



REPORT of Activities

January 2020 – May 2023



“The challenges we face and the technologies we need to develop are ever evolving. I’m proud to say that we prepare engineers to tackle the problems of today — and provide them with the knowledge, vision, and confidence to enable systems that help shape the future.”

John Ross Snoderly, PhD
INCOSE Foundation Chair

The INCOSE Foundation, through the SE Global Member Project, is expanding access to the best practices of systems engineering to create a more equitable future — and shape the future for students and practitioners everywhere, regardless of economic ability to join INCOSE. This enables us to reach higher levels of technical achievement, student empowerment and equity around the globe. With your support, we can shape the engineering future workforce, elevate the systems engineering community and advance the public good.

We will continue to earn the confidence that our flagship donors have placed in us to bring our resources to all those who can benefit.

Cover: The INCOSE Foundation celebrates at Soirée 2023. Photo by Andy Pickard.

Letter from the Chairman

Dear Colleagues,

The INCOSE Foundation is proud to present this Report, summarizing activities and accomplishments of 2020 – 2022/23. It will not escape your attention that this period covers the pandemic years. This affected our ability to gather at the Annual Wine Soirée, an evening of celebration and an opportunity to raise funds. Despite this, our financial position remains stable.

While we were unable to meet in person, we used the time to hold a series of strategy sessions online, which have resulted in The INCOSE Foundation signature project — The SE Global Member Project. You will read more about that in the following pages.

You will note some changes in Board Members. First, we thank those who served so well and we welcome new Board Members who have shown leadership in their own professional lives and have agreed to share that with The INCOSE Foundation.

We have continued to use Foundation funds appropriately to support various projects and scholarships over the years. This Report will give you a good picture of how these donations have supported the overall mission of advancing systems engineering, including some important shifting in the focus of our funding.

We continue to be grateful to you, our supporters, whose generosity makes everything possible. It is our goal to support programs that help the INCOSE Foundation fulfill its place in making this a better world to live in and that we will continue to earn the confidence that our flagship donors have placed in us to promote the best practices of systems engineering to all those who benefit from these resources.

The future is extraordinary and challenging. We believe the SE Global Member Project will go a long way to making the valuable INCOSE resources available to engineering students, faculty and practicing professionals in parts of our world where the country economy makes membership in INCOSE largely beyond reach.

We thank you for your support and, with your help, we will continue to meet the challenge.

John Snoderly, PhD
Chairman
INCOSE Foundation

Letter from the Managing Director

The INCOSE Foundation is dedicated to making a difference in people's lives by advancing the development of systems engineering practice throughout the world. The Directors of the INCOSE Foundation are committed to the substantive role we fulfill.

We have compiled the financial data for The INCOSE Foundation for the years 2020-23. These, of course, were the years of the pandemic. A foundation's measure of its financial position depends on three main things:

- Dispersals of funds in accordance with the activities of the foundation (philanthropic activity / administrative fees)
- Donations
- Investments

Traditionally, The INCOSE Foundation has supported Chapters, Working Groups and individuals with grants and scholarships. These certainly had an impact for the recipients. In 2020, The INCOSE Foundation undertook strategic planning to assess how we might make a greater impact in the systems engineering universe — an impact that would not only benefit a greater number of recipients but one that would also elevate the prominence of The INCOSE Foundation within INCOSE to stimulate higher levels of giving.

Process

We spent two years exploring concepts and established the SE Global Member Project to make it possible for people who live in areas of the world where the economy puts INCOSE resources largely out of reach to participate. This is important because these same parts of the world are where significant development is either needed, planned or underway. We know from conversations with the INCOSE Corporate Advisory Board (CAB) that companies want to know they have a qualified workforce. Access to INCOSE resources goes a long way to ensure that with the extra benefit of offering Certification.

Jon Wade, Foundation Board Member, INCOSE Fellow, and Director of Convergent Systems Engineering, Professor of Practice at the Jacobs School of Engineering UC San Diego led the initial research and discussions leading to the decision, which was based on the following:

We have used BKCASE (Body of Knowledge and Curriculum to Advance Systems Engineering) website access rates as an indication of a nation's interest in systems engineering, focusing on the leading academic organizations in nations which have demonstrated interest in systems engineering and which are dramatically underserved by INCOSE. While this is not an exact proxy of SE interest, it is a reasonable first order metric. Table 1 on the following page shows national data for the top 25 countries with the greatest number of unique visitors to BKCASE in 2020.

