Scientometric Analysis of Total Quality Management Output: A Global Perspective

Mahadeva M
Research Scholar
Dept of Library and Information Science
VTU, RRC Belagavi
e-mail: mahadev2005@gmail.com

Dr. Anitha S Rai
Head, Library and Information Centre
New Horizon College of Engineering,
Bangalore, India
e-mail: anithasrai@gmail.com

Praveen B Hulloli
Librarian
Maratha Mandal Engineering College Belagavi
Karnataka, India
e-mail: praveenbhulloli@yahoo.com

Abstract - *Contributed from the Web of Science database during the study period of 2009-2018with a total number of 52,190 publications with 8,15,986 citations. This study aims to analyze Scientometric tools such as Growth of publication, percentage analysis, relative growth rate and doubling time, and country wise contribution. During the study period maximum of 6,399 (12.27%) research publications are contributed to the year 2018 and 2009 to 2018 citations slowly decreasing with CAGR -1726. The relative growth rate is identified decreasing trend and doubling time is increasing trend from 2009 to 2018. Top ten ranking of USA is the most contributing top-ranking articles with 6411 (0.79%) in the year 2009 on TQM research articles. Even through USA is the pot positioning to produce research articles in TQM area. Hardly Indian institutions are not listed among the productive institutions*
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Keywords: Scientometric, Web of Science (WoS), Total Quality Management (TQM), Countries, high cited, citation, growth rate and doubling time.

Introduction

The concept of TQM came into practice in the late 1980's as an American version of Kaizen philosophy (5S keys) developed during1945 (Samuel, K.H. 1995). It is a journey not a destination and covers every activity of an organization. (Batra, 1994-95). TQM is free from any cultural biases and can be applied anywhere to all types of organizations which remain ahead of their customers (Jurow, 1993). It evolved from inspection to a broad, holistic, strategic, and customer-oriented management framework (Johannson, 1995). TQM is targeted at satisfying the consumer needs on a continuous basis (quality, very first time, each time, all of the time) by involving everybody in the ca, and also at a lower price. Along with the objective of continuous improvement, TQM has the three following principles:

- "Customer driven instead of generator driven.
- Focus on processes rather than be preoccupied with results.
- Total involvement of staff (Chakraborty,1996)".

The exponential growth of fast development and literature of libraries created a number of evolutionary studies about the effectiveness as well as the effectiveness of info services. These experiments led to the identification as well as the region of proper quantitative measuring methods referred to as Scientometrics. Libraries, as well as info experts around the world, started using Scientometrics studies to throw light on the pattern of growth of quality, obsolescence studies, collaborative investigation, a rank of journals, the interrelationship among various branches of expertise, influence and efficiency of authors, the pattern of compilation build-up, the use etc of theirs.

Scientometrics and total quality management

TQM is an emerging discipline and has been widely used both in engineering and management field currently. The existing database has seen a lot of articles in TQM discipline in the over the years. The researcher would like to understand the prevailing trend in TQM with using Scientometrics.

Methodology

TQM research publications are identified and extracted by using Bibliographic tool from the Web of Science multidisciplinary online database during 2009-2018 total ten years and classifying Microsoft Excel. Further some statistical tools and indicators such as top ten ranking publications of high cited articles, percentage analysis, growth of literature, country wise publication frequency distribution and Bibliometric techniques such as Relative Growth Rate and Doubling Time were used to analyse for this study.

Objectives

1. To find out the year-wise growth of TQM research publications
2. To analysis relative growth rate and doubling time
3. To find out country wise growth
4. To find out high cited articles of TQM

Review of literature

Simran Gupta and Nabi Hasan (2018) in their review, it can be noticed that the overseas contribution in Indian log is considerably less. This identifies that there's an immediate need to attract researchers of the different nations to have a major presence in Indian journals also. It's very apparent that technological infrastructure and research money are actually crucial prerequisites to get over the issue. **Alexander Serenko et al.(2013)** Most of the scientific work on knowledge management / IC published in high-level peer-reviewed journals is focused on a number of other academics. Their journal articles are written in a specific scientific language and organized in a way that is not easily comprehended by people without innovative master's training. As the proportion of research-based practitioners continues to decline, so does the number of non-academic readers. **Vivekanandhan, S., & Sivasamy, K. (2017)** Revealed in their study using Scopus databases form 2009- 2018 The relative growth rate is found that, maximum of 0.696 in the year 2010 and minimum of 0.11 in the year 2018 and it is identified a decreasing trend. At the same time doubling time values are 1.00 in the year 2010 and 6.23 in the year 2018 and it is identified an increasing trend.

