

# Analyzing the research output presented at European Networked Knowledge Organization Systems workshops (2000-2015)

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**Abstract.** In this paper we analyze a major part of the research output of the Networked Knowledge Organization Systems (NKOS) community in the period 2000 to 2015. We focus on the paper output presented at the European NKOS workshops in the last 15 years. Our open dataset, the "NKOS bibliography", includes 14 workshop agendas (ECDL 2000-2010, TPDFL 2011-2015) and 4 special issues on NKOS (2001, 2004, 2006 and 2015) which cover 171 papers with 218 distinct authors in total. A focus of the analysis is the visualization of co-authorship networks in this interdisciplinary field. We used standard network analytic measures like degree and betweenness centrality to describe the co-authorship distribution in our NKOS dataset.

**Keywords:** NKOS workshops, Output analysis, Network analysis, Central authors, Collaboration

## 1 Introduction

The European NKOS network has held a long-running series of annual workshops at the European Conference on Digital Libraries (ECDL), latterly reformed as the International Conference on Theory and Practice of Digital Libraries (TPDL). Typically, recent advances of KOS have been reported at the NKOS workshops, e.g. including the Simple Knowledge Organization System (SKOS) W3C standard, the ISO 25964 thesauri standard, the CIDOC Conceptual Reference Model (CRM), Linked Data applications, KOS-based recommender systems, KOS mapping techniques, KOS registries and metadata, social tagging, user-centred issues, and many other topics. A comprehensive and well cited review article on KOS and NKOS topics was published in 2004 [6]. Special issues on Networked Knowledge Organization Systems (NKOS) have been published in Journal of Digital Information in 2001 and 2004, in New Review of Hypermedia and Multimedia in 2006 and in the International Journal of Digital Libraries in 2015 [2].

The motivation of this paper is to analyse the research output of the NKOS community. We are focusing on the informal part of this output, the paper

presentations given at the past NKOS workshops (the first European NKOS workshop in 2000 to the 14th European NKOS workshop in 2015). The specialty of this research output is that these research papers typically are not published in journals or conference proceedings. These papers appear just as oral presentations at the workshop and are documented on the website. To our knowledge nobody has done an analysis on this part of the NKOS research output before.

## 2 NKOS workshop bibliography

For our analysis we have compiled an open dataset the "NKOS bibliography"<sup>1</sup> which includes 14 workshop programs with all presented papers at ECDL 2000, ECDL 2003-2010 and TPDL 2011-2015 (see Table 1). We added papers from 4 special issues on NKOS which have been published in the same period (see Table 2).

In a first step we have extracted all paper titles presented at the NKOS workshop websites. We added papers from the special issues. These papers are the only formal publications in our analysis. In the end we manually disambiguated author names of all papers.

Our dataset covers 171 papers in total with altogether 218 distinct author names. Table 1 provides an overview of all workshop papers.

**Table 1.** Overview of all NKOS workshop papers

venue	papers	authors
ECDL 2000	4	4
ECDL 2003	13	11
ECDL 2004	14	27
ECDL 2005	12	26
ECDL 2006	12	27
ECDL 2007	15	26
ECDL 2008	11	16
ECDL 2009	12	31
ECDL 2010	12	25
TPDL 2011	11	26
TPDL 2012	9	22
TPDL 2013	7	17
TPDL 2014	9	17
TPDL 2015	7	13

Table 2 provides an overview of all papers in the special issues.

<sup>1</sup> The NKOS workshop bibliography is maintained in the following github repository: <https://github.com/PhilippMayr/NKOS-bibliography>

**Table 2.** Overview of all NKOS special issue papers

venue	papers	authors
JODI 2001 [1]	5	8
JODI 2004 [4]	5	15
NREW 2006 [5]	6	11
IJDL 2016 [2]	7	20

### 3 Analysis

In order to analyze the collaboration in the community of NKOS workshops we built a network of all authors in this community and computed the centrality of each author. For this purpose we utilized some standard centrality measures in Pajek<sup>2</sup>. The network is composed of pairs of author names. Each pair means that two authors cooperated for writing a paper. If we have  $n$  papers and the paper  $i$  has  $m_i$  authors, the number of pairs are

