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Developing the Next Generation of the INCOSE Systems Engineering Competency Framework

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Overview

- This presentation describes the proposed development of the INCOSE Systems Engineering (SE) Competency Framework.
- This framework will be developed as an evolution of the current INCOSE United Kingdom (UK) SE Competencies Framework (INCOSE UK, 2010).
- The INCOSE Competency Working Group (CWG) is conducting this project in collaboration with the National Defense Industrial Association (NDIA), SE Division, Education and Training Committee to develop a common approach to the definition of an SE Competency Framework.

Objectives

- Evolve to a globally accepted* 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, tailorable to the needs of the customer organizations (pending further discussions with INCOSE Competency WG).

*** Approved for release as an INCOSE product.**

Proposed Evolution

We propose an evolution of the current INCOSE UK Competencies Framework along four paths of development and growth:

1. Evolve to an SE role-based competency framework that is extensible, scalable, and tailorable by the customer organization.
2. Evolve by adding the concept of classes. This is where the competencies achieve their interdependence with each other.
3. Evolve by ensuring there is a Professional Class that covers leadership and soft skill competencies.
4. Evolve by adding a new level of proficiency called the Senior Practitioner to the existing four levels in the INCOSE UK Competencies Framework.

SE Role-Based Competency Framework Taxonomy

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SE Role		A collection of interrelated and interdependent activities assigned to a person in a contextual environment such as Systems Engineering
↳ Activity		A specified pursuit defined by a set of essential functions and desired outcomes that enable the successful accomplishment of one's role
↳ Class		A grouping of closely related competencies considered essential to an individual's ability to successfully perform an activity
↳ Competency		An observable and measurable pattern of knowledge, skills, abilities, behaviors, and other characteristics that an individual needs to successfully perform an activity
↳ Description		A competency should be described in a way that clearly defines its essential function and desired outcome
↳ Knowledge Skills Abilities Behaviors		The decomposition of a competency into specific and clearly defined knowledge, skills, abilities and behaviors is necessary to successfully execute and assess key requirements of an activity at a corresponding level of proficiency

SE Role-Based Competency Framework Architecture

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- Each SE Role consists of one or more SE Activities.
- Each SE Activity consists of a set of competencies, with one or more competencies from each of the following Classes:
  - **C1: Technical Processes**
  - **C2: Technical Management**
  - **C3: Enterprise**
  - **C4: Professional**
  - **C5: Analytical**
  - **C6: Domain / Context**
- Each competency consists of:
  - **The Competency Description**
  - **Associated set of Knowledge, Skills, Abilities, and Behaviors, described at Five Levels of Proficiency**

SE Role-Based Competency Framework Architecture

- Knowledge, Skills, Abilities, and Behaviors can be acquired through Education, Training, Experiences, and Cultural Immersion.
- Five Levels of Proficiency:
  - **Awareness**
  - **Supervised Practitioner**
  - **Practitioner**
  - **Senior Practitioner *(Proposed New Level)***
  - **Expert**

- This architecture approach allows us to map any SE Role into a set of clearly defined knowledge, skills, abilities and behaviors at the appropriate levels of proficiency.

Concept of Classes

- The concept of classes was introduced to help categorize and group the competencies.
- More importantly, the concept of classes enables competencies to be viewed as interrelated and interdependent when they support an SE activity.
- The concept of classes also helps to ensure that all the appropriate competencies are considered for a particular SE activity.
- A class is defined as a grouping of closely related competencies considered essential to an individual's ability to successfully perform an activity.
- Any SE activity must therefore consist of several interrelated and interdependent competencies.

Class Definitions

- **Technical Processes** – competencies required to perform fundamental SE activities
- **Technical Management** – competencies required to plan, assess and control the technical effort
- **Enterprise** – competencies required to relate the technical effort on a program to the organizational and inter-organizational mission, vision, goals, resources and objectives

Class Definitions

- **Professional** – non-technical competencies required to enable systems engineers to effectively and efficiently achieve objectives in the organizational context
- **Analytical** – competencies required to develop inputs for decisions or to inform fundamental SE activities
- **Domain / Context** – competencies required to understand and operate effectively in a particular problem space

Professional Class

- Emerging global belief that if you are a systems engineer, then you must also be a leader.
- Every level of systems engineering requires some type of leadership.
- INCOSE Corporate Advisory Board and other respected centers of thought on the practice of systems engineering encouraged us to include a **Professional Class** in the competency framework evolution.

