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# Systems Engineering Role Evolution and the Right Stuff

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# Presenters and Agenda



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## Agenda:

- Why this paper?
- Research Questions
- Historical Evolution of SE Roles
- SE Role Framework
- The Role-Personality Fit Challenge
- Belbin Team Roles Summary
- Myers-Briggs & DISC Summary
- LLM AI Role Suitability Method
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- Educator Role vs. Traditional SEs
- Innovator & Stakeholder Interface Roles
- Conclusion and Take-Aways

# Why This Paper?

- The original 1996 systems engineering roles framework remains widely cited.
- Nearly 30 years of change: MBSE, cyber-physical systems, sociotechnical complexity.
- How have SE roles evolved? Are today's engineers still the "right stuff"?

## Research Questions

1. Can LLM AI analyze SE roles against personality/team roles effectively?
2. What are the limitations of this approach?
3. Which personality types fit best with each SE role?

### TWELVE SYSTEMS ENGINEERING ROLES

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**Abstract.** Twelve roles are described which are occasionally or frequently assumed to constitute the practice of systems engineering. These roles fit comfortably in life-cycle roles, others fit the Program Management set of roles, while still others are not normally thought of as either group. Interactions between the roles are discussed, and the systems engineering roles assumed by the papers in the upcoming issue of Systems Engineering, the Journal of INCOSE, are compared to these categories.

#### INTRODUCTION

Since its inception, INCOSE has been attempting to resolve the question of what, exactly, is systems engineering. Several difficulties have been explored, including whether systems engineers are specialists or generalists, and whether systems engineering is a set of life-cycle roles, such as the generation of specifications and verification programs, or is an overall program management discipline. There has even been a discussion on whether systems engineering is a discipline or an attitude [Mc92]. Workable and viable arguments have been put forth on both sides of each issue, leaving some to despair of ever being able to pin down definitions that all can agree on.

A local chapter presentation on the value of systems engineering<sup>1</sup> provided the impetus for this paper. The presenter seemed to be talking about entirely different definitions of systems engineering and the roles that systems engineers play. A compilation of the roles seemed essential to developing more important questions in the field of systems engineering. A companion paper in this volume, "The Value of Twelve Systems Engineering Roles" [Sheward96], addresses the value of systems engineering from the point of view of the roles described in this paper.

To derive these twelve systems engineering roles, papers in the upcoming issue of Systems Engineering,

the Journal of INCOSE, were reviewed for assumptions about roles that systems engineers play. More than seven descriptions of roles were collected and grouped into the twelve groupings presented below. Thus four years of INCOSE symposium proceedings were scanned to assure that most of the possible systems engineering roles were captured. This initial scan to include roles applicable both to the typical DOO and enterprise environment and to less structured systems engineering environments such as smaller programs and commercial companies. Finally, the *Stratagem* Post newspaper's "High-Tech" classified advertisement section was examined to determine what the world of employers considered systems engineering to be.

This paper is organized in four sections. First, the meaning of "systems engineering roles" is discussed. Next, twelve systems engineering roles are defined. These roles are then considered in relation to "life-cycle" and "program management" roles, the two major paradigms of systems engineering responsibility. Finally, the roles assumed in the first issue of Systems Engineering are characterized with respect to the twelve defined roles.

#### SYSTEMS ENGINEERING ROLES VERSUS SYSTEMS ENGINEERS' ROLES


There has been much discussion about whether INCOSE is about systems engineers or about systems engineering. The difference here is whether all engineers should be included in systems engineers or just those with a "systems engineering" title or job. If all engineers can do systems engineering, it is by considering the idea that they are engineering to be a system within a larger system, and by accounting operational issues, interfaces, and architecture of both systems.

