Version 0.75 of the Proposed INCOSE Competency Framework

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Motivation for New INCOSE Competency Framework (ICF)

INCOSE leadership tasked the Competency Working Group with two objectives:

- Evolve the current INCOSE Competency Framework (UK Framework) to a globally accepted (i.e., approved for release as an INCOSE product) and marketed standard competency framework, based on systems engineering effectiveness, that can be used to produce competency models tailored to the needs of the customer organizations.

- Create a globally used standard assessment instrument/tool based on the competency framework that is tailorable to the needs of the customer organizations.

  - The tool may be published separately as an ancillary INCOSE product in the future.

ICF Version 0.75 Outline

- Introduction
  - Purpose
  - Scope
- Competency Framework
- Systems Engineering Roles Descriptions
- How to Use the Competency Framework
  - Use Cases
  - Tailoring the Competency Framework
  - Competency Model Assessments using the Framework
- Future Evolution of the Competency Framework
- References
- Appendices
  - Guide to Competency Evaluation
  - Alignments to other Initiatives
  - Domain Based Competency Model Examples
- Glossary

5 Competence Groups and 36 Competence Areas

Level 1 Competence Groups	Level 1 Concept Description	Level 2 Core Competence Areas
Core SE Principles	This competence group covers core principles which underpin engineering as well as systems engineering.	Systems Thinking
		Lifecycles
		Capability Engineering
		General Engineering
		Critical Thinking
		Systems Modelling and Analysis
Professional Competencies	This competence group covers behavioural competencies which are all well-established within the HR domain. It is important that the definition of these competencies would be taken from well-established, internationally-recognised definitions rather than partial or complete re-invention by INCOSE. This will facilitate alignment with wider HR frameworks used in larger organisations.	Communications
		Ethics and Professionalism
		Technical Leadership
		Negotiation
		Team Dynamics
		Facilitation
		Emotional Intelligence
		Coaching and Mentoring
Technical Competencies	This competence group relates to the ability to perform a series of tasks associated with the Technical Processes identified in INCOSE SE Handbook at Version 4. As a resutl, there needs to be a clear relationship (does not need to be1-1 however) against the handbook / ISO 15288.	Requirements Definition
		System Architecting
		Design for...
		Integration
		Interfaces
		Verification
		Validation
		Transition
		Operation and Support
SE Management Competencies	This competence group relates to the ability to perform tasks associated with controlling and managing Systems Engineering work. Once again it is desirable for these to be a clear relationship to Management processes identified in INCOSE SE Handbook at Version 4. However, this does not need to be 1-1 as these tasks also could be utilised for other activities.	Planning
		Monitoring and Control
		Decision Management
		Concurrent Engineering
		Business & Enterprise Integration
		Acquisition and Supply
		Information Management
		Configuration Management
		Risk and Opportunity Management
Integrating Competencies	This competence group recognizes the fact that Systems Engineering is an integrating discipline, joining activities and thinking from specialists in engineering or other disciplines in order to create a coherent whole. It covers the systems engineering competencies required to understand and integrate the viewpoints and perspectives of others into the overall picture.	Project Management
		Finance
		Logistics
		Quality

COMPETENCY AREA - Systems Thinking

Description:

The application of the fundamental concepts of systems thinking to systems engineering. These include understanding what a system is, its context within its environment, its boundaries and interfaces and that it has a lifecycle. The definition, development and production of systems within an enterprise and technological environment.

Why it matters:

Systems thinking is a way of dealing with increasing complexity. The fundamental concepts of systems thinking involves understanding how actions and decisions in one area affect another, and that the optimisation of a system within its environment does not necessarily come from optimising the individual system components. Systems Engineering is conducted within an enterprise and technological context. These contexts impact the lifecycle of the system and place requirements and constraints on the Systems Engineering being conducted. Failing to meet such constraints can have a serious effect on the enterprise and the value of the system.

