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Start-up Accelerator: State of the Art and Future Directions

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Abstract:

Purpose: *The paper presents a review of the literature concerning start-up accelerators and a classification of related research untill August 2021.*
Approach/Methodology/Design: *While elaborating the classification, the authors coded works according to the type of accelerator and implemented acceleration program. Furthermore, the paper identifies the countries, research bodies and authors who focus on research on the functioning of accelerators. The authors present how various accelerator forms operate and how they perform.*
Findings: *The paper systematizes knowledge related to start-up accelerators available in the Scopus base and suggests directions for future research.*
Practical Implications: *Recently a clear phenomenon is shown that is the development of a start-up ecosystem, in particular creation and professionalization of the new form of organisation that is a start-up accelerator. This entity acts as a bridge between start-ups and corporations and big enterprises, promoting success of both sides – conclusion of business contracts. More start-ups and corporations decide to collaborate with accelerators that, with their acceleration programs involving big companies, support them both. By monitoring the corporate-start-up collaboration, accelerators actively promote both parties, also in terms of generating necessary innovations to support, for instance, production, sales or service processes in big companies. An evergrowing number of accelerators and accelerator programs worldwide translates into more interest in research in this field.*
Originality/Value: *Despite the increasing research trend related to start-up accelerators, no precise research classification has been available to date.*

Keywords: *Start-up Accelerator, Start-up, Accelerator*

JEL classification: *H7, M2, O3, O5.*

Paper Type: *Research study.*

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1. Introduction

Recent years have been invariably associated with numerous changes that take place in the economy (Andriankaja *et al.,* 2018; Salwin and Kraslawski, 2020; Salwin *et al.,* 2020). We have witnessed a strong emphasis on environmental protection, Industry 4.0 and digital solutions (Abou-foul *et al.,* 2020; Tronyoll *et al.,* 2020; Gaiardelli *et al.,* 2021). Both manufacturing and service companies focus their efforts to satisfy an ever-higher number of needs of individual and institutional clients (Salwin *et al.,* 2021a; Salwin *et al.,* 2021b; Lipak and Salwin, 2019). This gives rise to the need to generate and develop various types of inno-vations (Kukurba *et al.,* 2021; Salwin *et al.,* 2021a; Boons *et al.,* 2013). More often than not, innovations are created by start-ups, that is young innovative enterprises or temporary organisations searching for a business model that will guarantee them additional values.

The objective of a start-up is to scale up business to the level of a company marketing an epoch-making product or service. Especially in the primary stage of operation of a young innovative company, participation in an acceleration program makes this to much extent possible. Many a time, this is the only chance to find a scalable and repeatable business model. Very often, gained interest of media and investors prove insufficient to start collaboration with big enterprises, which follow a different manner of operation. The clash of both those worlds, i.e., start-ups and corporations, often leads to the misunder-standing of business.

A popular tool to promote development of collaboration with technology recipients is a start-up accelerator (Moritz *et al.,* 2021; Laspia *et al.,* 2021). It is a significant element of the global start-up ecosystem that guarantees, and at the same time accelerates, development of start-up products or services and their chances for commercialisation in corporations or in the market. Accelerators provide multi-dimensional support, care and expertise for start-ups and go between start-ups and corporations, connecting them with each other. Thus, they contribute to development of new and innovative solutions elaborated by start-ups, supplying them with specific clients. In recent years, the issue of research in start-up accelerators has become ever more popular.

A novelty raised by the authors is the fact that there has been no systematic research referring to current knowledge (Carvalho *et al.,* 2017; Gur 2021; Gutmann *et al.,* 2019; Garcia *et al.,* 2019; Crisan *et al.,* 2021). Carvalho *et al.* (2017) in their review concentrate their efforts to organise knowledge on various types of accel-erators and distinct methods to promote entrepreneurship (Carvalho *et al.,* 2017). Gutmann *et al.* (2019) attempted to order literature referring to various forms of corporate venturing, with particular emphasis on accelerators, incubators and venture capital (Gutmann *et al.,* 2019). In 2019, Garcia *et al.* (2019) use a bibliometric analysis to analyse 21 papers to organise current knowledge of start-up accelerators, trends and gaps in that field (Garcia *et al.,* 2019). In his review, Gür (2021) focuses on the

functioning of technology transfer in corporate accelerators (Gur, *2021*). A paper by Crișan *et al.* (2021) provides an insight into the operation of start-up accelerators and their role in promoting entrepreneurship and innovation (Crisan *et al.,* 2021).
This paper is focused on the classification of research on start-up accelerators. Thanks to employing the systematic literature review technique, the authors were able to identify 76 research works referring to start-up accelerators in the Scopus base. All papers were organised into six groups, according to accelerator type and acceleration program type. The presented classification of the literature is the first of its kind in the discussed field. The paper systematises the available and, up to now, dispersed knowledge on start-up accelerators and thus responds to the demands on this issue that so far has had no well-established position in science (Wright *et al.,* 2018; Cohen *et al.,* 2019).

The paper is composed of four parts. First is the introduction. The second part is concerned with the research methodology. The third part includes the classification of the available literature and an overview of the literature referring to each of the distinguished groups. The last part presents conclusions.

2. Research Methodology

The objective of the research discussed in this paper was to collect and classify the latest knowledge on start-up acceleration. The paper defines the following research question:

RQ1: How to classify available knowledge of start-up accelerators?

As a result of the conducted analyses 76 works referring to accelerators were classified in 6 major thematic groups. This produces a clear and systematic review of the literature to support researchers handling the issue and provides quick access to precise information to practitioners.

The research method adopted for the purposes of this paper comprises two major stages:

1. Systematic Literature Review: The research implements the solutions proposed by Tranfield *et al.* (2003), as a result of which three major steps were adopted:

1.1. The first step covers Planning the Review. The focal point of the paper is the essence of operation of start-up accelerators and the analysis of the state of knowledge in that field and start-up accelerators' impact on the start-up ecosystem. As part of the conducted systematic literature review, the authors selected publications for analysis focusing only on those papers that include a term "startup accelerator" or its synonyms.
1.2. The next step is Conducting the Review. At this stage, the Scopus data base was browsed for the term "startup accelerator" or its synonyms in the parts related to

title, abstract and key words. The foregoing base was chosen as it is distinguished with high quality of covered publications and is also acknowledged in the scientific community. Scopus is one of the most popular data bases among theorists and practitioners. For the purposes of the research, the author assumed that only journals, conference monographs and papers in English would be considered.
1.3. The last stage covers Reporting and Dissemination. In this part the issues of accel-erators and start-ups are discussed in detail. The foregoing assumptions brought 81 publications covering the years 2011-2021. Based on manual verification of the works selected for research (the authors become acquainted with entire works), 76 papers that focused on start-up accelerators were selected and ultimately subject to further analysis.

2. Having analysed the state of knowledge, the authors proceeded to develop a classification that was supposed to cover characteristic traits of accelerators and acceleration programs for start-ups conducted by them. The papers were coded according to accelerator type and acceleration program type. On this basis, six groups were determined: 1) general approach to startup accelerators, 2) corporate accelerators, 3) seed accelerators, 4) academic accelerators, 5) many types of accelerators, 6) other types of accelerators. To these groups, 76 analysed scientific publications were assigned.

At the end, the authors indicated the directions for further research in the field of accelerators, start-ups and effectiveness of conducted acceleration activities.

3. Automatic Contract Execution

In this part, the researched publications were classified according to the types of accelerators to which they refer. Six major groups were distinguished, to which 76 ana-lysed scientific publications were assigned (Figure 1):

1. General approach to startup accelerators – this class is focused on publications related to accelerators and start-up acceleration programs conducted and sponsored by dedicated companies, non-profit organisations or government programs. It covers accelerators in their broad sense, which is why publications that do not clearly de-termine the discussed type are also included.
2. Corporate accelerators – this class covers related publications that presented the results of research on accelerators and acceleration programs conducted by well-known corporations that are distinguished with their recognisability and strong position in the market.
3. Seed accelerators – this class includes publications examining seed accelerators and corresponding acceleration programs. This term is usually interchangeable with the term “start-up accelerator” or “start-up acceleration program”. Here, it was distin-guished as many authors emphasise that there is a theoretical gap in the researched field (Garcia *et al.,* 2019; Crisan *et al.,* 2021) and also for the sake of full compliance with the quoted sources. Publications in this

category should in the first place be treated as a supplement of the general approach to startup accelerators category, unless they reveal sufficiently clear individualising traits.

4. Academic accelerators – this group of publications is focused on any initiatives taken by scientific bodies in the scope of supporting entrepreneurship and promoting innovativeness among the academic community – students, graduates and scientists. These are bodies financed by higher education facilities and often enjoy financial support from collaborating companies, e.g. the start-up accelerator at Oxford Uni-versity.