The confusion arises about in part because many of the companies who have provided the basis for the field of systems engineering have done so by creating "systems engineering" departments or other groups, and charging them with systems engineering the product that is delivered to the customer. Within the company, those engineers who work on the sub-systems or



# Historical Evolution of SE Roles

- 1996: 12 roles defined by Sheard.
- 2000–2019: Roles expanded and adapted (e.g., Architect, Modeler, Innovator) – Sheard (2000), Amit et al (2013), Hutchison et al (2017), Græssler et al (2019)
- Reflects tech trends: cybersecurity, stakeholder focus, digital modeling.
- See IS 2025 Paper 40 for a full description of the latest evolution of the Systems Engineering Roles (Presented on Tuesday 29 July 2025 at 1:30pm)



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## Systems Engineering Roles for a New Era

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**Abstract.** Nearly thirty years ago, a classic paper was written that described systems engineering in terms of twelve roles (actually eleven plus an “other”). (Sheard, 1996) That paper is still being cited today, and the ResearchGate site reported it surpassed 20,000 reads on their site alone, including 46 citations since 2020. Yet model-based systems engineering, digital engineering, ubiquitous agile, DevSecOps, intense sociotechnical systems, and global systems of distributed architectures were nonexistent or at best newborn when that paper was written. Furthermore, an easily adopted kind of artificial intelligence appeared on the systems engineering stage around 2015 and exploded beginning in about 2020.

This paper updates the roles in the 1996 paper to provide a clearly-still-needed set of systems engineering roles consistent with today’s systems engineering reality. With these roles, practitioners, managers, and those working with systems engineers have a description of what needs to be done to engineer 21<sup>st</sup> century systems and a means to negotiate what performs what tasks for which system levels. This allows a more complete set of system agreements and better operating complex systems.

**Keywords.** Systems engineering roles, digital engineering, artificial intelligence, value of roles, systems engineering challenges.

### Introduction

In the 29 years since the well-known *Twelve Systems Engineering Roles* paper (Sheard 1996) was published, the environment around systems engineering has changed drastically. Google was not even around in 1996. Model-based systems engineering (MBSE) has grown to prominence, digital engineering has taken over from document-based engineering, and artificial intelligence has recently exploded into systems engineering practice. That systems engineering authors still cite such an old paper is evidence that the community needs a reference for critical systems engineering roles. However, we should be using a baseline of roles better adapted to this changed and changing environment. This paper presents new roles that account for industry input, software dominance, digital engineering, and sociotechnical systems, as well as the recent explosion of the use of artificial intelligence.

# SE Role Framework

- 10 primary roles:  
Core SE tasks
- 8 support roles

Source: IS 2025 Paper 40, Consolidated from 1996–2019 frameworks.

Primary Roles	
1 CL	Coordinator/Leader
2 CY	Security Engineer
3 MO	System Modeler
4 RO	Requirements Owner
5 SA	Systems Architect
6 SD	System Designer
7 SI	System Interface Owner
8 ST	Stakeholder Interface Manager
9 TM	Technical Manager
10 VV	Validation and Verification Engineer

Support Roles	
11 AI	AI Chief
12 CH	Systems Engineering Champion
13 ED	Educator
14 IE	Implementation Engineer
15 IM	Information Manager
16 IN	Innovator/Initiator
17 LC	Life Cycle Engineer
18 PO	Process Owner



# The Role – Personality Fit Challenge

- Not all engineers are the same.
- Assigning roles without considering personality or preferred team role risks poor performance.
- Considering personality and preferred team role identifies opportunities for mentoring and coaching.
- Used LLM AI to match SE roles with:
  - o Belbin Team Roles (9 types)
  - o Myers-Briggs (16 Personality types)
  - o DISC (4 Personality types)



# Belbin Team Roles Summary

## Key team role traits:

- Plant: Creative but aloof.
- Shaper: Driven but abrasive.
- Monitor Evaluator: Discerning but uninspiring.
- Specialist: Expert but narrow.

Belbin, R.M. and Brown, V. (2023). Team Roles at Work - third Edition, Routledge, eISBN 978-1-003-16315-2.

