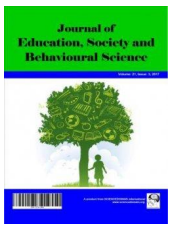

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Ethical Considerations and Design of Metric to Identify Key Opinion Leaders in Research

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Author's contribution

The sole author designed, analysed, interpreted and prepared the manuscript.

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ABSTRACT

This paper developed a new scheme to identify Key Opinion Leaders in research, based on design of methodology and approaches that are ethical and scientifically sound. Expositions were made to elucidate on ethical issues relevant in the design of appropriate approaches for identifying Key Opinion Leaders in research. The developed methodology is a rational approach for evaluating Average Percentile Rank of individual researcher by measuring their collaborative strength through their published works. The study considered and introduced new parameters useful in measuring collaboration, and Average Percentile Rank. With these parameters, a new relationship to quantify Percentile Rank was introduced and applied to evaluate the Research Key Opinion Leader status of individual research staffs of INGENIO, the joint research institute of the Spanish National Research Council (CSIC) and the Polytechnic University of Valencia (UPV), Spain. The total number of research staff at INGENIO was studied. Overall, the result shows that, number of persons

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collaborating in a particular research, and the relative positions of the collaborators among their peers and within their organization are relevant and important in determining the KOL status of a researcher.

Keywords: Co-authorship; social development; research collaboration; psychological processes; key opinion leader.

1. INTRODUCTION

Becoming great and successful organization requires great leaders, and the best organizations understand that deliberately cultivating leaders for the organization is pivotal in this important endeavour [1,2]. Specifically, the role and competence of leadership in creating effective working environment and in motivating their team have been identified to be very important to the performance of an organization [3]. One of the ways to remain innovative and successful in present day highly competitive and regulated work-life is connection to expertise from individuals commonly referred to as Key Opinion Leaders (KOLs) [4-6]. Connections to expertise from KOLs can be through knowledge sharing which engenders learning as suggested by Abdollahzade & Jafari, [7] and the theory of social development - social interaction and More Knowledgeable Other (MKO) of Vygotsky, [8]. The work of Abdollahzade & Jafari, [7] showed that majority (about 90%) of learners learn by the philanthropic-active approach, where learning ensues through knowledge sharing with others, help from peers, experimental learning and learning through participation in teams [7,9]. While the role of leadership competences has been reported to be important to improved team performance [10], however, the method used in the work of Ammeter & Dukerich, [3] cannot resolve the usefulness of team building in project performance. Other works have shown that team building/collaboration, and team cohesion can enhance performance [11,12]. Rising stars are emerging KOLs that outshine their peers in many ways, showing great potential for the future [6,13]. One of the key issues in organizations is sustainability of organizational performance [14]. Therefore, one of the key management strategies to ensure organization success at present, and in the future is identification of KOLs and rising stars in the fields relevant to the business of the organization [15,16]. It is important to note that the complexities of human resources management calls for scientific management which is the focused and more organized form of management. In scientific management, considerable care is given, so that design of methodology and approaches adopted are ethical and scientifically sound.

2. ETHICAL ISSUES IN COLLABORATION METRICS

Cronin, (1984) described science as a large social system where there is norms and values which guide and constrain the actions of individual scientists. It was identified that the image of science as a selfless and dispassionate search after truth; a search in which the individual scientist subjugates personal gain and vanity to the greater communal good; does not generally hold when examined in the light of sociological investigation which provided a 'relativist' account of science derived from observed behaviours [17]. The science social system is the principal mechanism to disseminate knowledge; ensure the preservation of standards; and to distribute rewards. In academics, performances in research have been used as indicators of academic rising stars. Cronin, [17] identified rewards to be distribution of credits and recognition through citation system in the primary scientific communication system. Also, Zhang et al., [13] studied and reported on how to identify academic rising stars. Specifically, the work of Zhang et al. [13] dwelled on how to effectively predict the top k% researchers who achieve the highest citation. While Zhang et al. [13] have reported that the methodology for their study is robust and outperforms all given benchmark methods, with over 8% average improvement, however, the weakness of this method is that it relies solely on citation impact. However, other indices are now being used and developed. There are other methods that have equally been adjudged as adequate and useful for the purpose of identifying KOLs and emerging KOLs. The other prominent methods of evaluating individual researchers include: g-Index [18]; h-Index [19]; i10 – Index [20]; Research Leadership Index and Collaborative Strength [21,22]. Particularly, measuring collaboration is now considered an indicator of research performance. Many studies

