

## **Recent development of Operational Research in Colombia**

Carolina Castañeda P.<sup>a</sup>, Juan G. Villegas<sup>b</sup>, Andrés L. Medaglia<sup>c</sup>, Eliana Toro<sup>d</sup>

<sup>a</sup> Instituto Tecnológico Metropolitano-ITM

<sup>b</sup> Universidad de Antioquia

<sup>c</sup> Universidad de los Andes

<sup>d</sup> Universidad Tecnológica de Pereira

### **Creation of ASOCIO**

The Colombian Association of Operational Research (ASOCIO) was founded in 2014 after some preliminary activities oriented to get information about the Colombian academic community and their interest in establishing a network to promote the practice of Operational Research in the country.

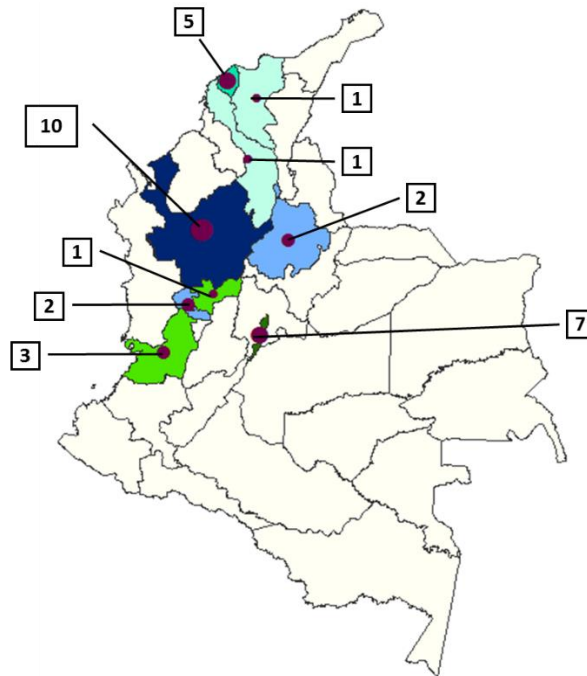
In Colombia there have been at least two known attempts to bring together people working in Operational Research (OR). The first one, is the Colombian Association of Computing and Operational Research-ACCIO founded in 1966, their goal was gather people interested in Computer Sciences, due to the recent creation of the first Informatics Engineering undergraduate programs in several universities of the country. In recent years, they seem to be inactive. The second attempt was the Colombian Society of Operational Research-SOCIO founded in 2000. They organized the XIV Latin-Iberoamerican Conference on Operations Research (CLAIO 2008). Nowadays, because of their inactivity, since 2014 ALIO do not recognize them as the official Colombian OR society.

In 2012, Luciana Salete Buriol president of the Association of Latin-Iberoamerican Operational Research Societies (ALIO), visited Medellín to know the work in Operations Research at some universities. She encouraged the creation of an association due to the visibility of Colombian activity in the field in recent years and the lack of a representative body.

After this visit, professors from several universities at Medellín started an itinerant seminar where they showed their works and research interests, also graduate students presented their thesis progress. This activity remained active until 2014. Additionally, a group of these professors were meeting monthly to plan the creation of a Society. They spread the idea of a new Colombian OR Society between their colleagues, who expanded the message to other people in the country and abroad.

The call for a new Association had a participation of more than 120 people from 32 Colombian universities, 5 organizations (included research centers and private companies) and 8 foreign institutions where there are Colombian professors or doctoral students.

The meeting for the legal constitution of ASOCIO was the 3<sup>th</sup> October 2014 in Medellín where 41 founding members participated (28 from different regions of the country and abroad connected by videoconference), besides the Board of Representatives was elected. Fig. 1 depicts the regional distribution of the founding members.



