PROPOSAL FOR WORKING GROUP ON SYSTEMS ENGINEERING

1.0 INTRODUCTION

This document presents a proposal for INCOSE (International Council on Systems Engineering) to establish and host a Working Group on Systems Engineering, to be established for an initial 3-year period 2024-2027.

INCOSE is a not-for-profit membership organization founded to develop and disseminate the transdisciplinary principles and practices that enable the realization of successful systems.

INCOSE is designed to connect Systems Engineering professionals with educational, networking, and career-advancement opportunities to develop the global community of systems engineers and systems approaches to problems. We are also focused on producing state-of-the-art work products that support and enhance this discipline's visibility worldwide.

INCOSE became an international member of WFEO in March 2024 with the approval of the Executive Council.

2.0 BACKGROUND

Systems engineering is distinct from traditional branches of engineering in that it fundamentally relies on the concept of a system to view and address problems holistically. While traditional engineering disciplines such as mechanical, electrical, or civil engineering typically focus on specific technical aspects or components of a problem, systems engineering takes a broader approach. Both are crucial for creating advanced technology and engineered systems, but they look at problems differently.

In systems engineering, a "system" is defined as a set of interrelated components working together towards a common goal. This discipline emphasizes understanding the entire system, including its environment, stakeholders, and interactions among its components. By doing so, systems engineers can see the totality of the problem and address it comprehensively.

Systems engineering offers a comprehensive view of complex problems by considering all components and their interactions. This holistic perspective is crucial for addressing multifaceted challenges like sustainability and energy, where multiple factors such as environmental impact, resource availability, and technological feasibility must be balanced. It bridges various disciplines, integrating knowledge from different fields to develop robust solutions. This interdisciplinary approach ensures that solutions are well-rounded and take into account technical, social, and economic factors.

The demand for systems engineers spans diverse industries and domains, underscoring the field's relevance and significance.

3.0 STRATEGIC CONTEXT FOR A WORKING GROUP ON SYSTEMS ENGINEERING

Establishing a Systems Engineering Working Group within WFEO is strategically important and it will enhance interdisciplinary collaboration, address global challenges, support WFEO's strategic goals, bridge gaps in knowledge and practice, promote global standards, facilitate innovation, and enhance WFEO's global influence.

3.1 Alignment with WFEO's Strategic Goals

WFEO aims to promote the role of engineering in achieving sustainable development goals (SDGs). Systems engineering can play a pivotal role in this effort by ensuring that engineering projects are designed with sustainability in mind from the outset. Establishing a Systems Engineering Working Group will support WFEO's strategic goals by promoting best practices, fostering innovation, and facilitating the integration of sustainable engineering principles across various disciplines.

3.2 Enhancing WFEO's Global Influence

With a Systems Engineering Working Group, WFEO can strengthen its position as a leading global engineering organization. The group's work will enhance WFEO's reputation for promoting interdisciplinary collaboration, addressing global challenges, and fostering innovation. This, in turn, will attract new members, partnerships, and opportunities for collaboration, further enhancing WFEO's influence and impact on the global engineering community.

3.3 Addressing Global Challenges for Sustainable Development

Systems engineering is uniquely positioned to tackle global challenges to sustainable development including climate change and rapid technological advancements. By considering the entire lifecycle of systems and their interactions, systems engineers can develop solutions that are sustainable, efficient, and effective. A dedicated working group will enable WFEO to leverage systems engineering principles to address these critical issues, aligning with the organization's mission to advance engineering for the benefit of humanity.

The proposed work of the Working Group aligns with SDG 13 (Climate Change), SDG 6 (Water), and SDG 7 (Energy).

3.4 Enhancing Interdisciplinary Collaboration

The establishment of a Systems Engineering Working Group will foster interdisciplinary collaboration among the existing Working Groups and Committees. Systems engineering is inherently interdisciplinary, integrating knowledge from various fields to develop comprehensive solutions.

3.5 Bridging Gaps in Knowledge and Practice

Many engineering disciplines can benefit from a deeper understanding of systems engineering principles. By establishing a dedicated working group, WFEO can provide a platform for knowledge exchange, professional development, and the dissemination of best practices in systems engineering. This will help bridge gaps in knowledge and practice, ensuring that engineers across all disciplines can benefit from the holistic, systems-based approach.

3.6 Promoting Global Standards and Practices

A Systems Engineering Working Group can play a crucial role in promoting global standards and practices in systems engineering. By collaborating with member organizations, the group can

help develop and disseminate guidelines, standards, and best practices that ensure consistency and quality in systems engineering projects worldwide.