have been carried out to evaluate one or other aspects of research collaboration [23-26]. As a result, many services aimed at quantification of extent of collaboration are now available. These include: Article Count (AC), Fractional Count (FC); and Weighted Fractional Count (WFC) which have been used to identify the rising stars performers in the research world [27-30]. The flaw here is that, for AC, a publication is given a score of 1 unit irrespective of the number of authors listed on the publications. This implies that, if the number of authors listed is n, then reward attribution to each author is given as:

$$\textit{Reward (R)} = \frac{1}{n} \quad (1)$$

The argument is that, if the number of authors listed does not affect the score attributed to a publication, then, of what value is collaboration? The proper conceptual thought line should be that quality of publication improves with the number of listed authors; this because the input of every contributing author should add to the quality of the publication. The soundness of this thought line is by its agreement with the core principles of ethics, the principle of non-maleficence, which implies that it is wrong to waste resources that could be used for good. Where an author has not added to the quality of a publication, then what is he/her contribution to justify being listed? The thought is equally in line with the ethical principle of justice. There should be obligation to provide others with whatever they are owed or deserve. The obligation to treat all people equally, fairly and impartially. The system will be fair and just only if listed authors have been attributed with rewards equivalent to the input they offered. Definitely, the output is bound to be of higher quality where there are more quality inputs. It is a widely known adage that two heads are better than one. This adage is widespread, cross-cultural, and equally supported by the Holy Bible (Ecclesiastes 4: 9-12). The Bible verse actually indicated that there will be good returns for labour where two or more people are involved as compared to situations involving fewer persons. If every publication is given a score of 1 unit irrespective of the number of authors listed, then reward attribution to each author will diminish as the number of listed authors increases. The limiting value of reward *(R)* as value of *n* increases will then be zero, which is not a good reward. The Bible suggested that reward of collaborative work will be good.

i.e.

$$\lim_{n\to\infty}(\text{Re}\,ward) = \lim_{n\to\infty}(R) = \lim_{n\to\infty}\left(\frac{1}{n}\right) = 0 \quad (2)$$

As regards FC, all contributing authors are attributed with a uniform count, which is determined by diving 1 unit with the number of contributing author. For instance, where a publication has 10 authors [28,29], then it means that each author receives an FC of 0.1. This idea is equally flawed, because it is a fact, generally known in scientific publishing that the order of author listing is indicative of the extent of contribution/influence of the authors as per the published research. If order of author listing is irrelevant, author listing would rather follow an alphabetic order, which is not the case in real time publishing. Since author list order has indicated the order of importance of contributions of listed authors, the ethical approach to quantification is to respect the autonomy of the authors as expressed in the author list. It is important to respect the decisions made by these authors concerning their own endeavours. Weighted Fractional Count (WFC) is a normalize-tion of overrepresentation of paper, and it applies to the field of Astronomy [28,29].

The Weighted Fractional Count (WFC) of Nature Index is widely applied, and can be used Although, the Nature Collaboration metric is already in use to evaluate scientific collaboration worldwide, however, the methodology of this metric is significantly flawed. It does not take cognizant of the total number of collaborators and the order of collaborator per publication. It is a fact, generally known in scientific publishing that the order of author listing is indicative of the extent of contribution/influence of the authors as per the published research.

In this present study, a measure of collaborative strength, used to determine percentile position ranking of scientists at INGENIO, the joint research institute of the Spanish National Research Council (CSIC) and UPV - the Polytechnic University of Valencia is presented. The approach in the new scheme introduces a new feature which considers the position of scientists in the author list of their published works. The author order list actually expresses the order of the worth of opinions of these authors in the specific publication, to whoever decides the order of the author list. Worth of opinions can also be influenced by power play. Author positioning just means one author displaces the other to get a position. An author

who is not satisfied with his positioning moves away. With this perspective, the study is original, and has great potentials. Herein, the rationale for the study is identified.

