

Work-life balance of engineering professionals: A bibliometric analysis

Luciane Silva Franco¹, Claudia Tania Picinin², Luiz Alberto Pilatti³, Antonio Carlos Franco⁴, Sandra Martins Moreira⁵, Fanny Kovaleski⁶, Gustavo Carolino Girardi⁷

^{1,4}Masters student in the Postgraduate Program in Production Engineering – PPGEF, Federal University of Technology, Paraná, UTFPR, Ponta Grossa, Brazil.

^{2,3}Professor at Postgraduate Program in Production Engineering – PPGEF, Federal University of Technology, Paraná, UTFPR, Ponta Grossa, Brazil.

^{5,6,7}Doctoral Student in the Postgraduate Program in Production Engineering – PPGEF, Federal University of Technology, Paraná, UTFPR, Ponta Grossa, Brazil.

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Abstract— The concept of work-life balance refers to achieving a balance between professional and family life through the management, organization and prioritization of family tasks and work routines. This study aims to review the literature on the work-life balance of engineering professionals through a bibliometric analysis, evaluating the evolution of the concept since its inception. The study was based on a bibliometric analysis of 58 articles from the Scopus database, from 2006 to June / 2020. The following bibliometric techniques were used using the VOSviewer software: citation analysis, co-occurrence of authors and keywords. In addition, an analysis of publications by year, countries, institutions and most influential journals is carried out. The results show that this study presented significant managerial and academic contributions. In the managerial factor, it contributes to the fact that intervention policies on the part of the industries are carried out with engineers, in relation to job satisfaction, health and safety, which were the main aspects identified that impact on the work-life balance of engineering professionals. It is also worth mentioning the organizational climate, identified as a factor that impacts the satisfaction and, consequently, the work-life balance of female engineers, who live in a work culture dominated by men. As an academic contribution, it provides comprehensive data from the main authors, journals, institutions and countries that have shaped the literature in this field of research. When analyzing the gradual evolution of the concept over the years, it indicates that the theme has not been exhausted and studies are still needed to continue the research.

Keywords— Work-life balance, balance, work, family, engineering.

I. INTRODUCTION

There are several approaches that define work-life balance. Malone and Issa (2013) state that work-life balance is related to increasing efficiency at work, through time management to achieve a balance between work and family. Soni and Bakhru (2019), complement when conceptualizing that the work-life balance is the state of equivalence perceived and reached in the roles of work and family, in such a way that access to one domain

increases the success of the other. According to Helen et al., (2010), the work-life balance encourages the individual to divide their time based on priorities.

Researchers have attempted to conceptualize work-life balance in the field of engineering professionals in general, through theoretical frameworks (Chan et al., 2020; Sairam and Ramakrishnan, 2020; Ragothaman et al, 2019). In addition, studies link work-life balance with job satisfaction of engineering professionals, through

empirical research. Managers need to seek alternatives to achieve the work-life balance of the engineering collaborators, with the objective of maintaining the well-being of the professionals combined with the productivity of the industry (Chan et al., 2019; Francis and Prosser, 2013).

However, no studies were found in the literature that carried out a bibliometric analysis on the work-life balance of engineering professionals in an attempt to identify the development of this concept over the years. Review studies by authors such as McFedries and Jurgenson (2013) and Pierce (2006), address some ideas about the experiences of professional engineers, assessing workload hours and working time at home and on weekends, which impacts on the time available for family demands.

As such, there is a limitation in studies that assess the difficulties faced by engineers in the work-life balance. There is a research gap that comprehensively assesses the concept from its inception to the present years.

Therefore, our objective in the present study is to review the literature on the work-life balance of engineering professionals, through a bibliometric analysis in an attempt to answer the following research questions:

i) Which the authors, institutions, journals and countries contribute most to the analyzed area of the study?

ii) What are the main aspects that impact the work-life balance of engineering professionals?