5. Many types of accelerators – this class includes publications describing many types of accelerators and acceleration programs, presenting a broad insight into many forms of support for young enterprises (to name a few, incubators, co-working spaces).

6. Other types of accelerators – this group comprises publications distinguished by some authors. It is focused on less popular or new models of accelerators and acceleration programs.

Figure 1. *Number of publications qualified to respective groups.*

Source: *Own study.*

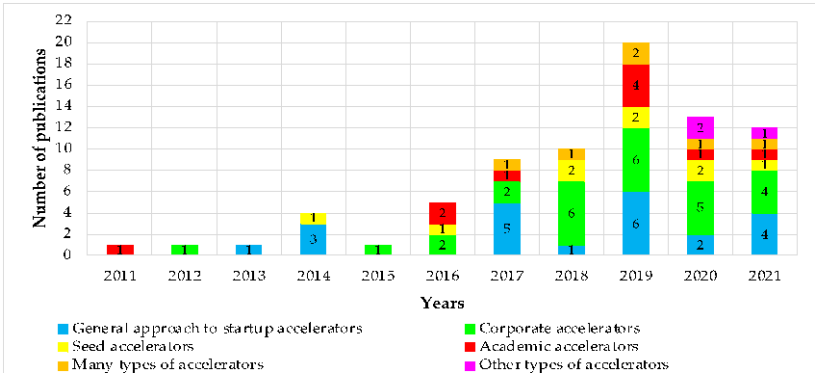
The conducted analysis reveals that the issue of corporate accelerators is the one most often analysed in the literature. 27 publications handling this issue were distinguished. One publication was included both in the corporate accelerator group and the other types of accelerators group due to the broad scope of issues covered (Pielken *et al.,* 2020).

3.1 General Analysis

The analysis covers 76 scientific publications from the years 2011-2021. The division of the publications into six groups in chronological order (Figure 2) reveals

that the first one refers to academic accelerators (Azinheiro *et al.,* 2017). Recent years have brought numerous publications covering corporate accelerators and general approach to start-up acceleration. This trend is strictly connected with the situation in the market and ever more frequent phenomenon of corporations' engaging in acceleration activities to take advantage of the potential of start-ups to implement innovative and environment-friendly solutions.

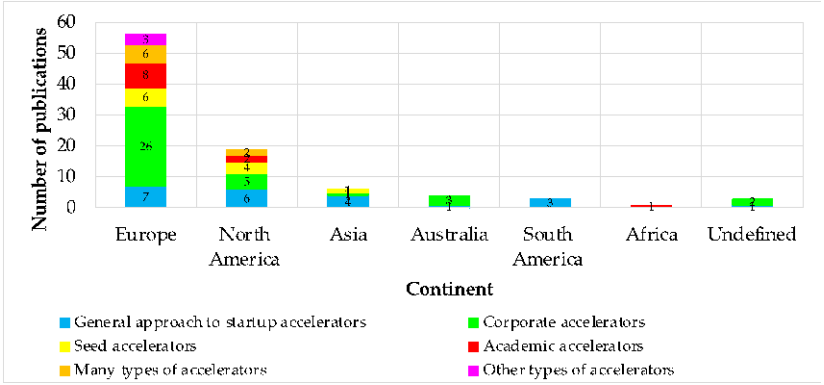
Figure 2. *Publications found in the Scopus base in chronological order by accelerator class.*



Source: *Own study.*

It should be noted that the research on start-up accelerators is conducted in Europe and North America in the first place. European scientists carried out 56 studies in each of the analysed groups – here, research on corporate accelerators prevails. The research on the other groups remained at a similar level. The authors from North America were involved in 19 studies. A similar research trend is apparent in five proposed groups. In Africa, there was only one publication referring to academic accelerators. This is most probably the first study referring to accelerators on that continent (Ismail, 2020).

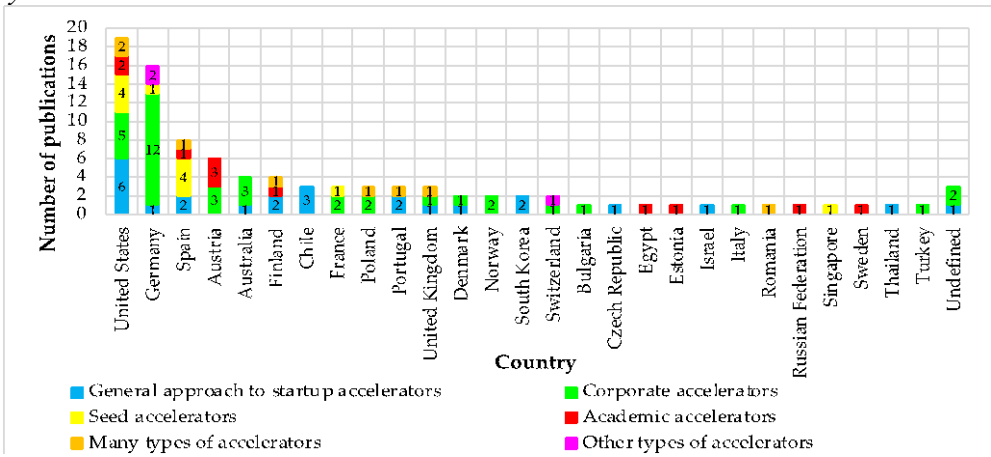
Figure 3. *Continents from which the publications found in the Scopus base originate by accelera-tor class.*



Source: *Own study.*

The highest number of studies related to start-up accelerators was conducted in the United States (19) and Germany (16). The studies conducted by U.S. scientists focused on general approach to start-up accelerators (6), corporate accelerators (5) and seed acceler-ators (4). The studies conducted by German scientists covered corporate accelerators in the first place (12).

Figure 4. *Countries from which the publications found in the Scopus base originate by accelerator class.*



Source: *Own study.*

Currently, 110 research institutions are involved in research on start-up accelerators, of which:

- 46 institutions participated in research on general approach to startup accelerators;
- 44 institutions participated in research on corporate accelerators;
- 14 institutions participated in research on seed accelerators;
- 12 institutions participated in research on academic accelerators;
- 11 institutions participated in research on many types of accelerators;
- 5 institutions participated in research on other types of accelerators.

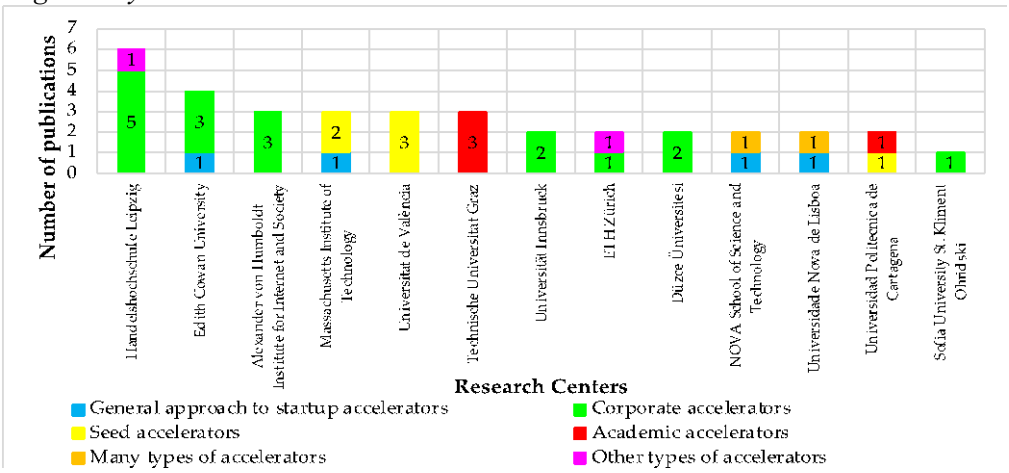
Handelshochschule Leipzig of Germany (currently, HHL Leipzig Graduate School of Management) is the facility that participated in the highest number of studies on corporate accelerators. Universitat de València conducted the highest number of studies in the field of seed accelerators, while Technische Universität Graz of Austria is focused on research on academic accelerators.

The analysis carried out in the Scopus base shows that in total 159 scientists from all over the world covered the issue of start-up accelerators. On the basis of the proposed classification, it may be stated that:

- 54 scientists participated in works over general approach to startup accelerators;
- 56 scientists participated in works over corporate accelerators;

• 17 scientists participated in works over seed accelerators;
• 23 scientists participated in works over academic accelerators;
• 18 scientists participated in works over many types of accelerators;
• 6 scientists participated in works over other types of accelerators.