3. METHODOLOGY

The co-authorship pattern of research staff at the INGENIO, Valencia in Spain was studied by measuring the collaborative strength of individual researcher at the institute. To determine the collaborative strength of individual researcher, the co-authorship of each publication as recorded against the researcher at the website of the following link: http://www.ingenio.upv.es/en/researchers#.WIXwZBJYvMw was obtained. The information used was as obtained at this link as at 23rd January, 2017. A simple count of the total number of authors listed on a particular publication was made, and recorded as *n*; the position of the researcher in the author list is recorded in ascending order as *r*; starting with the first author listed. A record of distribution of *n* and *r* was obtained for all the research staff of INGENIO who had publication records. The collaborative strength of individual researchers was determined using the relationship expressed as follows:

$$C_S = \sqrt[4]{\sum_{i=1}^{P}(n_i - r_i + 1)} \quad (3)$$

Where C_S is the collaborative strength, P is the total number of publications of the scientist and i is indicative of a particular publication of a scientist. The mean of the number of persons collaborating per paper (n_{mean}) and mean of the positions of a specific research staff (r_{mean}) were calculated using the following expressions

$$n_{mean} = \frac{\sum_{i=1}^{P} n_i}{P} \quad (4)$$

$$r_{mean} = \frac{\sum_{i=1}^{P} r_i}{P} \quad (5)$$

The percentile ranks of each researcher were also evaluated. The percentile ranks for each researcher within the organization (P_{Org}); and among research peers were determined (P_{Peer}). A schematic representation of P_{Org} and P_{Peer} is presented in Fig. 1. P_{Org} is indicative of the rank of the researcher as measured by the collaborative strength relative to collaborative strength of other researchers within the organization. P_{Peer} indicates the rank of the researcher relative to other researchers with which s/he has worked/collaborated. This includes all research peers within and outside the organization. The position of the researcher in the author list is indicative of the weight of the opinions of the researcher in the published work.

The overall average percentile ($P_{Avg.}$) ranks was also determined. $P_{Org.}$ was determined by finding the relative position of the researcher when the measured collaborative strength of all researchers in the organization was ordered in ascending order, i.e. from weakest collaborative strength to the strongest collaborative strength. P_{Peer} was determined as a function of the mean of the number of persons collaborating per paper (n_{mean}) and mean of the positions of a specific research staff (r_{mean}). The functional relationship used to determine P_{Peer} is expressed in equation (6) while equation (7) was used to determine as follows:

$$P_{Peer} = \frac{n_{mean} + 1 - r_{mean}}{n_{mean}} \quad (6)$$

$$P_{Avg} = \sqrt{P_{Org}.P_{Peer}} \quad (7)$$

The product of P_{Org} and P_{Peer}, as illustrated in Fig. 1, indicates area of influence of opinion of researchers. It corresponds to area of rectangle with breath and length equal to P_{Org} and P_{Peer} respectively.

The adoption of co-authorship for measuring collaboration was informed from the premise laid by Katz & Martin [25], which was similarly adopted by Bozeman et al. [23]; Gal et al. [24] and Voutilainen & Kangasniemi, [26]. Count of number of listed authors and total number of publications have also been used in Nature Index [27,30]. Zhang et al. [13] equally indicated that percentile is a useful guidance to identify academic rising stars in the research community.

4. RESULTS AND DISCUSSION

Information on the full names of the researchers at INGENIO, the initials corresponding to the full name of each researcher, the total number of publications of each researcher, the n_{mean}, r_{mean},

the collaborative strength (C_S) of each INGENIO researcher, the P_{Org}, P_{Peer}, and P_{Avg} is presented in Table 1. Figs. 2 and 3 show the distributions of *n* and *r* respectively. They inform that INGENIO researchers collaborate mostly in groups ranging from 1 to about 5 persons in a group; and these researchers are mostly listed between the first and fourth authors.