You cannot manage men into battle. You manage things; you lead people.

Grace Hopper

Professional Class

- Professional and interpersonal competencies that enable the successful accomplishment of SE activities.
  - **Leadership**
  - **Communications**
  - **Critical Thinking**
  - **Coordination**
  - **Team Dynamics**
  - **Problem Solving**
  - **Negotiation**
  - **Persuasion**
  - **Ethics**
  - **Cultural Change Management**
  - **Judgment**
  - **Mission and Results Focus**
  - **Coaching and Mentoring**
  - **Strategic and Tactical Planning**
  - **Etc.**

Current Proficiency Levels

- **Awareness Level:**
  - *The person is able to understand the key issues and their implications. They are able to ask relevant and constructive questions on the subject.*
- **Supervised Practitioner Level:**
  - *The person displays an understanding of the subject but requires guidance and supervision.*
- **Practitioner Level:**
  - *The person displays detailed knowledge of the subject and is capable of providing guidance and advice to others.*

Source: INCOSE UK Competencies Framework (INCOSE UK, 2010)

Current Proficiency Levels

- **Senior Practitioner Level *(Proposed New Level):***
    - *The person displays both in-depth and broad knowledge of the subject based on practical experience and is capable of leading others to create and evaluate solutions to complex problems in the subject.*
- **Expert Level:**
    - *The person displays extensive and substantial practical experience and applied knowledge of the subject.*

Source: INCOSE UK Competencies Framework (INCOSE UK, 2010)

Senior Practitioner Proficiency Level

- Those who achieve **Senior Practitioner Level** would have:
    - An in-depth and broad knowledge of the particular SE competency
    - Ability to lead others in solving complex problems utilizing the competency
- **Senior Practitioner Level** provides a bridge that makes it easier to transition from the Practitioner level to the Expert level.

Source: INCOSE UK Competencies Framework (INCOSE UK, 2010)

Summary

- We proposed a way to evolve the INCOSE UK Competencies Framework along four paths of development and growth.
- We described each path and showed how that path enables the appropriate evolution.
- The resultant competency framework would be tailorable, extendable and scalable by the customer to produce competency models well suited to their needs.
- The proposed fifth level of Senior Practitioner would provide a needed bridge between Practitioner and Expert.

Next Steps

Action	Due Date
Finalize v0.5 of Framework, Begin Review with CAB and CWG	August 1, 2014
Finalize Review of v0.5 with CAB and CWG	October 1, 2014
Adjudicate Comments and Update to v0.75	December 15, 2014
Evaluate Draft v0.75 at IW 2015	January 2015

Questions?

Don's Contact Info

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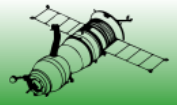
Back Up Slides

Example Use Cases

- Use the Competency Framework as a tailorable set of criteria to guide the customer organization's assessment tool in order to select, filter, and screen candidates for SE job positions, thus helping to ensure that the right person is placed in the right job.
- Use the Competency Framework to identify differences or gaps in an organization's existing SE competencies and mitigate those gaps through the appropriate training, experiential opportunities, etc.
- Use the Competency Framework to enable comparisons of different organizations' competency models to each other.