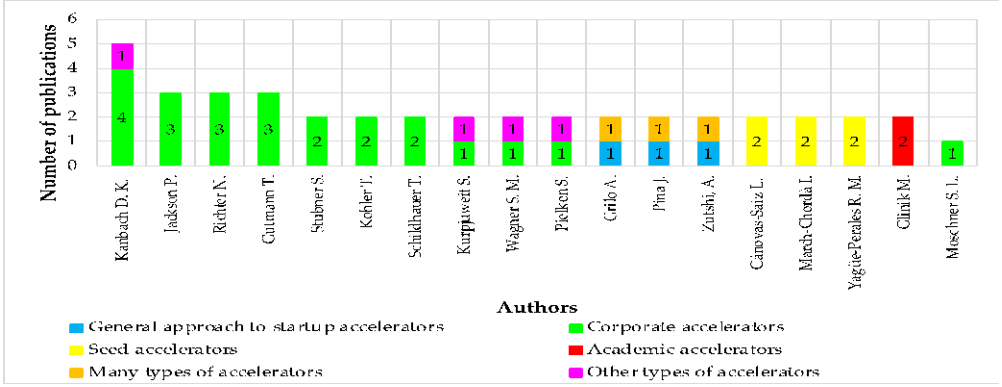
Figure 5. *Research facilities from which the publications found in the Scopus base originate by accelerator class.*



Source: *Own study.*

The highest number of papers referring to corporate accelerators was co-created by Pielken *et al.* (2020), Kanbach *et al.* (2016), Gutmann *et al.* (2019), Gutmann *et al.* (2020), L. Cánovas-Saiz, I. March-Chordà, R.M. Yagüe-Perales of the Universitat de València are the leaders in the field of seed accelerators (Canovas-Saiz *et al.,* 2018; Canovas-Saiz *et al.,* 2020; Canovas-Saiz *et al.,* 2021). M. Glinik of Technische Universität Graz in his studies examined mostly academic accelerators (Glink, 2018; 2019).

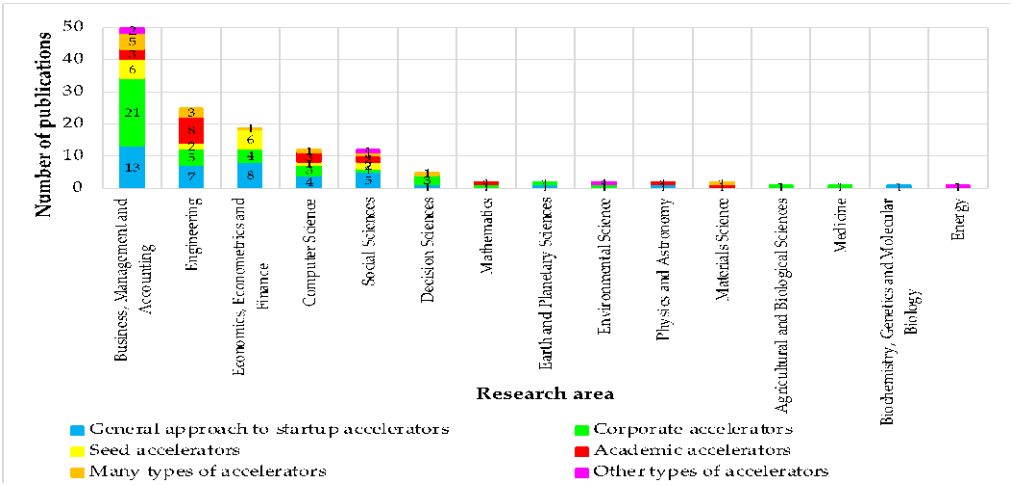
Figure 6. *Major authors of the publications found in the Scopus base by accelerator class.*



Source: *Own study.*

The analysed publications are focused on 15 research areas dominated by business, management and accounting, engineering and economics, econometrics and finance. The research works included in the corporate accelerators group refer mainly to the area of business, management and accounting. The papers covering general approach to startup accelerators cross five research areas presented in Figure 7. The publications referring to academic accelerators are mostly focused on the area of engineering.

Figure 7. *Research areas of the publications found in the Scopus base by accelerator class.*



Source: *Own study.*

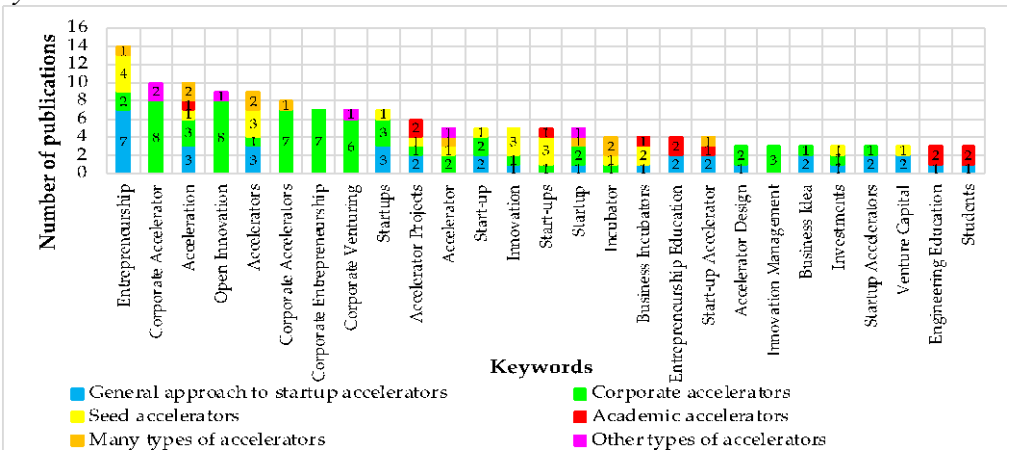
The analysed publications contain in total 351 key words. When examining that according to the proposed classification, the authors determined that the most frequent key words are Entrepreneurship, Corporate Accelerator and Acceleration. Most key words, the number of which reached 144, appeared in General approach to startup accelerators. Apart from that, the following key words may be distinguished:

- 101 key words in works over corporate accelerators;
- 49 key words in works over seed accelerators;
- 58 key words in works over academic accelerators;
- 45 key words in works over many types of accelerators;
- 13 key words in works over other types of accelerators.

Figure 8 presents the most frequent key words in the analysed papers divided into the proposed groups.

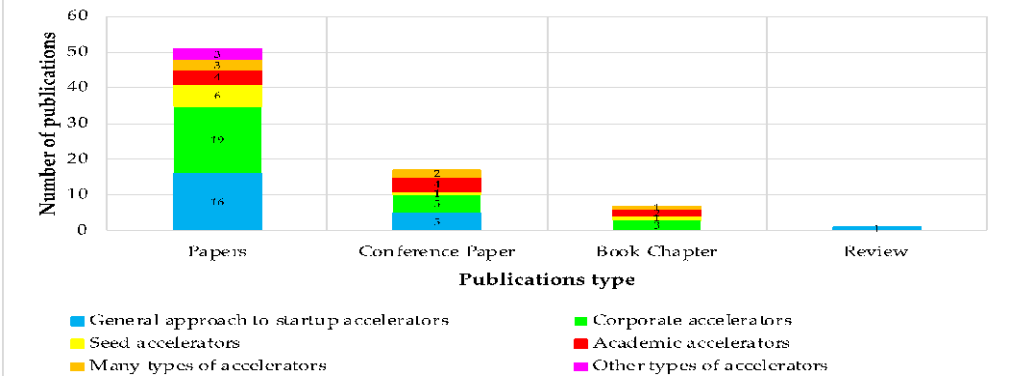
In the next step, the authors checked what type of publications prevails in the proposed groups. Each of the six groups is dominated by papers, followed by conference materials. Figure 9 presents the types of publications divided into groups.

