Journal of Management and Research (JMR)
Volume 9 Issue 1, Spring 2022
ISSN$_{(P)}$: 2218-2705 ISSN$_{(E)}$: 2519-7924
Homepage: https://ojs.umt.edu.pk/index.php/jmr

Article QR

Title:	**A Scientometric Analysis of University Business Incubators and Accelerators Based on 20 Year of Research**
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DOI:	https://doi.org/10.29145/jmr/91/03
History:	Received: December 16,2022, Revised: May 15, 2022, Accepted: June 20, 2022, Published Online: July 19, 2022
Citation:	Ali, A., Irfan, S., & Salman, Y. (2022). A scientometric analysis of university business incubators and accelerators based on 20 Year of Research. *Journal of Management and Research, 9*(1), 51-85. https://doi.org/10.29145/jmr/91/03
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Conflict of Interest:	Author(s) declared no conflict of interest

A publication of
Dr. Hasan Murad School of Management
University of Management and Technology, Lahore, Pakistan

A Scientometric Analysis of University Business Incubators and Accelerators Based on 20 Year of Research

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Abstract

University business incubators (UBIs) are established with a vision to promote entrepreneurship at university levels by providing people with support services. The purpose of this approach is to stimulate the growth and development of new startups, spin-offs, TTOs (Technology transfer offices), and existing firms. (UBIs) are dedicating a facility by providing subsidized office space, consultation, and other services. The current study is aimed to systematically review the literature of university business incubators and accelerators by keeping in view the importance of (UBIs). Besides, it also focuses on their roles of performance in economic and social development by promoting entrepreneurship at university campuses. This study is unique in a sense that it contributes to the university business incubation research by reviewing, synthesizing, and evaluating its literature with 'citations-based analysis approach'. Data of this research has been analyzed with the 'Scopus Database' since, 2001 to 2020. Articles have been screened and shortlisted based on predefined eligibility criteria. We have used 'R-Studio Biblioshiny Software' for articles' Scientometric analysis including most influential journals, authors, articles, and top contributing countries. Quantitative analysis has performed including yearly publications trend, citations trend, and top articles based on average citations. VOS-Viewer Software has also been used to perform co-occurrence analysis and co-authorship analysis. The content analysis of top 50, highly cited articles has been conducted to identify the methodological approaches, variables, and theoretical underpinnings. Findings contribute to university business incubation's (UBIs), literature by analyzing the articles individually, start-ups, incubators, networks, and university levels. Theoretical underpinnings used in (UBIs), represent the 'institutional theory', 'knowledge spillover theory of entrepreneurship', 'resource-based view' (RBV), 'structural theory', and 'triple helix model'.

***Keywords*:** bibliometric analysis, SLR, university business accelerators, university business incubators

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Introduction

Entrepreneurship has always been perceived as creating, launching, and operating new start-ups from a small scale at conventional level. However, this notion of entrepreneurship has been changed now due to its main role and performance in the economic growth and development. Moreover, it is reducing unemployment, exploiting opportunities, and providing a wide range of products and services, that benefits the society as a whole (Al-edenat, 2021).The creation and development of new startups, and firms significantly contribute to the global economy by promoting the social and economic development in the society (Zapata-Guerrero et al., 2021). While from last few decades, there has been an exponential growth in entrepreneurship development initiatives, which promotes entrepreneurship education and development programs at university campuses. Furthermore, it introduces special zones in the form of student's start-up centers, business incubators, and accelerators (McGee et al., 2021).

Moreover, business incubators have been considered as enablers and launching centers for the new startups, which tackle unemployment, economic development, and generate wealth in several developed countries (Al-edenat, 2021). Furthermore, business incubators, and accelerators have been considered as important tools and supportive mechanisms across the world. They not only create the new ventures, but also nurture its growth and development (Lukeš et al., 2019; Nicholls-Nixon & Valliere, 2020). Similarly, business incubators and start up centers are established to create, nurture, develop, and accelerate the technology-based firms. They are also contributing as important tools to introduce, initiate and revive the innovation in products and services, which paves a way to commercialize the current research from the university campuses(Aaboen, 2009).

Business incubators or accelerators are established to provide conducive environment to the startups so that they can perceive, initiate, nurture, and develop their business ideas and turn them into viable business ventures. In this way, business incubators have emerged as significant strategic tools to promote economic development in the industrialized and emerging economies, worldwide (Kiran & Bose, 2020). Business incubators provide support and services to newly established small businesses, such as office working space, consultation regarding legal aspects, guidance, trainings and workshops, and capital support. They also support the customized business services as per the needs and requirements of the startups (Del Campo et al.,2020). In this way, business incubators boost small business development and help them to cope with the growth challenges (Li et al., 2020).

Business incubation and entrepreneurship development centers are classified into three further categories that are (a) publicly funded business incubation, innovation, and technology transfer offices (TTOs), (b) university business

incubators and accelerators, (c) corporate private incubators. All these business centers have a common goal to promote entrepreneurial initiatives. They also support small businesses and create a hub of business activity (Piterou & Birch, 2016). However, among all these types of incubation centers, university business incubators (UBIs), are considered as an integral part of the entrepreneurship eco-system.

Besides, they also promote and support entrepreneurial activities at university campuses (Nicholls-Nixon et al., 2021). Although , the University incubators have gained maximum importance in entrepreneurial eco-system due to their distinctive performance in the way of success and development of university startups (Maritz et al., 2021). Hence, universities have made huge investments in the establishment of incubation centers and entrepreneurship development programs, over the last two decades across the globe (Breznitz & Zhang, 2019; Metcalf et al., 2021). University incubation centers are also influencing the startups in the reginal development along with promoting the entrepreneurial eco-system in the universities (Franco, 2020).

Pellegrini and Johnson-Sheehan (2021), find that most states are supporting their public sector universities to develop their new products and services by launching new startups and establishing entrepreneurial ecosystems, only in USA. One of the initiatives to promote entrepreneurship in this eco-system is to establish university business incubators (UBIs), which help in the launch of start-ups by students, researchers, university professors, and local entrepreneurs. Moreover, (UBIs), are established with a vision to foster transnational entrepreneurship (Pellegrini & Johnson-Sheehan, 2021), by providing support service. They are also assisting the growth and development of new startups, spin-offs, and existing firms through a dedicated facility, which provide subsidized office space, consultation, and other services (Etzkowitz, 2002; Grimaldi & Grandi, 2005).

