

## Overcoming Challenges on an International Project to Advance Systems Engineering

Heidi Davidz, T.L.J. Ferris, Devanandham Henry, Thomas B. Hilburn, Nicole A.C. Hutchison,  
David H. Olwell, Daniel Prun, Art Pyster, Jean-Claude Roussel, Hillary Sillitto,  
John Snoderly, Alice F. Squires,  
Ken Zemrowski

### Abstract

The Body of Knowledge and Curriculum to Advance Systems Engineering (BKCASE) project's dual product development cycle spanned a three-year period from the September, 2009 to December, 2012. During this timeframe, BKCASE authors met quarterly at various locations, primarily in various regions of the United States, but also in Stockholm, Sweden; Toulouse, France; London, England; and Rome, Italy (BKCASE, 2009-2019). The team successfully worked through challenges and differences to produce The Guide to the Systems Engineering Body of Knowledge (SEBoK) wiki and a Graduate Reference Curriculum for Systems Engineering (GRCSE) publication. This article is a collection of personal stories from the team members that focus on overcoming obstacles to successfully produce the final published products.

**Keywords:** Systems Engineering, Body of Knowledge, Graduate Reference Curriculum, Cultural Diversity

### 1. Introduction

In the same year of its official public release, the Body of Knowledge and Curriculum to Advance Systems Engineering (BKCASE) project was awarded the 2012 International Council on Systems Engineering (INCOSE) Product of the Year. The project, comprised of a Guide to the Systems Engineering Body of Knowledge (SEBoK) wiki and a Graduate Reference Curriculum for Systems Engineering (GRCSE) publication, was initiated in the Fall of 2009. By the release of version 1.0 of both products in 2012, the BKCASE team had grown to include seven core team members, 76 authors from 11 countries, and 179 reviewers from around the world (SEBoK contributors, 2012). As of the end of 2018, the released SEBoK wiki had over 1.4 million unique visitors with over 2.8 million pageviews (Hutchison, 2019). In 2018 alone the wiki had over 315 thousand unique visitors where the most frequenting top ten countries were (Hutchison, 2019):

1. United States (75,756)
2. India (53,485)
3. United Kingdom (28,796)
4. Australia (13,673)
5. Philippines (12,235)
6. South Africa (8,639)
7. Nigeria (8,575)
8. Canada (7,819)

9. Germany (7,028)

10. Pakistan (6,446)

This article is a collection of brief personal stories from a small subset of the original version 1.0 BKCASE team related to their challenges and experiences working on an international project with an international team to successfully produce globally recognized authoritative sources of knowledge and guidance on the systems engineering discipline and systems engineering content and curriculum. The full list of 76 version 1.0 authors can be found on the SEBoK wiki website ([sebokwiki.org](http://sebokwiki.org)).

## **2. Stories** (*note: in alphabetical order by last name*)

### *Heidi Davidz*

Working on the BKCASE project was a rewarding and enriching experience. Team members were professional, pleasant, and respectful of all opinions. Even though I had less years of experience than many, I never felt patronized. The international team worked through cultural differences with ease.

One area of difference is that I was one of the few female authors for the original version 1.0. At the BKCASE meeting in Toulouse, France, the spouses of the authors met together for a tour of the city, generously provided by the host family. My husband found himself to be the only male in the tour group. It was a bit hard for him, since the preferences for activities were different (i.e. shopping) and he did not speak the language. However, everyone was flexible and cordial, and they had a wonderful day. Continuing to be open to what may not be the norm is important. Being light-hearted also helps.

Another cultural difference I recall was discussing recommendations for work experience for GRCSE. During my graduate studies, one powerful, influential, tenured professor noted that if a person has spent a day in industry, they are not a true academic. This is a very different perspective than those who highly value industry work experience. I remember offering this perspective at a BKCASE meeting, that not everyone views industry experience positively. Team members seemed shocked and opposed. I noted that I did not necessarily agree with that perspective, but I wanted to make people aware of it. After a bit of discussion, one of the authors from academia said he has also seen this perspective. It was not a problem for the team, but it was striking to me how what one group values so highly (industry work experience) is considered a stain or weakness by another group. Others seemed as shocked and appalled as I was when I first heard this perspective. However, it is an example of how blind we may be to a cultural perspective that drives decision making and opportunities.

Being a woman among many men did not seem to be a problem with such a professional, pleasant, and cordial team as the BKCASE team. I contrast this to other situations where it was a real problem that I was a woman. One difference is the level of basic professionalism. Another difference is whether the environment is a meritocracy. The level of self-confidence and competence of team members is also important, since exploiting petty differences for gain is not needed. A results-driven environment also sets the stage for no nonsense about gender differences. I tend to assimilate and accept the culture in which I am used to living, but in reflection, I am thankful for such an outstanding, capable, and egalitarian BKCASE team.

