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Critical success factors of startups in the e-health domain

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ABSTRACT

Objective: Though health-tech startups are increasingly bridging the affordability, accessibility, and quality gaps in healthcare through innovative solutions, only some sustain and become successful. Knowledge about the critical success factors (CSFs) is limited and shall be helpful for the stakeholders of health-tech startups. The present paper attempts to fill the gap.
Methods: We collected data through in-depth personal interviews with founders and other important stakeholders in India. The data were analyzed using Braun and Clarke's thematic analysis process. We also collected structured inputs from the interviewee to classify the identified CSFs. The Service-Technology-Organization-Finance (STOF) framework was used to guide the data collection and analysis.
Results: The thematic analysis of the interview transcripts revealed eighteen CSFs and five themes: actor's knowledge and communication process, service value and effectiveness, robust technological infrastructure, revenue generation ability, and regulation management capacity.
Conclusion: The delineated CSFs will guide the startups to understand various stakeholders' needs, market demands, regulatory compliance, and policy requisites. The present paper is the first of its kind to extensively examine the CSFs and adds to the knowledge about the health-tech startups' success. In light of the findings, the paper modifies the STOF framework and shares practical implications and future research directions.
Public interest summary: Health-tech startups are increasingly transforming the healthcare industry by leveraging technologies to improve patient outcomes, enhance the patient experience, and deliver value to all stakeholders. There is a need to identify the critical success factors to address the high mortality among these firms. The present research identifies the factors under five broad themes: actor's knowledge and communication process, service value and effectiveness, robust technological infrastructure, revenue generation ability, and regulation management capacity. The findings will help entrepreneurs, policymakers, and other stakeholders in the health-tech startup ecosystem.

Introduction

Health-tech startups have become significant players in the healthcare industry, revolutionizing the way healthcare is delivered, monitored, and received. With the advent of cutting-edge technologies and the increasing demand for more personalized and efficient healthcare services, health-tech startups have carved a niche for themselves in the industry [1]. They are small and may cater to a niche part of the market but have higher scalability potential. They are also nimble but have a high failure rate with only a few becoming unicorns. Their contributions are significant as they deploy sophisticated medical inventions and aim to reach the under-served market by reducing healthcare costs and increasing service delivery speed. Though there are different terminologies such as e-health or digital health ventures, in the commercial startup and technology entrepreneurship domains, health-tech startup is a well-accepted umbrella term [2].

The global health-tech market has been growing significantly since the last decade. It is envisioned to reach $639.4 billion by 2026 from $106 billion in 2019. It is estimated that this market's compound annual growth rate (CAGR) will be 28.5% [3]. This enhancement has been greatly shaped by emerging information and communication technologies (ICTs), especially smartphones, supportive government initiatives,

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and rising health-tech ventures [4]. Despite the advances in healthcare technology, gaps in healthcare services are observed throughout the world. The unevenness in healthcare access in the global south, especially in the rural areas is greater. The proportion of the rural population is greater in the global south and is predominantly poor and at the bottom of the social grid. For instance, in India, 69% of 1.3 billion people live in rural areas. One doctor serves more than 4000 people due to the uneven distribution of healthcare services across the country [5] which is lower than the World Health Organization's (WHO) recommendation of 1 doctor for 1000 people in developing countries. Moreover, most global south countries face challenges to fulfill WHO's guidelines on that ratio compared to global north countries where an average of 3.53 doctors serve 1000 people [6].

It is challenging for the government to provide quality healthcare services as a sole player in the global south. Traditionally, a few big private players are filling this gap, but also end up monopolizing the market, leading to high out-of-pocket expenditures for the patients. The need for cost-effective solutions is increasingly filled or attempted by health-tech startups. The scope of these ventures is enormous as a developing country has a large customer base [7]. Despite the opportunity, 98 out of 100 health-tech startups don't survive in the long run and cause financial and economic losses [8]. This is not surprising given that 60% of startups do not endure the first five years, and 75% of venture capital-backed startups perish [9].

The success of these startups is not guaranteed, and several factors play a crucial role in determining their success. The literature seems inadequate in providing insights into what makes health-tech startups successful. While there are success factors that work well for technology startups may not be as effective for health-tech startups due to the following reasons. Firstly, health-tech startups deal with human lives directly and face stricter and rigid regulatory, and compliance challenges that other technology startups may not. They must comply with strict data privacy laws, obtain regulatory approval for medical devices, and adhere to ethical guidelines in medical research [10]. Secondly, the healthcare ecosystem is complex and fragmented, with multiple stakeholders such as patients, healthcare providers, payers, and regulators [11]. Each stakeholder may have different needs and priorities, making it challenging for health-tech startups to create a product that meets everyone's needs. In contrast, technology startups may have a more straightforward user base and customer segment. Thirdly, they usually have longer sales cycles and higher barriers to entry compared to technology startups due to the regulatory environment and the complexity of the healthcare ecosystem. This can make it more difficult to generate revenue and gain traction in the market, which is different than other technology startups. Therefore, the unique challenges faced by health-tech startups need to focus on different success factors compared to other technology startups. The present paper aims to fill the gaps by identifying them. Investigating the success factors will help the stakeholders in the entrepreneurial ecosystem – policymakers, venture capitalists, incubators, and aspirants.

