

TEN YEARS OF FRUGAL INNOVATION: BIBLIOMETRIC AND THEORETICAL REVIEW

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Abstract: *The aim of the research is to present a comprehensive bibliometric analysis complemented with a perspective of theoretical review, based on the data that incorporates the research papers including the term of frugal innovation from 2010 till October 10, 2019, which clarifies the present-day focus of research in this topic and summarises areas of research. In doing so, we carried out a bibliometric analysis and analysed 238 publications that have been published since 2010 till 2019, along with the theoretical review, based on the insights identified from a group of top-cited articles on frugal innovation. We organised and synthesised 47 papers according to the sector (industry) focus, type/ method of research, country focus, and focus of research. Thus, we estimated the evolution of past research and used the key findings to outline future research pathways.*

Keywords: frugal innovation, economical improvements, publications, information, literature review, analysis.

A combination of bibliometric analysis with a theoretical approach delivers the synergy effect for research of the scope and conceptualisation into this kind of innovation. In our research paper, we present the bibliometric analysis of the academic discussion on frugal innovation, since bibliometric indicators can reflect necessary and important facts-based insights, decreasing the subjective factor of research activity¹, while the theoretical literature review is used to assess the prior research². Few attempts were undertaken to present bibliometric analysis on frugal innovations, among of them authors R. Tiwari and K. Kalogerakis³, C.T.S. Tatum and S.L. Russo⁴, while V. D'Angelo and M. Magnusson⁵ were focused on intellectual communities, meanwhile the sectors

¹ H.F. Moed, W.J.M. Burger, J.G. Frankfort, A.F.J. Van Raan, "The use of bibliometric data for the measurement of university research performance", in *Research Policy*, 1985, vol. 14, no. 3, p. 131-149.

² D. Tranfield, D. Denyer, P. Smart, "Towards a methodology for developing evidence-informed management knowledge by means of systematic review", in *British Journal of Management*, 2003, vol. 14, no. 3, p. 207-222.

³ R. Tiwari, K. Kalogerakis, *A bibliometric analysis of academic papers on frugal innovation*, 2016. Available at <https://tore.tuhh.de/handle/11420/1314>.

⁴ C.T.S. Tatum, S.L. Russo, "Bibliometric analysis for frugal innovation", in *International Journal for Innovation Education and Research*, 2020, vol. 8, no. 3, p. 01-14.

⁵ V. D'Angelo, M. Magnusson, "A Bibliometric map of intellectual communities in frugal innovation literature", in *IEEE Transactions on Engineering Management*, 2020, vol. 11, p. 1-14.

were not considered. Our research presents also, the insights of the top-cited publications considering the sector (industry) focus, type/ method of research, country focus, and focus of research. Hence, the relevance of the period 2010-2019 is justified by the increasing number of publications year by year. Moreover, the term “frugal innovation” was under discussion during these years, and was reconsidered significantly. Initially definition was aimed at developing countries, countries with low incomes, and further at developed countries⁶, while the perception and criteria of the definition changed significantly.

The origin of the concept has been addressed to the “emerging economies”, especially India. The etymology of the word “frugal”, (XVI century); from Middle French frugal, also frugi “useful, proper, worthy, honest, temperate, economical”. Different authors consider frugal innovation with diverse perspectives. Among them, Radjou et al.⁷ defined it as “fail cheap, fail fast, fail often”. Furthermore, frugal innovation is based on affordability, accessibility, availability, and sustainability⁸. However, it is important to highlight that frugal innovations contribute to sustainability⁹. Due to its sustainable feature, the definition of frugal innovation also overlaps with “responsible innovation”¹⁰. Frugal innovation is the reconsideration of business models, reconfiguration of value chains, and redesign of products in order to save resources and serve the inclusive markets in constrained conditions in a sustainable way¹¹. The phenomenon may be described in different categories, dimensions or avenues of research: first, frugal innovation

⁶ M. Zeschky, S. Winterhalterm, O. Gassmann, “From cost to frugal and reverse innovation: mapping the field and implications for global competitiveness”, in *Research-Technology Management*, 2014a, vol. 57, no. 4, p. 20-27.

⁷ N. Radjou, J. C. Prabhu, S. Ahuja, *Jugaad innovation: think frugal, be flexible, generate breakthrough growth*, Jossey-Bass, Hoboken, 2012.

⁸ R. Varadarajan, “Marketing strategy: discerning the relative influence of product and firm characteristics”, in *AMS Review*, 2011, vol. 1, no. 1, p. 32-43; N. Radjou, J. C. Prabhu, S. Ahuja, *Jugaad innovation: think frugal, be flexible, generate breakthrough growth*, Jossey-Bass, Hoboken, 2012.

⁹ M. Hossain, “Frugal innovation: Conception, development, diffusion, and outcome”, in *Journal of Cleaner Production*, 2020, vol. 262, article number 121456.

¹⁰ C. van Beers, P. Knorringa, A. Leliveld, “Can frugal innovations be responsible innovations?”, in *Responsible Innovation in Large Technological Systems*, 2020, vol. 13, p. 80-95; E. Ginters, A. Aizstrauts, G. Dreija, M. Ablazeveica, S. Stepucev, I. Sakne, M. Baltruks, M.A.P. Eroles, R. Buil, M. Gusev, G. Velkoski, “Skopje bicycle inter-modality simulator – E-involvement through simulation and ticketing”, in: *26th European Modeling and Simulation Symposium, EMSS 2014*, p. 557-562, Bordeaux, France, 2014.

¹¹ Y.A. Bhatti, “What is frugal, what is innovation? Towards a theory of frugal innovation”, *SSRN Electronic Journal*, 2012. Available at https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2005910; A. Butyrskyi, L. Nikolenko, B. Poliakov, N. Ivanyuta, L. Donchak, I. Butyrska, “Economic, investment and legal paradigm of shale gas development: World experience and prospects for Ukraine”, in *Montenegrin Journal of Economics*, 2019, vol. 15, no. 2, p. 165-179.

aims at customers with low incomes as co-creators of solutions, target groups and satisfaction of the primary customers' requirements without complexity¹²; second, the obtaining sufficient level of taxonomy with low R&D investments by adapting product management, production, and development¹³; and, finally, provided solutions may be used for developed countries¹⁴.

The aim of the research was to present a comprehensive bibliometric analysis complemented with a perspective of theoretical review, based on the data that incorporates the research papers including the term of frugal innovation from 2010 till October 10, 2019, which clarifies the present-day focus of research in this topic and summarises areas of research.

Materials and methods

However, so far, a lot of scholars have focused on the determination of the term, trying to define its relevance for business in the context of consumers in developing countries¹⁵, and developed countries. For instance, N. Radjou and J. Euchner¹⁶ argue that frugal innovation provides solutions that integrate five key variables: affordability, simplicity, sustainability, quality, and purpose (Table 1). T. Weyrauch and C. Herstatt¹⁷ claim that it must lead to a significant decrease in expenses, focus on the key features, modify output level. However, the optimised performance criterion, such as geographical location has to be adapted, since it is strongly related to the customer. Also, the characteristics may be distinguished into three major groups: market; product; and business¹⁸.

¹² M. Zeschky, B. Widenmayer, O. Gassmann, "Frugal innovation in emerging markets", in *Research-Technology Management*, 2011, vol. 54, no. 4, p. 38-45.

¹³ B.N. Bhattacharyay, "Seamless sustainable transport connectivity in Asia and the Pacific: prospects and challenges", in *International Economics and Economic Policy*, 2012, vol. 9, no. 2, p. 147-189.

¹⁴ E. Ginters, D. Aizstrauta, "Technologies sustainability modeling", in *Advances in Intelligent Systems and Computing*, 2018, vol. 746, p. 659-668.

¹⁵ R. Tiwari, C. Herstatt, "Assessing India's lead market potential for cost-effective innovations", in *Journal of Indian Business Research*, 2012, vol. 4, no. 2, p. 97-115; A. Ramdorai, C. Herstatt, "Frugal innovation in healthcare", in *India Studies in Business and Economics*, Springer International Publishing, Midtown Manhatta, 2015.

¹⁶ N. Radjou, J. Euchner, "The principles of frugal innovation: An interview with Navi Radjou", in *Research-Technology Management*, 2016, vol. 59, no. 4, p. 13-20.

¹⁷ T. Weyrauch, C. Herstatt, "What is frugal innovation? Three defining criteria", in *Journal of Frugal Innovation*, 2016, vol. 2, no. 1. Available at <https://link.springer.com/content/pdf/10.1186%2Fs40669-016-0005-y.pdf>.

