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LINKING TECHNOLOGICAL INNOVATIONS AND DIGITAL MARKETING TO BUSINESS INCUBATOR SUCCESS AT UNIVERSITIES: THE MEDIATING INFLUENCE OF ENTREPRENEURIAL POTENTIAL

1. Sadia Munir
Teaching Assistant, Government College Women University, Faisalabad, Pakistan
sadiamunir@gcwuf.edu.pk
2. Gohar Mahmood*
Lecturer, Government College University, Faisalabad, Pakistan
goharmahmood@gcuf.edu.pk
3. Ayesha Noreen
Lecturer, University of Agriculture, Faisalabad, Pakistan
ayesha_noreen@uaf.edu.pk
4. Dr. Qaisar Maqbool Khan
Senior Lecturer, SKANS School of Accountancy, Multan, Pakistan
qmk707@gmail.com
***Corresponding Author: goharmahmood@gcuf.edu.pk**

Abstract:
Promoting entrepreneurship is commonly considered the cornerstone of economic growth and new job creations. These incubation centers do a lot by providing the startups with the resources, guidance and necessary infrastructure to develop. However, considering the technological advances and central pressures to the world market, the traditional incubation models are no longer optimal. In the current setting, technology innovations and digital strategies need adaptation for startups in a business incubator to thrive. Although there is increasing interest in the field, there is limited prior research on the relationships between digital marketing and technological innovations and success of student-founded startups in university incubators. This study examines the relationship between technological support and the digital marketing practices in business incubators as well as the moderating role of the potential of the entrepreneurs. A quantitative research was adopted based on the analysis of information from 260 university students involved in entrepreneurial activities ranging from different fields. The analysis was conducted using Partial Least Squares Structural Equation Modeling (PLS-SEM). Incubator performance's positive impact of the use of digital marketing and technological innovations are corroborated by the research. Notably, entrepreneurial potential arises as a mediator to prove its worth in optimizing the benefits of digital and technological capital for positive results. The model shows considerable statistical support and reliability for all of its constructs. The evidence suggests that university incubators should not be concerned with equipment and facilities delivery alone. They should develop entrepreneurial skills of student founders. The research presents an integrated approach that confirms the need for digital tools, technological integration, and entrepreneurial capabilities to deliver sustainable results in academic incubation settings.

Keywords: ***Technological Innovations, Digital Marketing, Entrepreneurial Potential, Business Incubator Success***

Introduction:

Over the recent decades entrepreneurship has turned out to be a determining factor of economic growth, development and employment throughout the world (Suyuti, Siraj, and Aslinda 2025). They are specifically in universities known to be important vehicles that help early-stage ventures access resources, guidance, and connections in academic settings (Yáñez-Valdés and Guerrero 2024). They have a central role of developing business concepts which creates start-ups with the appropriate physical facilities, technical know-how and frameworks (Man, Berger, and Rachamim 2024). However, with the current business environment being more global and technological, mere incubation in the above-mentioned discriminating factors is not enough to ensure the success of the startups (Bhuiyan 2024). In this regard, the adoption of technology as well as other innovative marketing techniques

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within the context of business incubation has been considered as a central theme in the improvement of the incubation process and the achievement of better results for incubated enterprises (Favour Oluwadamilare Usman et al. 2024).

Mega-trends of technology and digital marketing plan and execute strategies allowing entrepreneurs to enhance business performance in terms of operations, coverage and timely adaptation to the customers' needs (Almansour 2024). Application of automation tools, digital platforms, data analytics, and artificial intelligence give the startups a new way to adopt solutions and advance in their fields (Almansour 2024). Like any form or marketing, digital marketing enables low-cost promotion, customer reach and creating brands, which is essential given that most start-ups lack the financial might (Nicholls-Nixon et al. 2024). However, these factors have not been well understood in terms of their contribution to the startup success in university incubator (Felicetti, Corvello, and Ammirato 2024).

This is where the position of the entrepreneur himself fails to be considered an important factor in this relationship (Máté, Estiyanti, and Novotny 2024). On the relation between technology and its usage in a startup and digital marketing. The use of technology and relevant forms of digital marketing is contingent on the level of entrepreneurial potential of the company's founders (Mahmood, Khakwani, Zafar, et al. 2024). Entrepreneurial potential is the ability to identify opportunities, be willing to accept the risks involved with it, create something new and come up with ways of overcoming the inevitable challenges (Khakwani et al. 2024). According to (Mahmood and Kouser 2024), it has been observed that the outcome of new entrepreneurial initiatives depends highly on the cognitive characteristics and other abilities of the entrepreneur even if the resources are available (Aamir et al. 2024). Hence, it will be advisable to deduce that entrepreneurial potential therefore plays a moderating role in the relationship between technological advancement and innovation, utilization of digital marketing, and success of business incubators (Kouser et al. 2024).

It is with this idea in mind that the analysis of the role of entrepreneurial potential as a mediator becomes central to the university process (Zahra, Liu, and Si 2023). University incubators are not only the environment in which business is created but the learning space where student-entrepreneurs are in the process of constructing their entrepreneurial self (Sonia and Hania 2023). In such circumstances, technology and online marketing might not be a guarantee to success provided that the entrepreneurs are not ready, creative enough, and willing to make use of these resources (Dourado Freire et al. 2023). This view is in tune with the RBV of the firm positing that strategic resources are the root of competitive advantage but in the hands of capable managers (Lemaire et al. 2023).

Furthermore, in the modern world, it is not a set of simple one way advertisements but an effective, fully utilized digital channel of interacting with customers through social media, search engines and content (Annas and Meilinda 2023). Professionals with various levels of technical skills are now required to understand business basics and come up with good stories to tell their target customers, via social media (Rosli et al. 2023). Likewise, the technological tools reviewed in this paper can only be a force of change if the entrepreneurs are willing to embrace these changes and assimilate them into their business strategies (Bhat 2023). This is because even with the right technology in place, if the people who are supposed to use the technology do not have the motivation or the capacity to engage in entrepreneurship, then the technology will not go very far (Cuvero et al. 2023).

