**IJARBM – International Journal of Applied Research in Business and Management**
Vol. 03 / Issue 03, pp. 34-55, December 2022
ISSN: 2700-8983 | an Open Access Journal by Wohllebe & Ross Publishing

This paper is available online at
www.ijarbm.org

# Effects of Technology Endowment on Open Innovation Success in Medium-Sized Enterprises in Kenya

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https://doi.org/10.51137/ijarbm.2022.3.3.3

**Abstract –** Technology is an infrastructural enabler that ensures success of open innovation (OI) activities in modern enterprises. The Kenyan experience indicates that the OI success strategy for medium enterprises (MEs) hinges on endowment of technological capabilities in operation and management of MEs. Notwithstanding, the aggregate entrepreneurial orientation (EO) of firms seems to be a determining factor in connecting the technological investment and stakeholders' collaboration to activate the innovation potential of MEs. This study sought to determine the moderating role of EO on the relationship between firms' technological endowment and OI success of service and manufacturing MEs in Kenya. The data collected were analyzed using Statistical Package for Social Scientists (SPSS) Version 23 and Smart PLS3 application software. The formulated hypotheses were tested using structural equation modelling. The results showed that Technology positively influences OI success; however, they did not confirm that EO moderates the Technology and OI success relationship. While the study recommends a strategic investment in Technology to enhance OI success, it also advises further research into the dynamics of the triple relationship between Technology, EO and OI Success to optimize their combination for enhanced organizational innovation.

**Keywords –** Open Innovation Success, Technology, Innovation Potential, Technology Investment

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# 1 Introduction

In today's ever-changing and competitive economic landscape, firms must work within and outside of their organizations' boundaries to achieve performance objectives that endear them to their clients and thus ensure their continued existence. Technology in the form of external technology acquisition and external technology exploitation are considered open innovation (OI) strategies that can effectively improve the innovation performance of organizations. The concept of technology ropes in different operational perspectives, including the hardware as well as the software aspects. If used well, technology in its various aspects affords many benefits to firms and their clients. The benefits include improved workflow (Buhler & Vidal, 2005), enhanced company's flexibility to respond to customer needs (Gunasekaran & Ngai, 2004), increased product quality (Thatcher & Pingry, 2004), and improved communication between companies and their clients, including suppliers (Fiala, 2005).

External technology acquisition, external technology exploitation and innovation culture have significant and positive effects on OI (Zanchiri, Jalilian, & Mehrjardi, 2019). A suite of new technologies, otherwise dubbed 'innovation technology', helps to support OI (Dodgson, Gann, & Salter, 2006). Technologies like social media can help organizations to scout for appropriate technology, and source for ideas and knowledge from external sources to support their innovations. Moreover, digitalization can hasten business operations and enhance the innovation process of firms (Tajudeen, Jaafar, & Sulaiman, 2019). Technological complexity has been observed to be one of the key factors that drive the recognition of OI. Adamides and Karacapilidis (2017) explain that technologies are required for strategic OI capabilities and also for operational OI capabilities. The acquisition of external technology (inbound innovation), the external exploitation of technology (outbound innovation), and coupled innovation are different processes through which OI is expressed (Bigliardi, Ferraro, & Filippelli, 2020).

Quite often, when companies realise the entry of new technologies that are working for other firms, necessity drives them to resort to the acquisition, integration and improvement of these technologies, with a view to increasing their profit margins from new forms of development and thus remain competitive in the market place. Therefore, they are forced to accept new knowledge into their production processes; thus, they are able to increase effective innovation, although this behaviour reduces their internal R&D activities. Nevertheless, these actions enable them to access the benefit of converting value chains in which they are embedded into intelligent data-driven systems (Bigliardi, Ferraro, & Filippelli, 2020). Further, Bigliardi et al (2020) postulate that technological aptitude has been demonstrated to increase the impact of incoming OI on firm performance, although its relative influence on the relationship between outbound OI and firm performance has not been established. It seems that a greater technological aptitude combined with experienced management of market information enhances the effects of outbound OI. Other views hold that if firms with fully developed technological competence implement incoming innovation activities, they

can obtain better results if they maintain a reasonable level of management skills related to market information (Liao, Fu, & Liu, 2020).

Firms which encounter management difficulties when they try to benefit from the effects of external technology transfer should implement strategic planning processes that take into account commercialized external technology. In this respect, Lichtenthaler (2008) proposed two tools that can help firms to combine external technology exploitation with internal technology planning – a product technology roadmap, which should include the external technology development, and a concept of the functional market, which moves from the vision of product markets to that of technological markets.

