Human Systems Integration: What's in it for me?

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INCOSE San Diego

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Today's Discussion

- Human Systems Integration
- HSI in the System Development Life Cycle
- INCOSE HSI Working Group
- Open Forum / Q&A

Human Systems Integration: Definitions

- INCOSE
- HSI is a transdisciplinary sociotechnical and management approach of systems engineering (SE) used to ensure that system's technical, organizational, and human elements are appropriately addressed across the whole system lifecycle, service, or enterprise system.
- HSI considers systems in their operational context together with the necessary interactions between and among their human and technological elements to make them work in harmony and cost effectively, from the early design to disposal.

- Department of Defense (DoD)
- HSI is a comprehensive, interdisciplinary management and technical approach applied to system development and integration as part of the wider systems engineering process to ensure that human performance is optimized to increase Total System Performance and minimize total system ownership costs.
- The definition of HSI is the systems engineering process and program management effort that provides integrated and comprehensive analysis, design, and assessment of requirements, concepts, and resources for the seven HSI domains (DoDI 5000.95).

Figure 1. HSI emerges from the overlapping of three main circles: (1) technology, organization, and people within an environment at the heart; (2) examples of HSI perspectives; and (3) contributing disciplines and operational domain.

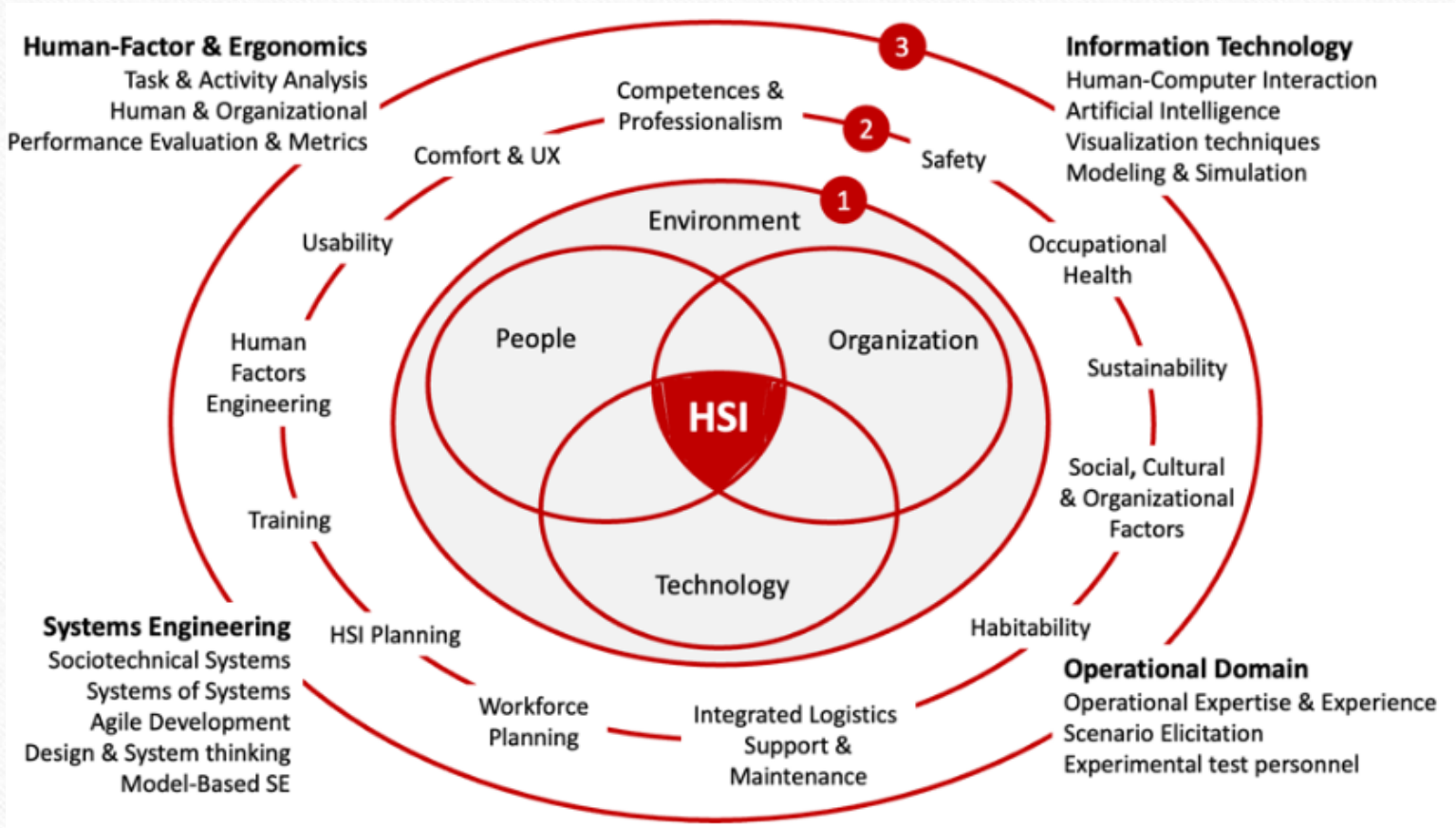

Figure 2. HSI emerges from the overlapping of three main **circles**: *(1) technology, organization, and people within an environment at the heart; (2) examples of HSI perspectives; and (3) contributing disciplines associated with the Operational Domain at stake in the periphery.*