The current study is aimed to systematically review the literature on (UBIs), and accelerators by keeping in view their importance and role in economic and social development by promoting entrepreneurship at university campuses. Although, prior studies have been conducted on the business incubators but there is a dearth of systematic literature on the (UBIs), u and accelerators. So, this particular study is contributing to the (UBIs), literature by reviewing, synthesizing, evaluating it with citations-based analysis in its unique ways. This research has twofold objectives a) to perform Scientometric analysis of bibliographic data, retrieved from Scopus data base, and b) to perform the content analysis of top 50 highly cited articles on (UBIs).

Methodology

This citation-based systematic literature review about (UBIs), and accelerators was conducted with a very articulate and rigorous process. Moreover, it was processed to ensure maximum objectivity in the articles search criteria and final selection based on predefined eligibility parameters. We performed search on Scopus database by applying below mentioned search criteria:

Table 1

Articles Search Criteria

Search Indicators	Parameters
Search Database	Scopus
Search Fields	Article Title, Abstract and Keywords
Subject Area	Business, Management and Accounting Economics, Econometrics and Finance Social Sciences Decision Sciences
Tenure	2001-2020
Document Type	Articles
Source Type	Journal
Language	English

After performing the query on Scopus advanced search with the articles search criteria, there were 432 articles, appeared in the initial results. Bibliographic data of these articles were exported in CSV and Bibtex format. After applying stringent eligibility criteria, 268 out of 432 articles, were included in this systematic.

Table 2

Articles Eligibility Criteria

Eligibility Indicators	Description
Articles Status	Published journal articles
Design of studies	Review, theoretical, quantitative, and qualitative studies
Main issue of studies	Studies on any issue of university business incubators, and accelerators.
Field of articles	University business incubation

We read the articles' titles, abstracts, and keywords to select those articles which meet eligibility criteria. The selected articles were as follows; a) if any of these keyword(s) (university incubator(s), university accelerator(s), university business incubator, university business accelerator, university incubation, and academic incubator) are found in title, abstract or keywords; b) if the issue of

research was related to any aspect of (UBIs), whether directly or indirectly (indirectly through stakeholders). We excluded all those articles which were not related to research on (UBIs). Although, the current research was conducted on the various aspects of business incubators, we still focused on the various facets of (UBIs). However, the objectives of this citation-based systematic literature review was another focus of this particular study. We used R-Studio Biblioshiny package developed by Aria and Cuccurullo, (2017), Scientometric analysis that included most influential journals, authors, articles, and top contributing countries.

Microsoft excel software was used for quantitative analysis of the yearly publications trend, citations trend, and top articles based on average citations. NVivo (R-1) software was used to identify most frequent words in the articles, titles, abstracts and key words. Similarly, VOS-Viewer software was used to perform co-occurrence analysis of key words based on the bibliometrics, co-occurrences, and content of the articles. For this purpose, the following mentioned citations were based on SLR, in which we reviewed the work of (Ahmad et al., 2020; Ali et al., 2019; Almeida & de Paula, 2019; Corbet et al., 2019; Pourkhani et al., 2019), and adopted various technical analysis techniques from these articles.

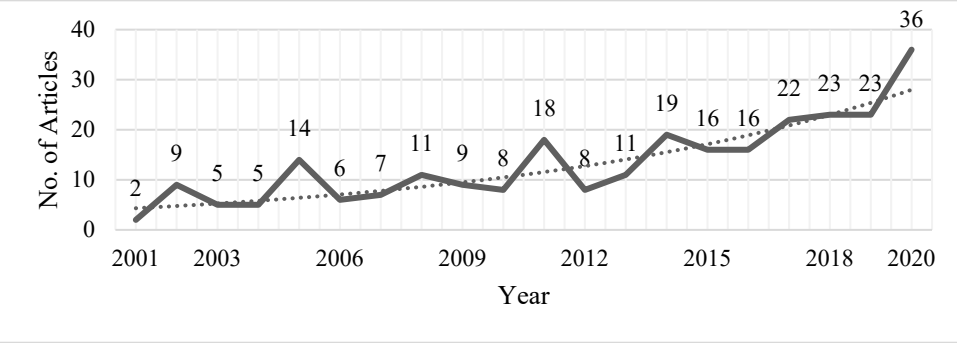
Analysis and Results

The results are divided into three main sections. Section 1, represents annual publications trend, annual citations trend, influential journals, influential authors, influential papers, and influential countries in the field of university business incubation. Section 2, represents co-occurrence analysis of article's titles, abstracts, keywords, and co-authorship analysis. Section 3, represents content analysis of top 50 journals.

Section 1 Bibliometric Analysis

Figure1

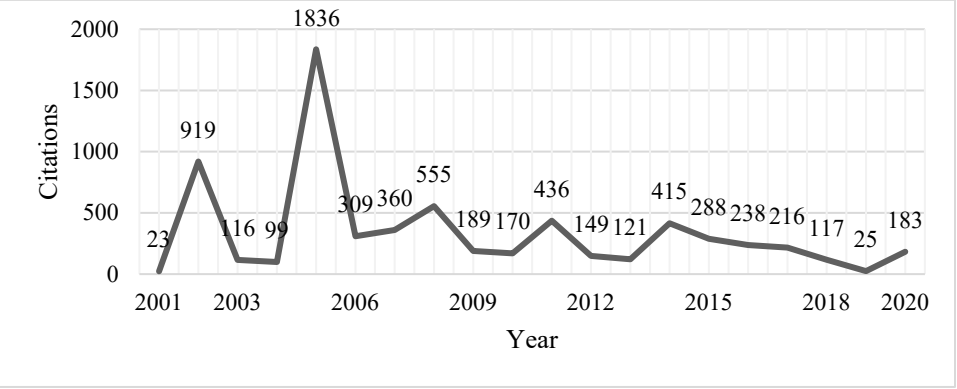
Annual Publications Trend, (2001 to 2020).