*Figure 1. Geographical distribution in Colombia of founder members of ASOCIO*

The current Board of Representatives is:

**President**

Juan Guillermo Villegas Ramírez (Universidad de Antioquia, Medellín)

**Vice-President**

Jairo Rafael Montoya Torres (Universidad de los Andes, Bogotá)

**Secretary**

Francisco Javier Díaz Serna (Universidad Nacional de Colombia, Medellín)

**Treasurer**

Juan Pablo Fernández Gutiérrez (Universidad de Medellín, Medellín)

**Board members**

Carlos Eduardo Díaz Bohórquez (Universidad Industrial de Santander, Bucaramanga)

John Wilmer Escobar Velásquez (Pontificia Universidad Javeriana, Cali)

Juan José Bravo Bastidas (Universidad del Valle, Cali)

Jairo Rafael Coronado Hernández (JARACOE S.A.S, Cartagena)

Jorge Ernesto Mendoza Giménez (Polytech Tours, Tours (France))

Juan Carlos Rivera Agudelo (Universidad EAFIT)

Mario César Vélez (Universidad EAFIT)

Carolina Castañeda P. (Instituto Tecnológico Metropolitano)

Later, in CLAIO 2014 held in Monterrey (Mexico), ASOCIO's president, Professor Juan G. Villegas presented the new Association to ALIO's authorities in the Council of Representatives meeting.

The Association plan to have an annual ordinary assembly with its members, the first one was the 15<sup>th</sup> July 2015, and the second one was the 29<sup>th</sup> July 2016.

After its creation, ASOCIO has been promoting several activities around the research and practice of OR. In July 2015, ASOCIO sponsored the first ASOCIO national Conference organized by the International School of Economic and Management Sciences from Universidad de la Sabana. ASOCIO 2015 conference was chaired by Professor Jairo Montoya and organized by the Operations & Supply Chain Management research group of this university. This event had 195 attendees from 28 universities, 6 companies or research centers and 1 foreign participant. Post conference special sections were edited in DYNA and *Ingeniería y Ciencia*, two national journals (the first one included in JCR). ASOCIO Conference will be a biennial event, the next one will be held on 2017 at Medellín (Colombia) and will be organized by the Universidad EAFIT.

Also, between 2015 and 2016 ASOCIO has opened its own communication channels. First, a web page (<http://asociocolombia.wix.com/asocio>) to give information about the different activities sponsored by the Association, the Board of Representatives, the bylaws and the membership. Second, an email-based group to disseminate information of interest for the OR Colombian community, like job opportunities, doctoral and postdoctoral positions, conferences and call for papers. Third, a periodic bulletin to update the members about ASOCIO activities.

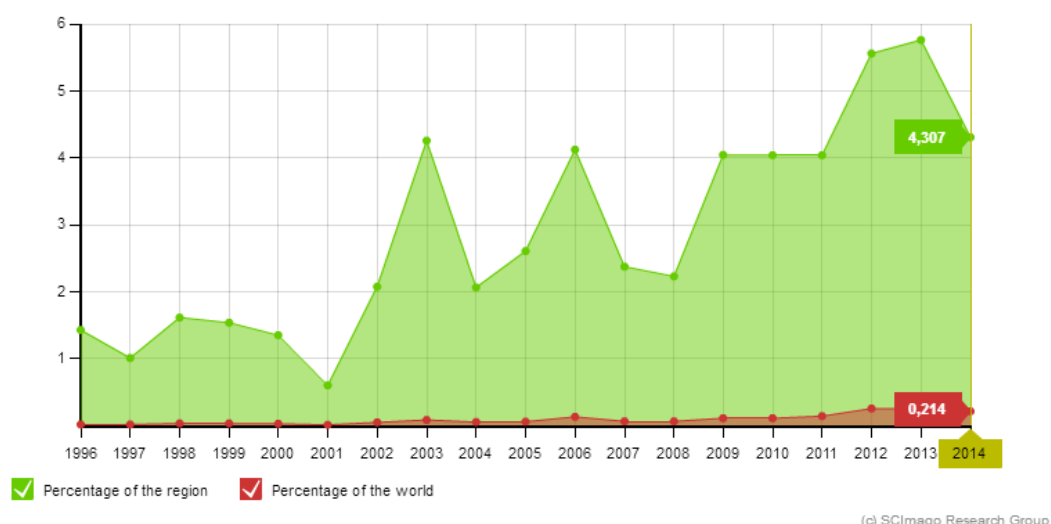
Recently, ASOCIO organized the Latin American Summer School of Operational Research-ELAVIO 2016 in Cali (<http://elavio2016.univalle.edu.co/>), with the support of IFORS and co-organized by the Universidad del Valle (Industrial Engineering School), the Pontificia Universidad Javeriana (Civil and Industrial Engineering School), the Universidad de Antioquia (Industrial Engineering Department) and the Universidad de Medellín (Sciences Department). Previously, ELAVIO 2005, was organized by the Universidad de los Andes, with collaboration of the Universidad Tecnológica de Bolívar and Chaired by professor Andres L. Medaglia.