### *T.L.J. Ferris*

I was sponsored by INCOSE to join the BKCASE project. At the time I knew of previous 'Reference Curricula' for systems engineering and other fields, all of which bothered me for the same reason: they were focused on what content was required. Put

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crudely they answered: “what stuff should a graduate in X-engineering know?” This troubled me because I had a colleague who could give lectures about, and research, the methods to discover stakeholder needs and to explore the appropriate solution to challenges, but also had a tendency to shortcut discussions about projects saying: “I know the answer to that.”

I saw that systems engineering practice demands commitment to the systemic approach to engineering. This reminded me of the profound difference between “believe that” and “believe in”, contrasting knowing about and giving assent to something, and actually being committed to it. This position prompted me with a vision of what I wanted to influence through my work in BKCASE and GRCSE, in particular. I asked for, and was given the role of leading the GRCSE team.

My vision was to expand GRCSE beyond the traditional cognitive domain content focus to include the affective domain as essential in systems engineering. This introduced a challenging set of cross-cultural issues. The origin of these issues was a combination of engineering discipline and ethnic cultural factors. This situation led to confronting the following challenges:

1. Engineers perceive engineering as working with things in the objective “out there” space;
2. I found a common misunderstanding of the affective domain of Bloom’s taxonomy (Krathwohl, Bloom, and Masia 1973), to the effect that the affective domain is study about the “soft skills”, whereas the affective domain concerns the development of the student’s value system in relation to the subject matter of their study. This had its roots in both engineering professional culture and some elements of US ethnic culture.
3. Engineers emphasise quantitative reasoning and decision making. This is compounded with a US approach to demonstrating bias-free decision making through quantitative methods leading to a question of how affective engagement with systems engineering theory and methods could be measured.

The practical issue at the nexus of the contesting cultural positions was whether engineering education is about content or transformation of the student.

The result is that the main text of GRCSE describes intended levels of learning of the Core Body of Knowledge topics in terms of Bloom’s cognitive domain descriptors: knowledge; comprehension; application; analysis; synthesis; and evaluation (Bloom et al. 1956). We discussed, at length, whether these descriptors represented quantitative or qualitative differences in the learning achieved. Bloom *et al* present these descriptors as representing different kinds of learning, revealing an interdisciplinary cultural difference. This was resolved through teaching and careful discussion.

The more contentious matter of the affective domain was resolved by placing a discussion of this issue in Appendix D. These category descriptors are: receiving; responding; valuing; organization; and characterization (Krathwohl, Bloom, and Masia 1973). Measuring students’ affective engagement with systems engineering knowledge became the subject of Fanny Camelia’s PhD (Ferris, Squires, and Camelia 2015)(Camelia, Ferris, and Cropley 2018)(Camelia and Ferris 2018)(Camelia and Ferris 2017). A method to measure students’ affective engagement with systems engineering knowledge has been developed.

### *Devanandham Henry*

I joined the BKCASE core team in 2012. Though I joined late, my BKCASE connection goes back to the days when the project was just getting conceived.

In April 2007, I was a relatively new Ph.D. student from India at Stevens Institute of Technology. I was still getting used to life in the US, and Dr. Art Pyster had just joined Stevens as a Distinguished Research Professor. I supported him in establishing a new project

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to develop an integrated software and systems engineering reference curriculum (iSSEc) and helped develop the initial version of a Graduate Software Engineering Reference Curriculum (GSwERC – pronounced “guesswork”). I left the iSSEc project when the final version of GSwERC was under preparation. Fast forward 5 years, and I re-joined Dr. Pyster when final versions of SEBoK and GRCSE were being prepared!

BKCASE was a large-scale high-complexity project. It was a perfect eco-system of SE professionals with a mix of all possible characteristics – young and experienced; men and women; academia, industry, and government; US and non-US; native English speakers and non-native English speakers; migrants to SE from SwE and native SE professionals; and so on. My first BKCASE workshop was the tenth for many others, and I was a total stranger to almost everyone. Yet, I never felt that way at all! I was warmly welcomed by all and I rubbed shoulders with the greats of the SE discipline who were down-to-earth, friendly, approachable, and fun to work with. I had some interesting challenges too!

- Coming from India, it was not easy for me to address seniors by their first names, even though they were totally comfortable with it! I did try, but I felt uncomfortable. So, I usually addressed them with a prefix (“Dr.” or “Prof.”) and was sure to use “sir” or “ma’am” otherwise.
- My Indian English was more British than American. Having lived in the US for about 5 years already, I had shifted to American spellings but my pronunciation was more British. While I had no issues understanding the American accent, I had to consciously switch to an American pronunciation at times, in order to be understood. But during our BKCASE telecons and workshops, I enjoyed talking/listening to authors particularly from UK and Australia where I could speak without having to worry about my pronunciation!
- Editing the content of SEBoK was an interesting task. In some articles, it was not just the spellings but the sentence formations that made it evident that the author was non-US. I had to take extra efforts to modify some sentences to ensure that they are aligned with the spelling, grammar, and structure of the rest of the SEBoK.

