performance Support (Input)

- Can the performer easily recognize the input requiring actions?
- Can the task be done without interference from other tasks?
- Are the job aids and work flow logical?
- Are adequate resources available for performance (time, tools, staff, information)?

1. Performance Specifications (Output)

- Do performance standards exist?
- Do the performers know the desired output and performance standards?
- Is performance measured?
- Are measurements based on task performance?
- Do performers consider the standards attainable?



5. Consequences

- Are consequences aligned to support desired performance?
- Are consequences meaningful from performer's viewpoint?
- Are consequences timely?

6. Feedback

- Single Loop - Do performers receive information about their performance?
- Double-Loop – Do the leaders receive information about performance?
- (Both) Is the information they receive:
  - ✓ relevant? ✓ accurate?
  - ✓ timely? ✓ specific?
  - ✓ easy to understand?

3. Skills/Knowledge/Attitudes

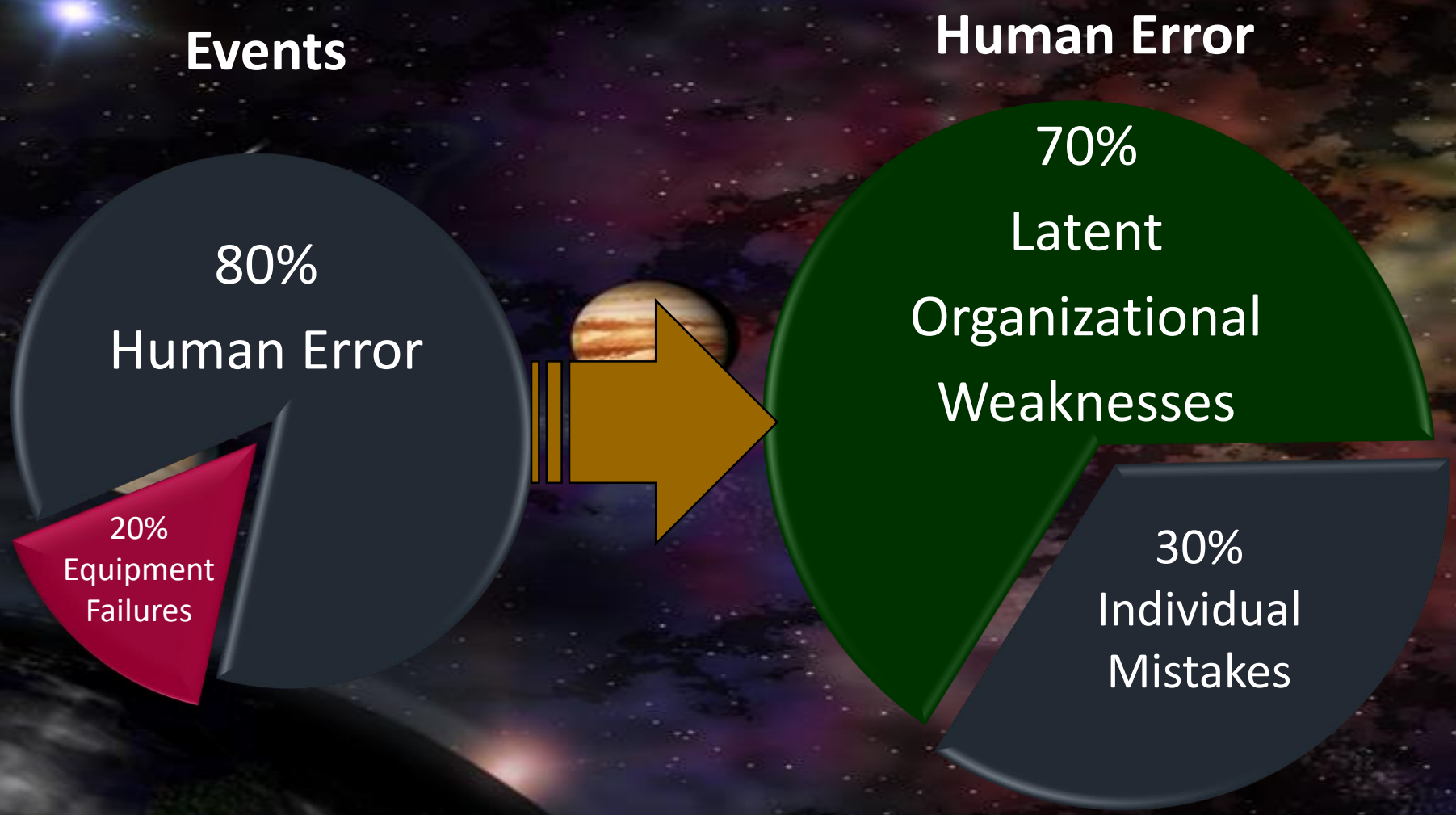
- Do the performers have the necessary skills and knowledge to perform?
  - Did task before?
  - Previous training?
- Do the performers know why desired performance is important?