3.7 Facilitating Innovation and Technological Advancement

Systems engineering is at the forefront of innovation and technological advancement. By establishing a dedicated working group, WFEO can harness the innovative potential of systems engineering to drive technological progress. This will not only benefit existing projects and initiatives but also pave the way for new, cutting-edge solutions to global challenges.

4.0 Planned activities

4.1 Schedule of Activities

First Year:

- Establish the Working Group: T0+1
- Define survey content and target groups: T0+1 to T0+8
- Launch the survey: T0+9 to T0+10
- Analyze the survey: T0+10 to T0+12

Second Year:

- Establish an Editorial Group and assign roles for the White Paper: T0+13
- Identify contributors and authors: T0+14 to T0+16
- Conduct editorial activities: T0+17 to T0+24

Third Year:

- Knowledge sharing through a series of webinars T0+24 to T0+36

4.2 Outcomes

First Year: Oct 2024-Oct 2025

A report on awareness and knowledge other engineering disciplines have about systems engineering, based on a survey of WFEO members. The report will map identifying domains, challenges, and geographical areas where systems engineering could enhance the work already being done by other engineering disciplines in government, industry, and academia and make recommendations for work to be done in the second year.

The specific activities will include:

- A questionnaire and launch a survey to globally understand the awareness and knowledge other engineering disciplines have about systems engineering.
- A map identifying domains, challenges, and geographical areas where systems engineering could enhance the work already being done by other engineering disciplines in government, industry, and academia.
- Recommendations for work to be done in the second year.

Second Year: Oct 2025-Oct 2026

A white paper on the role of systems engineering in various application domains, both traditional (aerospace and defense) and others (rail, automotive, energy, transportation, etc.).

The white paper will include results and conclusions from the first year survey, as well as contributions from prominent voices in engineering worldwide, from governmental, industrial, and academic spheres.

The group will aim to present the White Paper to WFEO members through webinars, at important events such as the WFEO annual meetings and, if opportunity arises, at the UN STI Forum held in May each year in New York.

Third year: Oct 2026-Oct 2027

Knowledge sharing through a series of webinars on systems engineering approaches in various contexts for sustain able development including water, energy, sustainable cities etc. These webinars will be organised in collaboration with one or more of the WFEO Standing Technical Committees e.g. Committee of Water, Committee on Energy, Committee on Information and Communications, Committee on Engineering Innovative Technologies.

It is anticipated that specific white papers will be produced on the use of systems engineering approaches to:

- Water
- Energy

5.0 Structure of the Working Group

The structure of the working group will consist of:

5.1 Membership

- Chair of the Working Group, nominated by INCOSE
- Deputy Chairs for sub committees working on applications of systems engineering in different sectors, for example:
  - Water
  - Energy
  - Education in Engineering
  - Climate Change
  - Other...
- Each relevant Standing Technical Committee will be asked to nominate a representative to the relevant sub group, for example:
  - Committee on Water to Water Sub Committee on Systems Engineering
  - Committee on Energy to Energy Sub Committee on Systems Engineering
  - Committee on Education in Engineering to Education in Engineering Committee on Systems Engineering
  -
- Individual members from WFEO member institutions (to be determined)

For each specific initiative, INCOSE may invite experts of recognized prestige to be invited to participate as corresponding members.

5.2 Meetings

The Working Group will hold one face-to-face meeting each year, normally at the same time as the WFEO annual meeting – Executive Council or General Assembly.

The Secretariat of the Working Group will coordinate quarterly meetings held virtually.

Each Sub-Committee will have its own virtual meetings, supported by the Secretariat of the Working Group. The Chair of the Working Group and Secretary will be invited to attend these meeting.

6.0 Budget and Resources

INCOSE will support the Working Group regular functioning (headquarter, secretary, web page -integrated in WFEO website-).

The participation of each subcommittee will be supported by the organization to which he/she is affiliated.

a) Headquarters and Secretariat for the Working Group will be located at INCOSE head office located at 7670 Opportunity Rd, Suite 220 San Diego, CA, USA.

b) Proposed Chair: **Dr. Bernardo A. Delicado, INCOSE ESEP** nominated by INCOSE (see CV attached as appendix).

The nominated has the required skills and experience, the time and capability to serve as the Chair of the Working Group.

It is confirmed that the Chair will be available for attendance at WFEO meetings including the Executive Council and General Assembly meetings. Funding for travel by the Chair will be provided by INCOSE as described under the budget.

c) Proposed Deputy Chairs: will be nominated by WFEO members that have nominated representatives to participate in the Working Group, with particular expertise in the subject area.

d) Proposed Secretary: **Dr. Garima Bhatia, INCOSE ASEP** nominated by INCOSE (see CV attached as appendix).