Although, there has been a steep increase in the literature on the business incubation, there is a lack of empirical evidence for exploring these three important aspects of technological innovations, digital marketing strategies, and entrepreneurial potential within the context of university based incubation (Muldoon et al. 2023). Previous research investigates these variables separately, with most of the studies investigating one of the

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following sources of support – incubator resources or entrepreneurs' characteristics without taking into account the interaction between them. Thus, this research aims at attempting to fill this gap by positing that entrepreneurial orientation partially explains the relationship between technological development, digital marketing and business incubator performance in universities.

This research aims at finding out how technological innovation and digital marketing affects startup success in university incubators and the moderating role of the entrepreneurial potential. Therefore, it is important for policy makers and incubator managers who formulate and implement support programs that seek to enhance the effectiveness of incubation processes to have a clear understanding of this relationship. If entrepreneurial potential is to be found to be a significant mediator, it implies that incubation programs should consider not only offering technology and marketing tools to the student founders but also try and build the entrepreneurial capabilities of the founders.

Moreover, this research also contributes to the knowledge expansion as it presents a framework that consolidates technological, marketing, and human capital viewpoints on the business incubators success. This study also brings attention to universities' incubators while also drawing the contrast between student entrepreneurship and traditional entrepreneurship, in the sense of skills, experience, and resources possessed by the two groups. Thus, the specific research question to be addressed in this investigation is the following: Technological advancement and the adoption of the digital media in marketing affect business incubator success at universities and how it is moderated by the level of entrepreneurial orientation. To answer this question; it will be beneficial is order to gain some understanding into how technology and marketing can be utilized to improve startup performance in academic incubation context.

The findings of this research will be useful for universities, incubator managers, and policymakers because they reveal the importance of the entrepreneurial potential for the effective utilization of technological innovations and digital marketing to achieve better incubator performance. The results should inform ways to improve incubation programs for the support of entrepreneurship, improvement of start-up business, and economic growth.

Literature Review:

Technological Innovations and Business Incubator Success

Accoridng to (Li, Wu, and Li 2023) technological advancement has thus presented itself as the most influential factor that contributes to business growth and competitiveness in the global economy. Technologic aids are vital in business incubation especially in universities where such incubators are developed to provide startups with the enablement tools, platforms and infrastructure that could improve their performance and likelihood of success (Alawamleh, Francis, and Alawamleh 2023). Business incubators are defined as programs that aim at offering young business people different essentials such as advisory services, physical space and other needs in addition to funding (Page and Holmström 2023). Nevertheless, in the contemporary world, the success of these incubators is contingent upon the incorporation and utilization of technologies that support innovation, flexibility, productivity, and creativity of the involved startups (Chibuike Daraojimba et al. 2023).

According to (Anwar, Anwar, and Mahmood 2023) technological advancement on the other hand is the implementation of technology or the application of one form of technology to another in order to enhance product, services or business processes. For startups located within incubators it could become possible to gain such innovations as key competitive advantages (Munir et al. 2023). These may include the minimization of time spent on basic operations, utilization of data in making decisions, use of cloud adoption for flexibility, incorporation of AI, as well as machine learning solutions for improving product

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development or customer relations (Abdullah et al. 2023). These technologies help the startups to manage their business operations efficiently, minimize overhead costs and adapt quickly to the market dynamics thereby having a direct impact on their performance (Mahmood et al. 2023).

According to (Gupta and Rubalcaba 2022) the information technology and many other inventions have been greatly embraced by entrepreneurs due to the impacts they have on the success of businesses. (Battour, Salaheldeen, and Mady 2022) also agrees with the RBV proposition by arguing that businesses that employ rare, valuable, and resources have better opportunities of gaining competitive advantage as well as superior performance (Adeosun and Shittu 2022). In this respect, technological capabilities are considered strategic resources that help a startup to be innovative, flexible, and grow (Wirata, Astawa, and Sulandari 2022). In the case of university based incubators, it is important to point out that availing these kinds of resources can enable a student entrepreneur who may not have the means to fund procurement of such technologies. In doing this, incubators play a useful role of enhancing the future outlook of their incubates (Anon 2022).

However, more specifically, technological advances are also vital in the improvement of communication, interaction and knowledge transfer within incubation context (Wasdani, Vijaygopal, and Manimala 2022). Through the use of digital platforms, the incubators can link the startups with other mentors, investors and other expertise from all over the world (Yaseen, Mahmood, and Naheed 2022). It also enhances not only the academic environment but also the visibility of the incubated businesses in the market (Mahmood et al. 2022). Incubators that adopt technological tools for administration of the program through technological tools like; virtual mentoring, computer based training, and performance management tools are likely to achieve a better structured, and particularly more effective support system to the entrepreneurs (Bodolica and Spraggon 2021).

According to (Gupta and Etzkowitz 2021) it can therefore be argued based on fact that incubation environment that incorporates technology results to improved business performance. As it has been pointed out by (Elia et al. 2021) and others, the use of technology-based incubation tends to have significantly higher rates of start-up survival and innovation yields, as well as better market performance compared to traditional incubation. These findings imply that the integration of technological innovation is not an enhancement on services offered in business incubation but a fundamental component of it (Muafi et al. 2021).

Therefore, the hypothesis that technological innovations foster business incubator success has support from not only literature review but also empirical evidences. The use of current technologies enables start-ups create, run and compete in the market by helping them meet their goals. University incubators should focus on the cultivation of technology resources to help the incubation enterprises exhibit improved performance as well as sustainability. As a result, those incubators that underline technology advancement as one of the important aspects of the support structure will foster entrepreneurial success at an excellent rate hence promoting economic development.