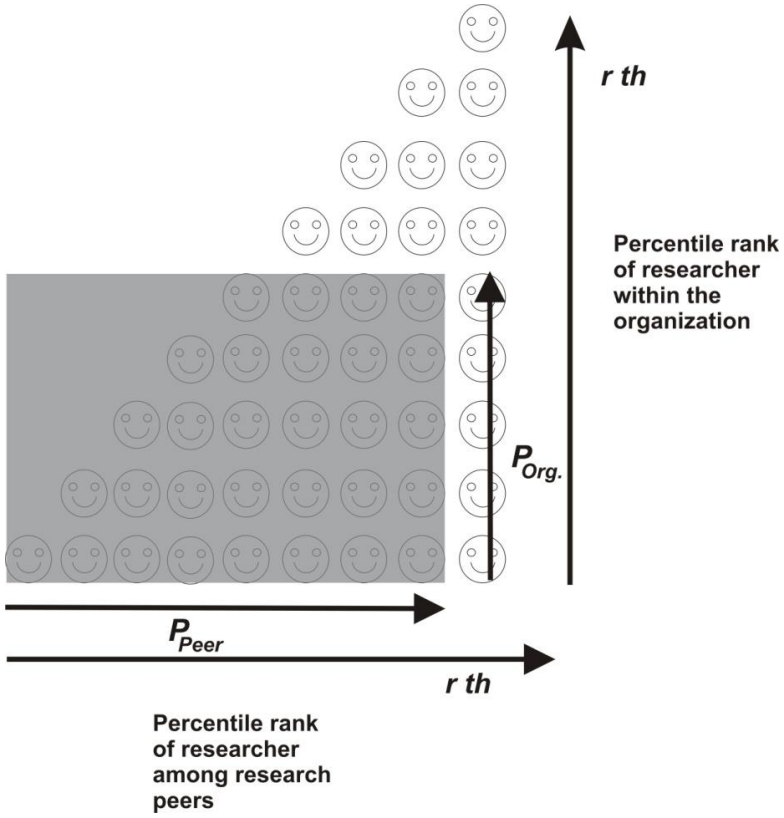

Fig. 1. A schematic representation of relative positions of researchers within organization and among peers

