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The Soft Skills to Give Systems Engineers a Hard Edge

# Professional Competencies

www.incose.org/symp2019

# The Presenters

Richard Beasley joined Rolls-Royce in 1986 with a Physics Degree from Bristol University, and an MSc in Gas Turbine Engineering from Cranfield University. After working on Integration Aerodynamics, Safety, Reliability and Life Cycle Engineering, he became the Global Chief of Systems Engineering and in 2011 was made Rolls-Royce Associate Fellow in Systems Engineering. He was part of the BKCASE SEBoK author team, one of the leading authors on the INCOSE SE competency framework, and is a Past-President of the UK INCOSE Chapter. He is a Chartered Engineer, Fellow of the Royal Aeronautical Society, INCOSE ESEP, and was a Visiting Fellow to the Systems Centre at Bristol University.

Dr. Don Gelosh is the Director of Systems Engineering Programs at Worcester Polytechnic Institute (WPI). He is responsible for growing and developing the various SE programs delivered by WPI. Dr. Gelosh has over 43 years of systems engineering experience from the US Air Force, government, industry, and academia. Before WPI, Dr. Gelosh was Deputy Director for Workforce Development, working for the Deputy Assistant Secretary of Defense for Systems Engineering at the Pentagon. In a previous assignment, he was lead systems engineer for communications and payload integration on NASA's Vehicle Integration and Test Team supporting the Space Shuttle.

Andrew Pickard joined Rolls-Royce in 1977 after completing a Ph.D. at Cambridge University in Fatigue and Fracture of Metals and Alloys. He is a Rolls-Royce Associate Fellow in System Engineering, a Fellow of the Institute of Materials, Minerals and Mining, a Chartered Engineer and a member of SAE International and of INCOSE. He is Chair of the SAE Aerospace Council, represents Rolls-Royce on the INCOSE Corporate Advisory Board and is Chief of Staff for INCOSE.

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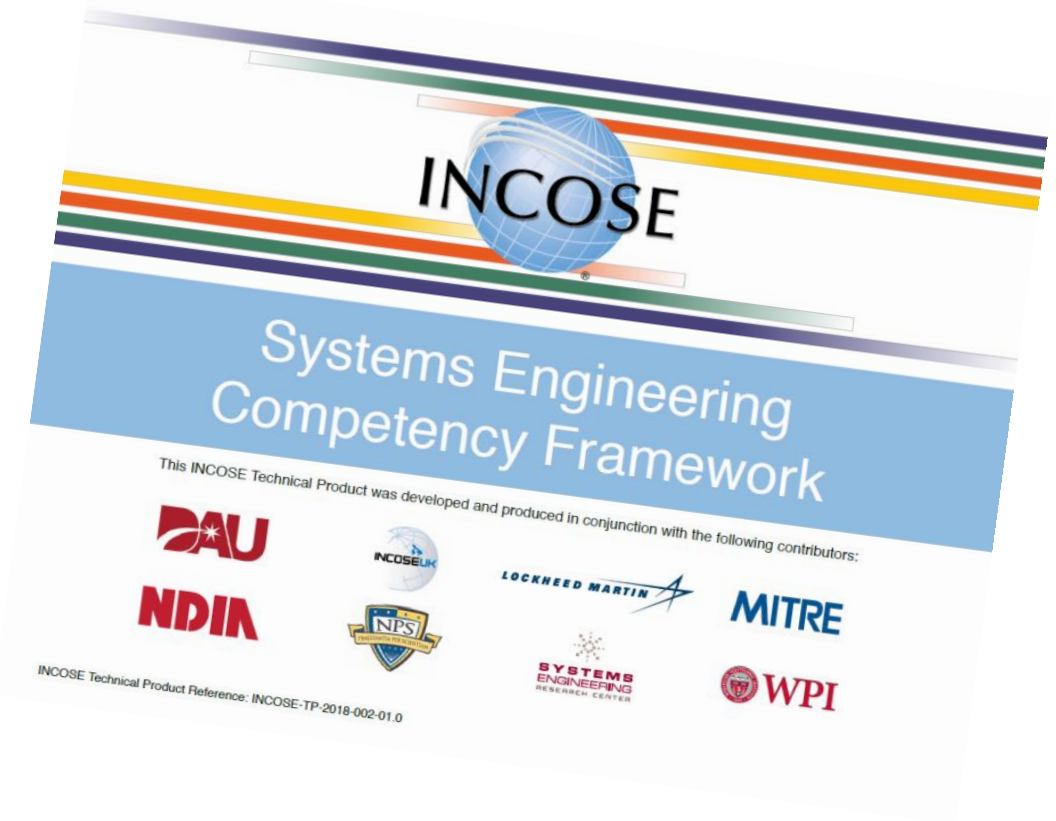
# Introduction

- The objective of the new INCOSE Competency Framework is to leverage existing competency frameworks and models in order to:
  - Capitalize on feedback received on existing frameworks and models from a decade of practical use globally.
  - Improve alignment with other INCOSE initiatives.
  - Address content and language to widen its appeal, recognizing the growth of a systems approach within several new domains.
  - Reflect the latest collective intelligence of industry as reflected in the data, descriptions and standards available as learning benchmarks globally.
- The framework represents a world view of 5 competency groupings with 36 competencies central to the profession of Systems Engineering, including evidence-based indicators of knowledge, skills, abilities and behaviors across 5 levels of proficiency.

