

Humboldt-Innovation GmbH
Ziegelstr. 30
10117 Berlin

Phone: +49 (0) 30 2093 70759
E-Mail: cb@humboldt-innovation.de
Web: www.humboldt-innovation.de



Digital Entrepreneurship for the “Decade of Action”

How Entrepreneurs can impact
our race towards the
Sustainable Development Goals.*

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How Entrepreneurs can impact our race towards the Sustainable Development Goals.

Manouchehr Shamsrizi, M.P.P. FRSA (✉)

gamelab.berlin of Humboldt-Universität and RetroBrain R&D GmbH

Email: manouchehr.shamsrizi@leuphana.de

Adalbert Pakura, RetroBrain R&D GmbH

Jens Wiechers, Mensa International

Dr. Stefanie Pakura, University Hamburg

Dominique V. Dauster, Yunus + You - The YY Foundation

Authors:

- Manouchehr Shamsrizi, M.P.P. FRSA (corresponding author // Co-Founder gamelab.berlin of Humboldt-Universität, Co-Founder RetroBrain R&D GmbH)
- Adalbert Pakura (Managing Director RetroBrain R&D GmbH)
- Jens Wiechers, FRSA (International Director, Mensa International)
- Dr. Stefanie Pakura (PostDoc Researcher at the Chair of Management & Digital Markets, University Hamburg)
- Dominique V. Dauster, FRSA (Managing Director of the Yunus + You - The YY Foundation)

Conflict of Interest Statement / Acknowledgements

Manouchehr Shamsrizi is a Co-Founder, shareholder, and employee of RetroBrain R&D GmbH, and has previously served as one of its managing directors during the past five years. He is a Co-Founder of gamelab.berlin of Humboldt-Universität and was a member of the Jury of the Federal Government's “WeVSVirus”-Hackathon.

Adalbert Pakura is the current Managing Director of RetroBrain R&D GmbH.

Jens Wiechers is a Co-Founder and previously was a shareholder and employee of RetroBrain R&D GmbH, serving as one of its managing directors during the past five years; he has no current affiliation, financial or otherwise, with the company.

Dr. Stefanie Pakura has no current affiliation, financial or otherwise, with any of the organisations discussed in this chapter.

Dominique V. Dauster is Managing Director of the Yunus + You - The YY Foundation of Nobel Peace Prize Laureate Prof. Muhammad Yunus.

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Abstract

In 2020, the UN launched the “Decade of Action” to achieve the Sustainable Development Goals (SDGs) by the year 2030. As the SDGs are interdependent, intersectional and interdisciplinary, so must be their solutions. This chapter argues that the best way to identify, develop, and scale solutions of such quality is (digital) entrepreneurship, building on the principles of open innovation, cutting-edge technologies, and social business. The COVID-19 pandemic in early 2020 in particular serves as a stark reminder of the interconnected nature of the SDGs and the challenges we face in achieving them. In this article, we explore the third SDG (SDG-3), “Good health and well-being”. We show the potential for digital entrepreneurship to foster the rise of new forms of digital healthcare and to accelerate the digitalization of the healthcare sector. Due to both perceived and real issues of regulatory compliance, user experience and long investment/equipment use cycles, SDG-3 has been one of the slowest to adopt innovative solutions by far. We discuss specific areas, such as blended reality or quantum computing, for emerging and future digital health applications.

In this chapter we provide: the “memoreBox” of social startup RetroBrain R&D, a special edition of gamelab.berlin’s app “Singleton”, and D-Wave’s free access to its cloud quantum computing services. All these examples of digital entrepreneurship utilize in whole or in part a combination of *open innovation*, *future and emerging technologies*, and *social business*, thus supporting our rationale. The article closes with recommendations for different stakeholders of entrepreneurial ecosystems, demonstrating both the necessity and the potential of digital entrepreneurship for the SDGs and the “Decade of Action.”

1 Introduction

“We have a choice - either we go back on the old tracks, or we build new tracks to take us to a new civilization.

We are now in position to build new tracks. We missed our chance in 2008 in building those after the global financial crash.

Let us not miss the chance this time.”

Muhammad Yunus¹

The 17 Sustainable Development Goals (SDGs) initiated and adopted by all United Nations Member States in 2015 have been a driving force behind numerous initiatives and projects around the world. They constitute an *agenda for sustainable development* that “provides a shared blueprint for peace and prosperity for people and the planet, now and into the future” (United Nations Department of Public Information, 2015, p.1) while also serving as calls to action for a better future. At their core, SDGs are interdisciplinary, intersectional and interdependent and address a variety of areas that are of critical importance for both humanity and the planet: environmental protection, ending hunger and reducing inequality are closely linked to e.g. sustainable consumption and management of natural resources, improving education and providing elementary health care and sanitation for all. Still, five years into the program timeframe, many initiatives and projects still fail to address this fundamental interconnectedness. These risks falling short of not only their potential, but also interference and competition for already scarce resources. In consequence, the UN declared the 2020s to be the “Decade of Action” (Guterres, 2020, p.1) and has since then appealed to states, corporations, non-governmental organizations, and other stakeholders to more consistently and deliberately combine forces in order to deliver on the goals set out in 2015 (United Nations, 2020).

The global COVID-19 pandemic that began to unfold in late 2019, severely shuttering the global economy starting from February 2020 and expected to cause the worst global recession in almost a century (BBC, 2020), serves as an additional stark warning of just how necessary an alignment of forces is. At the time of this writing (end of May, 2020), despite rapid and extensive public health measures being taken in many countries, there are more than 5.4 million confirmed cases and over 345.000 deaths (WHO, 2020). The outbreak of COVID-19 not only sent whole countries into lockdown, but also demonstrated how relatively ill-prepared the world is for a global health crisis, even one that has long been anticipated: Corona viruses, like influenza viruses, have been the cause of previous pandemics and have been actively studied as likely candidates for future pandemics. Despite drawing on lessons learned from recent pandemics caused by CoV, e.g. SARS, MERS, the global response has been mixed (Park, Thwaites & Openshaw, 2020; Malik et al., 2016; Hayward et al., 2014), partly because of inadequate data bases, comparable to other global public health challenges like antibiotic-resistant infections (Shamsrizi, P. et al., 2020). In many cases, the responses to the crisis from governments, health care professionals and the public demonstrate a significant gap between the claimed commitment to the ideals of SDG-3, i.e. “Good health and well-

¹ Corona Pandemic: Time Is Running Out Fast, A Letter from Prof. Muhammad Yunus (2020).

being,” and actual reality in the face of a crisis. This is of particular relevance as health (SDG-3) serves as a foundation for many of the other SDGs (Rosling, Rosling Ronnlund & Rosling, 2018). Considering the current situation, the slow adoption of digital health in general and digital therapeutics in particular - partly because of plausible reasons (including issues of trust, data protection and reimbursement) - over the past couple of years seems alarming. Still, *digital health and especially digital therapeutics* are expected to have a tremendous and positive impact on society if they are adopted by more and more patients, doctors and other health care professionals (Deloitte, 2019). One way to foster digitalization in the health care sector and to bring better care to more people is through digital entrepreneurship. Technological developments and advances in infrastructure create various opportunities for entrepreneurs (Kraus, Palmer, Kailer, Kallinger & Spitzer, 2018). However, research on digital entrepreneurship is still in its infancy (Kraus et al., 2018).