Figure 8. *Key words appearing in the publications searched for in the Scopus base by class*



Source: *Own study.*

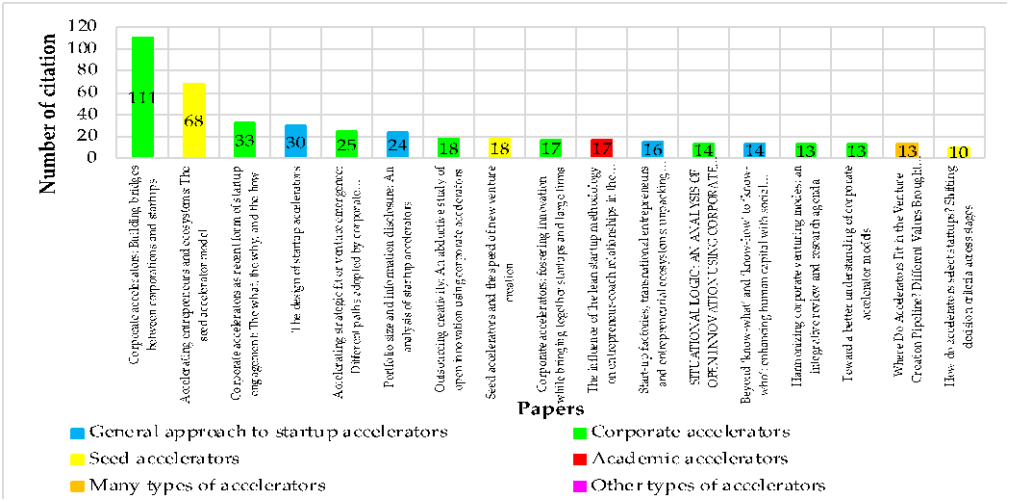
Figure 9. *Types of the analysed publications by accelerator class*



Source: *Own study.*

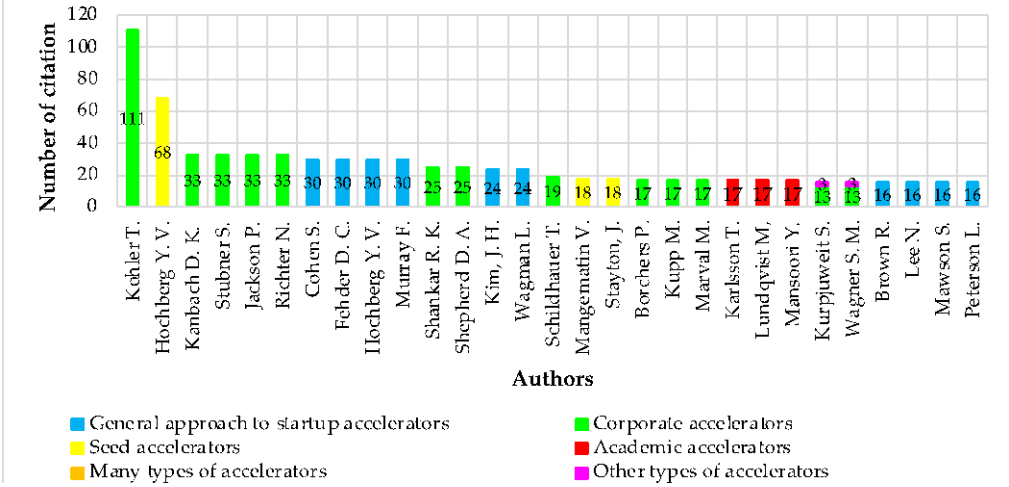
In the next part of the analysis, the authors concentrated on the analysis of citations of the papers classified into the presented groups. Figure 11 presents the most often cited publications in the researched area. Figure 12 presents the most often cited authors. Figure 13, in turn, presents the most often cited research facilities in the researched area. In each of those cases, the substantial part of citations refers to the publications classified as corporate accelerators. In aggregate, papers from that group were cited 273 times, while papers from the other groups were cited 125 times (general approach to startup accelerators), 106 times (seed accelerators), 24 times each (academic accelerators and many types of accelerators), 3 times (other types of accelerators). The most frequently cited publication is Corporate accelerators: Building bridges between corporations and start-ups (35). It is an paper published in Business Horizons by Thomas Kohler, who at the same time is the most frequently cited author, similarly as the research facilities represented by him – Universität Innsbruck and Hawaii Pacific University.

Figure 11. *The most frequently cited publications in the Scopus base by accelerator class.*



Source: *Own study.*

Figure 12. *The most frequently cited authors in the Scopus by accelerator class.*

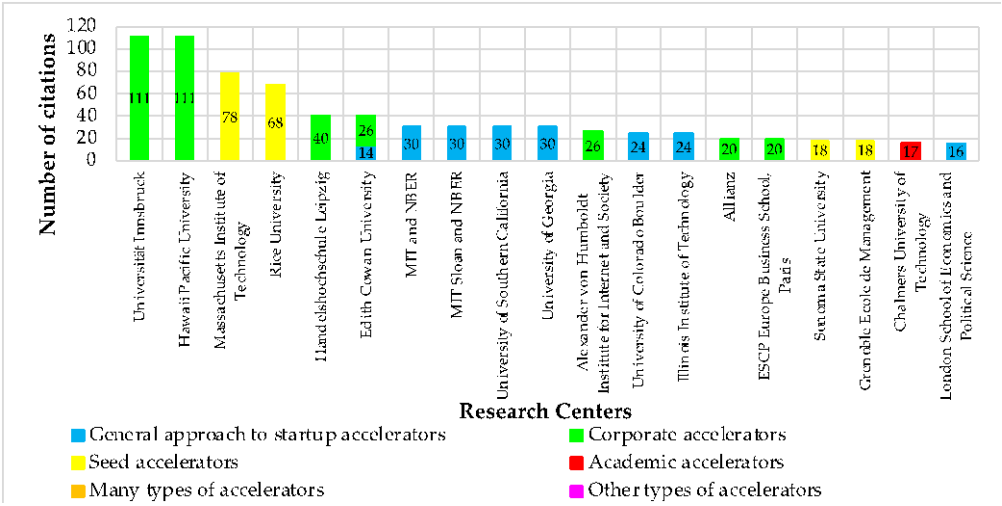


Source: *Own study.*

3.2 General Approach to Start-up Accelerators

The first paper from this group was published in 2013. It is a unique attempt to synthesise the methodology for running start-ups and the methodology for developing games in order to provide a provisional proposal of a series of dedicated acceleration programs, with a scientific approach combining high quality studies with immediate results that may increase start-up's chance of success and reduce the investment risk. The paper was also expected to trigger a discussion on the covered issue among scientists and practitioners (Järvi *et al.,* 2013).

Figure 13. *The most frequently cited institutions in the Scopus base by accelerator class*



Source: *Own study.*

The next year brought a case study of a collaboration between a European crowdsourcing platform connecting students with employers and a start-up accelerator (Chile). The examined company needed support in expansion into new markets that was restricted due to cultural differences. As a result of the evaluation, it is found that the platform needs to change its business model. It turns out that the activities based on relationships with higher education facilities that encouraged students to participate by logging in to the system by means of the university e-mail service were ineffective (Carmel *et al.,* 2014).

In the same year, an analysis of the policy for information management and selection of the portfolio of accelerated companies was conducted. It revealed that with reasonable expectations, the portfolio volume failed to reach its effective value. Apart from that, much attention is paid to the partial disclosure strategy, following which the accelerator pub-lished only positive feedback on its portfolio (Kim *et al.,* 2014). The authors from South Korea screen start-up accelerators from the USA, United Kingdom and Israel and compare them with domestic start-ups so as to support their national business ecosystem by spreading knowledge, identifying success factors for accelerators and proposing directions for de-velopment of their activity. Relying on interviews with employees of selected under-takings and secondary data, the authors suggest that the government should conduct activities to promote foundation of private accelerators by experienced business leaders by creating a favourable environment. They also raise the need to encourage companies to go global through partnership with foreign accelerators, support for specialist indus-try-targeted acceleration initiatives and development and application of criteria for as-sessing the effectiveness of acceleration.

Moreover, the authors postulate the necessity to launch an appropriate legal and institutional apparatus and introduce tax relief so as to eliminate external activity limitations (Seo *et al.,* 2014).

Further publications of this group were released in 2017. One of them analyses the use of a digital marketing (DM) strategy by start-up accelerators – what DM goals are set and what channels are selected to implement them. Using correlation analysis and sta-tistical significance tests, the study determines the dependency between variables, among other things, the profile of an organisation, DM goals and channels, discovering how a particular accelerator type forms its DM. The study results were expected to help to select a DM strategy adequate to the program profile (Azinheiro *et al.,* 2017).

Another paper is an attempt to establish a new framework of a start-up scouting concept, i.e., an activity initiating re-cruitment for a program for the best start-ups that have the highest chances to gain funds. Relying on expert interviews and surveys, 7 activity areas are distinguished and grouped on 3 levels, executive, management and ambassador. In order to confirm their functionality, the authors test the management level, adjusting it to scouting as part of a partner program between an accelerator and a corporate venture capital fund. This study encourages in-depth, in particular in terms of quantity, research on the process to provide for its thorough understanding and possibility to monitor it (Heinz *et al.,* 2017).

Next publication in this group is quite peculiar – it was prepared in connection with introduction by U.S. Accreditation Board for Engineering and Technology of potentially disadvantageous changes in the effects of engineer education. It was expected to indicate which necessary competences were missed by the Board, based on interviews with, among others, edu-cation investigators and numerous entrepreneurs, including leaders of start-up acceler-ators from Chile, Colombia, USA, Spain and United Kingdom. The interlocutors refer to engineers' existing skills as well as areas which are worth improving, distinguishing also skills important when working at a start-up and founding one.