Role	Team Role Contribution	Allowable Weaknesses	Unallowable Weaknesses
Plant	Creative, Imaginative, Unorthodox, Solves Difficult Problems	Ignores Details, Too Preoccupied to Communicate Effectively	Strong Ownership of Idea When Cooperation with Others Would Yield Better Results
Resource Investigator	Extrovert, Enthusiastic, Communicative, Explores Opportunities, Develops Contacts	Overoptimistic, Loses Interest Once Initial Enthusiasm has Passed	Letting Clients Down by Neglecting to Follow up Arrangements
Coordinator	Mature, Confident, A Good Chairperson, Clarifies Goals, Promotes Decision Making, Delegates Well	Can be Seen as Manipulative, Delegates Personal Work	Taking Credit for the Effort of a Team
Shaper	Challenging, Dynamic, Thrives on Pressure, Has the Drive and Courage to Overcome Obstacles	Can Provoke Others, Hurts People's Feelings	Inability to Recover Situation With Good Humor or Apology
Monitor Evaluator	Sober, Strategic, Discerning, Sees all Options, Judges Accurately	Lacks Drive and Ability to Inspire Others, Overly Critical	Cynicism Without Logic
Teamworker	Cooperative, Mild, Perceptive, Diplomatic, Listens, Builds, Averts Friction, Calms the Waters	Indecisive in Crunch Situations, Can be Easily Influenced	Avoiding Situations that May Entail Pressure
Implementer	Disciplined, Reliable, Conservative, Efficient, Turns Ideas into Practical Actions	Somewhat Inflexible, Slow to Respond to New Possibilities	Obstructing Change
Completer Finisher	Painstaking, Conscientious, Anxious, Searches out Errors and Omissions, Delivers on Time	Inclined to Worry Unduly, Reluctant to Delegate, Can be a Nit-Picker	Obsessional Behavior
Specialist	Single-Minded, Self-Starting, Dedicated, Provides Knowledge and Skills in Rare Supply	Contributes on Only a Narrow Front, Dwells on Technicalities, Overlooks the "Big Picture"	Ignores Factors Outside Own Area of Expertise

# Myers-Briggs and DISC Summary

- MBTI: 16 personality types
- DISC:
  - Dominance: Direct, decisive
  - Influence: Sociable, persuasive
  - Steadiness: Supportive, reliable
  - Conscientiousness: Precise, analytical

		Sensing Types		Intuitive Types			
		With Thinking	With Feeling	With Feeling	With Thinking		
Introverts	Judging	ISTJ Inspector/ Logistician	ISFJ Protector/ Defender	INFJ Advocate	INTJ Architect	Judging	Introverts
	Perceptive	ISTP Virtuoso	ISFP Composer/ Adventurer	INFP Mediator	INTP Thinker/ Logician	Perceptive	
Extraverts	Perceptive	ESTP Entrepreneur	ESFP Performer/ Entertainer	ENFP Campaigner	ENTP Debater	Perceptive	Extraverts
	Judging	ESTJ Supervisor/ Executive	ESFJ Consul	ENFJ Protagonist	ENTJ Commander	Judging	
		With Thinking	With Feeling	With Feeling	With Thinking		
		Sensing Types		Intuitive Types			

Briggs-Myers, I. and Myers, P. B. (1980). Gifts Differing: Understanding Personality Type – first edition, Consulting Psychologists Press Inc. (republished by Davies-Black Publishing), eISBN 978-0-89106-300-1.

Marston, W. M. (1928). Emotions of Normal People, 2019 edition, Read and Co. Science.



# LLM AI Role Suitability Method

Each SE role was assessed for:

- Belbin role suitability (rank 1–9)
- MBTI type suitability (rank 1–16)
- DISC type suitability (rank 1–4)

Color-coded

- Green = Very High & High
- Yellow = Moderate to High & Moderate
- Pink = Moderate to Low & Low

LLM AI Questions:

- Rank all nine Belbin Team Roles for their suitability or unsuitability to be {SE Role} and provide rationale for the ranking
- Rank all sixteen Myers-Briggs Personality Types for their suitability or unsuitability to be {SE Role} and provide rationale for the ranking
- Rank the four DISC Personality Types for their suitability or unsuitability to be {SE Role} and provide rationale for the ranking

Each question was posed 18 times, for each of the 18 Systems Engineering roles.

# Key Belbin Role Insights

- No Belbin role matched all SE roles.
- Monitor Evaluator had consistent medium-to-high suitability, and high suitability for all of the ten Primary SE Roles.
- Team-worker was generally least suited – but note the two high-ranked roles.
- Use Belbin profiles to assign roles more effectively.