Activity	**Budget**	**Comment**
Secretariat	USD 15,000.00	Provided by INCOSE
Office rent	USD 3,000.00	Provided by INCOSE
Computers	USD 3,000.00	Provided by INCOSE
Web maintenance (WFEO web site)	USD 3,000.00	Provided by INCOSE
Editorial support and publication of Reports and White papers	USD 2,000.00	Provided by INCOSE
Events virtual and face to face, including expenses for side events, if arranged at the UN STI Forum	USD 3,000.00	Provided by INCOSE
Travel to WFEO Meetings	USD 6,000.00	Travel for Chair of WG
Total annual budget	USD 35,000.00	
Total budget 3 years	USD 105,000.00	

7.- OPERATING TERM.

The term of minimum functioning of the Working Group is proposed for 3 years from October 2024 to October 2027, extendable under the decision of the WFEO competent bodies.

8.-CONFIRMATION OF COMPLIANCE WITH WFEO RULES OF PROCEDURES FOR COMMITTEES.

This proposal for the Working Group on Systems Engineering aligns with relevant clauses WFEO Rules of Procedure Clauses 3.2, 3.3 and 3.4 and Annex C Clauses 2.1 to 2.3 as approved by the Executive Council in Lisbon on 5 March 2024.

9.- CONFIRMATION OF GOOD STANDING.

INCOSE is in good standing as it has paid all member dues. It confirms that it will consistently be in good standing during the term as host of the Working Group as required under WFEO Rules of Procedure as approved by the Executive Council in Lisbon on 5 March 2024.

APPENDIX CV's

Proposed Chair: Dr. Bernardo A. Delicado, INCOSE ESEP

Proposed Secretary: Dr. Garima Bhatia, INCOSE ASEP

Bernardo Delicado, PhD

Address
Madrid, Spain

Contact
bernardo.delicado@incose.net
+34 625302470

Personal Summary

Bernardo is a seasoned systems engineer with 32 years of experience in the aerospace and defense sectors. He has held senior roles across top organizations such as INTA, Airbus Defense and Space, MBDA Missile Systems, and Indra Sistemas, contributing to major multinational projects like military aircraft programs, space programs and the Future Combat Air System (FCAS).

Currently, he serves as an internal advisor at Indra. Bernardo holds a PhD in Interdisciplinary Engineering, an M.S. in Physics, and a B.S. in Aerospace Engineering. He is also an INCOSE Expert Systems Engineering Professional (ESEP) and an active member of INCOSE. He has been very active as a part-time university professor for over 26 years.

Education

European University of Madrid, Madrid, Spain

Ph.D., Interdisciplinary Engineering, 2017

Carlos III of Madrid, Madrid, Spain

DEA, Diploma of Research Proficiency prior to Doctorate, 2004

Faculty of Science, UNED, Madrid, Spain

M.S., Physics, 1997

Polytechnic University of Madrid, Madrid, Spain

B.S., Aerospace Engineering, 1991

Certifications

INCOSE Certified Systems Engineering Professional (CSEP), 2011-2019

INCOSE Expert Systems Engineering Professional (ESEP), 2019-Present

Industrial Experience

Indra Sistemas, Madrid, Spain

Senior Advisor in Systems Engineering, Engineering Office, 2023-Present

System of Systems Engineering Director, FCAS (Future Combat Air System), Engineering Office, 2020-2022

MBDA Missile Systems (Airbus Group), Transnational Europe

Engineering Director, Systems Engineering Lead, 2011-2020

Airbus Defence and Space (Airbus Group), Transnational Europe

Chief Engineer Research & Technology Projects, Engineering Office, 2007-2011

Head of Electromagnetic Compatibility (EMC), Engineering Office, 2000-2007

Instituto Nacional de Técnica Aeroespacial, Madrid, Spain

EMC Test Engineer and Airworthiness Authority, 1997-2000

Wind Tunnel Test Engineer, 1992-1997

Academic Experience

ETSIAN (School of Naval Weapons Engineering), Navy, Madrid, Spain

Course coordinator, systems engineering course (40 hours), 2022-2023

Delft University of Technology, Delft, South Holland, Netherlands

Alumnus mentor in the TU Delf Mentor Alumni Program, aerospace engineering master students, 2018-2023

Polytechnic University of Madrid, Madrid, Spain

Adjunct Professor, Master in Flight Testing and Aircraft Certification at School of Aeronautics ETSIAE, 2009-2014

Adjunct Professor, Master in Defense technologies at School of Telecommunication Eng ETSIT, 2013-2014

EOI Business School, Madrid, Spain

Adjunct Professor, Executive Master in Business Administration for Engineers. Teaching Innovation and Technology, 2011-2013

