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Impact Tech Startups: A Conceptual Framework, Machine-Learning-Based Methodology and Future Research Directions

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Abstract: The Impact Tech Startup (ITS) is a new, rapidly developing type of organizational category. Based on an entrepreneurial approach and technological foundations, ITSs adopt innovative strategies to tackle a variety of social and environmental challenges within a for-profit framework and are usually backed by private investment. This new organizational category is thus far not discussed in the academic literature. The paper first provides a conceptual framework for studying this organizational category, as a combination of aspects of social enterprises and startup businesses. It then proposes a machine learning (ML)-based algorithm to identify ITSs within startup databases. The UN's Sustainable Development Goals (SDGs) are used as a referential framework for characterizing ITSs, with indicators relating to those 17 goals that qualify a startup for inclusion in the impact category. The paper concludes by discussing future research directions in studying ITSs as a distinct organizational category through the usage of the ML methodology.

Keywords: SDG; social enterprises; Impact Tech; startups; hybrid ventures; entrepreneurship; innovation; impact investing; machine learning

1. Introduction

The Impact Tech Startup (ITS) is a new, rapidly developing phenomenon. With an entrepreneurial approach and technological foundations, ITSs adopt innovative strategies to tackle a variety of social and environmental problems within a for-profit framework, usually backed by private investments similar to the venture capital models seen in other types of startups. Unlike other startups, which may deal with areas such as security (i.e., face recognition), gaming (i.e., virtual-reality computer games), or finance (i.e., financial trade software) and are formed primarily for commercial reasons, Impact Tech Startups are creating social and/or environmental impact; thus, they also benefit a social or an environmental cause. Examples of such startups are those dealing with the loneliness of elderly persons (https://elliq.com/, accessed on 15 July 2021), fighting hunger and food waste (https://toogoodtogo.org/en/, accessed on 15 July 2021), helping refugees find employment (https://skilllab.io/en-us/, accessed on 15 July 2021), using microalgae and nanofluids to generate energy and oxygen (https://greenfluidics.com/, accessed on 15 July 2021),

or capturing airborne moisture for clean drinking water (https://www.watergen.com/, accessed on 15 July 2021). This category of organizations has not been discussed in the academic literature (see Section 3 for an elaboration of the concept, its roots, and other categories in its organizational vicinity).

This new hybrid form of organization has been recognized by the UN Interagency Task Team (IATT) on Science, Technology and Innovation for Sustainable Development Goals (SDGs) in 2015 (https://sdgs.un.org/tfm/interagency-task-team/, accessed on 12 June 2021) as an emerging form with the potential to catalyze the business sector toward aiding with the Sustainable Development Goals—SDGs [1]. Whereas the concept of Impact Tech Startups is vividly discussed in the practical literature and hubs are created around it (see for example: https://www.techforgood.co/, accessed on 12 July 2021), surprisingly, this new type of startup has barely been addressed in the academic literature.

The importance of conducting research on this new organizational category is related to the growing trend of introducing technology-based innovative solutions (products and services) in the domains of society and the environment. Traditionally these have been domains for which the public and the nonprofit sectors were responsible, and those sectors are less inclined to engage in technology-based innovation. The startup format, anchored in the entrepreneurship of individuals, has demonstrated that products and services based on new technologies can be easily applied in all corners of the globe. The application of the startup format into the societal and the environmental domains that is currently taking place in the form of ITSs is a very important development that calls for the attention of the research community.

From an organizational ecology theory perspective [2], the evolution of a new organizational category is a process that initially develops against certain background conditions. These conditions enable experimenting with new ideas that are translated by visionaries and entrepreneurs into organizational realities. The background conditions for the evolution of the ITS organizational category are outlined below in Section 2. The next phase in the process of the evolution of a new organizational category is the search for legitimacy, which usually comes from funding sources, public opinion (the press), and academia. At present, the ITS category has limited legitimacy: It is only recognized by a small number of networks of investors, such as *tech2impact* (https://tech2impact.com/, accessed on 12 July 2021). In the press or academia, one may occasionally find a story or article about a specific startup, but case studies are not sufficient to enable legitimacy of the entire category. This is the phase where the ITS category is at present. With a higher level of legitimacy, according to theory, the new organizational category will carve out its own niche and develop its own institutions (for accreditation, ethical standards, etc.). The highest level of societal acceptance is when it acquires a separate legal status.

Given the important societal role of ITSs and the lack of research about that organizational category, initial conceptualization to be followed by empirical research is needed in order to understand their unique characteristics [3]. This has been the case with other newly developed organizational forms and categories (see below, Section 4.1). The contribution of such infrastructural research is both to the academic and the practical worlds: From an academic perspective it should lead to developing theoretical formulations by linking ITSs to other organizational categories and forms. In the world of practice, it should help formulate policies that will encourage and support their activities.