In this chapter, we apply a holistic perspective and see entrepreneurship as more than just starting up a new business. Following Hsieh and Wu (2018), we understand entrepreneurship as “the process of designing, launching and running new business” with its distinct characteristic of “new value creation” (Hull, Hung, Hair, Perotti & DeMartino, 2007). However, entrepreneurial activity arises from the interplay of stakeholders, institutions and entrepreneurs themselves (Palmer, Kraus, Oner, Kailer & Huber, 2018). Referring to Kraus et al. (2018), providing a state-of-the-art literature review of “Digital Entrepreneurship”, we understand digital entrepreneurship “as a “subcategory of entrepreneurship in which some or all of what would be physical in a traditional organization has been digitized” (Hull et al., 2007, p.293) and is thus defined as “the sale of digital products or services across electronic networks” (Guthrie, 2014, p.115). To summarize, due to the numerous opportunities for entrepreneurial activity, created through digitalization (cf., Hull et al., 2007) and its ability to develop interdisciplinary and intersectoral solutions for complex problems (Breidenbach, Krawietz & Shamsrizi, M. 2020), digital entrepreneurship offers an impactful instrument for the advancement of sustainable innovations (Kraus et al., 2018), thus the SDGs in general.

2 Digital Entrepreneurship as a Game Changer for SDGs

Every new tech-generation makes our societies more inclusive, healthy, and democratic, and leads to our institutions having greater transparency and accountability (Pinker, 2018). Through digital transformation, which can generally be understood as the “disruptive implications of digital technologies” (Nambisan, Wright & Feldman, 2019, p.1), many new business and science areas have spawned - and numerous implications for culture and society will most likely be enormous (Hausberg, Liere-Netheler, Packmohr, Pakura & Vogelsang, 2019). Murphy et al. argue that it is entrepreneurship which has been the main driver for the increase in (western) per capita income over the past 200-300 years (Murphy, Liao & Welsch, 2006). Entrepreneurship can transform whole industries and scale solutions in a quicker and more agile way than other economic approaches. It is not only one of the “transversal key competences applicable by individuals and groups,” (Bacigalupo, Kampylis, Punie & Van den Brande, 2016, p.10) as defined by the European Commission, but also a key driver for economic growth “at the heart of national advantage”, as Porter (1990, p.125) noted. Digital transformation has had an enormous impact on most aspects of daily life and has also changed the way organizations and whole industries operate (OECD, 2019), facilitating new types of work and self-employment - and paving the way for digital entrepreneurship: “the enterprising human action in pursuit of the generation of value, through the creation or expansion of economic activity, by identifying and exploiting new ICT [Information and Communications Technology] or ICT-enabled products, processes and corresponding markets” (Bogdanowicz, 2015, p.4). The pervasive accessibility of internet services has lowered the barriers to start a project, organize, and interact online; this fosters ever-new forms of digital entrepreneurship, especially by allowing even those who could not or would not have formed a company traditionally to find an audience and a market (Allen, 2018). At the same time, the current state of accessibility and inclusiveness should not be overstated: it is still the privileged elite that utilizes and benefits from digital entrepreneurship opportunities the most (OECD/European Union, 2019). When the United Nations Millennium Development Goals (MDGs) were formulated in the year 2000, digital technology had already become a major part of everyday life, but few foresaw the degree to which it would permeate our lives only fifteen years later. In consequence, where the MDGs were mostly formulated in a technology-agnostic manner, the SDGs embrace the central role digital interconnectedness and technology generally have to play in improving the state of the world (Noville-Ortiz, De Fatima Marin & Saigi-Rubio, 2018).

New ventures can and, more importantly, have a strong incentive, to catalyze structural changes in sectors currently held by large incumbents, whose incentives usually lie with maintaining the status quo (Apostolopoulos & Liargovas, 2018; Hockerts & Wüstenhagen, 2010). While it is by no means a given that entrepreneurs will be intrinsically motivated towards founding ventures which particularly take into account the SDGs, recent data from countries such as Germany is encouraging. It shows a trend towards more new ventures directed at solving social challenges, expanding renewable energy or improving health (Bundesverband Deutsche Startups, 2018). Startups are able to challenge established companies by disrupting “existing conventional production methods, products, market structures and consumption patterns, and replace them with superior environmental and social products and services” (Schaltegger & Wagner, 2011, p.223). If this trend is to be harnessed and further encouraged, it is crucial to understand (a) what motivates these entrepreneurs, (b) whether their ventures actually end up providing

a sustained and positive impact towards the transition to a “sustainable and resilient path” as laid out by the United Nations (General Assembly of the United Nations, 2015; Apostolopoulos & Liargovas, 2018), and (c), if not, what can be done to assist or direct them towards providing such benefit. At present, research into these questions remains scarce (Moon, 2018). To conclude, we contend that digital entrepreneurship might have the biggest impact on the SDGs, if it is successful to utilize three concepts: *open innovation, future and emerging technologies and social entrepreneurship*. To show how these concepts can help Digital Entrepreneurs achieve their goals, we will explain each of the three concepts and present examples as case studies of impactful implementations. While every single concept in itself can help elevate digital entrepreneurship in a meaningful way, we argue that a combination of all three may have the biggest impact on the challenges linked with the SDGs, which shall be elaborated using SDG-3.

2.1 Open Innovation as a key driver for Digital Entrepreneurship to enhance SDGs

Open innovation provides a central element in speeding up the digitalization in the health care sector through the development and implementation of innovative technologies. As the United Nations Conference on Trade and Development stated (2017), we need “digitally enabled open and collaborative innovation: Fostering open, digital collaborations. Such innovation approaches draw on and recombine multiple sources and forms of knowledge, especially through digitally enabled open collaboration.” However, as von Geibler et al. (2019, p.20) argue, “this early innovation stage proves to be a challenge for corporate practitioners and innovators, largely due to the concept’s intangible, qualitative nature and the lack of data.”