Though it is over 5 years since I have moved out of the BKCASE project, I continue to cherish the many relationships I established while on it. This professional network is perhaps my most valuable takeaway from BKCASE/Stevens/US, especially as I transition into a new systems engineering career in my home country India.

*Thomas B. Hilburn*

In the spring of 2007, I got a call from Art Pyster with the greeting of “I have an offer you cannot refuse”. Art was part of group proposing an effort to better define a curriculum in systems engineering. I had worked on a software engineering project for Art when he was the FAA’s Deputy Chief Information Officer, and his offer to be part an effort that led to creation of the SEBoK and the GRCSE was intriguing and challenging.

I worked on both the SEBoK and GRCSE projects, attending workshops in Monterey, Daytona Beach, Denver, Phoenix, London, Toulouse, and New Jersey. One of my special delights was working with such a diverse, experienced, and competent group – people from all over the U.S, Europe, the Middle East, and Asia. It was a challenge to work with such a large diverse group, which was separated by distance, time zones, experience, and cultures. It is amazing that we worked together so efficiently and effectively.

Although I had extensive work in software engineering knowledge areas and curriculum development, my experience in systems engineering was limited. Limited experience in systems engineering was a concern for me; but the project teams provided me

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with the motivation, opportunity, and support needed by me to increase my system engineering knowledge and contribute the project.

Lastly, I want to thank the people I worked with most closely: Tim Ferris, Heidi David, Mary VanLeer, Dick Fairley, Massood Towhidnejad, Art Pyster, Alice Squires, and Paul Croll. And, maybe the most valuable contribution to this project was the organizational and administrative work of Nicole Ann Hutchison and Stephanie Enck. The professionalism and dedication of all is one my fondest memories of BKCASE.

### *Nicole A.C. Hutchison*

I joined the BKCASE project in December 2009, just before the first workshop in Monterey, California. Having worked on a related project developing the reference curriculum for software engineering, I was excited to have a chance to rejoin some of the same individuals but also to work with new people in the community, in particular members of INCOSE from around the world that I had not yet had a chance to meet.

One of the first challenges we experienced was how to organize a body of knowledge for systems engineering. As a discipline that covers diverse subject matter, there were a variety of opinions. The team started with the existing standards and began by utilizing ISO/IEEE 15288. But one of the advantages of having individuals from so many cultures was the diversity of opinions. Though the team agreed to start with 15288 as an outline, how could we improve upon this? One of the questions that came up in discussion was that of systems thinking. The group agreed that systems thinking was important, but what to do with topics like systems thinking that aren't reflected in 15288? This led to a broader discussion of systems engineering – not just the processes but the enablers, both for individuals and organizations, and the science that underpins systems engineering. So from the beginning, the diversity of views helped us to start to shape the SEBoK in a way that encompassed more fully the discipline.

About a year into the project, another interesting question was posed: should the SEBoK simply be a document, like every other body of knowledge at the time? The first draft of the SEBoK (v. 0.25, which was released in September 2010), was a PDF document that was well over 800 pages and many of the team lamented that this format didn't allow them to connect the information and knowledge in the way that they would like. Eventually, the discussion moved to other mechanisms for publishing the SEBoK and the concept of Wikipedia was brought up. There was a lot of diversity of opinion about this – the team responded well to the idea of something that could be easily updated, would allow internal linkages between content, and which they believed would be more readily used than a PDF but was unsure of how to use a wiki – an open platform – and still create the quality and control required of a formal body of knowledge. It was an interesting challenge and required the group to work together to determine appropriate ways to balance these issues. In the end, the group created something unique for formal bodies of knowledge: a process for control balanced with a periodic update schedule for publishing in a wiki format. Without having such a broad international team, we never would have received the variety of inputs and opinions we needed to find a way to make this work.

### *David H. Olwell*

In early 2009, Art Pyster called me and asked if I would help with a new project that he was putting together for INCOSE and DOD. I was delighted to say I would help, and thus began my involvement with BKCASE.

I'd like to highlight four areas of "working through cultures" during the project: working with an international team, working with an industry/academia team, working for

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two sponsors – the US military and a professional society, and last, being sensitive to the different needs of a diverse team of people.

The great joy of the BKCASE was the people on the team. We often said we had members from six of the seven continents, and we were still recruiting from Antarctica. It was amusing seeing how different team members reacted in different contexts. I distinctly remember an enormous cultural gulf over the duration of lunch when we met in Toulouse, with our American and German authors ready to go in 30 minutes and our French hosts insisting lunch could not possibly be served and eaten in under an hour and a half! Similarly, scheduling web meetings was a challenge because of the many time zones involved. Surprisingly, language difficulties were few and easily resolved. The goodwill and harmony displayed by our 70 initial authors was inspirational.

