

## **THE COUNTRIES OF THE WINTER SIMULATION CONFERENCE**

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### **ABSTRACT**

For 50 years, the Winter Simulation Conference (WSC) has brought together researchers and practitioners from the field of discrete-event simulation. This paper discusses the demographics of the authors of the many thousands of papers that have appeared in the WSC proceedings over that time span. From its origins as a “regional” conference whose participants hailed primarily from the United States, we shall see that the WSC has evolved into a truly top-flight, international conference.

### **1 INTRODUCTION**

The Winter Simulation Conference (WSC) has long been regarded as the “go to” conference to learn about the latest in the theory and practice of discrete-event computer simulation. Since the first WSC in 1967, the conference has evolved in numerous ways. The range of topics covered has grown tremendously, touching all the bases from highly theoretical topics to hardcore computer programming to practical applications. Moreover, a diverse group of attendees has always participated in the WSC, and the conference has found numerous homes as it has moved from city to city over the years.

But it might surprise some to know that for many years, the WSC was, in a sense, merely a very nice “regional” conference, where almost all of the presentations were given by authors originating in the United States. Moreover, it was not until 2012 that the WSC finally ventured out of its comfort zone to a non-U.S. venue, when it enjoyed its first trip across the pond to a highly successful coming out party in Berlin, Germany.

This is a companion paper to Goldsman, de Almeida Costa, and Goldsman (2017). In the current paper, we examine how the WSC has evolved from a “regional” conference whose participants hailed primarily from the United States, into a prestigious international conference. In particular, we will look at various trends in participants’ countries of origins; and we find that the U.S. is no longer alone in the WSC world. To this end, the remainder of the paper is organized as follows. Section 2 informally explains our methodology. Section 3 discusses some yearly trends in WSC participation. Section 4 summarizes who we are, and Section 5 provides conclusions and an outlook for the future.

## 2 METHODOLOGY AND DATA SOURCES

The annual proceedings of 50 years of the WSC include about 9000 papers, collected in 47 or 48 volumes, depending on what is counted as a legitimate proceedings. We pulled data from various sources, including the WSC website [www.winter.org](http://www.winter.org), and the ACM website [www.acm.org](http://www.acm.org), and (in order to do random manual checks) hard copies of the proceedings themselves. We also utilized three different citation databases — Web of Science, Scopus, and Google Scholar — along with many, many corveées of tedious, forced labor.

Note that we do not use data from the following years:

- 1967 — There was no published proceedings for this incarnation of the conference.
- 1975 — Even though a proceedings exists, there was no conference! This “zombie” proceedings originates from a *completely different* conference, and is not considered legitimate; see Sargent, Roth, and Schriber (2017) for details.
- 2017 — The data are not yet complete for this conference.

In addition, we attempted to limit our search to full, refereed papers, as discussed in Goldsman, de Almeida Costa, and Goldsman (2017). Although we were not completely consistent, we tried our best to preclude abstract-only proceedings entries, Ph.D. Colloquia presentations, poster sessions, certain case studies, most recent vendor tutorials, some panel sessions, and most keynote and “Titan” addresses.

## 3 TRENDS

In this section, we give a high-level overview of some trends involving participation in the WSC. In particular, over the years, how many countries have participated in the WSC, and how many papers have originated from U.S. sources and from non-U.S. sources?

In this section, we admittedly take on a slightly narrow definition of “participating country” — namely, for the most part, we only look at the *first author* when determining where a paper originates. Thus, for example, if the authors of a particular paper are listed as Smith, Brown, and Jones in that order, and if they respectively hail from from The United Kingdom, Canada, and France, then we give credit to The U.K. as the originating country for that paper. This avoids double counting papers, though it has the drawbacks that (i) it is a bit arbitrary, and (ii) we have no way of definitively knowing which authors were actually present at that year’s conference. We occasionally make an exception to this rule in order to sneak in low-participating countries to the list. For instance, if Smith, Brown, and Jones had been from The U.S., Uzbekistan, and The U.S., then we might be compelled to put that paper in Uzbekistan’s bucket.