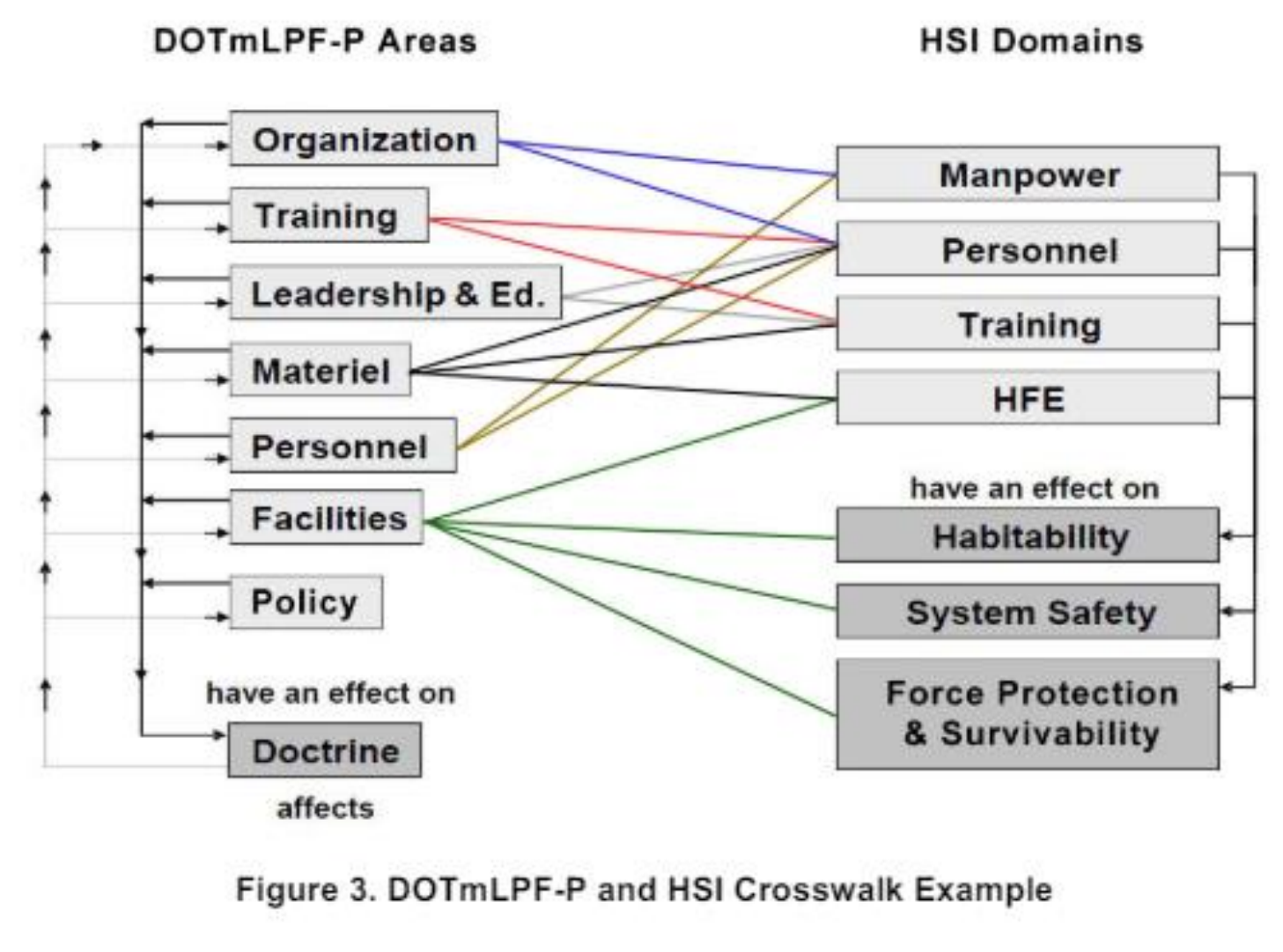

Figure 3. DOTmLPF-P and HSI Crosswalk Example

DoD HSI Guidebook

Activity: What is an HSI problem statement that you're currently working on?

- **Human.** What are the users or stakeholders in your System of Interest (SoI)?
  - Includes system owners, operators, maintainers, trainers, customers, support personnel and the public.
  - Can be cooperative / vested interested or those with maligned intent..
- **Systems.** Define the System of Interest.
  - Consider a sociotechnical system perspective that includes natural and artificial elements, and organizations of humans and machines, where machines includes both hardware and software.
  - Include both humans and machines, operating within an environmental, organizational, and cultural context, and that to optimize the system all these elements must be considered within SE activities.
- **Integration.** What are the integration challenges?
  - Effective integration of the human and technological components in a system
  - Efficient integration of the different perspectives of the human element within the system.