H1: Technological Innovations has a positive impact on Business Incubator Success

Digital Marketing and Business Incubator Success

According to (Hughes et al. 2021) the business world today is highly competitive and dominated by innovation through the use of technology when it comes to marketing, making digital marketing a key element in creating awareness to the new startups as well as creating a market for them. This is particularly the case given that startups within business incubators carry out their business activities with restricted capital and need affordable means of communicating with their target markets (Tang et al. 2021). Marketing through digital

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technology platforms including social media, website, search engines, e-mail and content development makes it easier for the startups to convey their value proposition to the customers and increase their market visibility in the domestic and international market (Nicholls-Nixon et al. 2021). Therefore, the application of digital marketing within the offered support services in business incubators contributes to the effectiveness and longevity of incubated enterprises (Mahmood, Munir, et al. 2021).

According to (Mahmood, Khan, et al. 2021) the overall success of business incubators can be explained by the performance of these incubated entities such as growth, profitability, market reach and innovative skills. Mobile marketing is central to these outcomes as it provides quantitative, niche, and engaging marketing strategies that can be used to optimally deploy scarce resources by startups (Hausberg and Korreck 2020). In contrast to conventional marketing communication, which involves difficult and expensive resources to put across the message, digital marketing avails more efficient cheaper tools of communicating the message to a wider audience interactively (Demydenko et al. 2018). The use of social media tools such as Google Ads, Facebook Ads, Instagram promotions, LinkedIn promotions, and search engine optimization assist in the branding of the new firms, create awareness of the products and services to the potential customers and make sales to the customers within the incubation hub from the universities without having to invest much capital (Hassan, Mahmood, and Nawaz 2013).

According to (Lalkaka 2002) aanother reason is that through the use of digital marketing four, the market is easily accessible and expansive in incubation. This is because new product ideas and concepts can be introduced on the digital platforms in order to assess how customers will react and use these products, making it easier to achieve the right product market fit and improving the level of satisfaction that customers have for these products (Hassan et al. 2013). In addition, digital marketing facilitates decision making in business as it contains analytics and marketing performance indicators that enable the identification of the success of the marketing strategies and the real-time adjustment of the strategies (Demydenko et al. 2018). This level of flexibility and responsiveness is valuable to fast-growing companies that are apt to operate in highly volatile and uncertain environment that is characterized by scarce resources (Hausberg and Korreck 2020).

According to (Bodolica and Spraggon 2021) theory supporting the positive influence of digital marketing to business incubator success is the theory of market orientation since it focuses on the customer needs in order to support business achievement. Digital marketing helps in this process through providing tools that allow customers to interact and be followed as well as tools for addressing them (Gupta and Etzkowitz 2021). Through social media monitoring, CRM systems and content marketing, startups should be able to achieve good interaction with the audience ultimately creating a sustainable relationship with the consumers (Elia et al. 2021).

According to (Muafi et al. 2021) aadditional empirical evidence also points towards the effectiveness of digital marketing boosting up the performance of the start-ups. (Hughes et al. 2021) suggests that firms that use digital marketing strategies have higher growth in business and customer sales than those firms that use the traditional marketing techniques. Even though, within the incubation environment, giving knowledge and guidance on how to apply the specific digital marketing strategies enhances the ability of the entrepreneurs to apply these strategies effectively thus improving the performance rates of the incubated startups (Tang et al. 2021).

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According to (Nicholls-Nixon et al. 2021), through the use of technology, incubated businesses are able to reach global markets and this reduces the barriers of location for the startups to compete more extensively. Using technology, incubation ventures can reach out to its international customers, partners and investors over online marketplaces, E-Commerce sites and social media platforms making the incubation process and incubators more successful (Mahmood, Munir, et al. 2021). Based on both the theoretical and empirical analysis, it is possible to conclude that the hypothesis in question, namely the hypothesis stating that digital marketing has a positive effect on business incubator success (Mahmood, Khan, et al. 2021). Digital marketing plays a role of an enabler for startups to obtain market presence, attention and growth within the context of the incubators. Hence, business incubators or those that are university affiliated, should ensure that they incorporate digital marketing training, digital marketing tools, and digital marketing support services to increase the rate of success as well as sustainability of the existing entrepreneurial start-ups.

H2: Digital Marketing has a positive impact on Business Incubator Success

Entrepreneurial Potential and Business Incubator Success

According to (Gupta and Rubalcaba 2022) bbusiness incubation itself is not a guaranty to success in any business; it depends a lot on the qualities of the owners and their ability to manage different aspects of the business. The concept of entrepreneurial potential involves the individual characteristics, including personal traits and factors within an individual that can help one identify opportunities for new business, create new ideas and products, use relevant risks and resources in the right way, and keep trying until success is achieved (Battour et al. 2022). This is because in the case of business incubators particularly university incubators, the entrepreneurial capacity of the incubate, plays a crucial role in the creation of an effective linkage between support received from the incubators and business success (Battour et al. 2022).

The following competencies fall under entrepreneurial potential; creativity, risk taking ability, proactivity, tenacity, opportunity identification, and leadership (Adeosun and Shittu 2022). These are some of the characteristics widely documented in entrepreneurship literature to influence the success of the venture (Wirata et al. 2022). Startups led by such entrepreneurs are unable to exploit the resources such as technological advances and internet marketing effectively, even if they are available (Anon 2022). Thus, incubators that seek to give more than just support to the participants with an emphasis on entrepreneurship tend to gain better performance results (Wasdani et al. 2022).

According to (Mahmood et al. 2022) the Human Capital Theory also complements this argument by asserting that stock of human capital which is knowledge, skills and competencies of people is a major source of business resources through which it achieves its goals. Accordingly, the higher level of potential should lead to a higher likelihood of making correct decisions, perceiving changes in the market, and using the resources available in the incubator (Zahra et al. 2023). They show excellent management skills in assembling the teams, controlling the processes, and interacting with the customers which are crucial for the successful functioning of the startups in context of the given incubator (Sonia and Hania 2023).