The summary presents recommendations for the Accreditation Board and plans for future quantitative studies (Hilliger *et al.,* 2017). An equally meticulous approach was adopted to examine start-ups and the related mobility and adaptation of the entrepreneurship culture in the labour market. The study is based on European circumstances in the context of migration of qualified young pro-fessionals in connection with the economic crisis of 2008. Its authors pay particular at-tention to Spain and migration movements between Spain and Germany. Generally speaking, the publication has three objectives: 1) identifying economic, demographic and institutional causes of a start-up boom; 2) profiling persons launching a business activity in social and demographic terms; 3) determining a relation between a beginner entre-preneur and the nature of his/her business activity.

On this basis, complex research methods are employed, analysis of statistics, law, data from accelerators and netnographic research (virtual ethnography) (Sota *et al.,* 2017). The publishing year was closed with a case study explaining the manner in which start-ups negotiate and introduce institutional changes, implementing digital service innovations in the medical care industry, which is partic-ularly conservative. The applied methods are limited to interviews and analysis of documents obtained from several start-ups participating in acceleration programs. The conclusions point out key processes for introducing the mentioned changes, elaborating the theory of institutional entrepreneurship, and suggest that it should be more fre-quently referred to in similar research on service innovations. They also sum up the observations from the practical point of view (Wallin *et al.,* 2017).

In the next year, only one work was classified to this category – it is a study analysing enhancement of human capital with social capital in a start-up accelerator and its impact on learning entrepreneurship. It handles in particular the interaction between three pro-cesses: "know-what", "know-how" and "know-who". The adopted research method is thematic analysis of interviews with participants of an Australian accelerator conducted, among others, according to the Design Thinking, Business Model Canvas and Lean Startup concepts. Its results demonstrate that there is a relation between the mentioned processes, whereby it is proved that "know-who" is most important for learning and closes the learning loop for "know-what" and "know-how" – knowing "who", the participants learned "what" and "how" by social learning. Furthermore, the role of mentors and experts in formation of learning and development of an entrepreneurship network is underlined (Seet *et al.,* 2018).

The year 2019 brought a research revival in the discussed category as six further papers were classified there. Among others, an paper analysing the role of acceleration programs in promotion of international entrepreneurship and examining one of them in qualitative terms. It emphasises the intermediary role of accelerators, making it easier for start-ups to establish better relations as part of business networks. Those networks attract entrepreneurs, who exploit them intensively deriving profits from various areas of ac-tivity, what is expected to maximise the capacity of accelerators and effects of programs conducted thereby. The authors also raise their concern over governmental attempts to replicate similar programs, noting that they are dubious in weaker entrepreneurship ecosystems (Brown *et al.,* 2019).

Another study demonstrates the importance of the contracting potential and institutional distance when deciding on in- and outsourcing by taking into account transaction costs, resource-based view and institutional theories. Various sources were used to create a panel of 405 meetings organised by start-ups participating in an inter-national acceleration program. The conclusion is that the invoked potential and distance are formed by the relation of transaction-related and bureaucratic costs of start-ups and decision on their development vary depending on their origin. It is also suggested – apart from deliberations on a transaction level – that the specific features of a company and country have a considerable impact on company

management and that it is worth ex-amining the possibilities and institutions in terms of a growth strategy (Bustamante, 2019*).*

Other authors invoke an issue of ever increasing role of acceleration programs in the entrepreneurship ecosystems, particularly emphasising the fact that there are differences between accel-erators even if they have constant defining features. The study covers key differences in antecedences of organisational projects against theoretical results at the company level, creating descriptive correlations between elements of those projects and results of start-ups participating in an acceleration program. Adopting that approach, the authors were able to determine the relations between a project and performance, integrating them with previous, discrepant research on that issue and extending the understanding of the accelerator role (Cohen *et al.,* 2019).

Next study handles a general approach to innovativeness and a tendency toward open and sustainable innovations in Portugal. That study is original in that it applies a graphic method HJ-Biplot to analyse data from a community innovation survey (CIS). The results suggest that companies carry out numerous activities bringing poor results and wasting resources. The problem could be resolved by better selection of partners – in this case start-up accelerators – with respect to popularisation of solutions under Industry 4.0 and Smart Cities (Fernandes *et al.,* 2019).

Another locally-oriented study from that period examines start-up accelerators and crowdfunding to support progress of entrepreneurship in Thailand (in particular, in the direction of the so-called "Thailand 4.0") and similarly developing economies. It considers major accelerator programs and a start-up eco-innovation system. The problems are located within a triple helix model – co-operation between universities, industry and government proved not strong enough to effectively commercialise technologies. The supposed remedy is institutional involve-ment of accelerators (Harris *et al.,* 2019). The last to be published were conference materials discussing Astropreneurs, an aerospace start-up acceleration program, its first results and derived conclusions. It also presents the condition of European space industry and the impact of start-ups on it (Kunes, 2019).

The year 2020 enriched the category with two new studies. The first one examines key assumptions of the action learning method, being a part of the lean start-up meth-odology, focusing in particular on a start-up team. The authors discuss and test the mentioned assumptions based on data of 152 teams supported by US federal National Science Foundation (NSF). The researchers find that the assumptions, i.e., formulating hypotheses, probing and idea convergence, integrate with each other correctly and in the context of a team they conclude that MBA graduates are uneager to follow them, but having applied the method they find it valuable. This leads to a conclusion that business education of team members is a critical boundary condition for success. Further, they notice that the lean startup method is credited with

excessive universality, what leads to its poor testing and ignoring possible critical values of the boundary conditions.

At the same time, they suggest that its implementation may in an 18-month perspective improve companies' results (Leatherbee *et al.,* 2020). The second publication from that year explores the course of interaction between start-ups, accelerators and investors, building up their model ac-cording to the game theory. The authors discuss the manner in which accelerators set priorities for their services and how macroeconomy and legislation impact their results. The analyses reveal that, generally speaking, the screening service is the most important, while in view of limited resources it should also have the highest priority, prevailing over mentoring and investing. The authors further prove the impact of heterogenicity of the entrepreneurship ecosystems on a macro scale on their effectiveness, which is higher than in less developed regions (Zarei *et al.,* 2020).

As at mid-2021, four new studies may be qualified to this category. One paper handles the concept of ecosystems and clusters, providing an insight into their contri-bution to the growth of the life science/biopharma industry. It presents the literature foundations of the issue and cases of ecosystems developing in the USA, Europe and Australia. The analysis covers also the future of innovations relying on collaboration and involvement of digital technologies in the mentioned industries in the context of recent experience connected with the COVID-19 pandemic (Boni *et al.,* 2021). Another paper discusses the importance of reputation of a start-up accelerator for its information policy with respect to co-operation with investors (Charoontbam *et al.,* 2021).

Another paper is concerned with the impact of neoliberal education reforms on the area of Computer-Managed Instruction (CMI) in the Israeli education system. The analysis covers the activities of the R&D unit of MindCET, run-ning, among other things, a start-up accelerator. It considers also data drawn from two years of the activity of that unit, interviews and publications to explore the CMI activities and the ways to promote the methods and understanding of technology as well as the undertaken reform.

Furthermore, the authors analyse an approach derived from a business theory of disruptive innovation, which affected the carried out educational changes (Ramiel, 2021). The publication output in this category ends with a study that notices weaknesses and needs of Nigerian economy, with emphasis on sustainable development. That study investigates the performance factors of accelerators in the Silicon Valley. For this purpose, the multiple regression analysis method is employed that synthesises the existing knowledge, and numerous case studies are mentioned. As a result, the authors prove the theory of "start-up sustainable growth", which assumes that the quality of conducted acceleration activities is more important than the number of start-ups accepted for a program and that accelerators should specialise in a respective industry (Shenkova, 2021).

3.3 Corporate Accelerators

The group of publications covering corporate accelerators is opened with a short paper of 2012 discussing a program of a U.S. branch of Volkswagen and a big tech start-up accelerator Plug and Play. It was designed to support a few selected start-ups from dif-ferent industries that would develop modern technologies for the purposes of the au-tomotive industry (integration of mobile devices with vehicles, parking applications, visual calculations etc.) (Hilton, 2012).

After three years, another publication came out – a review of the literature related to Business Model Canvas, a business modelling tool that provides a framework supporting entrepreneurs in discovering clients and possibilities and then creating an adequate business model to accelerate commercialisation of a product. It offers a new approach to action-oriented entrepreneurship, demonstrating that the reverse modelling frames inspired by discovery-driven planning may be used not only by tech start-ups but also by corporate accelerators. It is supposed to minimise the required re-sources and risk and optimise entrepreneur's chances of profit in connection with inno-vation transfer (Ruseva *et al.,* 2015).