Open Innovation evolved into an approach that many incumbent firms use regularly. They do not rely solely on knowledge generated within the company, but also facilitate knowledge outside their company to innovate (Bogers & West, 2012). Chesbrough (2003) argues that the border between firms and their immediate intellectual environment is not impermeable and therefore enables companies to acquire new knowledge. Sources of valuable knowledge for innovation can be customers, suppliers and universities (Dahlander & Gann, 2010; Brunswicker & Vanhaverbeke, 2015). Startups face different challenges than incumbent firms, but can just as well facilitate open innovation to succeed. They often lack intangible (e.g. technological expertise) and financial resources (Baum, Calabrese, & Silverman, 2000) and are seldom able to form strong strategic alliances (Freeman & Engel, 2007). By opening up to external partners (outside in), startups are able to compensate for their resource constraints which can positively affect overall firm survival (Eftekhari & Bogers, 2015). As Pakura, S. (2020) points out, open innovation acts “as a driver for new organisations”, which is especially true at three levels of impact: *firm development, technology development, and technology commercialization*. The findings show that startups can use different types of relationships with a variety of network partners in order to drive the development and commercialization of innovations. Such relationships can range from loose and informal networking ties to close and formal partnerships, e.g. R&D collaborations with universities and incumbent firms. Although all types of relationships can forward innovation processes of startups, Pakura, S. (2019) concludes that “synergetic partnerships, such as R&D collaborations with universities and incumbent firms, create opportunities at all three levels” and that innovation benefits the most from those partnerships. Recent findings suggest that increased links to and knowledge flows from various external partners, particularly in uncertain environments, lead to improved

innovation outcomes (West & Bogers, 2011). Especially towards the end of the 20th century, the shift from closed innovation approaches to open innovation models was fuelled by the emergence of digitalization processes (Bogers & West, 2012). While the world became more and more digitized, open innovation became a key driver for entrepreneurship and allowed for reducing research costs, spreading risks, and commercializing innovations faster and on a global scale. In recent years, open innovation has been successfully applied in many industry contexts, for example, health care and IT, as well as in academic entrepreneurship (Siegel & Wright, 2015), government innovation (Gascó, 2017), and social innovation businesses (Nambisan et al., 2019). Chesbrough (2020, p.3) pointed out how “[o]pening up will speed up [the firms] internal innovation process, and allow you to take advantage of the knowledge of others in your business (outside in), even as you allow others to exploit your knowledge in their business (inside out)”. Opening up has the power to create even more experiments, generate more knowledge, and explore more ways to apply that knowledge for challenges (Chesbrough, 2020). It can help solving a variety of challenges, but those with a higher level of complexity profit the most from this interconnected approach. The more complex a challenge seems, the more a firm must engage in extensive knowledge sharing to get closer to a solution. Furthermore, opening saves time, which is critical in the health care sector, especially when facing a pandemic (Chesbrough, 2020). In a global pandemic, where time is of the essence, openness and open innovation can even save lives (Chesbrough, 2020). To conclude, Digital Entrepreneurs that engage with large-scale problems, and / or want to impact complex ecosystems (like the health care sector), must consider open innovation approaches.

2.2 Future and emerging technologies as enablers of Digital Entrepreneurship towards SDGs

While the future is arguably uncertain and many believe that we are living in an “Age of Paradox” (Handy, 1995), there are several future and emerging technologies that entrepreneurs can exploit today or where entrepreneurship can profitably contribute to the development or implementation of future technologies. Thinking ahead and implementing future technologies can give entrepreneurs a competitive edge or even enable them to create entirely new markets. So-called “Future and emerging technologies” (FETs) are also part of the “Horizon 2020” program by the European Union with the goal to “create a fertile ground for responsible and dynamic multi-disciplinary collaborations on future technologies and for kick-starting new European research and innovation ecosystems” (Horizon 2020, 2018, p.4). Future and emerging technologies are self-evidently complex and not widely known and implemented. Implementing them requires a strong strategic focus and the ability to innovate by means of tools that are currently not available in the mass market. Moreover, deeper factors are necessary to obtain economic and social value from technology. Generating technology alone is insufficient and must also be broadly disseminated, and then absorbed and put to work before its full value could be realized, as Chesbrough (2019) argues. To get a short overview of presumably impactful FETs, the World Economic Forum (2020) created an overview that we adopted (Table 1) and that shows not only how FETs like Artificial Intelligence and Quantum Technologies will potentially shape our future, but also how they will affect the different SDGs.

Table 1: List of future technologies

Technology	Impact on the following SDGs	Technology	Impact on the following SDGs
Quantum-computing determined optimal carbon capture material	SDG-7, SDG-13	Ultra-high-speed, zero-emissions long haul transport, including underground, surface, aviation, shipping and drones	SDG-7, SDG-9, SDG-11, SDG-13
4IR-enabled deployable nuclear fusion using AI to predict disruptions that halt feasibility	SDG-7, SDG-13	Zero-waste advanced materials for clean energy and advanced waste heat capture and conversion	SDG-7, SDG-9, SDG-11, SDG-12, SDG-13
Advanced materials for generation of low-cost and zero-emissions gaseous fuels, incl. ammonia and hydrogen	SDG-7, SDG-13, SDG-14	Quantum-enabled extreme efficiency data centres and supercomputers	SDG-7, SDG-9, SDG-12, SDG-13
Genetic rescue and genome modification for endangered and extinct species and resilience	SDG-14, SDG-15	4IR-enabled internet connectivity for all (drones, satellites)	SDG-1, SDG-4, SDG-5, SDG-8, SDG-9, SDG-10, SDG-11
Attracting and removing micropollutants (synthetic biology)	SDG-6, SDG-11, SDG-13, SDG-14, SDG-15	Quantum cryptography for the prevention of cyberattacks on AI/quantum computers	SDG-9, SDG-16
Low-zero emissions and ultralow-cost desalination technology using advanced materials	SDG-3, SDG-6, SDG-13	AI-enabled privacy-protected, public good digital health platform collating healthcare data, sensors, wearables and genomic data	SDG-3, SDG-16
End-to-end automated, connected and optimized food and fibre system, incl. elimination of spoilage, loss and waste	SDG-2, SDG-12, SDG-13, SDG-15	AI-enabled development of new antibiotics to address microbial resistance to current antibiotics	SDG-3, SDG-10
Low-cost, low-GHG emissions synthetic proteins (AI and synthetic biology)	SDG-11, SDG-12, SDG-13, SDG-15	4IR-enabled “access to care” digital technologies, distribution and delivery systems	SDG-3, SDG-10