Results and Discussion

Year-wise growth articles and Citations development on TQM

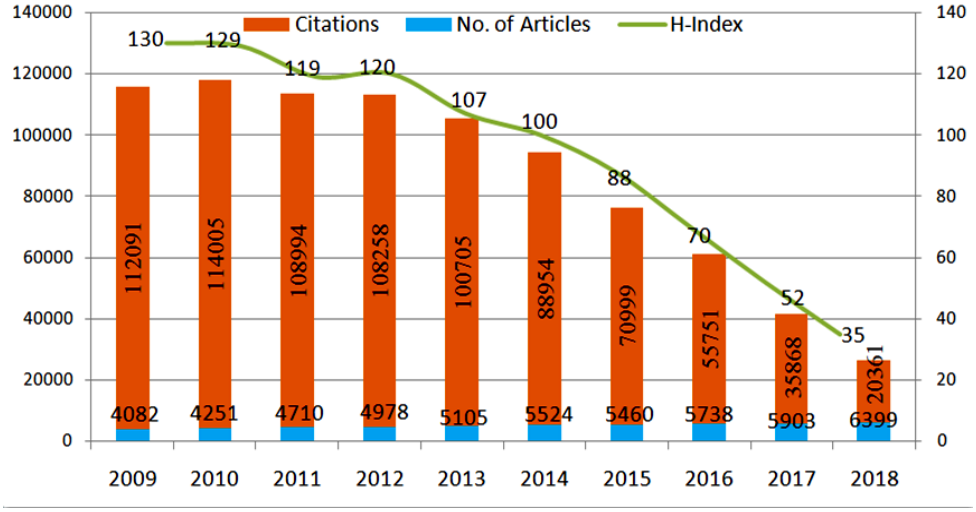
Table-1 shows that, the year-wise growth of TQM research publications is contributed in the WOS database for the selected ten years study period from 2009 to 2018.

Table-1: Year-wise Distribution of Articles and Citations

Year	No. of Articles	%	Citations	%	H-Index
2009	4082	7.83	112091	13.74	130
2010	4251	8.15	114005	13.97	129
2011	4710	9.03	108994	13.36	119
2012	4978	9.55	108258	13.27	120
2013	5105	9.79	100705	12.34	107
2014	5524	10.59	88954	10.90	100
2015	5460	10.47	70999	8.70	88
2016	5738	11.00	55751	6.83	70
2017	5903	11.32	35868	4.40	52
2018	6399	12.27	20361	2.50	35
Total	**52150**		**815986**		**193**
CAGR	**5.12**	**5.12**	**-17.26**	**-17.26**	

During the study period, it is identified that 52150 research publications are contributed to TQM research. Out of that, a maximum of 6399(12.27%) with 20361 (2.50%) citations research publications are contributed in the year 2018. Followed by 5903(11.32%) with 35868 (4.40%) research publications in the year 2017, 5738(11.00%) publications in the year 2016. Minimum of 4082(7.83%) research publications are contributed in the years 2009. Observing that in the year 2009 very low paper published overly ten years but highly cited with 130 h-index. Show figure-1 noticed that 2009 to 2018 citations slowly decreasing with CAGR -1726.

Figure-1: Year-wise Distribution of Articles and Citations with h-index



Relative Growth Rate and Doubling Time

The progress of publications was analysed by utilizing Relative Growth Rate and doubling period by the formula of (Mahapatra 1985)11. RGR is actually a measure to learn the expansion in the number of posts at a specific period. It's estimated as.

$$R(a) = \frac{(W2 - W1)}{(T2 - T1)}$$

"R(a) = RGR = the mean relative growth rate over the specific period of interval
W1 = the logarithm of beginning number of publications/pages
W2= the logarithm of ending number of publications/pages after a specific period of interval
T2 – T1 = the unit difference between the beginning time and the ending time".