The purpose of this paper then is (1) to introduce the ITS concept as a new organizational category in an academic context, (2) to propose a conceptual framework to study the Impact Tech Startup organizational category, and (3) to suggest a methodology for studying it. This should encourage researchers with interest in innovative organizations to engage in studying it.

The paper is divided into four main sections: The first provides general background for the development of ITSs. The second presents a conceptual framework for ITSs, based on two key organizational categories. The third proposes a machine learning (ML) methodology to distinguish ITSs from other startups to facilitate the mapping of this type

of organization. The concluding part discusses future research directions for the study of ITSs through the use of the machine learning methodology.

2. Background: The Calls to Transform the Economy

The evolution of ITSs since around 2010 has unfolded against a background of growing international awareness that the world's future threatens to be bleak if it continues to pursue profit maximizing, neo-liberal economic policies without regard to the effect on health, social inequalities, and the environment. In recent years, calls for change have come from institutions that were once-staunch supporters of neo-liberalism, such as the International Monetary Fund (IMF) and the World Economic Forum (WEF). Klaus Schwab, executive chairman of the WEF, recently published two books in which he summarizes his philosophy on the matter [4,5]. Both books call for a change of course on how the world economy is run. In the second book, which he entitled *Stakeholder Capitalism: A Global Economy that Works for Progress, People and Planet*, he outlines an alternative to the prevailing capitalist model of business, which is based on shareholders' interests. In recognition of the dangerous fate the world is facing, he proposes a different model, based on stakeholders, in which companies seek long-term value creation instead of short-term profits, where governments cooperate in order to create prosperity for their people, and civil society organizations representing customers and employees participate in the dialogue so as to protect the interests of people and the planet.

Such ideas found expression in leading financial media outlets [6] and have been echoed by large companies, such as Walmart (the company has set itself the goal of become a "regenerative company" that produces zero net emissions by 2040. It also aims to protect, manage, or restore at least 50 million acres of land and one million square miles of ocean by 2030 [7]). The COVID-19 crisis has intensified the criticism of the prevailing economic system: As Nobel Prize Laureate entrepreneur, economist, and civil society leader Muhammad Yunus has exhorted, "Don't plan for economic 'recovery' post Covid. Redesign it from scratch" [8].

The adoption of such ideas requires businesses to change from strictly profit-oriented goals of increasing value for shareholders to entities that have additional objectives in the areas of society and the environment. As is explained later in the paper, such ideas put into question the institutional separation between the commercial world guided by a business logic and the social world guided by society-based values (e.g., solidarity, equality). Combining different logics within the same organizational entity calls for a hybrid structure [9] (this does not mean that the entire business sector will fully and immediately adopt these ideas; it is clearly a process and we are witnessing its early stages).

The concept of hybrid organizational structures that combine commercial, social, and environmental objectives gained traction after the 2008–2009 economic crisis. The realization that there is a link between an economic system that benefits the few and the social reality resulting from the collapse became evident. This resulted in 2011 in "Occupy Wall Street"-style protests, which demanded social justice and took place in hundreds of cities around the world. After the demonstrations subsided, a phase of creative thinking on the topic of social justice took place [10]. Forums of entrepreneurs, professionals, and activists experimented with ideas on how to give concrete expression to new types and configurations of organizations in which commercial and social/environmental objectives could be combined in the same entity, namely, creating profits as well as social impact. These discussions gave rise to a variety of frameworks that can be categorized under the moniker of social enterprises and the entire process of experimenting with creative solutions was part of the building blocks of what was later characterized as the New Social and Impact Economy [11].

Thus, for example, Berger and Blugerman [12] wrote about a "new wave of organizations with social purposes" in Argentina as a result of an emphasis on entrepreneurship training and the "development paradigm that searches for modes of production and service that seeks not only profits but also service for humanity without social or environmental

costs" (pp. 34–35). Radyati and Tjahjono [13] wrote about community enterprises in Indonesia, which created their own microscale power plants in villages (p. 86). Chabanet and Lemoine [14] discussed these trends in France, which has a very long tradition of a social and solidarity economy, with strong ties to the cooperative movement and a social democratic ideology. With the introduction of entrepreneurs into the business and social arenas, they observe a tendency among those to "reconcile the principles of the market economy . . . with the virtues of solidarity and social action, which they feel are necessary in the fight against inequalities and to guarantee minimal social cohesion" (p. 153). Domaradzka [15] wrote about these developments in Poland and provided an example of an impact investment fund (Simpact) "in which the key criterion for investing . . . (is) their positive impact on society and the environment" (p. 130).