This section presented the introduction and objectives of the research. The next section describes the methods used. Following, the results and discussion of the bibliometric analysis are highlighted. Finally, the conclusion is presented with the limitations and suggestions of future studies.

II. METHODOLOGY

This study was based on data from Scopus, a comprehensive database widely used by researchers for bibliometric analysis in various areas. The Scopus database was chosen because it is among the largest bibliographic references in the multidisciplinary field of science. In addition, it is the largest base of abstracts and peer-reviewed articles, with wide coverage of journals classified with a high impact factor (Norris and Oppenheim, 2007). The study used a combination of keywords with truncation symbols and Boolean operators: "work-life balance" AND (engineering OR engineer*).

The study restricted the analysis to only the engineering discipline, giving a specific focus on a single area of investigation. The years of publication identified vary from 2006 to 2020, and the search was carried out in June / 2020. In addition, conference articles and book chapters have been eliminated from the study.

According to the conditions that were mentioned, the research presented a result of 65 articles. However, after reading the titles and abstracts of the articles, some were not suitable for the purpose of the research. For example, in the study by Kaur et al., (2018) entitled "*Work-life balance of women working in education*", the object of study refers to the work-life balance, however, the research public and the journal are not in the engineering area. A total of seven examples not suitable for the study were eliminated. Finally, after a rigorous selection and complete reading methodology, 58 articles were selected to investigate the research question.

To perform bibliometric analysis techniques, such as citation analysis and co-occurrence of key words and authors, we used the VOSviewer software. After extracting the files, this software creates visual maps for analyzing data from bibliographic references, being easy to interpret (Van Eck and Waltman, 2009).

III. RESULTS AND DISCUSSION

This section presents the following results: most cited documents; publications by year, countries, journals and most influential authors, as well as analysis by keywords. We performed an analysis of the general data. The results show a total of 58 articles written by 147 authors and co-authors from 96 institutions, with publications in 38 journals and a total of 1581 references cited (Table 1).

Table 1. General survey data

Criterion	Quantity
Article	58
Authors	147
Institutions	96
Journals	38
References cited	1581

These data highlight a general analysis of all the articles reviewed in the research on the work-life balance of engineering professionals. The revised publications were analyzed according to the year of publication and an interesting evolution can be seen (Figure 1).

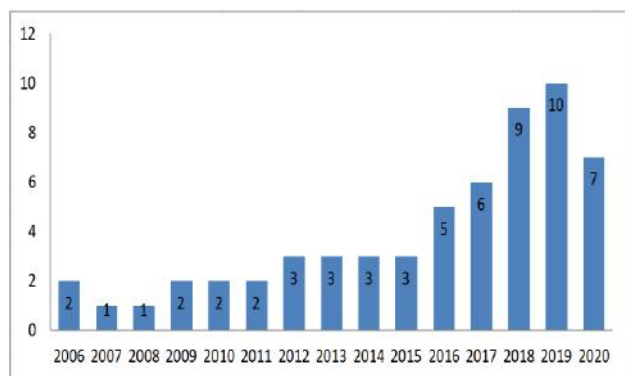


Fig 1. Number of publications per year

From 2006 to 2015, there is a variation between one and three publications. From 2016 to 2019 there is a gradual growth in publications. As the analysis was carried out in June, it is assumed that the year 2020 would register more publications when compared to the previous year.

Articles that obtained their studies with more than ten referenced citations were selected (Table 2).

Table 2. List of main articles according to number of citations

Rank	Article	Citations
1	The extent of regulatory consensus on health and safety expenditure part 1: Development of the J-value technique and evaluation of regulators' recommendations (Thomas et al., 2006).	48
2	The rhythms of project life: A longitudinal analysis of work hours and work-life experiences in construction (Helen et al., 2010).	38
3	On modeling telecommuting behavior: Option, choice, and frequency (Singh et al., 2013).	25
4	Sound the alarm: Health and safety risks associated with alarm response for salaried and retained metropolitan firefighters (Paterson et al., 2016).	20
5	Work-life balance and organizational commitment of women in the U.S. construction	15

industry (Malone e Issa, 2013).