# The Road to the Competency Framework

**International and Diverse Collaboration Founded on Consensus**:

- 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***

# Why Professional Competencies?

- General belief that if you are a systems engineer, then you must also be a leader – sometimes you have to lead without “authority”.
- Well executed systems engineering underpins all engineering efforts and has been proven to increase the probability of success on complex systems development.
- All engineering including systems engineering efforts are done by humans, which contributes to the overall complexity.
- It is therefore essential that all systems engineers understand how to effectively work with and lead people.

# Why these Specific Eight Competencies?

- The joint Competency Working Group (CWG) and the NDIA's SE Division's E&T Committee developed the first set of Professional Competencies in June 2013.
- The group considered well-established and internationally recognized definitions from their respective organizations and personal experience as managers and hiring authorities.
- Initial list included Leadership, Communication in a Virtual Environment, Communication, Team Dynamics, Interpersonal Skills, Problem Solving, Negotiation, Persuasion, Ethics, Critical Thinking, Judgment, Coordination, Mission & Results Focus, and Coaching & Mentoring.

# Why these Specific Eight Competencies?

- In November 2013, the joint group added Cultural Change Management and Strategic and Tactical Planning.
- In October 2015, V0.5 reduced the list to Leadership, Communications, Critical Thinking, Team Dynamics, Negotiation, and Ethics.
- At IW2016, reps from the INCOSE CAB agreed these were core: Leadership, Communications, Negotiations, and Facilitation.
- Final list June 2017 includes Communications, Ethics and Professionalism, Technical Leadership, Negotiation, Team Dynamics, Facilitation, Emotional Intelligence, Coaching and Mentoring.

# Professional Competencies

| Competence | Definition | Why it Matters |
|---|---|---|
| Communications | Dynamic process of transmitting and exchanging information | Communication plays a fundamental role within an organization to transfer information, develop a common understanding and maintain relationships. Ineffective communication identified as root cause of problems. |
| Ethics and Professionalism | Personal, organizational, and corporate standards of behavior expected of Systems Engineers | It is important that the professional Systems Engineer always acts ethically; in order to maintain trust, ensure professional standards are upheld, and that their wider obligations to society and the environment are met. |
| Technical Leadership | Application of technical knowledge and experience in SE with appropriate professional competencies | The complexity of modern system designs and challenges involved in producing solutions demands the highest levels of technical excellence throughout the lifecycle. |
| Negotiation | Dialogue between two or more parties intended to reach beneficial outcome where difference exist between them | Systems Engineers are the "glue" that hold elements of complex system development together. This necessitates resolution of many types of issue in order to gain agreement. Good negotiation skills are central to this activity. |
| Team Dynamics | Unconscious, psychological forces that influence the direction of a team's behavior and performance | Team dynamics can be good – for example when they improve overall team performance, or bad for example when they cause unproductive conflict, demotivation and prevent the team achieving its goals. |
| Facilitation | Act of helping others to deal with processes, solve problems, or reach a goal without getting directly involved | Systems Engineers work in situations where use of direct authority may not achieve desired results. An alternative form of leadership is "facilitative leadership", which is the ability to lead without controlling. |
| Emotional Intelligence | Ability to monitors one's own and others' feeling and use this information to guide thinking and actions | EI is regularly cited as critical competency for effective leadership / team performance. As SE involves interacting with many stakeholders, Emotional Intelligence key to success |
| Coaching and Mentoring | Development approaches using 1-to-1 conversations to enhance an individual's skills, knowledge or performance | Coaching and mentoring play an important role in the development of Systems Engineers, providing targeted development and guidance. It is a learning opportunities for both parties. |



# Exploring and Connecting Professional Competencies

- In the paper, we have explored connections and relationships between the eight Professional Competencies and various other Systems Engineering aspects (e.g. roles, other competencies, processes, etc.)
- We have indicated where we feel the Professional Competency makes a medium or strong contribution to these aspects
- These are based on the Authors' experience and understanding but are intended to be the start of a debate rather than definitive answers
- We believe discussing these relationships matures understanding of both the Professional Competencies and the other SE aspects