See Paper 49 for examples of ranking rationale

	Belbin Team Role								
	Plant	Resource Investigator	Coordinator	Shaper	Monitor Evaluator	Teamworker	Implementer	Completer Finisher	Specialist
Green = This team role would be good at this SE role									
Yellow = This team role could satisfy this SE role									
Pink = Caution should be used when assigning this team role to this SE role									
Coordinator/Leader (CL)	7	4	1	2	3	6	5	8	9
Security Engineer (CY)	5	7	8	6	1	9	4	3	2
System Modeller (Analyst) (MO)	3	8	6	7	1	9	4	5	2
Requirements Owner (RO)	9	6	2	8	1	7	5	3	4
Systems Architect (SA)	1	7	4	5	3	9	6	8	2
System Designer (SD)	1	7	4	6	3	9	5	8	2
System Interface Owner (Glue) (SI)	6	7	1	8	3	9	2	5	4
Stakeholder Interface Manager (ST)	8	2	1	5	4	3	7	6	9
Technical Manager (TM)	8	6	1	3	5	9	4	7	2
Validation/Verification Engineer (VVE)	6	7	5	8	2	9	3	1	4
AI Chief (AI)	2	8	1	4	3	6	7	9	5
Systems Engineering Champion (CH)	6	8	1	4	3	9	5	7	2
Educator (ED)	5	4	1	9	7	2	8	6	3
Implementation Engineer (IE)	7	8	4	6	5	9	1	2	3
Information Manager (IM)	7	5	2	9	1	8	4	3	6
Innovator/Initiator (IN)	1	3	5	2	6	9	7	8	4
Life Cycle (Logistics/Ops) Engineer (LC)	9	6	3	8	4	7	1	2	5
Process Owner (Engineer) (PO)	8	7	2	6	4	9	1	3	5
Role Score	10.0%	8.6%	15.8%	9.1%	14.9%	5.2%	12.5%	10.6%	13.2%
Role Score = $18 \times 10 - \text{sum}(18 \text{ SE role ranks})$ , expressed as a % of the total score. It a measure of how much each Belbin Team Role addresses the 18 SE roles									



# Key Myers-Briggs Findings

- Top types for SE roles:
  - INTJ (Architect)
  - ENTJ (Commander)
  - ESTJ (Supervisor/Executive)
  - INTP (Thinker/Logician)
- NASA SEs mostly: INTP (23.5%), INTJ (17.6%)
- Some types (ISFP in particular – Composer/ Adventurer) had low suitability for technical SE roles.