Advanced materials for durability of energy-intensive products and materials	SDG-2, SDG-9, SDG-12, SDG-13	Decoding well-being and longevity using AI and sensors for personalized health maps and sequenced genomes and phenotypic data	SDG-3, SDG-10
Zero-emissions chemicals, steel, aluminium, cement using advanced materials and/or biotech (e.g. biocement)	SDG-11, SDG-12, SDG-13	Gene editing (e.g. CRISPR) to tackle human diseases driven by gene mutation	SDG-3

Source: adopted from: World Economic Forum 2020

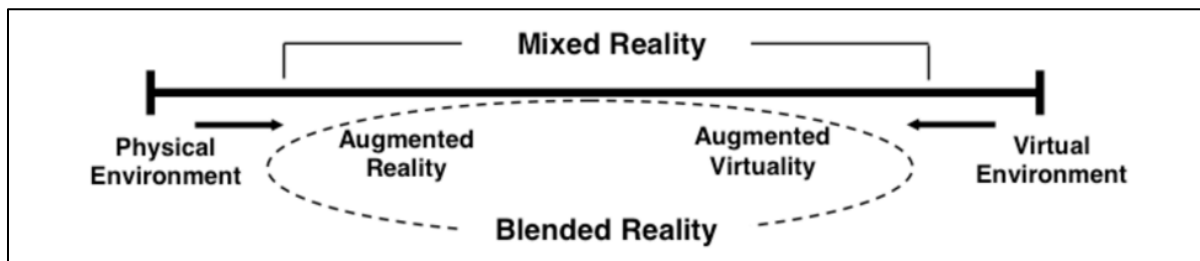
While we cannot go into detail regarding the different technologies and their respective effects on society, we will focus on two major technological concepts that we assume will have tremendous impact on achieving the SDGs and which we will take up and reflect in our case studies (see chapter 4): *Quantum Computing and Blended Reality*.

Although it might sound puzzling, quantum technologies are already widespread: “computers, data networks and the majority of medical imaging techniques could not have been achieved without quantum effects. This is because components such as transistors, diodes and lasers all make use of principles of quantum physics.” (Federal Ministry of Education and Research, 2018, p.6). These are examples of first-generation quantum technologies that started as scientific endeavors which were then implemented in a myriad of ICTs and everyday devices that we use today. Almost a century after the field of quantum physics was created in Central Europe, an increased understanding of those quantum technologies is now creating new opportunities. As Krutzik & Shamsrizi (2020) outline, the ‘second quantum revolution’ will massively impact the 21st century, and is widely seen as “[that which] comes *after* the digital transformation”. The manifold areas in which this impact can be seen include “measuring devices with much higher precision, vastly enhanced data communication security, and [...] higher-performance satellites and computers” (Federal Ministry of Education and Research, 2018, p.6). Quantum technologies and their specific applications are based on quantum principles, that in turn, exploit the unique physical principles of the quantum world.

The second example of a potentially impactful FET is the concept of so-called “blended reality”: Many Health and Exergames use virtual or augmented reality to promote active living and exercise despite the still widely held preconception of gaming being an “unhealthy” (or at least not health-positive) activity. The popular VR rhythm-game *Beat Saber*, for example, is “widely considered a good option for exercise in VR” and uses the technology to reach people at home and motivate them to move and stay healthy (Fingas, 2020). In a study on the potential health impact of Pokémon Go, Duke University’s School of Medicine was able to show that “increases in physical activity were highest among individuals who stood most to benefit from additional activity, such as

individuals who are overweight or obese, or who get little regular exercise to begin with.” (Will, 2017). Another illustrative example is provided by blended reality exercise equipment or applications, such as those provided by Peloton (onpeloton.com). Their smart exercise equipment enables its users to sign up for training regimes overseen by remote trainers, to exercise and receive instruction “together” via integrated video-conferencing. Other offerings such as *Supernatural* even allow for exercise in full virtual reality (Oculus, 2020). Many of these technologies are actively used today, but big technological leaps will make true “Blended Realities” a part of our everyday life. Steinicke defines Blended Reality as the seamless transition between the fully physical and fully virtual, described as a continuum between these two poles. Steinicke (2016) anticipates that in about 30 years, virtual and “real” reality will not only be blended, but even merged, and humans will not be able to perceive any difference. The consequences of such a situation have been described as potentially even turning “real” reality into a “homeopathicum” (Sedláček & Shamsrizi, M., 2017).

Figure 1: Blended reality in relation to the physical-virtual environment continuum