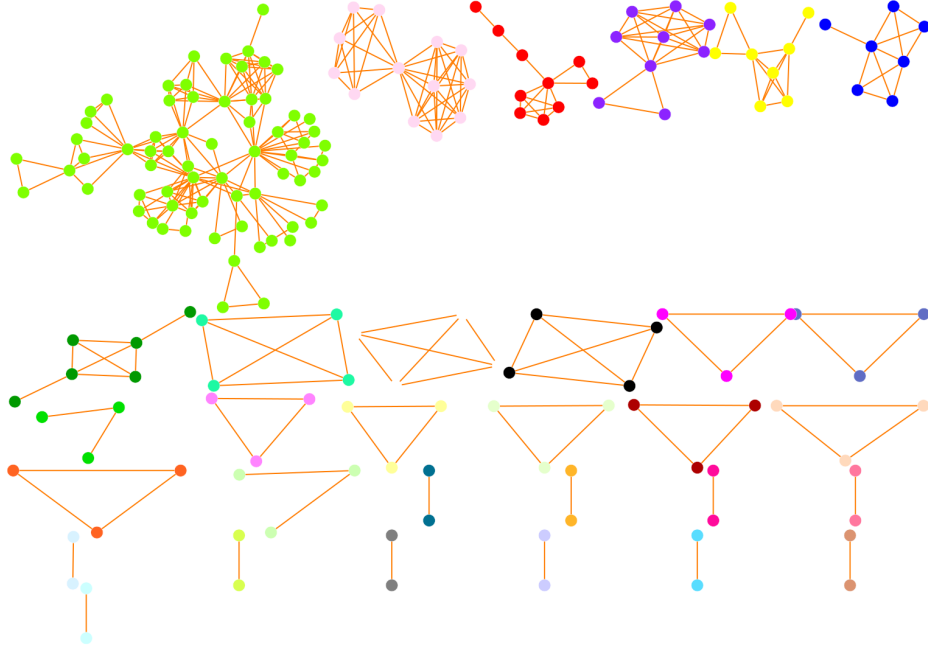
$$\sum_{i=1}^n \frac{m_i(m_i - 1)}{2} \quad (1)$$

These pairs built the network for our analysis in Pajek. To avoid repetition of pairs, we gave weight to pairs and it is equal to the number of cooperations of two authors in different papers. Two often used centrality measures of authors are degree and betweenness. Degree is the number of nodes that a focal node is connected to, and measures the involvement of the node in the network [3]. In our authorship-network it specifies the sum of co-authors for all papers that each author has written. Betweenness assesses the degree to which a node lies on the shortest path between two other nodes, and is able to funnel the flow in the network [3]. In the authorship-network the author with high betweenness has a large influence on the transfer of information.

### 4 Results

Figure 1 demonstrates a general view of the network. In this view each author has at least one co-author. This network contains 31 components. From the network illustrated in this figure we selected the largest component that is represented in Figure 2. 68 authors (31% of all authors) are in this component.

<sup>2</sup> A program for analysis and visualization of very large networks(<http://mrvar.fdv.uni-lj.si/pajek/>)



**Fig. 1.** The whole network of authors in the NKOS community

To show the quantity of collaboration in the community we measured the degree centrality for each author. Figure 3 shows the percentage of authors with different degrees. In this Figure we see that 15% (with degree=0) of authors had no co-authorship with others and 53% of them had just a maximum of 6 cooperations with other authors. 32% had at least 8 co-authors for all their papers.