Two other developments were at the background of this evolution: The first was the tremendous technological advances of the new millennium, foremost of which are the Information and Communication Technologies (ICTs) that allowed for new modes of interaction between people. The second was the development of entrepreneurship, both business and social, which encouraged creative thinking by individuals and the spread of this insight through organizations such as Ashoka, which resulted in finding and implementing new solutions to existing problems.

3. The Conceptual Framework for ITSs

ITSs are a product of these trends, using technology to address major social and environmental challenges within for-profit organizations funded primarily by venture capital. Thus, a conceptual framework for analyzing ITSs needs anchoring in both the social enterprise and the startup conceptions of organizations.

3.1. Social Enterprises

It was Muhammad Yunus who coined the term "social business" [16]. His experience as a banker in Bangladesh demonstrated to him that it is possible to combine a business orientation with social values to the benefit of both. This was a new approach to a world largely characterized by an institutional separation between the economy and private business on the one hand and society and the public and non-profit sectors on the other. It was in a way a visionary outlook of the things to come that eventually resulted in statements such as those by Klaus Schwab. Adoption of the idea brought about the rapid establishment of social enterprises throughout the world, ecosystems to support them, and a rich literature of academic analysis analyzing them.

A social enterprise is an organization that applies business strategies and models to the enhancement of individual, social, and environmental well-being, rather than maximizing profits. Social enterprises are hybrid in form, producing goods or services using market-oriented strategies while promoting social and environmental objectives. As such, they must build infrastructures (governance structures, marketing strategies, personnel practices, and more) around their dual objectives and need to develop measurements to demonstrate how they accomplish both.

Many social enterprises focus on employment schemes for marginalized populations, providing creative solutions suitable for the particular abilities of the specific social group and the goods or services offered, enabling them to be competitive. Examples include Aspiritech (www.aspiritech.org/, accessed on 20 June 2021) and Call Yachol (https://callyachol.co.il/, accessed on 20 June 2021). Others operate in "social tourism" and education, often created by entrepreneurs with knowledge or experience of the particular issue addressed. They frequently serve the dual personal purpose of contributing to social and environmental goals as well as providing a living for their owners and employees.

Many countries have developed ecosystems and policies to support the development of social enterprises. Policies often include measures that provide direct or indirect public financial support to social enterprises [17–20]. A substantial body of academic literature on social enterprises has emerged, on both theoretical [21–25] and empirical [26–28]

aspects. Others have sought to characterize the phenomenon [29,30], the forms of management [31–33] their governance structures [34], and the kind of entrepreneurs that establish them [35,36]. The theoretical literature on social enterprises deals principally with their key and most distinctive feature: their hybrid form based on competing institutional logics [37,38]. Another line in the theoretical literature relates to the nature of the entrepreneurs establishing social enterprises. This literature distinguishes between business-oriented and socially oriented entrepreneurs, with social enterprises requiring "ambidextrous" entrepreneurs to run them [39].

This hybrid, social enterprise organizational form also challenges the idea that interventions that help, heal, or educate people, and/or promote values, such as gender and racial equality, can only be performed by organizations without commercial imperatives, namely, public or non-profit institutions, as was the leading notion (and practice) in traditional welfare states. This discussion on hybridity, however, pertains primarily to countries with developed economies and a welfare state history (or similar state intervention), where this institutional separation between the commercial and the social exists. It is less applicable in emerging economies, where the needs are very elementary and the distinction between "social" and "commercial" is less relevant. Sengupta and Sahay [40] suggested that in those countries "the critical issues are triggered by shared necessity such as livelihood generation, poverty eradication, rural entrepreneurship, improved education, to name a few. These are addressed through group collectivism, and implemented by connecting beneficiary indigenous communities within the format of micro-institutional structures such as self-help groups." An example of such a framework in Indonesia was discussed earlier [13]. Sengupta and Sahay added that under such conditions the social entrepreneurship process generates both economic and social value. In other words, in emerging economies, the institutions engaged in development can actually be characterized as hybrid from the outset, as the social and the economic are interlinked in the issues they are facing (see also [41]).

Social enterprises reflect the notion that it is possible to pursue both social and commercial objectives within one organizational framework. Indeed, if the enterprise is organized correctly, these two objectives can complement each other and be beneficial for all concerned. In recent years, we have witnessed that such hybrid organizational forms are viable and can even thrive. Social enterprises can be incorporated in a variety of legal forms: Business, non-profit (NGO), cooperative, and even public institutions; in some countries they have their own legal form [42].