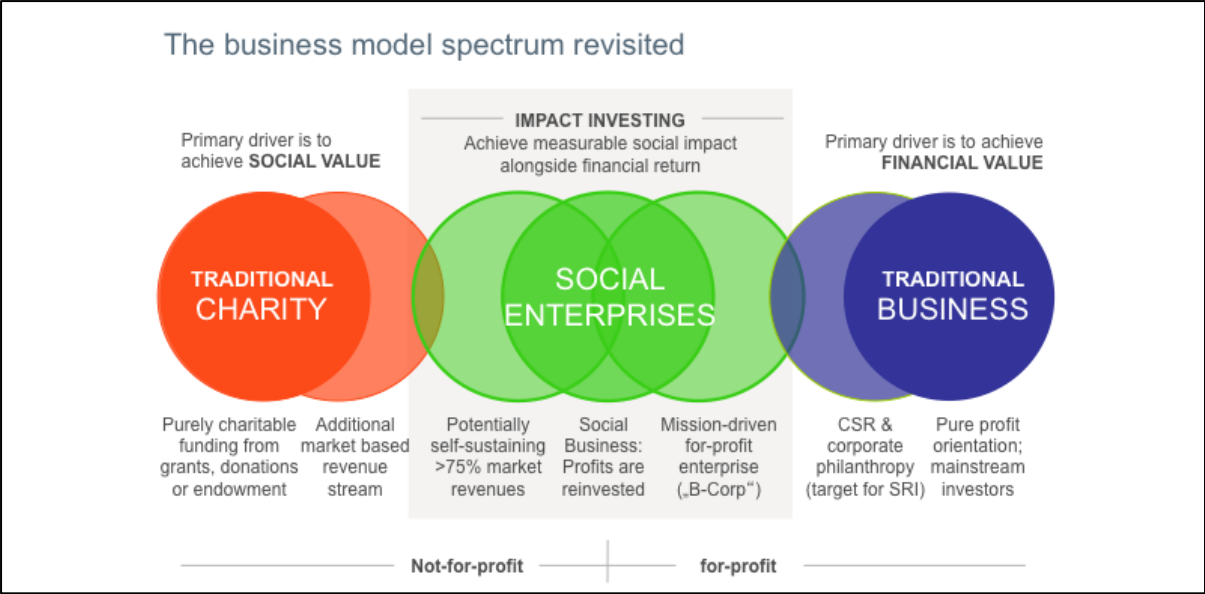


Source: adapted from Milgram & Kishino, 1994, in Bower et al. 2010

2.3 Social Business as an essential element towards SDGs

As we are entering the second decade of the new millennium, one can observe rather unexpected changes even amongst thought-leaders of both theory and practice in economy and business: Michael Porter wants his students to create *Shared Value* (Porter & Kramer, 2011), BlackRock is “making sustainability integral to portfolio construction and risk management” (Fink, 2020) and lets its portfolio companies know that “purpose is the engine of long-term profitability”, and the founder of the World Economic Forum, Klaus Schwab, opened this year’s WEF Annual Meeting by pointing out that while “‘stakeholder capitalism’ has been around for a half-century, it has only recently begun to gain traction against the prevailing shareholder-primacy model of profit maximization.” (Schwab, 2019). Consistently, the “Ethics in Action”-initiative of the UN Sustainable Development Solutions Network pointed out that “the challenges of sustainable development are primarily ethical in nature”, thus “the Sustainable Development Goals require ‘moral capacity’ as much as financial or technical capacity” (Annett, Sachs, Sanchez Sorondo, & Vendley, 2017). At the core of this SDG-driven transformation is the idea of a “new capitalism”, in which both traditional for-profit (blue, cf., figure 2) and not-for-profit (red, cf. figure 2) organizations are complemented by social entrepreneurial actors in all of their varieties (green, cf. figure 2), including the supporting impact investing ecosystem surrounding them:

Figure 2: Continuum of varieties of organisations in the “new capitalism”



Source: Ryder, P. & Vogeley, J. (2018)

While “debates about the definition of social business vs. social entrepreneurship keep coming up at conferences,” the scientific community is “getting closer to clearer definitions” (Grove, as cited in YY Foundation, 2019, p.22). Independently of the definition, it seems that Social Entrepreneurs may play a major role in creating more inclusive societies (European Commission, 2015) and solving the most pressing issues of our time. In particular, social businesses “work in many different areas where they often have a direct impact, such as health, education and infrastructure”, as Gass sums up (Gass, as cited in YY Foundation, 2019, p.30). Regarding the definition of Social Business, the OECD (2014, p.188), for example, follows a twofold definition of Muhammad Yunus: Type 1) a “non-loss, non-dividend company’ that creates social benefits through the nature of its products, services and/or operating systems”, and Type 2) a “profit-maximising company owned by its poor or otherwise disadvantaged target beneficiaries, or by a dedicated trust.” As such, the concept of social businesses is notably distinct from any form of charity. In this sense, combining digital entrepreneurship and Social Business, we assume that stakeholders are enabled to create scalable solutions - especially in light of the “Decade of Action”. Furthermore, it has also been argued that large corporations/multinational enterprises (MNEs) “[need] a change of course to achieve the UN’s Sustainable Development Goals by 2030.” (Bruysten, S., López Ramos, S., Nowack, D., 2020). This transformation is strongly driven by “a breed of entrepreneurs who work as employees within companies to develop business solutions for social or environmental problems:” social intrapreneurs. The OECD anticipates that “social businesses can create new sources of income, raise productivity, reduce ‘aid’ dependency and provide low-income consumers with access to products and services for their basic needs.” (OECD 2014, p.187). With the pressing issues in front of us and the COVID19-pandemic as a huge “call to immediate action”, solutions that tackle a SDG like “Good health and well-being” should and can facilitate both of these worlds, as “Social businesses will have a direct impact on whichever SDGs they engage in” (Gass, as cited in YY Foundation, 2019, p.30).

3 A Conceptual Framework and Canvas of Digital Entrepreneurship for a “Decade of Action”

We see digital entrepreneurship as a necessary component in achieving many, if not all, of the SDGs. A variety of conceptual models, policy frameworks and measurement instruments have been developed to study the driving and impending factors influencing digital entrepreneurship as well as the factors influencing organizational decision-making which furthers sustainable and more generally SDG-oriented business practices. Many of these frameworks, however, adopt a macro-perspective with a focus on the incentives and obstacles faced by multinational enterprises, or organizations that are designed to quickly scale to a global level (George & Bock, 2011; George, Howard-Grenville, Joshi & Tihanyi, 2016). Yet the vast majority of all enterprises in both highly-industrialized and less developed countries are actually small and medium sized enterprises (SMEs) (Ayyogari, Demirguc-Kunt & Maksimovic, 2017; European Union, 2018; Small Business Profile, 2018). While the disproportionate impact of MNEs on the overall sustainability should not be understated, SDG-oriented Digital Entrepreneurship, presenting the right overall conditions, potentially may rapidly develop and adapt to niche opportunities. This is due to the domain expertise of its founders and significantly lower regulatory, organizational and structural constraints with the SDGs being nevertheless supported through socially/environmentally responsible practices. At the same time, it seems unlikely that any single framework could adequately quantify and qualify the wide variety of factors that influence the entrepreneurial activities of SMEs. Following the argument put forward by Kuratko, Morris, and Schindehutte (2015), we agree that only a synthesis of multiple frameworks has any potential to adequately represent Digital Entrepreneurship, especially Social Digital Entrepreneurship. All economic systems are complex networks that are interconnected and interdependent (Bair & Palpacuer, 2015; Rasche, de Bakker & Moon, 2013), and the formation of networks among entrepreneurs, the startups they create, and the SMEs they become have been found to be crucial to success (Austin, Stevenson & Wei-Skillern, 2006; Dacin, Dacin & Tracey, 2011). Based on these underlying considerations, we explored the possibilities to help potential digital entrepreneurs to successfully support the SDGs thus positively impacting the “Decade of Action” through the structured application of open innovation, social digital business approaches, and future and emerging technologies. To use these concepts effectively, we developed a special variant of Osterwalder's Business Model Canvas (BMC) (Osterwalder & Pigneur, 2010). Our “*Digital Entrepreneurship for the Decade of Action*” - Canvas” (short: “Decade of Action”-Canvas) adds multiple layers to the well-known version by Osterwalder to let Digital Entrepreneurs better engage with the SDGs.

