WPI

Evidence-Based Approach to Implementing the New INCOSE Systems Engineering Competency Framework

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Overview

In this presentation:

- Worcester Polytechnic Institute
- The New INCOSE Systems Engineering Competency Framework
- Evidence-Based Indicators
- The Steps to Success
- Conclusion

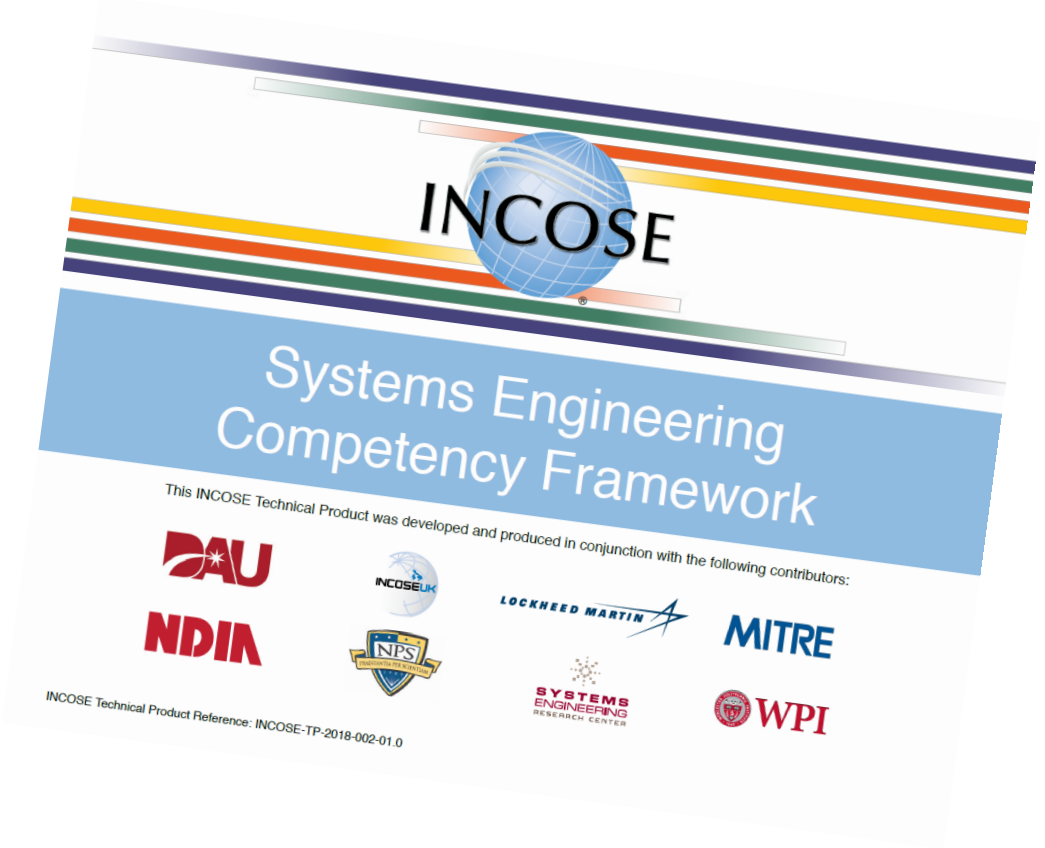
Worcester Polytechnic Institute (WPI)

- Founded in 1865
- Undergraduate, graduate, doctorate
- More than 6,600 students enrolled
- Science, engineering, and business
- Motto: Theory and Practice
- World-class faculty
- Cutting-edge research

Systems Engineering Competency Framework

International and Diverse Collaboration:

- 7 Years
- 2 Professional Societies
- 12 Companies
- 4 Schools
- 1 Research Center
- 1 National Lab
- 5 Primary Authors
- 23 Secondary Authors/Reviewers
- 6 Countries