Carlos III University of Madrid, Madrid, Spain

Adjunct Professor, Polytechnic School, analogue/digital electronics to under-graduate students of Industrial, telecommunication and computer science engineering, 1998-2012

Deputy-Director, Master Degree in Aircraft Systems Integration for young employees from Airbus sponsored by Airbus in partnership with University. Academic management and teaching aircraft systems integration and systems engineering, 2009 – 2012

Awards

INCOSE Working Group Award, Product of the year 2018 for INCOSE Systems Engineering Competency Framework, 2018

Product of the year 2023 for Systems Engineering Handbook Fith Edition

Best Paper published in Systems Engineering Journal in 2018

Diploma in acknowledgment of his contribution and commitment to the success of the first flight of UCAV BARRACUDA, Airbus Defence and Space,2006

Innovation Award received in the UK from British Aerospace Systems for his engineering contribution to Eurofighter Typhoon program (UK, Spain, Germany and Italy), 2004.

Diploma in acknowledgment of his contribution and commitment after having delivered the IRMA (In Orbit Reconfigurable Multi-beam Antenna) for launching of SpainSat satellite , Airbus Defence and Space, 2003

Patent

Electrical System for an Aircraft, patent date issued Apr 5, 2013, number H02J3/00, https://patentados.com/2013/un-sistema-electrico-de-una-aeronave

Professional Societies, Industrial Associations and initiatives

International Council on Systems Engineering (INCOSE)

Membership Levels

Affiliate, INCOSE, 2007-2011 (CAB Airbus Defence and Space)
Member, INCOSE, 2011-Present

Positions

Chapter Vice-President, Spain, 2011-2013
Chapter President, Spain, 2013-2015
Education Officer, National Chapter, Spain, 2018-2020
Technical Director, National Chapter, Spain, 2020-2021
Member, System of Systems Working Group, 2015-Present
Member, Systems Engineering Competency Working Group, 2016-Present
Member, Systems Science Working Group, 2016-Present
Member, INCOSE Technical Leadership Institute (Cohort 1), 2017-Present
Paper reviewer, International Symposium, 2017-Present
Reviewer, INCOSE Systems Engineering Vision 2035,
Editor, Systems Engineering Handbook 5th Edition, 2019-2023
Part 5 Editor Lead, Systems Engineering Body of Knowledge, 2016-Present
Certification Application Reviewer (CAR), 2019-2024
Academic Equivalency Coordinator, Certification Advisory Group CAG, 2021-2023
Outreach Director, INCOSE Board of Directors, 2024-Present

Spanish Association of Defense, Aeronautics, Security and Space Technology Companies (TEDAE)

Member, 2012-2020

Advisory Council for Aviation Research and Innovation in Europe (ACARE)

WG5 Member, Strategic Research & Innovation Agenda, 2013-2020

Spanish Aerospace Technology Platform

Professional Competence Working Group Leader, 2017-2019

European Defense Skills Partnership (EDSP)

Member, 2018-2020

Spanish Association for Mentoring and Consulting in Entrepreneurship, Startups, and Social Economy (AMCES)
Member, 2016-2018

American Institute of Aeronautics and Astronautics (AIAA)
Contributor, Aerospace System Integration Guide (ASIG), AIAA Systems Engineering on Standard (SEoS), 2011-2016

Spanish Royal Academy of Engineering
Advisor in Systems Engineering, 2016-2023

Conferences/ Symposiums/ Journals Service

Member, Conference Program Committee, INCOSE Human Systems Integration Conference, 2019, 2021 and 2024.

Reviewer, International Journal of Information Technologies and Systems Approach (IJITSA),IGI Global, 2021-2023

Member, Industrial Program Committee, Complex Systems Design & Management Conference, 2017-2019

Organizer, Systems Engineering lecture series, Spanish Navy HQ, February-May 2021

Member, Organizing Committee, Complex Systems Design & Management Conference, 2020-Present

Reviewer, Industrial Program Committee, Complex Systems Design & Management Conference, 2017-Present

Member, Technical Committee, 7th International Conference on Systems & Concurrent Engineering for Space Applications , October 5-6-7, 2016, Madrid

Member, Technical Program Committee, Conference on Systems Engineering Research (CSER) hosted by Georgia Tech on March 19-22, 2013 in Atlanta (USA).