See Paper 49 for examples of ranking rationale

Paper 49 – Systems Engineering Role Evolution and the Right Stuff

Green = This personality type would be good at this SE role  Yellow = This personality type could satisfy this SE role  Pink = Caution should be used when assigning this personality type to this SE role	Myers-Briggs Personality Type															
	ESTJ Supervisor/ Executive	ENTJ Commander	ISTP Virtuoso	INTP Thinker/ Logician	ESFJ Consul	ENFJ Protagonist	ISFP Composer/ Adventurer	INFP Mediator	ESTP Entrepreneur	ESFP Performer/ Entertainer	ISTJ Inspector/ Logistician	ISFJ Protector/ Defender	ENTP Debater	ENFP Campaigner	INTJ Architect	INFJ Advocate
Coordinator/Leader (CL)	3	1	15	9	8	2	13	14	10	16	7	12	6	11	4	5
Security Engineer (CY)	5	4	6	8	12	15	11	13	10	16	1	7	9	14	2	3
System Modeller (Analyst) (MO)	9	5	6	2	14	11	10	15	13	16	3	8	7	12	1	4
Requirements Owner (RO)	5	6	8	7	11	9	13	15	12	16	1	3	10	14	2	4
Systems Architect (SA)	8	2	7	3	12	13	11	15	10	16	6	9	5	14	1	4
System Designer (SD)	8	4	8	2	14	13	11	15	12	16	6	9	3	10	1	5
System Interface Owner (Glue) (SI)	6	2	7	4	13	12	11	15	10	16	3	9	8	14	1	5
Stakeholder Interface Manager (ST)	6	4	15	12	2	1	10	16	13	7	14	9	8	5	11	3
Technical Manager (TM)	3	1	10	6	13	9	12	15	7	16	4	11	5	14	2	8
Validation/Verification Engineer (VVE)	4	10	5	6	11	12	9	14	8	16	1	3	13	15	2	7
AI Chief (AI)	5	1	10	8	11	3	16	14	9	15	6	12	7	13	2	4
Systems Engineering Champion (CH)	4	2	11	7	10	6	15	13	12	16	3	9	8	14	1	5
Educator (ED)	11	3	16	10	5	1	13	8	15	12	14	6	9	4	7	2
Implementation Engineer (IE)	3	8	4	6	10	15	9	13	7	14	1	5	12	11	2	16
Information Manager (IM)	4	7	9	6	8	15	14	12	11	16	1	3	10	13	2	5
Innovator/Initiator (IN)	12	5	8	3	16	9	10	13	7	11	15	14	1	2	4	6
Life Cycle (Logistics/Ops) Engineer (LC)	2	4	6	8	10	13	9	14	7	16	1	5	11	15	3	12
Process Owner (Engineer) (PO)	4	3	7	8	11	13	12	15	10	16	1	5	9	14	2	6
Percentage of NASA SE Population (34 people)	0.0%	2.9%	8.8%	23.5%	2.9%	0.0%	0.0%	0.0%	14.7%	2.9%	8.8%	2.9%	11.8%	0.0%	17.6%	2.9%
Percentage of Engineering Student Population	21.7%	4.9%	7.2%	3.1%	8.8%	1.6%	1.4%	2.3%	12.9%	7.0%	9.0%	3.9%	7.2%	6.1%	2.7%	0.2%
Type Score	8.3%	9.6%	6.0%	7.8%	4.7%	5.5%	4.0%	2.3%	5.0%	1.6%	8.9%	6.8%	6.7%	4.0%	10.5%	8.3%

Type Score =  $18 \times 17 - \text{sum}(18 \text{ SE role ranks})$ , expressed as a % of the total score. It is a measure of how much each Myers-Briggs Personality Type addresses the 18 SE roles

# DISC Suitability Highlights

- Conscientiousness fits best with technical roles (e.g., Architect, Validator).
- Influence aligns well with roles like Stakeholder Interface Manager and Educator.
- Dominance useful in leadership and innovation.
- Steadiness valuable in support and consistency roles.

See Paper 49 for examples of ranking rationale

	Dominance (D)	Influence (I)	Steadiness (S)	Concienciousness (C)
Coordinator/Leader (CL)	M	H	H	M
Security Engineer (CY)	M	L	M	H
System Modeler (Analyst) (MO)	M	L	M	H
Requirements Owner (RO)	M	L	H	H
Systems Architect (SA)	H	L	M	H
System Designer (SD)	M	L	M	H
System Interface Owner (Glue) (SI)	M	L	M	H
Stakeholder Interface Manager (ST)	M	H	H	M
Technical Manager (TM)	H	L	M	H
Validation/Verification Engineer (VVE)	M	L	H	H
AI Chief (AI)	H	M	L	H
Systems Engineering Champion (CH)	H	H	M	M
Educator (ED)	L	H	H	M
Implementation Engineer (IE)	M	L	M	H
Information Manager (IM)	M	L	H	H
Innovator/Initiator (IN)	H	H	L	M
Life Cycle (Logistics/Ops) Engineer (LC)	M	L	M	H
Process Owner (Engineer) (PO)	M	L	H	H

# Educator Role vs. Traditional SE Roles

- SEs with high detail, logic, or introversion often poorly matched to Educator.
- Educator needs Influence, Steadiness, and strong communication.
- Select Educators carefully—not just any good SE!