The relative growth rate (RGR), as well as the doubling time (Dt), had been estimated, and the outcome is proven in table X. Doubling time is directly related to the relative growth rate. It's the time necessary for posts to be double the current selection of records. The corresponding doubling time for every particular time of interval may be estimated by the following formula.

and used by Vivekanandhan S and Sivasamy K (2017)12,

.

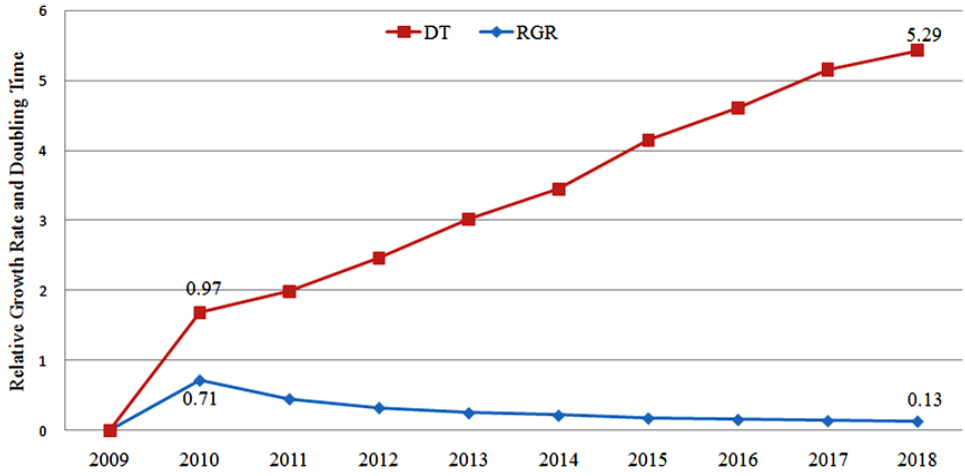
$$Dt = \frac{0.693}{R(a)}$$

Table-2:Relative Growth Rate and Doubling Time in TQM Research

Year	No. of Articles	Cumulative values	RGR	Mean RGR	DT	Mean TD
2009	4082	4082	-		-	
2010	4251	8333	0.71		0.97	
2011	4710	13043	0.45		1.55	
2012	4978	18021	0.32		2.14	
2013	5105	23126	0.25		2.78	
2014	5524	28650	0.21		3.24	
2015	5460	34110	0.17		3.97	
2016	5738	39848	0.16		4.46	
2017	5903	45751	0.14		5.02	
2018	6399	52150	0.13		5.29	
Total	**52150**		**2.55**	**0.28**	**29.42**	**3.27**

Table-2 and figure-2 signifies the chronological distribution of relative growth rate and doubling time in the field of TQM research publications between 2009 and 2018. Doubling time can be calculated directly from the growth rate. The relative growth rate is found that a maximum of0.71 in the year 2010 and a minimum of 0.13 in the year 2018 and it is identified that RGR is a decreasing trend. At the same time doubling time values are 0.97 in the year 2010 and 5.29 in the year 2018 and it is identified that doubling time is increasing trend from 2009 to2018.

Figure-2: Relative Growth Rate and Doubling Time in TQM Research



Top 10 Countries Contributions

Top ten country wise growth of TQM research study publications during the year 2009-to-2018-yen year period.