*Annual growth rate 31.8%

Figure 2

Annual Citations Trend, (2001 to 2020).



Annual publications trend in figure; 1 reveals that annual publications growth rate is 31.8%. It also indicates that in the first decade of research, (2001 to 2010), only 76 (28%) articles were published whereas in time period of (2011 to 2015), 72 (27%) articles were published, and among (2016 to 2020) years, 120 (45%) articles were published. This calculation depicts that majority of the research on (UBIs), was carried out in the last 10 years as there had been almost 300% increase in the publications. It clearly indicates the importance of research on (UBIs), for the promotion and development of entrepreneurship at the university campuses.

Moreover, annual citations trend as depicted in figure:2 indicates the interesting statistics, as 4576 (68%) citations are from articles published among (2001 to 2010), years whereas 2188 (32%) citations are from those articles published among (2011 to 2020). Citations analysis indicate that majority articles have been cited, which were published in the time period of (2001 to 2010).

Table 3

Ranking of Top 20 Most Influential Journals

Title of Journal	Publications		Citations			Average Citations per Year (APY)	
	N	%	N	%	Rank 1		Rank 2
Research Policy	6	2.6	1242	18.6	1	15	3
Technovation	13	5.6	1209	18.1	2	10.6	7

Title of Journal	Publications		Citations			Average Citations per Year (APY)	
	N	%	N	%	Rank 1		Rank 2
Journal of Technology Transfer	24	10.3	782	11.7	3	10.2	8
Journal of Business Venturing	2	0.9	591	8.8	4	19.2	2
Entrepreneurship: Theory and Practice	3	1.3	283	4.2	5	9.6	9
Journal of Management Studies	2	0.9	270	4.0	6	13.8	4
Science and Public Policy	2	0.9	194	2.9	7	6.4	13
Technological Forecasting and Social Change	6	2.6	187	2.8	8	11.0	5
International Journal of Entrepreneurship and Innovation Management	13	5.6	187	2.8	8	1.3	17
Foundations and Trends in Entrepreneurship	1	0.4	139	2.1	9	10.7	6
Technology in Society	2	0.9	116	1.7	10	7.1	11
International Journal of Entrepreneurial Behaviour and Research	5	2.1	112	1.7	11	4.4	15
Journal of Small Business Management	3	1.3	98	1.5	12	6.7	12
Small Business Economics	2	0.9	84	1.3	13	21.3	1
Journal of Business Research	2	0.9	75	1.1	14	9.4	10

Title of Journal	Publications		Citations			Average Citations per Year (APY)	
	N	%	N	%	Rank 1		Rank 2
World Development	1	0.4	53	0.8	15	4.4	15
International Entrepreneurship and Management Journal	3	1.3	52	0.8	16	5.6	14
Industry and Higher Education	15	6.4	52	0.8	16	0.4	18
International Small Business Journal	1	0.4	50	0.7	17	3.8	16
International Journal of Management Education	1	0.4	44	0.7	17	11	5

Table 3 represents top influential journals, in which Ranks 1, indicates the 'journals' according to total citations and Rank 2, indicates the 'ranking of journals' according to average citations per year. According to Rank 1, Research Policy, Technovation, Journal of Technology Transfer Journal of Business Venturing, Entrepreneurship 'Theory and Practice', and Journal of Management Studies, are the top 5 highly influential journals. Whereas, according to Rank 2, (Average citations per year), Small Business Economics, Journal of Business Venturing, Research Policy, Journal of Management Studies, International Journal of Management Education, and Technological Forecasting and Social Change, are the top five influential journals. Average citations per year were calculated by following the method as specified by Ahmad et al. (2020) in their paper titled "Banking Sector Performance, Profitability, And Efficiency: A Citation-Based Systematic Literature Review".

Top five most influential journals based on the (APY), are representing small business economics, being the number one and having 21.3, average citations per year. This is followed by the journal of business venturing having 19.25, average citations per year, research policy at number three having 15 average citations per year, journal of management studies stood at 4th having 13.8 average citations per year. Further, 'technological forecasting and social change' and 'international journal of management education' both secured 5th position having 12.5 average citations per year.

Figure 3

Top 5 Influential Journals based on Average Citations per Year, (APY).

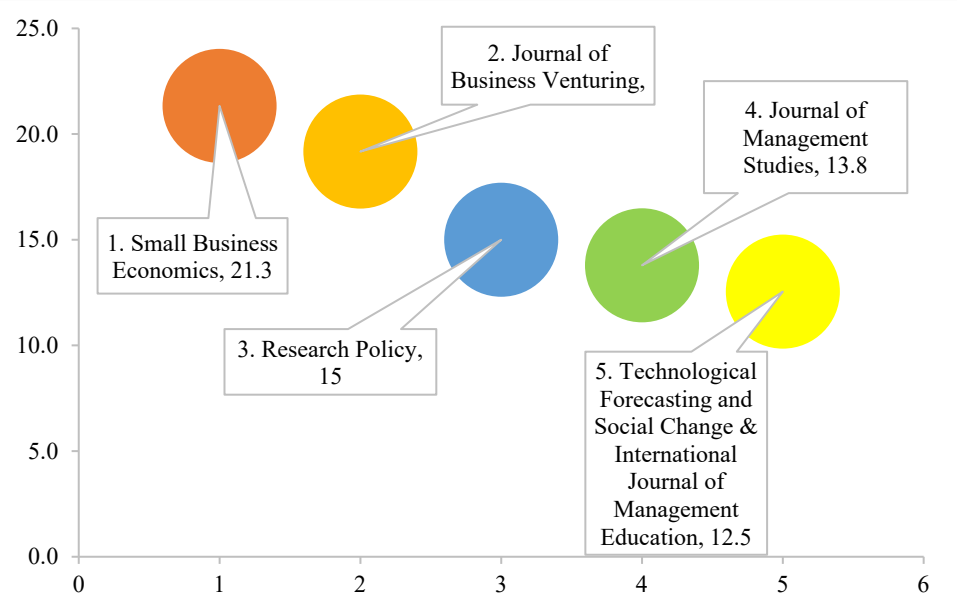
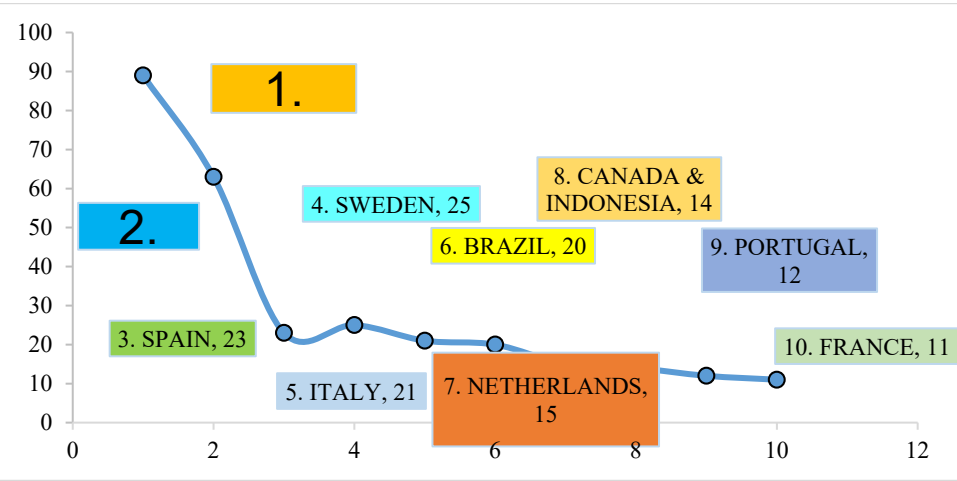


