

A Study of the Effects of Professional Society Development on the Advancement of the Profession: The Systems Engineering Example

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Abstract.

The advancement of professions depends on global collaborations. Professional societies are enablers to this growth in a multitude of ways. Publication outlets to disseminate new ideas, collaboration mechanisms to form communities of interest and conferences to enable networking and recognition all play critical roles in defining and advancing disciplines. In response to this, INCOSE has made a conscious decision to hold its flagship event, the annual Symposium, at strategic locations around the world. At the moment, the majority of INCOSE members, approximately sixty percent, are based in the U.S. although the diversity of membership has increased over time. In this paper, we seek to analyze the impact of hosting a symposium in a particular location through the use of six retrospective case studies to determine how a professional society such as INCOSE can impact the systems engineering profession. We investigate the consequences of hosting a symposium in a specific region and analyze the impact of the symposium on the advancement of the profession of Systems Engineering

Introduction

Professional societies form a net centric entity, in which communication and continuous flow of ideas drive the advancement of the profession. As we embrace a world in which technology and development drive our actions, it is necessary for us to have a clearer understanding of the role that professional societies play in global development. A professional society is more than a sum of its parts—it is a self-organizing community of practice where individuals continually learn from one another and share new solutions as they devise them. But no matter how well it is serving its most established members, no professional society can afford to rest on its glory. Continuing efforts are necessary to create an ecology of learning that will effectively recruit and nurture younger members (Bickel 2007). Professional societies have been created and have expanded with various goals in mind, including the development of new professions, diversity, minority issues, need for regulation within the profession etc. In this paper, we seek to understand the roles of professional societies and explore how certain events such as symposia help meet these goals, both locally and internationally. We approach this study by using six retrospective cohort case studies to investigate and analyze the value added when an organization such as the International Council on Systems Engineering (INCOSE), representative of the emerging and rapidly developing field of Systems Engineering, makes decisions on where and how to host its Symposia, and investigate the impact that the symposia have on the advancement of the profession and realizing the goals of the professional society.

Professions and Professional Societies

Before we can explore the effectiveness of professional societies such as INCOSE in accomplishing their objectives or their relative impacts on the profession, we must first understand why

they were formed. The term *profession* has through the years embraced numerous definitions, which have contributed significantly to developing the characteristics of a profession. According to the literature on professions (Parsons 1939; Larson 1977; Abbott 1988; Friedson 2001; Adler, et al. 2007) a profession is characterized by:

- Formal education and/or advanced training
- Apprenticeship
- Barriers to entry (i.e., professional certification)
- Technical expertise within a specific domain
- Autonomy in practice
- Informational asymmetry with the client
- Institutional and social legitimacy
- Collegiality as a regulatory mechanism
- An ethics code

With a rapidly developing environment, population growth coupled with exponential advance in technology and demand for effective management of resources, it becomes necessary to have a more structured professional hierarchy and provide an avenue for an interconnected network.

The Role of Professional Societies

Professional societies have been created not only to be a resource to professionals and their members, but also to ensure that professionals maintain the oaths they have made to themselves and society (Friedson 1970). They ensure that ideas and information flow freely, while maintaining standards of conduct that allow performance expectations and societal needs to be met. Professional societies form a living matrix where minds meet and engage and where trusted colleagues pool their knowledge, helping each other to glimpse and plumb larger forces at work, to see connections among events, and to imagine the future (Bickel 2007). They are source of energy, ideas and motivation and form a network of professions ranging from medicine, law and business related fields to science, technology and engineering. In a complex world, defining the roles of professional societies can be a challenge due to differences in geographic location, politics, wealth, population etc.

Professional societies are also key to helping the professionals understand *why* they are doing what they're doing, *when* to take actions and *whom* to connect with. It is essential for any professional society to ensure that its members build healthy relationships with critical thinking partners who would be an asset to their professional development by providing both encouragement and a challenging environment that would spawn nothing but the best quality in profession. Professional societies ensure that knowledge is preserved from one generation to the next. Therefore, they are responsible for creating that avenue whereby junior members and senior members can interact - the younger generation introduces new innovative ideas that are in sync with a developing world, while older members can pass on the knowledge of the highest professional norms and assist with career-building through creation of networks and challenges.

Some professional societies, such as the American Bar Association (ABA) are mainly concerned with regulation and being a representative of the profession – the ABA exists to serve as the national representative of the legal profession, serving the public and the profession by promoting justice, professional excellence and respect for the law (Clarke 2007). In Eastern Europe, the recent democratic and economic transition has created an avenue for greater professional autonomy and new possibilities to participate in policymaking and developing standards of conduct. Compared to the industrial democracies of the West in which scientific and technical societies provide a source of technical expertise for government policy makers and serve as a mechanism through which scientists and engineers can participate in the political process, Eastern Europe faces the additional responsibility of persuading policy

makers and the public of the long-term value of investment in research and development and have to respond to the public's concerns about the social and ethical implications of advances in science and technology(Frankel 2009).

Perhaps one of the most fundamental reasons for having professional societies is the need for a standard of professionalism, a specific code of conduct to which members are expected to comply, especially for high risk and emergent professions (Nichols 1997). Engineering associations have outlined their roles and responsibilities as engineers, and their obligations to themselves, their employers, employees, and society in general. Each organization is faced with ensuring the members adhere to these stipulations in order to meet the levels of expectations of the profession. For emergent fields such as Systems Engineering, the professional organization sets out the standards of definition of this field, helps define the profession's scope and boundaries, and carves out the expectations of members (Smith 2006). Of course these objectives vary from society to society and region to region, but the success of any profession rests on the ability of members to recognize and implement the appropriate actions to accomplish the goals of the profession.