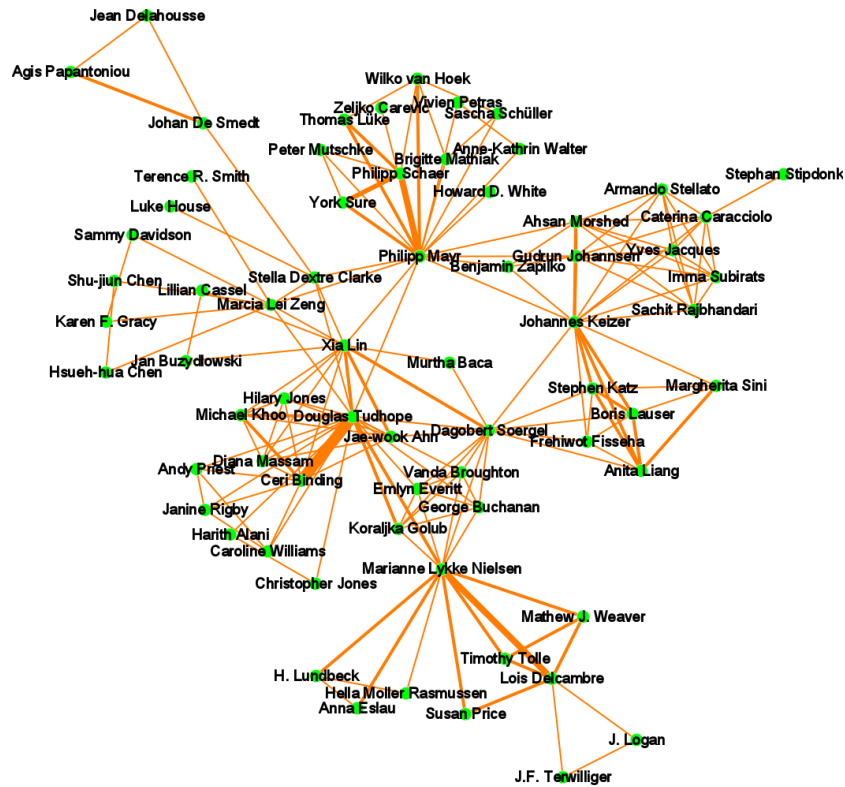


Fig. 2. Largest component in the NKOS authorship-network

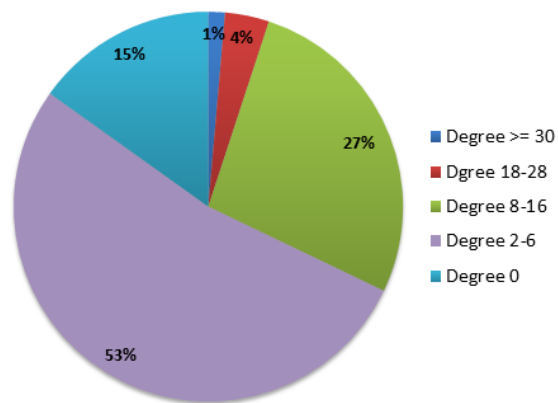
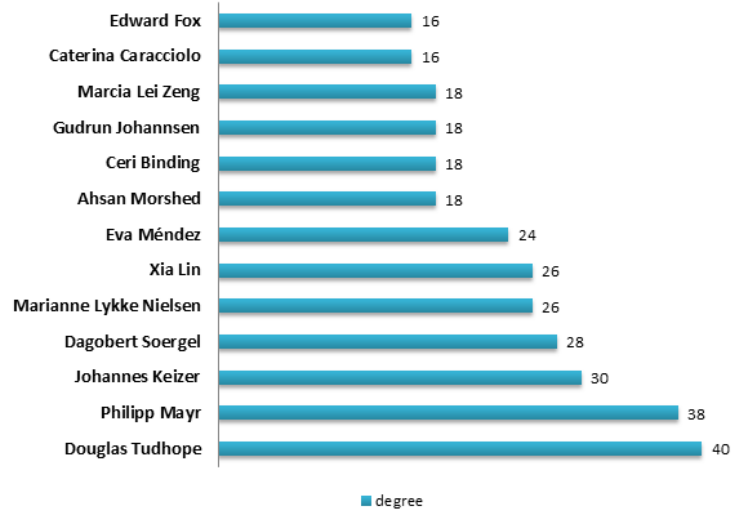


Fig. 3. Distribution of degree numbers of authors in the network

Figure 4 shows the authors with most degree (more than 16) in the network.



**Fig. 4.** Authors with degree more than 16

To detect the influence of authors on information exchange we calculated the betweenness centrality of authors. Figure 5 shows the authors with the highest betweenness (more than 0.001).

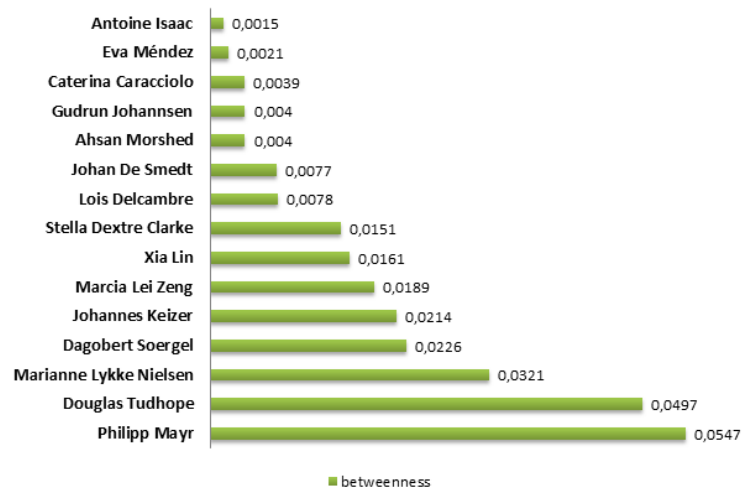
To detect the influence of authors on information exchange we calculated the betweenness centrality of authors. Figure 5 indicates the authors with most betweenness (more than 0.001). comparing betweenness with degree we can see, the ranking of authors has changed in betweenness. Some authors despite their high cooperation with other authors, have lower ranking in betweenness comparison to others with lower degree.

## 5 Conclusion

In this paper we analyzed the collaborative working of authors and their connectivity to each other. It showed us that

## 6 Acknowledgment

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**Fig. 5.** Authors with betweenness more than 0.001 in the community of NKOS workshops

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