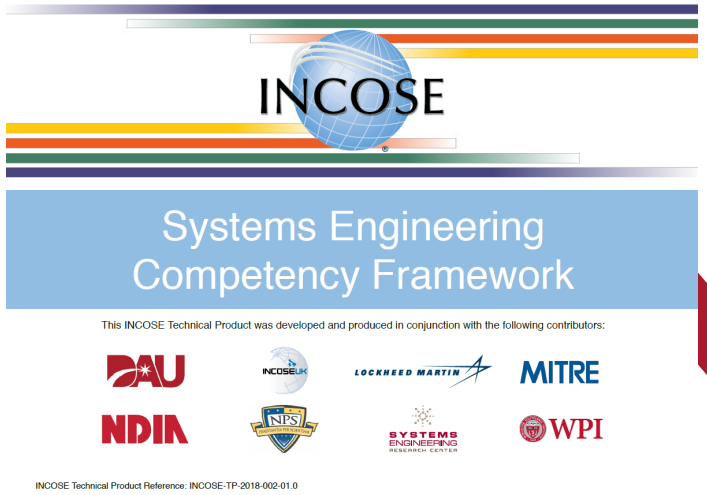


The complete Competency Framework can be accessed at:

https://www.incose.org/CompetencyFramework

Systems Engineering Competency Framework

Represents a world view of 5 competency groupings with 36 competencies central to the profession of Systems Engineering, including indicators of knowledge, skills, abilities and behaviors across 5 levels of proficiency.

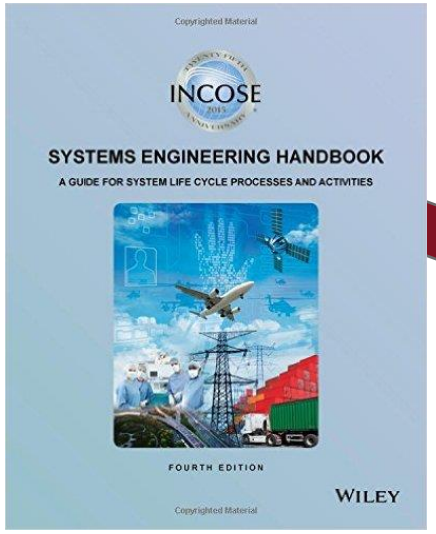


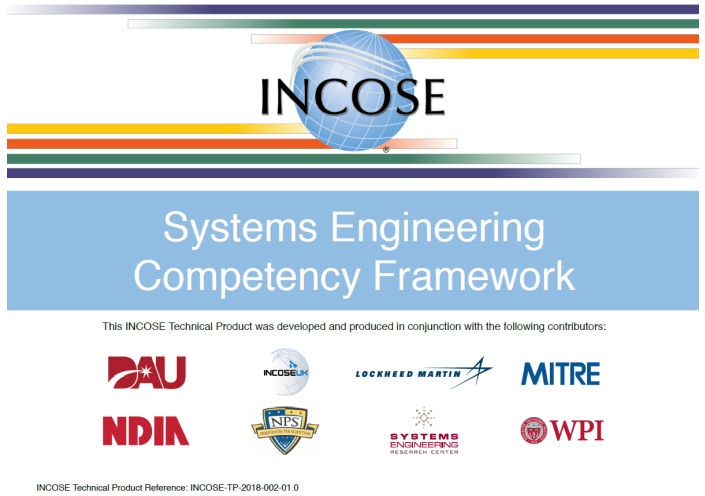
Aligns with major ongoing INCOSE initiatives.

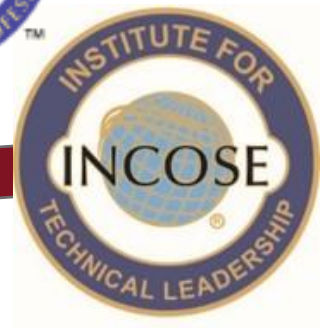
Supports a wide variety of usage scenarios including individual and organizational capability assessments.

Enables organizations to tailor and derive their own competency models that address their unique challenges.

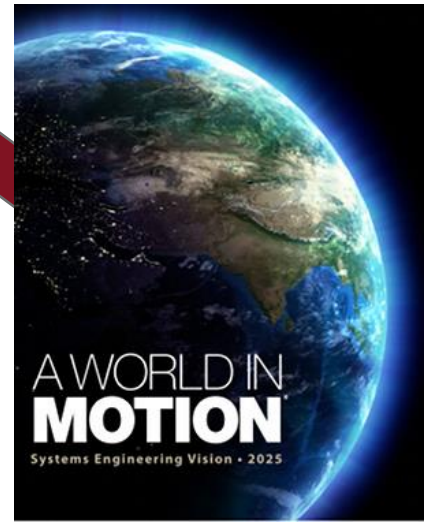
Alignment to Major Initiatives







Atlas Proficiency Model



What's in the Framework Document?