Publications

Vision and Leadership: Two Inseparable Pillars for the Future of Systems Engineering, PPI Systems Engineering Newsletter, SyEN 67 - July 20, 2018

Introduction to INCOSE Systems Engineering Handbook Fith Edition, Newsletter, INCOSE Spain, Dec 2020

INCOSE Systems Engineering Handbook Update, INCOSE Newsletter, 2023

Systems Engineering Competency Framework, INCOSE Technical Product INCOSE-TP-2018-002-01.0, July 2017

Guide to the Systems Engineering Body of Knowledge (SEBoK) version v1.8 onwards (editor and author Part 5: Enabling Systems Engineering), 2017-Present

Delicado BA, Salado A, Mompó R., “Conceptualization of a T-Shaped engineering competency model in collaborative organizational settings: Problem and status in

the Spanish aircraft industry", Systems Engineering Journal, Wiley , 2018; 21: 534–554. https://doi.org/10.1002/sys.21453

Godfrey, P. et al (co-author), " Building a Technical Leadership Model" , INCOSE International Symposium, 26: 757–772, Edinburgh, Scotland , 2016, doi:10.1002/j.2334-5837.2016.00191.x

Delicado B., Mompó, R., " Integrating Individual Competencies to Form Organisational Capability : Towards a More Holistic Approach in Aeronautical Industry", 8th International Conference "Supply on the Wings" (8th International Aerospace Supply Fair), Frankfort (Germany), 5-7 November 2013.

Delicado B., Mompó, R., "Análisis Holístico de las Meta-Competencias en Equipos Multidisciplinares de Ingeniería y su Influencia sobre la Capacidad Organizacional en el Entorno Empresarial Aeronáutico" (holistic analysis of meta-competencies within multidisciplinary teams and their influence on the organizational capability of aeronautic industry " , Poster and article. X Jornadas Internacionales de Innovación Universitaria de la Universidad Europea de Madrid, Villanueva de la Cañada, July 2013.

Ramírez O. , Zumel-Vaquero J.A., Sanz M., Raga C., Izquierdo D., García-Suárez O. , Barrado A., Prieto- López R., Azcona R., Delicado B., Cobos-Márquez J. A.," High level Decision Methodology for the Selection of a Fuel Cell Based Ower Distribution Architecture for an Aircraft Application", Energy Conversion Congress and Exposition ECCE 2009, 20-24/09/2009, California, USA. ISBN 978-1-4244-2893-9 https://doi.org/10.1109/ECCE.2009.5316145.

Izquierdo D., Azcona R., López del Cerro F.J., Delicado, B. Fernández C., "Sistema de Distribución de Potencia Eléctrica (SDPE) a 270 Vcc, para su Aplicación en Aviones Más Eléctricos (HV270DC)" (Power Supply Distribution Systems of High Voltage 270 DC for application to All Electric Aircraft) , SAAEI'09, XVI Seminar on Automation, Industrial Electronics and Instrumentation, 2009, Madrid, Spain. ISBN: 978-84-692-2596-7

Santos F., Vázquez J., Martínez R., Delicado B., "Análisis Comparativo de los Métodos EN60512 y Triaxial para Medir la Impedancia de Transferencia en Cables Apantallados" (Comparative analysis of the EN60512 and Triaxial methods to measure the Surface Transfer Impedance of Shielded Cables) , SAAEI'09, XVI Seminar on Automation, Industrial Electronics and Instrumentation, 2009, Madrid, Spain. ISBN: 978-84-692-2596-7

Delicado, B., "Certificación de Aeronaves Militares Frente a Amenazas Electromagnéticas "(Military Aircraft Certification against Electromagnetic Threats),Boletín de Observación Tecnológica en Defensa Nº 17, 2007, Spanish Ministry of Defence Publication, https://www.tecnologiaeinnovacion.defensa.gob.es/Lists/Publicaciones/Attachments/163/BoletinN17.pdf

Delicado, B. , " Nuevas tecnologías y seguridad en el transporte aéreo : la compatibilidad electromagnética " (New Technologies and Safety in Air Transport : Electromagnetic Compatibility), 2003, Economía industrial, ISSN 0422-2784, Number 353, pag. 95-98 (issue focused on innovation and new technologies in the transport system)

Presentations

Present and Future of Systems Engineering: Air Combat Systems, Masterclass, May 2024, King Juan Carlos University, Madrid, Spain

INCOSE Systems Engineering Handbook, 5thEdition : Novel aspects and its impact on SEP certification & academic programs worldwide, Latam Chapter, 24th August 2023

SEP Exam Question Details and SEH5E Update, INCOSE LA and San Diego Chapters, 3rd August 2023.