According to (Dourado Freire et al. 2023) the existence of entrepreneurial potential means that the founders can adapt well in the market, come up with new and improved ways of providing added values to the products or services they offer as well as acquire competitive advantages in the market. By mentoring the potential, skill development, and

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exercises, ability of the student entrepreneurs, incubation programmes encourage them to actively manage the enterprises and bring them to life (Lemaire et al. 2023). They also enlighten the fact that business owners with high self-efficacy, opportunity recognition and risk taking propensity are more likely to thrive in startups conditions (Annas and Meilinda 2023). These attributes allow them to leverage the technological tools and marketing strategies that are offered by the incubators to transform the opportunities into businesses (Rosli et al. 2023).

Therefore, the more the level of entrepreneurial potential, the more the ability to effectively use the resources available in the incubator, design ways and means of implementation of the ideas and strategies developed under the business incubation process and to overcome the challenges arising in the process of business development (Bhat 2023). Development of entrepreneurial capital, it is thus logical that incubation programs should prioritize the development of this factor to ensure continued sustainability and growth of the start-up firms.

H3: Entrepreneurial Potential has a positive impact on Business Incubator Success

Technological Innovations, Entrepreneurial Potential, and Business Incubator Success

According to (Cuvero et al. 2023) technological advancements are now considered key drivers for growth strategies of the new economy business ventures, especially the ventures operating in business incubators. The advancements such as digital tools, automation systems, cloud technologies, and data analytics increase operation performance, product creation, and market sensitivity (Muldoon et al. 2023). Nevertheless, possessing such technologies does not guarantee that such businesses will be successful, particularly for start-ups (Li et al. 2023). Entrepreneurial potential can be said to moderate the relationship between technological innovations and business incubator success because the ability of the startups to properly harness technological innovations is anchored on the entrepreneurial potential of their founders (Alawamleh et al. 2023).

According to (Page and Holmström 2023) entrepreneurial readiness means the ability of an individual to identify opportunities, act on them independently, create something new and persistent in its implementation. Even if the present day environment is characterized by the availability of such technologies, an entrepreneur lacking in such traits will not be in a position to use them properly or create new methods and means for their use (Chibuike Daraojimba et al. 2023). On the other hand, the competent entrepreneurs with potential are capable of using the technological innovation in a constructive and innovative manner to suit the business models and in fulfilling the market needs (Anwar et al. 2023). This is in line with the Resource-Based View (RBV) stipulating that the sheer possession of resources is not enough to deliver a competitive edge; but, how these resources are deployed given their characteristics and the individuals who manage them, do indeed affect business performance (Munir et al. 2023).

According to (Abdullah et al. 2023) the mediating role of entrepreneurial potential implies that an adoption of technology has positive impact on incubator success with a proposition that is premised on the notion that the entrepreneurs have the potential of harnessing these technologies. According to (Mahmood et al. 2023) using data analytics or automation tools involves not only the technical features, but also the entrepreneurial skills in order to analyse the insight, take the right decision and put it in practice. The decision-making capability of such high potential entrepreneurs also enables them to try out the new

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technologies, be innovative and adapt should the need arise, factors that are critical in enhancing start-up success in incubators (Yáñez-Valdés and Guerrero 2024).

According to (Man et al. 2024) ssupport for this mediation model can be obtained from the empirical literature where it as established that other internal characteristics of entrepreneurs namely self-efficacy, creativity as well as opportunity recognition mediate the relationship between external sources such as technology and business performance (Bhuiyan 2024). Hence, in the case of university-based incubation centres that work with first-time or less experienced business initiates, it is possible to nurture entrepreneurial capacity so that the technology support offered by the incubator is translated to venture success (Favour Oluwadamilare Usman et al. 2024).

Hence, entrepreneurial potential plays the moderating role in the relationship between technological innovations and business incubator success meaning that the innovation in technology translates to actual business success due to the presence of the entrepreneurial potential (Almansour 2024). This underscores the need for incubators not only to provide technological support to these firms but also to develop the abilities of the firms so as to follow better and more efficient pathways to success.

H4: Technological Innovations has a positive impact on Business Incubator Success with mediating role of Entrepreneurial Potential

Digital Marketing, Governance and Regulatory Frameworks, and Business Incubator Success

According to (Almansour 2024) the growth of the digital marketing has influenced how startups introduce their products to the market, interact with customers as well as compete in the market. In the business incubation within universities in particular, digital marketing acts as a tool that helps early-stage ventures to establish the identity of their business, to attract consumers and to grow through social media, content marketing, SEO, and email marketing at significantly low costs (Nicholls-Nixon et al. 2024). However, the efficiency of utilizing the digital marketing strategies is not only in the strategies themselves that are used for the business incubator promotion (Felicetti et al. 2024). These marketing initiatives are carried out within certain governance and regulatory structures, which moderates how digital marketing can foster success in startups (Máté et al. 2024).

According to (Mahmood, Khakwani, Zafar, et al. 2024) legal foundations are the systematic written or unwritten rules that apply to organizations and guide the actions of firms and their representatives through policy and legal requirements governing business conduct in a certain country or jurisdiction, including the digital marketing environment. These frameworks help in the responsible, ethical and legal carrying out of marketing activities in accordance to the laws set by the national and international organizations (Khakwani et al. 2024). In the context of BI and especially when it refers to university-based BIs, proper governance structures and compliance with the required regulations contribute to the creation of a tame environment that supports the digital marketing processes while being in line with ethical marketing principles including GDPR and consumers' rights (Mahmood and Kouser 2024).

According to (Aamir et al. 2024) with the help of governance and regulation of digital marketing strategies, different issues like incorrect information, or breaches of data privacy, or unethical advertisement, may occur which would negatively affect the reputation of a start-up and in extension its growth. In this regard, following the laid down regulations will help the startups to use digital marketing in the right manner from the side of the customers as

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well as incubator supported ventures (Kouser et al. 2024). In addition, digital marketing incubators that teach clients on how to go about the digital marketing legal framework afford their startups the ability to manoeuvre the digital environments legally thus avoiding any repercussions of noncompliance (Mahmood, Khakwani, Memon, et al. 2024).