Figure 4

Ranking of Top 10 Countries Based on Publications



Top ten countries producing research publications in the area of university business incubation are USA, UK, Spain, Sweden, Italy, Brazil, Netherlands,

Canada, and Indonesia, Portugal, and France. Interestingly, maximum researches have been done and published in USA and Europe, whereas, only 1 country Indonesia, is from Asia.

Table 4

Ranking of Top 25 Influential Authors Based on Total Citations

Rank	Author	H_index	G_index	M_index	TC	NP
1	Wright M	6	6	0.38	607	6
2	Grimaldi R	5	6	0.25	535	6
3	Markman GD	2	2	0.13	465	2
4	Phan PH	2	2	0.13	423	2
5	Marvel MR	4	4	0.29	379	4
6	Rothaermel FT	2	2	0.13	379	2
7	Thursby M	2	2	0.13	379	2
8	Siegel DS	3	3	0.20	369	3
9	Etzkowitz H	6	6	0.32	367	6
10	Colombo MG	1	1	0.05	320	1
11	Delmastro M	1	1	0.05	320	1
12	Lockett A	2	2	0.13	309	2
13	Siegel D	2	2	0.13	309	2
14	George G	1	1	0.05	307	1
15	Zahra SA	1	1	0.05	307	1
16	Balkin DB	1	1	0.06	284	1
17	Gianiodis PT	1	1	0.06	284	1
18	Grandi A	3	3	0.15	274	3
19	Ensley MD	1	1	0.06	271	1
20	Mcadam M	4	4	0.31	230	4
21	Lumpkin GT	1	1	0.07	229	1
22	Mcadam R	4	5	0.27	212	5
23	Chan KF	1	1	0.06	199	1

Rank	Author	H_index	G_index	M_index	TC	NP
24	Lau T	1	1	0.06	199	1
25	Von Zedtwitz M	2	2	0.11	187	2

Table 4 ranks the top 25 most influential authors, based on the total citations of their articles in the field of business incubation.

Table 5

Ranking of Top 25 Journals Based on H-Index

Rank	Source	H_index	G_index	M_index	TC	NP
1	Journal of Technology Transfer	13	19	0.87	782	24
2	Technovation	12	13	0.71	1209	13
3	International Journal of Entrepreneurship and Innovation Management	6	13	0.32	187	13
4	Research Policy	6	6	0.32	1242	6
5	Industry and Higher Education	4	6	0.18	52	15
6	Journal of Technology Management and Innovation	4	5	0.44	43	5
7	Technological Forecasting And Social Change	4	5	0.44	187	6
8	International Journal of Entrepreneurial Behaviour and Research	4	4	0.31	112	5
9	International Journal of Entrepreneurship and Small Business	3	3	0.27	11	6
10	Entrepreneurship: Theory and Practice	3	3	0.21	283	3

Rank	Source	H_index	G_index	M_index	TC	NP
11	International Entrepreneurship and Management Journal	3	3	0.25	52	3
12	International Journal of Innovation and Technology Management	3	3	0.19	17	3
13	Journal of International Entrepreneurship	3	3	0.25	26	3
14	Journal of Small Business Management	3	3	0.18	98	3
15	International Journal of Innovation Management	2	3	0.20	11	4
16	International Journal of Technoentrepreneurship	2	3	0.14	11	4
17	International Journal of Technology Management	2	3	0.13	17	3
18	Engineering Economics	2	2	0.15	6	2
19	Enterprise Development and Microfinance	2	2	0.17	6	2
20	European Journal of Innovation Management	2	2	0.22	7	2
21	International Journal of Gender and Entrepreneurship	2	2	0.18	26	2
22	International Journal of Technology and Globalisation	2	2	0.13	28	2
23	Journal of Business Research	2	2	0.33	75	2

Rank	Source	H_index	G_index	M_index	TC	NP
24	Journal of Business Venturing	2	2	0.11	591	2
25	Journal of Management Studies	2	2	0.15	270	2

Table 5 ranks the top 25 journals based on H-index articles in the field of business incubation.