¹⁸ T. Sjafrizal, "Frugal innovation characteristics: market, product and business perspective", in *Proceeding of the 8th International Seminar on Industrial Engineering and Management*, 2015, vol. 5, p. 38-43; V.M. Yanchuk, D.S. Antoniuk, A.G. Tkachuk, E. Maestri, O. Vizghalov, "Integration of delivery services business cases for improvement of business and environmental sustainability of e-commerce solutions", in *CEUR Workshop Proceedings*, 2020, vol. 2732, p. 363-376.

Table 1: Different criteria of frugal innovation

Variable, criteria and perspectives identification		Authors
Five key variables of frugal innovation	Affordable price; Incomplex; Ecological friendly; Good enough quality; Clear purpose;	(Radjou and Euchner, 2016)
Three criteria of frugal innovation	Significant decrease in expenses, focus on the key features, modify output level;	(Weyrauch and Herstatt, 2016).
Combination of characteristics into 3 major perspectives	Unreserved market with a constraint on resources; Products with low cost, high reliability and using state-of-the-art technologies; Effective business model with a razor-thin profit margin;	(Sjafrizal, 2015)

The base of frugal innovation is good-enough innovation but targeted on resource-constrained environments, providing a new value proposition, however lately it also targets the economically developed world¹⁹. The concept has also been recognized due to the fact of the limitation and less exploitation of resources. The data used in this work were extracted from the Elsevier Scopus database. The search was conducted on October 10, 2019, and consisted of filtered publications that had the phrase “frugal innovation” in its title, summary, or keywords. Two hundred thirty-eight documents were obtained: 136 articles, 50 conference papers, 15 book chapters, 13 reviews, eight notes, five editorials, four short surveys, three books, two conference reviews, one type, and one indefinite document. The period of the publications ranged between 2010 and 2019. The information obtained from each publication includes such data as, publication name, author(s) and their affiliations (institution and country), year, source of the publication, summary, and cited references. The visualization and analysis were performed by Microsoft Excel, then VOS viewer.

¹⁹ M. Zeschky, S. Winterhalterm, O. Gassmann, “From cost to frugal and reverse innovation: mapping the field and implications for global competitiveness”, in *Research-Technology Management*, 2014a, vol. 57, no. 4, p. 20-27; E. Lavrov, N. Barchenok, O. Lavrova, , N. Savina, “Models of the dialogue 'human-computer' for ergonomic support of e-learning”, in: *2019 3rd International Conference on Advanced Information and Communications Technologies, AICT 2019 – Proceedings*, p. 187-190, Lviv, Institute of Electrical and Electronics Engineers, 2019.

Results and discussion

The outcomes presented in Figure 1 reflect the increase of information in terms of frugal innovation. From 2010 ($n = 1$), the number of publications is increasing in the following period at the sustained rate, in 2012 it appears 5, 2013 rises to 18, and continues with the growing trend in the subsequent years to date (2014 – 24, 2015 – 27, 2016 – 43, 2017 – 35, 2018 – 61). Each direction has its own progress, as was mentioned by Dereck J. Solla Price in 1956 about the exponential growth of scientific information which claims that existing global information doubles rapidly every 10-15 years²⁰.

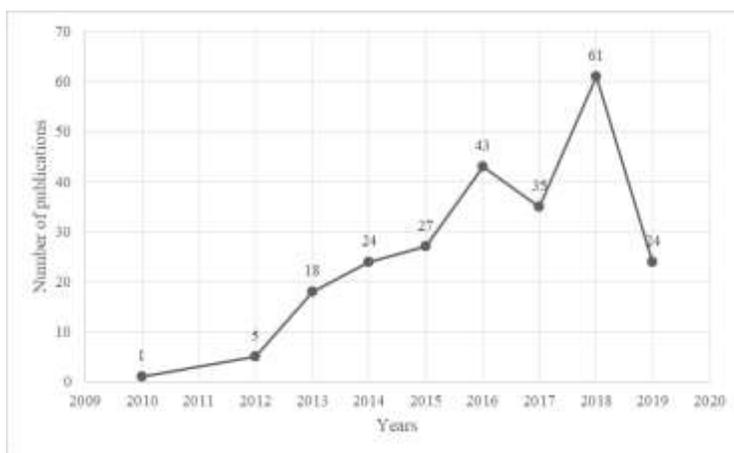


Figure 1: Yearly distribution of the number of publications

In total, 159 different authors were identified, 87 of them have only one publication, 45 have two publications and 27 authors have three or more publications up to a maximum number of seven publications, such as D. Mourtzis, Figure 2 presents authors that have the highest number of publications.

²⁰ J. Ardanuy, “Breve introducción a la bibliometría”, in *La Base de Datos Scopus y Otros E-Recursos Del CBUES Como Instrumento de Gestión de La Actividad Investigadora*, 2012, Available at <http://diposit.ub.edu/dspace/bitstream/2445/30962/1/breve%20introduccion%20bibliometria.pdf>.

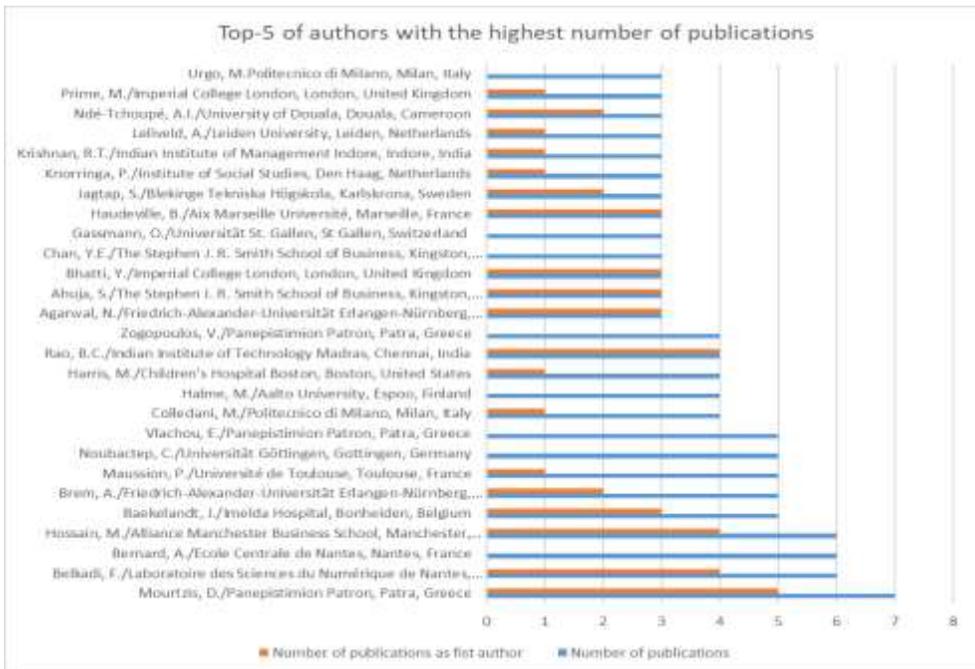


Figure 2: Top 5 of authors with the highest number of publications

In Figure 3, the 72 authors who published at least two documents are represented below, generating a total of 28 different working groups. The most significant workgroup is represented by red colour and made up of 8 elements, the following two groups are formed by six authors, one is green and the other is blue. It can also be observed that this blue group is the only one that is linked to another purple one with five authors. The yellow group appears to be more substantial, it contains five elements, but the first two groups are not connected with other workgroups.

Each circle represents an author in this network that has at least two publications. The dimensions of the circle indicate the number of research papers per author, while the linkages, collaboration between authors. The colours indicate the cooperation cluster. The analysis was performed with VOS viewer.