How to Apply for Academic Equivalency, INCOSE EMEA Sector, Seville, April 2023

ISO/IEC/IEEE 15288 Systems Engineering (impact on safety and airworthiness standards), Spanish Air Force HQ, 20th October 2022

Systems Engineering : Key National Capability for Defense sector, Ministry of Defense, 27th October 2022

FCAS Think Different (System of Systems Engineering), Master in Aircraft Systems Integration, Carlos III University of Madrid, 9th June 2021

Acquisition of Defense Material Starts with More Questions than Answers, Spanish Navy, School of Naval Weapon Systems Engineering, 16th April 2020

Past and Future of Systems Engineering in ASD Programs : Spain vs the World, INTA (Instituto Nacional de Técnica Aeroespacial), Ministry of Defense, 2019

A pressing need for a true Systemic Technical Leadership in High-Tech Companies in a Fast-Changing World, Master in Aircraft Systems Integration, Carlos III University of Madrid, 2nd October 2019

A Career in Systems Engineering has SPACE for Dreams, Master in Space Engineering, Carlos III University of Madrid, 19th September 2019

INCOSE Systems Engineering Competency Framework (ISECF), INCOSE Spain Chapter, 20th June 2019

Introduction to Systems Engineering, awareness seminar SESGE-INCOSE, 29th May 2029

Towards Intelligent Organization: guidelines for deploying a systems approach in twenty-first century organizations, 1st Iberoamerican Congress of Systemic Solutions for Organizational Transformation, 28-29-30 November 2018, Madrid (Spain)

Recognizing the Future of Systems Engineering in a Changing World : Systems Engineering Leadership for the Common Good, ETSII School of Industrial Engineering, Polytechnic University of Madrid, Madrid, Spain, 21st May 2018

Adaptation to NATO STANAG 4728 through ISO/IEC 15288 processes, Area of Methods & Tools, Procurement Agency, Spanish Ministry of Defense, Madrid, Spain, 23rd April 2018.

Introduction to Systems Engineering “,ETSIAE School of Aeronautical and Space Engineering, Polytechnic University of Madrid, Madrid, Spain 27th November 2017

Concepts Development : How To Create Products Customers Love, Polytechnic School ,Carlos III University of Madrid, Leganés (Madrid) , Spain, 4th December 2017

Unraveling Systems Engineering", ETSIAE School of Aeronautical and Space Engineering, Polytechnic University of Madrid, Madrid, Spain, 27th November 2017

Systems Engineering : The Art of Gluing Pieces, ETSII School of Industrial Engineering, Universidad Politécnica de Madrid, Madrid, Spain, 22th May 2017,

The role of Systems Engineering for the competitiveness of the industry , Business Centre of Aeropolis, the Aerospace Technology Park of Andalusia, Seville (Spain), May 2015

Surprising Path to Greater Creativity : Using systems models in Engineering to improve understanding and problem solving across domains and boundaries in complex projects and modern organisations, 7th Systems & Concurrent Engineering for Space Applications Conference (SECESA) , Madrid, Spain, 2016

INCOSE Systems Engineering Professional Certification, Royal Academy of Engineering, 14th December 2015

People in terms of systems engineering organizational capability : intangible value on planning and acquisition of military capabilities, Spanish Navy, School of Naval Weapon Systems Engineering, 9th December 2015

Framework for Technical and Technology Management for Complex Products and Projects ", PMI-Project Management Institute, Monthly Meeting of Members, May 2014

Systems Engineering and Project Management Integration, I National Congress of Defense Logistics at The Higher Center for National Defense Studies (CESEDEN) is the main joint military educational center of the Spanish Armed Forces .April 2014

Strategies in large industrial interdisciplinary projects Radio 3 Nacional Radio of Spain, April 2013.

Systems Engineering : The Art of Simplifying the Complexity", Polytechnic School , Carlos III University of Madrid, Leganés (Madrid), Spain, January 2013

Development of Systems Engineering Competencies, Spanish Chapter of INCOSE; June 2012.

Garima V. Bhatia

4354 Brookstone Dr, Canton, MI 48188 ● +1 (515) – 708 – 3736 ● garimabhatia92@gmail.com

OBJECTIVE

To make a significant contribution to the organization by applying acquired analytical skills and knowledge, while making parallel personal career growth by continually growing and acquiring new skills.

EDUCATION

Doctor of Philosophy in Industrial and Systems Engineering | 2016 –2021

The University of Alabama in Huntsville

- GPA: 4.0
- Research Emphasis:
  - Mathematical Theory for Establishing Organizational Architectures for Systems Engineers
    - Systems Engineer Roles and Tasks
    - Set Theory, Relations, Functions
  - Model-Based Systems Engineering (MBSE)
  - Value modeling

Master of Science in Aerospace Engineering | 2014 - 2016

Iowa State University of Science and Technology, Ames, IA

- GPA: 3.85
- Research Emphasis:
  - Value-Based Design (VBD)
  - Game Theory
  - Multidisciplinary Design Optimization (MDO)
  - Systems Engineering

Bachelor of Technology in Aerospace Engineering | 2010-2014

Indira Gandhi National Open University (Full-time on-campus program)