According to (Hausberg and Korreck 2020) the agency theory and the institutional theory back the propositions that improved governance mechanisms enhance performance by increasing certainty and standardizing actions for organizational performance with the formulated long-term goals. In the context of the digital marketing, it stands for the rules regarding online advertisement, textual, graphic and video content, the usage of copyrighted material and interaction with customers (Bodolica and Spraggon 2021). These frameworks also make the startups to operate in a transparent manner, builds credibility and this is essential in determining the success of business incubators (Gupta and Etzkowitz 2021). Literature review reveal that, Startups within good legal environments are likely to adopt right digital tactical, stay out of legal risks as well as continue serving their clients (Elia et al. 2021). Hence, governance and regulatory frameworks are not impediments but facilitators of digital marketing that channel the processes to legal, moral, and optimal ways (Muafi et al. 2021).

Therefore, it can be concluded that governance and regulatory frameworks moderate the positive relationship between digital marketing and business incubator success in the sense that digital marketing efforts must be legal, moral, and aligned with the goals of business incubators. This means that there is need to incorporate regulatory compliance and governance assistance in the training on digital marketing for the incubated businesses to enhance success of the incubated ventures.

H5: Digital Marketing has a positive impact on Business Incubator Success with mediating role of Governance and Regulatory Frameworks.

Methodology:

This paper adopts a quantitative research design to analyses the moderating effect of entrepreneurial potential on the relationship between technological innovations and digital marketing and business incubator performance (Hughes et al. 2021). Based on a positivism viewpoint, this research is committed to objectivity, quantity measurement and verification, which can only examine the relationships between the given constructs. The positivism paradigm believes in the use of presented quantitative data collected for testing the hypothesis that has emanated from theory (Tang et al. 2021). To this end, the deductive research method is used, and the research starts with theories and hypotheses that are tested on actual data.

As the research population sample would be very large and heterogeneous, a structured survey was deemed the most appropriate research approach for data collection (Nicholls-Nixon et al. 2021). The target population includes university students in various faculties for the following reasons; majority of the students are currently exposed to entrepreneurship education, information technology, and various university incubation centers (Mahmood, Munir, et al. 2021). The last sample is composed of 260 university students from various fields of study of Business, Engineering, Social Sciences, and others. These participants were either running their own or have partaken in a university incubation

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or were taking entrepreneurship courses. To make the samples relatively equal across fields of study, stratified random sampling was adopted (Mahmood, Khan, et al. 2021).

This procedure was adopted to minimize selection bias and increase the applicability of the findings to the university students. Data were collected using structured questionnaire with five major parts in the questionnaires. The first part included questions regarding the gender, age, the academic level of the participant and the field they are working on in the incubator, if they have been in an incubator before. The next four sections assessed the core study variables namely technological innovations, digital marketing, entrepreneurial potential and business incubator success (Gupta and Rubalcaba 2022). Each variable was assessed by five developed items and adapted from existing scales in the literature to make sure that the items used are valid and appropriate.

The survey responses were measured using a 5-point Likert scale: 1=strongly disagree; 2=disagree; 3=neutral; 4=agree; 5=strongly agree to ensure that all the responses are quantifiable and could be compared and analyzed easily. To test the hypotheses, Partial Least Squares Structural Equation Modeling (PLS-SEM) was used and with the help of SmartPLS software (Battour et al. 2022). This technique was chosen because PLS-SEM is suitable for model with direct and mediating effects of multiple variables. Specifically, the process that has been followed in the analysis was multi-stage.

First, the measurement model was examined to ensure reliability and validity tests by Cronbach's alpha, composite reliability, and average variance extracted (AVE) (Adeosun and Shittu 2022). To establish discriminant validity, the Fornell-Larcker criterion was inspected, as well as the HTMT ratio. After the measurement model of the research has attained the hypothesized threshold, the structural model was developed to check the path relationship between technological innovation for business incubator success, and digital marketing on business incubator success (Wasdani et al. 2022). To investigate the mediating effect of entrepreneurial potential, bootstrapping with 5,000 resamples was used to obtain reliable and accurate t- values for both direct and indirect effects. The addition of entrepreneurial potential as a moderator accounts for the fact that students' ability to use and market digital tools and strategies may vary and depends on their confidence, awareness, propensity to take risk, and perseverance – all aspects of entrepreneurial potential (Mahmood et al. 2022).

In as much as it concerns the ethical consideration, all the due process was observed in this study. I also ensured that all the participants were informed about the purpose of the study and they all agreed with their rights to participate in the study (Zahra et al. 2023). To this end, their identity and identification were not revealed, and the data were collected for educational use only. The participants were informed freely and willingly agreed to participate, and that they could leave the study at any time without any consequences (Sonia and Hania 2023). This premise was because the research used a cross-sectional time horizon that obtained all responses at a single point in time. Although this design is useful for data collection and identifying relationships between variables, changes in variables over time are also limited (Dourado Freire et al. 2023).

Another limitation lies in the use of survey data; this may exposed the study to common bias like social desirability bias or subjectivity bias among others. Nevertheless, such risks are often unavoidable and the decision to use validated measurement instruments as well as being careful with the questionnaire design was made to minimize them and maximize data reliability (Lemaire et al. 2023). This paper also properly ensures the selection of the university student sample with regard to the research interest. University incubators

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have gradually grown more important in developing entrepreneurial capabilities and promoting entrepreneurial companies. Therefore, university students constitute an important sample of population in examining role of technology and digital marketing and personal capital in incubator success.

Altogether, this methodological framework gives a proper and coherent context for a research, which explores how technological advancements and digital marketing practices are positive for business incubator performance with entrepreneurship as a moderator. By the use of statistical analysis and a systematic sample of 260 university students' data, the study provides relevant recommendations on how incubators can assist young entrepreneurs to flourish in todays' digital economy.