4. Individual Capacity

- Are the performers physically, mentally, and emotionally able to perform?

Source: Adapted from Rummler and Brache, *Improving Performance: How to Manage the White Space on the Organization Chart*, Jossey-Bass, 1995

Drive to Address Root Causes



Sources: Perrow (1984) Normal Accidents: Living with High Risk Technologies and Reason (1999) Human Error.

Prescriptive (*What should we do?*)
- Analytics software platforms use the data from the previous three levels.
- Explore various possibilities and recommend actions to decision-makers.
- Provides strategic/tactical insights to optimize investment decisions to improve consequential workforce behaviors.

Predictive (*What could happened?*)
- Analytics software platforms take the historical and current data points to find new correlations.
- Correlations are used to predict probabilities of the future and potential impact if those probabilities occur.
- Takes systemic perspective on organizational complexities.

Diagnostic (*Why did it happen?*)
- Performance Analysis to diagnose root cause(s) that are driving the consequential human behavior data.
- Focus on systemic relationships between the data to gain insights to diagnose performance barrier root cause(s).
- Root cause insights are critical to develop the most appropriate targeted human capital improvement solution(s).

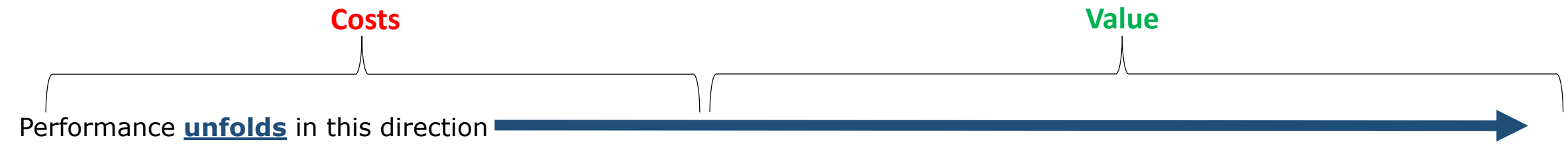
Descriptive (*What happened?*)
- Represents traditional efficiency HR metrics where the emphasis is on process improvement and cost reduction.
- A foundational level focused on relationships and patterns of data, both past and present.
- Includes dashboards, scorecards, and basic data mining reports.

Taxonomy of Performance

Changing the System	
Invent	Produce a new method, process, device, or system from study or experimentation.
Improve	Advance an existing method, process, device, or system to a better state or quality.
Maintaining the System	
Troubleshoot	Locate and eliminate sources of trouble in an existing method, process, device, or system.
Operate	Run or control the functioning of a method, process, device, or system.
Understand	Comprehend the language, sounds, form, or symbols of an existing method, process, device, or system.

Source: Swanson, R.A. (2007). *Analysis for improving performance: Tools for diagnosing organizations and documenting workplace expertise* (Second ed.). San Francisco: Barrett-Koehler.

Human Performance Results Chain



Select People…	provide required Resources…	…so that they can perform Tasks on the job…	..to produce Accomplishments that….	…produce organization Impact Results or Outputs that also	…add measurable Societal Value to all Stakeholders
Worker Individual Repertory of Behavior	**Workplace** Environmental Support	**Work Behaviors** Worker + Workplace - Behavior Indicators	**Work Outputs** Accomplishment Gaps – Leading Indicators	**Work Goals** Impact Gaps – Lagging Indicators	**Mission** Value Gaps – Lagging Indicators
Competence	Standards	Performance			
Capabilities	Conditions	Compliance			
Commitment	Incentives	Accountability			