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36 Competencies Across 5 Groups

SE Management

- Information Management
- Planning
- Monitoring and Control
- Risk and Opportunity Management
- Business & Enterprise Integration
- Decision Management
- Concurrent Engineering
- Configuration Management
- Acquisition and Supply

Professional

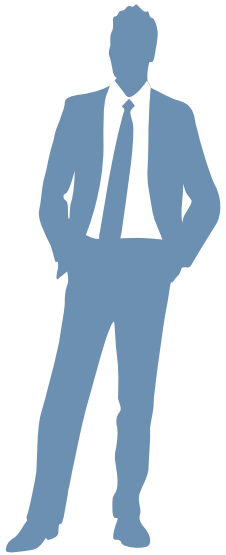
- Communications
- Facilitation
- Ethics and Professionalism
- Coaching & Mentoring
- Technical Leadership
- Emotional Intelligence
- Negotiation
- Team Dynamics

Core SE Principles

- General Engineering
- Systems Thinking
- Capability Engineering
- Critical Thinking
- Systems Modelling and Analysis
- Lifecycles

Integrating

- Quality
- Finance
- Project Management
- Logistics



Technical

- Requirements Definition
- Systems Architecting
- Transition
- Operations and Support
- Design For …
- Integration
- Interfaces
- Verification
- Validation

Each Competency has 5 Proficiency Levels

The person displays knowledge of key ideas associated with the competency area and understands key issues and their implications.

The person displays an understanding of the competency area and has some limited experience.

The person displays both knowledge and practical experience of the competency area and can function without supervision on a day-to-day basis.

The person displays extensive and substantial practical knowledge and experience of the competency area and provides guidance to others including practitioners experiencing unusual situations.

In addition to extensive and substantial practical experience and applied knowledge of the competency area, this individual contributes to and is recognized beyond the organizational or business boundary.

Evidence-Based Indicators

COMPETENCY AREA – Technical: Requirements Definition

Description:

To analyze the stakeholder needs and expectations to establish the requirements for a system.

Why it matters:

The requirements of a system describe the problem to be solved (its purpose, how it performs, how it is to be used, maintained and disposed of and what the expectations of the stakeholders are).

EFFECTIVE INDICATORS OF KNOWLEDGE AND EXPERIENCE

AWARENESS	SUPERVISED PRACTITIONER	PRACTITIONER	LEAD PRACTITIONER	EXPERT
Describes different types of requirements (e.g. functional, non-functional, business etc.). Explains why there is a need for good quality requirements. Identifies major stakeholders and their needs. Explains why managing requirements throughout the lifecycle is important.	Identifies all stakeholders and their sphere of influence. Assists with the elicitation of requirements from stakeholders. Describes the characteristics of good quality requirements and provides examples. Describes different mechanisms used to gather requirements.	Defines governing requirements elicitation and management plans, processes and appropriate tools and uses these to control and monitor requirements elicitation and management activities. Elicits and validates stakeholder requirements. Writes good quality, consistent requirements.	Recognized, within the enterprise, as an authority in requirements elicitation and management techniques, contributing to best practice. Defines and documents enterprise-level policies, procedures, guidance and best practice for requirements elicitation and management, including associated tools. Challenges appropriateness of requirements in a rational way.	Recognized, beyond the enterprise boundary, as an authority in requirements elicitation and management techniques. Contributes to requirements elicitation and management best practice. Champions the introduction of novel techniques and ideas in requirements elicitation and management, producing measurable improvements.