# 12 Roles vs. Professional Competencies

| KEY | Requirements owner | System Designer | System Analyst | Validation / Verification engineer | Logistics / Ops engineer | Glue Among subsystems | Customer Interface | Technical Manager | Information Manager | Process Engineer | Coordinator | Classified Ads SE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Communications | Strong | Medium | | Strong | | Strong | Medium | Medium | | Medium | Strong | |
| Ethics and Professionalism | Medium | | Medium | | Strong | | Medium | Medium | Strong | Strong | | |
| Technical Leadership | Medium | Strong | Strong | Medium | | | | Strong | | Medium | | |
| Negotiation | Medium | Strong | | Strong | | Strong | Strong | Medium | | | | |
| Team Dynamics | | Strong | Medium | | Medium | Medium | | Medium | | | Strong | |
| Facilitation | Strong | Medium | | | | Strong | Medium | | | Medium | Medium | |
| Emotional intelligence | Strong | Medium | | | | Strong | Medium | | | | Strong | |
| Coaching and mentoring | Medium | Strong | Strong | Medium | | Medium | | Medium | | Medium | | |

Sheard, S., 1996 *Twelve Systems Engineering Roles*, INCOSE International Symposium 6: 478-485, https://doi.org/10.1002/j.2334-5837.1996.tb02042.x

# Core Competencies

| KEY: Medium enablement / Strong Enablement | Systems Thinking | Lifecycles | Capability Engineering | General Engineering | Critical Thinking | Systems Modelling & Analysis |
|---|---|---|---|---|---|---|
| Communications | Medium | | | Strong | | Strong |
| Ethics and Professionalism | | Medium | | Strong | Strong | |
| Technical Leadership | | | Medium | Strong | Strong | Medium |
| Negotiation | Medium | | Strong | | Strong | |
| Team Dynamics | Medium | Strong | Strong | Medium | Medium | Medium |
| Facilitation | Strong | Medium | | | | Medium |
| Emotional intelligence | Strong | | Medium | Medium | Medium | |
| Coaching and mentoring | Strong | Medium | Medium | Medium | Strong | Strong |

# Mapping of SE Handbook Processes to Framework Competencies

Ref: Beasley et al, 2018: INCOSE Systems Engineering Competency Framework, INCOSE-TP-2018-002-01.0, Figure 3.