Investigation of critical success factors of health-tech startups is essential to understand what drives their success and mitigate risks. This may help startups to focus on what matters most and increase their chances of success. As a consequence, successful startups will attract investors, achieve long-term sustainability, and contribute to the overall growth and development of the healthcare industry.

Theoretical background

Concept of critical success factor

The critical success factors (CSFs) are defined as: "the few key areas of activity in which favorable results are absolutely necessary for a particular manager to reach his goals"[12]. It provides directions ensuring the competitive advantage for startups is maintained and enhances the startups' performance and assists in strategic policy formulation to achieve their goals [13].

There are existing studies that focus on the CSFs of startups [14] and focus on the financial success or profit and the focus points apart from market opportunity, partnership, and customer perspectives. The CSFs are also explored for several industries, such as oil, gas, textile, chemical, and others. It varies according to industry and market dynamics [15], but industry or domain-specific CSFs are very scarce. The usage of technology startups based CSFs can give a few directions [16], but generalizations for other different domains may be challenging. For example, lessons from a startup that books hotel rooms or movie tickets may not be useful for booking appointments with different specialist doctors, which involves one-to-one interactions. Moreover, health-related business offerings are regulated very strictly. Health-tech startups may need to consider different aspects, such as regulatory compliance, ecosystem complexity, and longer sales cycles when identifying and prioritizing their CSFs. The significant differences between the nature of business and industry make CSFs less applicable to health-tech startups. The unique challenges of health-tech startups warrant different CSFs.

A startup's CSFs are conceptualized at three levels- firm, individual, and external. At the firm level, factors can be the firm size, age, and location as facilitating variables [17]. The individual level includes human capital as a factor. A health-tech startup needs an experienced and well-trained medical workforce. On the external level, factors represent environmental attributes like a pandemic, new technology intervention, and so on. It has been found that these external factors can act as the prime impetus for the emergence of health-tech startups [18].

Service-technology-organization-finance framework

The study uses Service-Technology-Organization-Finance (STOF) framework as a guide for approaching the conceptualization of CSFs, data collection, and analysis. The STOF framework was developed on the ground of different business models and their components [19]. It offers broader dimensions by considering the essential view of business models with a special emphasis on the consumer value aspects of the provided services and providers' value capture for those offerings (Fig. 1).

The four domains of the STOF framework are interlinked with each other. The technology domain fulfills the requirements of the service domain and is linked with the cost which is in the finance domain. The service domain is connected with the organization domain's value network and the finance domain's pricing aspects. Actors and activities of the organization domain are directly linked with all the other domains. Similarly, the cost is associated with all domains [19].

The STOF framework also considers three market dynamics: changes in technology, market, and regulatory environment that impact the domains. Market dynamics are the forces that affect businesses. These are conceptualized as external forces that are crucial for keeping a sustainable business model over time. Current literature discusses several such constraints that could be economical, political, cultural, legal, and cognitive in nature [20]. The forces can be at the industry level or macro-economic level. These two levels of forces can influence a firm's performance and sustainability in the long run. Five predominant industry forces include buyers, suppliers, substitutes, new entrants, and competitive rivalries. Another side, the PESTEL framework represents common macro-economic level forces: political, economic, social, technological, environmental, and legal [21]. Market dynamics influence a startup to shape its business towards a better market fit. Existing studies explored technology startups in this context, but sector-specific aspects remain scant, especially for healthcare [22]. Macroeconomic level forces are the same for every startup, irrespective of industry. However, industry-specific forces can be different for startups.

The STOF also focuses on identifying the critical components of the service value chain, including customer needs, service delivery, service operations, and service support. By analyzing these components, the