I don't think that our industry authors ever quite grasped the academic rhythms that governed the academics work scheduling. People from Lockheed, MITRE, Raytheon, Rolls Royce, and other big companies were used to more rapid task assignment and completion, as I recall. Many of our academics had a much more sedate view of how work was completed, and a fondness for "percolation" time. As well, summers saw more productivity than when school was in session. One of the enormous advantages the academics brought was access to a wonderful pool of graduate students, faculty, and research staff. Much of the hard work of compilation and editing was done by our talented team from Stevens (Nicole Hutchison, Deva Henry, Alice Squires) and NPS (Stephanie Enck). The entire team was dazzled by both their energy and commitment.

Similarly, we had financial sponsorship from DoD DASD(SE) and society sponsorship from INCOSE, IIE, ACM, NDIA, and IEEE Systems Council. It is a tribute to the legendary administrative and people skills of Art Pyster that they were all kept happy, aligned, and out of our hair.

We had a diverse team: men and women; multiple ethnic and racial groups; a wide range of religious backgrounds with customs to be respected; and (frankly) young people and old people. We strove to accommodate the needs of each member, including maternity leave, dietary and alcohol restrictions, attendance of religious services, and patience with the age-based differences in approaches. Sometimes the older brusque guy from the military had to tone it down while working with the young female author. Everyone learned to listen better, I believe, and how to participate in large group meetings while respecting everyone's need to be heard.

BKCASE was one of the great experiences of my professional life, and I am proud of the work that was done. I am even more proud to count the wonderful authoring and editing team as among my closest professional colleagues.

It was a happy confluence of leadership, vision, funding, and talent. I don't expect to see the likes of this project again.

### *Daniel Prun*

My first contact with the BKCASE project was during the 4th workshop in Toulouse, France in October 2010. A few weeks before the event, Jean-Claude Roussel and Alain Faisandier who were already involved in the project offered me to join the team in order to increase the French academic participation in the SEBoK. Working with the best system engineering experts, in an international context, with the objective to provide added value for the whole SE community... who would refuse the offer? Of course, I said "yes"!

I then started working with GRCSE team. I got responsibility of chapter 8 (Assessment). The project was punctuated by bi-monthly online meetings and physical ones. As we had US, European, Asian and Australian participants, the key point was to find a

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meeting time slot appropriate for everybody: 4pm EST... 6am in Sydney, 5am in Kyoto and 10pm in Toulouse ... Not so bad for me!

Works on the project were very exciting, highlighting numerous problems I had not thought before. For example, I remember that one of the biggest challenges we were faced with during a large part of the project was to deal with different existing education pathways between US and Europe. The question was how to reconcile them in a unique and consistent way. Have a look at figure 1 of the GRCSE and you will get the answer!

Finally, I would like to warmly thank Tim Ferris, the GRCSE project leader, for the masterful way he managed the team. During the project, he has been able to integrate people from various origin and with different background. For a Frenchy, without a great experience with international project like me, it was highly helpful and valuable. I think Tim was among the primary architects of the project success.

### *Art Pyster*

It was one of the greatest honors and joys of my professional life to lead the BKCASE project. A team from across the world, mostly volunteers, selflessly came together for three years to help the broad systems engineering community. That team was intentionally diverse – diverse in culture, age, gender, experience, language, nationality, occupation, business sector, and race. The team reflected many of the important differences across the world in what systems engineers do, how they are educated, how they are rewarded, how they think, and how they approach problems. Throughout the project, those differences strengthened our deliberations, especially for the most fundamental decisions.

When developing recommendations for graduate education, one of the most contentious issues centered around whether students should have industrial experience prior to entering a master's program in systems engineering. The "pure" academics tended to minimize the importance of prior experience. Academics with considerable industrial experience, such as myself, saw the value of prior industrial experience for their students. People from industry thought prior experience very important. The diversity of the team enabled those discussions to be deep and thoughtful. It took about a year of back and forth deliberation before the team settled on a compromise – a recommendation for at least two years of prior experience.

Bringing together a team of 70 people from around the world, many of whom did not know each other before joining BKCASE, presented challenges I had not faced before. We needed to jell as a team. The answer was to have four face-to-face multi-day workshops annually to complement electronic communication. Many of the venues were selected because the volunteer team would find them attractive places to go, including London, Rome, Toulouse, and Stockholm. We needed good turnout. However, such events are expensive. We were remarkably fortunate to have as our sponsor Kristen Baldwin, who was responsible for much of the systems engineering research in the US Department of Defense at that time. She was deeply vested in the success of BKCASE and had remarkable instincts about what was important to its success. I certainly never had a better sponsor in my career. She never hesitated to support the workshop budget. I truly believe the comradery engendered by those workshops was the single most important factor in the project's success. Years later, many of the original authors whom I run into at conferences tell me how much they enjoyed those workshops, how productive they were, and how they still stay in touch with colleagues they met there.