Challenges faced by Professional Societies

Professional societies face perpetual challenges worldwide. How do they recruit and involve their younger colleagues, particularly those with the greatest leadership potential? How do they intend to retain their members to pass on their experiences? How do they help bridge the gap between the older generations and younger generation? How do they help members build the fortitude necessary to achieve their goals and become the next generation of leaders? How do they ensure that members get the value they are seeking in a professional society? Societies that represent emergent professions face the additional challenge of emphasizing the importance of the profession, developing relationships with corporations, government and other leaders in the profession. They need to offer incentives to encourage and retain membership and establish the codes of conduct for the profession, which requires tremendous effort and cooperation. To do this, societies plan events on a regular basis to create an avenue for members to meet and interact with each other, share ideas, develop the profession, address challenges in the profession and help to meet the profession's goals. For international societies, this may be done in segments, but to organize a central meeting point for all regions, this is done through symposia or conferences, which attract members worldwide. This helps the profession and the societies develop on an international level rather than being limited to only regional events. The remainder of this paper focuses on how The International Council of Systems Engineering (INCOSE) uses its symposia to develop the Systems Engineering profession.

The Systems Engineering Example

Systems engineering fulfills an historic need to manage complexity in technology-enabled systems. However, acquiring academic prestige and establishing itself as a legitimate profession poses serious challenges to the community (Dixit and Valerdi 2007). INCOSE was formed in an effort to solidify the work of Systems Engineering and has evolved its own definition of systems engineering:

“Systems Engineering is an interdisciplinary approach and means to enable the realization of successful systems. It focuses on defining customer needs and required functionality early in the development cycle, documenting requirements, then proceeding with design synthesis and system validation while considering the complete problem”.

Over the years, INCOSE has embraced its role as the international representative of the profession of Systems Engineering, by focusing its efforts on developing a standard of professionalism,

providing an avenue for networking and idea flow and a means for the development and expansion of Systems Engineering.

Introduction to INCOSE

INCOSE’s vision is to be the world’s authority on Systems Engineering. Formed in 1990, it is a not-for-profit membership organization founded to develop and disseminate the interdisciplinary principles and practices that enable the realization of successful systems (Honour 1998). Its mission is to share, promote and advance the best of systems engineering from across the globe to benefit humanity and the planet. As a professional Systems Engineering society, INCOSE’s specific goals are well in tune with the general goals of any professional society. They include:

- Providing a focal point for dissemination of systems engineering knowledge.
- Promoting international collaboration in systems engineering practice, education, and research.
- Assuring the establishment of competitive, scalable professional standards in the practice of systems engineering.
- Improving the professional status of all persons engaged in the practice of systems engineering.
- Encouraging governmental and industrial support for research and educational programs that will improve the systems engineering process and its practice.

Source: <http://www.incose.org/>

As of December 2009, INCOSE is made up of 7047 corporate members and individual members from six regions (Witte 2010)

Region	Countries	Number of Members
I	Northwest North America	464
II	Southwest United States;	1055
III	Africa, Europe, Israel, Russia, Turkey	2045
IV	Northeast North America	914
V	South America, Central America and South Eastern United States	2149
VI	Asia, Australia, and the Middle East.	452

The regions are currently divided into fifty seven chapters of full (6313), electronic (236), student (361), senior (179) and lifetime (8) members, some of whom do not belong to any specific chapter. The INCOSE and member breakdown structures are demonstrated in Figure 1.

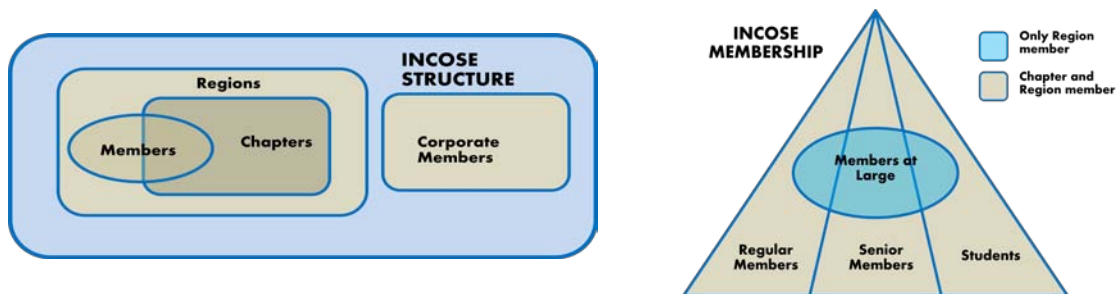


Figure 1: Diagram of INCOSE structure (left) and INCOSE membership (right)

While the central administration promotes cohesiveness and organization, INCOSE recognizes that the local chapters are key players in realizing the goals of the organization. They are *the performing units that organize a multitude of professional and social programs, conduct membership recruitment and*

retention drives, support technical activities striving to advance the state and art of systems engineering, and market INCOSE as the international authoritative body on systems engineering.