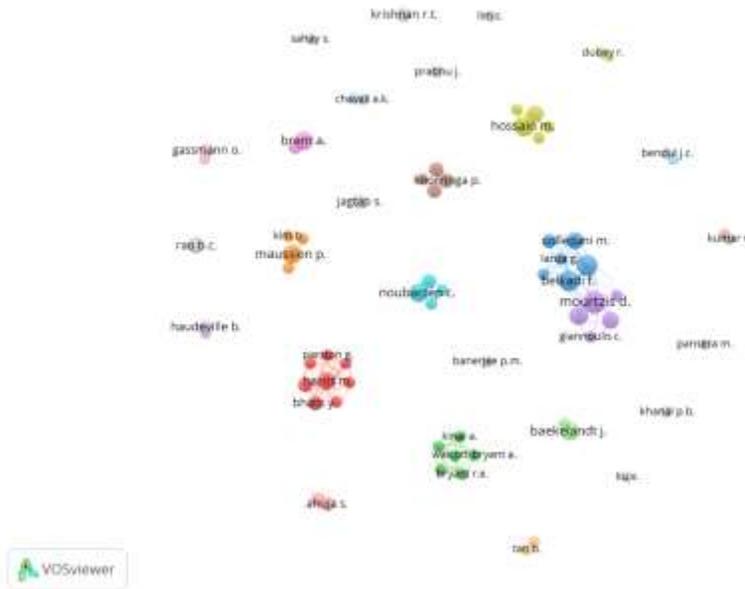


Figure 3: Co-author cooperation in frugal innovation research

The 238 documents found on frugal innovation, in 122 diverse sources, among them, journals, conference papers, books, which stands for the diversity of approaches in this field. Figure 4 shows the Top-5 of the sources with the vast number of articles published on the topic, with the European Journal of Development Research on top ($n = 9$), followed by Journal of Cleaner Production ($n = 8$), CIRP procedure ($n = 5$) and Sustainability Switzerland ($n = 5$). According to the indexes of citations, the highest ranking has Journal of Cleaner Production, $n = 7.32$), the “Scimago Journal Rank” (SJR), that estimates the impact factor according to Scopus database, the “Source Normalized Impact per Paper index” (SNIP) including the study area of the journal.

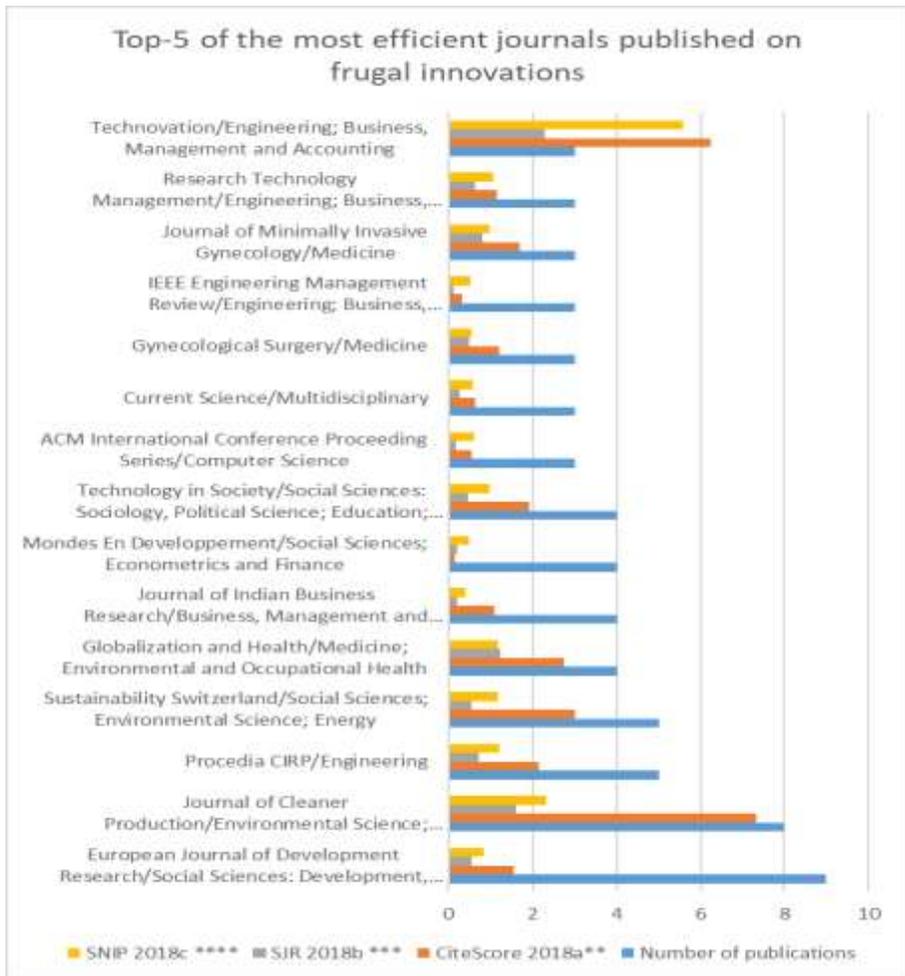


Figure 4: Top 5 of the most efficient journals published on frugal innovations

Note: **“CiteScore” estimates mean citations obtained per scientific paper in the serial; ***“SCImago Journal Rank” evaluates weighted citations obtained by the serial. It depends on the subject area and prestige (SJR) of the citing serial; ****“Source Normalized Impact per Paper” evaluates actual citations obtained relative to citations anticipated for the serial’s subject area.

The countries and affiliated institutions are indicated according to the Scopus database. 47 countries or territories were identified, and 13 publications appear with an indefinite allocation. Figure 5 shows a worldwide distribution. It is observed that 40.42% (n = 19/47) of the publications appear in the European continent, followed by 23.40% (n = 11/47) of the Asian continent, 17.02% (n = 8/47) in the American continent such as in the African continent, and 2.12% (n = 1/47) in Oceania.



Figure 5: Frugal innovation publications distributed by country

Figure 6 shows the most productive countries on frugal innovation. The leading countries are India (46 publications), United States (39 publications), United Kingdom (29 publications), France (28 publications), and Germany (26 publications).

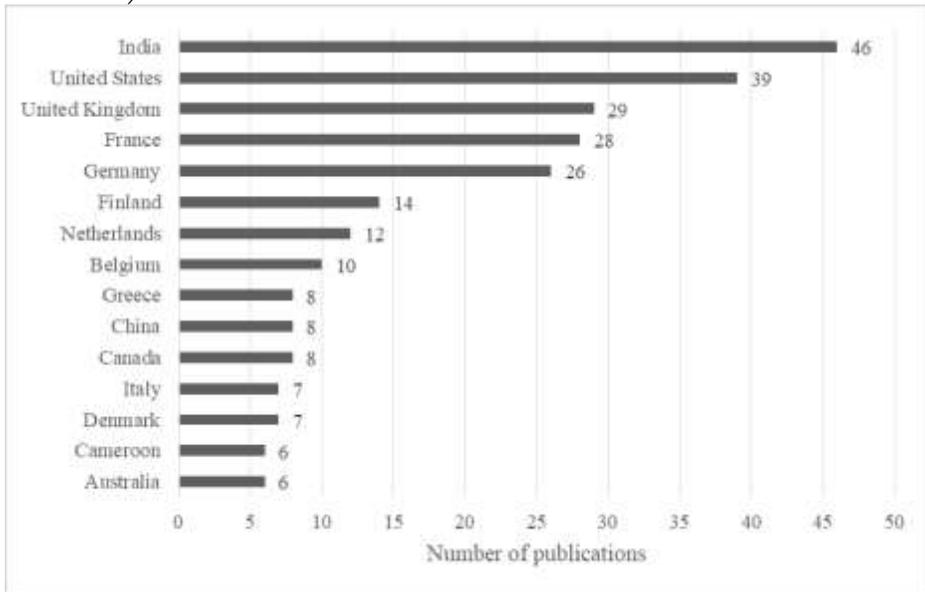


Figure 6: Top 5 effective countries in frugal innovation

*Note: *Countries which produce equivalently have the same score number.*

47 countries were identified, ten of them are not related to any working group. The rest is represented in the following figure 7. The remaining 37 countries are all linked to each other, forming nine different working groups. The group with the highest number of members is the red one with eight countries (Canada, Finland, Kenya, Netherlands, Rwanda, South Africa, Sweden, and Vietnam), the next group indicated by the green colour, formed by six items (France, Cambodia, Greece, Italy, Tunisia, and Turkey); the blue group shaped by five countries (United States, Venezuela, Switzerland, Slovakia, and Colombia). The yellow group is represented by four items (Germany, Portugal, Brazil, and Belgium) and the purple by (China, Tanzania, Zimbabwe, and Cameroon). Australia, India and Norway are indicated by aqua colour; United Kingdom, Qatar, and Nigeria are presented by orange colour; Denmark and Spain are indicated by coffee colour, while Japan and South Korea by pink colour.