The data include:

- number of unique site visits
- number of INCOSE members (Senior, Regular, and Student)
- population
- per capita GDP
- language spoken
- various ratios of interest

Table 2 on the next page shows the correlation of a number of these factors.

The following are some observations based on these data. Singapore and Australia have far and away the highest BKCASE usage per capita (769 and 758 per million) and are clearly systems focused countries. However, when normalized by GDP, the Philippines (42,453) is the leader followed by Kenya (38,413), South Africa (38,347) and Sri Lanka (37,548). BKCASE usage is most strongly correlated with the number of INCOSE members (.82), followed by GDP (.57), population size (.37) and then GDP per capita (.29) which is likely due to the fact that access to BKCASE is free.

Table 1: National BKCASE visit rates, INCOSE membership, and national population and per capita GDP

Country	Population	GDP/ Capita	Language	BK Rank 2019	BK Rank 2020	BKCASE 2020	BKCASE per Million	BKCASE/ GDP (\$T)	INCOSE	INCOSE per Million	INCOSE/ GDP (\$T)	BKCASE/ INCOSE
United States	331,002,651	\$ 63,051	English		1	95637	289	4583	5173	15.6	247.9	18
India	1,380,004,385	\$ 1,763	English		2	61153	44	25135	151	0.1	62.1	405
United Kingdom	67,886,011	\$ 39,229	English		3	22565	332	8473	953	14.0	357.9	24
Australia	25,499,884	\$ 51,885	English		4	19329	758	14609	783	30.7	591.8	25
Philippines	109,581,078	\$ 3,431	English		5	15961	146	42453	2	0.02	5.3	7981
South Africa	59,308,690	\$ 4,736	English		6	10771	182	38347	212	3.6	754.8	51
Canada	37,742,154	\$ 42,080	English		7	10113	268	6368	153	4.1	96.3	66
Germany	83,783,942	\$ 45,466	German		8	10028	120	2632	740	8.8	194.3	14
Malaysia	32,365,999	\$ 9,826	Malay	10	9	8226	254	25866	1	0.03	3.1	8226
Pakistan	220,892,340	\$ 1,739	English,	U 11	10	8061	36	20985	3	0.01	7.8	2687
Nigeria	206,139,589	\$ 2,149	English	9	11	5623	27	12693	1	0.00	2.3	5623
China	1,439,323,776	\$ 10,839	Chinese	19	12	5230	4	335	96	0.1	6.2	54
France	65,273,511	\$ 39,257	French		13	5011	77	1956	917	14.0	357.9	5
Netherlands	17,134,872	\$ 51,290	Dutch		14	4629	270	5267	373	21.8	424.4	12
Singapore	5,850,342	\$ 58,484	English	18	15	4496	769	13140	40	6.8	116.9	112
Kenya	53,771,296	\$ 2,075	English	12	16	4286	80	38413	0	0.0	0.0	Infinite
Indonesia	273,523,615	\$ 44,038	Indonesia	16	17	4022	15	334	2	0.0	0.2	2011
Russia	145,934,462	\$ 9,972	Russian	15	18	3766	26	2588	12	0.1	8.2	314
Japan	126,476,461	\$ 39,048	Japanese	17	19	3526	28	714	89	0.7	18.0	40
Turkey	84,339,067	\$ 8,506	Turkish	21	20	3377	40	4707	154	1.8	214.7	22
Ethiopia	114,963,588	\$ 974	English,	23	21	3376	29	30150	0	0.0	0.0	Infinite
Saudi Arabia	34,813,871	\$ 19,587	Arabic	20	22	2965	85	4348	15	0.4	22.0	198
Egypt	102,334,404	\$ 3,561	Arabic	>25	23	2778	27	7623	2	0.0	5.5	1389
Brazil	212,559,417	\$ 6,450	Portugal	>25	24	2759	13	2012	29	0.1	21.2	95
Sri Lanka	21,413,249	\$ 3,373	Sinhala	>25	25	2712	127	37548	1	0.0	13.8	2712
Sweden	10,099,265	\$ 50,339	Swedish	22			0	0	144	14.3	283.2	0
Italy	60,461,826	\$ 30,657	Italian	24			0	0	170	2.8	91.7	0
Peru	32,971,854	\$ 5,845	Spanish	25			0	0	2	0.1	10.4	0