Table 6

Top 25 Articles based on Average Citations per Year (APY)

Rank	APY	Total Citations	Effective Years	Article Title	Reference
1	69	69	1	Business incubators and accelerators: a co-citation analysis-based, systematic literature review	(Hausberg & Korreck, 2020)
2	27.5	55	2	How intermediary organizations facilitate university–industry technology transfer: A proximity approach	(Villani, Rasmussen, & Grimaldi, 2017)
3	24.5	49	2	An emerging ecosystem for student start-ups	(Wright, Siegel, & Mustar, 2017)
4	22.0	22	1	A social capital approach to the development of sustainable entrepreneurial ecosystems: an explorative study	(Theodoraki, Messeghem, & Rice, 2018)

Rank	APY	Total Citations	Effective Years	Article Title	Reference
5	20.7	62	3	A trajectory of early-stage spinoff success: the role of knowledge intermediaries within an entrepreneurial university ecosystem	(Hayter, 2016)
6	20.3	284	14	Entrepreneurship and university-based technology transfer	(Markman, Phan, Balkin, & Gianiodis, 2005)
7	19.4	271	14	The creation of spin-off firms at public research institutions: Managerial and policy implications	(Lockett, Siegel, Wright, & Ensley, 2005)
8	19.1	229	12	Technology entrepreneurs' human capital and its effects on innovation radicalness	(Marvel & Lumpkin, 2007)
9	18.8	320	17	How effective are technology incubators? Evidence from Italy	(Colombo & Delmastro, 2002)
10	18.7	262	14	Business incubators and new venture creation: An assessment of incubating models	(Grimaldi & Grandi, 2005)
11	18.4	92	5	Entrepreneurial universities in two European regions: A case study comparison	(Guerrero, Urbano, Cunningham, & Organ, 2014)

Rank	APY	Total Citations	Effective Years	Article Title	Reference
12	18.1	307	17	The effects of business-university alliances on innovative output and financial performance: A study of publicly traded biotechnology companies	(George, Zahra, & Wood Jr, 2002)
13	16.7	50	3	The impact of university-based incubation support on the innovation strategy of academic spin-offs	(Soetanto & Jack, 2016)
14	16.5	181	11	Research and technology commercialization	(Markman, Siegel, & Wright, 2008)
15	16.4	131	8	Complements or substitutes? the role of universities and local context in supporting the creation of academic spin-offs	(Fini, Grimaldi, Santoni, & Sobrero, 2011)
16	14.5	58	4	Knowledge flow in Technological Business Incubators: Evidence from Australia and Israel	(Rubin, Aas, & Stead, 2015)
17	14.2	199	14	Assessing technology incubator programs in the science park: The good, the bad and the ugly	(Chan & Lau, 2005)

Rank	APY	Total Citations	Effective Years	Article Title	Reference
18	14.2	156	11	High tech start-ups in University Science Park incubators: The relationship between the start-up's lifecycle progression and use of the incubator's resources	(McAdam & McAdam, 2008)
19	14.0	14	1	Determinants of Graduates' Start-Ups Creation across a Multi-Campus Entrepreneurial University: The Case of Monterrey Institute of Technology and Higher Education	(Guerrero, Urbano, Cunningham, & Gajón, 2018)
20	13.9	195	14	University-incubator firm knowledge flows: Assessing their impact on incubator firm performance	(Rothaermel & Thursby, 2005b)
21	13.1	184	14	Incubator firm failure or graduation?: The role of university linkages	(Rothaermel & Thursby, 2005a)
22	13.0	117	9	The role of science parks and business incubators in converging countries: Evidence from Portugal	(Ratinho & Henriques, 2010)
23	13.0	13	1	Tech. BI mechanisms and sustainable regional development	(Lamine et al., 2018)

Rank	APY	Total Citations	Effective Years	Article Title	Reference
24	12.0	12	1	Creating entrepreneurial universities in an emerging economy: Evidence from Brazil	(Dalmarco, Hulsink, & Blois, 2018)
25	12.0	12	1	Have you been served? The impact of university entrepreneurial support on start-ups' network formation	(Breznitz, Clayton, Defazio, & Isett, 2018)

Table 6 ranks the top 25 articles in the field of business incubation, based on average citations per year.

Section 2 Co-occurrence and Co-Authorship Analysis

Co-occurrence and Co-authorship Analysis was conducted by using VOS Viewer software, which was developed by van Eck and Waltman (2010). This analysis indicates the terms co-occurrence pattern across different clusters. Figure: 5 represents the co-occurrence based on titles and abstracts of the articles, minimum occurrence of a term was kept at 10. Which means, any term having frequency of less than 10 was not included in the analysis, so 163 terms met threshold and 7 clusters were developed. Figure 6 depicts the co-occurrence based on articles' titles, minimum occurrence of a term was kept at 2 so 122 terms met threshold12 clusters were developed. Further, Figure 7 also represents co-occurrence based on the abstracts, whereas minimum occurrence of a term was kept at 10 and 148 terms, met threshold 6 major clusters were emerged.

Figure 8 represents co-occurrence based on keywords in which minimum occurrence of a keyword was kept at 2 and 125 terms met threshold and 11 clusters were emerged. Lastly, Figure: 9 represents co-authorship based analysis whereas minimum articles of an author were kept at 1 and found that 32 authors were connected and 7 clusters were emerged.