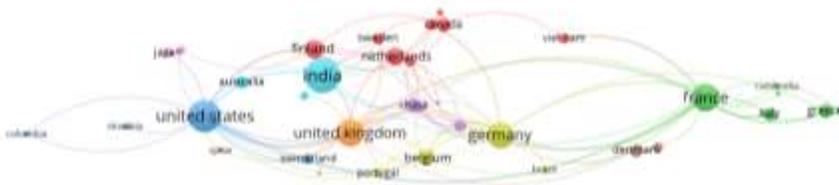


Figure 7: Collaboration clusters according to the countries and territories in frugal innovation

The dimension of the circle stands for the number of research papers, and the linkages, for the strong point of the cooperation. The colours identify the cooperation groups. The results showed 160 different institutions of authors' affiliation. It is observed that 55.62% ($n = 89/160$) of the institutions appear only once, 26.87% ($n = 43/160$) appear twice and 17.5% ($n = 28/160$) appear three or more times. Figure 8 shows the Top-5 productive institutions on frugal innovations.

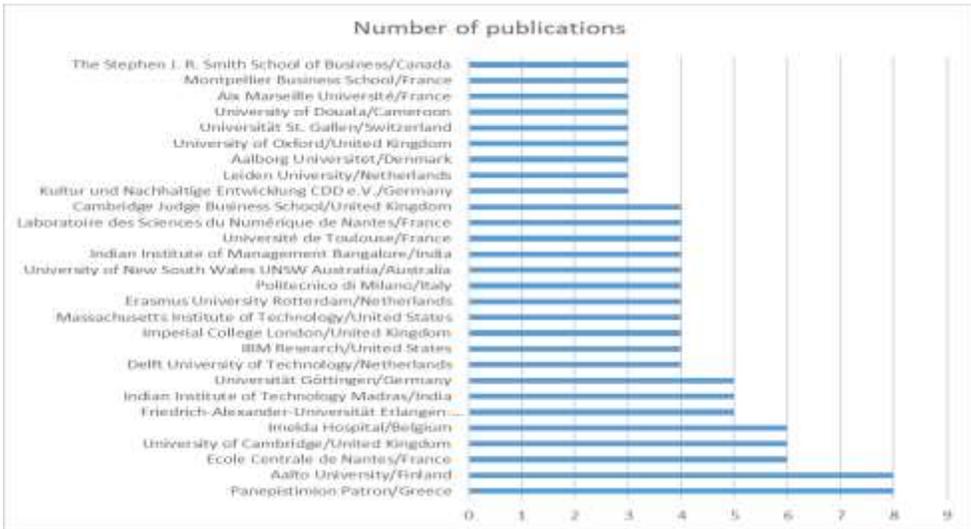


Figure 8: Top 5 of the most productive institutions on frugal innovations

Bibliographic coupling analysis occurs when two publications refer to a third common paper in their bibliographies. It would be presumed that the larger number of references in common have two publications, the more significant thematic relationship will be between them.

Of the 238 publications, 15 relevant working groups are generated (with more than two articles up to 36, the largest); that means that among the production of frugal innovation topic, 15 bibliographic aggregations have been generated, and each of them shares common references. Figure 9 is the result of the most interconnected workgroups.

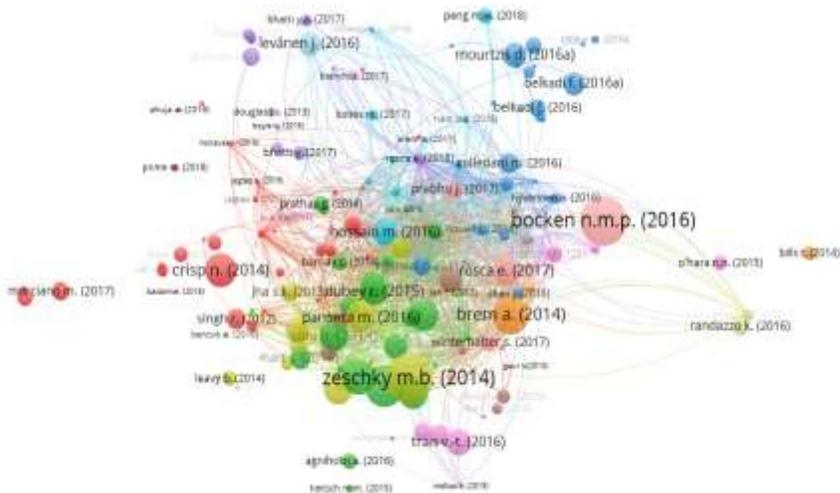


Figure 9: Bibliographic coupling analysis

On the grounds of the title and abstract analysis of the research papers in the largest clusters, a relevant mark defined. The yellow is the major one and refers to the field of frugal innovation mainly related to health, IT, energy, and generally focused publications. The green colour refers to the practical solutions, introducing cases of frugal innovations in different industries, while the orange cluster represents publications on engineering, ICT, advanced frugal innovations, product design²¹. The authors in the blue cluster are concentrated on business strategies²², management, and sustainable development in terms of frugal innovations²³. The purple cluster is more practical and strongly focused on the healthcare industry, whereas the pink cluster is focused on small business, economic development, and investments in terms of frugal innovations.

The citation analysis provides the number of times publications/or authors have been cited by others in Scopus. In total, 1392 citations have received the 238 documents found; nevertheless, by subtracting the self-citation, there are 1102 total citations, which would mean that on average, 4.63 citations per document. This part includes synthesis and analysis of the research conducted by a group of top-cited articles in frugal innovation, which includes 47 articles (Table 2). In addition to the identifying data of the articles and the reference to quotations, topic, industry (sector) focus, type of research paper/method, country focus and the main focus of research are considered.

²¹ I.M. Bezhenar, "Assessment of the industry development," in *Ekonomika APK*, 2021, no. 2, p. 25-40.

²² A. Yasinska, "Accounting procedures digital transformation for business processes improvement", in *Economics, Entrepreneurship, Management*, 2021, vol. 8, no. 2, p. 44-50.

²³ K.S. Nesterova, I.A. Kurovska, R.V. Hryshova, "Problems and instruments of state organizational and economic support of the circular economy development", in *Ekonomika APK*, 2021, no. 5, p. 57-63.

Table 2: Analysis of tip-cited publications on frugal innovations

5	4	3	2	1	Document Title
Assessing India's lead market potential for cost-effective innovations (Tiwari and Herstatt, 2012)	Research and development from the bottom up - introduction of terminologies for new product development in emerging markets (Brem and Wolfram, 2014)	How disruptive is frugal? (Rao, 2013)	Towards a sufficiency-driven business model: Experiences and opportunities (Bocken and Short, 2016)	From cost to frugal and reverse innovation: Mapping the field and implications for global competitiveness (Zeschky et al., 2014a)	Authors
Innovation Emerging markets Frugal innovations Journal of Indian Business Research	Innovation Emerging markets Frugal innovations Journal of Innovation and Entrepreneurship	Innovation Emerging markets Frugal innovations Technology in Society	Business model Industry Business model innovation Environmental Innovation and Societal Transitions	Innovation Emerging markets Frugal innovations Research Technology Management	Topic Journal Title
35	39	48	57	71	Total cites
5.00	7.80	8.00	19.00	14.20	Average citation per year
Cooling systems/ Energy/ Water/ Vehicles	Different industries	Different industries	Furniture manufacturer, clothing manufacturer, sports gear manufacturer, document management system manufacturer, vehicle, equipment ('unprinter' manufacturer)	Different industries	Sector (industry) focus
Empirical/ analysis, literature review, synthesis	Theoretical/ conceptual/ literature review, synthesis, induction, deduction	Empirical/ case study	Empirical/ case study	Empirical/ literature review and a series of case studies	Type/ method of research
India	Not specified	Not specified	Developed countries	Not specified	Country focus
Assessment of reasons that influence on India and leads to emerging of frugal innovations/India as a country with a leading position on frugal innovations	The presentation of a complete summary of the resembling definitions of frugal innovations and their identification. Introduction of the conceptual framework according to sophistication, sustainability, and focus on developing countries	Identification of different types of frugal-innovations in terms of disruptiveness/ Examination of the resembling types for formalizing the process of frugal innovations based on examples, that will complement the common one	Sufficiency as a key element of sustainable business framework/Definition of proper strategy in order to get the correct attitude to the sufficiency	Analysis and discussion of the various types of innovations related to frugal type/Analysis of approaches/Framework for practitioners and actors of real business	Focus of research