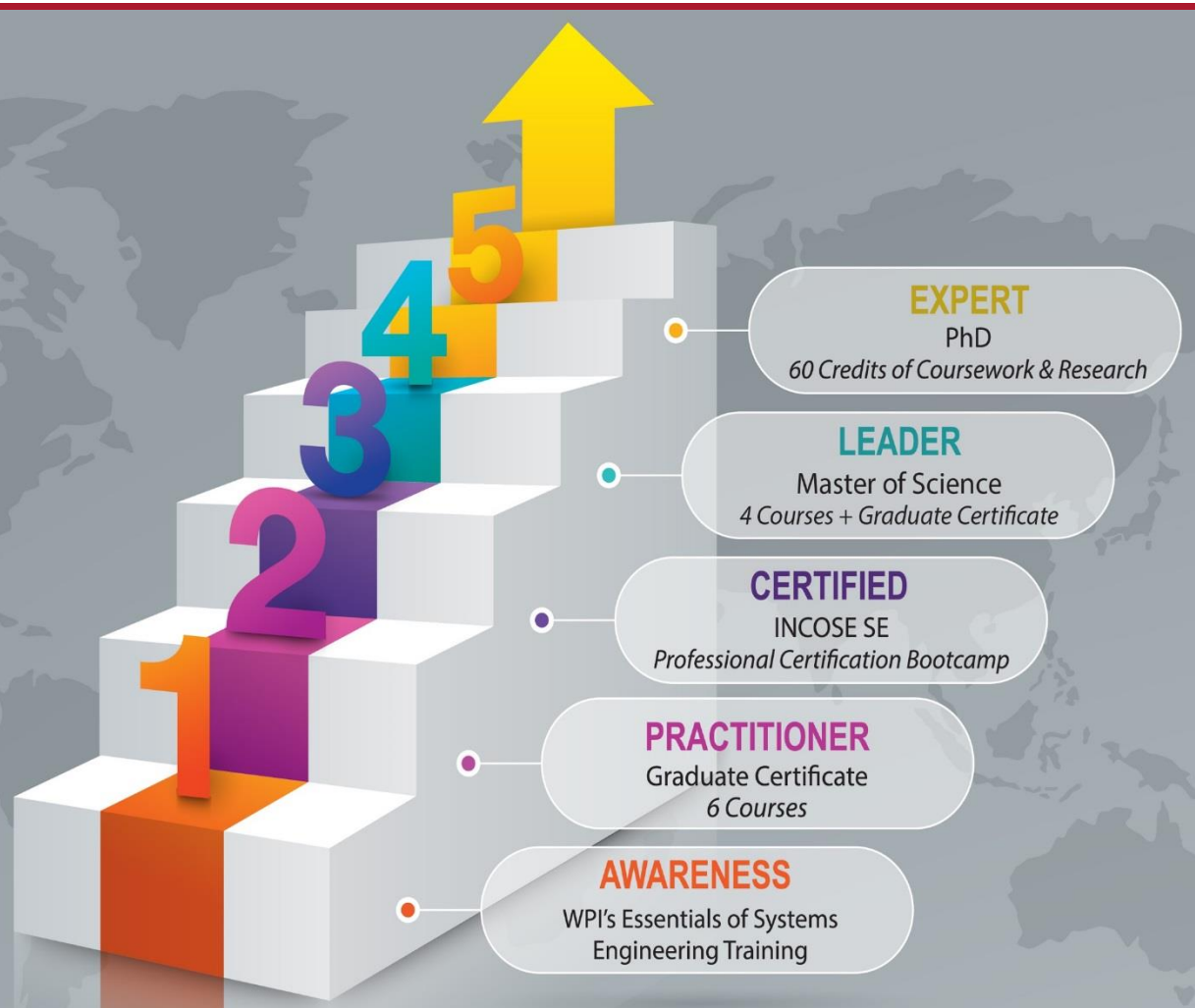
COMPETENCY AREA – Systems Engineering Management: Risk and Opportunity Management

PRACTITIONER	LEAD PRACTITIONER
Defines governing risk and opportunity management plans, processes and appropriate tools and uses these to control and monitor risk and opportunity management activities.	Recognized, within the enterprise, as an authority in Systems Engineering risk and opportunity management, contributing to best practice.
Establishes a project risk and opportunity profile including context, probability, consequences, thresholds, priority and risk action and status.	Reviews and judges the tailoring of enterprise-level risk and opportunity management processes and associated work products to meet the needs of a project.
Identifies, assesses, analyzes and treats risks and opportunities for likelihood and consequence in order to determine magnitude and priority for treatment.	Coordinates Systems Engineering risk and opportunity management across multiple diverse projects or across a complex system, with proven success.
Treats risks and opportunities effectively, considering alternative treatments and generating a plan of action when thresholds exceeds certain levels.	Establishes an enterprise risk profile including context, probability, consequences, thresholds, priority and risk action and status.
Guides supervised practitioners in Systems Engineering risk and opportunity management.	Coaches new and experienced practitioners in Systems Engineering risk and opportunity management.