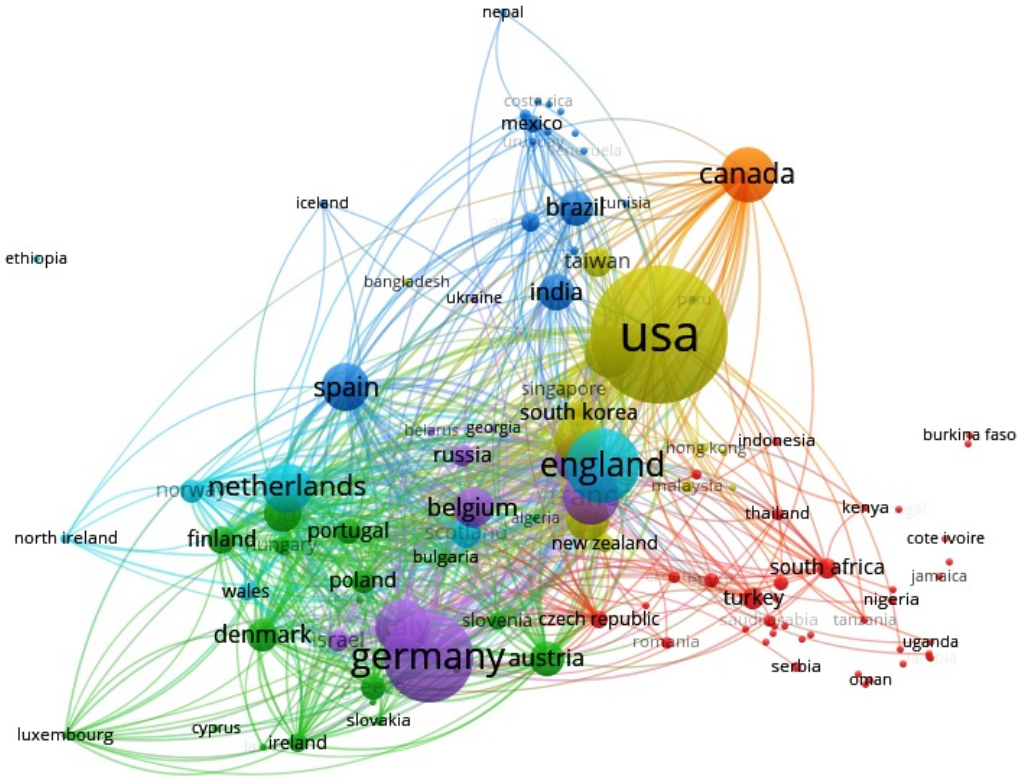
Table-3:Countries Wise Contributing on TQM

Top Countries	TP	TP %	TC	TC %
USA	14978	28.70	183323	22.47
Germany	5534	10.60	94376	11.57
England	4462	8.55	96332	11.81
China	4507	8.64	46346	5.68
Canada	2510	4.81	52745	6.46
Italy	2386	4.57	44473	5.45
France	2312	4.43	44029	5.40
Spain	2047	3.92	37364	4.58
Japan	1912	3.66	35857	4.39
India	1321	2.53	13090	1.60
Other Countries	10221	19.58	168051	20.59
Total	**52190**		**815986**	

TP: Total Papers, TP%: Total Papers Percentage, TC: Total Citations, TC%: Total Citations Percentage.

Table-3 and figure-3 shows that the top ten contributing countries in TQM research publications. From the study it is identified that, USA is most contributing top-ranking countries with14978(28.70%) plus 183323(22.47%) total citations TQM research publications. Followed by Germany with 5534 (10.60%) research publications plus 94376 total citations (11.57%). Third-ranking country is England with 4462 (8.55%) publications plus 96332 total citation (11.81%) and 4th ranking country is the China with 4507(8.64%) research publications plus 46346 total citation (5.68%). This study identified that top four countries are contributed more than (56.49%) of overall publications and it is because research in TQM may scattered among the different authors and Institutions. India is 10thplace of in terms of contributing articles on TQM with 1321 (2.53%) plus 13090 (20.59%)total citation.

Figure-3: Countries Wise Contributing on TQM Network Mapping



Growth of High Cited Articles Publications

Table-4:Top Ten Ranking of Highly Cited Articles and journals on TQM

YR	Authors	Article Title
2009	"Bustin, SA; Benes, V; Garson, JA; Hellemans, J; Huggett, J, et al".	"The MIQE Guidelines: Minimum Information for Publication of Quantitative Real-Time PCR Experiments".
2013	"Quast, C; Pruesse, E; Yilmaz, P; Gerken, J; Schweer, T; Yarza, P,et al".	"The SILVA ribosomal RNA gene database project: improved data processing and web-based tools".
2013	"Goodenough, JB; Park".	"The Li-Ion Rechargeable Battery: A Perspective".
2011	"Mizushima, N; Komatsu"	"Autophagy: Renovation of Cells and Tissues".
2010	"Kroemer, G; Marino, G; Levine, B".	"Autophagy and the Integrated Stress Response".
2011	"Schmieder, R; Edwards, R".	"Quality control and pre-processing of met genomic datasets".
2011	"Hartl, FU; Bracher, A; Hayer-Hartl, M".	"Molecular chaperones in protein folding and proteostasis".
2013	"Vizcaino, JA; Cote, RG; Csordas, A; Dianes, JA; Fabregat, A, et al.".	"The Proteomics Identifications (PRIDE) database and associated tools: status in 2013".
2012	"Youle, RJ; van der Bliek".	"Mitochondrial Fission, Fusion, and Stress".
2012	"Patel, RK; Jain, M".	"NGS QC Toolkit: A Toolkit for Quality Control of Next Generation Sequencing Data".