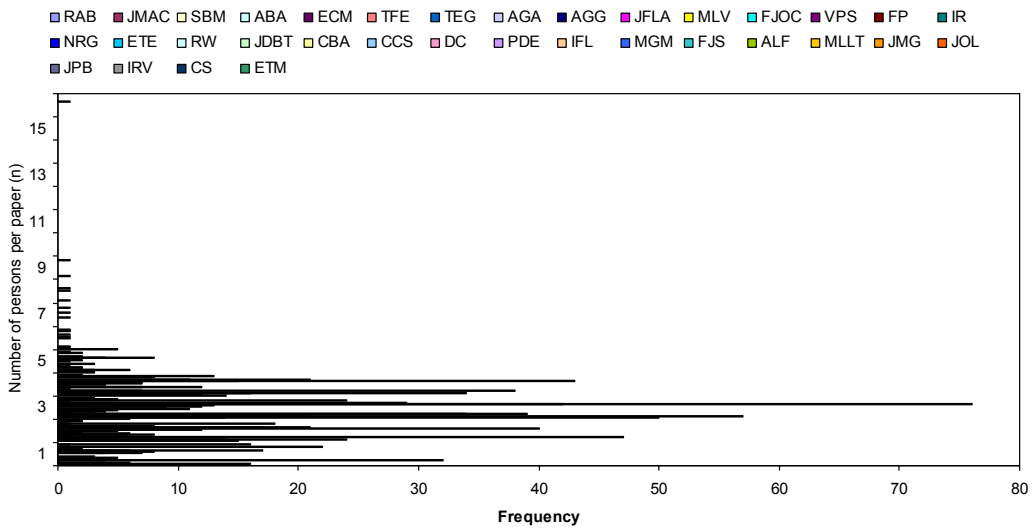

Fig. 2. Frequency distribution of n for the study

Table 1. Full names of CSIC-UPV (INGENIO) scientists investigated

S/N	Names	Initials	Number of papers	n_{mean}	r_{mean}	C_s	P_{org}	P_{peers}	P_{Avg}
1.	Rafael Aleixandre Benarent	RAB	28	4.25	2.79	2.88	65th	58th	61st
2.	Joaquin Maria Azagra Caro	JMAC	96	2.70	1.28	3.90	94th	90th	92nd
3.	Sergio Belda Miquel	SBM	28	3.18	1.39	2.93	68th	88th	77th
4.	Alejandra Boni Aristizabal	ABA	60	3.13	1.82	3.43	82nd	74th	78th
5.	Elena Castro Martinez	ECM	129	3.15	2.06	4.09	97th	66th	80th
6.	Teresa de la Fuente Espinosa	TFE	1	4.00	3.00	1.19	6th	50th	17th
7.	Teresa Escrich Gallardo	TEG	6	2.17	1.33	1.82	29th	85th	50th
8.	Adela Garcia Aracil	AGA	122	2.18	1.41	3.82	91st	81st	86th
9.	Antonio Gutierrez Gracia	AGG	82	3.48	2.63	3.51	85th	53rd	67th
10.	J. Felix Lozano Aguilar	JFLA	9	2.22	1.56	1.97	32nd	75th	49th
11.	Monique Leivas Vargas	MLV	2	4.5	2.5	1.57	15th	67th	32nd
12.	Francisca Javier Ortega Colomer	FJOC	16	1.88	1.50	2.19	38th	73rd	53rd
13.	Victoria Pellicer Sifres	VPS	5	2.80	2.00	1.73	26th	64th	41st
14.	Francois Perruchas	FP	9	3.78	2.44	2.14	35th	62nd	47th
15.	Ismael Rafols	IR	30	3.33	2.23	2.82	62nd	63rd	62nd
16.	Nicolas Robinson-Garcia	NRG	4	2.75	1.75	1.68	18th	73rd	36th
17.	Enrique Tortajada Esparza	ETE	14	2.93	1.86	2.32	47th	71st	58th
18.	Richard Woolley	RW	20	3.20	2.50	2.41	50th	53rd	51st
19.	Jose David Barbera Tomas	JDBT	39	2.64	1.41	3.04	71st	84th	77th
20.	Carlos Benito Amat	CBA	15	2.53	2.00	2.19	41st	60th	50th
21.	Carolina Canibano Sanchez	CCS	17	2.59	1.47	2.45	53rd	82nd	66th
22.	Davide Consoli	DC	70	2.39	1.69	3.30	74th	71st	72nd
23.	Pablo D'Este	PDE	86	2.97	1.74	3.79	88th	75th	81st
24.	Ignacio Fernandez de Lucio	IFL	166	3.04	2.19	4.19	100th	61st	78th
25.	Monica Garcia Melon	MGM	19	3.74	1.95	2.70	59th	75th	67th
26.	Fernando Jimenez Sacz	FJS	62	3.21	2.29	3.30	76th	60th	68th
27.	Aurora Lopeh Fouges	ALF	2	2.00	1.5	1.32	9th	75th	26th
28.	Maria Luz Lopez Terrada	MLLT	1	2.00	2.00	1.00	3rd	50th	12th
29.	Jordi Molas Gallart	JMG	75	2.45	1.68	3.40	79th	72nd	75th
30.	Julia Osca Lluch	JOL	4	3.00	2.00	1.68	21st	67th	38th
31.	Jordi is Blanes	JPB	21	3.95	2.62	2.65	56th	59th	57th
32.	Irene Ramos- Vielba	IRV	3	3.67	1.67	1.73	24th	82nd	44th
33.	Carolin Schmitz	CS	2	1.50	1.00	1.32	12th	100th	35th
34.	Enrique Tortosa Martorell	ETM	24	1.79	1.75	2.24	44th	58th	51st