In 2016, further researchers handled the theory, conducting a pioneer case study for 13 programs offered by corporate accelerators. They also compared and systematise them by assessing their objectives and adopted action model. The results are expected to provide managers with knowledge on the operation of accelerators along with directions as to program designing (Kanbach *et al.,* 2016). At the same time, a frequently cited study of 40 corporate accelerators was prepared based on interviews with their managers and participants that was supposed to give an insight into universal construction patterns of such undertakings and frame them to facilitate designing acceleration programs.

Data were supplemented with available materials and reports. Relying on the results, the strategies for effective acceleration and the factors facilitating the corporate-start-up collaboration are identified. It is also stated that an effective collaboration within the frames of company's innovative strategy has to include specified project dimensions: proposal, process, people and place (Kohler, 2016).

The next year brought two more papers. First is a study based on interviews with managers and participants of a corporate accelerator and incumbent companies that use innovations generated in acceleration programs. It was supposed to identify inhibitors to the collaboration between such companies and start-ups within the frames of acceleration programs in the context of the social realist theory by Margaret Archer, which provided for a conceptualisation of the reflexivity of the participants and the situational logic of conflict and competition in which they find themselves. The authors discover that col-laboration is inhibited by conflicts in basic beliefs or authority issues, autonomy and risk, as well as competition for resources and personal goals (Jackson *et al.,* 2017).

The second work is a case study of an European acceleration program of Deutsche Telekom. It examines the com-pany's 5-year experience in management of such type of activity and its impact on supported enterprises to select success factors. The study is based on conducted interviews and academic collaboration with the accelerator. It distinguishes 5 major success factors of programs, i.a. transparent and aligned goals, a large external network or performance indicators, that may increase the chances of success when designing new programs of this kind. The author also underline that in practice, this means multiplication of the corpo-rate-start-up collaboration (Kupp *et al.,* 2017).

With the beginning of 2018, the interest in the issue increased threefold. There is a publication analysing corporate accelerators with respect to the agribusiness, agro-tech and food industry and the concept of responsible innovation (RI), which takes into account the good of the society and public interest when considering new initiatives. Deriving from the experience of Alltech's Pearse Lyons accelerator, it discusses the impact on the start-up ecosystems and practices for their implementation and coordination, taking into account the objectives and tasks of all interested parties. The conclusions are summed up with an acronym IGNITE, intent, group, neighbourhood, independence, transparency and expertise. They are expected to make it easier for corporations to understand accel-eration programs, demonstrating their benefits, and to lead to popularisation of start-up successes as desirable changes in the agriculture industry (Connolly *et al.,* 2018).

Furthermore, there is a case study of a maritime port complex where a framework to design and run an indus-try-led start-up accelerator is devised. It is comprised in four steps: orchestrating the ecosystem, generating an innovation funnel, flexible matching and scaling recurrent engagement. The conclusions are dedicated in particular to managers of corporate accelerators (Garcia-Herrera *et al.,* 2018).

A chapter from another book explores the forms of activity taken by corporations against start-ups and the motives behind them, using a qualitative review of secondary data and a series of interviews with corporate managers. It discusses the forms of collaboration (accelerators, incubators, events, hackathons) integrating start-ups, accelerators and corporations. The authors state that initiatives such as hackathons or acceleration programs are an extension of the innovation outsourcing process and result mostly from corporations' problems with internal innovativeness or creation of its culture. Moreover, they formulate 9 basic collaboration motives (Jung, 2018).

Another publication seeks to determine the success factors of those accelerators based on a case study of a company with experience of running 12 acceleration programs. Relying on the results, it is supposed that the success of a program depends on designing a divergent proposal of benefits for start-ups based on shared corporate resources and specified process for managing the relationships between a corporation and start-ups. In order to implement those assump-tions, it should be

helpful to assign dedicated business developers, the so-called boundary spanners, which provide for convergence of interests and exchange of information in collaboration with external companies (Mahmoud-Jouini *et al.,* 2018). The authors of another study from that period discuss key features of corporate acceleration programs by means of abductive reasoning. They collect data for the study by carrying out an extensive review of the literature and a series of interviews with start-up employees, managers of corporations and accelerators. Using the standard, holistic systematics, the authors distinguish such features as, strategy, resources, roles and structure, to analyse and assess data derived from stakeholders.

The findings provide for theoretical and empirical extension of knowledge about the operation of acceleration programs, helping to justify their existence by giving the understanding of the expectations for them (Richter *et al.,* 2018a). In 2018, also some critical voices began to appear. A chapter of another publication analyses corporate accelerators from the point of view of the pro-gram management process, presenting their key aspects. The authors stress that those aspects depend on the context and negate a universal approach, instead proposing a checklist for building up an appropriate individual framework for collaboration with any start-up, taking into account people, processes and culture. Such approach is a counter-weight to key success factors developed in other publications (Richter *et al.,* 2018b).

The year 2019 was opened with an attempt to systematise various forms of corporate venturing (CV), namely accelerators, incubators, venture capital. It is concerned with organising the source literature, analysing indicators of CV forms proposed by other researchers, standardising their framework and providing for its consistency in line with the appli-cable innovation flow (Gutmann, 2019). In another study, the same author seeks to give a qualitative insight into mutual benefits and reflections derived from the collaboration between start-ups and accelerators. The study is based on an inductive case study of a newly es-tablished program SAP Industry 4.0 Startup Program as one of the biggest producers of business software worldwide.

In terms of benefits for start-ups, it distinguishes acceleration of the process of product market debut, sales, improvement of skills and knowledge and facilitation of business growth in the context of a strategy, business model, pitching, financing and partnership (Gutmann *et al.,* 2019). Other scientists explain the operation and essence of corporate accelerators and incubators and give tech start-ups hints how to take the most advantage out of them. Additionally, they discuss corporations' expectations for accel-eration programs, relying on a qualitative study comprising interviews conducted with representatives of 17 German incubators and accelerators (Kohlert, 2019).

Next analysed paper is an overview of four types of corporate accelerators comparing their objectives and distinguishing features. It was prepared as part of a guide for managers who are ahead of selection of an optimum program for their organisation. The observations are based on secondary data and interviews

containing opinions of repre-sentatives of companies and accelerators. Elements distinguishing particular types in-clude, without limitation, the number of participants and the governance structure (Moschner *et al.,* 2019). Another study is concerned with divergences in the manner in which corporate accel-erators build up their ecosystems, which justify their heterogeneity. Relying on inter-views with experts of 16 German accelerators and following differences in the provided support, start-up selection and finalisation of programs, the study identifies 5 types of accelerators that build up ecosystems divergently. The developed systematics, apart from research value, is a direction for designing and positioning accelerators with respect to a corporate strategy (Prexl *et al.,* 2019). The last of the papers of 2019 refers to basic corporate start-up acceleration processes and explains how and why they are designed and conducted (Shankar *et al.,* 2019).

The year 2020 has 5 publications. One of them is a summary of the operation of a pilot aerospace start-up accelerator program conducted in collaboration with Starbust Aerospace and Techstarts, a leading corporate accelerator, with industrial and government (NASA) financing. 10 enterprises participated in this very complex program, and its objective was to gain innovations for future missions of the Jet Propulsion Laboratory (JPL) (Cwik *et al.,* 2020). Gutmann, the author of several publications in this field, draws the attention to the role of corporate accelerators in providing start-ups with appropriate resources. He develops a hierarchy of program aspects and suggests improvements, examining one of the biggest institutions of this type – the Wayra accelerator of Telefónica (Gutmann *et al.,* 2020).

On the basis of interviews with managers of incubators and accelerators of leading tech companies, he considers the impact of the activities taken as part of preparations for corporate entrepreneurship programs and their effectiveness (Heinzelmann *et al.,* 2020). Also an paper by German researchers distinguishes corporate accelerators founded by family-run companies, which are popular there, as a separate type of accelerator, drawing the attention to the specific nature of their operation resulting from engagement of one's family.

In addition, it presents acceleration programs unique for family-run companies and their general importance for the industry (Pielken *et al.,* 2020). In Poland, corporate acceleration was examined in terms of emotional dynamics from the point of view of systems psychodynamics. The material was a study of 10 cases where the points of view of both a start-up and a corporation were taken into account. This study is expected to contribute to a better understanding of the corporate-start-up relationship and recommend how to better manage corporate accelerators, enhancing their effec-tiveness, from a perspective that has never been considered before (Wójcik *et al.,* 2020).