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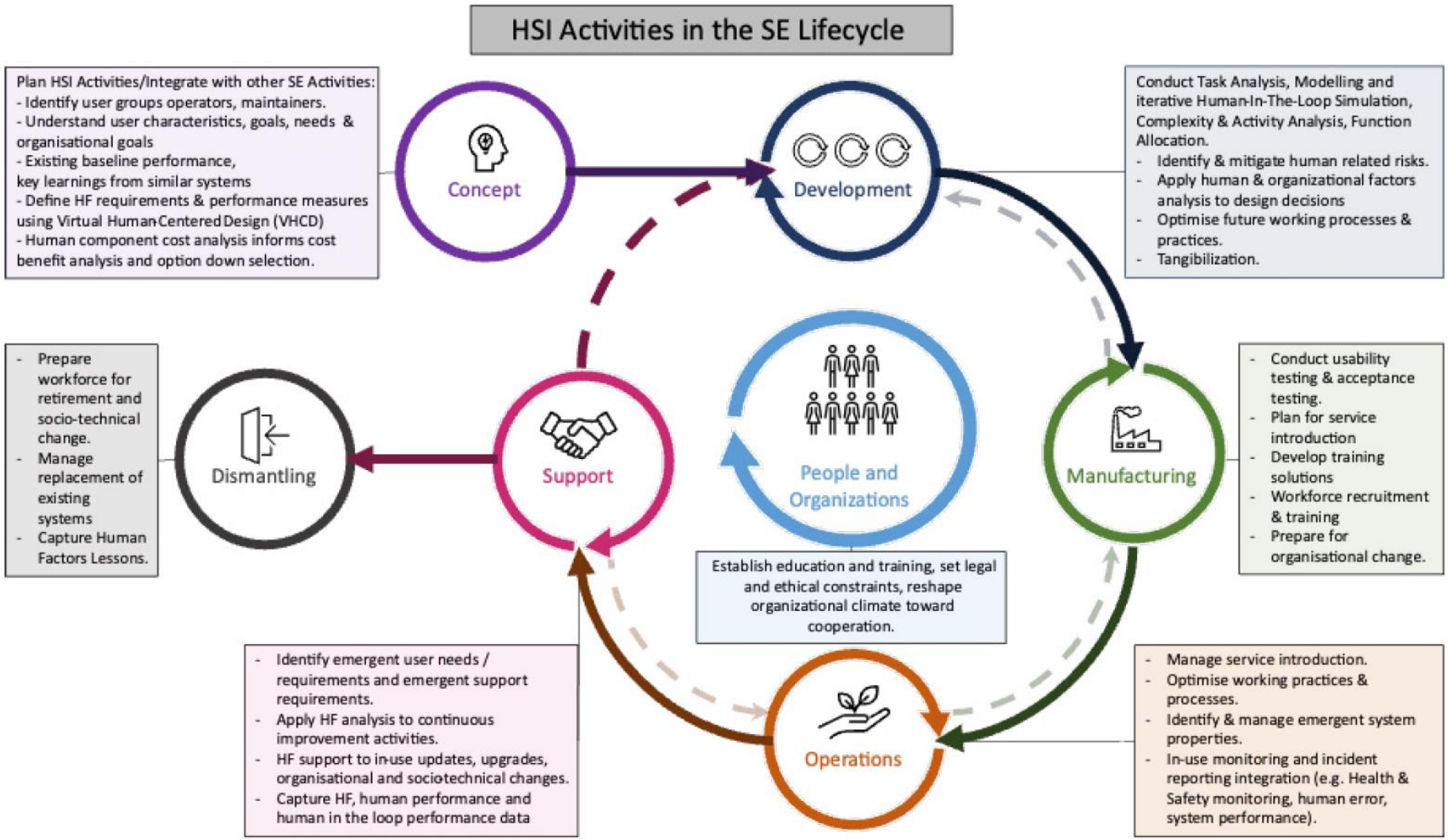