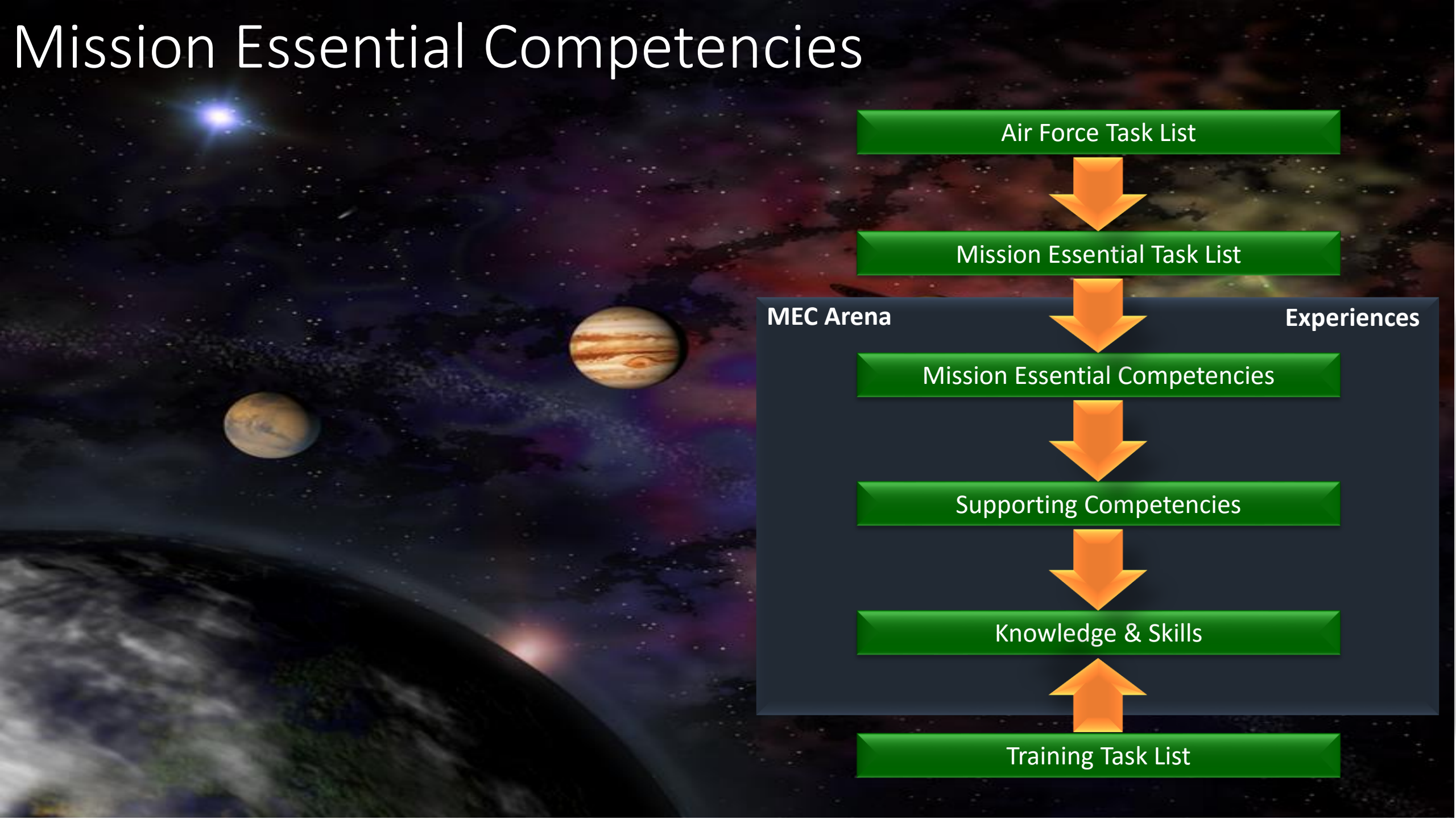
Diagnose and **Align** performance in this direction

