The Growing Role of Systems Engineering and Women in This Discipline
Complexity, Technical Skills, and Soft Skills

by Emanuela De Fazio (*)

The growing role of Systems Engineering (SE) within organizations and the increasing presence of women in this discipline is today linked to several factors. Chief among them is the complexity of the modern world: organizations are now more than ever called to be competitive, innovative, and responsive to continuous, non-linear, and sometimes unpredictable market changes. The ambition level of the market is incredibly high, pushed beyond traditional limits by a technological innovation that seems more vigorous and dynamic than ever before.

However, this boost and the opportunities provided by globalization are not always well-directed: wars— including those in Western territories—political and economic tensions, widespread instability, natural disasters, debt, low GDP per capita, depletion of natural resources, the effects of cyber threats, and countless other indicators and phenomena suggest that things are far from under control. In this context, every organized entity must combine different types of skills to find the right balance among execution time, cost, quality, precision, and accuracy. This is where Program Management and Systems Engineering come into play, providing the processes, skills, styles, and tools necessary for value creation—alongside human capital, including women.

Women, still on a path to full emancipation, are beginning to place new value on their actions and are playing increasingly broader political, social, and economic roles. In this context, Diversity, Equity, and Inclusion (DEI) initiatives developing in many organizations are helping raise societal awareness of these issues through information, sharing, and the realization that indifference and distrust are attitudes to be rejected.

Food for Thought

Engineering, supported by the human and natural sciences, and technology, has enabled greater human progress in recent decades than ever before. Science provides understanding, technology and engineering shape our ambitions and drive evolution. Continued progress requires both rigor and flexibility.

Systems Engineering can be a key enabler in organizations, helping individuals realize their potential for exploration, discovery, experimentation, and innovation. **In this context, the contributions of women are particularly valuable**. Their unique blend of technical and soft skills, often honed through diverse experiences, brings a fresh perspective to problem-solving, fostering greater collaboration, creativity, and adaptability. Organizations that embrace gender diversity and empower women in Systems Engineering roles are better positioned to navigate complexity, drive innovation, and achieve sustainable success. By valuing human capital in all its forms, and recognizing the distinct strengths that women bring, we can unlock new

levels of progress and create a more dynamic and effective engineering workforce. Success arises from a strong technical foundation combined with a principled and adaptive approach.

Scenario and Context

The world described in the *Global Risk Report 2024* by the World Economic Forum is, on one hand, full of opportunities and, on the other, a space of incredible uncertainty. All human dimensions—political, economic, social, cultural, technological, environmental, and legal—are characterized by countless interlinked variables, like the gears of a complex engine. Each of these dimensions impacts citizens, professionals, and organizations, deeply affecting the economic-industrial fabric and individual opportunities.

Humans have become fully dependent on technological tools, which are numerous and use high amounts of technology—often unbeknownst to us—interoperable, and data-exchanging (exposing us to underestimated threats and vulnerabilities). On the production side, the goods we use today have varying life cycles, combining technologies, products, services, and programs. They are created through broad, distributed (and often uncontrolled) industrial supply chains and are developed, modeled, designed, produced, maintained, and disposed of within a complex framework of standards and regulations in a constantly evolving market and industry.

In such a scenario, it's vital to think, communicate, and act with systemic and systems-based approaches. The survival of organizations is not guaranteed and can only be ensured through Systems Engineering, which allows them to create value both for themselves and the market.

Creating value today means developing something that the market understands, recognizes, and adopts promptly. It means creating something useful, reliable, high-quality, innovative, sustainable, maintainable, and competitive. These attributes embody the essence of Systems Engineering—a discipline offering a mindset and a set of multidisciplinary, holistic, iterative, scalable, and modular principles and processes.