Note: This paper fills in the gaps against Professional Competencies

| New Framework Competency Areas | | INCOSE SE Handbook Processes: TECHNICAL PROCESSES | | | | | | | | | | | | | | | TECHNICAL MANAGEMENT PROCESSES | | | | | | | | AGREEMENT PROCESSES | | ORGANIZATIONAL PROJECT-ENABLING PROCESSES | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Business or mission analysis | Stakeholder needs and requirements definition | System requirements definition | Architecture definition | Design definition | System analysis | Implementation | Integration | Verification | Transition | Validation | Operation | Maintenance | Disposal | Project planning | Project assessment and control | Decision management | Risk management | Configuration management | Information management | Measurement | Quality assurance | Acquisition | Supply | Life cycle model management | Infrastructure management | Portfolio management | Human resource management | Quality management | Knowledge management |
| Core SE principles | Systems Thinking | ✓✓✓ | ✓✓✓ | ✓✓✓ | ✓✓✓ | ✓ | ✓ | ✓✓✓ | ✓✓✓ | ✓ | ✓✓✓ | ✓✓✓ | ✓✓✓ | ✓✓✓ | ✓✓✓ | ✓✓✓ | ✓ | ✓ | ✓ | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓✓✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| | Lifecycles | ✓ | ✓ | ✓ | ✓ | | ✓ | ✓✓✓ | ✓ | ✓✓✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | ✓ | | | ✓ | ✓ | ✓✓✓ | | ✓ | | | |
| | Capability Engineering | ✓ | ✓✓✓ | ✓ | ✓ | ✓ | ✓ | | ✓✓✓ | ✓ | ✓ | ✓✓✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓✓✓ | ✓ | ✓ | ✓ |
| | General Engineering | ✓ | ✓✓✓ | ✓ | ✓✓✓ | ✓✓✓ | ✓✓✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | ✓ | ✓✓✓ | | ✓ | | | | | | | | | | ✓ |
| | Critical Thinking | ✓ | ✓✓✓ | ✓ | ✓✓✓ | ✓✓✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓✓✓ | ✓✓✓ | ✓✓✓ | | ✓ | ✓ | ✓✓✓ | | | | | | | ✓✓✓ | ✓ |
| | Systems Modelling and Analysis | ✓✓✓ | ✓✓✓ | ✓✓✓ | ✓✓✓ | ✓✓✓ | ✓✓✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | | ✓ | ✓✓✓ | ✓ | ✓ | | | | | ✓ | ✓ | | ✓ | ✓ | ✓ |
| Professional Competencies | Communications | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | Ethics and Professionalism | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | Technical Leadership | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | Negotiation | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | Team Dynamics | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | Facilitation | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | Emotional Intelligence | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | Coaching and Mentoring | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Technical Competencies | Requirements Definition | ✓✓✓ | ✓✓✓ | ✓✓✓ | ✓ | | | | | ✓ | | ✓ | ✓ | ✓ | ✓ | | | | ✓ | | ✓ | | ✓✓✓ | ✓ | ✓ | | | | | ✓✓✓ | |
| | System Architecting | | ✓ | | ✓✓✓ | ✓✓✓ | | | | | | | | | | | | | | | | | | | | | | | | | |
| | Design for… | | | | | ✓✓✓ | ✓✓✓ | | | | | | | | | | | | | | | | ✓ | | | ✓ | | | | ✓✓✓ | |
| | Integration | | | | ✓ | ✓ | ✓ | ✓✓✓ | ✓✓✓ | | | | | | | | | | | | | | | | | | | | | | |
| | Interfaces | | ✓ | | ✓ | ✓ | | | ✓ | | | | | | | | | | | | | | | | | | | | | | |
| | Verification | | | | | | | | | ✓✓✓ | | | | | | | | | | | | | | | | | | | | | |
| | Validation | ✓ | ✓ | | | | | | | | | ✓✓✓ | | | | | | | | | | | | | | | | | | | |
| | Transition | | | | | | | | | | ✓✓✓ | | | | | | | | | | | | | | | ✓✓✓ | | | | | |
| | Operation and Support | | | ✓ | ✓✓✓ | ✓✓✓ | ✓✓✓ | | | | | | | | | ✓✓✓ | | ✓ | | | | | | | | | | | | | |
| SE Management Competencies | Planning | | ✓ | ✓ | | ✓ | ✓ | ✓ | ✓✓✓ | ✓ | ✓✓✓ | ✓✓✓ | | | | ✓✓✓ | | | ✓ | | | | | | | ✓ | | ✓ | | | |
| | Monitoring and Control | | | | | | | ✓ | ✓ | ✓ | ✓ | ✓ | | ✓ | | | ✓✓✓ | ✓ | ✓ | | | ✓✓✓ | | | | | | | | | |
| | Decision Management | | | | ✓✓✓ | ✓✓✓ | | ✓ | | | | | | | | | | ✓✓✓ | | | ✓ | | | ✓ | | | | | | | | |
| | Concurrent Engineering | | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | | | | | ✓ | ✓ | | | | ✓✓✓ | | | | | | | | | | |
| | Business & Enterprise Integration | ✓✓✓ | ✓ | | | | | ✓ | | | ✓ | | ✓ | ✓ | ✓ | | | | | | ✓ | | | | | | ✓✓✓ | ✓ | ✓✓✓ | ✓✓✓ | ✓✓✓ |
| | Acquisition and Supply | | | ✓✓✓ | | | | ✓✓✓ | ✓ | | | | | | | | | ✓ | ✓ | ✓ | | | | ✓✓✓ | ✓✓✓ | | | | | | |
| | Information Management | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | ✓ | ✓✓✓ | | ✓ | ✓ | ✓ | ✓ | | | | | | ✓✓✓ | | | | | | | | | | |
| | Configuration Management | | | | ✓ | ✓ | ✓ | | ✓ | ✓✓✓ | ✓ | ✓ | ✓ | ✓ | | | | | | ✓✓✓ | | | | | | | | | | | ✓ |
| | Risk and Opportunity Management | | ✓ | | | | | | | | | | | | | ✓✓✓ | ✓✓✓ | ✓ | ✓✓✓ | ✓ | ✓ | | | | | | | ✓✓✓ | | | |
| Integrating Competencies | Project Management | | ✓ | | | | | | | | | | | | | ✓✓✓ | ✓✓✓ | | ✓ | | | | | ✓ | ✓ | ✓ | ✓ | ✓✓✓ | ✓ | | |
| | Finance | ✓ | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | Logistics | | | | | | | | | | | | | | | | | | | ✓ | ✓ | | | ✓ | ✓✓✓ | | ✓ | | | | |
| | Quality | ✓ | ✓ | ✓ | | | | | | | | | | | | | | | | | | | ✓✓✓ | ✓✓✓ | ✓✓✓ | | | | | ✓✓✓ | |

# Technical Processes

| KEY | Business or mission analysis | Stakeholder needs and requirements definition | System Requirements definition | Architecture definition | Design Definition | Systems Analysis | Implementation | Integration | Verification | Transition | validation | Operation | Maintenance | Disposal |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Medium Enablement / Strong Enablement | | | | | | | | | | | | | | |
| Communications | M | S | M | M | M | M | M | S | M | S | M | S | S | |
| Ethics and Professionalism | M | M | S | M | M | M | S | M | S | M | S | S | S | S |
| Technical Leadership | | M | M | S | S | S | M | S | M | S | M | M | M | M |
| Negotiation | S | S | S | M | S | | M | | S | | M | M | | |
| Team Dynamics | | M | M | | M | S | | | S | M | M | M | M | |
| Facilitation | M | S | M | S | M | | | M | M | | | M | M | |
| Emotional intelligence | S | S | S | S | M | M | | M | | S | | M | M | M |
| Coaching and mentoring | S | S | S | M | M | S | M | M | M | M | M | M | M | M |