YR	CY	Journal Name	TC	TC%	NR	NR%
2009	USA	Clinical Chemistry	6411	0.79	87	0.01
2013	Germany	Nucleic acids Research	4085	0.50	23	0.00
2013	USA	Journal of the American Chemical Society	3060	0.38	50	0.00
2011	Japan	Cell	2128	0.26	131	0.01
2010	USA	Molecular Cell	1687	0.21	99	0.01
2011	USA	Bioinformatics	1596	0.20	7	0.00
2011	Germany	Nature	1428	0.18	100	0.01
2013	England	Nucleic acids Research	1269	0.16	53	0.01
2012	USA	Science	1040	0.13	45	0.00
2012	India	PlosOne	1015	0.12	14	0.00

TC: Total Citations, TC%: Total Citations Percentage, NR: Number of References, NR%: Number of References Percentage, YR: Year, CY: Country.

Table 4 shows that, the top ten ranking of highly cited articles is contributed to the Web of Science database for the selected ten years study period from 2009 to 2018. During the study period, it is identified that 24,744 research publications are contributed to TQM research. Out of that, a maximum cited article on TQM of 6,411(0.79) citations with NR 87 research publications are contributed to the year 2009 by "Bustin, SA; Benes, V; Garson, JA; Hellemans, J; Huggett, J, et al." Paper title "The MIQE Guidelines: Minimum Information for Publication of Quantitative Real-Time PCR Experiments" USA. Followed by 4085(0.50%) citations with NR 23 research publications in the year 2013 by "Quast, C; Pruesse, E; Yilmaz, P; Gerken, J; Schweer, T; Yarza, P, et al." Paper title "The SILVA ribosomal RNA gene database project: improved data processing and web-based tools" Germany and third-ranked highly cited by "Good enough, JB; Park, KS" paper title "The Li-Ion Rechargeable Battery: A Perspective" 3,060(0.38%)citations with NR 50publications in the year 2013 aging from the USA. Majority are the from the USA Minimum of 1040 (0.13%) research publications are contributed in the years 2012 by India. Noticed that in the year 2011 authors by "Mizushima, N; Komatsu, M" title "Autophagy: Renovation of Cells and Tissues" paper highly no of reference received 131 overly research study period 2009 to 2018.

Findings

1. During the study period the TQM research publications are contributed to the Web of Science database for the selected ten years study with 52190 research publications and a maximum of 6399 research publications are contributed to the year 2018 (12.27%).
2. The relative growth rate is found that maximum of 0.97 in the year 2010 as shown in the results and minimum of 0.13 in the year 2018 and it is identified a decreasing trend. at the same time doubling time value are 0.97 in the year 2010 and 5.29 in the year 2018 and it is identified as increasing trend.
3. Maximum of 14978 research publications are contributed from USA with top raking publications and maximum of 14978 (28.70) and minimum from the India with 1321 (2.53%).
4. During 2009 USA got highly cited articles with 6411 (0.79) and 1015 (0.12) from India in 2012.

Conclusion

During the ten-year study period, it is identified that Total Quality Management research is increasing and decreasing trend. Worldwide research publications in the field of TQM research shows that USA is most contributing countries. Many of the USA authors and institutions are doing the TQM research effectively and acquire top place in the high cited publications, but India needs to be improved as quality revolution is started later stage as per Web of Science resources. In future the same study will be continued from the different database like Scopus and other database Like EBSCO, Elsevier, and Springer to identify the research trends in the field of TQM research output. The comparison results are very useful to research scholar and scientist to do many more research without bias and enhance the objectivity of the work.

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