## Operational Research in Colombia: Recent Development

In Colombia, Operational Research teaching and research is held mainly in Industrial Engineering and related programs. According to the Administrative Department of Science, Technology and Innovation-Colciencias approximately 32 research groups out of 215 registered in Industrial Engineering and related fields have research interests in Operational Research. In areas as Computing and Information Science and Mathematics there are approximately 6 research groups in each of them related to this subject<sup>1</sup>.

According to the National Higher Education Information System-SNIES, there are 19 master programs and one PhD program in Industrial Engineering. Moreover, at least another seven Ph.D programs in Bussines or Engineering Schools include OR within their research areas. There are other postgraduate programs in specific areas related to Industrial Engineering, as Logistics and Supply Chain, Analytics and Operations Management. Also, some applied mathematics programs use topics of Operational Research in their courses and research works.

A measure of the increasing development of Operational Research in Colombia is the number of published documents in recent years. According to the Scimago Journal & Country Rank (SJR), between 1996 y 2014 Colombia had 322 publications in the Decision Sciences area. Moreover, Fig. 2 shows an increasing trend over the years. This figure presents the relative number of Colombian publications in Decision Sciences as a percentage of the Latin American (green line) and world publications (red line).



**Figure 2. Percentage of Colombian relative publications in Decisions Sciences area from 1996 to 2014**

In SJR, Management Sciences and Operational Research (MS/OR) is included in the Decision Sciences area. Considering the number of publication in MS/OR between

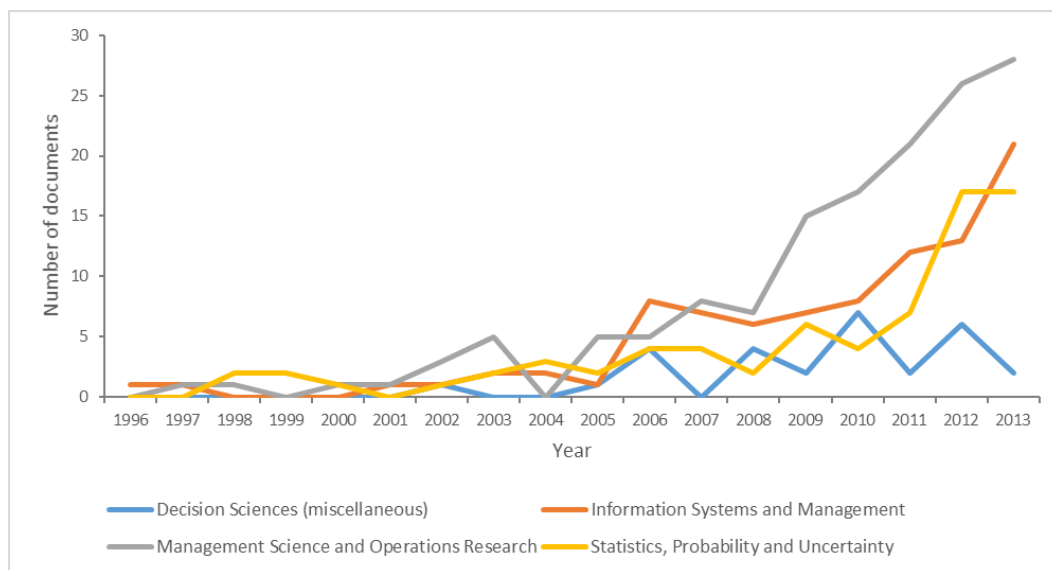
<sup>1</sup>Web page of the Administrative Department of Science, Technology and Innovation-Colciencias to search the groups by area: <http://scienti.colciencias.gov.co:8083/ciencia-war/BusquedaGrupoXArea.do>