Operationalization of variables

Variable	Measurement Focus	References
Technological Innovations	Access to digital technologies, tool usage, innovation support, efficiency improvement	(Chibuike Daraojimba et al. 2023)
Digital Marketing	Social media usage, digital training, content marketing, online visibility	(Almansour 2024)
Entrepreneurial Potential	Risk-taking, opportunity recognition, determination, innovation mindset	(Lemaire et al. 2023)
Business Incubator Success	Startup performance, mentorship access, funding, satisfaction with incubator	(Elia et al. 2021)

Analysis and Results:

This part represents the research findings with focus on the key demographic aspects, the corresponding statistic trends and the role of the central variables for the business incubators success.

Variable	Response Option	Frequency	Percent
Gender	Male	160	61.54%
	Female	90	34.62%
	Prefer not to say	10	3.85%
Age Group	Below 20	30	11.54%
	21-25	130	50.00%
	26-30	70	26.92%
	31-35	20	7.69%
	Above 35	10	3.85%
Education Level	Undergraduate	140	53.85%
	Graduate	80	30.77%
	Postgraduate	40	15.38%
Discipline/Field of Study	Business	100	38.46%
	IT/Computer Science	80	30.77%
	Engineering	60	23.08%
	Other	20	7.69%
Startup Involvement	Yes	200	76.92%
	No	60	23.08%
Role in Startup	Founder	100	38.46%
	Co-founder	50	19.23%

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	Marketing Lead	40	15.38%
	Tech Lead	40	15.38%
	Other	30	11.54%
Experience with Digital Marketing	Yes	150	57.69%
	No	60	23.08%
	Planning to use	50	19.23%
Use of Technology Tools	Yes	170	65.38%
	No	90	34.62%
Entrepreneurial Training	Yes	180	69.23%
	No	80	30.77%

A distribution of the 260 students that responded reveals that the sample is fairly balanced and inclusive. The survey sample was mostly male (61.54%) followed by females at 34.62% with few refusing to mention team gender. About 50% of the sample were 21-25 years of age, indicating that the wealth of entrepreneurship is clearly young and vibrant. The sample was largely comprised of undergrads (53.85%), with substantive numbers from business (38.46%) and IT (30.77%) departments (Munir et al. 2023).

More than 76.92% of respondents involved in startup activities manifesting a strong desire for entrepreneurship. A notable 38.46% in the survey were founders which spilled their nook of leadership status among entrepreneurship students. The research points to a high level of digital readiness as 57.69% are using digital marketing while 65.38% are making use of technological tools in their startup operations. Additionally, 69.23% of the respondents had undergone formal entrepreneurial training indicating the positive impact that academic programs matter to places in-between startups (Khakwani et al. 2024). The aggregated data reflect a collection of students who possess strong technical skills and innovative spirit which are ready to utilize academic learning in business expansion.

Outer loading

	Business Incubator Success	**Digital Marketing**	**Entrepreneurial Potential**	**Technological Innovations**
BIS1	**0.766**			
BIS2	**0.755**			
BIS3	**0.752**			
BIS4	**0.740**			
BIS5	**0.669**			
DM1		**0.737**		
DM2		**0.757**		
DM3		**0.670**		
DM4		**0.763**		
DM6		**0.701**		
EP1			**0.683**	
EP2			**0.744**	
EP4			**0.741**	
EP5			**0.740**	
EP6			**0.659**	
TI1				**0.728**
TI2				**0.772**

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TI3				**0.686**
TI4				**0.656**
TI6				**0.704**

The outer loading results show consistent measurement of all indicators in the constructs. All of the items associated with Business Incubator Success (BIS1 to BIS5) exhibit loadings exceeding 0.66, indicating satisfactory convergent validation. Analogically, loadings for Digital Marketing items (DM1-DM6) range between 0.670 and 0.763, confirming high internal reliability (Zahra et al. 2023). The loadings for Entrepreneurial Potential have a healthy spread between 0.659 and 0.744, and for Technological Innovations the loadings progress between 0.656 and 0.772 both of which are greater than the 0.6 value (Almansour 2024). This supports the fact that the indicators employed are valid indicators for each construct following the rule of thumb standard in reflective measurement models (Almansour 2024). The findings validate that each indicator explains its latent variable well, in turn making the structural model stable and hypothesis testing reliable.

Correlations

	Business Incubator Success	**Digital Marketing**	**Entrepreneurial Potential**	**Technological Innovations**
Business Incubator Success	**1.000**			
Digital Marketing	**0.585**	**1.000**		
Entrepreneurial Potential	**0.608**	**0.725**	**1.000**	
Technological Innovations	**0.506**	**0.676**	**0.625**	**1.000**

The correlation matrix shows strong interrelationships between variables that are researched. The highest correlation observed between Entrepreneurial Potential and Digital marketing (r = 0.725) proves that the more entrepreneurial potential a person has, the better he/she is able to apply digital marketing techniques (Wirata et al. 2022). Moderate relationship with Business Incubator Success is observed between Entrepreneurial Potential (r=0.608) and Digital Marketing (r=0.585) implying much influence on business incubator performance. Technological Innovations has moderate relations with all of the study variables most closely related to Digital Marketing (r = 0.676), but less so with Business Incubator Success (r = 0.506), which suggests that its impact on incubator outcomes relies more on the findings ascertain the speculated Entrepreneurial Potential's mediating effect on incubator performance and show how marketing and innovation are integrated in influencing those outcomes (Zahra et al. 2023).

Quality Criteria

R Square

	R Square	**R Square Adjusted**
Business Incubator Success	**0.420**	**0.412**
Entrepreneurial Potential	**0.559**	**0.555**

R Square values describe how much of the variability of the dependent variable is accounted for the model. Regarding Business Incubator Success, R^2 was 0.420 An R^2 of 0.559 of the Entrepreneurial Potential suggests that, 55.9% of its variance is credited to Digital Marketing and Technological Innovations which is evident and a strong (Sonia and Hania 2023). The Adjusted R^2 figures of .412 and .555 show that the model stays consistent with minimal loss in explanatory ability. These results highlight the reliability of the model

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and show that the independent variables possess excellent predictive power.