Role	Activity	C1:Technical Process	C2:Technical Management	C3:Enterprise	C4-Professional / Leadership	C5:Analytical	C6: Domain / Context
Requirements Manager							
	Requirements Management Process & Tools	Stakeholder Needs & Req Definition (SuP)	Requirements Management (P)		Communication (P)		
		System Requirements Definition (SuP)					
		Verification (SuP)					
		Validation (SuP)					
	Mission Analysis & CONOPS	Business & Mission Analysis (SrP)	Technical Risk Management (SrP)		Leadership (E)		
		Stakeholder Needs & Req Definition (SrP)	Technical Management (E)		Communication - Includes Virtual Environments (SrP)		
			Requirements Management (SrP)				
	Best Practices of Good Requirements	Stakeholder Needs & Req Definition (SrP)	Requirements Management (P)		Leadership (P)		
		System Requirements Definition (P)			Communication - Includes Virtual Environments (P)		
		Verification (P)					
		Validation (P)					
Notes: Proficiency Levels: A=Aware; SuP=Supervised practicioner; P=Practicioner; SrP=Senior Practicioner;							
Proficiency Level in each competency indicates the minimally acceptable proficiency							

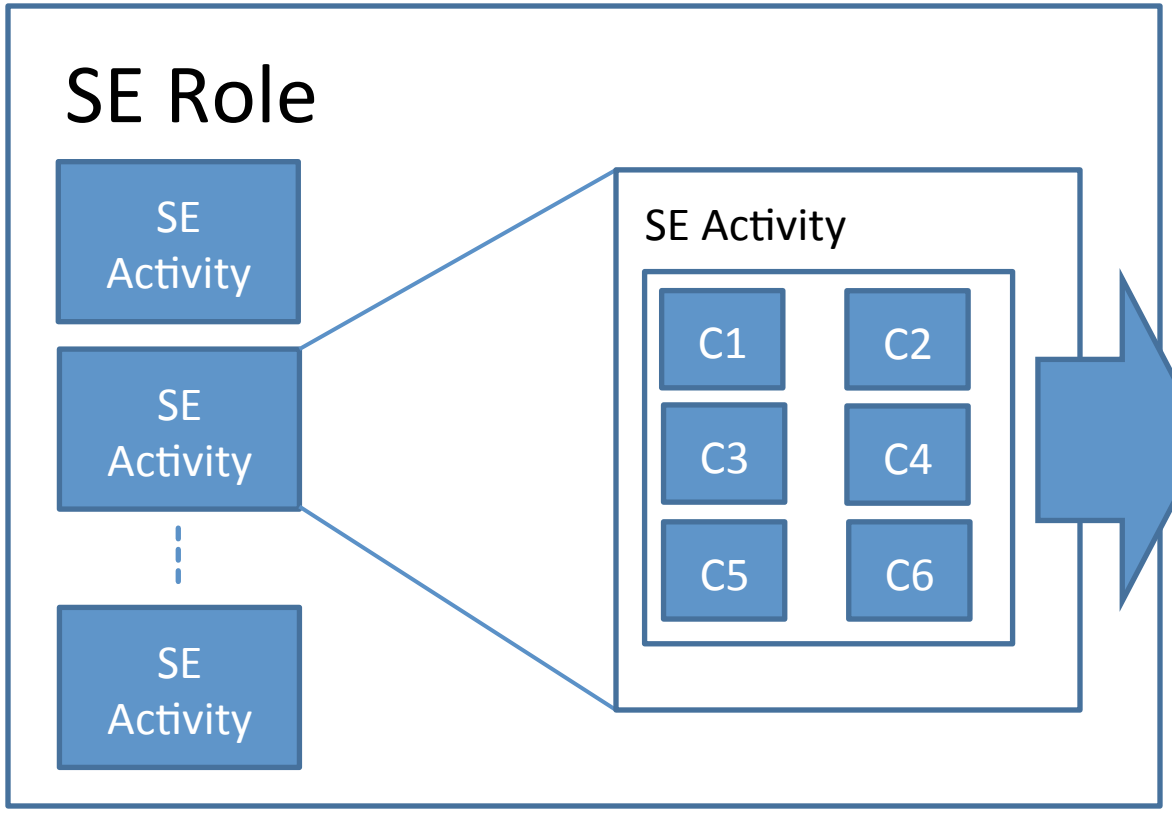




SE Role – Based Competency Framework

SE Role: Requirements Manager

SE Activity →	• Works with SE Requirements Management Processes and Tools
SE Activity →	• Conducts Mission Analysis of Stakeholder Needs and Concept of Operations
SE Activity →	• Applies Best Practices of Good Requirements