Source: <http://www.incose.org/>

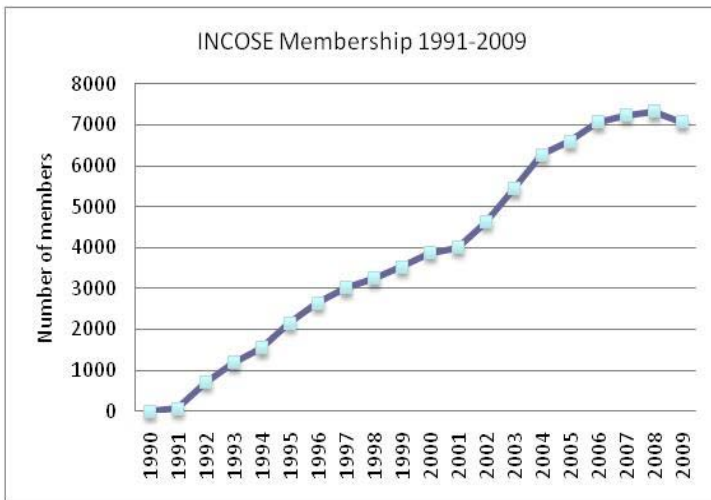


Figure 2: Increase in INCOSE membership from 1990 to December 2008

Since 1990, INCOSE has witnessed constant growth in its membership (Figure 2) and continues to grow steadily mainly due to its recruitment efforts over the years and the increased need for cohesion in the development of Systems Engineering. INCOSE's membership has increased from 64 members in December 1991 to 7047 members in December 2009. One of the main ways in which INCOSE recruits its members is through the use of Symposia. Each year, members, corporations, and guests are invited to attend the symposium, which creates a central meeting point for networking, presentation and development of ideas, and transfer of knowledge. Through the symposium, the values of the organization are filtered to members, papers

are presented on cutting edge research and application, corporations learn how to integrate a Systems Engineering approach to management and operations, and it is the intention to promote and reinforce the concept of Systems Engineering on a global scale. Considerable emphasis is placed on the location of these symposia and in recent years INCOSE has strategically branched away from hosting its symposia in the United States, which is home to more than 60% of its members, in line with its vision of becoming the worldwide authority in Systems Engineering.

Figure 3 shows the general locations of symposia for the past 19 years within the regions. Of these, 6 have been held outside the US, in regions I, III and VI. In order to assess the impact of these Symposia on the profession we explore the outcomes of the symposia specific to the regions in which they were hosted, and evaluate how this has contributed to the advancement of the profession of Systems Engineering.

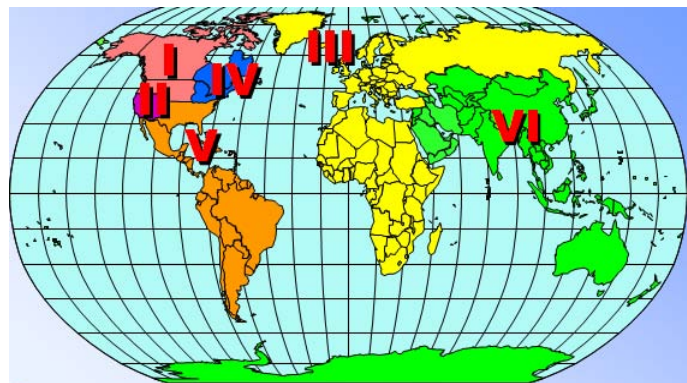


Figure 3: INCOSE regions where symposia were held <http://www.incose.org/about/index.aspx>

Research Methods

In our analysis we use a combination of approaches to understand the role of professional societies, and how INCOSE has influenced these objectives through its symposia. First, we use an interpretive approach to develop theories about the role of professional societies in the development of professions, we use INCOSE as a specific retrospect cohort case study methodology (Yin 2002) to explore the historical role of INCOSE Symposia in countries outside of the US, and interview a variety of stakeholders involved, including host chapters, organizers, Board of Directors Members, corporate sponsors, and attendees of the symposia.

We focus our sample selection on countries and regions that have hosted an INCOSE Symposium between 1990 and 2009 outside of the U.S. These include Canada (1998), United Kingdom (1999), Australia (2001), France (2004), The Netherlands (2008), and Singapore (2009). We place emphasis on the countries, regions, chapters and corporations that were involved with and were affected by symposia. Some of the obvious impacts of symposia on the local region are an increase in the:

- Number of new individual members, corporate advisory board members and chapters in the region
- Number of Certified Systems Engineering Professionals in the region
- Number of local attendees at each symposium
- Number of papers by local members submitted and accepted
- Number of local corporate and government sponsors
- Number of partnerships with local organizations closely related to systems engineering
- Number of academic programs in local universities
- Number of papers submitted to the *Systems Engineering* journal by local authors
- Level of participation in INCOSE Working Groups by local members
- Number of INCOSE award recipients from the local region
- Increase in government funding to support Systems Engineering

We seek to explore these metrics through interviews and analysis of historical data for the six case studies described. Each Symposium has its own story and its own outcome based on geographic location, individuals involved, strategic priorities of INCOSE, and local resources. Global economic considerations are an important factor in analyzing the outcomes of each case since world events have shown to have an important influence in the planning and execution of a Symposium

Preliminary Findings

In this section we present the information we have gathered to date, through literature searches, data available on the INCOSE website, and detailed interviews with the immediate past President of INCOSE, Pat Hale of the Massachusetts Institute of Technology, and the current President of INCOSE, Samantha Brown of BAE Systems. We also gather information from present Executive Board members and persons who have been involved first hand with planning symposia in the past. We first attempt to understand the thought process behind choosing a location for a symposium then show the correlations between our hypothesis for measuring symposia impact and the data we have gathered, and track the evolution of Symposia planning from 1990 to 2009.