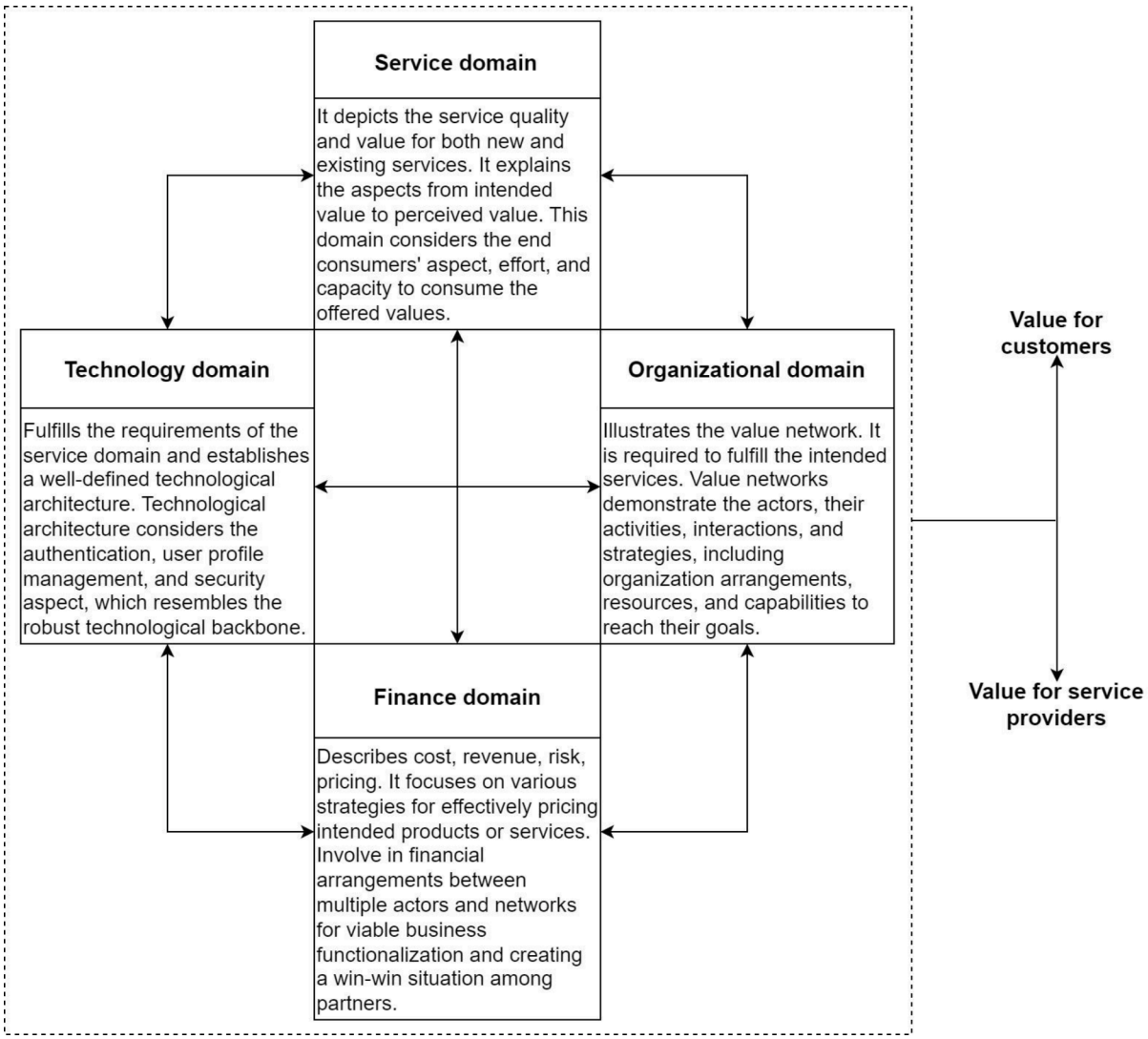

Fig. 1. Infographic presentation of STOF framework.

framework aids in identifying the CSFs for service-oriented businesses. In earlier research, the STOF framework was utilized to explore CSFs for defining the success of innovation. There have been attempts to use this as a theoretical framework for understanding e-health businesses, but not focusing on CSFs [23]. The framework is also deployed for the e-health innovation process and identification of success factors for e-health innovations [24], but not in the service delivery. The framework provides a systematic approach to analyzing and improving the operations and financial performance of the organization, which can help identify the key drivers of success. In the case of health-tech startups, the STOF framework can guide exploring the critical components of the healthcare service delivery chain. This can include patient needs, service delivery through technological solutions, service operations management, and support through customer service and regulatory compliance. Therefore, STOF is considered in identifying critical success factors of health-tech startups.

Methodology

To explore the critical success factors of health-tech startups in healthcare service delivery, we conducted a qualitative investigation with different stakeholders.

Data collection

Initially, we developed an interview guide from the conceptual understanding of the STOF's dimensions discussed to capture the critical insights from the target participants. The guide contained open-ended queries that included day-to-day patterns of the e-health service uses, approaches utilized for technology implementation, investment, revenue generation, and strategies to deal with the challenges. The sample questions include: what motivated you to build the startup or work with this venture?; what is the unique selling point of this startup?; what are the challenges in this venture?; and how does this startup generate revenue? We improvised the interview guide as the data collection proceeded. In all the interviews, the interviewer continuously encouraged the respondents to express their thoughts on any of the aspects that were pertinent to the CSFs of health-tech startups in healthcare service delivery. This method assisted in collecting in-depth, firsthand information from the participants who have longstanding experience and knowledge in the field of the study. It generated comprehensive information from the interviewees with follow-up questions based on their previous responses. Overall the method followed inductive research to bring significant insights through exploratory investigations [25].

We looked for interviewees in various healthcare environments and roles, including healthcare entrepreneurs, business managers, specialized physicians in e-health services, and telenursing practitioners

Table 1
Characteristics of interviewees.