Systems Engineering enables decomposition of system complexity because it:

1. Analyzes contexts and problems by breaking them into smaller parts and assessing each part's behavior individually and collectively, considering relationships and dependencies;
2. Identifies various architectures and design solutions, choosing the best candidate based on cost, time, quality, performance, constraints, and use scenarios;
3. Embraces multiple perspectives, gathering, analyzing, and integrating the needs of all stakeholders;
4. Integrates technical disciplines with each other and with the humanities, anthropology, and sociology;
5. Enables the realization and lifecycle management of complex systems from concept to disposal;
6. Ensures compliance throughout the lifecycle with constraints such as safety, security, certifiability, maintainability, and economic sustainability ("by design" principles);
7. Establishes a redundant and reliable design cycle based on formal or informal phase reviews.

Many organizations have acknowledged the strategic value of Systems Engineering and have taken internal actions to strengthen internal enablers—affecting governance, processes, continuous improvement, standards selection, and best practices (like V-Model, Architectural Frameworks, MBSE, Lean, Digital Twin, Agile, Hybrid Approaches).

Approaches like Architectural Frameworks standardize system representation, maintain traceability and alignment across the lifecycle, centralize functional/behavioral system info, and enhance collaboration and efficiency. Tools like MBSE and Digital Twin guide system design through digital models (not documents), offering visual/mathematical/physical representations that:

- Simplify problem-solving,
- Separate functional and physical layers,
- Anticipate risks,
- Monitor system health,
- Optimize predictive maintenance and value chains,
- Improve logistics, obsolescence, and training processes.

Other enablers span the organization and people dimension (internal communities, international forums, training/certification), the supply chain (promoting system thinking), and IT (integrated toolchains for business lifecycle support). These toolchains ensure data accuracy, requirement traceability, automated model checks, and impact analysis.

Female Presence in Organizations Today

Until a few decades ago, the industrial world and Systems Engineering were male-dominated.

Recently, however, hiring, career growth, and salary data show women gaining ground in technical roles, albeit slowly. According to *Il Sole 24 Ore*, in 2023 women held only 23.3% of board seats globally and chaired just 8.4% of boards. In Europe, numbers are better but often due to quotas rather than merit recognition.

Eurostat reports that in 2022, women made up 52% of the STEM workforce in Europe (with Lithuania leading at 58%, and Italy and Malta lagging below 49%). Science and engineering account for nearly a quarter of STEM jobs. Though women represent half of the STEM workforce, growth has been slow—only a 2% increase in ten years.

Why? Causes include the education system, persistent generational stereotypes, and societal views of "male-only" professions. Historically, leadership in science/industry favored rational intelligence, neglecting creativity, empathy, and social/communication skills—traits long associated with women. As a result, their recognition in such roles has been slow.

Nevertheless, women are demonstrating their value—especially in mobilizing diverse intelligences. Hence the rise of STEAM (with "A" for Arts), acknowledging non-rational aptitudes. Many of these skills, long seen as limitations (e.g., motherhood, domestic roles), have honed women's technical and soft skills in unique ways.

Today's market complexity demands more than time and control—it needs a mix of:

- **Business Acumen**: market knowledge, strategic innovation;
- **Ways of Working**: mastery of processes, tools, adaptability;
- **Power Skills**: inspiration, motivation, co-creation, shared values (responsibility, respect, autonomy, quality orientation, critical/lateral thinking).

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She holds several certifications: MBA (2005), PMI/PMP (2009), ICMC/CMC (2011), Selex ST/Training Manager (2012), CMMI Appraisal Team Member (2017), and ELS/Role Model (2020). Emanuela has published articles in national and international journals (PMI, AISE, IEEE, POLARIS, AIRI, ANU TEL, Confindustria) and participated in conferences and educational initiatives at schools and universities (Sapienza University, Unicusano, Campus Bio-Medico, Polytechnic of Taranto, Unical, Cassino, CHIES-Pescara, Taranto), as well as professional associations (AFCEA Europe).

She is a Role Model and mentor in STEM outreach projects for Elis.org, a volunteer since 2000 with the PMI Central Italy Chapter—serving as Director of Training from 2016 to 2019—and Chief in Editor of AISE since 2016.