Construct Reliability and Validity

	Cronbach's Alpha	rho_A	Composite Reliability	Average Variance Extracted (AVE)
Business Incubator Success	**0.789**	**0.791**	**0.856**	**0.543**
Digital Marketing	**0.776**	**0.780**	**0.848**	**0.528**
Entrepreneurial Potential	**0.759**	**0.759**	**0.839**	**0.510**
Technological Innovations	**0.757**	**0.765**	**0.835**	**0.505**

The metrics reliability and validity of the constructs evidence highly reliable measurement across all latent variables. The Cronbach's Alpha ranges between .757 and .789 which means that Cronbach's Alpha measures the items in the scale in a consistent manner as a whole (Bodolica and Spraggon 2021). All values of Composite Reliability (CR) exceed the cutoff point of 0.70 (0.835 – 0.856), this shows that constructs are consistently measuring their intended items (Dourado Freire et al. 2023). AVE scores for everything constructs easily exceed the cut-off point of 0.50, showing that the latent construct explains more than fifty percent of the variance in the indicators, not error (Gupta and Etzkowitz 2021). The findings as a whole point to the need for both high reliability and convergent validity characteristics of the measurement model, which justifies the use of these constructs in structural analysis.

Discriminant Validity

Fornell-Larcker Criterion

	Business Incubator Success	Digital Marketing	Entrepreneurial Potential	Technological Innovations
Business Incubator Success	**0.737**			
Digital Marketing	**0.585**	**0.726**		
Entrepreneurial Potential	**0.608**	**0.725**	**0.714**	
Technological Innovations	**0.506**	**0.676**	**0.625**	**0.710**

According to the Fornell-Larcker Criterion, the model discloses a strong discriminant validity. For each construct, the AVE's square root (diagonal values: all greater than 0.71) are higher than the correlations between the construct and the other constructs (off-diagonal values) (Man et al. 2024). The square of AVE for Business Incubator Success is 0.737, the highest compared to its correlations with Digital Marketing (0.585), Entrepreneurial Potential (0.608) and Technological Innovations (0.506). In the same way, the square root of the AVE for Digital Marketing (0.726) is higher than its correlations with Entrepreneurial Potential, Technological Innovations, and Business Incubator Success (Lemaire et al. 2023). This finding confirms that the constructs are in fact measuring separate constructs; thereby validating the discriminant validity of the model and removing construct redundancy.

Model_Fit

Fit Summary

	Saturated Model	Estimated Model
SRMR	**0.082**	**0.082**

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d_ULS	**1.407**	**1.407**
d_G	**0.402**	**0.402**
Chi-Square	**530.582**	**530.582**
NFI	**0.718**	**0.718**

The overall fit of the structural model is acceptable and sustained by the findings of the model fit indices. Since the value of SRMR is at 0.082, less than the limit of the standard of 0.10, it indicates a good fit between observed and predicted patterns of correlations. d_ULS is low at 1.407 and d_G at 0.402, both new value close to the observed values which means the model is very close to the observed data (Bhuiyan 2024).

Although, the Chi-square value of 530.582 is mentioned, its prominence in PLS-SEM is quite limited, due to its predisposition to change from the number of samples size is it taken from. The obtaining of the NFI value of 0.718, which is lower than the common 0.90 level, is still considered adequate within the boundary of exploratory work. Overall, the results endow the structural model as a good fit of data, providing for robust interpretation of hypothesized associations between constructs (Annas and Meilinda 2023).

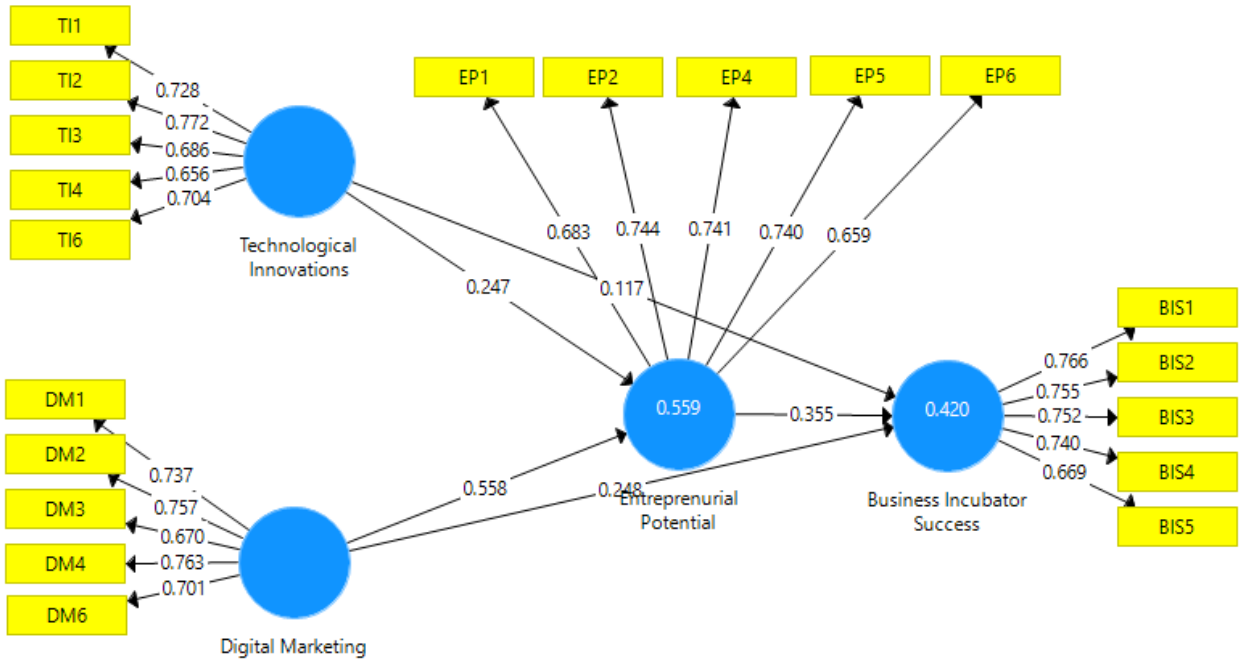

Figure 1: PLS-SEM Research Framework

Mean, STDEV, T-Values, P-Values

	Original Sample (O)	**Sample Mean (M)**	**Standard Deviation (STDEV)**	**T Statistics (|O/STDEV|)**	**P Values**
Digital Marketing -> Business Incubator Success	0.446	0.450	0.074	6.024	0.000