Strategic Considerations in planning Symposia

The location of a symposium is planned at least three years in advance and there are a number of factors, which feed into choosing the most appropriate location. INCOSE prides itself and is committed to being an international community promoting a global awareness of the profession, as well as reaching out to those interested in the advancement of the field of Systems Engineering. One of the criteria for symposium location is the existence of local interest in Systems Engineering, which can manifest itself in the presence of strong INCOSE chapter(s) in the region, as well as corporate sponsors who have a vested interest in the field. The organization ensures that the appropriate balance is met between the need to reach out to promote and expand the field of Systems Engineering and ensuring that the location has some existing standing in the field.

Also in line with its commitment to international development, INCOSE seizes the opportunities to expand into new countries, hence the move towards having more symposia outside the U.S. every third year. However, in considering venue, costs of travel for the individual participants and heightened security in certain regions makes some locations such as South Africa and Israel less desirable. Needless

to say, for the first time in its history, INCOSE held two consecutive symposia outside of North America¹ in 2008 (Netherlands) and 2009 (Singapore). We explore whether this decision had its intended impact by measuring outcomes in Western Europe (Region III) and Asia Pacific (Region VI).

While historically Systems Engineering has been more applicable to aerospace and defense domains, the developments in the field to date have warranted the need to expand into other areas to which similar principles can be applied. The symposium held in The Netherlands in 2008 focused on how systems engineering could achieve balanced solutions for a sustainable planet. INCOSE saw the opportunity to demonstrate a systems approach in an application area that had not been highlighted before and what systems engineering could do well beyond its traditional domains. The Netherlands was also ideal because it provided an avenue for collaboration between an already well-established rail and transport system in the Netherlands and The New York City transit, an organization with which INCOSE had been working on the application of Systems Engineering principles. In choosing its locations, while INCOSE is geared towards expanding to different domains, it also looks for the industry presence, availability of speakers and contacts in the field it is attempting to penetrate.

INCOSE places great emphasis on its strategic objectives when planning its symposia. As one of our interviewees clearly stated, “in spite of how small the world is electronically, nothing makes the connection better than up-close and in-person; the more we are able to visit each other in our respective venues and connect person-to-person, and visit each other’s workplaces, if only briefly, the more willing we are to share information and build businesses.” When the organization first held its symposium outside of the U.S. in 1998, it selected Vancouver, Canada because of its close proximity to Seattle (the home of many INCOSE members and INCOSE Headquarters at the time). INCOSE had already successfully held seven symposia in the US and attempted to branch out to a non-US community by using a relatively low risk approach. Immediately following the successful demonstration of the first international symposium, the UK hosted the first overseas symposium in 1999. After this symposium, the UK chapter remained extremely active and is now the second largest chapter in INCOSE.

While the majority of INCOSE’s membership is based in the US, INCOSE has strong presence outside of the US. Region III, to which the UK chapter belongs, and Region VI have developed their own mini symposia – EuSEC² and APCOSE³. This leads to another factor that is considered in planning symposia, and includes the potential for collaboration between the international and regional symposia. Over the years, a four-year cycle of combined international symposia and Region III and Region VI symposia has developed. For instance, Toulouse, France (2004) and The Netherlands (2008) were also the Region III EuSEC. It is hoped that in 2012, the international symposium will be held in Region III once again in conjunction with EuSEC. Singapore (2009) was also a merger between Region VI APCOSE and the international symposium, and it is possible that the 2013 symposium will once again be held in conjunction with APCOSE in Japan.

Other factors which affect the location of a symposium include the ease of travel, practicality of the location, attractiveness for travel and timing, as INCOSE does not want to clash with other major Systems Engineering efforts in the area. INCOSE does not plan a symposium with the sole aim of making a profit, and while it accepts that it may not make significant profits, it does not want to make a loss since this reduces its reserves for funding its other strategic priorities. One of the elements that can help balance the financial aspects of symposia is corporate sponsorship. We will discuss this in more detail in the next section. INCOSE places more emphasis on encouraging membership growth and development, corporate integration and the overall development of Systems Engineering irrespective of the location chosen and carefully plans its symposia with the aim of accomplishing its objectives as an international professional society.

¹ The first time two consecutive symposia were held outside of the U.S. was in 1998 (Vancouver) and 1999 (UK)

² European Systems Engineering Conference

³ Asia Pacific Conference on Systems Engineering

Impacts of Symposia

While INCOSE plans years in advance where a symposium is to be held based on a combination of factors, the outcomes of these symposia have had varying effects on the regions in which the symposia were held. Because it is important for the governing bodies within INCOSE to understand whether their attempts to accomplish their objectives have been successful, it is necessary to measure the impact that the symposium has on the profession in the region in which it is held. We present evidence of symposium impact that we have gathered from our initial interviews and data analysis.

Membership Growth

In addition to a general increase in INCOSE membership, we have witnessed growth in membership when a symposium was held outside of the US. Figure 4 provides a summary of the membership growth between December of the year before the symposium was held and December of the year of the symposium. Those in black represent the growth seen by INCOSE when the symposium was held outside of the US. Growth for the 2009-2010 period when the Singapore symposium was held is yet to be determined.

The data show that, although there is an increasing trend in the membership of INCOSE, there is significant fluctuation in the membership growth from one year to the next. We also see that there was always a growth in membership even for those symposia held outside the US. In particular, after the Toulouse, France symposium in 2004, INCOSE experienced an increase of 988 members, almost a 25% increase from the previous year's recorded membership, and the highest record growth for any INCOSE symposium held in the last 19 years..