Another study of 2020 is a systematic literature review in the scope of conclusions on the functioning of technology transfer in corporate accelerators. It supports them

with a devised model based on absorptive capacity concepts and data drawn from numerous case studies (Gur, 2021).

Next study fills in the gaps in the literature related to overcoming difficulties arising in different stages of corporate acceleration. It relies on a series of interviews with innovation experts from various industries operating in one of the biggest European accelerator of that type. It presents directions for enhancing organisational learning and innovative performance of incumbents (Hutter *et al.,* 2021). Another work explores current practices in the corporate-start-up collaboration and open innovations (OI) in Europe. Its matter of interest covers companies leading innovation and pursuing an effective corporate-start-up collaboration. Relying on the results, 6 key activity areas of OI are distinguished and compared with each other with respect to required resource involvement on the part of a corporation.

It turns out that the optimum are orders and investments in start-ups, the most popular and least demanding – one-off events or provision of free-of-charge re-sources, while the rarest and most engaging – start-up acquisitions. In this way, good practice, trends and barriers in those relationships are identified (Onetti, 2021). The publication output in this field is once again closed with Polish authors, employing qualitative methods to consider the motives behind the operation of corporate accelerators and identify accompanying benefits and challenges. In their study they use in-depth inter-views (IDI) with managers working over accelerators, a focus group interview and secondary data.

The findings confirm numerous benefits which may be derived from accelerators and their importance in terms of initiation of innovations fostering entre-preneurial learning and entrepreneurial-market logic Further, the theoretical canon of motives for launching accelerators is extended by internal and external push and pull motives (Urbaniec *et al.,* 2021).

3.4 Seed Accelerators

The concept of a “seed accelerator” for the first time appears in the results of the Scopus base in a paper of 2014. The paper formulates theoretical implications and ex-amines in a macro and micro scale how the local geographical and culture specificity impacts an accelerator and technology development, at the same time following how accelerator’s activities shape the technological landscape. Attention was also given to things that the ecosystems of emerging countries can learn from the Silicon Valley model and vice versa – what the Silicon Valley can learn from local adaptations of the model.

For this purpose, the author uses ethnographic methods, interviews and surveys conducted among participants and employees of accelerators from South-East Asia, Latin America and developed and emerging markets (Haines, 2014). Two years later, another paper referring to seed accelerators was published. It puts an emphasis

on multidimensional examination of their role in regional American entrepreneurship environments. In the summary, the authors underline the need for rigid evaluation of the local impact of programs to explain the factors for growth and reallocation of companies and investments in regions. Further, the study emphasises the social significance of accelerators in numerous key industries as a critical factor necessary for long-term enhancement of economic competitiveness in the USA and notes their association with industrial clusters.

Another noteworthy issue is the determination of programs or their elements with the greatest importance for the success of an accelerator, taking into account different concepts of success depending on the perspective – for decision makers, investors, founders and participants of accelerators. Ultimately, it is suggested that further research should be directed at the impact of re-gionalisation on program results (i.a., cultural influences, prosperity, industry) (Hochberg, 2016).

After two years, two further studies were published. It is worth mentioning that the first one is at the same time the first out of three studies in this group prepared by L. Cánovas-Saiz, I. March-Chordà and R.M. Yagüe-Perales. Thanks to that, Spaniards gained the status of pioneers, analysing quantitatively the performance of accelerators and seed start-ups in terms of generated employment. It is prepared on the basis of detailed information on 116 entities included in the Seed Accelerators Knowledge Base and supplemented with data obtained from entrepreneurs, accelerator owners and in-vestors. It provides empirical conclusions as to real possibilities of such type of activity at a social, economic or territorial level and proposes a model of their impact on foundation of new companies and new employment created by them.

In connection with that, the authors present approximate information on the number of jobs offered by start-ups, thus confronting the expectations for those entities with the reality and notice that accelerators in the USA most strongly stimulate foundation of new undertakings and, consequently, new employment (Saiz *et al.,* 2018). The second study from that period investigates the manner in which the best accelerators select start-ups, taking the example of the first seed accelerator in South-East Asia and a group of few enterprises applying for its programs. Their profiles along with the selection results are compared by means of the real-win-worth criteria and on this basis regression models are built to predict selection results, which is expected to help accelerator managers to improve their own decision-making processes (Yin *et al.,* 2018).

An paper from 2019 criticises an obsolete territorial concept of entrepreneurship ecosystem and proclaims a broader topological concept defining entrepreneurship as a practice shared between various regions and only partly embedded in each of them. By means of case studies of seed accelerators from three countries, the authors examine knowledge transfer between ecosystems and its dynamics. On this basis, they conclude that territoriality affects trends in digital economy that enable start-ups

to share business and technological information in a manner unattainable in classical knowledge clusters (Kuebart *et al.,* 2019). Another publication investigates reasons for a quick market debut of products of some tech start-ups. The study covers cases of four cleantech companies which quickly entered the market – two with help of accelerators and two independently.

On this basis, it is determined that the mentioned mechanisms are based on the assumption that a possible short debut time is the condition for survival of a company and that, in turn, requires access to various types of resources, while the role of an accelerator is to level deficiencies and provide support for young investors. The findings of that study may be helpful for designing and implementing effective acceleration programs (Stayton *et al.,* 2019).

The year 2020 continued that publication trend, bringing again only two works. First of them was written by the Spanish scientists mentioned above. It points at the key role of seed accelerators in the functioning of entrepreneurship ecosystems. Its objective is an ex-plorative and approximate evaluation of their impact and perspectives on the basis of a developed model and survey data obtained from 116 companies of the industry. The model is designed using the literature related to business incubators and four categories of variables are formulated within its frames – size, location, age and profitability – leading to two empirically tested hypotheses.

Once again, the authors demonstrate statistically a significant advantage of U.S. accelerators in terms of size and performance. Apart from that, the study may be a source of directions for decision makers, shareholders, entrepreneurs and investors with respect to potential performance indicators. Referring to their earlier study, the team emphasises a considerable global increase of the number of accelerators operating and their impact on new employment (Canovas-Saiz *et al.,* 2020). Another paper from 2020 investigates the criteria which drive seed accelerators when selecting projects. It is based on an analysis of a sample of 309 projects, of which 15 proceeded to the acceleration stage. The accelerators took into account purely business factors connected with the project itself (innovativeness, probability to reach next funding rounds etc.) and managerial skills (negotiation skills, communication skills etc.). It is demonstrated that the most significant criteria involve, without limitation, quality of the team and speed of the needed accel-eration (Marino-Garrido *et al.,* 2020).

The category is closed with a publication of 2021, prepared also by the Saiz, Chordà and Perales team. It provides empirical methods for measurement and analysis of seed acceleration performance from the point of view of an accelerator – evaluating its per-formance – and a start-up – evaluating its prospects. The study results confirm statistically that the portfolio size of accelerators, as well as the survival rates and the number of employees in the accelerated companies have a positive effect on the median value of the funding received by the accelerated start-ups from funds (Canovas-Saiz *et al.,* 2021).

3.5 Academic Accelerators

Academic accelerators were the first to emerge out of all discussed accelerator classes, for they debuted in 2011. First paper describes the actions and expansion plans of an inter-university start-up accelerators from Syracuse, a city located in the northern part of the State of New York. They were designed to limit the outflow of youth from the region, activating them in business terms both during and after their studies , thus leading to economic development of the region.

The publication discusses the most important rules lying behind the project, to name a few, motivating innovativeness not only among university scientists but also students, opening to students of all fields and integrating them, strengthening the university-business partnership, using coaching as a tool for creating programs and attracting talents; accepting failures and treating them as a lesson for students. The study is also expected to provide directions for other higher education facilities, presenting advantages, disadvantages, adjustments and scalability of the accelerator operation model (Azinheiro *et al.,* 2017).

After almost a four year break, next paper came out in 2016. It includes a description of the interdisciplinary Business and Technology Center at the Information Technologies, Mechanics and Optics University in Petersburg established for students and enthusiasts of new solutions. The Center was founded to integrate business incubators, start-up accelerators, start-ups, laboratory spaces and student centres, offering a comprehensive cycle of practical educational projects with the possibility to develop them further in business and scientific terms. The paper outlines its establish-ment, mission, structure, workshops, projects and obtained results.

Furthermore, it analyses its advantages and disadvantages, as well as benefits from collaboration with the student research laboratory for optical engineering. It mentions also the issues of student motivation, profiling the most outstanding entities in the design, scientific, commercial and social area (Ivashchenko *et al.,* 2016). The same year saw a case study of the second edition of Catalyze CU, an academic interdisciplinary acceleration program at the University of Colorado directed at companies associated with the university. The study assesses the functioning of the program in terms of the objectives connected with its development (Komarek *et al.,* 2016).