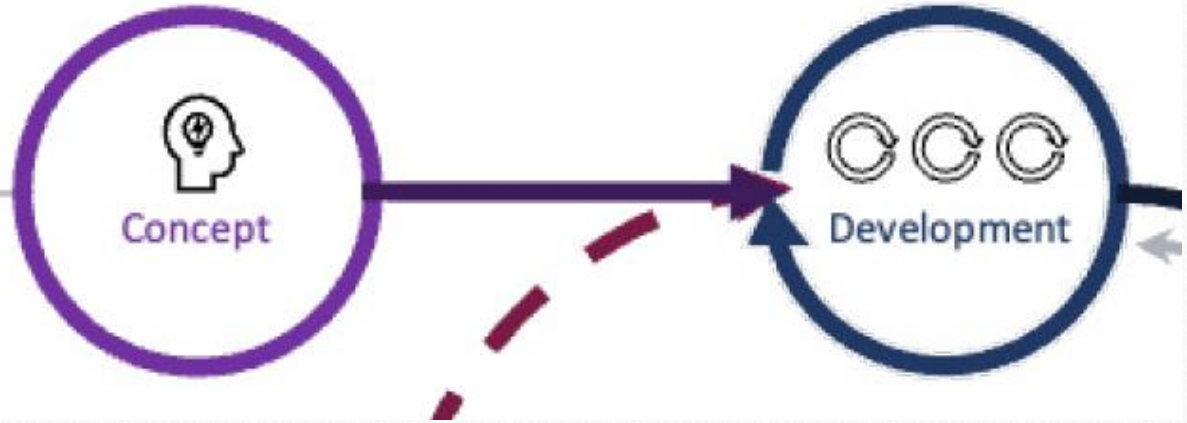
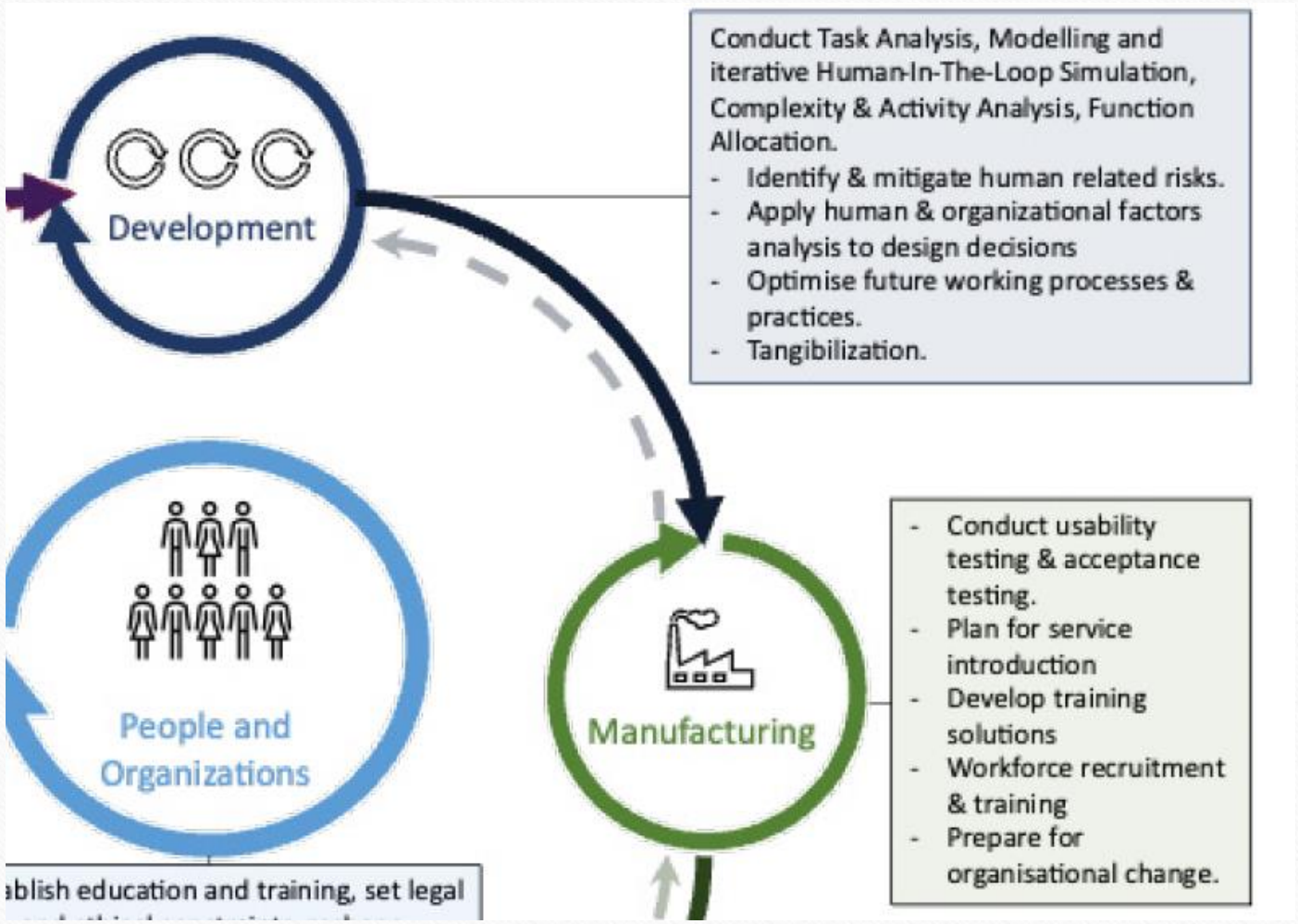