Interviewee	Professional role	Experience (Years. Months)	Founded or involved in startups	Currently active startups
I01	Doctor & co-founder	12	1	1
I02	CEO & entrepreneur	18	1	1
I03	Co-Founder & CPO	20	1	1
I04	Doctor	16	1	1
I05	Co-founder & CTO	11.8	1	1
I06	Investor & e-health expert	18	2	1
I07	Co-founder & CEO	15	1	1
I08	Business manager	17.5	1	0
I09	Doctor & professor	21	1	0
I10	Co-founder & nurse	19	1	1
I11	Founder & board member	17	1	1
I12	Co-founder & COO	13	2	1
I13	Doctor and e-health expert	23	0	0
I14	Co-founder & telenursing expert	17	1	1
I15	Doctor & e-health expert	11	1	1
I16	Investor	18	1	1

(Table 1). We didn't consider patients as participants because this study was designed and explored from the perspective of startups. The sample represented different stakeholders of health-tech startups: entrepreneurs, medical practitioners, business managers, and telehealth experts. The average duration of the interview was about 40 min.

All the participants had more than ten years of experience in health-tech startups as founding team members or experts. They are actively engaged in strategic decision-making and performance improvement of heath-tech ventures. The participants have experienced the continuous journey of the health-tech startups, including sectoral challenges, and recognized the crucial aspects of business success in the health-tech space. We considered their experience as a rich source as they have worked as core team members of health-tech startups and are also recognized as healthcare domain experts. This covered entrepreneurial competence and industry knowledge. Therefore, insights from interviews helped us to identify the critical factors for a health-tech startup's success.

We employed the snowball sampling technique to identify the next possible respondents from the initial respondent. All interviewees are located in India. We conducted all the interviews via telephone or videoconferencing with the respondents who are linked with the e-health services of startups. To protect the interviewees' confidentiality, we didn't disclose any statements attributed to specific persons or companies in this paper. Once we were able to deduce the CSFs, we again contacted the respondents to categorize them. We shared a google form with the interviewees to mark the identified factors in three levels: firm, individual, and external. The respondents classified them and identified those that are applicable at more than one level. This method allowed us to maintain significant control over bias by taking judgment from the experts. Our own biases regarding the CSFs' classifications were possibly eliminated by capturing the rating from the industry experts.

Data analysis

We transcribed all the semi-structured interview recordings for the data analysis. We used the qualitative data analysis tool NVivo QSR International Software (Version-12.6) to analyze interview transcripts. At the commencement of open coding, we utilized the interview outline as the preliminary coding frame for the semi-structured interview data. The coding focused on areas such as e-health service delivery infrastructure, revenue generation, and challenges associated with health-tech startups. We created the initial codes as success factors based on the recurring ideas or concepts from the transcripts.

We employed Braun and Clark's thematic analysis approach. This approach follows six steps: data familiarization, initial factors generation, final factors and initial themes identification, revision of identified themes, defining the final factors and themes, and finalizing the analysis [26]. The final themes to illustrate the findings were concluded with interactive interactions between the research team members. From the experts' remarks, we considered an 80% cut-off to classify the CSFs among firm, individual, and external levels. As we did not encounter any conflict from the experts' input, we proceeded with a single iteration of the feedback process. Finally, the identified factors were represented under three levels and also aligned the emerged themes with the STOF's dimensions to connect the findings with the theoretical frame of the investigation.

Findings

This section describes the emerged themes, corresponding identified success factors, and their classification at three levels.

Thematic analysis

Five themes emerged from the analysis: actor's knowledge and communication process, service value and effectiveness, robust technological infrastructure, revenue generation ability, and regulation management capacity. We have summarized the success factors, their definition, and collated themes in Table 2.

Based on the interviews, there was a clear view that the healthcare professional's knowledge and experience are crucial in the e-health services as well as startup infrastructure. The emerging ideas for the values provided by startups are dependent on the clear vision of the services, their quality, performance monitoring, and continuous advancement. The efficiency of the technological platform relies on ease of use, data security, network infrastructure, customization capacity, and social media integration. The most crucial factor reported by all the respondents is the platform's user-friendliness. Their revenue strategy depends on value effectiveness, affordability, investment return, and source of the products or services. The benefits of value are only attained when promised and perceived value are met effectively. Besides, the requirement for transparent policies and the capacity to curtail challenges was highlighted.

Identified CSFs' level mapping with STOF dimensions

We mapped the CSFs at three levels and represented them under the emerging themes. We also aligned the emerged themes with STOF dimensions and mentioned the regulatory aspect as well in the mapping. This mapping primarily assists in understanding the factors associated with the themes and STOF dimensions. Additionally, it will help conceptualize and follow the CSFs from three perspectives: organizational, individual, and external.

The mapping of interviewees' responses revealed fourteen factors at the firm level, seven at individual level, and only two at the external level. Providers' experience, performance monitoring, and data security are recognized as firm and individual-level factors. Similarly, integration of social media and challenge minimizing capacity are firm and

Table 2
Description of the identified critical success factors.