9	9	8	8	7	6
Business models for sustainable innovation – an empirical analysis of frugal products and services	Organising for reverse innovation in Western MNCs: The role of frugal product innovation capabilities	Crafting sustainable development solutions: Frugal innovations of grassroots entrepreneurs	Capability building through innovation for unserved lower end mega markets	Frugal innovation: Aligning theory, practice, and public policy	Mutual learning and reverse innovation- where next?
(Rosca et al., 2017)	(Zeschky et al., 2014b)	(Pansera and Sarkar, 2016)	(Lim et al., 2013)	(Soni and Krishnan, 2014)	(Crisp, 2014)
Innovation Emerging markets Frugal innovations	Subsidiaries Multinational corporations Multinational enterprises	Innovation Technology Inclusive innovation	Catch-up Innovation Latecomer firms	Innovation Emerging markets Frugal innovations	Health Income Health care
Journal of Cleaner Production	International Journal of Technology Management	Sustainability (Switzerland)	Technovation	Journal of Indian Business Research	Globalization and Health
25	25	28	28	29	33
12.50	5.00	9.33	4.67	5.80	6.60
Health/ Different industries	Healthcare / Electronics	Hygiene/ Energy/ Agriculture/	Vehicles/Automotive	Different industries	Healthcare
Empirical/ Case study	Empirical/ Case study	Empirical/ Case study	Empirical/Case study	Theoretical/conceptual/ literature review, synthesis, induction, deduction	Theoretical/empirical/ literature review, synthesis, induction, deduction
Developed and developing countries	Developed and developing countries	India	India	Not specified	Not specified
The systemisation and description of the business model in terms of frugal and reverse innovation/Facilitation of sustainable development	Process of organisation of the international RandD in multinational corporations of the healthcare and electronics industries in terms of reverse innovations	Four case studies of business in scarce resource conditions in India. Examination of businesses that create ecological, inexpensive products from available materials	Experimental case study of building innovation capabilities. Creating a process that would provide a solution in producing budget service or product and would have an impact on the building of innovation	Not specified	Focused on creating a practical local solution in healthcare, which could be useful for developing and developed economies

14	Emerging economies drive frugal innovation.	13	12	11	10	10
15	Frugal innovation in medicine for low resource settings	13	12	11	10	10
16	Antecedents of innovation and contextual relationship	13	12	11	10	10
17	Frugal and reverse innovation - Literature overview and case study insights from a German MNC in India and China	13	12	11	10	10
18	Approaches and establishments of multinational corporations in developing countries. Differentiation of frugal and reverse innovation and analysis of the practices of German multinational corporations	13	12	11	10	10
19	Public Money and Management	13	12	11	10	10
20	Healthcare	13	12	11	10	10
21	Healthcare	13	12	11	10	10
22	Healthcare	13	12	11	10	10
23	Healthcare	13	12	11	10	10
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89	Healthcare	13	12	11	10	10
90	Healthcare	13	12	11	10	10
91	Healthcare	13	12	11	10	10
92	Healthcare	13	12	11	10	10
93	Healthcare	13	12	11	10	10
94	Healthcare	13	12	11	10	10
95	Healthcare	13	12	11	10	10
96	Healthcare	13	12	11	10	10
97	Healthcare	13	12	11	10	10
98	Healthcare	13	12	11	10	10
99	Healthcare	13	12	11	10	10
100	Healthcare	13	12	11	10	10

17	Open innovation as a new paradigm for global collaborations in health	(Dandonoli, 2013)	Health Income Health care	Globalization and Health	13	2.17	Healthcare	Empirical/ Observation, analysis, synthesis, induction, deduction	Not specified	Description of an early-stage pilot project based on open innovation in scarce resources which involves communities, partners, and expertise. Discussion of the solutions that would involve developed economies
17	Jugad-From 'Making Do' and 'Quick Fix' to an Innovative, Sustainable and Low-Cost Survival Strategy at the Bottom of the Pyramid	(Singh et al., 2012)	Innovation Emerging markets Frugal innovations	International Journal of Rural Management	13	1.86	Different industries	Empirical/ interviews, analysis	India	Focused on the innovations "Do It Yourself" level/innovations in local business in scarce resource conditions
16	How frugal innovation promotes social sustainability	(Khan, 2016)	Emerging markets Frugal	Sustainability (Switzerland)	14	4.67	phone/ Financial service/	Empirical/ Case study Literature review, analysis, synthesis, induction, deduction	Developing countries	Creation of the linkage between social sustainability and frugal innovations, the insights of different cases
16	Poverty, Business Strategy, and Sustainable Development	(Hart et al., 2016)	Base of the pyramid Bottom of the pyramid Poverty alleviation	Organization and Environment	14	4.67	Different industries	Theoretical/ Literature review, analysis, synthesis, induction, deduction	Not specified	Analysis of vast literature and approaches about the opportunities and limitations of the companies that could decrease the poverty and deliver sustainable development.
15	Frugal Innovation and Development: Aides or Adversaries?	(Knorringa et al., 2016)	Innovation Technology Inclusive innovation	European Journal of Development Research	16	5.33	Mobile phone/ Financial service/	Theoretical/ Literature review, analysis, synthesis, induction, deduction	Developing countries	Discussion about the necessity of empirical approach for frugal innovations in order to assess the proper time and location for facilitating the inclusive development
15	Can frugal go global? Diffusion patterns of frugal innovations	(Hossain et al., 2016)	Innovation Emerging markets Frugal innovations	Technology in Society	16	5.33	Cooling systems/ Automotive/ Energy/ Financial service/ Healthcare	Empirical/ Case study, comparison, analysis	Developing and developed countries	Exploration of various kinds of frugal innovation distribution, identifying four forms: local, closeness, distance, and international distribution
15	Total Vaginal NOTES Hysterectomy: A New Approach to Hysterectomy	(Baeckel, 2015)	Natural Orifice Endoscopic Surgery Laparoscopy Orifice specimen	Journal of Minimally Invasive Gynecology	16	4.00	Healthcare	Empirical/ Experiment, observation, comparison, analysis	Not specified	Demonstration of the practicability of frugal innovation in gynaecological surgery/The innovation provides less adverse effects and could be also used in scarce resources conditions

20	Business Models for Frugal Innovation in Emerging Markets: The Case of the Medical Device and Laboratory Equipment Industry (Winterhalter et al., 2017)	20	19	19	18	17
Frugal innovations on sustainable development: Evaluating water and energy (Levänen et al., 2016)	Designing metallic iron-based water filters: Light from methylene blue discoloration (Bhatku-K. et al., 2016)	Frugal innovation (Bhatti et al., 2013)	Local innovation: The key to globalization (Jha and Krishnan, 2013)	Serving poor people in rich countries: The bottom-of-the-pyramid business model solution (Angot and Plé, 2015)	Frugality, grassroots and inclusiveness: New challenges for mainstream innovation theories (Pansera, 2013)	
Emerging markets Frugal	Iron Dechlorination Nanoscale zero-valent	Design Product development Tool frames	Innovation Emerging markets Frugal innovations	Innovation Emerging markets Frugal innovations	Innovation Technology Inclusive innovation	
Sustainability (Switzerland)	Journal of Environmental Management	Globalization, Change and Learning in South Asia	IMB Management Review	Journal of Business Strategy	African Journal of Science, Technology, Innovation and Development	
10	10	11	11	12	13	
5.00	3.33	1.83	1.83	3.00	2.17	
Healthcare	Water/ Energy/	Different industries/ Multinational Corporations	Different industries/ Multinational Corporations	Different industries	Different industries	
Empirical/ Case study Literature review, analysis, synthesis, induction, deduction	Empirical/ Experiment, measuring, analysis, synthesis, induction, deduction	Theoretical/ Literature review, analysis synthesis, induction, deduction	Empirical/ in-depth interviews, analysis	Theoretical/ Conceptual article/ Literature review, analysis synthesis, induction, deduction	Theoretical/ Literature review, analysis synthesis, induction, deduction	
India, China	Not specified	Developing and developed countries	Developing and developed countries	Developing and developed countries	Developing countries	
Focused on disruptive forms of innovations. Establishment of approaches in order to satisfy the customers with limited access to the resources	Design of water filtration as a frugal innovation	Discussion about globalization that has impacted South Asia, in terms of organisations' respond to opposing issues, where multinational companies could take advantage of the South Asian companies	Reflection of lessons, challenges of multinational corporations from developed and developing countries in terms of innovating	The suggestion of the scarce resource innovations transfer to the firms for developed countries through adapted business models, taking into account the location of strategies application	Different kind of innovation concepts and perception of innovations that appear in countries with scarce resources. Analysis of the main drivers of this kind of innovations	