There are also other factors that we must consider if we are to use membership trends as a measure of impact on the profession in the local region. While one of the main aims of symposia revolves around recruiting new members, INCOSE maintains approximately a 70% membership retention rate, which is the standard for professional societies of its nature. The growth numbers presented above are most likely overestimates of the actual growth since it does not include members lost as a result of having the symposium outside of the U.S. In general, there can always be membership fluctuations in an area caused by people wanting less expensive registration payment and never renewing the following year. At the same time, the last six symposia have been regional collaborations, and these relationships these relationships do strengthen the regions and chapters participating.

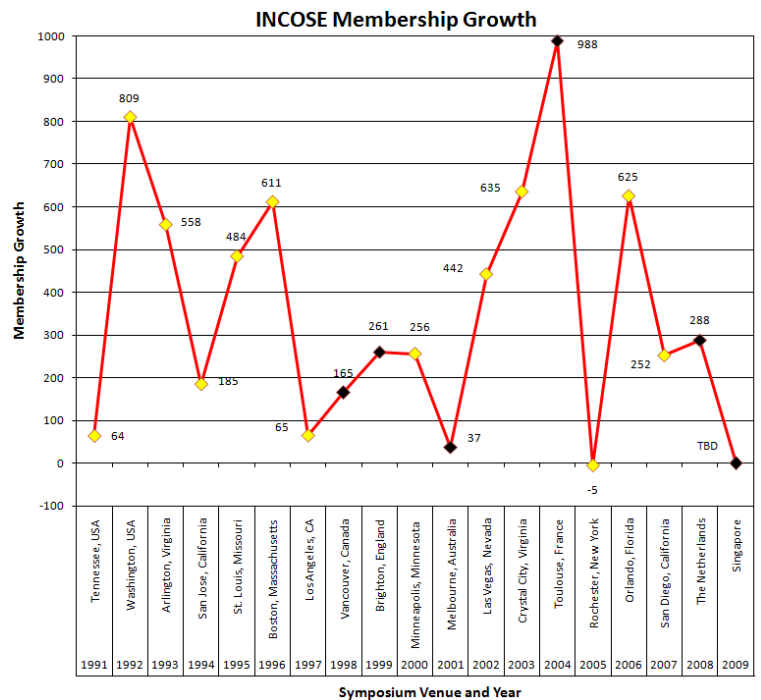


Figure 4: Membership growth from December previous year to December year symposium was held

Source: <http://www.incose.org/>

Region and Chapter Growth

Through the years, INCOSE has seen a constant expansion in its regional growth. Figure 5 shows the general trends with which this growth has occurred. In some cases, because many individuals sign up for a one year membership, professional societies often experience a decline in membership in a region the year after a symposium was held in that region. This is particularly evident in the dip in the behavior of the Region III growth curve after the symposium held in the Netherlands in 2008.

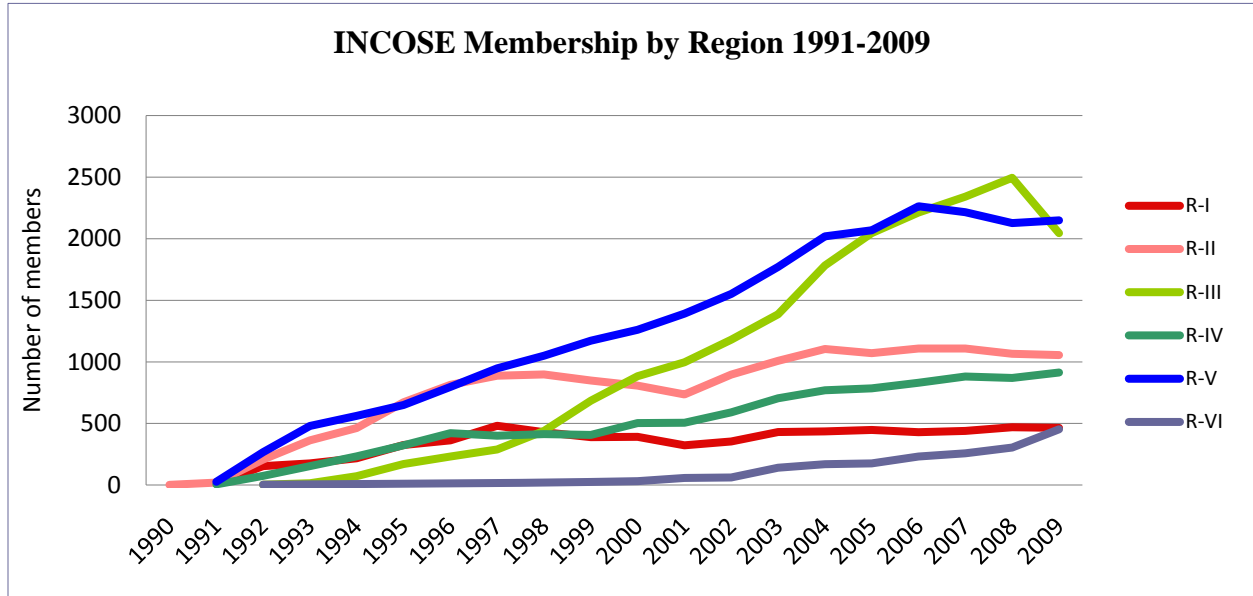


Figure 5: INCOSE membership growth trends by region from 1990 to 2001

There have also been reinforcements in chapter formations as a result of symposia hosting. Shortly after the Chicago was chosen for the 2010 symposium, the region was motivated to establish a Chicago land chapter, which was chartered in February 2010. Also, the UK chapter is now the second largest and extremely active in INCOSE, due to the impact of the symposium of 1999 in Brighton. Each year, the UK chapter hosts at least two national events to keep its members active and well engaged with the field of Systems Engineering. The Netherlands and France chapters are also very active locally and globally. Currently Regions III, to which the UK chapter belongs, and the North American Regions constitute a large proportion of INCOSE membership compared to the rest of the world.