With these caveats in mind, Figure 1 depicts the number of countries presenting at WSC over the period 1968–2016. We see very low numbers of international participants (sometimes just The U.S. alone) until about the 1989 Washington, DC conference, when the numbers start a long-term trend up, peaking at 42 countries participating in the 2012 conference that took place in Berlin.

Figure 2 breaks down the numbers of U.S. and non-U.S. WSC Papers by year. Figure 3 gives the analogous time series corresponding to the proportion of non-U.S. papers. The non-U.S. numbers remained small during the WSC’s early years, when the conference still had a “regional” flavor. In fact, the number of non-U.S. papers did not go above 20 until the 1991 WSC in Phoenix, AZ; and the proportion of non-U.S. papers did not pass 20% until the 1998 conference in Washington, DC. But from there, the march up was inexorable. The number of non-U.S. papers passed the 100 mark for the first time at the 2005 Orlando conference. And the proportion of non-U.S. participants has hovered around 50% since 2008. The exceptional 2012 WSC in Berlin had 245 papers originating outside of the U.S., accounting for 73% of the conferences participants. The WSC had become truly international.

As we have mentioned before, for consistency purposes, we tried to limit our analysis to full, refereed papers. However, in additional analyses (not reported here), we note that several years — including all recent years — have had substantial numbers (sometimes hundreds) of participants contributing abstracts, Ph.D. Colloquia presentations, poster sessions, case studies, professional vendor tutorials, panel sessions,

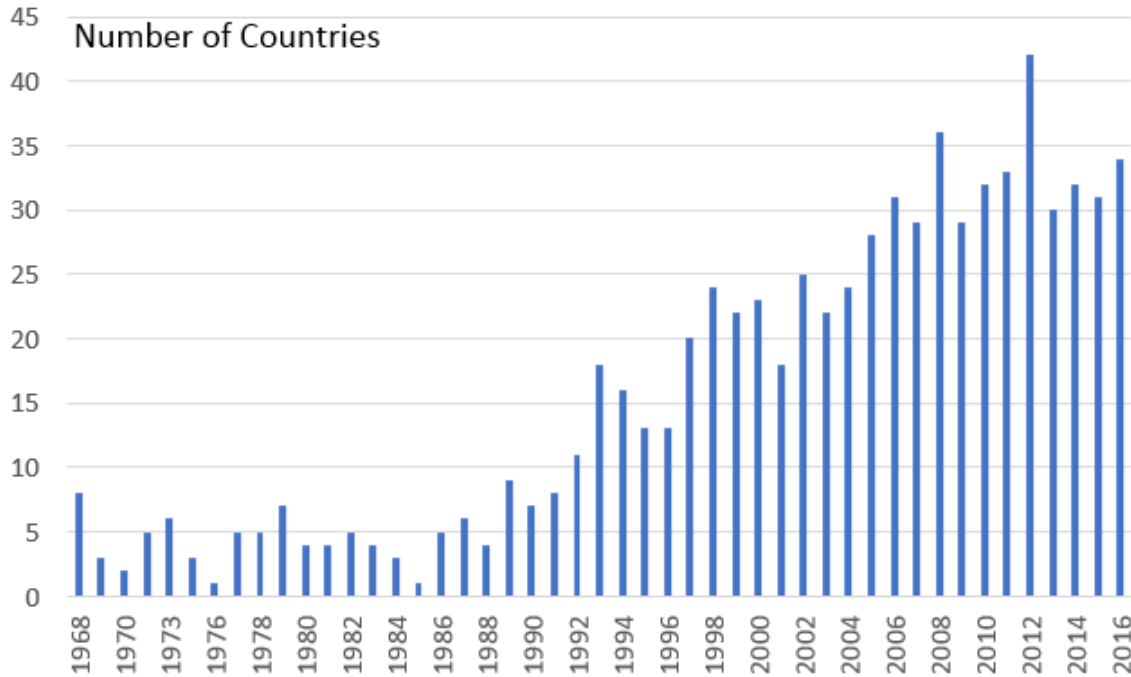


Figure 1: Number of Countries Presenting at WSC, 1968–2016.