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|---|---|----|
| 6 | Stress among South African construction professionals: a job demand-control-support survey (Cattell et al. 2016). | 13 |
| 7 | Predictive models for work-life balance and organizational commitment of Women in the U.S. construction industry (Malone e Issa, 2014) | 13 |
| 8 | Women engineers and work life balance a case study of women working in manufacturing industries in Mysuru city (Raghavendra e Raghunanda, 2018) | 11 |

Of the analyzed articles, eight obtained more than ten referenced citations. The study entitled “The extent of regulatory consensus on health and safety expenditure part 1: Development of the J-value technique and evaluation of regulators' recommendations” (Thomas et al., 2006), was rated as most relevant with 48 citations. In this article, research engineers at the University of London (England), develop a technique with an index of quality of life according to the life expectancy, average income and work-life balance of professional engineers. The method is used to assess the degree of consensus on health and safety expenditures of professionals in different sectors of the industry.

The second most cited is the article entitled “The rhythms of project life: A longitudinal analysis of work hours and work-life experiences in construction” (Helen et al., 2010), with 38 citations. In this study, the researchers collected data from civil construction engineers regarding hours worked, satisfaction with the work-life balance and the ability to complete the necessary tasks at work and at home. It was found that the working hours were significantly in line with the participants' ability to complete tasks at work and at home, but not satisfaction with the work-life balance.

Next, an analysis of the most influential authors was carried out. The criterion of authors who presented more than 30 citations was adopted (Table 3).

Table 3. List of the most influential authors

Rank	Authors	Citations
1	Lingard H.	55
2	Francis V.	46
3	Alghaffar M. A	46
4	Stupples D. W.	46
5	Thomas P. J	46
6	Helen C. L.	38
7	Turner M.	38
8	Issa R. R. A	35

The authors' influence is measured by the number of citations of the articles published on the work-life balance of engineering professionals. In these conditions, the author Helen Lingard appears as the most influential with a total of 55 citations.

About the institutions, the University of Florida (USA), University of Melbourne (Australia) and Tun Hussein Onn University (Malaysia), were the ones that stood out the most with two publications each.

With a total of 38 journals, five most influential journals with three or more publications were selected (Table 4).

Table 4. List of the most influential journals

Rank	Journal	Number of articles	Citations
1	<i>Journal of Professional Issues in Engineering Education and Practice</i>	4	36
2	<i>Evaluation Engineering</i>	4	1
3	<i>Construction Management and Economics</i>	3	99
4	<i>Journal of Construction Engineering & Management</i>	3	21
5	<i>International Journal of Engineering and Advanced Technology</i>	3	4

In number of articles, the “Journal of Professional Issues in Engineering Education and Practice” and “Evaluation Engineering” appear with greater prominence. Regarding the number of citations, “Management and Economics” is the most influential with 99 citations.

A total of 17 countries were identified that published on the work-life balance among professional engineers, among these, nine appear with more than one publication (Figure 2).

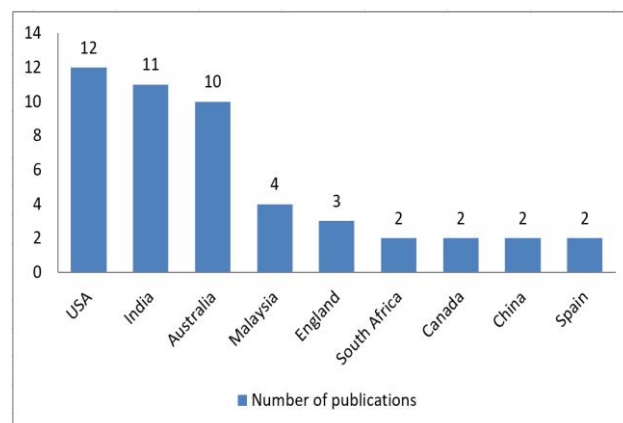


Fig 2. Number of publications by country

The USA appears as the most influential country with 12 publications, followed by India and Australia, with 11 and 10 publications. Frehill (2006) conducted a survey of engineering professionals in the United States, and showed that the main reason that impacts men's work-life balance was the frequent concern of having to leave the field and seek opportunities for progress, or even others professional issues like salary. For women, the main reason was the negative organizational climate.