Figure 5

Co-occurrence Based on Titles and Abstracts

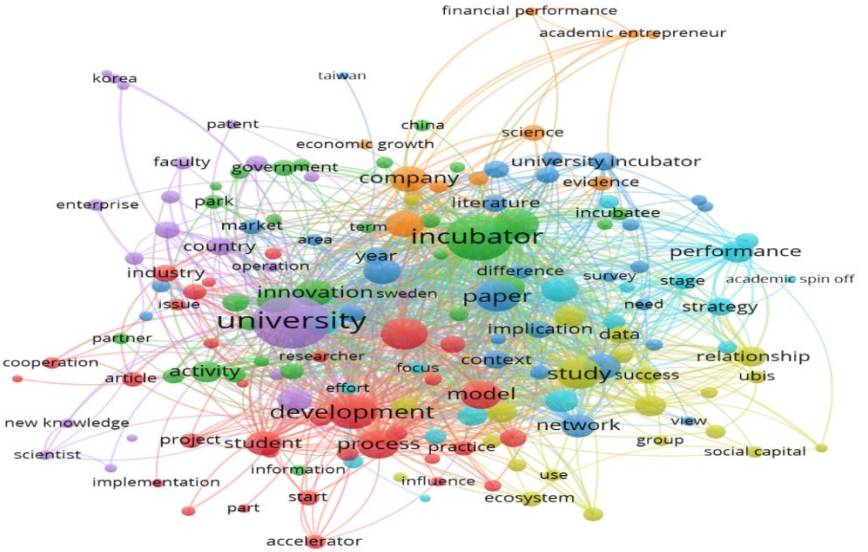


Figure 6

Co-occurrence Based on Article Titles

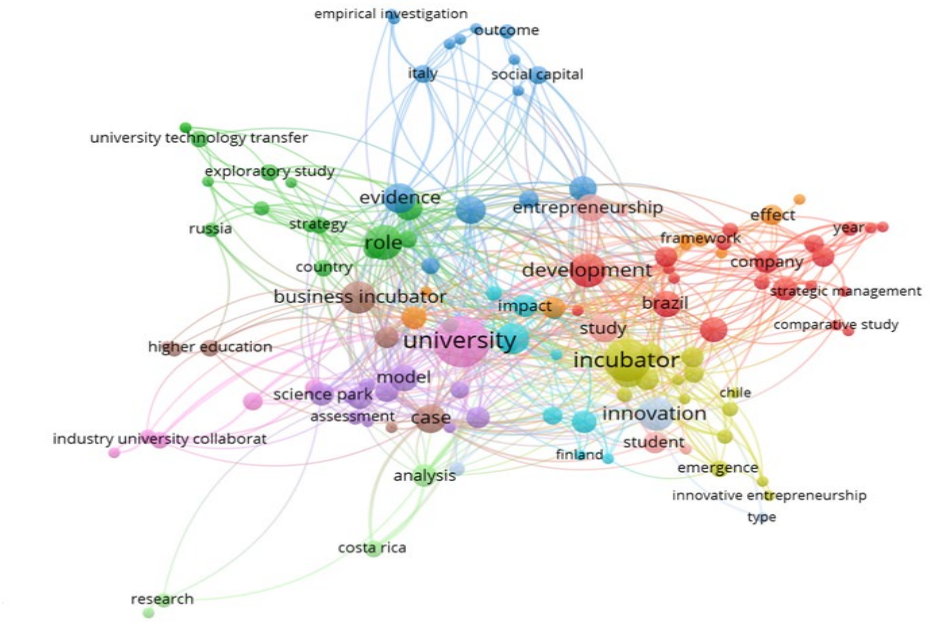


Figure 7

Co-occurrence Based on Articles Abstracts

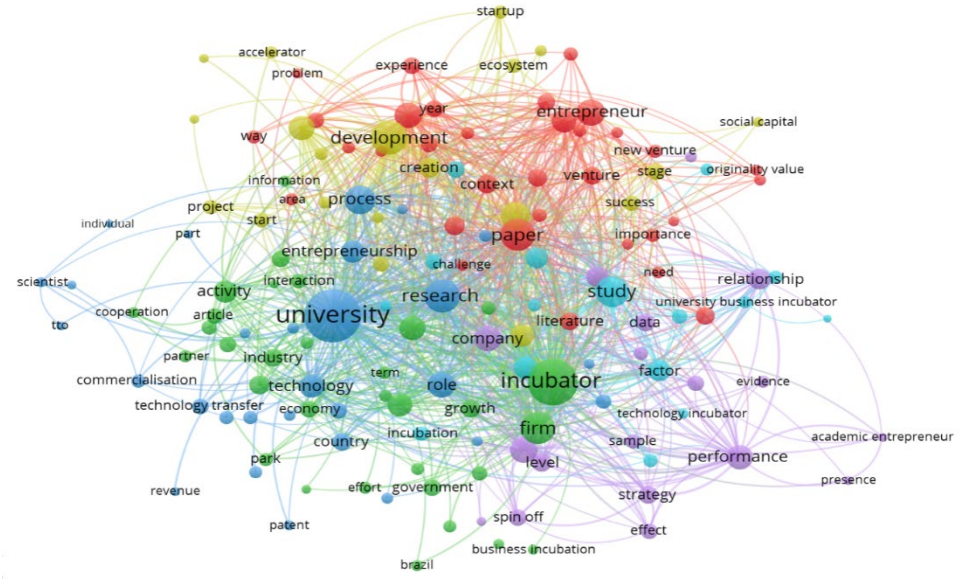


Figure 8

Co-occurrence Based on Articles Keywords

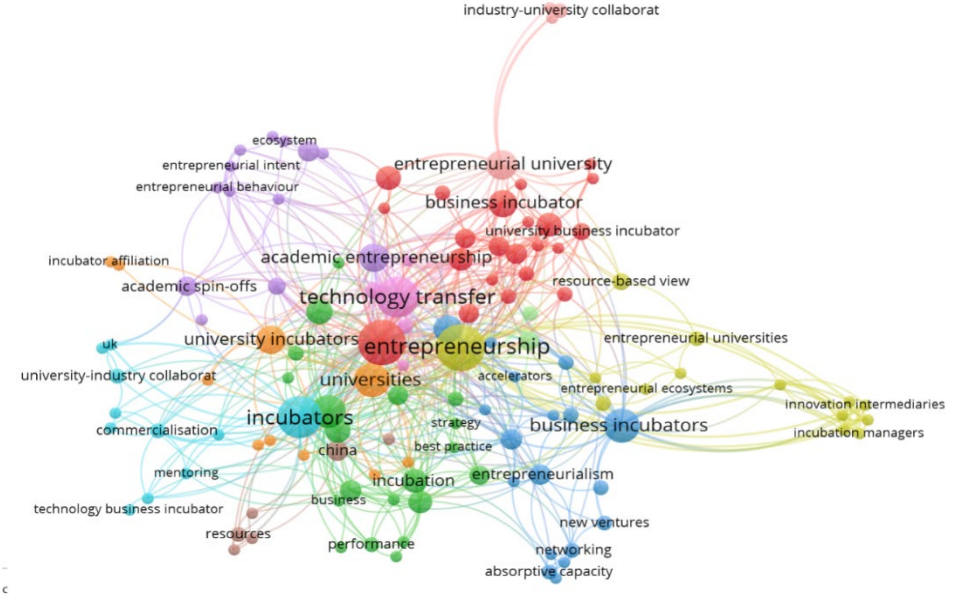
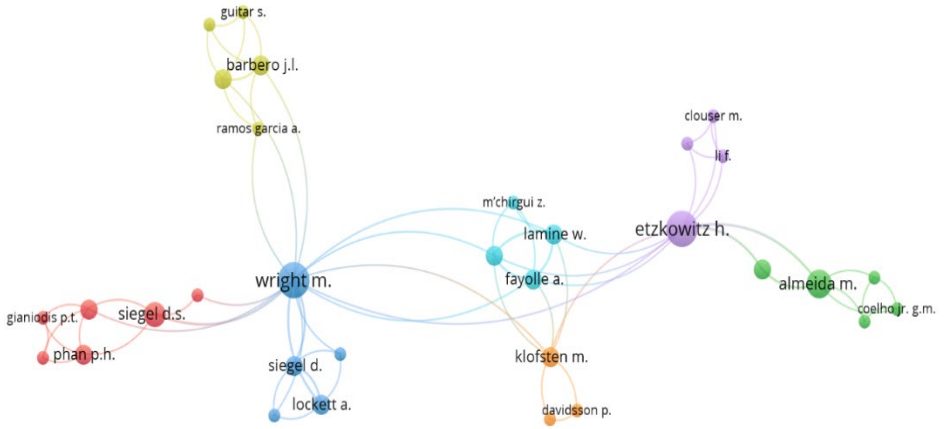