23	Mapping the frugal innovation phenomenon	22	22	22	21	20
(Hossain, 2017)	Exploring the dynamics of water innovation: Foundations for water innovation studies	(Wehn and Montalvo, 2018)	A systematic literature review of constraint-based innovations: State of the art and future perspectives	(Morciano et al., 2017)	(Gupta et al., 2016)	(Prabhu, 2017)
Innovation Emerging markets Frugal innovations	Innovation Sustainable development Socio-technical transitions	Innovation Emerging markets Frugal innovations	Desalination Steam generators Solar steam	Open innovation Innovation Organizational ambidexterity	Economics Innovation Demand reduction	
Technology in Society	Journal of Cleaner Production	IEEE Transactions on Engineering Management	Scientific Reports	Journal of Open Innovation: Technology, Market, and Complexity	Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences	
7	8	8	8	9	10	
3.50	8.00	4.00	4.00	3.00	5.00	
Healthcare/ ICT/ Transportation/ Vehicles/ Automotive/ Energy/ Water/ Financial service	Water	ICT	Water/Energy	Different industries	Manufacturing/ Food/ Automotive/ Energy	
Empirical/ Systematic approach in the literature review, analysis synthesis, induction, deduction, comparison	Theoretical/ Conceptual/ Literature review, analysis synthesis, induction, deduction, comparison	Empirical/ Systematic Literature review, analysis synthesis, induction, deduction, comparison	Empirical/ Experiments, analysis, synthesis, induction, deduction, comparison	Theoretical/ Conceptual/ Literature review, analysis synthesis, induction, deduction, comparison	Theoretical/ Conceptual/ Literature review, analysis synthesis, induction, deduction, comparison	
Not specified	Not specified	Not specified	Developing countries	Developing countries	Developing and developed countries	
Exploration of the trend of published articles that use a case study method on frugal innovations	Introduction of the framework in water innovations topic/ main key findings for future research	Systematically organisation and synthesis of approaches to innovations related to scarce resources conditions. The research distinguishes innovations into different types.	Development of solar steam generator as a water filtration device and implementation for rural places with limited access to resources.	The link between frugal innovations and open innovation concepts/Challenges of perception/Climate challenges/obligations of formal and informal actors	Introduction of the concept of frugal innovation/Incomplex, affordable, budget solutions, in scarce resources conditions/discussion on strategies/practical examples	

26	Investigating the suitability of Fe ^{<sup>0</sup>/sup> packed-beds for water defluoridation}	(Heimann et al., 2018)	Iron Dechlorination Nanoscale zero-valent	Chemosphere	4	Co-production of frugal innovation: Case of low-cost reverse osmosis water filters in India	(Anjala et al., 2018)	Base of the pyramid Bottom of the pyramid Poverty alleviation	Journal of Cleaner Production	5	5.00	Water	Empirical/ Mixed methods, interviews, literature review, analysis, synthesis, induction, deduction	India	Design of inexpensive water filtration based on Fe ⁰
					5	Value capture and value creation: The role of information technology in business models for frugal innovations in Africa	(Howell et al., 2018)	Innovation Emerging markets Frugal innovations	Journal of Cleaner Production	5	5.00	IT	Theoretical/ Conceptual/ Literature review, analysis, synthesis, induction, deduction, comparison	Africa	Demonstration of information technology (IT) in frugal innovations, and its impact on business in terms of delivering frugal innovations to the customers with limited access
					5	The growth of the firm in (and out of) emerging economies	(Beng et al., 2018)	Internationalization Emerging markets Outward foreign direct investment	Asia Pacific Journal of Management	5	5.00	Different industries	Theoretical/ Conceptual/ Literature review, analysis, synthesis, induction, deduction, comparison	Developing countries	Exploration of three major key elements for business development/Growth as the main component of research/Company's growth/Introduction of topics and insights of the last twenty years of research
					6	Canibalizing the Informal Economy: Frugal Innovation and Economic Inclusion in Africa	(Meagher, 2018)	Base of the pyramid Bottom of the pyramid Poverty alleviation	European Journal of Development Research	6	6.00	Mobile phones/ Financial service	Empirical/ Mixed methods, literature review, analysis, synthesis, induction, deduction	Africa	Examination of four mechanisms of unfavorable incorporation in terms of frugal innovation, based on cases of M-Pesa and micro-insurance
					6	Frugal approach to innovation: State of the art and future perspectives	(Pisoni et al., 2018)	Innovation Emerging markets Frugal innovations	Journal of Cleaner Production	6	6.00	Different industries	Empirical/ Systematic Literature review, analysis, synthesis, induction, deduction, comparison	Not specified	Exploration of the development of the concept of frugal innovation; analysis of the results; identification of gaps in the current literature

27	Does Frugal Innovation Enable Sustainable Development? A Systematic Literature Review (Rosca et al., 2018)	27	Frugal Innovation and Development Research (Leiveldt and Knorrings, 2018)	27	Frugal innovation for supply chain sustainability in SMEs: multi-method research design (Shihin et al., 2018)
	Innovation Technology Inclusive innovation		Innovation Emerging markets Frugal innovations		Supply chain management Supply chains GSCM practices
	European Journal of Development Research		European Journal of Development Research		Production Planning and Control
3		3		3	4
3.00		3.00		3.00	4.00
Different industries	Mobile phones/ Financial service	Automotive	Different industries		Different industries
Empirical/ Systematic Literature review, analysis, synthesis, induction, deduction, comparison	Theoretical/ Literature review, analysis synthesis, induction, deduction, comparison	Empirical/ Case study Literature review, analysis, synthesis, induction, deduction			Empirical/ Mixed methods, survey, analysis, synthesis, induction, deduction, comparison
Not specified	Africa	China	Not specified		Not specified
The potential impact of frugal innovation on sustainable development, particularly concerning different types of the private sector	Focused on the determination of frugal innovations. Contribution to inclusive innovation and development, illustrated by Mobile Money and Financial Inclusion	the influence of the market segments in the automotive industry on the company's development in developing countries (China)			The hierarchical framework based on supply chain sustainability and frugal innovations for a business entity. Frugal innovation is a key element for the supply chain.

* Equally total citation number has the same ranking number

Our research contributes with a descriptive analysis based on the industry (sector) focus, type of research paper/method, and country focus of the most cited articles in frugal innovation. The most of the researchers were focused on different types or mixed industries (23%), healthcare (15%), energy (11%), water (10%), vehicles, automotive and transportation (9%), IT and ICT (7%), financial services (6%) and the other less than 6%. A lot of researchers were focused on the different type of industries, we have also included in that group conceptual and exploratory papers, which are focused on the general information about the frugal innovations and may be implemented in different industries²⁴. M. Zeschky et al.²⁵ were focused on various types of innovations in

²⁴ R. Baembitov, T. Dokic, M. Kezunovic, Y. Hu, Z. Obradovic, “Fast extraction and characterization of fundamental frequency events from a large PMU dataset using big data analytics”, in *Proceedings of the Annual Hawaii International Conference on System Sciences*, 2021, vol. 2020, p. 3195-3204.

²⁵ M. Zeschky, S. Winterhalterm, O. Gassmann, “From cost to frugal and reverse innovation: mapping the field and implications for global competitiveness”, in *Research-Technology Management*, 2014a, vol. 57, no. 4, p. 20-27; M. Zeschky, B. Widenmayer, O. Gassmann,

resource-constrained conditions²⁶. According to these authors, companies searching for relevant offers for developing countries should return them to the Western world. Due to the novelty of phenomena of frugal innovation, there are plenty of research papers that are aimed at investigating a term, definition of frugal innovations.

B.C. Rao²⁷ says that conducting the research on frugal-innovations, it highlights the features of the innovations and also tests the disruptiveness with respect to other innovations. The terms have the same base of the BoP (bottom-of-the-pyramid). Some of the researchers are focused on poverty reduction, while others try to establish a linkage between formal and informal economies. The social aspect is a key element for future scenarios; nevertheless, the researches should not underestimate the unique path of development of countries with low income and the difference of developed economies that faced with the industrial revolution²⁸. Some multinational companies demonstrate both types of innovations, frugal, and reverse. Siemens has developed different frugal products, and at the same time implements reverse innovations through them. Multinational corporations try to offer a disruptive product, while good-enough innovations have more possibilities to be distributed in the market²⁹. Multinational corporations deliver a vast number of innovations to the developing countries, India in particular, and the global world. They are focused on developing close relationships, co-creating with customers, empowering engineers, and product development³⁰.

It is important to increase exchanges between developing and developed countries in healthcare for the facilitation of knowledge transformation and exchange. The Laboratories are vital in knowledge exchange and support, they have to be implemented not only in middle-income countries but to be

“Organising for reverse innovation in Western MNCs: the role of frugal product innovation capabilities”, *International Journal of Technology Management*, 2014b, vol. 64, no. 2-4, p. 255.