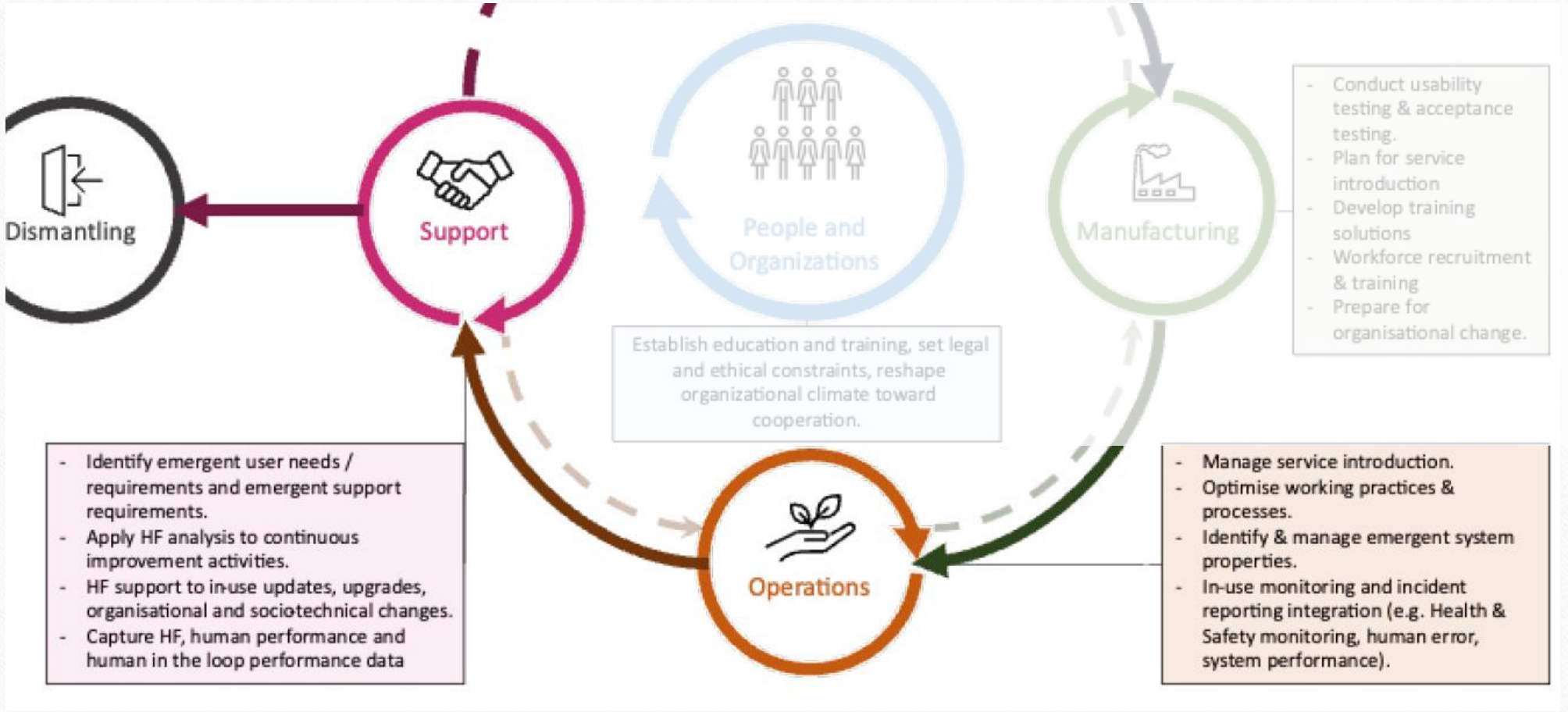
HSI Activities in the SE Lifecycle