# Alignment to the Remaining Processes

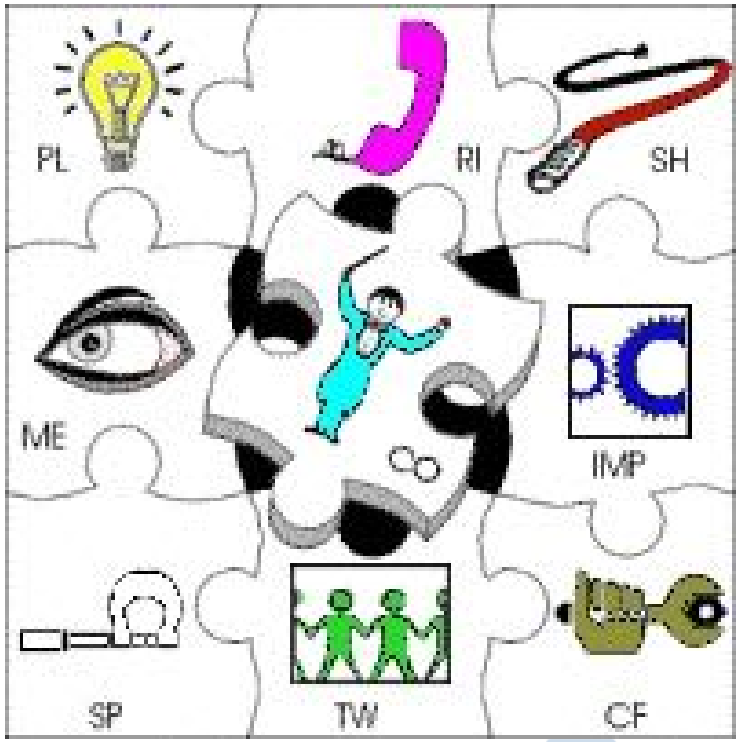
| KEY | Technical Management Processes | | | | | | | | Agreement processes | | Organizational Project Enabling Processes | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Medium Enablement / Strong Enablement | Project planning | Project assessment and control | Decision management | Risk management | Configuration management | Information management | Measurement | Quality assurance | Acquisition | Supply | Life cycle model management | Infrastructure management | Portfolio management | Human resource management | Quality management | Knowledge management |
| Communications | Strong | Strong | Strong | Medium | | | Medium | Medium | Medium | Medium | | | Medium | Strong | Strong | Strong |
| Ethics and Professionalism | Medium | | Strong | Medium | Medium | Medium | Strong | Strong | Strong | Strong | | Medium | Medium | Strong | Strong | |
| Technical Leadership | | Medium | Strong | Medium | | | Medium | | | | Medium | | | | | Medium |
| Negotiation | Strong | Strong | Medium | | | | | | Strong | Strong | | Strong | Strong | Strong | Medium | |
| Team Dynamics | | Strong | Medium | | | Medium | | | | | | Strong | Strong | Strong | | Medium |
| Facilitation | Strong | | Medium | Strong | | | Medium | | | | | | | Strong | | Strong |
| Emotional intelligence | Strong | Strong | Strong | | | | Medium | Medium | Medium | Medium | Medium | Medium | Medium | Strong | | |
| Coaching and mentoring | Strong | Strong | Medium | Strong | Medium | Medium | Medium | Strong | Medium | Medium | Medium | Medium | Medium | Strong | Strong | Strong |

# Belbin Roles vs. Competencies

| KEY | Plant. | Resource Investigator | Coordinator | Shaper | Monitor Evaluator | Team Worker | Implementer | Completer Finisher | Specialist |
|---|---|---|---|---|---|---|---|---|---|
| Communications | | Strong | Medium | | Medium | Strong | | | Medium |
| Ethics and Professionalism | | | | Strong | | Medium | Strong | Strong | Medium |
| Technical Leadership | Strong | | | | Medium | | Strong | Medium | Strong |
| Negotiation | | Strong | Medium | | Strong | | | | |
| Team Dynamics | | Medium | Strong | Medium | Medium | Strong | Medium | | |
| Facilitation | Medium | Medium | Strong | | | Medium | Medium | | Medium |
| Emotional intelligence | Strong | | Strong | Medium | Strong | | | | Medium |
| Coaching and mentoring | | | Medium | | | | Medium | | Strong |

| | |
|---|---|
| Plant | Creative, imaginative. Solves difficult problems |
| Resource Investigator | Extrovert, enthusiastic. Develops contacts |
| Coordinator | Mature, confident. Clarifies goals, promotes decision-making, delegates well |
| Shaper | Challenging, dynamic. Thrives on pressure. Overcomes obstacles |
| Monitor Evaluator | Strategic and discerning. Sees all options, judges accurately |
| Team Worker | Co-operative, perceptive and diplomatic. Listens and averts friction |
| Implementer | Disciplined, reliable and efficient. Turns ideas into practical actions |
| Completer Finisher | Painstaking, conscientious. Searches for errors and omissions. Delivery on time |
| Specialist | Single-minded, dedicated. Provides knowledge and skills in short supply |