Quotes	CSF	Definition
Actor's knowledge and communication process (healthcare professionals, including patients)		
"…provider's effectiveness is one of the critical considerations in startups value creation. Experience provider assists in working in the right direction and mostly know how to deal with a difficult situation." [I13] *"Health-tech entrepreneurs' experience and their optimal utilization of medical resources lead the way for sustainable health care startups."* [I04]	Provider's experience	Healthcare professional's practical knowledge helps to predict and handle uncertain situations
"…skilled employees who can handle systematic activities. Technicians, therapists, nurses, and other ancillary workers are trained properly before they start working with doctors and directly taking the responsibilities for e-health." [I14] *"Venture in this space should be able to arrange skilled persons or provide training to unskilled employees. Training and retraining of such individuals are fundamental considerations where limited healthcare paramedical staff is available."* [I09]	Skilled professionals	A workforce that has the skills to contribute to healthcare
"Providers should have strong clinical expertise, possess good communication skills, including critical thinking ability to address the problem." [I15] *"If clinicians or patients have any query, that should be solved quickly. We are running a customer-helping cell during office hours except for Sunday. We are planning to extend this assistance to 24 × 7."* [I10]	Effective communication	Fruitful communication between every actor in healthcare, including the consumers
Service value and **effectiveness** (Intended value of a startup)		
"We have a clear vision to sustain in a highly competitive healthcare market. We are providing a home-based monitoring system for chronic illnesses like diabetes, hypertension, and heart diseases." [I03]	Clear vision	Clarity about the providing services and proposed values
"If the patient once finds that service is not worthy, then the success rate will decline very steeply in this market…it is needed to boost productivity, reduce service cost, and improve healthcare quality." [I04]	Service quality	Service that is reliable and performs its intended functions
"Health care system is changing rapidly. The spread of the Corona pandemic has brought a massive change in healthcare services and the mode of delivery. We have to improve our system regularly to deal with the current need and future opportunities." [I11]	Continuous advancement	Engage in the process of improvement or development
"We are taking regular feedback on the services and keeping track of internal and external processes. Feedback helps us to improve our internal system as well as assist in serving better as per customer requirements." [I08]	Performance monitoring	Set of processes that help in examining how well the services or platform are running
Robust technological infrastructure (Infrastructure that connects seekers and providers)		
"Platforms are working well and improving the service delivery process, more accessible for clinicians, and as well as the patients." [I01] *"If I select a drug, and it automatically gets included in the prescription, then it will reduce my workload."* [I05]	Ease of use	How easy the technological platform is to use by its intended consumers
"On our website, a chatbot is running to answer basic queries and options for specific queries. This intervention has been solving specific requirements of patients." [I09]	Personalized platform	Designed to meet patient's or user's unique requirements
"Online services come with an ease of access but with a risk of privacy breakout… the privacy of subjects should be taken care of." [I07]	Data security	Protecting the highly sensitive healthcare data
"Linked the website with WhatsApp messenger… a group on WhatsApp for the patients so that experienced patients can suggest and motivate the newly pregnant women." [I11] *"Modern encryption technology (for example, AES, RSA encryption) can be used to secure sensitive data… patient needs to open their profile using the username/password to access the reports. The process is similar to that of an email id."* [I06]	Integration of social media	Linking with social media platforms to facilitate service access easily and expand the service network
"Fiber optics and the 4 G network are there but not up to the level they should be. We are continuously dealing with this problem and have to have at least one alternative option for network connectivity." [I05]	Network infrastructure	Highly stable internet connectivity that provides various information and communication facilities
Revenue generation ability (Investment source to revenue generation capacity)		
"Sustainable funding is a big challenge for emerging startups. Practo[1] got its first funding after three years of its journey and took more than ten years to create sustainable value in the healthcare market." [I13] *"Investors see early-stage health-tech startups as complex and full of high risk. Startups are facing challenges to unlock funding. Fundraising options are highly competitive."* [I07]	Investment source	Financial institution or capitalist who wants to invest in a startup's venture

(continued on next page)

Table 2 (*continued*)

Quotes	CSF	Definition
"Whether a doctor-patient platform, lab aggregator, specialized services; any startups in healthcare face extreme difficulties to earn back the original investment." [I08] *"High technology takes a high price in the initial phase, at least. And the return on investment is less."* [I16]	Return on investment	The monetary ratio of financial gain or loss in relation to the investment cost
"Digital services should be cost-effective and must be inexpensive. We are focusing on reaching the maximum number of customers and expanding the business based on the socioeconomic status." [I15]	Value effectiveness	The degree of startup values to produce a desirable result that ultimately leads to success
"It reduces patient travel costs. It reduces the travel time for renowned practitioners. Both patients and providers get benefited from this service." [I02]	Cost affordability	User's ability to afford the cost of providing services that initiate the revenue generation
Regulation management capacity (Policy, rules, and challenges)		
"Health sector has to follow some stringent rules and regulations as it deals with human lives… Most of the policies were unclear which induced confusion in the workplace." [I10] *"Recent e-health practice guidelines help to manage the unique challenges of this pandemic, and it can be a booster shot for the entire healthcare sector."[I09]*	Clear policy	Transparent laws and guidelines that explain how to deliver the intended services
"It is important to have the capacity to tackle ups and downs. A lot of hard work is required to keep growing." [I12]	Challenge minimizing capacity	Role and functions that handle all the predictable and unpredictable uncertainties of startups