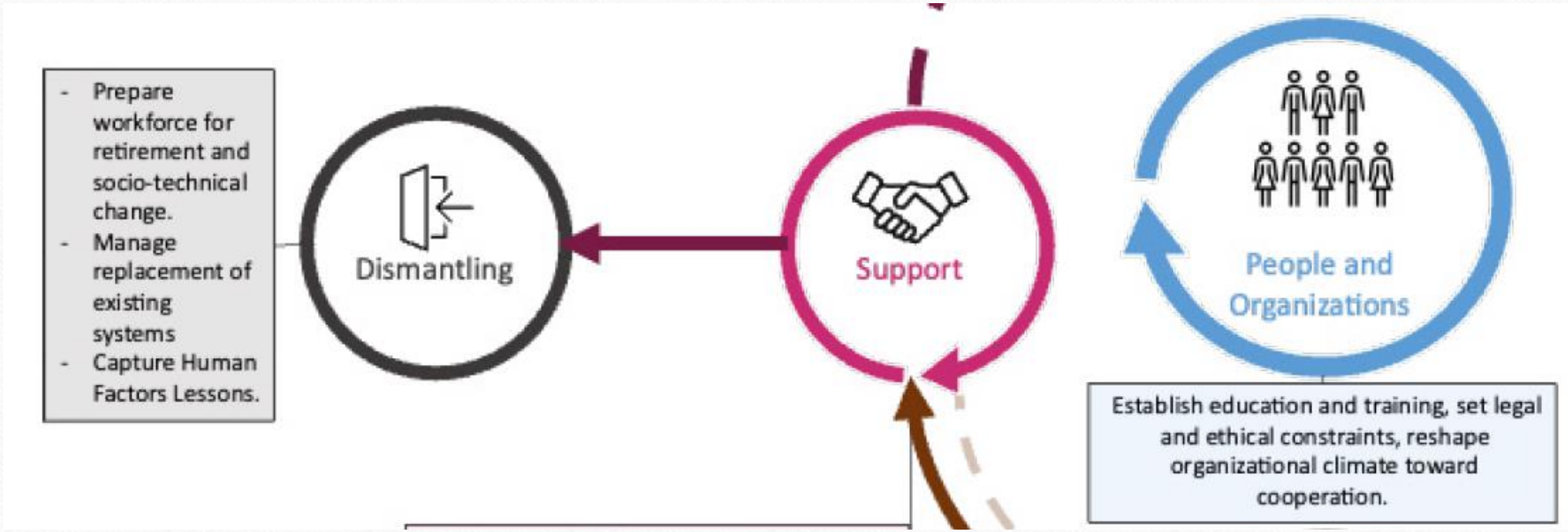


Plan HSI Activities/Integrate with other SE Activities:
- Identify user groups operators, maintainers.
- Understand user characteristics, goals, needs & organisational goals
- Existing baseline performance, key learnings from similar systems
- Define HF requirements & performance measures using Virtual Human-Centered Design (VHCD)
- Human component cost analysis informs cost benefit analysis and option down selection.




Development
People and Organizations
Manufacturing
Conduct Task Analysis, Modelling and iterative Human-In-The-Loop Simulation, Complexity & Activity Analysis, Function Allocation.
- Identify & mitigate human related risks.
- Apply human & organizational factors analysis to design decisions
- Optimise future working processes & practices.
- Tangibilization.
- Conduct usability testing & acceptance testing.
- Plan for service introduction
- Develop training solutions
- Workforce recruitment & training
- Prepare for organisational change.
ablish education and training, set legal


Dismantling
Support
People and Organizations
Manufacturing
Operations
- Conduct usability testing & acceptance testing.
- Plan for service introduction
- Develop training solutions
- Workforce recruitment & training
- Prepare for organisational change.
Establish education and training, set legal and ethical constraints, reshape organizational climate toward cooperation.
- Identify emergent user needs / requirements and emergent support requirements.
- Apply HF analysis to continuous improvement activities.
- HF support to in-use updates, upgrades, organisational and sociotechnical changes.
- Capture HF, human performance and human in the loop performance data
- Manage service introduction.
- Optimise working practices & processes.
- Identify & manage emergent system properties.
- In-use monitoring and incident reporting integration (e.g. Health & Safety monitoring, human error, system performance).


- Prepare workforce for retirement and socio-technical change.
- Manage replacement of existing systems
- Capture Human Factors Lessons.
Dismantling
Support
People and Organizations
Establish education and training, set legal and ethical constraints, reshape organizational climate toward cooperation.

Activity: Identify HSI tradeoffs and ROI

- What are the barriers to effective HSI in the part of the System Development Lifecycle in your SOI?