Note: This analysis is not included in the paper






# Professional Competencies and Incompetencies

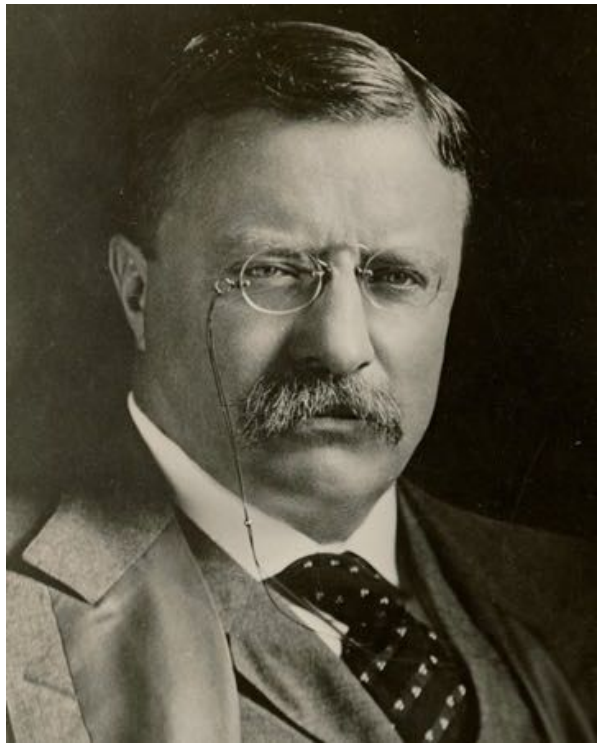
- Serious side – there is one!
- Not just the absence of the competency
- Not just bad behaviour
- In some circumstances and in some organizations these are seen as strengths
- Four of the Professional Incompetencies are selected for further discussion in this presentation – please see the paper for a more comprehensive discussion

# Professional Competencies and Incompetencies

| Competence | Competency Definition | Incompetence | Incompetency Definition |
|---|---|---|---|
| Communications | Dynamic process of transmitting and exchanging information | Confuse and Insult (aka Consult) | Taking information from the frustrated and feeding it back to management as new insights |
| Ethics and Professionalism | Personal, organizational, and corporate standards of behavior expected of Systems Engineers | Being Economical with the Truth | The art of leaving a trail of destruction without getting found out or having to clear up the mess |
| Technical Leadership | Application of technical knowledge and experience in SE with appropriate professional competencies | Copying the Competition | Removing risk by replicating the ideas of those who got there before you |
| Negotiation | Dialogue between two or more parties intended to reach beneficial outcome where difference exist between them | * Carrying a Big Stick and Shouting About It | Treating suppliers as enemies and misunderstanding the difference between cost and value |
| Team Dynamics | Unconscious, psychological forces that influence the direction of a team's behavior and performance | * Creating Dysfunctional Teams | The resource managers who ignore team dynamics when allocating people to a team.<br>The project managers who recruit people to the team in their own image. |
| Facilitation | Act of helping others to deal with processes, solve problems, or reach a goal without getting directly involved | * Creating Ivory Towers | The act of creating barriers between teams for successful product sub-optimization |
| Emotional Intelligence | Ability to monitors one's own and others' feeling and use this information to guide thinking and actions | Graves Level 3 Management | The ability to force everyone else to follow your lead by power-play, focusing on the "now" and blind stubbornness |
| Coaching and mentoring | Development approaches using 1-to-1 conversations to enhance an individual's skills, knowledge or performance | * Mushroom Management | Development approaches based on keeping people in the dark and feeding them with only your version of the truth |

* Two of these four (Negotiation and Facilitation) are strong enablers of Sheard's "glue among disciplines" – so remember SE must work not to be "yet another discipline" but an integration role to increase the probability of a successful outcome