PROFESSIONAL EXPERIENCE

***Senior Systems Engineer,* Ford Motor Company | Jan 2020 – Present**

- Systems engineering lead for suspension, brakes, and wheels and tires for the electric/ICE F-150 pickup trucks
- Apply descriptive modeling to develop design failure mode effects analysis (DFMEA) for keys systems
- Develop a vehicle functional architecture in conjunction with software teams, with a focus on input government regulations and customer-facing feature requirements
- Identify gaps in current designs and processes and focusing on improvements using a systems engineering approach, including design and process optimization
- Interface with various disciplinary teams to ensure holistic systems development
- Lead two projects focused on establishing end-to-end traceability between existent, currently disconnected systems engineering artifacts, including customer needs, use cases, requirements, and test cases in a SysML environment
- Developed strategy for shift from document-centric to model-centric culture in the organization
- Lead modeling effort in the organization, modeling strategies, and mentoring new hires and interns

***Member,* INCOSE Technical Leadership Institute Cohort 9 | June 2023 – June 2025**

***BOD,* INCOSE Michigan Chapter | Jan 2022 – Present (VP – 2022, President – 2023, Events Committee Chair – 2024)**

- Responsible for organizing chapter-related events, improving engagement, and promoting systems engineering within the Michigan community by promoting cross-functional interactions.

***Graduate Research Assistant,* The University of Alabama in Huntsville | Aug 2016 – April 2021**

- Research focused on studying roles of systems engineers in organizations and their impact on system performance
- Developed a mathematical framework for establishing organizational architecture for systems engineers
- Supported NASA's value of MBSE project to determine the value of MBSE in the SE community by performing approach attribute analyses and creating value models
- Worked on the joint NASA-Brazil Scintillation Prediction Observations Research Task (SPORT) project to support the systems engineering effort and modeling for a 6U CubeSat in SysML to study equatorial plasma bubbles
- Represented value models in SysML using NASA's NEA Scout small satellite example and optimized using MDO

***Graduate Research Assistant,* Iowa State University of Science and Technology | Nov 2014 – May 2016**

- Research focused on the design and acquisition of Large-Scale Complex Engineered Systems using Game Theory in the context of VBD

- Worked as a research assistant in the Multidisciplinary Optimization and Design Engineering Laboratory (MODEL)
- Designed a high-level aircraft model comprised of two subsystem levels in MATLAB, that captured aero-structural interactions
- Improvised requirements-driven approach in traditional systems engineering using VBD and MDO

***Graduate Teaching Assistant,* Iowa State University of Science and Technology | Sept 2014 – May 2016**

- Teaching assistant for AER E 378 (Fluid Mechanics), AER E 160 (Aerospace Engineering problems with Computer Applications Laboratory), and AER E 161 (Numerical, Graphical and Laboratory techniques for Aerospace Engineering)
- Covered the help desk in the Department of Aerospace Engineering for the subjects of Statics, Dynamics and Strength of Materials.

***Tutor at the Athletics Department,* Iowa State University of Science and Technology | Aug 2014 – Sept 2014**

- Tutored athletes on Mathematics, Statics and Dynamics, and Strength of Materials

***Aerospace Design Intern,* National Aerospace Laboratories, Bengaluru, India | Mar 2014 – Apr 2014**

- Assisted in the design of a two-seater Microlight Aircraft in the C-CADD division
- Executed in-depth analysis on design of airfoils and flap systems, focusing on the breakdown of requirements

***Aircraft Maintenance Intern,* Air India, Mumbai, India | Jun 2013 – Jul 2013**

- Performed airframe and mechanics maintenance on the Boeing – 747 aircraft
- Gained hands-on experience with aircraft systems and various maintenance practices
- Learned about documentation and aircraft certification

***Engineering Inter,* Gemsons Precision Engineering Pvt. Ltd. Mumbai, India | Jun 2012 – Jul 2012**

- Studied operational principles of machines such as Vertical Milling, Horizontal Milling, CNCs, Wire Cutting and Laser Etching
- Analyzed quality management and packing procedures
- Trained in Auto-CAD and CNC coding