Figs. 4 to 10; in respective order, present information on distributions of C_S, n_{mean}, r_{mean}, total number of publication per researcher, P_{Org}, P_{Peer}, and P_{Avg}. From these Figures, Ignacio Fernandez de Lucio has the highest collaborative strength. He has a total of 166 publications. This means he has been able to utilize about 166 collaborative opportunities. His average collaborations per publication (n_{mean}) and average position rank (r_{mean}) are 3.04 and 2.19 respectively. This implies that ordinarily, Ignacio Fernandez de Lucio collaborates with about three persons per publication and is mostly either the first or the second author listed. It can be surmised that average collaborations per publication (n_{mean}) and average position rank (r_{mean}) are respectively indicative of team building and leadership competences of an author, thus indicating that team building and leadership competences leads to improved performance as

identified in other body of knowledge by Albahali & Omran, [10], Rosenfield & Richman, [11] and Widmeyer & Ducharme, [12]. Although in Figures 5 and 6, Monique Leivas Vargas has the highest average collaborations per publication while Carolin Schmitz has the strongest position rank, however, the total number of publications by these staffs is rather very small, and the reason for their observed weak collaborative strength.

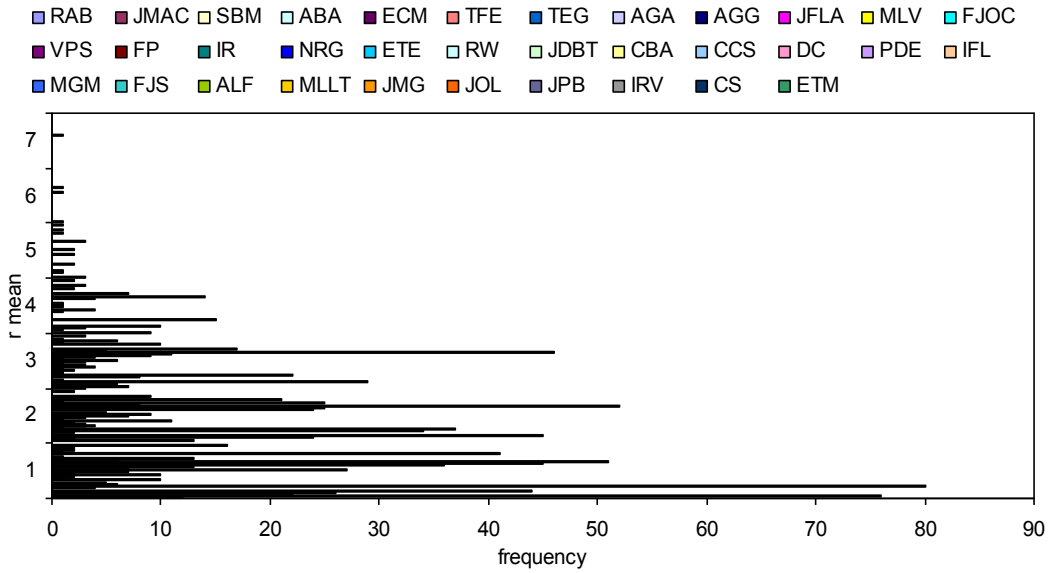

Fig. 3. Frequency distribution of r for the study