Table 2: Factor Correlations

Correlation:		
Factors	INCOSE	BKCASE
Population	0.04	0.37
GDP per capita	0.50	0.29
GDP	0.69	0.57
BKCASE	0.82	1
INCOSE	1	0.82

On the INCOSE side, BKCASE visitors have the greatest correlation (0.82), followed by GDP (0.69), then GDP per capita (0.5), with almost no correlation with population size (0.04). INCOSE membership for most countries in the BKCASE top 25 is between 100 (Italy) to 758 (South Africa) per \$1T in GDP. However, there are a large number of countries (12) that have 15 or fewer INCOSE members per \$1T GDP.

An important ratio is that of the number of BKCASE visitors to INCOSE members which indicates how well INCOSE serves systems engineering interests. While the

➡ continues on next page

Managing Director (continued)

BKCASE to INCOSE member ratio in a large number of well-represented INCOSE nations ranges from 5 in France to 112 in Singapore, there are seven nations in which this is ratio greater than 2000. India, Russia and Saudi Arabia fall somewhere in between.

The underserved nations with the greatest BKCASE activity are the Philippines, Malaysia, Pakistan, Nigeria and Kenya. It is reasonable to start the program with three nations, so we considered how to down select from this group of five. The strength of existing systems programs, relationships, language and other factors certainly played into this. For example, less than 50% of Malaysia speaks English and Malay is the language of instruction in state post-secondary schools. Gender equality issues in Pakistan make it problematic. As a result, the Philippines, Nigeria and Kenya were identified as the top candidates for Foundation outreach.

Decision and Implementation

As we explored ways to implement this program, it became clear that it is through membership in INCOSE and access to resources for students, faculty and practitioners.

The decision was to establish the first cohort in Africa at two Universities with which The INCOSE Foundation now has MOUs — the University of Lagos in Nigeria and the University of Nairobi in Kenya. Between the two Universities, thousands of students are in the engineering programs at these educational institutions.

In addition to signed MOUs, the Dean of the Faculty of Engineering at the University of Nairobi attended IW 2023, we have met twice monthly with the participants from both universities, and we have developed plans with INCOSE's certification program. Thanks to Certification Manager, Courtney Wright, the twenty faculty/practitioners will be able to take the exam at no cost. Thanks to Paul Martin's SE Scholar Training program, those same twenty people will be taking the exam preparation training course at a tremendous discount (approximately 99%).

In mid-2023, the INCOSE Executive Director looked at what we are doing, listened, liked what he heard and proposed a closer relationship with INCOSE to facilitate this needed growth. As we write this summary, we can also announce that INCOSE will make Academic Council membership available, through the Foundation, to universities in the areas the Foundation has been targeting and the membership rate will be at the PPP3 level of \$2612.50, paid by the Foundation. INCOSE will reimburse the INCOSE Foundation for a percentage of that membership, likely with a \$1500 contribution per university.

Needless to say, we are all delighted, as we recognize how much more we can accomplish with the money we raise under this new arrangement.

Finding Support

Nonprofit organizations rely on contributions of money and time to accomplish their missions. The INCOSE Foundation benefits from having support from the INCOSE organization in the form of an annual contribution and some of the marketing and communications provided through INCOSE Marcom, as well as access to the membership so we are able to update people about our expectations, achievements and needs.

Volunteers on The INCOSE Foundation board are outstanding. John Snoderly's (DAU) leadership as Chair continues; Jim Armstrong serves as Treasurer, having presided during the pandemic and helping us to keep our spirits up; all members participated in the strategic sessions with additional participation from Larry Strawser, JHU, who along with Jon Wade has kept us moving forward.