PUBLICATIONS AND PRESENTATIONS

- Bhatia, G., Kannan, H., and Mesmer, B. "A Mathematical Framework Addressing the Roles and Lifecycle Activities for Establishing Organizational Architectures for Systems Engineers". Revision in progress, 2024.
- Bhatia, G., Wirthlin, J., & Wu, Q. (2024). A Structured Approach to the Development of a Logical Architecture for the Automotive Industry (No. 2024-01-2048). SAE Technical Paper.
- Campo, K., Teper, T., Eaton, C., Shipman, A., Bhatia, G., Mesmer, B. "Model-Based Systems Engineering: Evaluating the perceived benefits and drawbacks, positive and negative aspects, metrics, and evidence through literature". Wiley Systems Engineering, September 2022.
- Bhatia, G., & Mesmer, B. (2022). Identification of Elements and Element Relationships for Organizational Architectures for Systems Engineers. In *Recent Trends and Advances in Model Based Systems Engineering* (pp. 631-641). Springer, Cham.
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- Bhatia, G., & Mesmer, B. (2017). Integrating Model-Based Systems Engineering and Value-Based Design with an NEA Scout Small Satellite Example. In *AIAA SPACE and Astronautics Forum and Exposition* (p. 5234).
- Bhatia, G. V. (2016). A game theory approach to negotiations in defense acquisitions in the context of value-driven design: an aircraft system case study.
- Bhatia, G. V., Kannan, H., & Bloebaum, C. L. (2016). A Game Theory Approach to Bargaining Over Attributes of Complex Systems in the Context of Value-Driven Design. In *54th AIAA Aerospace Sciences Meeting* (p. 0972).
- Bhatia, G.V, "Variable Specific Impulse Magnetoplasma Rocket", *Vol.2 - Issue 9 (September - 2013), International Journal of Engineering Research & Technology (IJERT), ISSN: 2278-0181, www.ijert.org.*

TECHNICAL PROJECTS

Modeling NASA's NEA Asteroid Small Satellite using SysML in Cameo Enterprise Architecture, Spring 2017

- Created structural and behavioral diagrams for CubeSat in SysML
- Integrated Matlab and SysML successfully to perform optimization of CubeSat mission

Design of an Automatic Soap Dispenser using SysML in Cameo Enterprise Architecture, Fall 2016

- Created a model that included all 9 types of SysML diagrams in Cameo

Comparison of traditional Systems Engineering approach with Value-Based Design using an Aircraft example, Fall 2015

- Compared single objective optimization, multi-objective optimization, and Value-Based Design approaches using an aircraft example
- Used Genetic Algorithm (GA) for multidisciplinary optimization of aircraft
- Used Utility Theory to examine the effect of different alternatives on rank ordering

Maximization of total profit for a commercial company designing a military weapon system, Fall 2015

- Used Genetic Algorithm (GA) to maximize the total profit for a company

Minimization of fuel weight of Airbus A320, Spring 2015

- Optimized the Airbus A320 for fuel weight considering a simple mission profile using MDO
- Formulated the optimization problem and solved using fmincon (multiple algorithms) and GA
- Visualized the design space and reduced the fuel weight by 24000 lbs

Finite Element Analysis of a bracket under thermal and mechanical loading using Abaqus, Spring 2015

- Modeled and analyzed an L-shaped bracket subjected to thermal and mechanical loading
- Studied the model to determine appropriate boundary conditions
- Analyzed the effects of mesh sizing and varying loads

Behavior of Composite Materials under Fatigue, Fall 2014

- Studied different modes of fatigue failure in Fiber Reinforced Plastics (FRPs)
- Studied the properties of composite fatigue and the associated S-N curves
- Analyzed and compared fatigue in Carbon Fiber Reinforced Plastics (CFRPs) and Glass Reinforced Plastics (GRPs)

SKILLS

- SysML (MagicDraw/Cameo Enterprise Architect)
- MATLAB
- Value modeling
- Minitab
- SPSS
- Finite Element Analysis using COMSOL and Abaqus
- Part Design in CATIA V5
- SolidWorks
- MS Office

RELEVANT COURSES

- Model-Based Systems Engineering (ISE 539, ISE 639)
- Advanced Game Theory – (ISE 739)
- Large-Scale Complex Engineered Systems (AER E 568X)
- Optimization Methods for Complex Design (ME 525)
- Decision Analysis (ISE 734)
- Engineering Systems (ISE 627)
- Game Theory – Special topics
- Introduction to MDO (AER E 563X)
- Metaheuristic Optimization (AER E 544X)

CERTIFICATIONS

- INCOSE ASEP (ASEP Certificate)
- OCSMP Model User (OCSMP MU Certificate)
- OCSMP Model Builder – Fundamental (OCSMP MBF Certificate)
- Women Rising (2023)
- ModelCenter Explore
- ModelCenter Integrate (MCI Certificate)
- ModelCenter MBSE

AWARDS

- Recipient of the *"Amelia Earhart Fellowship"* for the academic year 2018-19.
- Awarded *"Outstanding Graduate Student"* in the Department of Industrial & Systems Engineering at the University of Alabama in Huntsville for the academic year 2017-18.
- Recipient of the RAM Training Summit Student Scholarship for the years 2017 and 2018.
- Graduate Dean's Merit List holder at UAH from 2016 to 2021.