Key:

- Blue circle: Traditional SEs make good Educators
- Purple circle: Traditional SEs do not make good Educators
- Green circle: Good Educators do not make good Traditional SEs
- Red circle – Do not make good Educators or Traditional SEs

	Belbin Team Role								
	Plant	Resource Investigator	Coordinator	Shaper	Monitor Evaluator	Teamworker	Implementer	Completer Finisher	Specialist
Requirements Owner (RO)	9	6	2	8	1	7	5	3	4
Systems Architect (SA)	1	7	4	5	3	9	6	8	2
System Designer (SD)	1	7	4	6	3	9	5	8	2
Validation/Verification Engineer (VVE)	6	7	5	8	2	9	3	1	4
Educator (ED)	5	4	1	9	7	2	8	6	3

	Myers-Briggs Personality Type															
	ESTJ	ENTJ	ISTP	INTP	ESFJ	ENFJ	ISFP	INFP	ESTP	ESFP	ISTJ	ISFJ	ENTP	ENFP	INTJ	INFJ
Requirements Owner (RO)	5	6	8	7	11	9	13	15	12	16	1	3	10	14	2	4
Systems Architect (SA)	8	2	7	3	12	13	11	15	10	16	6	9	5	14	1	4
System Designer (SD)	8	4	8	2	14	13	11	15	12	16	6	9	3	10	1	5
Validation/Verification Engineer (VVE)	4	10	5	6	11	12	9	14	8	16	1	3	13	15	2	7
Educator (ED)	11	3	16	10	5	1	13	8	15	12	14	6	9	4	7	2

# Innovator and Stakeholder Interface vs. Traditional SE Roles

- Innovator best fits Plant, Shaper, and types like ENTP, INTJ.
- Mis-assigning this role risks major project issues.

## Key:

- Blue circle: Traditional SEs make good Innovators
- Purple circle: Traditional SEs do not make good Innovators
- Green circle: Good Innovators do not make good Traditional SEs
- Red circle – Do not make good Innovators or Traditional SEs

- The Stakeholder Interface role was discussed in IS 2025 Paper 23 “The Importance of Being Able to Hold a Stake” (Monday 28 July 2025, 3:30pm) and is also covered in paper 49

	Belbin Team Role								
	Plant	Resource Investigator	Coordinator	Shaper	Monitor Evaluator	Teamworker	Implementer	Completer Finisher	Specialist
Green = This team role would be good at this SE role									
Yellow = This team role could satisfy this SE role									
Pink = Caution should be used when assigning this team role to this SE role									
Requirements Owner (RO)	9	6	2	8	1	7	5	3	4
Systems Architect (SA)	1	7	4	5	3	9	6	8	2
System Designer (SD)	1	7	4	6	3	9	5	8	2
Validation/Verification Engineer (VVE)	6	7	5	8	2	9	3	1	4
Innovator/Initiator (IN)	1	3	5	2	6	9	7	8	4

	Myers-Briggs Personality Type															
	ESTJ	ENTJ	ISTP	INTP	ESFJ	ENFJ	ISFP	INFP	ESTP	ESFP	ISTJ	ISFJ	ENTP	ENFP	INTJ	INFJ
Green = This team role would be good at this SE role																
Yellow = This team role could satisfy this SE role																
Pink = Caution should be used when assigning this team role to this SE role																
Requirements Owner (RO)	5	6	8	7	11	9	13	15	12	16	1	3	10	14	2	4
Systems Architect (SA)	8	2	7	3	12	13	11	15	10	16	6	9	5	14	1	4
System Designer (SD)	8	4	8	2	14	13	11	15	12	16	6	9	3	10	1	5
Validation/Verification Engineer (VVE)	4	10	5	6	11	12	9	14	8	16	1	3	13	15	2	7
Innovator/Initiator (IN)	12	5	8	3	16	9	10	13	7	11	15	14	1	2	4	6



# Conclusions & Take-Aways

- SE roles have evolved significantly—and will continue to do so.
- Not all SEs are interchangeable.
- Understanding Peoples' Team and Personality preferences can help focus coaching and mentoring opportunities
- AI can help match people to roles more effectively.
- Role-personality alignment should lead to better systems outcomes.
- Optimal outcomes come when the role fits the person, not just the resume.
- There is the potential to use this type of assessment to compare Role Frameworks.

## Questions?