Finally, the other key decision that made the project work so well was the *core* team – the folks who put in countless hours making everything work. Dave Olwell, then a professor at the Naval Postgraduate School, was my co-lead and fabulous partner. Nicole Hutchison and Deva Henry, both then graduate students at Stevens Institute of Technology, Stephanie

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Enck, then a research assistant at the Naval Postgraduate School, and Alice Squires, a research faculty member at Stevens, kept everything moving, contributed to every key milestone, and were just plain awesome. Every meeting with them was fun – hard work, but fun. We respected each other, trusted each other, and enjoyed each other’s company. Great times.

### *Jean-Claude Roussel*

When I was contacted as a potential contributor to the new BKCASE project, I was immediately enthusiastic to be part of this initiative, although I had many questions. I had questions about a wiki on systems engineering, and a generic framework for systems engineering education, great, but no idea at all about the impacts in the world. I also had a question about how we would be integrated in a team with high participation from the United States (U.S.).

I was the single French participant among the three Europeans at the small kick-off meeting at the Naval Postgraduate School in Monterey, California. That meeting was rather impressive for me as we didn’t know the project’s future, but the members were so motivated that team alignment came quickly with active discussions, a first framework and table of contents, and SEBoK chapters’ writing allocations by the end of the meeting. We would hold one workshop per year outside of the U.S. to enable wider international collaboration; I therefore proposed to host the first one in Toulouse, France where I am based.

It became clear this project was important for the systems engineering community and I informed my colleagues in France and other countries in Europe so that we could quickly involve needed key contributors. Alain Faisandier joined the team and was a major contributor for the technical processes thanks to his experience and involvement in International Organization for Standardization (ISO). Unfortunately, Alain passed away in September 2018; this was a great loss for the SE community. When GRCSE was initiated Daniel Prun from ENAC (Ecole Nationale de l’Aviation Civile – the French Civil Aviation University) was the third French member to join the team and I was very happy for the French academic extension.

The Toulouse workshop was held October 2010. The French team paid specific attention to arrange a typical French dinner in a good restaurant at the appropriate time, from 8:30 pm, a bit too late for my US colleagues, but we managed anyway since the restaurant could not make the dinner any earlier. My wife organized a visit of Toulouse for spouses, walking of course as we are used to, including a lunch in a typical French restaurant and the group was happy to have a cruise on the Garona river in the afternoon to recover from the long run! Following BKCASE traditions, we started the second day with a recap of the previous day achievements and pictures of the team on location and from the previous night’s dinner; each time this was well managed and fully appreciated by all (see Figures 1 and 2).

In conclusion, the BKCASE project was an excellent international collaboration that we summarized around the world including in Japan, Australia, and Sweden (Roussel et. al, 2012). For BKCASE, we benefited from the best systems engineering experts in the world, combining the efforts and specialties of all team members, a real example of a successful project with direct added values for the whole systems engineering community.



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*Figure 1. BKCASE Team Experiences a Typical French Dinner*



*Figure 2. BKCASE Team Picture in Toulouse, France*

### *Hillary Sillitto*

I got involved in BKCASE around the end of 2009. As a Brit working for a French multi-national company, I felt duty-bound to represent the British and European Systems Engineering cultures and traditions - particularly what we in the UK regard as our more

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holistic view of systems, drawing on Checkland's Soft systems tradition, and the Tavistock Institute's earlier work on sociotechnical systems engineering. I hope this came over as positive, not just as complaining whenever I saw US-centricity!

I was well used to working in international, multi-lingual and politically-sensitive environments, knew many of the people already, and made many new friends. I'd like to think I helped ensure an international perspective, and that the soft systems methods I occasionally brought into play – which clearly baffled some of the Americans – added some value.

There was a vigorous discussion, early in the project – possibly in Toulouse - about whether we were limited to the ISO 15288 structure, or could add to it. A major victory was when it was agreed to add “mission and business analysis” to the front end activities. 15288 followed our lead. As an aside, there was debate on language – was it reasonable to assume that all readers would know what a “Conops” was? “Of course”, I was told. My experience told me otherwise. I was quite insistent that, while most round the table might have a shared understanding, be assured that many of our target audience would not!

I remember sitting with Art Pyster and a few others in Denver in 2011, having a difficult and non-convergent debate on the structure of some part of the SEBoK. I'd been quite forceful in a plenary meeting earlier, and could tell that Art wasn't very happy with me. However, the meeting proceeded. At some point, I saw an opportunity to shift perspectives towards some common ground. I jumped up, grabbed a felt pen, and started sketching on the flip chart. After lengthy, gentle but focused facilitation, we got to an agreement! In the next plenary session, Art came up to me and said “Hillary, that was ..... incredibly .... (I wondered what was coming next) ... helpful!”