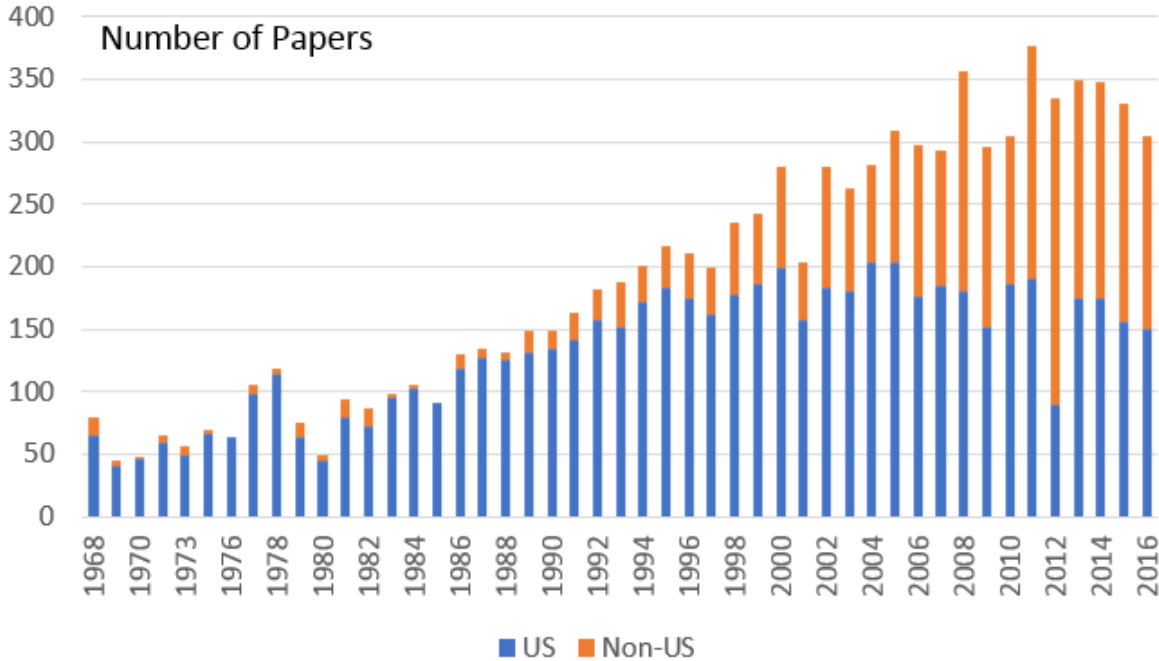


Figure 2: Numbers of U.S. and non-U.S. WSC Papers, 1968–2016.

and keynote and “Titan” addresses that may or may not have appeared in the proceedings. Some of these numbers are available upon request from the authors of the current paper.