The development of the social enterprise organizational form and its dissemination is clearly related to the discussion in Section 2 above regarding the criticism of the neoliberal economic regime. It is challenging the notion of the need for institutional separation between the commercial and the social aspects of life and therefore is in sync with the voices calling to transform the prevalent neo-liberal economic model.

Social enterprises, however, face two key challenges: The first has to do with sustainability, which becomes an issue, especially in times of crisis, when pressures mount to compromise on their dual objectives (usually the social aspects), possibly leading to mission drift. The second has to do with scalability, which can also be problematic for social enterprises, since, as business entities, they obviously face competition and need to grow, and yet their community and personal orientation can impose structural limits on their ability to expand their operations. Davies et al. [43] also saw barriers to growth when social commitments are necessarily compromised by market realities due to differences in values, business models, and institutional norms.

3.2. Startups

Although the term "startup" has been used since the 1970s, it grew to widespread international prominence during the late 1990s "dot.com revolution." The literature on startups since the 1990s has predominantly used the term to refer to new, small and medium enterprises (SMEs) designed to develop [44,45]. The growth orientation of startups is also

related to their technological and innovative goals, since newly founded companies tend to experience difficulties if they do not innovate [46].

A review of the literature on startups suggests that this category of organizations possesses the following common traits: (1) Startups are new organizations seeking to grow [47–49]; (2) they create technology-based innovative products and services [50,51]; (3) they create those innovative goods and services under conditions of extreme uncertainty, with little or no operating history, and operate in an environment with high volatility in technologies and markets [50–53]; (4) they aim to provide solutions to hitherto largely unsolved problems while exploring new business opportunities; and finally, (5) startups have also been frequently associated with an unconventional mindset and/or a different way of thinking, challenging reality [54].

3.3. Startup and Entrepreneurship Ecosystems

Startups require favorable social conditions to grow. These include support and encouragement, both material and moral, for entrepreneurs to establish them and, once established, to develop them. This is not a task for one institution; rather, a whole system of support is needed. The term "startup ecosystem" has been widely used to describe this concept. The Global Startup Ecosystem Ranking [55] suggests that a startup ecosystem consists of a city or other defined geographic area with a pool of relevant shared resources and a concentration of funders, investors, incubators, accelerators, and public and private service providers.

A related concept is the "entrepreneurial ecosystem" in which entrepreneurship is encouraged. It is a set of interconnected current and would-be entrepreneurial actors, along with stakeholders, such as companies, venture capitalists, business angels, banks, and other institutions like universities, public sector agencies, and financial bodies. These are served by processes that formally and informally come together to connect, mediate, and govern entrepreneurial activity within the particular locale. Collectively, the concept encapsulates activity of a dynamic and systematic nature that encompasses multiple actors, processes, and institutions [56]. Spigel [57] expanded the concept to include combinations of social, political, economic, and cultural forces within a region that support the development of innovative startups and encourage entrepreneurs and other actors to take risks by helping start, fund, and otherwise assist higher-risk ventures. Whereas two or three decades ago almost all tech startups developed within ecosystems such as Silicon Valley, technology-oriented entrepreneurship today is a burgeoning global phenomenon.

3.4. Government Support

Successful startups can have a significant impact on national economies. Kane [58] suggested that to effectively promote job growth, central consideration must be given to startups. They generate new jobs and tax revenue, as well as develop new services and solutions that fuel the renewal of more established businesses and industries. Hermann et al. [55] predicted that for the decades ahead, countries and regions with thriving startups will enjoy thriving economies.

Governments look to entrepreneurship and startups to solve problems of economic growth and to boost employment. They often prioritize the removal of obstacles to startup funding, especially minimizing unfairly burdensome taxation on small companies, attracting investment capital, helping them at sensitive stages of their development, and contributing to and stimulating R&D funding.

Penzel [59] stated that encouraging and protecting entrepreneurs and the companies they build is essential to the revitalizing of economies, and should be the key to governments' policy priorities in relation to startups. Direct grants, zero-interest loans, facilitating access to venture capital investment, employment support schemes, and promoting demand are vital measures governments can take in this regard.

3.5. The Impact Tech Startup: A Unique Category

Unlike social enterprises, which are often communal and local and face problems of scalability, ITS activities and target markets are not limited by geography. Nor do they usually experience mission drift, as they rarely change the focus of their products or services. Whereas ordinary social enterprises might at times receive funding from public sector or philanthropic sources, especially for infrastructure, ITSs mainly rely on private investment. However, in certain cases, when "proving the market" is especially challenging, they may also rely on government grants and other forms of equity-free financing in their early stages. Some entrepreneurs set up ITSs in their "second time around," having already exited a successful company.