EFFECTIVE INDICATORS OF KNOWLEDGE AND EXPERIENCE

AWARENESS	SUPERVISED PRACTITIONER	PRACTITIONER	LEADING PRACTITIONER	EXPERT
Is aware of the need for systems thinking	Can explain / understands the properties of a system	Able to identify and manage complexity with appropriate techniques in order to reduce risk	Able to review and judge the suitability of systems solutions and the planned approach	Able to review and judge the suitability of systems solutions and the planned approach
Aware of the importance of:	Understands principle of emergence and can see how system behaviour produces emergent porpoerties	Able to predict resultant system behaviour	Has reviewed and advised on the suitability of systems solutions	Influences and maintains the technical capability and strategy of their enterprise
■ hierarchy of systems	Understands system hierarchy and the principles of system partitioning	Defines context of a system from a range of view points, and defines system boundaries and external interfaces	Influences and maintains the local technical strategy in this area	Has led the development / capture of new / adjusted or combined Systems Thinking methods (including combination of methods)
■ system context (for a given system of interest	contributes to definition / understadning of system functionality	Able to assess the interaction between humans and systems, and systems and systems	Recognised as a local expert in systems thinking	Recognised as an authority in systems thinking
■ interfaces - understands need to identify them	Can identify system boundaries and understands the need to define and manage the interfaces	Identifies the enterprise and technology issues which will affect the design of a system and translates these into system requirements	Has introduced new techniques and ideas iinto the busienss which have produced measurable improvement	Has championed the introduction of novel techniques and ideas in this field which produced measurable improvement
■ interactions amongst systems and their elements	Understands how humans and systems interact and how humans can be elements of systems	Understands how to choose and use range of Systems Thinking methods and integrate outcomes, to get a full understanding of the whole	Has contributed to defintion of best practice for Systems Thinking within local organisation	Has contributed to best practice outside local organisation
■ understanding purpose and functionality of a system of interest	Identifies (with guidance) influence of business enterprise, and contributes to the technology development plan	Able to contribute to delivery of enterprise improvements to enable better system development	Able to intrduce and adapt Systems Thinking concepts and methods to group with no or limited competency, and / or to new siutations	Defines best practices in "Systems Thinking", embedding lessons learnt and experience (internally and externally generated)
Recognises that putting parts together achieves emergence of the whole and that emergence and be positive or negative	Contributes and supports (with their won insights) team Systems Thinking activities	Able to lead group Systems Thinking activities, aligned to purpose of current activity	Has coached new practitioners in this field	Has contributed to best practice in systems thinking extending beyond current organisation or business boundary
Aware of the influence that business, enterprise and technology has on the definition and development of the system		Able to reuse and adapt case studies and previous examples / application of Systems Thinking in new situations	Able to guide practitioners in best practice techniques	
Recognises that approach to Systems Thinking will vary according to situation		Able to guide supervised practitioner	Regarded as expert in systems thinking within current organisation or business	

ARCIFE terms

A – Accountable: This is the leadership, making sure the activity is done, and done right. Usually the accountable person delegates the activity and doesn't do it themselves. There should only be one accountable person for a specific activity or issue.

R – Responsible: This is the person or group of people (maybe different roles) that actually do the activity, and make it happen (so if the output of the activity is a report, these are the authors). Responsibility can be shared in a team.

C – Consulted: Need to be engaged in the work – they may provide input, or more likely, they either apply specific technical or domain knowledge to assist with the production of the work product, or they use or act on the outcome of the process step and influence it.
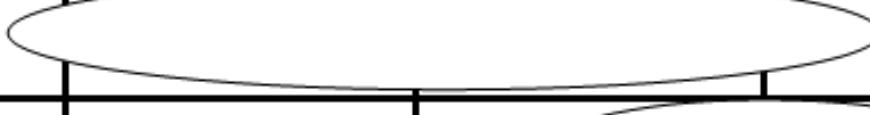
I – Informed: Need to know either that the work product is produced or the outcome. They may also know only part of outcome and decision from the process; it may be an input to their work, or may affect them in some way.