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Digital Marketing -> Entrepreneurial Potential	0.558	0.561	0.059	9.408	0.000
Entrepreneurial Potential -> Business Incubator Success	0.355	0.361	0.080	4.433	0.000
Technological Innovations -> Business Incubator Success	0.204	0.205	0.069	2.957	0.003
Technological Innovations -> Entrepreneurial Potential	0.247	0.245	0.067	3.682	0.000

The hypotheses presented in this study are seminal with respect to the empirical evidence obtained with the support of the structural model. A strong, statistically significant positive impact of Digital Marketing on Business Incubator Success is confirmed by the path coefficient of 0.446 and a t-value of 6.024 and a p-value of 0.000 (Elia et al. 2021). These discoveries indicate that the success of digital marketing ventures is directly related to the success level and effectiveness of startups handled in university incubators (Rosli et al. 2023). By contrast, the Digital Marketing effect on Entrepreneurial Potential is even greater as evidenced by the coefficient of 0.558, t-value of 9.408, and p-value of 0.000 meaning that the use and interaction of digital tools and platforms increases the students' entrepreneurial skills (Favour Oluwadamilare Usman et al. 2024).

Furthermore, Entrepreneurial Potential has a significant positive impact on Business Incubator Success ($\beta = 0.35$) (Bhat 2023). This shows that attributes such as boldness, creativity and persistence hold a lot of importance in turning incubator resources into actuality business results. Their insignificant effect on Business Incubator Success is further reflected in Technological Innovations ($\beta = 0.204$). This demonstrates that the startups gain from technological innovation, but it may be diminished by good marketing and entrepreneurship skills. Notably, the positive impact of access to Technological Innovations towards Entrepreneurial Potential ($\beta = 0.247$, $t = 3.682$, $p = 0.000$) means such technology strengthen both operation management and the general entrepreneurial character (Adeosun and Shittu 2022).

Results are statistically significant ($p<0.05$), as Digital Marketing and Technological Innovations do indeed have a direct and an indirect impact on Business Incubator Success, mediated via Entrepreneurial Potential (Almansour 2024). The results point to entrepreneurial traits as a mediator and that incubator performance relies on the integration of marketing, technology, and human capital.

Conclusion

This investigation examined the impact of innovation and digital marketing on business incubation outcomes in the universities, with the mediation by entrepreneurial skills. As we had anticipated, the research revealed that tech advances and digital marketing both have a significant influence on the performance of venturing companies that remain in business incubators. The results highlighted the importance of entrepreneurial potential as a mediator, and it is implied that the distinctive skills of student entrepreneurs bear strong influence on the capacity to convert digital and technological assets into impactful business outcomes. Together, the constancy of outer loadings, the standard of acceptable model fit, and statistically significant path coefficients provided by structural equation modeling confirm the framework, validating the research hypotheses.

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These inferences will have far reaching implications for policymakers, incubator managers, and academic bodies who will want to support survival entrepreneurial efforts. The findings show that although access to digital tools and technologies is the key, it is not a sufficient factor to make sure that entrepreneurship incubators work successfully. The main criterion for incubator success is the extent to which the entrepreneurs use these resources, which depends on their underlying entrepreneurial abilities; such as creativity, risk-taking, opportunity identification, and adaptive resilience. Therefore, incubators need to change their perspective from simply offering resources to really enable students to identify, develop, and exploit their innate entrepreneurial skills. By emphasizing the human aspect, incubators ensure that digital and marketing resources reach their maximum potential leading to better startup outcomes and sustainable trajectories.

Recommendations-wise, university-based incubators should integrate numerical entrepreneurial training programs with digital/ technological resources. Curriculum should have modules that develop competency in handling innovation, digital marketing strategies, data analysis for decision making as well as dealing with realistic entrepreneurial situations. Also equally, development and establishment of mentorship schemes whereby students are matched to experienced entrepreneurs in universities and incubators need to be brewed to foster knowledge exchange and professional development. Continuous follow up and evaluation by incubators enable to discover underutilization of resources, prioritizing corresponding interventions. To remain effective, institutional support systems to digital and technology should constantly interact with industry to facilitate their adaptation to the current market trends. Such an incentive to experiment and recover within students prepares them to surmount startup impediments and, in turn, raises the chances of successful incubator results.

Universities and incubators should promote the development of policies that will make the environment for entrepreneurship more favorable according to the study. Such an approach assists students secured funding, provided access to expert advisors, benefited from efficient administrative systems, and received innovation grants. Further research should be aimed at increasing the sample size and diversity to encompass greater geographic scope and establish these results be generalizable to a diverse institutional and cultural setting. Further studies that monitor incubator participants over long durations may show how the entrepreneurial skills develop and how this development leads to long-term results from incubators. Institutional assistance, capital availability, policy environments and the way in which variations in gender and socioeconomic status affect outcomes for the entrepreneurs would be helpful for future studies. It may yet be helpful to concentrate on sector-oriented incubators, in the form of healthcare-oriented incubators, agriculture-oriented incubators, and green technologies-oriented incubators, to expose the industry-specific digital and technological practices, and their association with the entrepreneurial attributes.

It is evident from this research that there is a critical synergistic relationship of technological innovation, digital marketing, and entrepreneurial potential for the efficacy of university incubators. The research proves the quality of combining a strong facility with a specific individual development program is necessary to reach higher performance and greater societal impact of university incubators. Universities have to view their incubators as more of these changing systems and less of physical structures, guided by proper repackaging of resources, seasoned mentorship, and promotion of person of autonomy. Such comprehensive plan will enable incubators to become key stakeholders in the incremental process of fostering innovation, encouraging economic prosperity and social progress in our generation.

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