Remedy and **Sustain** performance in this direction

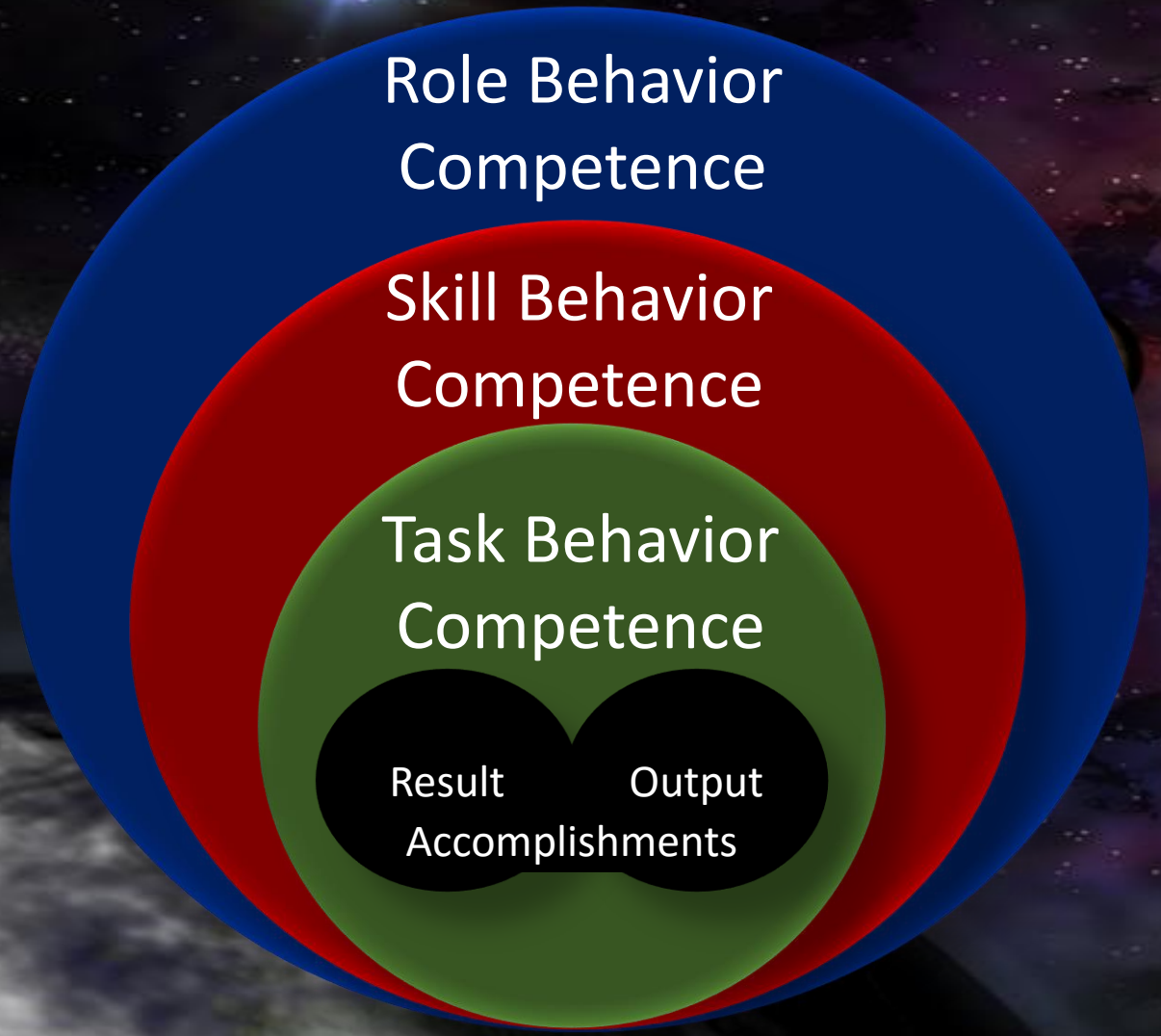
Costs inflicted here
Intervene here

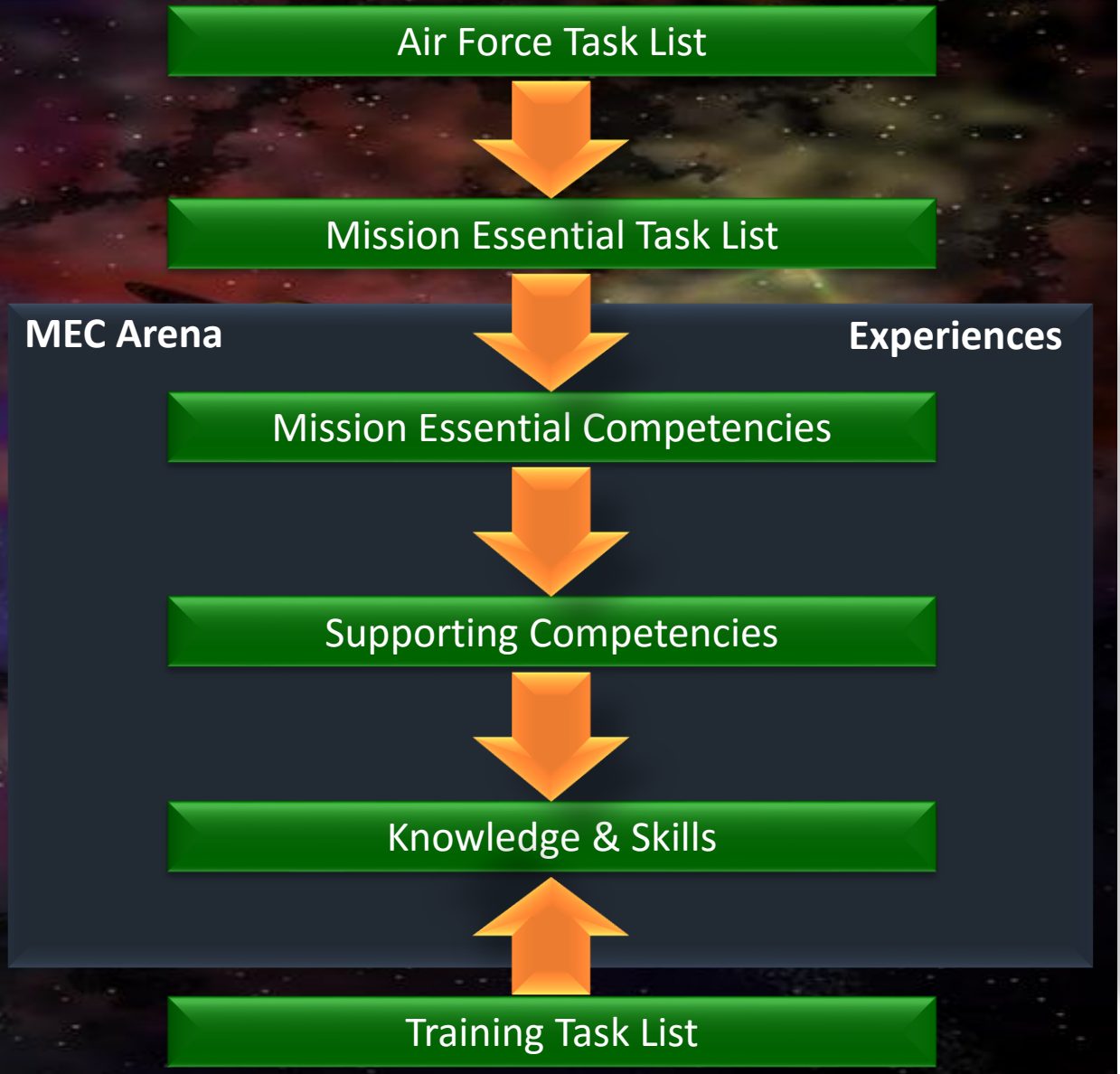
Value produced here
Measure here

Mission Essential Competencies



Mission Essential Competencies





What is Human Performance Technology?

International Standards for Performance Improvement
4 Principles

R	*Focus on Valued, Measurable **Results** or Outcomes* - Behavioral Accomplishments – Human Performance System Measures - Impact – Business Impact Measures (Output, Quality, Cost, Time, Intangibles) - Return on Investment – Monetary Benefits of Impact vs Program Costs
S	*Take **Systemic** View (Systems Perspective)* - Alignment – Worker, Work, Workplace, World (Society)
V	*Add **Value** By Producing Results That Make a Difference* - Business Case – Needs-Driven, Feasible, Worthwhile, and Sustainable - Evaluation – Evidence-Based, Reliable, and Worthy Results or Outcomes
P	*Work in **Partnership** to Produce Intended Results* - Trust and Respect - Candor, Intelligence, and Goodwill (Socratic conditions for conversation)
+	*Remain Solution **Neutral** as an Honest Broker* - Solve root causes to performance gaps, not sell predefined solutions or products

International Standards for Performance Improvement
6 Practices

Be systematic in all aspects of the process including:

- Determine a need or opportunity.
- Determine causes and requirements.
- Design solutions that are measurable and sustainable.
- Ensure solutions' conformity and feasibility.
- Implement solutions by developing strategies to sustain change.
- Evaluate results and impact.