The development of ITSs is closely related to the development of "impact investment." Impact investment is a new trend that has arisen out of the crisis in the neoliberal economy we have already discussed. Traditionally, investment companies have been an anchor for the neoliberal economy, seeking investment opportunities with the highest return and the lowest risk without regard for social and environmental impacts but solely focusing on value creation for shareholders. The growth of ideas promoting social and environmental values has exerted pressure on investment firms to change their strategies and invest in companies that bolster or at least cause no harm to such social and environmental aims. This has fostered the creation of impact investment, a phenomenon that has become a major aspect of the investment world [60–62]. In its broadest form, the incorporation of environmental, social, and corporate governance (ESG) criteria (when ESG refers to the three central factors in measuring the sustainability and societal impact of an investment in a company or business) into investment analysis and portfolio selection encompasses approximately one-third of managed assets. According to the Report on U.S. Sustainable and Impact Investing Trends, the figures in 2020 amounted to USD 17.1 trillion out of USD 51.4 trillion total U.S. assets under management [63]. These figures suggest that there is a clear potential for substantial investment in suitably attractive ITSs. This supply-side impetus has undoubtedly been key to the recent burgeoning of ITSs. Investment companies prefer ITSs to social enterprises because of their greater potential impact, given their global market orientation, along with the fact that the amounts required for investment in ITSs are substantially larger than those for social enterprises, thus better fitting investment companies' strategies. Furthermore, social enterprises are sometimes seen by investment companies as forms of NPOs, not part of the business sector.

Investment companies interested in impact have certain criteria for investing in startups, which usually include the following: startups clearly defining their social and environmental impact goals, the need to reliably measure impact continually throughout the investment lifecycle, and the need to be transparent about impact through reporting and risk mitigation. Impact measurement is a particularly fraught issue in this regard. Although measuring success in straightforward business terms is relatively easy, the measurement of social/environmental impact is complicated and variable across different fields, making universal measures a major challenge for impact investment.

Nonetheless, the presence of impact investment companies creates opportunities for startups, and we can observe them pivoting toward the ITS field in order to be eligible for such investment. In fact, we can observe a recent trend by companies that engage in fields such as agritech to modify their mission statements and develop impact measures to attract impact investment funding. Some see this as "impact washing," but such measures cannot be sustained long term if they are not genuine. Since these ideas are a component of the wider global trends in thinking discussed above. Over time they are internalized by boards, managements, and staff, and become a part of the company ethos.

The main impetus for studying ITSs as a unique category is their distinct role in providing technology-based, innovative solutions to social and environmental problems. At this point in history, it seems that ITSs provide a fitting solution for dealing with these issues on a global scale. ITSs also have unique attributes for that role, as distinct from organizations that seem to resemble them. The fact that ITSs pursue social/environmental

objectives within a framework that engages in commercial activities makes them appear closer to social enterprises, whereas their technologically innovative focus, their funding structure, and their global markets make them close to other venture capital-backed startups. This duality is intriguing and it calls for a better understanding of this unique organizational category.

Given their newness, ITSs have yet to be addressed by the academic literature. Poonamallee et al. [64] dealt with a related phenomenon—the socio-tech venture. This is a form of innovative social enterprise combining social/environmental objectives with for-profit organizational frameworks that use technology to achieve their objectives. Although this form includes startups, with several of their book's case studies presented applying that term to their cases, the editors preferred to see the phenomenon of what they term "socio-tech ventures" (including startups) in the framework of social enterprises. This paper analyzes a similar phenomenon in the framework of the startup concept. It may be an issue of framing. Although in both cases the term denotes organizations that use innovative technologies to tackle social/environmental challenges, the socio-tech venture concept may include NGOs, whereas the startup concept accentuates the for-profit status. Future research and conceptualization will determine whether Impact Tech Startups are a form or a sub-category of socio-tech ventures or will develop into separate concepts with distinguishable features.

An even broader conceptualization was proposed in a report by GoodTechLab (The Frontiers of Impact Tech, https://www.goodtechlab.io/reports/, accessed on 12 July 2021), which suggested that there is a new phenomenon of "impact tech," defined as "the intentional use of science and technology to benefit people and the planet." This can be realized via different types of entities: movements, companies (large, medium, and startup), nonprofits, academia, international organizations, and so on. Such a conceptualization implies a very broad framework of analysis. Our choice of focusing on a specific organizational category within the broader field, namely, Impact Tech Startups, accentuates its belonging to the startup phenomenon, which is a major economic driver in society. Such a choice also has major methodological implications for studying the phenomenon, as the next section details. To sum up, we are witnessing a growing trend to use technology to deal with social and environmental challenges. This trend takes different organizational forms and calls for a solid conceptualization if it is to develop.