F – Facilitator / Coach: They can lead workshops or discussions applying the systems approach, with people from other skills, to build consolidated and agreed models. This aspect includes sufficient expertise and knowledge in the systems approach (process and techniques) to select the most appropriate for the situation. They have to consider both the nature of the problem and the system of interest, and the "systems" competence and experience of the using organization.

E – Expert: This person develops, explains and teaches methods and process in this area, and advances the state of the art. They are considered a specialist in the competency.

Notional Mapping of ARCIFE vs ICF Proficiency Levels

	Awareness	Supervised Practitioner	Practitioner	Lead Practitioner	Expert
Accountable		⬭			
Responsible			⬭		
Consulted	⬭				
Informed	⬭				
Facilitator/Coach			⬭		
Expert					⬭

The Nine Steps

1. Map organization processes to organization roles.
2. Map organization processes to INCOSE Systems Engineering Handbook processes.
3. Combine output of Steps 1 and 2: map organization roles to INCOSE processes.
4. Map INCOSE competencies to any existing organization competency framework.
5. Extend INCOSE processes to competencies to include any extra organization processes and/or competencies.
6. Merge mapping of process to roles (step 3) and processes to competencies (step 5).
7. Merge mapping of organization competencies to INCOSE competencies (step 4) to output of step 6.
8. Define the competency levels needed for each role in order to translate ARCIFE levels to competency proficiency levels.
9. Complete organization specific role statements.

Standard Role Structure and Definitions

Standard Structure

Role Name	
Role Purpose	
Activities performed	
Competency class	**Competency and level required**
Other constraints / qualifications required	

Definitions

- **Role Name** – title of role
- **Role Purpose** – job summary / one sentence description (operational requirement
- **Activities Performed** (aka "accountability statement") – key activities from processes that role accountable or responsible for
- **Competency** – the named competency (list divided into classes) and the level required
- **Other** – statements on licences, qualification or other constraints on the role

Educational Institution Use Case Model

Identify Qualified Candidates

| Use Case Name	Identify qualified candidates
Preconditions	Use cases "Set up competency model" and the variant of "Assess competency for recruitment" called "Identify sources of candidates" (which may or may not include the variant of "Assess competency for education" called "Identify schools with capable programs") have been successfully completed
Actors	• Recruiter/Capability Manager (CM) • Candidate Provider (CP) (may include representatives of workforce placement services, internal or external job board services, educational institution faculty or administrators) • Candidate
Triggers	Application window for identified vacancy is about to open
Primary flow of events	1. The use case begins when the CM decides to begin recruiting and posts vacancies 2. CM communicates competency model to CP, along with application deadlines and other pertinent information 3. CP compares skills of potential applicants in their candidate pool to competency model 4. CP encourages qualified Candidates to apply 5. Candidate decides whether to apply and submits application 6. CM accesses their organization's vacancy posting system to generate an applicant listing and this use case ends, transitioning to a use case on applicant selection
Alternate flow	At Step 3, CP provides competency models to Candidate, who self-assesses skills Step 4 may be omitted in cases where automated systems that are used for candidate processing lack referral capability
Issues	The use case must account for the situation in which no qualified candidates are identified
Post condition	A list of qualified applicants

Identify Opportunities for Program Improvement

Use Case Name	Identify opportunities for program improvement
Preconditions	Use cases "Set up competency model" and the variant of "Assess competency for education" called "Identify schools with capable programs" including "Perform gap analysis" have been successfully completed
Actors	• Employer Recruiter/Capability Manager (CM) • Education Provider (Faculty/Administrators)
Triggers	Relationship between Employer and Education Provider established
Primary flow of events	1. The use case begins when the Education Provider requests dialog re: employer needs 2. Education Provider contacts Employer and arranges for a visit with Faculty/Administrators 3. CM communicates competency model and identified gaps to Education Provider 4. Education Provider validates gaps 5. Education Provider determines actions needed to address gaps and this use case ends
Alternate flow	At Step 3, CM communicates competency model only At Step 4, Education Provider performs self-assessment against competency model to identify gaps
Issues	The use case must account for the situation in which the Education Provider refutes the Employer's gap analysis
Post condition	Program improvement action list