The next year brought one publication devoted to the issue at hand. It describes the experience gained by creating Startup Scaleup, an European ecosystem of the IoT industry combining academic accelerators of tech start-ups and incubators from Spain, Nether-lands, Lithuania and Ireland. On this basis, it formulates some recommendations for other technological entrepreneurship programs, putting special emphasis on the need to pro-vide for access to investors, financing, business expertise etc., (Iborra *et al.,* 2017).

No other publication was issued in 2018, while 2019 was distinguished with an intensive publishing cycle – four studies were issued, of which three appearing one after another in this overview investigate the same subject matter. Ther first of them presents good academic acceleration practices by analysing a case study of Gründungsgarage, an academic interdisciplinary start-up accelerator under the patronage of two Austrian universities. The publication discusses the stages of development of the program – from an elective course offering expert support in implementation of students' business ideas to a professional academic start-up accelerator taking up also initiatives of academic staff (Glink, 2019).

The same author, M. Glinik, prepared also an extensive report of its operation, in which he reports that upon completion of its 10th edition the program recorded strong growth, with, among other things, subsequent educational facilities showing their interest in becoming a partner of Gründungsgarage (Glink, 2018). The third study on this issue presents similarly, but briefly, accelerator as an example of best practices in entrepreneurship education, moreover it demonstrates a practical model to categorise start-ups accelerated there according to the level of digitalisation of their projects (Poandl, 2019).

Other research from that year refer to integration of the entrepreneur-coach relationship and the lean start-up methodology in the context of an academic accelerator (Mansoori *et al.,* 2019). The last publication on academic initiatives is a paper of 2020 that was expected to fill in the research gap and provide practical aid, presenting a framework of the process for designing acceleration programs based on a case study of an academic acceleration program in Egypt. The presented model considers the process for designing, monitoring and adjusting a program based on internal factors – accelerator's capacity and resources – and external – the entrepreneurship ecosystem. It also formulates a set of design parameters, such as sector focus, duration, service offering etc., (Ismail, 2020).

The category is closed with a paper of 2021, which discusses the entrepreneurship ecosystem at the University in Aalto, Finland, comprising student start-ups promoted by lecturers and staff and supported by external entities. It is supposed to propose adaptation of the system adopted in the examined manner in other academic centres (Ainamo *et al.,* 2021).

3.6 Research Referring to Many Types of Accelerators

A substantial part of the publications of this category covers reviews and attempts to systematise knowledge in that field. The initiatory holistic research originates from 2017. It provides an in-depth overview of the literature supported by a survey of accelerator managers and statistical data mining. Its aim is to organise knowledge on different types of accelerators and divergent methods to support entrepreneurship. Furthermore, it aggregates visions of future challenges ahead of those programs. As

a result, the study provides an overview of accelerators, their business models, strategies and anticipated difficulties (Carvalho *et al.,* 2017).

The next year saw a study that provides a comprehensive review and discusses correlations between three subsystems of the entrepreneurship ecosystem and several types of accelerators, determining unique places and roles of each of them within a broader entrepreneurship ecosystem. It also proposes a pipeline model as a tool for de-cision makers for selecting start-ups and their projects and mapping subsystems to evaluate and manage them. When it comes to entrepreneurs, on the other hand, that model is supposed to allow them to locate their start-up within a broader ecosystem and select an accelerator that they can come forward to. That knowledge supplements the existing research with respect to differences in the operation of accelerators and values they can provide (Yang *et al.,* 2018).

In 2019, a publication was issued whose aim is to present and order to-date knowledge on start-up accelerators, identify existing trends and gaps in the literature and set the direction for future research. Similarly as in this overview, the bibliometric method is employed but used only to analyse 21 papers from the resources available in the Web of Science base from the years 2010-2019 (Garcia *et al.,* 2019).

Another study, embedded in Polish conditions, attempts, in turn, to explain the diversity of start-up accelerators as illustrated by the case of those operating within the Metropolitan Association of Upper Silesia and Dąbrowa Basin, whose robust growth has created favourable space for their activity. As a result, five consistent functional and structural pairs are distinguished to classify entities supporting start-ups (Kwiotkowska *et al.,* 2019).

The year 2020 has a paper presenting a case study based on interviews with practitioners at Finnish Oulu. Its subject matter covers the role of incubators, accelerators, co-working spaces, mentoring, venture capital funds fitting into the start-up ecosystem. The study discusses their types, similarities and differences between them and the types of un-dertakings on which they are focused (Tripathi *et al.,* 2020).

The last title provides an overview of the literature referring to the operation of start-up accelerators and their role in supporting entrepreneurship and innovation. The methodological framework of the overview relies on the Context–Intervention–Mechanism–Outcome (CIMO) model. As a result, four mechanisms of the mentioned operation are noted, the validation of ideas and products, the provision of product development and models learning, the provision of support to increase start-ups' market access and growth and the provision of support for innovation. Further, the methodological and theoretical gaps in current research are presented (Crisan *et al.,* 2021).

3.7 Other Types of Accelerators

Below are three publications that were released within the last two years, each of them indicates a new and distinct type of accelerator. Two were published in 2020, one – in 2021. The first one describes the model of accelerator as a start-up supplier. It is a new group of outside-in corporate acceleration programs that implement the corporate-start-up collaboration on the terms applicable in the corporate-supplier collaboration, thus ena-bling companies to get access to innovations or enhance productivity of processes at an organisation. That is empirically illustrated by exemplary successful project implementations (Kurpiuweit *et al.,* 2020). The second one already appeared under the umbrella of corporate accelerators and refers to accelerators established and pursued by family-run companies. It explains the impact of family relations on formation of programs and their general meaning for the industry, in particular in Germany, where that type of business is very popular (Pielken *et al.,* 2020).

The third publication dated 2021, in turn, reveals a new form of accelerator, being an evolution of those entities in response to ever-changing global needs. The paper addresses the issue of impact accelerators that are driven not only by economic profit but also – and contrary to commonly known accelerators – sustainable growth. It examines in the first place the start-up selection process and related criteria, pointing out great differences from the practices known from purely commercial programs (Butz *et al.,* 2021).

4. Conclusions

The paper comes up to expectations of scientists and business practitioners related to the need of more systematised research in the field of start-up accelerators. It presents a classification of research in this field indexed in the Scopus base in the years 2011-2021. It provides an overview of the state of the art according to the categorised groups of accelerators. The conducted studies illustrate the research referring to start-up accelerators as at July 2021.

First, the conducted literature analysis is focused on categorising studies related to start-up accelerators. This is the most lucid analysis of the literature available to date. The study identifies six groups of studies referring to accelerators, systematising knowledge of the issue which up to now has only been dispersed. It will help both theorists and practitioners to successfully reach the issues they are interested in. The findings of the conducted studies may inspire scientists to further research in this field, identify and initiate collaboration with leading institutions handling the issue of start-up accelerators and, thus, find associates among leading authors.

The presented classification relies on the state of the art and indicates various di-rections for development of start-up accelerators. As demonstrated, this field is

constantly developing and there is a visible need for further research to improve accelerators as a key element for development of entrepreneurship, directly in the market and among aca-demic institutions. The conclusions drawn from these studies suggest that there is no ultimate reliable operation model for start-up accelerators that leads to success, each case is different and requires an individual approach.

The conducted studies may also be of use to corporate executives and managers of big enterprises who seek opportunities to build up competitive advantages by collaborating with accelerators and start-ups within the frames of acceleration programs. Considering the studies invoked in this paper, managers can draw numerous conclusions regarding classification of accelerators and forms of offered support and then introduce changes in the activities conducted for the purpose of transferring innovation and creating and developing dedicated tools for co-operation with innovative enterprises.

For start-ups, in turn, this paper will be useful for adjusting a developed program to the offer available in the accelerator market. It may contribute to a better understanding of program expectations of parties engaged in acceleration programs (corporations, accelerators, venture capital funds) and identification of differences, owing to the devised classification of accelerators in terms of offered support, funds, mentoring, offered technical or organisational resources etc.

Even if the conducted studies provide the basis for several findings, they also contain certain restrictions. The presented analysis covers only publications in English included in the Scopus base. Therefore, it may be supposed that there are also other scientific papers referring to start-up accelerators that are not indexed in that base.

The authors will concentrate their future research to extend the literature overview by other scientific bases, e.g., Web of Science, and bibliometric analyses. They also plan to conduct start-up and corporation surveys to diagnose factors encouraging and discouraging co-operation with accelerators. It is recommended to develop a business model of accelerator that would satisfy the needs of the surveyed start-ups and corporations.

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