The canvas implements three major new aspects, which we derive from our theoretical triad of open innovation, future and emerging technologies and social (digital) business. These new aspects will directly help future digital entrepreneurs to evaluate how their solutions benefit the SDGs. First, in this canvas, not only the “usual” value propositions are to be explored, but, referring to the definition of social business, also the proposed value to the SDGs. This means that the potential project and its value proposition needs to relate to the SDGs and to explain how it supports achieving them. Second, we refer to the concept of open innovation and the importance of multiple and different types of relationships with a variety of network partners in order to drive the development and commercialization of innovations. We delimited Key Environmental Actors & Influencers from Key Partners.

By answering the question “Who is mostly impacting your field of impact / SDGs in the next ten years?” potential entrepreneurs learn that it is often the network to regulatory authorities or other societal or economic multipliers that can bring a competitive advantage. Working on your network and keeping key actors that affect your field of impact can pay off early on. Third, Beneficiaries are of utmost importance to consider: in contrast to customer segments, thinking about Beneficiaries enables Digital Entrepreneurs to embrace the “triple bottom line”, where environmental, social, and governmental actors benefit. This sensitization is supported by referencing concepts like Ashoka’s Theory of Change, or the Social Business approach (Drayton, 2003). Fourth, referring to future and emerging technologies, “Key Activities” and “Key Resources” force the Digital Entrepreneurs to re-evaluate their solutions with regards to other, more emerging technologies, which might have the potential to improve the impact and / or efficacy of their approach.

To summarize, we developed the “Decade of Action”-Canvas with these four specific adjustments, whereas the other fields of Osterwalder's BMC remain mostly unchanged.

Figure 3: “Decade of Action” - Canvas

„Decade of Action“ - Canvas				
KEY PARTNER <ul style="list-style-type: none"> The network of suppliers and partnerships that make your venture work. <ul style="list-style-type: none"> Co-Development-partner Strategic Alliances / Investors Social Intrapreneur Buyer / Supplier Relationships How will you leverage each other for impact? How can you minimize negative effects through your partnerships choices, e.g. environmental or social etc. 	KEY ACTIVITIES <ul style="list-style-type: none"> The most important actions your business must take to operate successfully. How are these activities related to the SDG, which activities will you regularly rethink to optimize impact or minimize negative externalities? Is your impact on SDGs at the core of your business or which specific business activities does it relate to? How are FETs incorporated? 	VALUE PROPOSITIONS <ul style="list-style-type: none"> What value does your business create for your customers? Can it be formed as a Social Business? 	CUSTOMER RELATIONSHIPS <ul style="list-style-type: none"> What type of relationship does your DigEnt want to establish with your customers / Beneficiaries? 	CUSTOMER SEGMENTS <ul style="list-style-type: none"> Who are your customers? Are your Customers also Triple Bottom Line Beneficiaries? How do they view the SDG? Do you want to impact their view?
KEY ENVIRONMENTAL ACTORS & INFLUENCERS <ul style="list-style-type: none"> Who are the key players that influence your area of business and the related SDG How will they impact the SDG in the next ten years, how will they position themselves? How do you and they interact to work towards achieving/hindering the SDGs? What type of relationship does your DigEnt want to establish with these actors? 	KEY RESOURCES <ul style="list-style-type: none"> The most important assets to make your DigEnt work. <ul style="list-style-type: none"> Physical / Intellectual / Human / Financial / Digital How do your key resources interact with the SDG; impact resources required to achieve the SDG positively or deplete resources which could be used to achieve them? 	PROPOSED VALUE TO SDGs <ul style="list-style-type: none"> How does your value proposition relate to the SDG and how does it support achieving them? What is the intended Impact? Is this impact scalable? Is your Output directly related to impact? How do these transition: Output – Outcome – Impact 	CHANNELS <ul style="list-style-type: none"> How does your DigEnt reach your customer? Do you have different channels when moving from Output to Outcome and Impact? 	BENEFICIARIES <ul style="list-style-type: none"> Who else would benefit, directly or indirectly due to your offerings? <ul style="list-style-type: none"> “Tripple Bottom Line” Who are environmental /social/ governmental beneficiaries? What is your “Theory of Change”?
COST STRUCTURE <ul style="list-style-type: none"> The most important costs incurred to operate the business model. Is your business model: <ul style="list-style-type: none"> Cost driven? Cost Sensitive? Has Variable Costs? Fixed Costs? Value Driven? How do the SDGs impact your cost structure? Which costs do they exacerbate, where can more SDG-conscious practices reduce costs? How is your competition impacted? 		REVENUE STREAMS <ul style="list-style-type: none"> Average price? How much will a customer pay? How many customers do you need to reach your break-even point? How many revenue streams do you have? <ul style="list-style-type: none"> Wholesale – Retail – Direct 		

(Abbreviation) „DigEnt“ = „Digital Entrepreneurship Activity“

Source: own table (adapted from Osterwalder & Pigneur, 2010)

The most current version can always be found at <http://www.doacanvas.org/>.

4 Case Studies

4.1 RetroBrain R&D GmbH: memoreBox

Germany's Federal Ministry of Health's Health Innovation Hub responded, among others, to the COVID-19 pandemic by compiling a list of recommendable "Digital Tools", which either mitigate COVID-19 directly or help address its wider societal impact (Health Innovation Hub, 2020). One of the companies mentioned on this list is **digital-therapeutics** company RetroBrain R&D, a spin-off of Humboldt-Universität's Cluster of Excellence. RetroBrain R&D develops a fully gesture-controlled video game console named "memoreBox," which has been called „a benchmark in the therapeutic gamification industry“ (LIFT Basel, 2015). The overall goal of RetroBrain's solution is to extend the quality of life of the elderly by developing state-of-the-art, evidence based therapeutic video games. The video game system - classified as a class 1 medical device - supports the prevention of typical age-related diseases and accompanies the therapy of diseases such as dementia or Parkinson's disease.