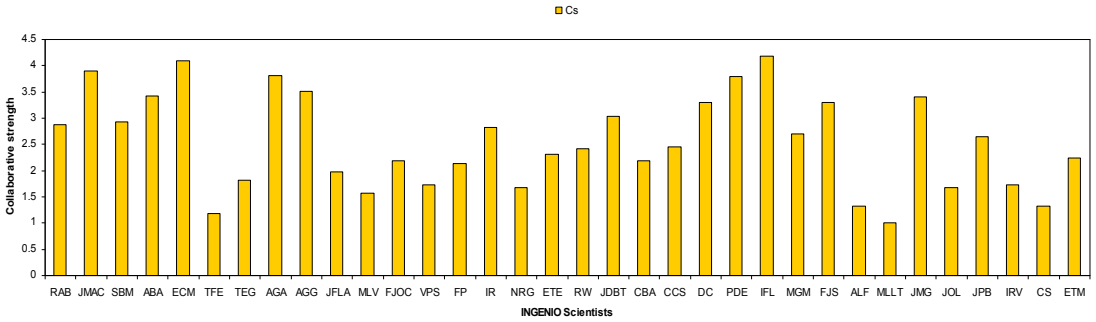

Fig. 4. Distribution of collaborative strength

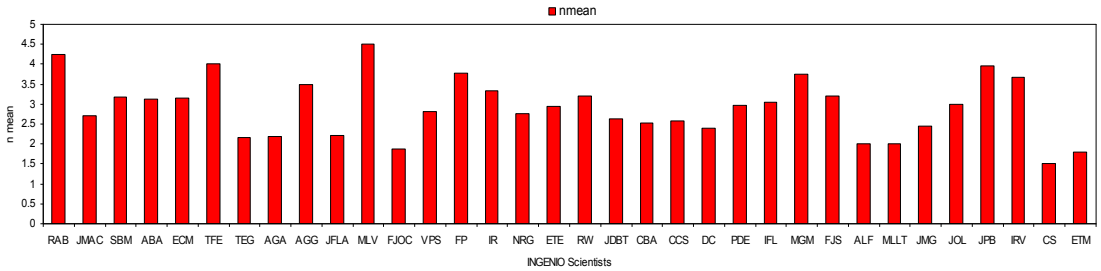

Fig. 5. Distribution of average collaborations

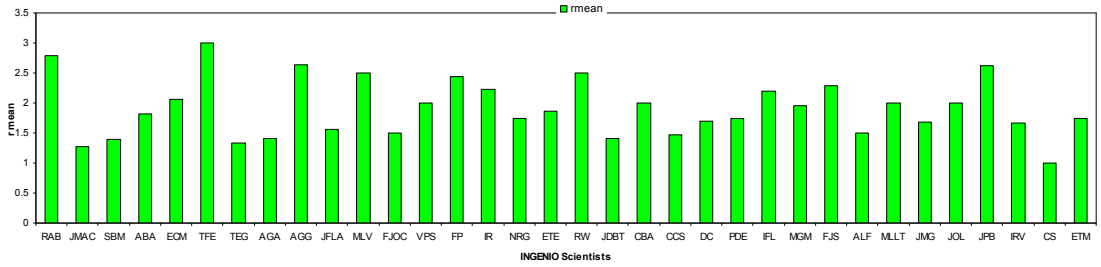

Fig. 6. Distributions of average position rank

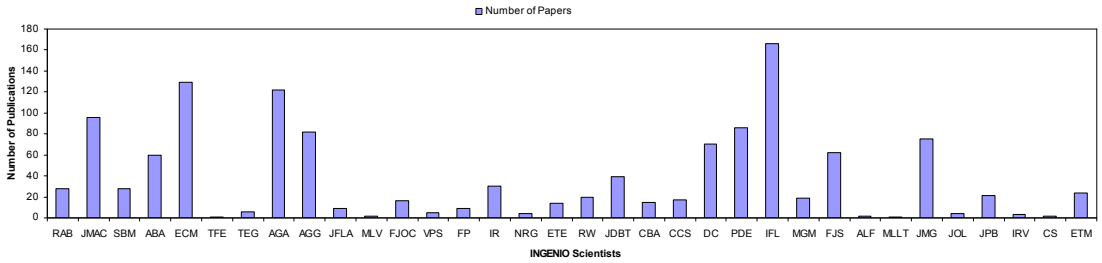

Fig. 7. Distributions of total number of publications

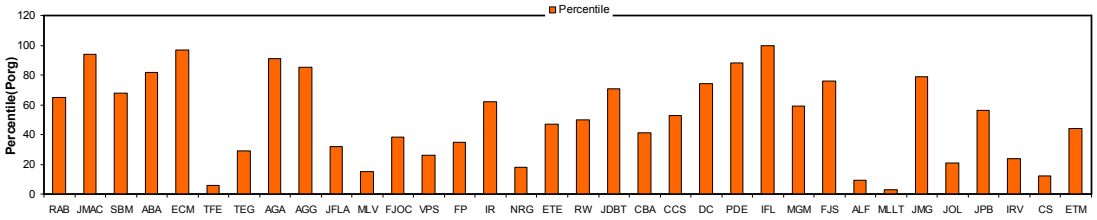

Fig 8. Distributions of P_{Org}

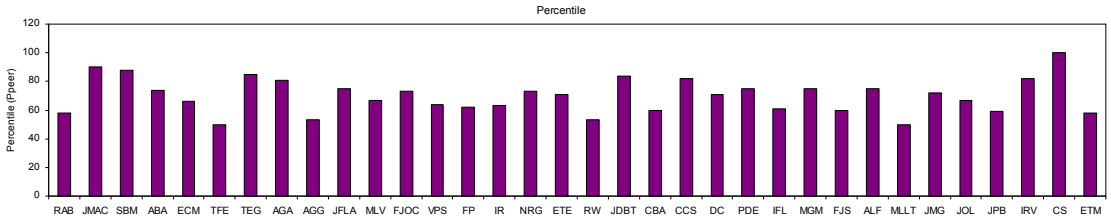

Fig. 9. Distribution of P_{Peers}

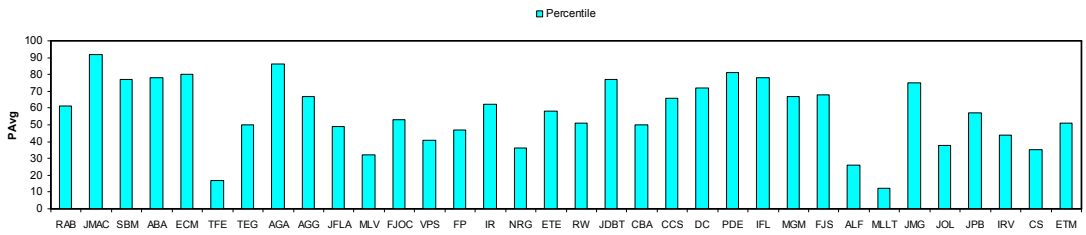

Fig. 10. Distribution of P_{Avg}

Considering Davide Consoli and Fernando Jimenez Sacz, these two staffs have the same collaborative strength despite that Davide Consoli has published 70 papers which is more than the total of 60 papers published by Fernando Jimenez Sacz. Ordinarily, Sacz collaborates mostly with about 3 persons per publication while Consoli collaborates mostly with 2 persons. The two staffs are mostly listed as the second author in their collaborative groups.

In Figs. 8 and 9, Ignacio Fernandez de Lucio has the highest Organization Percentile Rank (P_{Org}) of 100th Percentile, while Carolin Schmitz has the highest Peer Percentile Rank (P_{Peer}) of 100th Percentile.