We devised a visual expression of that new field. Figure 1 presents this phenomenon in a context from an ITS perspective and shows its two main organizational sources as well as the different configurations and organizational forms in its "neighborhood." These include startups that are potential ITSs. These start as regular startups, possibly not consciously oriented to society or environmental goals. They could be encouraged (by investors) to frame and measure their activity in impact terms in order to be included in the category of ITSs. On the right, the social enterprise organizational form (ITSs) are flanked by social tech non-profit organizations (NPOs) [65].

To summarize, ITSs as a distinct organizational category are anchored in different conceptual bases. Empirical research on that category is needed in order to gauge its actual characteristics and to compare them to similar organizational categories in its vicinity.

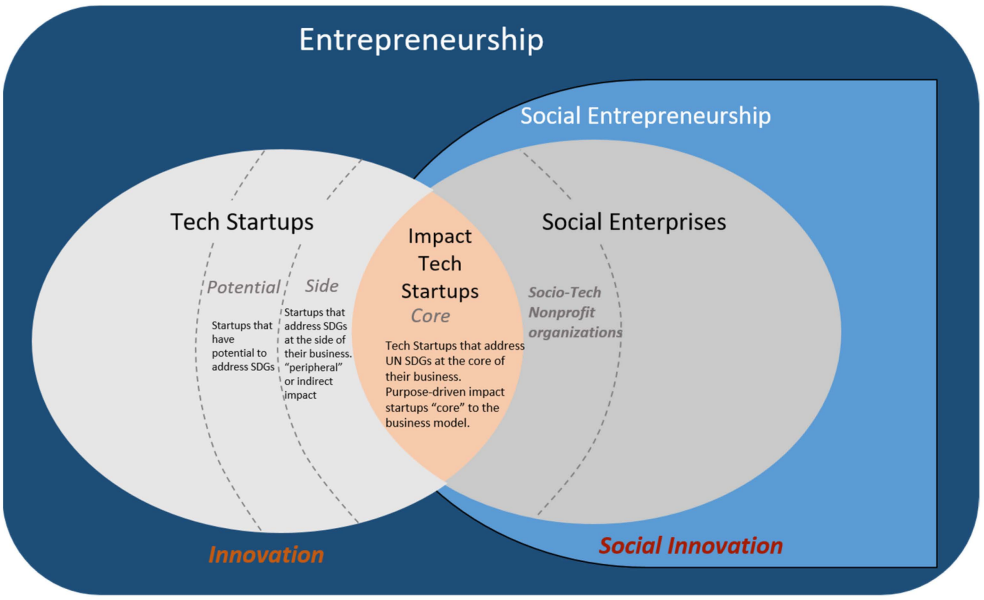

Figure 1. Conceptual and organizational roots of ITSs.

4. Methodology for Studying ITSs

4.1. Overview

In the early 20th century, the study of new organizational categories began with observation and then evolved into conceptualization. Max Weber's study of bureaucracy is a prime example. Later in that century and into our own, conceptualization and theorizing of new organizational phenomena started by mapping them, namely, systematically collecting data on the organizational phenomenon and analyzing them, looking for unique characteristics. A case in point is the study of the non-profit or "third sector" in the 1990s, which began with comparative mapping in over 40 countries. That study was enabled by the adoption of a common definition of the nonprofit organizational form that later became the standard one adopted by the UN [66]. The results of that mapping phase, which provided detailed data on the economic, legal, historical, and policy dimensions of the nonprofit sector, were the cornerstones of the conceptual literature that ensued, notably for the development of social origins theory that categorized countries by their nonprofit regimes [67]. Although this theory was later criticized [68], it was a mid-range theory that prompted broader conceptual development of the field, including a division of organizations in society into three sectors, as opposed to the previously prevalent two-sector concept of a society (that is, public and business). These breakthroughs brought about a multi-disciplinary research agenda for the nonprofit sector and civil society that enriched knowledge in this and related fields.

According to Leavit et al. [3], a study of a new organizational form must start with a description of its main features and characteristics before comparing it to similar organizational forms. For that task they recommended machine learning (ML) methodologies. They saw such methodologies that identify organizational categories as a first step, either complementing or superseding earlier survey methodologies. Leavit et al. suggested that "ML may serve as especially useful for testing boundary conditions, moderators, and inflection points, as the processing power of ML can allow for the testing of complex combinations of predictors which may otherwise go overlooked" (p. 20).