[1] Practo is one of the leading m-health platforms in India that connects patients with healthcare providers through booking appointments, check-ups, and consultations.

external level factors. The result of the level mapping is represented in Table 3.

Market dynamics

The above two sub-sections discussed the CSFs and their classification into three levels. Interviewees also mentioned about several external forces that influenced the health-tech startups' growth and success in the long run. They talked about the forces that altered the healthcare stakeholders' behaviors, especially providers and seekers, toward e-health services. It also reshaped the value-attaining aspect of a health-tech startup. Some of the mentioned predominant forces in healthcare are high-tech adoption, product differentiation, innovation, and regulatory changes. Besides, interviewees highlighted that technological innovation shifted the mode of service delivery. Technological innovation influences various stakeholders, broadly impacting the overall market. Respondents also highlighted the technology-driven shift in consumers' and providers' behaviors. It also directs the government to bring various policies and regulations to monitor the services provided by health-tech startups, especially in high-tech-associated healthcare offerings. One respondent stated:

Table 3
Mapping of CSFs.

Critical success factors	Level Firm	Individual	External	Aspects of STOF's dimensions (Emerged themes)
Provider's experience	●	●		Organization (Actor's knowledge and communication process)
Skilled professionals		●		
Effective communication	●			
Clear vision	●			Service (Service value and effectiveness)
Service quality	●			
Continuous advancement	●			
Performance monitoring	●	●		
Ease of use		●		Technology (Robust technological infrastructure)
Personalized platform		●		
Data security	●	●		
Integration of social media	●		●	
Network infrastructure	●			
Investment source	●			Finance (Revenue generation ability)
Return on investment	●			
Value effectiveness	●			
Cost affordability		●		
Clear policy	●			Regulation management capacity
Challenge minimizing capacity	●		●	

"Entrepreneurs find high-tech innovation in other industries and bring them into healthcare to disrupt the market. It opens the opportunity for other stakeholders by showing the technological innovation and also the benefits of technology adoption. Providers start using it, establish trust in technology-based services, and share its effectiveness among the patients. Meanwhile, many regulations are imposed to monitor and prevent unethical usage." [I02]

The respondents highlighted that providers' and seekers' perceived value toward e-health directly impacted the market dynamics. Providers' requirements to reduce the workload and effective service delivery induce the innovators to bring solutions. These solutions are a driving force in the market and caused a competitive environment for health-tech startups. Similarly, consumers' notions about tech-based services impacted the overall market. Consumers and providers could act as external forces and influence other market dynamics. Respondents also indicated that the regulatory side plays a significant role in such forces. They highlighted the regulator's restrictive measures for teleconsultation and electronic health records before COVID-19 and the sudden establishment of policies and guidelines that directly affected the startups' business model. Therefore, market dynamics broadly affect the existing services, technologies, and firms' activities. Providers, seekers, and regulators are three important stakeholders who act as drivers and also directly influence other forces to change in the market.

Based on our study findings on these dynamics, we have modified the STOF framework. Changes in the market are caused by several factors, such as the emergence of new technology, changes in regulating bodies, policy implementation, fluctuation of supply and demand, and so on. Therefore, the market dynamics itself represent the other drivers which impact the business model. Our modification in the STOF framework is depicted in Fig. 2.

We have introduced market dynamics that influence four domains of STOF, including consumers, providers, and regulators. However, we keep the regulator as an external force because the regulator directly affects the STOF by introducing and modifying guidelines and policies,