Perhaps the most significant volunteer activity change occurred in 2022 when DAU was mandated by Congress to place faculty in volunteer rotational assignments serving as defense systems engineering subject matter experts in support of the mission of a selected organization. The INCOSE Foundation was invited to apply and Tyrone Theriot, DAU's

Managing Director (continued)

Engineering and Technology Department Chair – also an INCOSE CSEP – grew interested in, and ultimately decided to join, The Foundation to fulfill his rotation. Ty has lent his experience and expertise in innumerable ways; so much so that, at the first opportunity, he was elected to join the Board of Directors of The INCOSE Foundation.

Every member of the Board contributes time and financial resources. Leroy Hanneman was the first to respond to our request for funding for the SE Global Member Project, supporting ten student memberships; Bob Stowe and Stephen Cook respond to every update with wise counsel and support; Regina Griego represents the Foundation's interests in her work organizing the annual ISEF Bill Ewald Award; and, Suja Joseph-Malherbe, former President of the South Africa chapter, has agreed to work with the University of Nairobi and the University of Lagos to help form another African INCOSE chapter. The newest board member, Dorothy Beneniste, has taken on the task of managing our social media presence.

Ongoing Foundation Supported Awards

While our concentration shifts to the SE Global Member Project, The Foundation continues to facilitate legacy awards:

- ISEF, the International Science and Engineering Fair INCOSE Bill Ewald Award to a pre-college student;
- The Chesapeake Chapter Award for undergraduates (Three \$500 awards);
- The San Diego Chapter STEM Awards
- The Stevens Doctoral Award for Promising Research in Systems Engineering to a PhD Candidate. *See the announcement of the 2023 Recipient later in this Report of Activities.*

There has been a realignment in two of the Funds managed by The INCOSE Foundation. Through the generosity of David and Donna Long, the James E. Long Fund now supports the SE Global Member Project with a \$5000 annual gift for three years; and, Lorraine Wright has graciously

offered to support the project from the David Wright Memorial Fund. We are so grateful to both.

As we are also grateful to all our donors....

Please be sure to look at the names of the many donors to The INCOSE Foundation included in this report. Every gift matters. As you know, we hold one fundraising event a year at IW — the now much anticipated Soirée. We had to forgo Soirée during the pandemic years and were delighted to bring it back in 2023.

In addition to the money raised through registrations and a raffle, both INCOSE President Marilee Wheaton and member Tina Srivastava donated a portion of proceeds from their two recent books, inspired by what they heard about the SE Global Member Project at Soirée.

It is also important to note the administrative support The INCOSE Foundation receives from Universal Management, the company that manages the affairs of both INCOSE and The INCOSE Foundation. It is always hard to define the back-of-the-office activities performed by admin so let this be a shout-out to the wonderful people who work with us.

In the last report we prepared, we wrote: “At the cusp of 2020, it is perhaps a good time for The INCOSE Foundation to review its place in the systems engineering universe.” We believe we have accomplished that with stellar results.

To our supporters, please accept our gratitude. We hope you will be inspired by what we are doing to renew your support.

Holly Witte, Managing Director
The INCOSE Foundation

2023 Stevens Award

The INCOSE Foundation has been bestowing the STEVENS Award for Promising Research in Systems Engineering to a Ph.D. candidate since 2002. This is made possible through a generous grant from the Stevens Institute for Technology.

The award, which carries a \$5000 gift, is made only in years when there is a worthy candidate. This year, 2023, we are pleased to recognize Ibukun Phillips who is not only recipient of the Stevens Award, but who is also the winner of INCOSE's Best Student Paper at IS 2023.

Mr. Phillips is a PhD candidate in Purdue's School of Industrial Engineering, where he also obtained his master's degree in Industrial Engineering. His bachelor's degree, in Industrial/Production Engineering, is from the University of Ibadan, Nigeria. Mr. Phillips' current research is on the verification and validation of AI-Enabled systems and Digital Twins.



The paper for IS2023 is titled 'System Verification via Model-Checking: A Case Study of an Autonomous Multi-differential Drive Robot.'