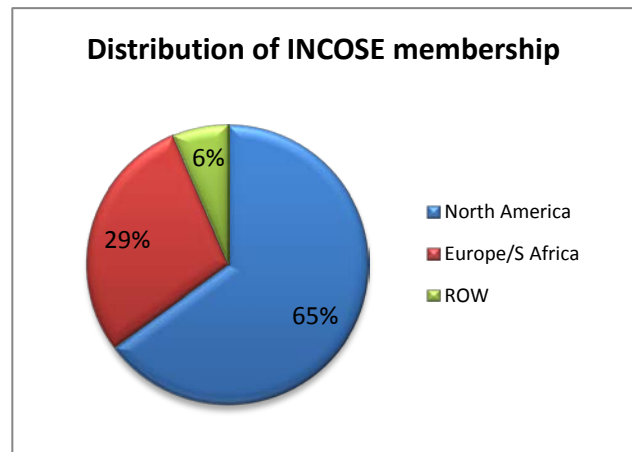


Figure 6: Distribution of INCOSE membership in 2009

Despite the positive effects of symposia on membership numbers, there are some unintended negative impacts on chapters, which become inactive after hosting symposia due to burn out from the amount of work involved. One example is the Vancouver chapter, which hosted the first international symposium in Vancouver in 1998 and is now fairly inactive. Another example, Boston's chapter, which hosted the symposium in 1996, is also relatively inactive due to burn out, while companies became less

supportive of the chapter or moved away from the region. As companies move, people move, and therefore withdraw membership from the society.

Attendees at Symposium

Attendance varies from one location to the next, influenced by both the geographical location and cost. The sixth symposium and first “international” symposium (which it was renamed to) in Boston in 1996 for example, offered a forum for a rich set of international activities. Eighty-three members from Australia, Brazil, France, Germany, Italy, the Netherlands, Norway, Sweden, and the United Kingdom attended the symposium. Attendance from the five INCOSE regions was as follows: Region I-5 percent; Region II-20 percent; Region III-14 percent; Region IV-28 percent; and Region V-22 percent. In Australia (2001), INCOSE partnered with SESA (the Systems Engineering Society of Australia); however, the turnout was lower than expected due to the expensive travel and long distance from core membership. In addition there were not as many exhibitors present as in previous years, and, in fact, many of these companies were represented by their partner companies in the region. For example, Boeing Australia represented the Boeing Company and the general trend has been that the further away from core membership the symposium goes, the more outsourcing of exhibition work takes place.

Paper Submission

As a professional society it is the role of INCOSE to provide the environment to present and share ideas, transfer knowledge, provide avenues for collaboration, and enforce a global awareness of Systems Engineering. At every symposium, INCOSE has a series of paper presentations for which presenters are chosen based on the quality and applicability of their work to the development of Systems Engineering. In Toulouse, France, for instance, the symposium theme "Systems Engineering: managing complexity and change" focused on higher-level complex Systems Engineering design and constant technological change. *It is axiomatic that systems complexity has a multiplying effect on the impact of change. Likewise, change itself is part of life and its rate is also on the increase* (Terje Fossnes - Symposium Technical Program Chair - President, Norwegian Systems Engineering Council). The papers and presentations showed how Systems Engineering was being used to manage complexity and change, and mitigate the consequences.

The papers that are submitted are a direct indication of how applicable current research and practice are in the progress in the development of Systems Engineering and the strategic objectives of the profession. In the Netherlands, the theme was targeted at moving away from the traditional domains of aerospace and defense to focus more on "Systems Engineering for the Planet" to achieve *balanced solutions that account for the social, technological, economic, environmental, and political constraints, in whatever the system or product of interest may be*. While papers are a great way of presenting innovative and cutting edge ideas, they can also be an indication of how much the organization has impacted the various regions if we can tell the origins of these papers and whether there is adequate correlation between paper origins and the regions in which symposia were held. While we were unable to get data showing the specific region submissions of papers, we were able to trace the number of papers, tutorials and panels submitted from 2000 to 2008. We see a spike in acceptances for the symposia held in Australia (2001) and Toulouse (2004).

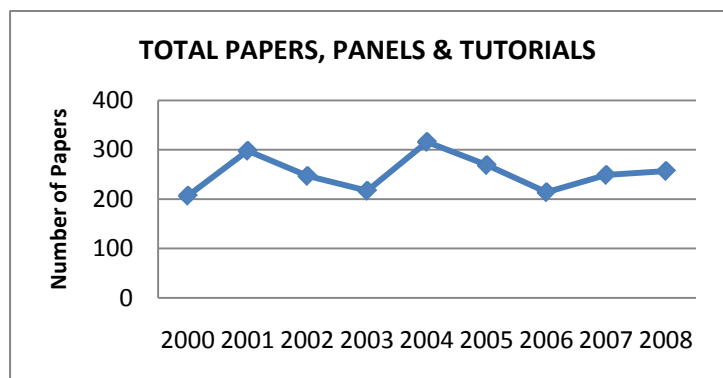


Figure 7: Trend in papers, panels and tutorials presented at international symposia from 2000 to 2008

Corporate Sponsorship

Corporate sponsorship is not treated solely an income source for symposia but rather as a partnership between the sponsor and INCOSE for the advancement of Systems Engineering. Corporations become sponsors of the INCOSE symposia for a number of reasons. Symposia allow corporations the opportunity to be a mark of support for formal Systems Engineering Practice. Such organizations may want to increase the use of Systems Engineering practices within their specific fields and use symposia as an avenue to tap into ongoing products and activities. Sponsorships also give the corporations exposure as a leader in systems engineering and many sponsors such as Project Performance International use the INCOSE symposia as a way to remain a permanent presence in the eyes of the community. Varying levels of sponsorship exist, platinum being the highest, and over the years, large organizations such as the BAE Systems, Thales, Airbus, Lockheed Martin, and Adacel have been platinum sponsors.