Such a methodology allows for the presentation of detailed descriptive data on a case and hypothesizing about relationships with a range of contextual variables, providing an infrastructure for theory building. In the process of categorizing ITSs as unique, a process of mapping that phenomenon is an obvious first step. This enables us to focus on ITSs' structural attributes, which may help distinguish them from both social enterprises and

regular startups. Such mapping is crucial for both conceptualizing the phenomenon and developing a research agenda.

Given the interest in and government encouragement in many countries of the startup phenomenon as an important component of the economy, databases on startups exist at regional, national, and international levels. Startups are interested in being included in such databases, not only in order to present themselves and display what they are engaged in, but also and primarily so, in order to attract investors. Thus, they have a strong motive to be part of the database(s) that may enable that. A first step in mapping ITSs is to identify them from within such databases.

Unfortunately, if an attempt is made to map socio-tech ventures within the concept of social enterprise, a similar procedure is not possible, as no comprehensive international databases of the social enterprise organizational form exist. Defourny and Nyssens [42], in a major international study of the social enterprise phenomenon, were unable to compile a database of such entities and focused instead on identifying social enterprise models. The models identified are based on the different legal statuses of social enterprises (the social–business model, the social–cooperative model, and the entrepreneurial nonprofit model), and not on their use of technology or other characteristics.

Distinguishing ITSs or socio-tech ventures from within social enterprise databases remains a worthy task, where databases make it possible. Doing so will complete the picture obtained from the analysis of ITSs within startup databases.

4.2. Identifying ITSs within Startup Databases: The UN SDGs as a Reference Framework

One of the challenges of studying impact has been the lack of agreement and shared language on what constitutes positive social and environmental impact [69–71]. In recent years, the UN Sustainable Development Goals have become an important unifying factor in defining the parameters of impact [72]. This framework, issued in 2015, sets out 17 interlinked goals for a better and more sustainable future, along with 169 indicators. These SDGs are considered the most ambitious effort to place such goal setting at the center of global policy and governance [73]. Concomitantly, the SDGs have been identified as highly beneficial for both business and investors, as they present the best long-term strategic market outlook for global policymaking [74,75]. More specifically, SDGs are a valuable reference point for impact investors [76,77].

The process of distinguishing ITSs in startup databases involves the use of artificial intelligence (AI). In the past, algorithms used for such tasks have been based on keyword identification in the analysis of texts related to the startup. The methodology we have proposed is based on natural language processing (NLP) technology providing a deeper analysis of the brief description appearing in the "About Us" section of a startup's website. The algorithm is designed to classify the startup by labels according to the 17 SDGs. To accomplish that, we used a data-driven approach by refining an ML model for descriptions of startups that were previously labeled for SDGs by Rainmaking. In their SDG Compass (https://rainmaking.io/impact/, accessed on 2 July 2021), a group of experts identified 2000 impact tech startups, categorized by the 17 SDG categories. These startups' webpages served as the basis for the machine learning process we used in the development of the algorithm. To address the semantic variability of the descriptions, as well as to compensate for the relatively small number of labeled examples that are available for training the algorithm, we used BERT. This is one of the most popular emerging neural network-based NLP technologies, based on a massive database of free English texts taken from a number of sources, and it learns the distribution of words in their context, an approach also known as transfer learning [78]. Using this algorithm, we were able to predict a single SDG label for a given startup. We experimented with two sets of labels. One included all 17 SDG labels, and another clustered the 17 SDGs together under five labels: People, Planet, Prosperity, Peace, and Partnerships. To evaluate the performance of the algorithm, we excluded about 10% of the startups from the training collection in SDG categories where no startups were found and calculated the accuracy of the algorithm's predictions. In our

best scenario, we were able to achieve a 77% accuracy for predicting one of the 17 SDGs, and 82% for predicting one of the five categories. We analyzed the mistakes that happened most frequently in relation to SDGs for which we had a relatively small number of relevant labeled startups. By removing 10 of those SDGs from the task and retaining only the most prominent goals, we were able to improve the results to 83% and 89%, respectively, and in an ML process, train the computer to identify those that possessed the qualities sought.

That process allowed us to distinguish ITSs from other startups and categorize ITSs by the SDG categories. The process also has the potential to provide insight into startups that may be able to address the SDGs, namely, those that operate in relevant fields but have not yet adopted a framework for addressing social and environmental issues.

In applying the algorithm to specific databases (see next section), we used our definition of ITSs presented in Section 3.2. We included in the analysis only startups with less than 200 employees and those in the beginning funding stages (A and B). The larger and more established companies started their journey as startups, but with success they became more concerned with marketing their product/service than with innovating it [79]. In accordance with our definition, they no longer counted.