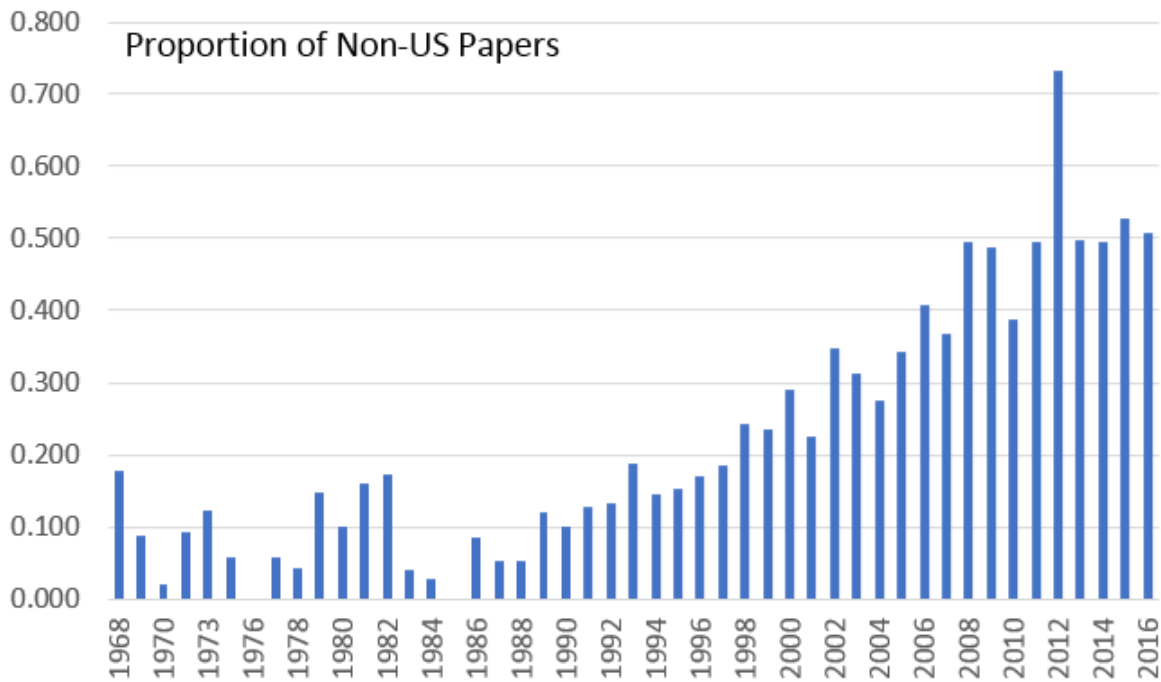


Figure 3: Proportion of WSC Papers Originating Outside of the U.S., 1968–2016.

#### 4 A WORLD FAMILY

In this section, we give additional details regarding the countries that have participated in the WSC. To begin with, Table 1 tallies the number of papers from each participating country, the “debut” year of each country at the WSC (i.e., the first time a paper from a country appeared), and the number of years that that country has had a paper. Of course, the world is a dynamic place, and certain countries have come in and out of existence as time has passed. We have tried to be as sensitive as possible to those issues in the table listings.

Of course, The U.S. dominates the listing with thousands of papers. But we find that several other countries such as Canada, France, Germany, Japan, The Netherlands, Singapore, and The U.K. all have numbers well above 100. In addition, many countries are consistently participating in the conference, as illustrated by the robust numbers in the “Yrs > 0” columns. The best news may be the fact that more and more countries are starting to attend WSC. Thus, for instance, we find recent appearances of colleagues from Macau, Madagascar, Mongolia, Nigeria, Qatar, and Vietnam. We also snuck Iceland onto the list owing to an appearance in a non-refereed proceedings entry and the fact that we have several American-based Icelandic colleagues.

We also carried out a Gephi ([gephi.org](http://gephi.org)) analysis in which we regard the various participating countries as a sort of social network to illustrate, in a very basic way, how research partners from various countries interact with each other. By way of example, consider Figures 4 and 5, which concern results from the 2012 (Berlin, Germany) and 2016 (Arlington, VA) conferences, respectively. To construct those figures, we compiled a list of *all* authors of WSC papers (not just the first authors) and determined how many papers had authors from multiple countries. The node sizes roughly indicate the numbers of such “international collaboration” papers from the countries depicted. We see from the figures that the usual suspects dominate the landscape, but there is a tremendous amount of connectivity among folks from different countries. And even more so, many researchers have immigrated to new countries to study and work, are dual citizens, etc., so that the connectivity is actually much, much greater than we think.

Table 1: WSC Parade of Countries.