²⁶ T.O. Nikolaychuk, “Innovative forms of experience services in business activities”, in *Scientific Bulletin of Mukachevo State University. Series “Economics”*, 2021, vol. 8, no. 3, p. 46-59.

²⁷ B.C. Rao, “How disruptive is frugal?”, in *Technology in Society*, 2013, vol. 35, no. 1, p. 65-73.

²⁸ M. Pansera, “Frugality, grassroots and inclusiveness: New challenges for mainstream innovation theories”, in *African Journal of Science, Technology, Innovation and Development*, 2013, vol. 5, no. 6, p. 469-478.

²⁹ N. Agarwal, A. Brem, “Frugal and reverse innovation. Literature overview and case study insights from a German MNC in India and China”, in: *18th International ICE Conference on Engineering, Technology and Innovation*, p. 1-11, Piscataway, Institute of Electrical and Electronics Engineers, 2012; A. Aizstrauts, E. Ginters, M. Baltruks, M. Gusev, “Architecture for distributed simulation environment”, in *Procedia Computer Science*, 2015, vol. 43, no. C, p. 18-25.

³⁰ S.K. Jha, R.T. Krishnan, “Local innovation: The key to globalisation”, in *IIMB Management Review*, 2013, vol. 25, no. 4, p. 249-256; A. Aizstrauts, E. Ginters, I. Lauberte, M.A.P. Eroles, “Multi-level architecture on web services based policy domain use cases simulator”, in *Lecture Notes in Business Information Processing*, 2013, vol. 153, p. 130-145.

examples of reverse or frugal innovations³¹. The Dutch company Qiagen is another example of frugal innovation that provides an HPV (human papillomavirus) care device, in order to find out the virus for places with limited access to the healthcare system. It is portable and suitable for rural conditions. All these features were not available previously³². However, frugal innovations may have difficulties with adoption, even if they provide a low-cost solution to healthcare issues. Many frugal innovations do not spread to other places with similar problems; they stay local, “below-the-radar”. Another example is the auto-transfusion with an absence of blood donor that was developed in South Africa, however, the healthcare system of the neighboring country was not familiar with this³³.

Some of the researchers were focused on the effective water filtration systems based on frugal innovations’ principles³⁴. J. Levänen et al.³⁵ estimated the most remarkable cases of frugal innovations, including the water sector in the literature. One of the notable case studies demonstrates the reverse osmosis (RO) technology which was implemented in India, shows that the involvement of the consumers is a significant part of creating solutions in terms of frugal innovations. This permits the businessmen to customize and adapt their solutions to the requirements of their clients and leads to private cost reduction³⁶.

Craft skills East Africa focuses on the rural environment in Africa, providing green energy, using local materials in a sustainable way to serve the communities with limited access to the energy sources. SELCO supplies solar power to underserved villages, rural places, using an innovative approach that

³¹ N. Crisp, “Mutual learning and reverse innovation—where next?”, in *Globalization and Health*, 2014, vol. 10, no. 1, p. 14.

³² M. Zeschky, S. Winterhalterm, O. Gassmann, “From cost to frugal and reverse innovation: mapping the field and implications for global competitiveness”, in *Research-Technology Management*, 2014a, vol. 57, no. 4, p. 20-27.

³³ V.-T. Tran, P. Ravaud, “Frugal innovation in medicine for low resource settings”, in *BMC Medicine*, 2016, vol. 14, no. 1, article number 102.

³⁴ K.B.D. Btateu, J.B. Tchatchueng, C. Noubactep, S. Caré, “Designing metallic iron based water filters: Light from methylene blue discoloration”, in *Journal of Environmental Management*, 2016, vol. 166, p. 567-573; L. Annala, A. Sarin, J.L. Green, “Co-production of frugal innovation: Case of low-cost reverse osmosis water filters in India”, in *Journal of Cleaner Production*, 2018, vol. 171, p. 110-118; S. Heimann, A.I. Ndé-Tchoupé, R. Hu, T. Licha, C. Noubactep, “Investigating the suitability of Fe0 packed-beds for water defluoridation”, in *Chemosphere*, 2018, vol. 209, p. 578-587.

³⁵ J. Levänen, M. Hossain, T. Lyytinen, A. Hyvärinen, S. Numminen, M. Halme, “Implications of Frugal innovations on sustainable development: Evaluating water and energy innovations”, in *Sustainability*, 2016, vol. 8, no. 1, article number 4.

³⁶ L. Annala, A. Sarin, J.L. Green, “Co-production of frugal innovation: Case of low-cost reverse osmosis water filters in India”, in *Journal of Cleaner Production*, 2018, vol. 171, p. 110-118.

provides credits for the customers through financial organisations³⁷. Another research was focused on the water distillation, implementing the solar energy for purifying the water, that is crucially important for the rural areas³⁸. Most of the publications are empirical and presented by 63 %, the rest of them are theoretical and consist of 37 %.

The literature review covers 37% of research studies; most of the papers are conceptual and exploratory. Several authors are focused on theoretical perspective, trying to distinguish the phenomena of frugal innovations from others³⁹. The case study method (28%) is one of the common methods that the authors use in the research on frugal innovations, due to the lack of information on this topic. Siemens provided successful solutions for developing countries, implementing the case study, the research is focused on the establishment of multinational corporations in developing countries, and their innovation strategies. The study distinguishes relative terms of frugal innovations and analyses various practices of the German multinational corporation⁴⁰. Also, the case study approach was used by S. Winterhalter et al.⁴¹ His research is focused on the healthcare sector investigating the value creation process in terms of achieving a new market in developing countries. M.

³⁷ R. Khan, "How frugal innovation promotes social sustainability", in *Sustainability*, 2016, vol. 8, no. 10, article number 1034.

³⁸ M. Morciano, M. Fasano, U. Salomov, L. Ventola, E. Chiavazzo, P. Asinari, "Efficient steam generation by inexpensive narrow gap evaporation device for solar applications", in *Scientific Reports*, 2017, vol. 7, no. 1, article number 11970.

³⁹ A. Brem, P. Wolfram, "Research and development from the bottom up – introduction of terminologies for new product development in emerging markets", in *Journal of Innovation and Entrepreneurship*, 2014, vol. 3, no. 1, article number 9; P. Soni, R. Krishnan, "Frugal innovation: aligning theory, practice, and public policy", in *Journal of Indian Business Research*, 2014, vol. 6, no. 1, p. 29-47; A.K. Gupta, A.R. Dey, C. Shinde, H. Mahanta, C. Patel, R. Patel, N. Sahay, B. Sahu, P. Vivekanandan, S. Verma, P. Ganesham, V. Kumar, M. Patel, P. Tole, "Theory of open inclusive innovation for reciprocal, responsive and respectful outcomes: coping creatively with climatic and institutional risks", in *Journal of Open Innovation: Technology, Market, and Complexity*, 2016, vol. 2, no. 3, article number 16; V.-T. Tran, P. Ravaud, "Frugal innovation in medicine for low resource settings", in *BMC Medicine*, 2016, vol. 14, no. 1, article number 102; N. Agarwal, M. Grottke, S. Mishra, A. Brem, "A systematic literature review of constraint-based innovations: state of the art and future perspectives", in *IEEE Transactions on Engineering Management*, 2017, vol. 64, no. 1, p. 3-15.

⁴⁰ N. Agarwal, A. Brem, "Frugal and reverse innovation. Literature overview and case study insights from a German MNC in India and China", in: *18th International ICE Conference on Engineering, Technology and Innovation*, p. 1-11, Piscataway, Institute of Electrical and Electronics Engineers, 2012.

⁴¹ S. Winterhalter, M.B. Zeschky, L. Neumann, O. Gassmann, "Business models for frugal innovation in emerging markets: the case of the medical device and laboratory equipment industry", in *Technovation*, 2017, vol. 66-67, p. 3-13.

Zeschky et al.⁴² focus on the R&D organisation processes of multinational corporations in the healthcare and electronics sectors, using the data and information from four case studies. The systematic literature review was presented by such authors as M. Hossain⁴³, and N. Agarwal et al.⁴⁴, E. Rosca et al.⁴⁵, A. Pisoni et al.⁴⁶. Experiments were used by other authors, Btatkeu et al.⁴⁷, M. Morciano et al.⁴⁸, S. Heimann et al.⁴⁹ in the water sector and J. Baekelandt⁵⁰ in healthcare. However, due to the fact of terms overlapping such as frugal innovations, reverse innovation, sustainable innovations, etc., in fact, much more papers could be extracted.