The symposium in Brighton, United Kingdom in 1999 was perhaps one of the largest breakthroughs in terms of sponsorship from the international community. As a professional society based on promoting the profession of Systems Engineering, the most significant outcome of this symposium was bringing INCOSE to the attention of the larger industries in the UK, particularly the aerospace and defense industries. Large companies such as BAE Systems, the British Ministry of Defense, became heavily involved with the ideals of INCOSE and have continued to remain involved. This is also a contributory factor to why the UK chapter still remains quite strong, as well as an increase in number corporate advisory board members.

For the past 18 years, we have seen a continual trend of region specific corporate sponsors, which were either the determining factor in hosting a symposium in a particular region or materialized after the decision to host the symposium in that region. Although the Toulouse, France symposium in 2004 was not as profitable as planned, the relationship that developed with Airbus during the symposium is irreplaceable. This was a typical example of how a close tie with the sponsor, Airbus became the primary pull factor in hosting the symposium in Toulouse and continues to be a pace setters in the Systems Engineering profession. However, it must also be noted that most regional sponsorship is a one-time only arrangement, and large sponsors may not obligated to remain sponsors in the future. Even platinum sponsors such as Lockheed Martin, which received exhibitor space, decided not to exhibit in 2009.

Recent strategies to branch out into other areas to which systems engineering principles can be applied have led INCOSE to pursue sponsors in other areas, such as rail and environmental companies in the Netherlands, where the focus was on the environmental applications of systems engineering in the 2008 Symposium. This not only encouraged sponsors that had not existed before but also opened the eyes of the Systems Engineering community to the strength in application of similar principles to domains beyond defense and aerospace.

Partnership with other organizations

Over the years INCOSE has planned and organized a number of symposia in collaboration with other organizations. This has helped to build and strengthen the relationship between the organizations and help promote the joint interest of Systems Engineering. The 2009 Singapore symposium was a joint effort between INCOSE Singapore Chapter together with five other Region VI Chapters of Australia, Beijing, Japan, Korea and Taiwan. Together they hosted the 19th Annual INCOSE International Symposium (INCOSE 2009) in conjunction with the 3rd Asia-Pacific Conference on Systems Engineering (APCOSE 2009). APCOSE, a very active regional organization within INCOSE will most likely also be joining forces with INCOSE again in 2013 for another symposium in Japan. These regional conferences have in fact had great influence on the success of the international symposia and all Region III and post 2001 Region VI symposia have been concurrent with the annual or biennial regional conferences. Another very important player in the Singapore symposium was the Singapore government, through the Temasek Defense Systems Institute at the National University of Singapore. While the aim

was to target the emergent areas in Systems Engineering, such as China, it was North America and Europe that had the strongest showing as expected. This was a reflection of the economic crisis and issues regarding security clearances, and not necessarily the global interest in systems engineering as a profession. In addition, INCOSE partnered with local institutions such as the Institution of Engineers of Singapore (IES) allowing those persons interested in attending the ability to do so as if they were members of INCOSE. This is part of INCOSE's commitment to being an open community, by being open to other organizations and allowing their members to participate in INCOSE's activities, thus enabling the development of Systems Engineering in other nontraditional domains.

Australia has also seen an evolutionary change since the 2001 symposium in Melbourne. Many government representatives were in attendance and this probably influenced the take-up of Systems Engineering approaches to acquisition. There has also been a ripple through effect, which has influenced the use of Systems Engineering in industry. Academic programs have increased in number, mainly through the development of additional programs at existing providers, including the Royal Melbourne Institute of Technology and the University of Southern Australia (UNiSA). Today, in addition to these major stakeholders, the University of New South Wales and the Australia Defence Force Academy, have become more actively involved in the development of Systems Engineering. Systems Engineering has taken root in government defense with the Defence Science and Technology Organization establishing an education process including a Systems Engineering masters program. This is particularly due to the change in their role as providers of advice related to the technical readiness and risks involved associated with proposed projects. The Defense Material Organization also has the educational concern to develop skills in the defense industry, which has resulted in both a masters and professional doctoral program at UNiSA. In addition, industry interest in SE has grown over time, along with motivation through government acquisition processes.

External Factors beyond INCOSE's control

Because INCOSE plans its symposia three years in advance, it is very difficult to predict influential events that may impact symposium participation and sponsorship. For example, the recent economic crisis creates significant cuts in air travel, which has impacted the number of systems engineers able to fly to Singapore. However this did not impact the quality of the event and the symposium's website reported that the symposium was *a great success and one of the most vibrant and memorable international symposium in the history of INCOSE*.

Additionally, the events of September 11, 2001 and the recent terrorist bombings in Spain in 2003 significantly impacted attendance at the symposium in Toulouse, France, the second European held conference. These events, coupled with political tensions between the US and France created a significant decline in US travel to Europe, making the France held symposium less successful in turn out compared to its predecessor, Brighton, UK. Regardless of these events however, the level of continued sponsorship of the symposium at the platinum level by Airbus, BAE Systems and Thales as well as support from all other sponsors, corporate advisory board, exhibitors, local chapters and members helped make the symposium a success. In fact the president of INCOSE at the time (Heinz Stoewer) stated "*This International Symposium is only the second to be held in Europe, after the very successful event in Brighton (UK) in 1999. It is also INCOSE's first Symposium venue in a non-English speaking environment. As such, it represents an important milestone in the organization's transition towards a truly international and global systems engineering organization. The Symposium program is designed to strongly stimulate the exchanges across many different industrial sectors and regions in the world*".