The algorithm we developed will be made public in a different paper, mostly technical in nature [80] 9in preparation). It is not presented in this paper, which focuses on the conceptual aspects of ITSs, as it needs a different focus.

The methodology we devised can also serve as the basis for research on single regions, countries, or cities, as well a comparative analysis between them. Obviously, this is not the only methodology for identifying and studying ITSs—there are more conventional ways of doing so, such as surveys. That said, once an algorithm to identify ITSs in startup databases has been created, it is less time- and resource-consuming than other options, and has the built-in advantage of easy comparison of variables to those of non-impact startups. The next phase of research into ITSs will be to probe deeper into their characteristics, comparing them to both startups in general and social enterprises. This, too, can be done with the use of AI. Interviews with founders and funders on their motivations, for example, can be recorded and analyzed for common themes.

5. Discussion and Conclusions

The purpose of this paper was to introduce a new important organizational category—the Impact Tech Startup, which thus far has not found expression in the academic literature. It discusses the background of the evolution of Impact Tech Startups during the second decade of the new millennium, outlines a conceptual framework within which it is possible to analyze this phenomenon, and proposes an ML-based methodology to identify and categorize ITSs into the SDG categories from within startups' databases.

Studying a new organizational category or form is always a challenge, because it lacks a conceptual framework in which to anchor it, a fact that leads to the lack of empirical data with which to analyze its unique features. This paper is thus an attempt to deal with both those issues—providing a conceptual framework as well as a methodology to enable empirical research on the phenomenon. It is meant to open the door for researchers to engage in the process of refining both the conceptual framework and the methodology.

Studying this new organizational category and understanding its dynamics is of utmost importance, as ITSs provide innovative technological solutions to major social and environmental challenges the world is facing, and policies to encourage ITS development are clearly needed.

Limitations of the concept and the methodology. The concept of an Impact Tech Startup, namely, an organizational entity that uses innovative technologies to deal with social and environmental challenges, which on the face of it is clearly positive, could raise ethical issues, which should not be ignored. Zuboff [81] outlined in her book the dangers of the "digital revolution," which allows large conglomerates to obtain information about individuals' personal preferences and needs, which is then sold to commercial interests. Certain impact tech startups (particularly those dealing with persons with disabilities

and/or their families) have in their possession personal data that could be turned over to a third party. Another ethical issue has to do with "greenwashing," discussed in Section 3.5. Given the interest by investors in the ITS phenomenon, the danger of abuse or compromise of the social/environmental focus by certain entrepreneurs is a real one. In both of those issues, clear guidelines of behavior for entrepreneurs establishing ITSs should be devised. Given the international nature of the phenomenon, these guidelines could be devised by the UN agency that developed the Sustainable Development Goals and implemented by national governments and civil society organizations.

The methodology presented is based on a process of "extracting" ITSs from general databases of startups. Although, as indicated in the paper, startups are interested in being included in such databases in order to attract investments, the methodology does not allow for the inclusion of startups not part of those databases. In other words, it assumes the comprehensiveness of the startup databases. In addition, the methodology and the categorization are based on the "About" page on the internet webpage of the startup. One could ask questions about the accuracy of that information in comparison to what the startup really is and does. Obviously, deeper information about the startup, beyond what is presented in its webpage, cannot be obtained by an algorithm and calls for a different methodology.

Future empirical research on the ITS concept should be divided into two categories. The first should be based on the algorithm and should explore additional variables that are listed in the startup's webpage, such as gender of the entrepreneur, funders, number of employees, stage of funding etc. The second needs to take a closer look at these organizational entities, exploring such issues as the motivations of the entrepreneur(s) as well as of the funders, the governance structures and the extent to which they are based on stakeholders, the measurements used to assess impact, their inter-organizational relations, etc. Answering such questions calls for methodologies such as questionnaires, interviews, and participant observation.

As stated above, the reality of the startup scene in emerging economies may be different and the conceptual framework proposed may not fit them, as the challenges they face are not divided along the social/economic divide. Future research on Impact Tech Startups in emerging economies may need to develop a different conceptual framework than the one proposed here.

Research providing answers to such questions will make it possible to engage in further conceptual refinement of our understanding of the ITS organizational category and relate it with more certainty to the literature on both social enterprises and startups in general. It will also aid in developing policies that promote ITSs and foster better links between them. Finally, it will help us to better understand the process by which certain startups with the potential to become ITSs change their infrastructure and mindset to become eligible for impact investing and the role played by their ecosystems' support.

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