- Often times they are tradeoffs that System stakeholders needs to make to ensure the balance between Cost, Schedule, and Performance.
- What are some best ways of communicating ROI for Systems Engineering (and other supporting disciplines like HSI and Cybersecurity)?

INCOSE HSI Working Group

- Chairs: Dr. Guy Boy, Grace Kennedy
- Domains) and develop a common framework.
- Quarterly meetings
- Vision
  - Facilitate embedding Human Systems Integration within Systems Engineering, promoting the benefit of placing the proper focus on the role of people in the development, efficient delivery and operations of effective systems.

- Goals
  - The HSI WG aims to demonstrate the value of HSI as an integral part of the Systems Engineering effort and to develop associated practices, resources, organizations, and training to support the Systems Engineering community's adoption of HSI.
  - Stay forefront of evolving SE practices to ensure that the presence of humans is integrated into the engineering in order to deliver successful sociotechnical systems across their life cycle.
  - Foster a community of practitioners from the contributing disciplines (System Engineering, Human Factors and Ergonomics, Information Technology, and Operational

HSI 2024: Keynote Speakers

Taking measure of Human Systems Integration: A view from NASA

Building on work from recent NASA studies, Dr. Null will discuss challenges and successes of implementing Human System Integration approaches across mission life cycle. Topics will include the implications of focusing on human resilient performance for mission and system design; the use of quantitative analyses of human performance in development of a mission architecture; and the need to expand HSI metrics.

Dr. Cynthia H. Null is the Technical Fellow for Human Factors for the NASA Engineering and Safety Center (NESC). The NESC was created in 2003, after the Columbia space shuttle accident, to perform value-added independent engineering assessments of NASA's high-risk programs to ensure safety and mission success. In this role, Dr. Null and her team of HSI and human performance experts identify technical risks in NASA programs; develop and execute studies to fill knowledge gaps; provide recommendations focused on HSI issues; and propose strategies to improve discipline capabilities.