I met Bud Lawson for the first time in a BKCASE meeting in Stockholm in Spring 2010. I was intrigued by the near-final drafts of his book “a journey through the systems landscape”. He was a really nice man – an American who had moved to Sweden. It was only gradually, as our friendship developed over the years, that I understood just how much he had achieved and how much of a contribution he has made to systems and software engineering – from inventing the pointer variable concept in C, to architecting ISO/IEC 15288, to the Systems Coupling Model which is the core of his “system landscape” book, to his very recent forward looking publications on software engineering. Sadly, he died in the summer of 2019. He was a fine man who led a full life, and will be sadly missed and fondly remembered.

### *John Snoderly*

When I joined the BKCASE effort, I was amazed at the number of INCOSE members gathered together to work on such an ambitious project. I chose to work on BKCASE SEBoK, since I was an Instructor at the US Defense Acquisition University (DAU), I knew that the SEBoK would become a great reference source for development for DAU's SE course material. I volunteered to work on Implementation and immediately asked the French team of Jean-Claude Roussel, Alain Faisandier and, Daniel Prun if I could join them on working SE Implementation.

They immediately said yes let's do it (or something to that effect). I thought this was going to be somewhat of a challenge since I don't speak French. The important thing was that the members of the team spoke English with a French accent. I remember we were given a word limitation on our write ups and the French team did most of the writing and they wanted me to make sure their sentence structure was correct. So my role was mostly editing their excellent technical work. Of course we had exceeded the word limitation and I remember Alain saying we must have all of these words to make sure the student understands fully the concept of Implementation and I strongly agreed with him.

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So a discussion occurred with the BKCASE team leaders over how to accommodate our article, since the French and I held strong agreement on their write-up. A brilliant solution was agreed to, I think it was Art Pyster that suggested perhaps we could add graphics and the graphics would not count against the word count. The French team agreed and off we went to develop graphics. In the end we exceeded the word count a little bit, but the graphics and the technical write-up was an excellent document from the French team.

Working with the French team was an excellent experience, and I truly admired their excellent technical acumen. At the INCOSE International Symposiums and International Workshops that I have attended since the SEBoK event, I always enjoy meeting with my French comrades. The friendships that evolved from that SEBoK experience continues today and I surely miss Alain Faisandier who passed away in September of 2018.

### *Alice F. Squires*

My opportunity to join the BKCASE team was a case of being in the right place at the right time. Hired as a full-time faculty at Stevens Institute of Technology several years earlier, I had decided to pursue a PhD. However, I faced several challenges working on the project in a university setting – my dual situation as a faculty and a student allowed me to observe a wide spectrum of implicit biases in action – sometimes with privilege as an experienced faculty, other times marginalized as ‘just a graduate student’. Historically, I had served various technical leadership and senior engineering management roles in the workforce. In both settings (industry and academia), I observed there are some in authority that treat students and younger professionals as ‘less capable’ while it is commonly accepted that these same leaders can take the majority of credit for their work.

On BKCASE, I felt that I belonged alongside other passionate systems engineering experts when we worked seamlessly together developing content for the SEBoK or GRCSE regardless of where we were from or for whom we worked. Highlights include working with Bill Bearden on requirements analysis, incorporating doctoral research on the value of systems engineering and systems engineering competency, working meetings with the late Bud Lawson incorporating systems concepts and listening to his stories about Grace Hopper, contacting Alex Levi in the twelfth hour of an editing session to integrate systems safety content, working with the Heidi Davidz to develop the case study strategy, and working with Tim Ferris and the GRCSE team.

However, there were other times that I felt excluded, and I had to find ways to deal with those feelings in order to complete the work that I was passionate about. Situations that caused me to feel like an outsider included those times when I was relegated to administrative only tasks in author working meetings; when I had to defend my place as first author on related BKCASE papers that I wrote; or when my project role was defined by viewing me as a graduate student rather than based on my industry experience and my full-time position as a research faculty, even after I graduated with a doctorate. Ultimately this caused me to return to industry. My small company supported my time to attend BKCASE workshops but was not able to fund my travel and expenses, and with no other funding, my support in the final months of version 1.0 development was remote, in my free time.

Today I continue to support BKCASE without this same challenge. I will always cherish the friendships developed throughout the BKCASE project that continue on to this day. Historically, I pursued the opportunity to work on BKCASE because I believed in, and helped develop, the project’s value proposition. The most satisfaction I get from my work is the belief that I am improving the lives of others and I strongly believe that the BKCASE products are making a difference in the world, every day.

### *Ken Zemrowski*

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I was a latecomer to the SEBoK project. My experience with working across cultures actually predates my SEBoK participation, but the experience is directly relevant because it relates to international standards. I was asked to bring the standards descriptions up-to-date and expand the material. During my earlier work, I served as a committee chair and as an editor on both American national standards and international standards.