A study in India shows similar results for female engineers. Vettriselvan et al. (2019) conducted a survey of 50 female engineers, where most feel insecure in the workplace. In industrial work, women aim to satisfy the family's economic needs, the freedom of traditional society and social recognition. Therefore, gender inequality and, as a result, the negative organizational climate at work, ends up impacting the work-life balance.

A visual map of keywords was created using a complete counting method, with a minimum number of three occurrences, resulting in 28 out of a total of 412 keywords (Figure 3).

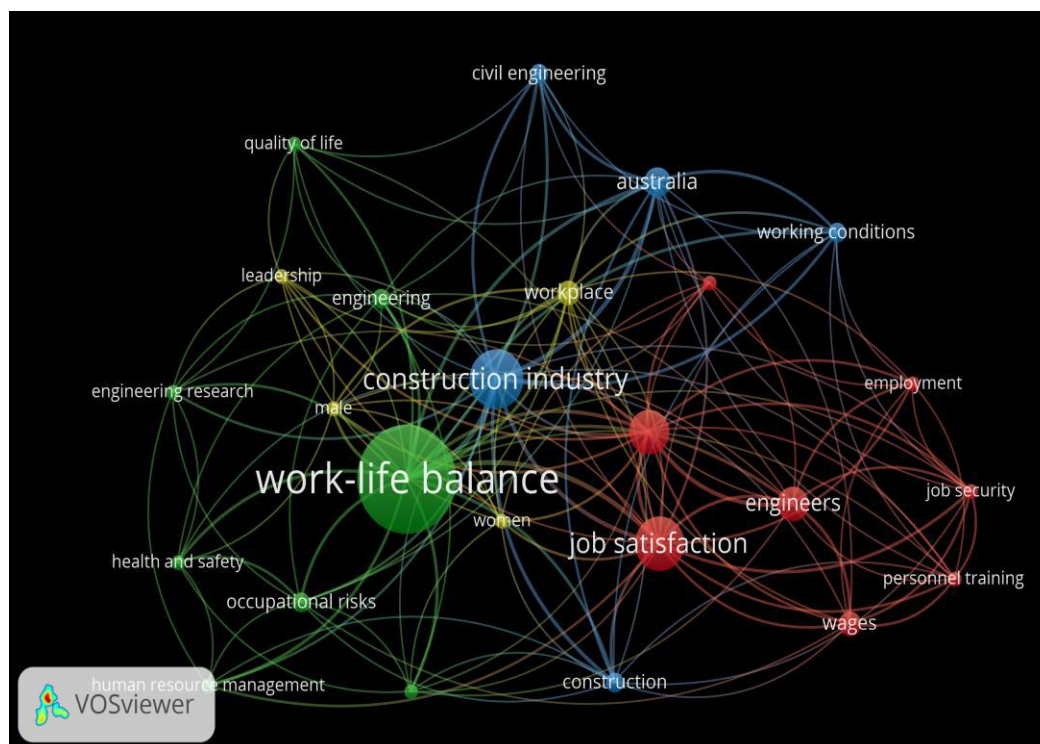


Fig 3. Co-occurrence of keywords

The keywords that most stand out in the theme are “work-life balance”, “job satisfaction” and “construction industry”. It is possible to observe that the work-life balance is related to job satisfaction of engineering professionals. Being the construction industry area the one that stands out the most in relation to publications in the analyzed field.