# Speak softly and carry a big stick…

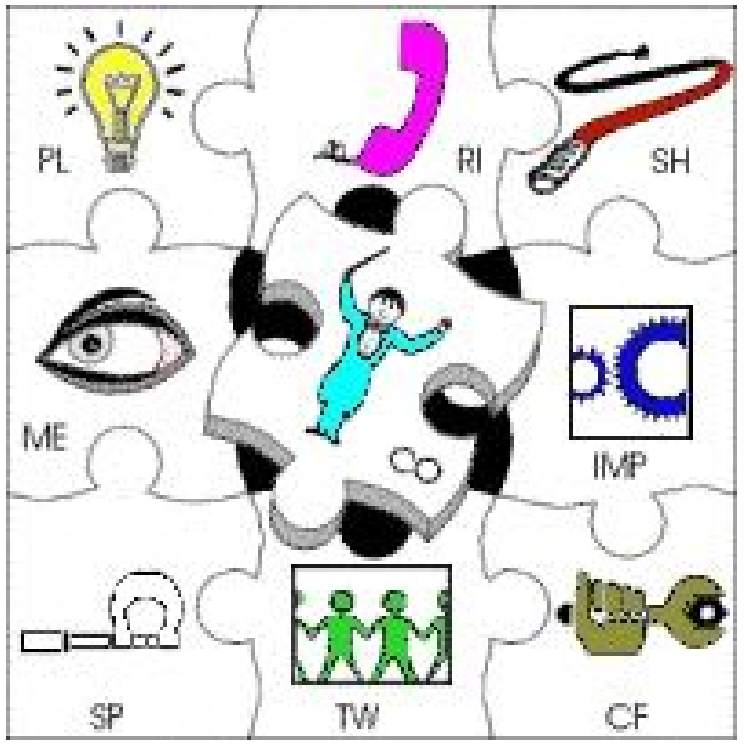


*"I have always been fond of the West African proverb: 'speak softly and carry a big stick; you will go far'. If I had not carried the big stick the Organization would not have gotten behind me, and if I had yelled and blustered as Parkhurst and the similar dishonest lunatics desired, I would not have had ten votes"* (Roosevelt, 1900)

Building Deeper Supplier Relationships (Liker and Choi, 2004)

- USA Auto Manufacturers (at the time): Suppliers threatened with a big stick (moving the business elsewhere) and a lot of shouting, with precious little negotiation.
- Japan Auto Manufacturers: *Keiretsu*: "building close-knit networks of vendors that continuously learn, improve, and prosper along with their parent companies"

# Creating Dysfunctional Teams




- Successful teams are balanced and over the course of a project all nine roles will be required.
- Dr Belbin's study and subsequent investigations showed that there was little to no bias in preferred roles associated with race or gender, although an organization, via its recruitment approach, may create a bias towards one or more of the team roles.
- Teams with an excess or absence of a role are less likely to be effective:
  - Too many Shapers = FIREWORKS!!!
  - Too many Monitor Evaluators = Analysis Paralysis
  - No Completer Finishers = Project not implemented or implemented ineffectively
- Self-awareness is key

Request More Information

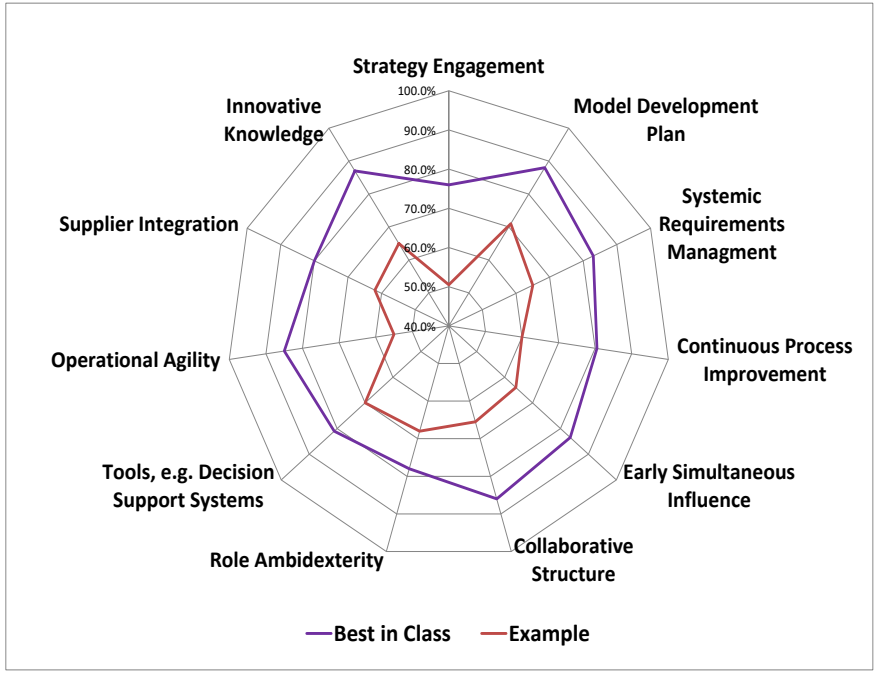
# Creating Ivory Towers

Pejorative: Creating areas of specialist knowledge which may not be related to the real world, with no intention of sharing this knowledge with others who are not part of that Ivory Tower.

Not pejorative: Withdrawing from the hustle and bustle of the world for some time for quiet contemplation. A positive thing to do, to bring balance to life and a different perspective on thinking about systems and their development.

The pejorative version is the opposite of Facilitation: The act of helping others to deal with processes, solve  problems, or reach a goal without getting directly involved