Figure 9

Co-Authorship Based Analysis



Section 3 Content Analysis

Table 7

Top 20 most frequent words in Titles, Abstracts, and Keywords of 268 papers

Rank	Title		Abstract		Keywords	
	Word	Count	Word	Count	Word	Count
1	University	109	University	551	University	130
2	Business	70	Incubators	422	Business	108
3	Incubators	65	Business	403	Technology	99
4	Technology	57	Technology	350	Entrepreneursh-ip	89
5	Incubator	44	Research	329	Incubators	82
6	Entrepreneuri-al	39	Incubator	272	Innovation	74
7	Incubation	36	Universities	260	Incubator	73
8	Study	33	Development	250	Entrepreneurial	49
9	Innovation	32	Entrepreneuri-al	228	Transfer	44
10	Case	31	Support	205	Incubation	39
11	Based	29	Knowledge	204	Knowledge	36

Rank	Title		Abstract		Keywords	
	Word	Count	Word	Count	Word	Count
12	Entrepreneurs -hip	27	Study	198	Academic	33
13	Universities	25	Based	186	Spin	31
14	Development	21	Paper	175	Development	27
15	Knowledge	20	Innovation	174	Based	25
16	Role	20	Entrepreneur-ship	166	Science	25
17	Science	19	Incubation	150	Education	24
18	Academic	18	Firms	146	Universities	23
19	Spin	18	Entrepreneur-s	126	Offs	22
20	Start	18	Science	121	Performance	22

*Query Method; NVIVO(R-1) Words Frequency Query run on top 20 words in titles, abstract, and keywords of all 268 articles, minimum word length kept at 4.

Table 7 represents the frequencies of top 20 keywords of all 268 articles. These are highlighted keywords which further consist of all three common categories, such as Titles, Abstracts, and Keywords. Table: 8 Analysis of the top 50 articles research type indicates that majority 23 (45%), articles were qualitative studies, 13 (25%), articles were quantitative studies, 12 (24%), articles were theoretical and review papers, and 3(6%), articles adopted mixed methods designs.

In qualitative studies, majority of the articles, around 15(65%), adopted case study designs followed by comparative, grounded theory, longitudinal, and narrative. In quantitative studies, majority articles 11(85%), adopted survey research design, followed by longitudinal design. So it could be articulated that majority of the articles were qualitative and theoretical among top 50 highly cited publications.

Content Analysis of Top 50 Highly Cited Articles

Table 8

Type of Studies

Study Types	F	Percentage (%)	Study Design	F	Percentage (%)
Quantitative	13	25%	Longitudinal	2	15%

Study Types	F	Percentage (%)	Study Design	F	Percentage (%)
			Survey	11	85%
Qualitative	23	45%	Case Study	15	65%
			Comparative	2	9%
			Grounded Theory	1	4%
			Longitudinal	2	9%
			Narrative	1	4%
			Qualitative Research	2	9%
Mixed Methods	3	6%			
Review/Theoretical Papers	12	24%			

Majority of the articles were out of 50 highly cited articles with adopted qualitative research designs, as 45%, followed by 25% quantitative, and 24% were found to be review articles. In qualitative studies majority 65% followed the case study designs, where in quantitative majority 85% followed survey designs.

Table 9

Quantitative Studies Analysis

Level of Study	Study Variables	References
Individual	Entrepreneurs' experience Entrepreneurs' formal education Entrepreneurs' prior knowledge of customer problems, and markets Knowledge acquisition (Technology, market)	(Lundqvist, 2014; Marvel, 2013; Marvel & Lumpkin, 2007; Sullivan & Marvel, 2011)
	Network reliance Innovation radicalness, Surrogate entrepreneur	
Start Up/Spin-off/Firms/TTOs	Characteristics of the Start up s/Spin-off Funding sources	(Barbero, Casillas, Ramos, &

Level of Study	Study Variables	References
	Relationship with university Relationship with incubator Patents Industrial collaborations Geographical location Networking support Entrepreneurial support Innovation strategy Performance (Sales growth, employment growth participation in domestic R&D programs Employment generation cost	Guitar, 2012; Salvador, 2011; Soetanto & Jack, 2016)
University and Incubator	Knowledge flows- From university to incubator firms Licensing agreement Incubator performance (Revenues, total funds raised, venture capital funding, failure, and graduation) Incentive structures for faculty to engage in commercialization Local-context support mechanisms No. of academic spin-offs Innovation (Technological, product, organizational)	(Barbero, Casillas, Wright, & Ramos Garcia, 2014; Fini et al., 2011; Rothaermel & Thursby, 2005b)

Table 9 depicts analysis of quantitative studies. It indicates that the variables which were studied at three levels individually, Start Up/Spin-off/Firms/TTOs and university or incubators level. The focus of the current research at individual level variables were the entrepreneurs' experiences at the incubation. The main focus was their formal education, prior knowledge of customer problems, markets, how do they acquire the knowledge of technology and market, network reliance, innovation radicalness, and surrogate entrepreneur.