In a pilot project under the patronage of among others Germany's Minister of State for Digitalization, which studied the health-promoting effects regular gaming has on the social, physical and cognitive resources of senior citizens, the findings were clear: Compared to non-gamers, gamers showed significant improvements in cognitive performance, gait stability, motor skills, stamina, and coordination. There are also moderate improvements as it pertains to the health-related quality of life, the extent of which is practically significant. There were also positive trends in the subjective experience of pain, which was reduced by regular gaming. As a result of this study, "BARMER [one of Germany's largest health insurance funds] is convinced of RetroBrain's memoreBox," as Dr. med. Mani Rafii, member of the board, comments: "The concept combines movement with enjoyment and games and makes it possible for elderly people to remain mentally and physically fit and to actively participate in society. Since we had positive experiences with the concept within the framework of a pilot phase, we are now rolling it out nationwide, so we can give even more elderly people the opportunity to take part in the preventive and health-promoting capabilities of this video game platform." (Rafii, M., as cited by Jakob-Pannier, 2019, p.1). In 2019, Germany's National Association of Statutory Health Insurance Funds commissioned the Institute for Innovation and Technology of VDI/VDE-IT to conduct a study on the potential impact of digital tools in care and nursing. According to this study, the memoreBox "proves, how people in need of care profit from the use of a digital tool in different fields including their cognitive abilities, social interaction and conclusion, as well as gait quality", and furthermore even the nursing staff benefits" (GKV-Spitzenverband, 2019, pp.151). What opened memoreBox the door to the Healthcare Market, was the German Act to Strengthen Health Promotion and Preventive Health Care, which has been in effect since the summer of 2015. The need for this law shows how diametrically opposed the two poles of "having fun" and "getting/being healthy" were at that time. The legislator created this law to motivate the health insurance industry to invest more money in prevention. Given that it generally takes fewer resources and is more promising to keep people healthy - instead of trying to heal them after they have taken ill, which takes much more effort and has far lower chances of success, - the legislator created the Prevention Act obligating health insurance companies to allocate sufficient funds to promote meaningful prevention. Like many Social Business startups making use of digital technology, RetroBrain R&D operates in an ecosystem of cross-

sectoral quality; besides the “PEP Program” of Ashoka, one may particularly mention the “Impact Factory”². Thus, RetroBrain R&D can be studied as an exemplary case for aspects like “key partner”, “key environmental actors & influencers”, and “beneficiaries” of our “Decade of Action” - Canvas.

4.2 gamelab.berlin: Singleton and the #WeVsVirus-Hackathon

Suggesting that “we as a society [can] work together to master the challenges that arise in the wake of the Corona (COVID-19) crisis with new solutions”, the Federal Government of Germany had invited people to take part in a virtual '#WeVsVirus' hackathon (<https://wirsvirushackathon.org>). Under the patronage of the head of the Federal Chancellery and supported by the Federal Government's “Digital Council”, more than 40,000 participants developed digital solutions to problems related to the COVID-19 pandemic. These participants spent 48 hours working on altogether 1,500 ideas, of which many can be classified as digital entrepreneurship and / or Social Businesses. Overall, “the model for this attempt to find digital solutions in the global fight against the coronavirus pandemic was a similar event in Estonia” (Hänel, 2020, p.1), and was considered as an exceptional and sophisticated approach of open innovation by a public administration (Gegenhuber, Lührsén, Thäter, & Scheve, 2020). The issues dealt with were mostly the following: 1. Spread of Sars-CoV-2, 2. Provision of Medical Care, 3. Politics Administration, 4. Economy, 5. Solidarity (including Education), 6. Living in (Self-)Isolation; evidently, these issues span all SDGs. As we focus on SDG-3 in this article, we will exemplarily describe the project “Singleton #WirBleibenZuhause”, which was chosen to be included in the “Solution Enabler Program” - by which the German government wants to implement the most promising solutions of the hackathon - and which is an especially promising digital solution for mental health in (Self-)Isolation. Originally a research project at gamelab.berlin, Singleton is now offered by the social business spin-off Homo Ludens GmbH, making this case a prototypical example of digital entrepreneurship as a vehicle for social impact.

Singleton is a card game that gamifies time-management while encouraging mindfulness in order to help those who traditionally struggle to adhere to to-do lists and tasking. It was initially designed as a physical game and played by the inventor and his fellow researchers at gamelab.berlin (Lilge & Stein, 2018). A digital version for Android and iOS was eventually created and open sourced, making it available to a wide community of developers. 60 Singleton cards with entertaining and socially activating challenges were created, which together formed a game that was highly adapted to the organizations needs. Singleton began to be used in all kinds of organizations and companies as a new way to deal with change. In the course of focusing on organizations, the scientists of gamelab.berlin spun out of the university and created a company with the goal of bringing the cultural technology of the game to areas of society that are typically not interested in games. The aim of the spin-off was to design systemic and individual learning processes in such a way that the most natural of all forms of learning motivation could be activated: the joy of discovering something new. In the context of university research, it had already become clear that games can do much more than just entertain. Based on the principles of open innovation,

² A joint initiative of a diverse group of founding partners including German family equity company Franz Haniel & Cie. GmbH, Beisheim Foundation, KfW foundation (of the KfW, the German government-owned development bank), and Anthropia gGmbH, a social business itself.

Gamelab developed games for data collection in research, political education, school education on climate change, and neurosurgical training and even created a game for people suffering from lethal diseases. It turned out that game mechanics and forms of motivation have an effect far beyond what we are used to calling games - into the most serious areas of society. The ideas still come from research and the connection with their scientific work remains, but being a social business allows them to have faster development cycles and opportunities for practical applications, which have a concrete impact on the SDGs through Digital Entrepreneurship. The new version of the game enables people to play it for themselves and at home, learning to be more mindful and improve their well-being and health, thus directly helping achieve SDG-3. In this case, expanding the development of Singleton in the course of the #WeVsVirus hackathon is a useful example of how to align the aspects “proposed value to SDGs”, “key partner”, “customer relationships” / “customer segments”, and “beneficiaries” of our “Decade of Action” - Canvas.

4.3 D-Wave Systems: access to quantum computer processing for projects addressing COVID-19

As we have indicated above, quantum computing will certainly have wide-ranging implications and a substantive impact on all aspects of life in the future. This obviously includes the SDGs. Witold W. Kowalczyk of Harvard-spinoff Zapata Computing (2020), a quantum computing software company, identifies five SDGs in particular that will be impacted by the novel computing resources quantum computing provides:

- Zero Hunger (SDG-2) via new algorithms for crucial soil composition analysis, nitrogen fixation, etc.
- Good Health and Well-Being (SDG-3) via increased velocity of drug discovery and simulation.
- Clean Water and Sanitization (SDG-6) via optimized water distribution, new catalyst discovery/development
- Affordable/Clean energy (SDG-7) via advances in materials science leading to e.g. better batteries
- Climate action (SDG-13) through improved meteorological modeling and analysis.