# SPOT Background

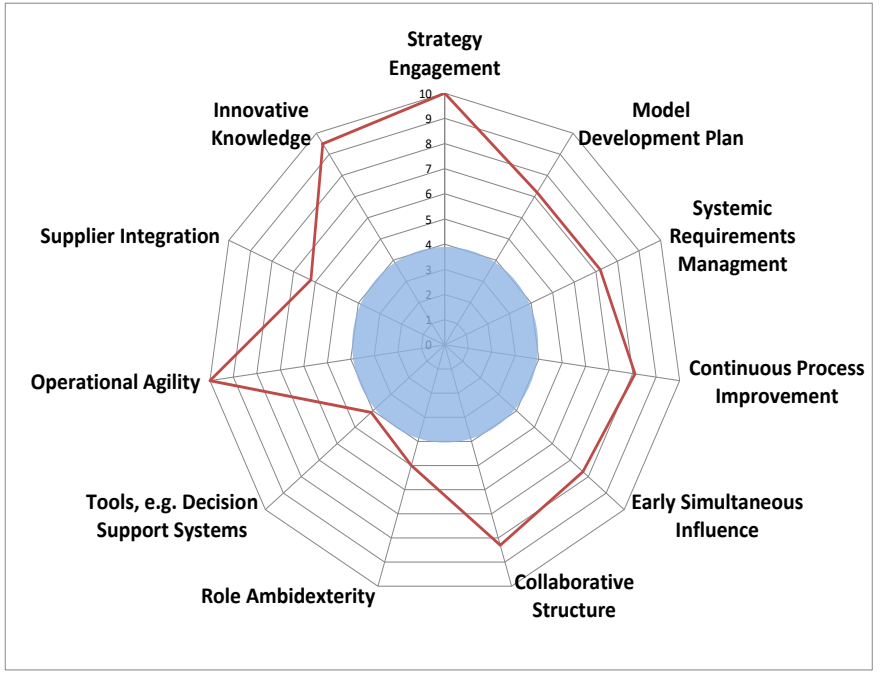



*Birdseye view of gaps vs. Best-in-Class practices*

The SPOT (Strategy, Process, Organization, Tools/Techniques) approach to improving project performance (Hull et al, 2004):

- Key factors that have a significant impact on an organization's capability to deliver successful projects

- Project performance includes:
  - Cost
  - Time
  - Quality
  - Innovation




*Big Bang gaps of high leverage opportunities*

Late stage Engineering Change Notices (ECNs) have also been correlated with the SPOT Key factors:

- Late Stage ECNs are a strong leading indicator of poor project performance

# SPOT Indicators of Mushroom Management

| SPOT Area | *Leading Indicator* Late Stage Engineering Change Notices | ECNs | Cost | Innovation | Cost, Time, Quality & Innovation |
|---|---|---|---|---|---|
| S | A. Strategy Engagement | | | | |
| P | B. Requirements Management | | | | |
| P | C. Process Improvement | | | | |
| O | D. Early Simultaneous Influence | | | | |
| O | E. Downstream Engagement | | | | |
| O | F. Decentralized Decisions | | | | |
| O | G. Role Ambidexterity | | | | |
| T | H. Agility of Operations | | | | |
| S | I. Innovative Knowledge Search | | | | |
| O | J. Lean/Concurrent Product Development | | | | |

= Very Strong Correlation

= Strong Correlation

= Moderate Correlation

= Weak Correlation

- Lack of Strategy Engagement shows a very strong correlation with Late Stage ECNs
- If the team does not understand the Project strategy, it is at risk of making wrong trade-offs, resulting in high levels of scrap and rework.
- The team may also feed the wrong information to high level decision makers if the team doesn't know what on their project has strategic impact.
- Lack of Early Simultaneous Influence and Downstream Engagement also limit communication with the team.

# Competencies and Leadership

- At IS2015, INCOSE established the “Institute for Technical Leadership”.
- Primary purpose: *Accelerate the development of systems engineering leaders who will exemplify the best of our organization and our profession.*
- A Technical Leadership Model developed by the members defines the state of “being a systems technical leader” through six interdependent concepts:
  - Holding the Vision (*Technical Leadership*)
  - Thinking Strategically (*Technical Leadership*)
  - Fostering Collaboration (*Negotiation, Team Dynamics, and Facilitation*)
  - Communicating Effectively (*Communications*)
  - Enabling Others to be Successful (*Mentoring/Coaching and Ethics/Professionalism*)
  - Demonstrating Emotional Intelligence (*Emotional Intelligence*)



# Implications for SE as a Discipline

Systems Engineering done by people, and they need right professional competencies

- INCOSE now has defined most relevant professional competencies as part of competency framework
  - We need to start using them, and using common language across the community
- Recognise the importance of adapting to specific organization situations (e.g. difference in accountability between PM and SE)
  - Need use cases / “war stories” of application
- Need to develop ideas of training for these competencies, within the context of the practice of Systems Engineering
- Recognize differences in interpretation
  - Talk about them – this paper / presentation meant to be START of conversation / debate
  - Recognize our unconscious bias when doing this

# Conclusions

- Inclusion of professional competencies (aka “soft skills”) in INCOSE competency framework is enormously important.
- Since all the professional competencies are “good things” to be, important to review / prioritize which most important to specific role / competency:
  - Ask what makes most difference in this situation?
- Reverse competencies (incompetencies) are all too common. So we do not only need to look for absence of SE competency, but to guard against negative practice.
- This is start of conversation – we want to provoke a debate especially on which competencies are most important to different situations.

**Unlike Fight Club, the first rule of Professional Competencies is that they must be talked about**

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