As we have identified, researchers of the top-cited articles in frugal innovation have mostly focused their research effort on three groups of countries. Thus, the vast number of articles focuses on India, developing countries, and almost the same number on both developing and developed countries. The 39% of articles can be categorised in an additional group named “Not specified countries”, including conceptual, exploratory papers that have a theoretical perspective and may be implemented in different countries. A lot of researchers in their studies (19%) were focused on India. Economic reforms starting in India in 1991 followed by the fast-economic development of the country, which became an attractive topic for scholars focused on organisations and management practices⁵¹. With a large number of higher education institutions and investigation activity India could become an

⁴² M. Zeschky, B. Widenmayer, O. Gassmann, “Organising for reverse innovation in Western MNCs: the role of frugal product innovation capabilities”, in *International Journal of Technology Management*, 2014b, vol. 64, no. 2-4, p. 255.

⁴³ M. Hossain, “Mapping the frugal innovation phenomenon”, in *Technology in Society*, 2017, vol. 51, p. 199-208.

⁴⁴ N. Agarwal, M. Grottke, S. Mishra, A. Brem, “A systematic literature review of constraint-based innovations: state of the art and future perspectives”, in *IEEE Transactions on Engineering Management*, 2017, vol. 64, no. 1, p. 3-15.

⁴⁵ E. Rosca, J. Reedy, J.C. Bendul, “Does frugal innovation enable sustainable development? A systematic literature review”, in *The European Journal of Development Research*, 2018, vol. 30, no. 1, p. 136-157.

⁴⁶ A. Pisoni, L. Michelini, G. Martignoni, “Frugal approach to innovation: State of the art and future perspectives”, in *Journal of Cleaner Production*, 2018, vol. 171, p. 107-126.

⁴⁷ K.B.D. Btatkeu, J.B. Tchatchueng, C. Noubactep, S. Caré, “Designing metallic iron based water filters: Light from methylene blue discoloration”, in *Journal of Environmental Management*, 2016, vol. 166, p. 567-573.

⁴⁸ M. Morciano, M. Fasano, U. Salomov, L. Ventola, E. Chiavazzo, P. Asinari, “Efficient steam generation by inexpensive narrow gap evaporation device for solar applications”, in *Scientific Reports*, 2017, vol. 7, no. 1, article number 11970.

⁴⁹ S. Heimann, A.I. Ndé-Tchoupé, R. Hu, T. Licha, C. Noubactep, “Investigating the suitability of Fe0 packed-beds for water defluoridation”, in *Chemosphere*, 2018, vol. 209, p. 578-587.

⁵⁰ J. Baekelandt, “Total vaginal notes hysterectomy: A new approach to hysterectomy”, in *Journal of Minimally Invasive Gynecology*, 2015, vol. 22, no. 6, p. 1088-1094.

⁵¹ A. Nair, D. Ahlstrom, L. Filer, “Localized advantage in a global economy: The case of Bangalore”, in *Thunderbird International Business Review*, 2007, vol. 49, no. 5, p. 591-618.

innovation and knowledge transfer centre, however, during the last years, the level of successful innovations is still low, which stands for some shortcomings. The analysis demonstrates that there is a need to establish infrastructure, including all the sectors, in order to unlock the innovative potential. Hence, there is a need for deeper research on outcomes associated with infrastructure investment and their results in innovation. Therefore, it is necessary to facilitate the development of small and medium enterprises. The research shows that innovation and entrepreneurship are interconnected; facilitating entrepreneurship requires financial and knowledge support⁵².

The economic growth of developing countries influences significantly on the world of global business. The mean rate of increase of emerging economies is far above developed countries, which provides a strategic opportunity for the market extension⁵³. Developing countries that are represented by the costumers with low income and scarce resources which constitutes one of the rapidly increasing markets⁵⁴. The companies that can keep balance in the low price and innovation, delivering high value to the client have a competitive advantage in the market⁵⁵. The notion of frugal innovation and its features for a wide range of people that employ scarce resources is crucially important for developing and developed countries as well⁵⁶. However, the adaption of business models from countries with limited resources to the countries with developed economies, requires the consideration of the location of strategies application⁵⁷. Interaction with local institutions, involvement of the clients, empowerment of employees and focus on product development allow multinational corporations to provide frugal innovations in developing and

⁵² A. Nair, O. Guldiken, S. Fainshmidt, A. Pezeshkan, "Innovation in India: A review of past research and future directions", in *Asia Pacific Journal of Management*, 2015, vol. 32, no. 4, p. 925-958; O. Bezvesilna, A. Tkachuk, L. Chepyuk, S. Nechai, T. Khylychenko, "Introducing the principle of constructing an aviation gravimetric system with any type of gravimeter", in *Eastern-European Journal of Enterprise Technologies*, 2017, vol. 1, no. 7-85, p. 45-56.

⁵³ OECD, *Globalisation and Emerging Economies*, 2009. Available at <http://www.oecd.org/regional/searf2009/42576801.pdf>; A. Drummond, "Research on emerging economies: challenges are always opportunities", in *Global Strategy Journal*, 2012, vol. 2, no. 1, p. 48-50.

⁵⁴ O. Kravets, O. Sandikci, "Competently ordinary: New middle-class consumers in the emerging markets", in *Journal of Marketing*, 2014, vol. 78, no. 4, p. 125-140.

⁵⁵ R. Mudambi, "Hierarchy, coordination, and innovation in the multinational enterprise", in *Global Strategy Journal*, 2011, vol. 1, no. 3-4, p. 317-323.

⁵⁶ J. Prabhu, "Frugal innovation: doing more with less for more", in *Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences*, 2017, vol. 375, no. 2095, article number 20160372.

⁵⁷ J. Angot, L. Plé, "Serving poor people in rich countries: the bottom-of-the-pyramid business model solution", in *Journal of Business Strategy*, 2015, vol. 36, no. 2, p. 3-15; B. Derevyanko, L. Nikolenko, I. Syrmamiik, Y. Mykytenko, I. Gasparevich, "Assessment of financial and economic security of the region (based on the relevant statistics of the Donetsk region)", in *Investment Management and Financial Innovations*, 2018, vol. 15, no. 4, p. 283-295.

developed countries as well⁵⁸. This approach allowed companies to succeed in the global market⁵⁹. Y.A. Bhatti et al.⁶⁰ claim that globalization has influenced on South Asia, multinational corporations have to take into account the knowledge of South Asian organisations, and to use the opportunity of investment in them, while South Asian organisations could develop a regional and international partnership. However, M. Hossain et al.⁶¹ have clarified how the frugal innovations distribute, according to four dimensions. The authors found out that the difference in socio-economic conditions is an obstacle for the distribution of frugal innovations.

Conclusions

In this study, publications in English (238) were collected from Elsevier Scopus database during the period of 2010-2019 for using in statistical, bibliometric analysis, and theoretical review. The results reported herein should be considered in the light of some limitations. First, the sample size was limited, our dataset was taken out only from Scopus data base, addition of the other databases would provide more comprehensive information in frugal innovation field. Our research included the examination of the articles that were written in English, while articles which were presented in other languages were unincluded in the examination, extending of other languages would enrich the study. In addition, due to the novelty of the term of frugal innovation, it frequently overlaps with others such as reverse innovation, Gandhian engineering, jugaad, low-cost innovation, etc., there is a probability that some of the researchers substituted the term, thus there is a need of seeking the information on that literature beyond the frugal innovation field. Finally, some articles were enough theoretical and based on the literature review, however, they were illustrated by cases or examples that could lead to the bias in distinguishing them between theoretical and empirical. Groups obtained in the coupling analysis can be taken to analyse and synthesise the information considering different lines of research by the group identified.

⁵⁸ A. Ignatyuk, A. Dikiy, L. Shevtsiv, Y. Petlenko N. Klymash, O. Zaitsev, "Determination of the company's value under the influence of various factors", in *Journal of Optimization in Industrial Engineering*, 2021, vol. 14, no. 1, p. 151–157.

⁵⁹ S.K. Jha, R.T. Krishnan, "Local innovation: The key to globalisation", in *IIMB Management Review*, 2013, vol. 25, no. 4, p. 249-256.

⁶⁰ M. Hossain, H. Simula, M. Halme, "Can frugal go global? Diffusion patterns of frugal innovations", in *Technology in Society*, 2016, vol. 46, p. 132-139.