	Total	Debut	Yrs > 0		Total	Debut	Yrs > 0
Algeria	2	1996	2	Macau	1	2015	1
Argentina	15	1973	11	Madagascar	1	2012	1
Armenia	1	1993	1	Malaysia	7	1999	5
Australia	59	1968	18	Mexico	14	1975	11
Austria	51	1981	26	Mongolia	1	2012	1
Belgium	17	2000	10	Netherlands	155	1980	26
Brazil	91	1999	17	New Zealand	12	1994	9
Canada	362	1968	44	Nigeria	1	2015	1
Chile	13	2001	7	Norway	24	1968	15
China	88	1982	17	Pakistan	1	2008	1
Colombia	18	2008	8	Panama	1	2006	1
Croatia	1	1994	1	Poland	15	2008	8
Cuba	1	2000	1	Portugal	14	1986	10
Cyprus	1	2007	1	Qatar	1	2016	1
Czech	5	1977	4	Romania	1	2009	1
Denmark	11	1990	9	Russia	5	1997	5
Egypt	6	2006	5	Saudi Arabia	2	2011	2
Finland	23	1992	14	Singapore	155	1994	21
France	102	1968	27	Slovakia	2	2007	1
Germany	444	1969	30	South Africa	2	2005	2
Greece	11	1979	10	South Korea	72	1993	22
Hong Kong	39	1997	15	Spain	58	1993	17
Hungary	4	1993	3	Sri Lanka	1	2008	1
Iceland	*	2015	*	Sweden	89	1968	27
India	31	1999	12	Switzerland	11	1968	8
Indonesia	1	2010	1	Taiwan	55	1987	24
Iran	8	2008	5	Thailand	8	2001	7
Ireland	43	1987	16	Turkey	29	1997	14
Israel	22	1978	16	United Arab Emirates	3	2011	2
Italy	57	1989	19	United Kingdom	333	1968	39
Japan	114	1973	32	United States	6239	1968	47
Jordan	9	1997	6	Uganda	1	2011	1
Kuwait	8	1993	6	Uruguay	3	2005	3
Latvia	5	1998	3	Venezuela	1	2007	1
Lebanon	2	2008	2	Vietnam	3	2012	3
Luxembourg	2	1999	2	Yugoslavia	1	1993	1