One company that has stepped up in the wake of the COVID-19 outbreak is the Canadian quantum computing company D-Wave, one of the earliest (Lardinois, 2020, p.1) of the latest generation of quantum computing startups. They announced that they would support anyone “focusing on new drugs,” but also that they are “open to any research or team working on any aspect of how to solve the current [COVID-19-]crisis, be that logistics, modeling the spread of the virus or working on novel diagnostics”. In addition, their partners³ will provide “engineering expertise to teams that are using Leap 2 for developing solutions” (Lardinois, 2020, p.1). Founded in 1999, D-Wave is a privately held company. Quantum technologies are believed to be “driving forward a technological revolution” and to become “the engine of innovations in science, economics and society in the 21st century”, as experimental physicist Prof. Dr. Rainer Blatt sums up the results of the 2016 Lindau Nobel Laureate Meeting on the “second quantum revolution” (von der Stein, 2016, p.1). Regarding the COVID-19-crisis as well as the issues targeted by

³ i.a. Volkswagen, DENSO, Jülich Supercomputing Centre

SDG-3 in general, particularly quantum computing is at the core of D-Wave's impact. According to one of D-Wave's partners, Prof. Dr. Kristel Michielsen from the Jülich Supercomputing Centre, it is promising "to accelerate the solution of complex problems in pharmacology and epidemiology, such as those that have arisen in the unprecedented COVID-19 crisis, by means of hybrid workflows from quantum-classical computer simulations." (Forschungszentrum Jülich, 2020). As Analytics Insight sums up, "The company's hybrid quantum-classical cloud service could conceivably help researchers simulate molecular interactions between coronavirus and its target cells, or simulate the spread of the COVID-19 disease in complex settings. It could also help planners optimize supply chains and hospital logistics." (Srivastava, 2020). In an interview with IEEE Spectrum, gathering the first week's worth of submissions from coronavirus researchers applying for D-Wave time, the CEO of D-Wave claimed that the initial response to their offer came from teams tackling a range of coronavirus-related problems: "We've seen problems being explored in the following areas: 1) the modeling and simulation of the spread of the virus, 2) the scheduling of nurses and other hospital resources, 3) assessing the rate of virus mutation, and 4) the assessment of existing drugs as potential treatments." (Anderson, 2020). Opening up access to their resources also allows other companies in the space which are already committed to the SDGs such as ZAPATA, to work with D-Wave and interested parties to leverage domain, quantum-software and hardware expertise, thus showing the potential of the simultaneous consideration of the aspects "proposed value to SDGs", "key partner", "beneficiaries", and "key activities" (notably its sub-aspect "How are FETs incorporated?") of our "Decade of Action" - Canvas.

5 Conclusion and Implications: How to make Open Innovation, Social Business, and Future and Emerging Technologies work for Digital Entrepreneurship aiming to impact the “Decade of Action”

The current COVID-19 pandemic shows how important the fight for the Sustainable Development Goals really is and how COVID-19 has prompted a wide variety of open, collaborative responses (Chesbrough, 2020). While all SDGs are impacted by the pandemic - especially the neglected issues in SDG-3 (Good health and well-being) become apparent - and the need for more and better digital health applications became obvious. Digital entrepreneurs now have to step up and build the next wave of impactful startups, notably Social (Digital) Businesses, for the Decade of Action. Based on our literature review and practical case studies, we developed the following six primary recommendations for action which target all stakeholder of the digital entrepreneurial ecosystem. In doing so we provide a holistic lens combining the findings of open innovation, social business and future technologies:

1. Foster knowledge- and technology transfer via open innovation from the scientific community beyond businesses towards all actors working on the SDGs, particularly taking into account the necessary access to finance
2. Foster entrepreneurship education, and expand its scope towards continuing education also focusing on senior and mid-career executives
3. Introduce and support Social Business (and / or Social Intrapreneurship) in the potentially impactful organizations working on the SDGs
4. Harness the potential of diversity, notably female entrepreneurship (Halberstadt, Spiegler, & Pakura, A., 2018), migrant entrepreneurship (Council of Europe, 2019), introverts (Castrillon, 2019), entrepreneurs of colour (Kauffman Foundation, 2016), and other forms of minority entrepreneurship (Bates, 2012)
5. Include founders and entrepreneurial ecosystems as part of the regulatory and economic policy framework to cope with COVID19
6. To obtain economic and social value from emerging technologies it is not enough generating technology. Moreover, it is necessary that the technology will be disseminated, absorbed and put to action before its full value can be derived (Chesbrough, 2019).

Furthermore, our findings culminated in an easy-to-use canvas. We took Osterwalder's “Business Model Canvas” and redesigned it to help digital entrepreneurs effectively tackle the SDGs: open innovation for complex problems, *future and emerging technologies for future proof solutions and social business thinking* to keep societal issues in mind. The relevance of digital health and therapeutics for achieving the SDGs is rising and an event severely restricting access to healthcare professionals and doctors due to capacity overload or isolation, such as the COVID-19 pandemic, serves as a stark reminder of just how fragile many of our achievements towards particularly SDG-3 can be in the face of global calamity. Fostering an entrepreneurial spirit among young people, but especially those who are not traditional founders such as women, the elderly, people with disabilities, refugees,

and others while also encouraging open innovation and cooperation within sectors will help build a more inclusive and resilient economy and health sector.

But how can one use the “Digital Entrepreneurship for the ‘Decade of Action’ - Canvas” best? Innovative teaching and learning formats at universities and other forms of higher learning - notably those engaged in lifelong learning - have increased, ever since the first formal entrepreneurship education formats were created in the early 2000s. However, many entrepreneurship education curricula continue to disregard the idea of fully Digital Entrepreneurship, not to mention how little is on offer addressing health challenges in particular. As “really big opportunities arise only when brilliant innovation meets overwhelming market needs at just the right time” (von Windheim, 2014, p.35). There are unique opportunities for entrepreneurship education to help shape the digital landscape in Germany and beyond, fostering connections between all stakeholders, which is why - in the spirit of our “Digital Entrepreneurship for the ‘Decade of Action’ - Canvas” - universities need to bring together all stakeholder and players potentially involved in founding new ventures (von Windheim, 2014). Teaching about the SDGs in the same manner as we more generally teach about business ethics and philosophy, must become the backdrop of our entrepreneurship education if we want to achieve the still ambitious agenda set out by the United Nations and transform our society for the better.

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