Lessons learned and impact on the evolution of planning and execution of Symposia

The way symposia are planned and conducted is largely influenced by prior symposia and their outcomes, both positive and negative. INCOSE treats every symposium as a learning experience on how to improve and ensure its objectives as a professional society are being accomplished. During the earlier

years, host chapters would propose locations to the Board of Directors. This was especially attractive to the host chapters because it established a profit sharing arrangement, while all losses would be incurred by INCOSE. However, a tremendous amount of work goes into planning and executing a symposium, and for this burden to be placed on one chapter requires great risk, sacrifice, and volunteer effort from the chapter members. This was particular evident in the case of the Boston chapter. After Boston hosted the INCOSE symposium in 1996, the chapter enjoyed a healthy profit but the burnout of members led to a decline in chapter activities.

Over the years, INCOSE has established itself as a professional society and approaches the planning and execution of all of its events and activities with utmost professionalism. It has learned from its experiences and has developed a stable infrastructure for running its events. In the case of the annual symposium, because the initial model was unsustainable and caused chapter burn out, today, a centralized model is used, in which a much larger permanent symposium committee, responsible to the Director of Strategy, is tasked with planning and organizing the symposia. The Board of Directors has the responsibility of deciding on the location based on strategic priorities and economic feasibility. There is still a strong reliance on local chapter presence to assist with relationships with sponsors, contacts, and logistical support. INCOSE has moved towards outsourcing many of the activities during the symposium, such as registration processing and meeting coordination, and has converged on a more stable model of planning and execution of its symposia.

However, INCOSE is aware that there are challenges surrounding organizing symposia from a central body especially when the symposia are becoming more and more global in location. There is a balance that has to be achieved between having a more fixed stable model and allowing the local flavor to be manifested in the symposium. This is of course inevitable and INCOSE recognizes that the local chapters in the regions are the ones who produce a significant drive in running the symposium, and will play the largest role in its success. The role of any professional society is to grow the profession in the local area and it is with this in mind INCOSE ensures that local sponsors support and contribute to the vision and execution of the symposium. In addition, INCOSE has moved towards not having themes for its symposia. Over the years, the themes have varied from *Innovate, Integrate and Invigorate* in Australia, to *Systems Engineering Managing Complexity and Change* in France, *Systems Engineering for the Planet* in the Netherlands, and *East Meets West: The Human Dimension to Systems Engineering* in Singapore, but INCOSE witnessed a limited correlation between paper topics and relevance to the theme at the time. Starting with the 20th symposium in Chicago, Illinois in 2010 there will no longer be a symposium theme. INCOSE is now encouraging papers relevant to the general Systems Engineering topics and will have sub themes during the symposium based on the papers accepted. This all forms part of the INCOSE strategy for strengthening the profession and the ability of the organization to achieve its goals as a professional society.

Conclusion

The intention of this paper was to outline the qualities of a profession, highlight the roles of professional societies in the advancement of the profession and show how INCOSE has been accomplishing those objectives through its symposia. A profession is characterized by many factors including a formal education and/or advanced training, technical expertise within a domain, autonomy in practice, professional certification, institutional and social legitimacy, and an ethics code. Through its symposia, INCOSE has embraced its responsibility as a professional society, to expand and improve the qualities of the profession of Systems Engineering. It provides an avenue for collaboration, communication and training, and allows individuals to have a voice in the development of the profession, both technically and ethically. Expansion in both its individual and corporate network on an international scale, has demonstrated INCOSE's commitment to the growth and advancement of Systems Engineering.

Since its formation in 1990, INCOSE has held 19 symposia and, through its commitment to global development, has branched out to locations beyond the US. We have shown how INCOSE measures its impact through the use of six retrospective case studies of symposia held in Canada, England, France, Australia, The Netherlands, and Singapore. While symposia locations are planned at least three years prior to the year in which it is held, each of these countries was chosen based on the strategic objectives and priorities of INCOSE at the time, with criteria ranging from new applications of systems engineering, to partnerships with sponsors, and potential for overall system engineering membership growth. INCOSE has witnessed a number of positive outcomes of these symposia, including membership and chapter growth, increased attendance at symposia, new and sustained corporate sponsorship, permanent corporation relationships formed as well as financial profits to be reinvested in INCOSE projects and host chapters.

Further, INCOSE treats each symposium as a learning experience and its tactics in planning symposia have reflected this learning. While planning is still done years in advance, there is now a centralized board that leverages best practices and removes the burden on host chapters. This way, the effort is more spread out and can benefit from a core of individuals who have the experience in running large events. INCOSE has developed what is hoped to be a more sustainable infrastructure for planning and executing its symposia and while previous symposia have been more focused on areas where there are existing INCOSE chapters, there has been discussion of expanding to areas in which there is interest in systems engineering, in an effort to promote the profession and the benefits it can offer. If a society is committed to raising the standards of the profession and ensuring that its members are well in tune with what is expected of them as professionals, it needs to ensure that its members are treated well, are involved, get the best learning experiences and encourage retention. This all forms part of the INCOSE strategy for strengthening the Systems Engineering profession and ensuring the organization fulfills all of its roles as a professional society.

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Biography

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