Working with the International Organization for Standardization (ISO) and the International Civil Aviation Organization (ICAO), an element of the United Nations, I had to become proficient in international English and not stray back to American. Not only are spellings different, but punctuation and grammar vary. Fortunately, both organizations have excellent editors and ISO requires editors to become familiar with their style manual.

Besides dealing with differences between the American and international variants of English, we also needed to be sensitive to the fact that the resulting standards might be translated and we had to be aware that some words do not translate well, or there might be multiple ways that a technical term might be translated. ISO has three official languages and ICAO has five.

Even the term “standard” does not always translate. German and French, for example, use normalisation rather than standardization. Fortunately, with SEBoK the entire resource is in English, but for INCOSE products we are starting to see translations.

Besides differences in natural languages, we also encounter differences depending on someone’s original professional specialization (e.g., mechanical, electronics, software) and the culture of the sector we work in (e.g., aerospace, medical devices, consumer products).

An example of a cultural surprise came with keyboards. Back in the days before we all brought our own laptop computers, desktop computers were sometime provided by the meeting host. I expected to see adaptations to handle the various diacritical marks used in some languages, but when I used a computer in Kobe Japan, the “z” character was in a different location, so I had to hunt for it.

Overall, I appreciated the opportunity to make a contribution that leveraged some of my past experience in an area that might be considered as clerical work rather than systems engineering, but sometimes systems engineering needs to involve administrative work in addition to exploring solutions to challenging problems that require innovation. Much of the work in expanding knowledge is the ability to find and assess what has been learned and fitting it into the body of knowledge.

### 3. Conclusion

This paper provides a glimpse from a subset of the original authors’ stories of how the BKCASE team overcame various cultural and diversity related challenges to produce a set of international products that continue to evolve and bring value around the world. Several factors were:

- The BKCASE leadership was unwavering in keeping the team on point while continuing to spark the group’s energy and dedication
- The BKCASE team shared a common vision of the future, a passion for the work being undertaken, and a strong respect for the leaders and each other
- The BKCASE team was dedicated to their work while also focused on taking time to get to know each other and learn about other perspectives and cultures

These and other factors created the right environment for producing SEBoK and GRCSE and continue to serve these products as they evolve to support the future global systems engineering community.

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## About the Authors

**Heidi Davidz** is a Principal Engineer in Systems Engineering (SE) at Aerojet Rocketdyne, currently in Systems Development, Verification, and Test. Previous roles included Model-Based Systems Engineering Project Lead, SE Discipline Lead, Chief Process SE, Stennis Space Center Achieving Competitive Excellence Manager, and RS-68 Test Conductor. At Aerospace Corporation, she supported NASA Headquarters and National Security Space. She earned a Ph.D. in Engineering Systems at the Massachusetts Institute of

Technology; an M.S. in Aerospace Engineering from the GE Advanced Courses in Engineering and the University of Cincinnati; and a B.S. in Mechanical Engineering from The Ohio State University.

**Timothy L.J. Ferris** holds the B.E.Hons, Adelaide, B.Th., Flinders, B.Litt.Hons., Deakin, GradCertEd, Queensland University of Technology, and PhD, University of South Australia. He is a Senior Lecturer in Cranfield University. He worked as an Engineer for the Electricity Trust of South Australia and Morrison Court, prior to becoming a faculty member in engineering in the University of South Australia. He has published about 150 papers in journals and conferences. His current research interests relate to foundational issues in systems engineering, systems engineering education, research methods, and resilience. He is a member of INCOSE and an Associate Editor of IEEE Systems Journal.

**Devanandham Henry** was a Scientist/Engineer with the Aeronautical Development Agency, Government of India for a decade before joining Stevens Institute of Technology, USA to pursue and earn a Ph.D. in Systems Engineering. He worked as a Research Engineer at the Systems Engineering Research Center and was involved in a number of projects including the BKCASE project that developed the SE Body of Knowledge (SEBoK) and the graduate reference curriculum (GRCSE), and the Helix project that developed Atlas: The Theory of Effective Systems Engineers. He is now back in India, pursuing a new career in Systems Engineering.

**Thomas B. Hilburn** is a Professor Emeritus of Software Engineering at Embry-Riddle Aeronautical University, Daytona Beach, Florida. From 1973 to 2007 he taught courses in mathematics, computer science and software engineering. From 1996 to 2010 he served as a Visiting Scientist at the Software Engineering Institute, Carnegie Mellon University. His last position at Embry-Riddle was as Dean of the College of Engineering. Professionally, Hilburn has conducted research and published numerous papers in computing education, software process, and software assurance. He developed and conducted numerous workshops in software engineering for the Software Engineering Institute and the IEEE Computer Society.

**Nicole A.C. Hutchison** is a research engineer with the SERC. She has supported the Helix project since its inception and currently serves as its Principle Investigator. Before coming to Stevens, Nicole worked for Analytic Services Inc. as an analyst working primarily on public health, biodefense, and full-scale exercise projects for the US Departments of Defense, Homeland Security, and Health and Human Services. She holds a PhD in systems engineering from Stevens.