Identify Resources for Professional Development

Use Case Name	Identify resources for professional development
Preconditions	Use cases "Set up competency model" and the variant of "Assess competency for education" called "Identify education resources" have been successfully completed
Actors	• Worker • Capability Manager (CM) • Education Provider
Triggers	Worker or CM determines need for professional development
Primary flow of events	1. The use case begins when the Worker or CM decides to initiate professional development 2. Worker or CM reviews the offerings of Education Provider against the competency model and selects development resources 3. Worker completes selected professional development activities and this use case ends, transitioning to a use case on documenting competencies obtained
Alternate flow	At Step 3, CM assigns workers to complete selected professional development Worker resumes as Step 4
Issues	The use case must account for professional development providers other than academia

WPI

Systems Engineering Technical Short Course

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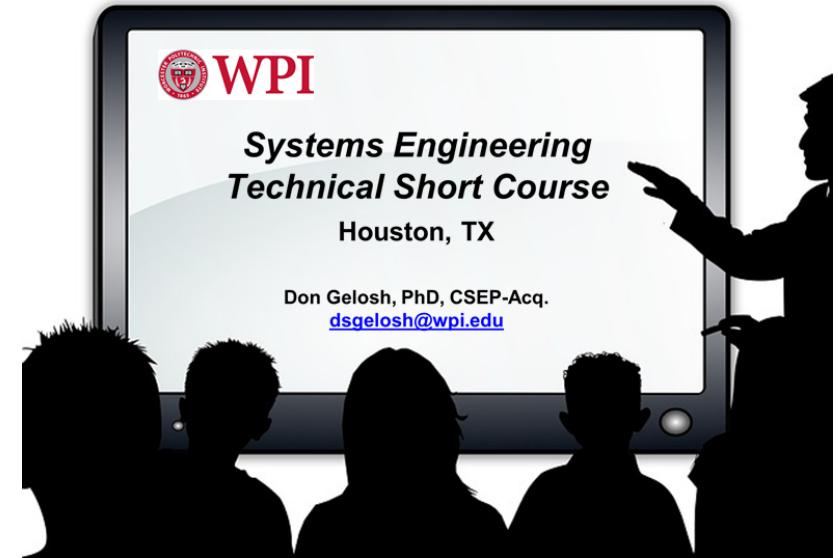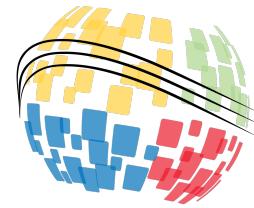
Looking Forward to ICF Version 1.0

- Version 0.75 is a major milestone in ICF development.

- Next phase is full development and publishing of Version 1.0.

- Need to accomplish a few things to get us to Version 1.0:
  - Fully coordinate and align with vision of the INCOSE PMI (Project Management Institute) Working Group.
  - Examine other models such as CMMI (Capability Maturity Model Integration) program and determine how they may impact the framework.
  - Fully develop complete set of use cases.
  - Develop an assessment methodology and consider how the framework can be used to support an individual or supervisor level assessment of competence.
  - Examine competencies outside traditional systems engineering to provide breadth.
  - Consider including foundational systems principles in the framework.

Questions?
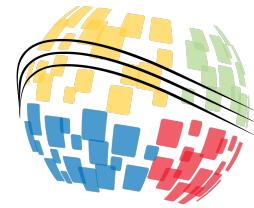
THANK YOU!

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