SE Role – Based Competency Framework



Competency Classes:

C1: Technical Processes
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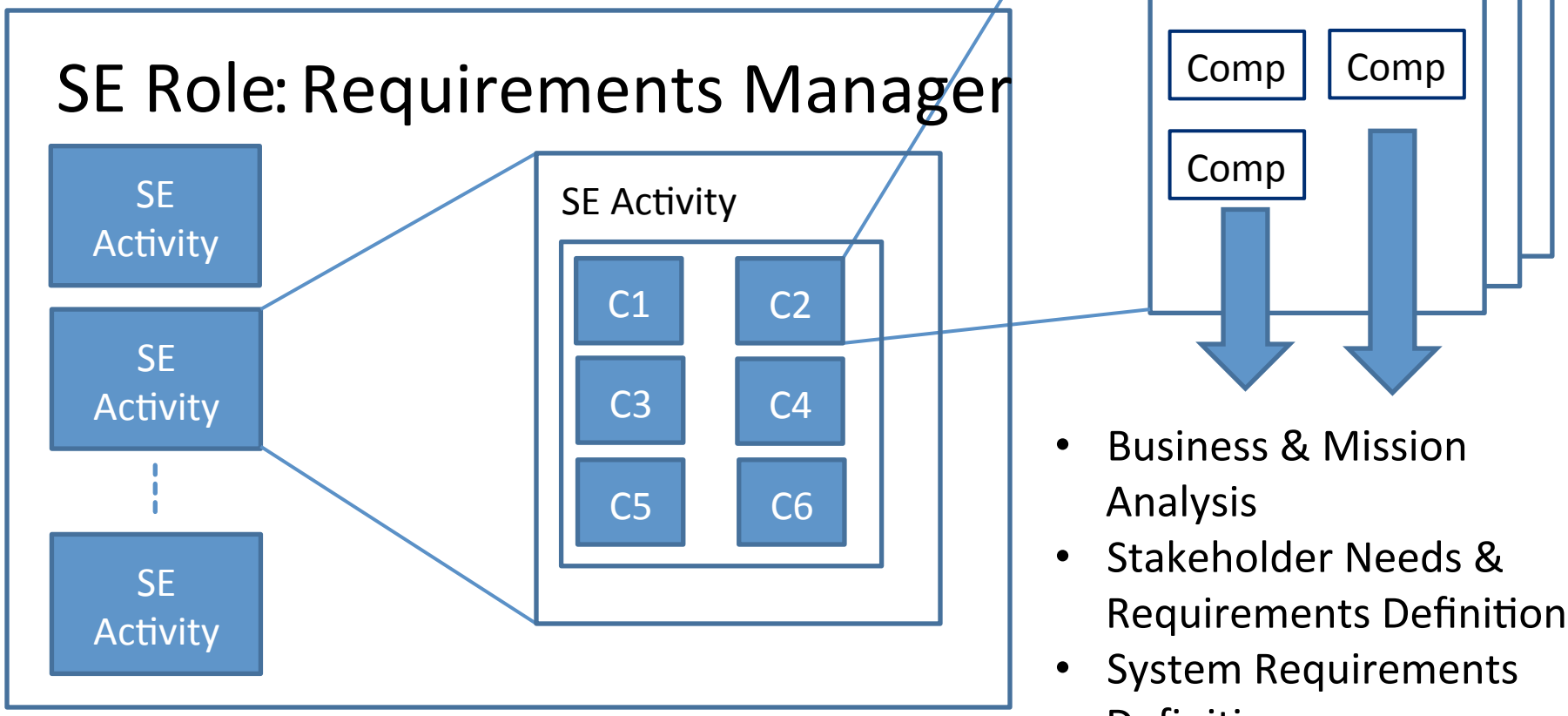
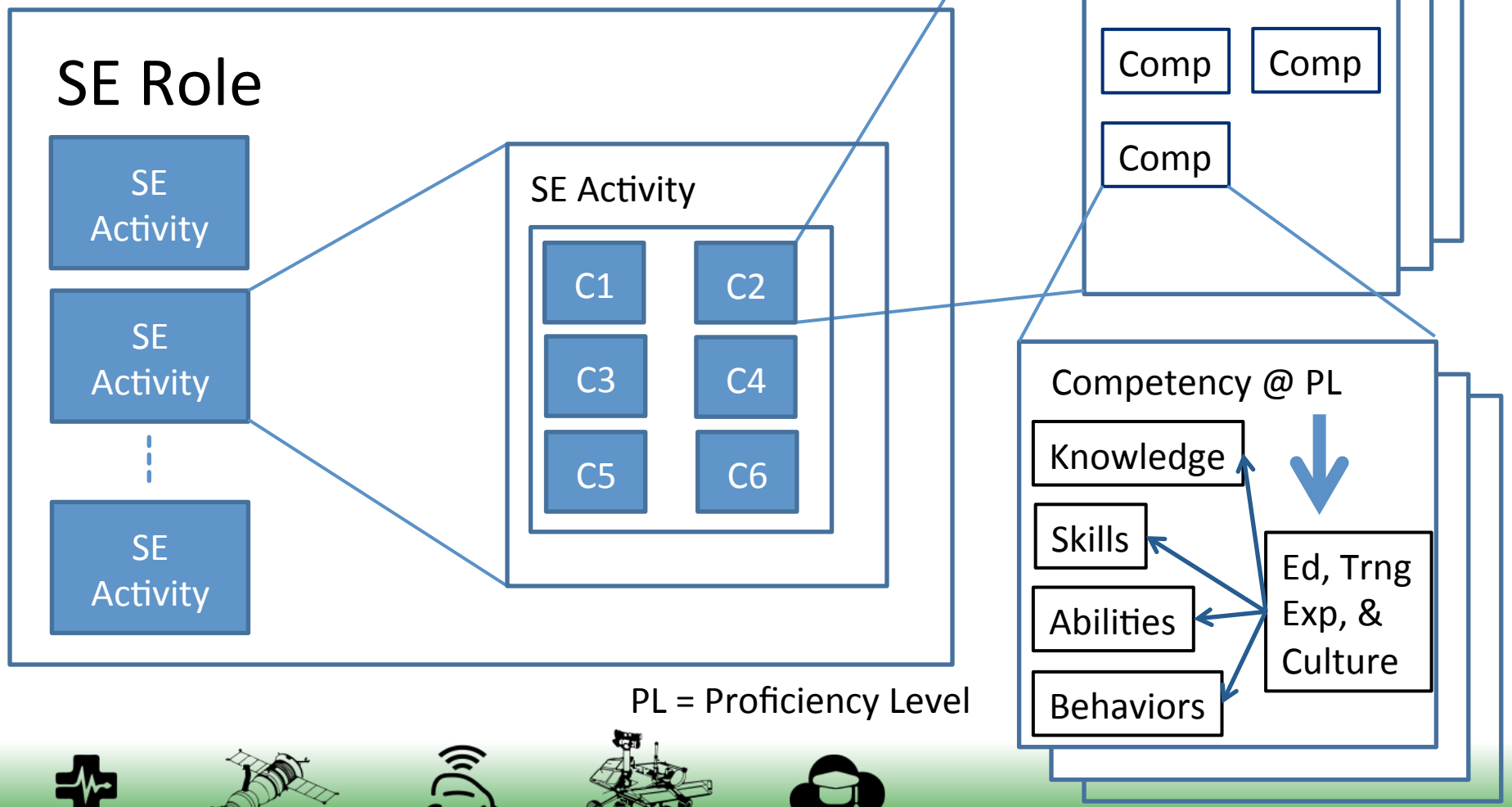
SE Role – Based Competency Framework



- Business & Mission Analysis
- Stakeholder Needs & Requirements Definition
- System Requirements Definition
- Etc.

SE Role – Based Competency Framework



PL = Proficiency Level