**David H. Olwell** is Professor and Dean of the Hal and Inge Marcus School of Engineering at Saint Martin's University. Dr. Olwell's research areas are in reliability engineering, systems engineering, and statistical process control. Dr. Olwell was previously on the faculties of the Naval Postgraduate School and the United States Military Academy. With Dr. Art Pyster, he was the co-PI for the BKCASE, 2008-2012.

**Daniel Prun** is an associate professor in System Engineering (SE) at ENAC (French Civil Aviation University) with over 20 years of SE industry experience. After earning a PhD in computer science at French University "Pierre et Marie Curie" (Paris 6) in system modeling and maintenance improvement in 1997, he left academic research and became an SE consultant, supporting several customers in various sectors (defense, air traffic control, aeronautic, railway, medical...). In December 2009, Daniel joined the ENAC school to develop SE teaching and research activities on human-system interaction. He is member of INCOSE and AFIS (Association Française d'Ingénierie Système - INCOSE Affiliate).

**Art Pyster** is the Associate Dean for Research and a Professor in the Volgenau School of Engineering at George Mason University. He has worked for more than 40 years in industry, government, and academia leading organizations in the creation, teaching,

adoption, and use of advanced technologies. Some of his previous roles include being Deputy Executive Director and COO of the Systems Engineering Research Center, Senior VP and Director of Systems Engineering and Integration for SAIC, and Deputy CIO for the US Federal Aviation Administration. He is an INCOSE Fellow and Founders Award recipient.

**Jean-Claude Roussel** is a Systems Engineering Senior Expert with 37 years of experience in different Aeronautics and Space Programs at Airbus, Toulouse (France) and an INCOSE certified ESEP. He consults in Systems Engineering since July 2018 following early retirement. He has been successively in charge of Configuration Management, Project Management and Systems Engineering for most of the aircraft developments within Airbus (A320/A319, A330/A340, A380, A400M and A350) and spent some years on space programs for ESA (European Space Agency). He served as INCOSE Technical Director 2011-2012, INCOSE EMEA Sector Director 2014- 2018, and now chairs the INCOSE PM-SE Integration working group.

**Hillary Sillitto** (CEng, FInstP, ESEP) studied physics at the University of St Andrews and then Imperial College, London. He worked first as an optical engineer, then held Senior Systems Engineering and Architecting positions in Thales and UK MoD, and now follows various academic and professional interests. His book *Architecting Systems – Concepts, Principles and Practice* was published by College Publications in 2014. He received several best paper awards at INCOSE international symposia, contributed to the INCOSE SE Handbook and the SEBoK, and led the INCOSE Fellows' Definitions project 2016-19. He is an INCOSE Fellow, and a member of Omega Alpha Association.

**John Snoderly** is currently the Learning Director of Engineering at the Defense Acquisition University. Prior to joining DAU, he has 16 years working for the U.S. Navy as a civilian engineer. He was the first President of the Washington Chapter of INCOSE and President of INCOSE from 2002-2004. He is the current 2018 Chairman of the INCOSE Foundation. An INCOSE CSEP and member of IEEE one of 70 authors of the 2012 SEBoK. He received a BSAE from WVU in 1963; MSSM USC in 1973; MS PA USC 1995 and USC DPA 1996. Dr. Snoderly, has worked for the US DoD for 56 years.

**Alice F. Squires** has served in professional roles for over 35 years including nearly 25 years in industry. She currently serves as an Associate Professor in Engineering and Technology Management at Washington State University. Alice serves INCOSE Academic Matters and founded the Empowering Women: Leaders in Systems Engineering (EWLSE) group; she also serves the ASEE Systems Engineering Division, Corporate Member Council, and Committee on Diversity, Equity, and Inclusion. Alice is an INCOSE certified ESEP-Acq. She recently authored the IEEE-USA WIE e-book on women overcoming challenges to succeed in STEM, titled: "Dandelion Wishes: A World Where We Collaborate as Equals" (<https://ieeusa.org/shop/careers/wie-book-21/>).

**Ken Zemrowski** is a senior systems engineer with SAIC, supporting the U.S. Federal Aviation Administration (FAA) for thirty years in a variety of systems engineering projects, including the modernization of the National Airspace System. Besides systems engineering work, he participated on behalf of the FAA in the International Organization for Standardization (ISO), International Civil Aviation Organization (ICAO), and the Radio Technical Commission for Aeronautics (RTCA), primarily in data communications and avionics safety. Previously, his career focused on software development. Ken is an INCOSE certified ESEP. He has served as INCOSE Assistant Director for Standards Initiatives, Assistant Director for Technical Information, and currently serves as Associate Director of Publications.

# Overcoming challenges on an international project to advance systems engineering

Davidz, Heidi

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