Model-Based Systems Engineering (MBSE) has been utilized in the design and behavioral modeling of cyber-physical systems. The Vee model helps frame MBSE's lifecycle approach, with system verification a vital aspect of the qualification process. However, popular modeling language tools in MBSE, such as Systems Modeling Language (SysML), are incapable of formally verifying these systems. In addressing this shortcoming, model checking can be looked upon since it allows for the development of formal system models similar in abstraction to SysML models towards automatically checking if these formal models satisfy formal specifications. In the paper, we proposed an approach to translate behavioral diagrams in SysML, such as state-machine diagrams, to the popular symbolic model checker NuSMV for formal verification. As a case study, we applied this process to autonomous multi-differential drive robots (DDR). Subsequently, the NuSMV model is verified against some formal operational specifications obtained from the requirements diagram of the DDR. This system verification approach can help System Engineers identify design flaws or incorrect modeling or specifications that could be missed during the design phase through the results of the model checking process.

The INCOSE Foundation extends congratulations to Ibukun Phillips; and, our gratitude to the INCOSE Fellows who annually establish the review team for the STEVENS Award.

2022 & 2023 ISEF Award Winners

The INCOSE Foundation believes education is a key to the future — not just for the student, but also for our civilization. Talent, genius, and inspiration may not always announce themselves or appear in settings one might expect. How many great basketball players shoot hoops on courts in public parks far away from the eyes of major Team scouts? How many kids sit on their beds doing homework and thinking thoughts far above those of their peers but whose chances of being discovered by a top engineering school are slim?

While the size of the gifts made by The INCOSE Foundation may not be life-changing in terms of what is needed to secure a stellar education, we know the value of recognizing talent, genius, and inspiration means a lot.

This is why we are proud to bestow an award to a student through the annual Regeneron ISEF competition and, better yet, to have that award acknowledge Foundation Founder and champion, Bill Ewald. There have now been two students to receive the Bill Ewald Socio-Technical Systems Engineering Award of \$1000.

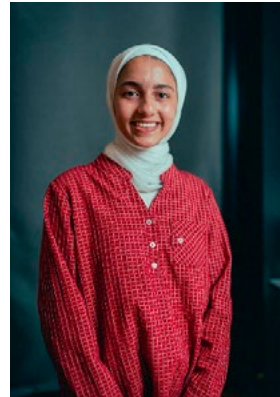
Led by Regina Griego, the selection team recommended that Okezue Bell become the first honoree in 2022 for his work in **Low-Cost and Non-Invasive Upper Limb Myoprosthesis**.

In addition to his significant work in science and engineering,



Mr. Bell is an activist and Climate Change ambassador to the UN.

The 2023 recipient is equally impressive.



Israa Shawabka, who attends Fawwar Girls Secondary School and lives in Hebron, West Bank, Palestine, has designed a medical device that enables women to self-examine for breast tumors. The small device works with a direct pressure mechanism to feel the presence of an abnormal solid lump. This can be used anywhere at any time, eliminating certain barriers women face, including those for pregnant women who cannot be exposed to harmful radiation.

INCOSE Foundation Financial Profile 2020-2023 to Date

During the pandemic, donations to the Foundation remained fairly stable. We did have significant fluctuations in earnings but appear to be recovering from a sizable loss last year.

Regardless of how the pandemic affected the economy and society in general, the simple truth is that for the INCOSE Foundation to grow and achieve maximum impact with projects like the SE Global Membership Project, we must have growth in donations and fund raising.

The following tables are a snapshot of how the Foundation functions financially. You will see how donations have remained stable. You will also see that expenses appear to exceed donations, which is true; however, investment income helps to subsidize our activities; as the economy improves, so have our investments, putting 2023 in line to be a positive year. A full financial report will be released after The INCOSE Foundation Board meeting in July.

We are firm in our belief that systems thinking is a significant key to finding viable solutions to the problems facing the world. Systems Engineers bring that unique quality to every issue. It is incumbent on us to do all we can to make the INCOSE resources available in an equitable way to students and practitioners everywhere.

What follows is a list of INCOSE Members who have chosen to support our Mission. We are grateful to those whose names appear. Every INCOSE member has the opportunity to increase our ability to shape the world.