According to Chan et al. (2019), in China the imbalance between professional and family life is a factor found in the construction industry, this ends up harming the attraction of young engineers to the industry, with health and safety in the workplace being the most critical factors that impact no work-life balance. The same fact is found in Australia in the study by Francis and Prosser (2013), which ends up worrying industrialized countries regarding the aging of the workforce in the area of Civil Engineering.

The largest cluster (red) consists of eight keywords: “employment”, “engineers”, “job satisfaction”, “job security”, “personnel training”, “professional aspects”, “societies and institutions” and “wages”. The main aspects that impact the work-life balance of engineering professionals are perceived: (i) job satisfaction and (ii) health and safety at work.

In the first aspect identified, career satisfaction through work is a fundamental tool to increase the performance of engineers (Martínez-Leon et al., 2018; Wei

et al, 2016). The second aspect identified involves the CSR (Corporate Social Responsibility) practices of the industry, which include health and safety at work (Chan et al., 2019; Ling, et al., 2016). The lack of this internal dimension of CSR has a significant relationship with the commitment to the continuity of engineers in the profession (Al-Bdour et al., 2010).

The second largest cluster (green) consists of seven keywords: “work-life balance”, “quality of life”, “organizational commitment”, “occupational risks”, “human resource management”, “health and safety”, “engineering research” and “engineering”. There is a relationship between the engineering area and the applied social sciences, because human resources management stands out among the articles evaluated, with studies involving occupational risk, health and quality of life of engineering professionals (Sairam and Ramakrishnan, 2020; Kannika and Chockalingam, 2019; Kumar and Chaturvedi, 2018).

IV. CONCLUSION

This research presented a study on the work-life balance of engineering professionals and a mapping of the development of the concept since its identification in the literature. The research used a bibliometric analysis of 58 articles in 38 journals from 2006 to June 2020. To answer the questions that were raised, an analysis of citations and

co-occurrence of keywords and authors was carried out, in addition to the analysis by year most influential publications, countries and journals.

First, a general analysis of the data was carried out which showed that the concept has grown steadily over the past five years in terms of quantity of publication. With regard to the emphasis on referenced citations, the study entitled “The extent of regulatory consensus on health and safety expenditure part 1: Development of the J-value technique and evaluation of regulators' recommendations” (Thomas et al., 2006), was evaluated as most relevant with 48 citations. The USA and India appear as major influencers in the field of engineers' work-life balance, with studies that mainly assess issues of gender inequality and the organizational climate as an impact of the imbalance between the professional and family life of female engineers. In relation to journals, the “Journal of Professional Issues in Engineering Education and Practice” and “Evaluation Engineering” appear with greater prominence in the quantity of publications.

In a second stage of the research, the co-occurrence of keywords was performed. The keywords that most stand out in the analyzed theme are “work-life balance”, “job satisfaction” and “construction industry”. It is noticed that the work-life balance is related to job satisfaction of engineering professionals. The construction industry area appears more prominently in relation to publications in the analyzed field. It was identified that the main aspects that impact the work-life balance of engineering professionals are: job satisfaction; and health and safety at work.

This study presented managerial and academic contributions. In the managerial factor, it contributes to the fact that industrial intervention policies are carried out with engineers in relation to job satisfaction, health and safety, which are the reasons why young engineers may not pursue careers in civil construction, in disagreement with expectations of a set of work-life balance. The organizational climate is also emphasized as a factor that impacts the satisfaction and, consequently, the work-life balance of female engineers, who live in a work culture dominated by men. As an academic contribution, it provides comprehensive data from the main authors, journals, institutions and countries that have shaped the literature in this field of research. When analyzing the gradual evolution of the concept over the years, it indicates that the theme has not been exhausted and studies are still needed to continue the research.

Despite the methodological rigor in investigating the theme, this study has limitations. The study worked only with the Scopus database, in order to avoid duplicates,

however, not including bases such as Web of Science (WoS) and ScienceDirect can lead to the exclusion of valuable articles in the field of engineers' work-life balance. As future research, it is suggested a research that includes other representative databases in the area of engineering

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