Overall, Joaquin Maria Azagra Caro has the highest Average Percentile Rank (P_{Avg}) of 92nd Percentile. Going by the study of Ready et al.,[16] reported in the June issue of Harvard Business Review, that research has shown that companies tend to think of the top 3 to 5% of their talents as the KOLs, this implies that there are NO research Key Opinion Leaders at INGENIO. Joaquin Maria Azagra Caro is only very close to being a KOL. However, if the definition of KOL permits the top 10 to 20%, then Joaquin Maria Azagra Caro will be the most authoritative KOL at INGENIO, followed by Adela Garcia Aracil (P_{Avg} = 86th), Pablo D'Este (P_{Avg} = 81st) and Elena Castro Martinez (P_{Avg} = 80th).

5. CONCLUSION

A new scheme to identify research Key Opinion Leaders through evaluating research collaborations in published works has been introduced. The new scheme shows that the Key Opinion Leadership status of a researcher is directly related to the number of collaborators per publication, the relative position of the researcher in the author list, and the total number of publication of the researcher. The significance of total number of collaborations publications on the measure of collaboration as reported in earlier studies is upheld by the study. The role of number of persons collaborating in a particular research, and the relative positions of the collaborators among their peers and within their organization are also confirmed relevant and important in determining the KOL status of a researcher.

COMPETING INTERESTS

Author has declared that no competing interests exist.

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