Here is where to donate: https://www.paypal.com/donate/?hosted_button_id=H249VSA6BJTFQ

Please note that contributions may be tax deductible to the extent allowed by law in your country. Please consult your personal finance professional to understand how your country governs such transactions.

1. Total dollar amount of donations each year for 2020, 2021, 2022, 2023 to date	
2020 –	\$45,491.37
2021 –	\$47,048.49
2022 –	\$42,612.56
2023 – YTD as of 5/31/23 –	\$22,355.04
2. Total expenses for the same years	
2020 –	\$49,952.45
2021 –	\$40,372.95
2022 –	\$34,683.55
2023 – YTD as of 5/31/23 –	\$11,099.98
3. End of year investment balance for 2020, 2021, 2022 and 2023 to date	
2020 –	\$273,262.42
2021 –	\$293,757.31
2022 –	\$253,371.35
2023 – YTD as of 5/31/23 –	\$274,817.88
4. End of year assets for 2020, 2021, 2022, 2023 to date	
2020 –	328,165.84
2021 –	359,645.78
2022 –	331,161.65
2023 – YTD as of 5/31/23 –	\$361,014.39

The INCOSE Foundation Board

BOARD CHAIR



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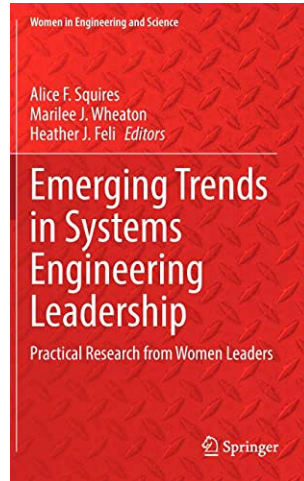
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Notable Donations

The INCOSE Foundation is honored to be the recipient of every donation that helps to take us to the next level. **INCOSE President Marilee J. Wheaton** gave the Foundation a portion of the proceeds from a book of which she was one of three Editors. The book reports on “...innovative and impactful research from women leaders in the field of systems engineering.”



EMERGING TRENDS IN SYSTEMS ENGINEERING LEADERSHIP — The book is available in hardcover and as an ebook at: <https://link.springer.com/book/10.1007/978-3-031-08950-3>

Another very generous donation came from **Dr. Tina P. Srivastava**. Tina, the recipient of the David Wright INCOSE Leadership Award bestowed by The Foundation in 2013, has led a distinguished career since. This donation is based on the success of her recent book **INNOVATING IN A SECRET WORLD The Future of National Security and Global Leadership** in which she “examines America’s legal and administrative framework for defense technology innovation and asks if it can take advantage of the open innovation model, and especially if it could be used by

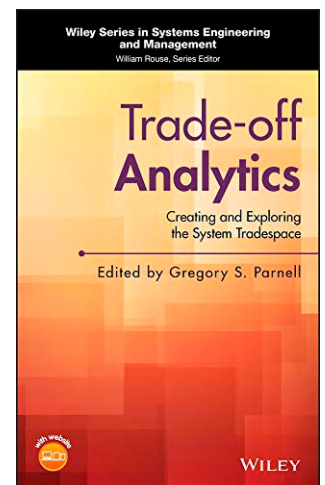


the U.S. government to manage delivery of innovative technologies in a system that prizes secrecy and delivery of low-cost hardware.”

You may purchase this book here: <https://www.amazon.com/Innovating-Secret-World-National-Leadership/dp/164012866>

Courtney Wright, Manager of the INCOSE Certification Program, and **Paul C. Martin**, SE Scholar, have both made it possible for twenty faculty members from the University of Lagos and the University of Nairobi to take certification training and to take the exam at no or very low cost.

Gregory Parnell served as Editor of **TRADE-OFF ANALYTICS**, a textbook sponsored by the INCOSE Decision Analysis Working Group. Greg and his team of editors and authors donate the proceeds of this book to the INCOSE Foundation.



Available at Wiley: <https://www.wiley.com/en-us/search?q=trade-off%7Crelevance> or at Amazon.

Foundation Donors — *You are the reason anything is possible.*

Every effort is made to be accurate in the listing of donors.
Please contact the INCOSE Foundation should a correction be needed.

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