At startup level, this particular research was focused on the understanding characteristics of the Start ups/Spin-offs, their funding sources. It further was focused on how they maintain relationship with university, and the incubators. Moreover, registering patents, making industrial collaborations, geographical location of the incubators, networking support, entrepreneurial support, innovation

strategy, performance (Sales growth, employment growth participation in domestic R&D programs), and employment generation cost.

At the university and incubator level, this research was focused on knowledge flows, from university to incubator firms, licensing agreement, incubator performance (Revenues, total funds raised, venture capital funding, failure, and graduation), incentive structures for faculty to engage in commercialization, local-context support mechanisms, number of academic spin-offs, and innovations (Technological, product, organizational).

Table 10

Qualitative Studies Analysis

Level of Study	Study Variables	References
University	UTTO (University technology transfer offices) structures Licensing for equity Knowledge source University Links Support measures for entrepreneurship education programs Attitudes toward entrepreneurship Suitability of management Entrepreneurial organization and governance structure	(Aaboen, 2009; Barbero et al., 2012; Berbegal-Mirabent, Ribeiro-Soriano, & García, 2015; Chan & Lau, 2005; Etzkowitz, 2002; Etzkowitz, de Mello, & Almeida, 2005; Grimaldi & Grandi, 2005; Guerrero et al., 2014; Jansen, Van De Zande, Brinkkemper, Stam, & Varma, 2015; Leca, Gond, & Barin Cruz, 2014; Markman et al., 2005; McAdam & Marlow, 2008; McAdam & McAdam, 2008; O'Gorman, Byrne, & Pandya, 2008; Patton, Warren, & Bream, 2009; Ratinho & Henriques, 2010; Roig-Tierno, Alcazar, & Ribeiro-Navarrete, 2015; Villani et al., 2017; Warren, Patton, & Bream, 2009; Zedtwitz, 2003)
	Support infrastructures for entrepreneurship Entrepreneurship encouragement offerings Commercialization of research ideas	

Level of Study	Study Variables	References
Incubators	Incubator business model	
	Incubator value creation processes Networked entityStrategic position of incubators Assessment model technology incubator Clustering effect	
	Role models	
	Provision of physical infrastructure Support infrastructures	
	TTO staff's specialist technical skills	
Capital and reward systems	Reward systems Human capital Financial capital Technological capital Social capital	
Start Ups	Opportunity recognition	
	Value creation in professional service firms	
	Cognitive, organizational, and social proximity	
	Clustering effect Credibility and image	
	Access to professional networks Performativity	

Level of Study	Study Variables	References
Networks	Social/personal networks Trust	
	Directional support and external networks Normative frameworks	

Table 10 indicates the main study variables of qualitative studies among top 50 highly cited articles. In qualitative studies, at university level, this research was focused on the structures of university, its technology transfers offices, licensing for equity, knowledge source, university links, and support measures for entrepreneurship education programs. Besides, attitudes towards entrepreneurship, suitability of management, entrepreneurial organization and governance structure, support infrastructures for entrepreneurship, entrepreneurship encouragement offerings, and commercialization of research ideas were also the part of focus. Similarly, at incubator level, the focus of major research was on the business model of incubator, value creation processes, networked entity, strategic position of incubators, assessment model, and technology incubator. Further, the clustering effects, provision of physical infrastructure, support infrastructures, and TTO staff's specialist technical skills were also under the consideration. Moreover, research was also focused on reward systems, human, financial, technological, and social capital. At start up level, the research focus was on the opportunity recognition process, value creation in professional service firms, cognitive, organizational, and social proximity, by giving the clustering effect credibility and image access to professional networks, and performativity.

Another stream of research was focused on network dynamics of the incubators, including social/personal networks, trust, directional support and external networks, and normative frameworks of the incubators.

Discussion

Conclusion

University business incubators (UBIs), play important roles in the development and growth of entrepreneurship at universities by providing conducive and enabling environment, infrastructure, and essential services to the start-ups. The current study is aimed to conduct the systematic review about university business incubators (UBIs), and accelerators. So, this particular study is contributing to the (UBI), literature by reviewing, synthesizing, and evaluating it with the citations-based analysis. This particular study had twofold objectives a)

to perform the Scientometric analysis of bibliographic data, retrieved from Scopus data base, and b) to perform the content analysis of top 50 highly cited articles, on university business incubators.

Annual publications trend revealed that annual publications growth rate is 31.8%. Majority of the researches on (UBIs), were carried out in the last decade among (2011 to 2020) years, as there was almost 300% increase in the publications. It clearly indicated the importance of research on (UBIs), for the promotion and development of entrepreneurship at the university campuses. Moreover, annual citations trend indicated that majority articles were being cited and published during the time period of (2001 to 2010). Co-occurrence and Co-authorship Analysis was conducted by using VOS Viewer software which was developed by van Eck and Waltman (2010). Co-occurrence based on titles, abstracts, and keywords analysis indicated the terms of co-occurrence pattern across different clusters. Analysis of the top 50 articles research type indicated that majority 23 (45%) articles were qualitative studies, 13 (25%) articles were quantitative studies, and 12 (24%) articles were theoretical and review papers, and 3(6%) articles adopted the mixed method designs. In qualitative studies, majority 15(65%) adopted the case study designs which were followed by the comparative, grounded theory, longitudinal, and narrative. In quantitative studies, majority 11(85%) adopted the survey research design followed by longitudinal design. So, it could be articulated that majority of the articles were qualitative, and theoretical among the top 50 highly cited publications. Theoretical underpinnings used in (UBIs), were the institutional theory, knowledge spillover theory of entrepreneurship, resource-based view (RBV), structural theory, and triple helix model.

Limitations of The Study

This citation-based SLR was conducted on the Scopus database only and it was limited to 20 years' time period of research from 2001 to 2020. So findings might be understood accordingly, and results might not be generalized to other databases. Researchers tried their best to ensure the maximum objectivity, while screening the eligible articles. The authors declared some possibilities of error or omission, during screening, selection, and analysis of the articles.

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