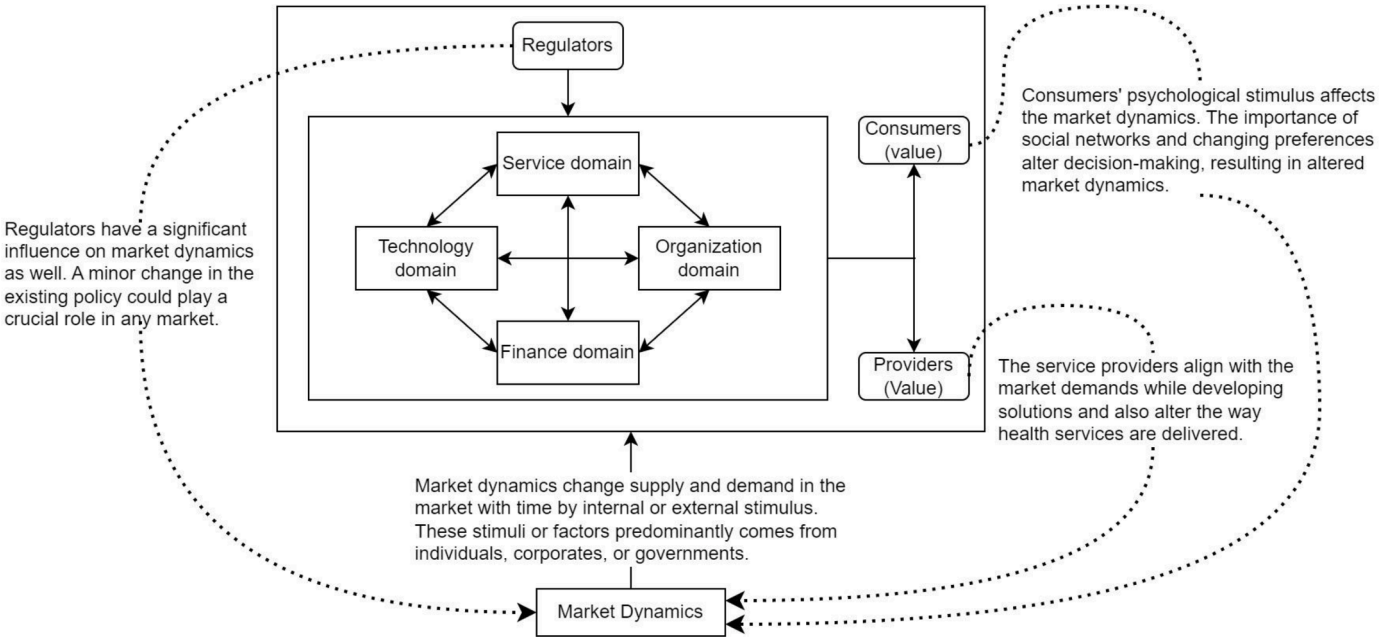

Fig. 2. Modified STOF framework.

also described in the existing STOF framework.

Discussion

The study aimed to explore the CSFs for health-tech startups in the global south. The qualitative analysis identified eighteen CSFs and discussed them under five broad themes. Analysis revealed that health entrepreneurs' prior experience could assist startups in the right direction. It is in line with the extant literature that showed such experiences endorsed the communication process between the internal system actors and serviced consumers [27]. The most substantial hurdle is the connection between the healthcare provider and seeker without time boundaries. Addressing this leads to the availability of on-time healthcare access to the patients, including direct communication with physicians or specialists. The engagement of the skilled workforce is also a significant challenge for the entrepreneur. The intervention of skill training might solve this problem, but the quality of the training and its effectiveness is still questionable [28]. Existing literature did not engage and raise this aspect for health-tech startups. However, it is an essential consideration for their growth.

Critical knowledge of the promised values is vital to the startup's effectiveness. Nevertheless, a concern might be raised about the services' effectiveness and quality. From the provider's point of view, the service effectiveness between e-health services and physical visits does not vary, as the same rigorous process is used to diagnose a disease [29]. A health-tech startup attains the value of its e-health services by aligning with existing service quality and delivery processes. The potential benefits of e-health care services and outcomes from the consumers' end give a positive outlook on the services provided by health-tech startups [30].

Besides service quality, performance monitoring and continuous advancements need attention. The measurements reflect the exact status at a specific stage of health-tech startups, and corresponding improvements help to perform adequately in the healthcare market. Current literature discussed the requirement of performance measurement of tech startups [31]. However, this evidence remains scant for sector-specific aspects, especially for health-tech startups.

Another significant aspect is the technological infrastructure that provides easy access and customization capability from the user end. Previous studies find this usability in bringing consumer attention to perceive startup services [32]. Our investigation further revealed a few technological instabilities for the e-health service delivery process. Firstly, network connectivity links the platforms between service providers and seekers, and the next challenge is protecting the massive healthcare data generated. Digital platforms should enable data encryption for electronic health records to tackle privacy issues and block unauthorised access by third parties. Security perceiving approach in the e-health cloud ensures the privacy of healthcare records, and additionally, the incorporation of blockchain technology enhances data protection [33]. Besides the effectiveness due to advanced technological solutions, integrating social sites into the platform extends the capacity to adopt the services furnished by health-tech ventures. It also aligns with current literature that shared prior consumer reviews and comments help new users select the startup's services [34].

Revenue generation capacity can bring substantial attention to a startup's success. This denotes a sustainable process comprised of investment source, value effectiveness, affordability, and returns. In a highly competitive space, fundraising demands the proposed values' effectiveness. Understanding startups' environment and funding stages are vital for health-tech startups in the open-ended market [35,36]. On the other hand, return on investment primarily comes from the affordability of the services. The cost-effective service shows the possibility of adequate returns from a health-tech startup's investment [37].