1996 and 2014, Colombia is in the fourth place in the Latin American ranking, as can be seen in Table 1.

Moreover, after 2007 MS/OR has the highest share in the number of Colombian publications compared to the other categories in the Decision Science area (see Fig. 3).

**Table 1. First ten countries of the Latin American ranking of scientific documents published in MS/OR between 1996 and 2014<sup>2</sup>**

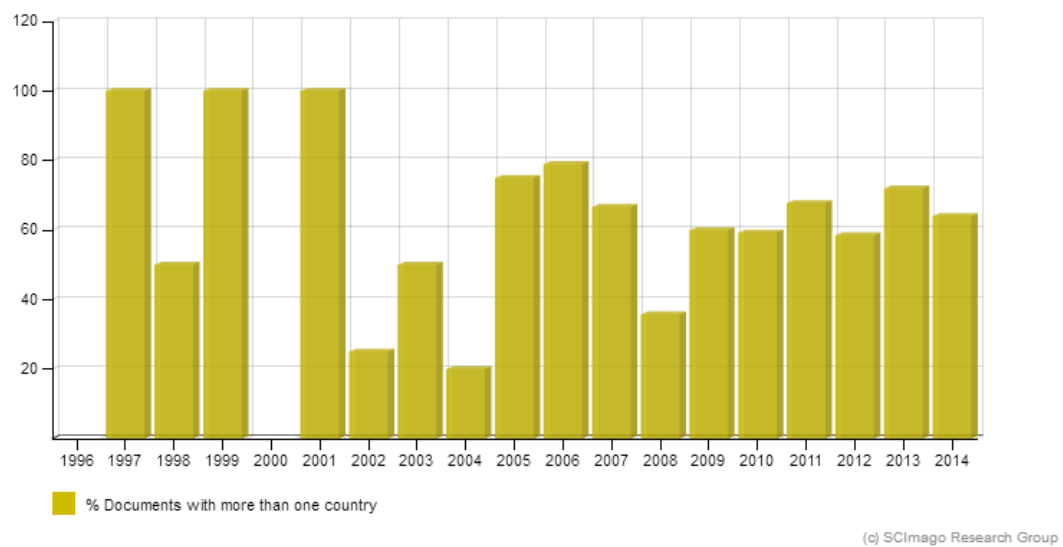
Rank	Country	Documents
1	Brazil	2393
2	Chile	492
3	Mexico	471
4	Colombia	164
5	Argentina	151
6	Venezuela	135
7	Peru	42
8	Cuba	39
9	Uruguay	38
10	Puerto Rico	31



**Figure 3. Colombian documents by categories of Decision Sciences between 1996 and 2014**

Other relevant feature of the development of research in Colombia in the Decision Sciences field is the international collaboration. Figure 4 shows the percentage of Colombian publications with authors from more than one country between 1996 and 2014. This figure shows an increase in the international collaboration of Colombian researchers in the field thanks to the contacts obtained in doctoral studies made abroad, the participation in international conferences and the internationalization of Colombian universities.

<sup>2</sup> <http://www.scimagojr.com/countryrank.php?region=Latin%20America&category=1803>



**Figure 4. Percentage of Colombian publications in Decision Sciences with international collaboration between 1996 and 2014**