All indicators:

- **Start with action verbs.**
- **Are evidence-based.**
- **Show progressions from lower to higher levels of proficiency.**
- **Can be mapped to a combination of knowledge, skills, abilities, behaviors and experiences.**
- **Enable individuals to self-assess and increase their proficiency levels.**

Steps to a Successful Career in Systems Engineering



WPI's Systems Engineering programs align with the INCOSE Competency Framework

The Steps to Success

STEP 1 – AWARENESS

- Fundamental understanding of the key concepts, impacts, and roles of Systems Engineering.
- WPI's **"Essentials of Systems Engineering"** training program:
  - Provides a concise overview of the critical principles, methods, and techniques, including theory-based lectures and application-based exercises and projects.

STEP 2 – PRACTITIONER

- Detailed knowledge of the theories of Systems Engineering and Systems Thinking.
- Practical experience through the application of best practices.
- **Graduate Certificate in Systems Engineering:**
  - Provides strong foundation enabling the development of a wide range of technical skills to lead teams and better design and implement complex systems.

The Steps to Success

STEP 3 – CERTIFIED

- Certification as a Systems Engineering Professional (SEP) is a key step upward.
- WPI offers a **SEP Boot Camp** program:
  - Prepares you for certification by INCOSE as an Associate or Certified Systems Engineering Professional.
  - Builds on your WPI Systems Engineering studies through a targeted review of coursework and the INCOSE Handbook 4th Edition to prepare you for your exam.
  - Provides personalized assistance to walk you through the application process.

STEP 4 – LEADER

- If you are a Systems Engineer, then you are expected to be a leader.
- We believe all engineers should have in-depth knowledge of Systems Engineering and Technical Leadership to be properly prepared for 21st Century realities.
- **Master of Science in Systems Engineering** program:
  - Provides real-world application of foundational and advanced topics that are crucial to effective leadership and engineering across a wide range of corporate and professional organizations.

The Steps to Success

STEP 5 – EXPERT

- Experts are expected to have extensive and substantial practical experience and applied knowledge of Systems Engineering so they can effectively advance the state-of-the-art.
- **PhD in Systems Engineering** program:
  - Provides opportunities to gain Expert-level knowledge and experience by conducting critical research with cutting-edge faculty who bring decades of practical academic and commercial expertise to solving real-world challenges.

Next Steps

- Adjudicate reviews and comments on the initial competency framework release.
- Develop “Guide to Competency Evaluation” (Annex E) to provide guidance on how individuals can evaluate themselves against the competency framework.
- Use the framework to develop Competency Models for various domains: SoS, SSE, Oil and Gas, Medical Devices, etc.
- Continue to explore use cases for how government, industry and academic organizations can use the framework’s evidence-based indicators to help identify, assess and develop the necessary knowledge, skills, abilities and behaviors at the appropriate levels in their workforce to enhance Systems Engineering effectiveness across the enterprise.

Questions?

WPI's State-of-the-Art Seminar in Systems Engineering

Development of Trustworthy and Secure Systems

WPI Campus, Gateway I – 60 Prescott, St.

Space is limited. Registrations will be accepted on a first come, first serve basis.

A trustworthy system is one for which there is assurance that it will perform as expected by the users, given attributes of interest such as dependability, security, reliability, availability, safety, security, resilience, and integrity. The speakers in this seminar have been invited to speak on the development of such systems, with a focus on the use of assurance cases as a means of increasing the confidence that the system will behave as intended.

Visit the link below for more information on speakers and to RSVP.

bit.ly/se-symposium-2018

Thank You!

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