Additionally, clear policy guidelines are denoted as a backbone of health-tech startups in the long term. There was no substantial evidence from the findings to support the in-depth facts about the regulations, including policies. Respondents talked about these at a superficial level, possibly to avoid revealing personal thoughts concerning the existing policies. Current literature remains inadequate to point out this aspect of health-tech ventures, but it can be a significant factor for the success of e-health service startups. However, policy challenge minimization capacity was mentioned under the primary criteria to succeed due to the uncertain journey of any startup [38].

In accompanying the extant literature, our comprehensive findings further recommended that health-tech startups become successful when they can meet the unique and evolving needs of the healthcare industry, deliver high-quality healthcare services, and achieve sustainable financial performance. Prioritizing a customer-centric clear vision, having a strong team, maintaining performance with regulatory compliance, and a cost leadership strategy can increase their chances of success.

Modification of the STOF framework

The STOF categorizes the industry-specific competitive and macro-environments into three external drivers: market, technology, and regulation. In the startup context, the macro-environments denote the macroeconomic conditions in which they operate. It also influences startups' performance. The representation of industry and macro-environments in the STOF did not hold include external forces, especially in the context of the healthcare industry. Changes in technology and innovation are significant forces in the industry and also impact the macroeconomic level. Integrating emerging technologies creates competitive rivalry in a specific sector, and its effectiveness also extends to other industries. One such example is blockchain technology. This technology has been revolutionizing the fintech sector for the last decade. In the past few years, health-tech startups have been trying to fill the sectoral gaps using this technology, such as secure transfer of healthcare records, helping to unlock genetic code, facilitating a better medical supply chain, and so on [39,40]. Technology drivers not only influence startups but also impact the market and regulatory drivers of the sector. Similarly, specific market requirements shape the technological drivers. The consumers' and providers' demand for electronic health records necessitates technological innovation and integration of emerging technologies in other sectors.

Overall, market dynamics affect health-tech startups' activities and influence different stakeholders. Providers, consumers, and regulators can also play as external agents that impact the other forces in the industry on a macroeconomic level. Our proposed modification of the STOF framework works well in the healthcare sector context. Our sector-specific claim could also pave way for similar explorations in other sectors, which future researchers may investigate.

Research implications

The present study highlighted regulation management as an essential dimension for health-tech startups, including policy and challenge minimization capacity. Eighteen CSFs are clustered into themes to understand the success. The representation of CSFs among the three levels brings clarity for further CSF framework development. The study also modified the STOF framework by establishing new connections and altering the external forces, which opens for future investigation and extension of the framework.

The CSFs identification helps startup founders to strengthen their business models and enhances the success probability in the healthcare industry. Investors can identify potential health-tech startups by following the CSFs as matrix. It also ensures them regarding the possibility of their returns. Incubators can utilize the CSFs to mentor, train, and provide resources to health-tech startups to solve their problems. It also assists the incubators in shaping the startups adequately to fit them in the target market. Business research students, especially in entrepreneurship, can use the CSFs to investigate startups and measure the success aspects of different kinds of health startups, such as med-tech ventures.

Limitations and future scope

CSFs are interconnected with each other to provide a strong base for a startup's success. But this study didn't establish the linkage between the success factors statistically. We invite future scholars to investigate the relationships. The COVID-19 pandemic has significantly altered the healthcare industry and drives different stakeholders to mitigate the crisis by bringing solutions, especially in the e-health space. The delineated CSFs may be likely to be modified in the post-pandemic period.

The research did not collect data from the patients or consumers of the startup services. What makes these patients to use the services continuously and what satisfies them may offer new insights into the CSFs. The study highlighted the importance of market dynamics in health-tech startups and bound the theoretical proposition in sectoral settings. The researchers may explore this view from other sectors' circumstances. Additionally, classifications of market dynamics according to the technological, cognitive, social, economic, legal, and political aspects were beyond the scope of this work. Future investigators can also inquire about the same.

Conclusion

This study considered the significant failure angle parallel to the rapid outgrowth of health-tech startups within the evolving e-health system. The research focused on identifying health-tech startups' critical success factors in a highly dynamic healthcare market. Findings broadly indicated the importance of entrepreneurs' experience in the right direction to fulfill essential aspects like clinicians' needs, consumers' requirements, market demands, and policy requisites. Additionally, continuous monitoring and advancement provide an integrated and efficient approach to a venture's revenue generation in the long run to achieve success. The identified CSFs offer valuable guidance to the sectoral stakeholders. Future research can establish relationships among them to strengthen the success direction.

Authors contributions

Imon Chakraborty The author contributes to conceptualization, data retrieval, data analysis, and manuscript writing.

P. Vigneswara Ilavarasan The author contributes to the design of the methodology, validation of the data analysis, and improvement of the manuscripts.

Sisira Edirippulige The author contributes to manuscript review and improvement, including oversight and leadership responsibility for the research activity.

Declaration of Competing Interest

No conflict of interest.

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