Human Systems Integration Across the Health Care Continuum: Examples, Opportunities, and the Future

There is an increasing and urgent need for infusing Human Systems Integration (HSI) and Human Factors Engineering (HFE) principles and methods to improve safety and quality of operations in complex, adaptive sociotechnical work systems such as in health care. In this presentation, Dr. Gurses will describe how HSI and HFE can be used to improve care across the entire care continuum (i) by systematically identifying hazards to patient safety, health care worker safety, and equity; and (ii) by developing effective and sustainable human-centered interventions with the purpose of eliminating and/or mitigating these hazards and improving adaptive capacity and resilience of the frontline care work and public health. Examples from a variety of health care settings (i.e., emergency department, operating rooms, patient home), and focus areas (e.g., infection prevention and control, pandemic preparedness, care transitions/ handoffs, healthcare information technology) will be provided. Lessons learned across the different projects and implications for future HSI efforts will also be discussed.

Ayse P. Gurses, PhD, MS, MPH is the Director, Center for Health Care Human Factors, Armstrong Institute, Johns Hopkins Medicine, and Professor, Schools of Medicine, Bloomberg Public Health, Whiting Engineering, Johns Hopkins University. Dr. Gurses is a globally recognized researcher, educator, and thought leader in infusing human factors and systems engineering principles and methods into health care work systems to improve safety, quality and equity in health care. She is the Founding Director of the Center for Health Care Human Factors at the Johns Hopkins Armstrong Institute for Patient Safety and Quality and Professor in the Johns Hopkins University Schools of Medicine, Bloomberg Public Health and Whiting Engineering. She is the author of more than 100 peer-reviewed publications. She has been a principal/ co-principal investigator on numerous research grants and contracts- funded by the Agency for Healthcare Research and Quality (AHRQ), Centers for Disease Control and Prevention (CDC), National Institutes of Health (NIH), National Science

HSI 2024: Topics

HSI principles, methods, and tools

Concepts of operations, scenario-based design
Creativity, design thinking, and design theories
Crisis & unexpected events management
Design for usability, UX
Digital human modeling
Ethnographic studies, Human error, Fatigue
Emerging operational issues in complex system
Experience feedback & reporting systems.
HSI metrics for certification
Human & organizational resilience
Human-Centered Design & Integration
Human Factors Engineering
Mock-ups, part-task, and full-task simulators
Neuroscience contributions
Performance, workload & competence
Role of HSI in accident investigations
Situation awareness, decision-making
Social systems, responsibility, accountability
Tools & methods for HSI
Training issues, personnel selection
Transdisciplinary Research and practice in HSI

Organizational/societal issues and solutions

Authority sharing
Automation across systems
Change management, lean management
Digital Enterprise, Digital engineering
Environment & Sustainability
Human-centered MBSE & Model-based HSI
Human-in-the-loop simulation
Maintenance resource management/CRM
Modeling & Simulation
Multi-agent systems
Next-generation OPS/technical documentation
Organization design and management
Organizational psychology
Socio-ergonomics and Socio-technical systems
Supervision, mediation, cooperation, competition
Tangible interactive systems
Teams of Teams & Systems of Systems
STEM, STEAM, SySTEAM

HSI, safety, and infrastructure

Agents-infrastructure integration
Biology-inspired functions & infrastructures
HSI planning
Hybrid humans-robots organizations
Influence of National and organizational cultu
Integrated Logistics Support
Integration and global coordination
Occupational health & safety
Quality and continuous improvement
Responding to Infrastructure collapse
Risk-taking and management
Safety Management Systems (SMS)
Sustainability and system design
Trust & Collaboration
Workforce planning

Legal and Regulatory

Criminalization of accidents. Legal issues
HSI evaluations for design and certification
HSI means of compliance
Regulating autonomous vehicles
Regulatory compliance
Responsibility & Accountability
Standards and specific regulations

Thank you!

- Resources
  - HSI Primer: Available on INCOSE Portal
  - DoD HSI Guidebook: https://www.cto.mil/wp-content/uploads/2023/06/HSI-Guidebook-2022.pdf
  - INCOSE Working Group: https://www.incose.org/communities/working-groups-initiatives/human-systems-integration
- Open Forum / Q&A