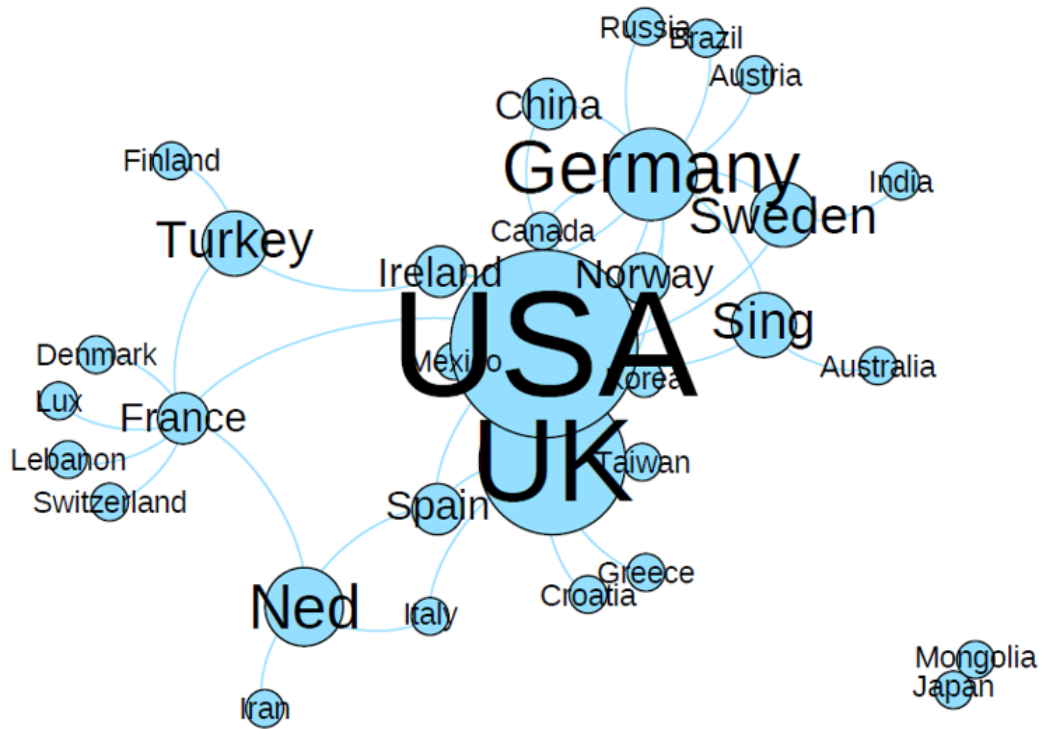


Figure 4: 2012 Worldwide Connections.

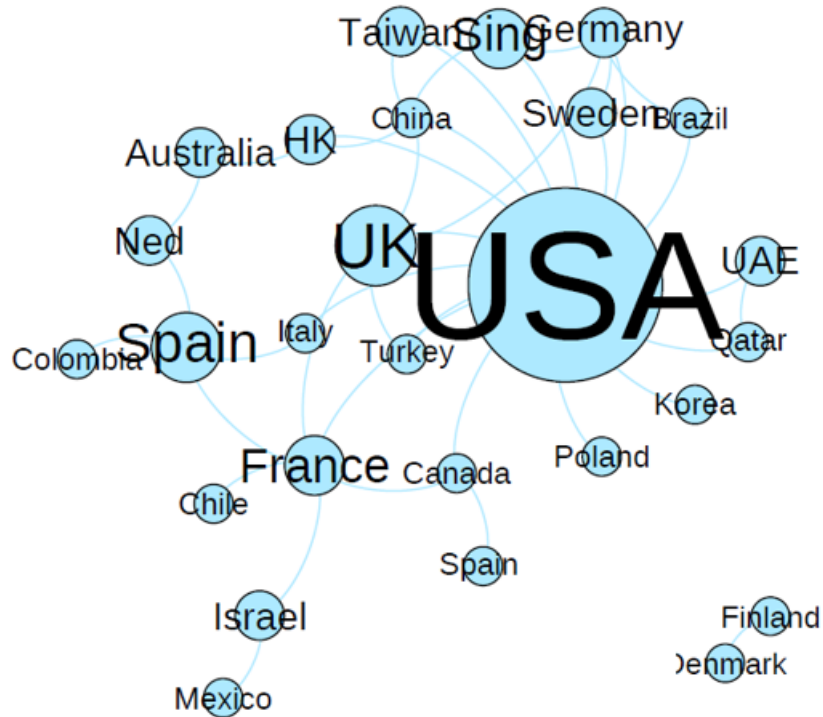


Figure 5: 2016 Worldwide Connections.

## **5 CONCLUSIONS AND FUTURE OUTLOOK**

The Winter Simulation Conference is certainly the most important conference in the field of discrete-event simulation. Over the years, we have seen that the WSC has expanded its reach beyond its original provincial home in the United States; truly, it is now a world-wide conference. This trend will continue as the conference visits future venues in Sweden, Singapore, and other countries. WSC has always been characterized by its close sense of community — a community which now extends around the world.

## **REFERENCES**

- Goldsman, D., M. de Almeida Costa, and P. Goldsman. 2017. “History of the Winter Simulation Conference: Notable Facts and Figures”. In *Proceedings of the 2017 Winter Simulation Conference* (ed. W. K. V. Chan, A. D’Ambrogio, G. Zacharewicz, N. Mustafee, G. Wainer, and E. Page), Piscataway, NJ: Institute of Electrical and Electronics Engineers.
- Sargent, R. G., P. F. Roth, and T. J. Schriber. 2017. “History of the Winter Simulation Conference: Renaissance Period (1975–1982)”. In *Proceedings of the 2017 Winter Simulation Conference* (ed. W. K. V. Chan, A. D’Ambrogio, G. Zacharewicz, N. Mustafee, G. Wainer, and E. Page), Piscataway, NJ: Institute of Electrical and Electronics Engineers.

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