That said, there is a way in which Technology seems to be connected to OI Success. While demonstrating the positive effect of both external technology acquisition and external technology exploitation on a firm's process innovation performance, Charmjuree, Badir and Safdar (2021) also found that the relationship between external technology acquisition and external technology exploitation is positively moderated by the firms' unabsorbed slack. Advisedly, if MEs collaborate with external partners, they raise the potential to innovate successfully and to reach more profitable positions in the competitive landscape.

Because entrepreneurial orientation (EO) capabilities have been shown to connect certain technological aspects of firm operation and their performance (Ndung'u, Wanjau, Gichira, & Mwangi, 2017), this paper surmises that EO has a moderating effect on the relationship between Technology and OI Success. However, there is little documented evidence that exists for specific relationships between Technology and OI Success; thus, the relationship remains blurred. Also, it is hard to come by any rich literature that directly investigates the role of EO on the relationship between Technology and OI Success. Specifically, the impact of Technology on OI Success is expected to depend on a firm's EO.

The purpose of this paper is to investigate the moderating role of EO on the relationship between Technology and OI Success amongst MEs in Kenya. Overall, the paper advances technology entrepreneurship anchored on the resource-based view (RBV) theory.

## 2 Literature Review

### 2.1 Technology

Technology refers to the basic components, as well as to all knowledge relevant for assessing the information technology infrastructure, for describing system features, and for examining the relationship between the capabilities of the existing infrastructure and the demands of a proposed system (Bassellier, Reich, & Benbassat, 2001). Bassellier et al (2001) also state that knowledge of current and emerging technologies is generic to all industries and organisations. Some critical technologies such as database management systems, computer networks, computer programming, computer secu-

rity, operating systems, distributed systems, computer organisation and architecture, and multimedia systems should be given much attention.

Zanchiri et al (2019) observe that nowadays, business development practices have dissolved the walls of separation between internal organisational environments and external influence; thus there is a diversified source of innovation imperatives to include the input of external technological know-how and processes. “External technology acquisition and external technology exploitation are considered as the principal parts of OI processes” (Zanchiri et al, 2019, p. 328). Holgersson and Granstrand (2017) hold that the ability of a firm to commercialize inbound technology is determined by the firm’s own technology base, which is its technological capability (or its technological competence asset). Dodgson, Gann and Salter (2006) observed that “a suite of new technologies for data mining, simulation, prototyping and visual representation, dubbed ‘innovation technology’, help to support open innovation” (p. 333).

The findings of Tajudeen et al’s (2019) study revealed a significant relationship between external technology exploitation, technology scouting through social media, and digitalization vision with innovation performance, and innovation performance is in turn positively related with firm performance. However, they observed that in the Malaysia context, external technology acquisition does not have a significant relationship with innovation performance.

The imiplication of the positive relationship is that managers of firms should keep informed about their technology portfolio or current assets and should be aware of their competitor’s use of technology (Holgersson & Granstrand, 2017). Even if an organisation obtains competitive advantage without appplying emerging technologies, knowledge about the next generation of technology may increase the level of competence of a manager. An outward-looking perspective of how competitors engage technology to seek competitive advantage in the economic playground provides important insight for a firm’s positional iterative realignment efforts.

### 2.2 Entrepreneurial Orientation Concept

The extent to which a firm is entrepreneurial is its entrepreneurial orientation, which should be seen as a process reflected in recurring organisational behaviour (Covin & Slevin, 1991) rather than the actions of specific individuals possessing certain attributes or characteristics. There is widespread agreement amongst researchers that entrepreneurial orientation has three core dimensions: innovativeness, proactiveness and risk-taking (Kroon, Voorde, & Timmers, 2013; Hughes & Morgan, 2007; Miller, 1983).

Innovativeness is a firm’s ability and willingness to support creativity, new ideas and experimentation which may result in new products/services (Lumpkin & Dess, 1996), while proactiveness is the pursuit of opportunities and competitive rivalry in anticipation of future demand to create change and shape the business environment (Lumpkin & Dess, 2001). Relating to risk-taking, it is the firm knowingly devoting resources to projects with chance of high returns, but may also entail a possibityof high failure (Lumpkin & Dess,

1996). However, risk-taking is also commonly associated with entrepreneurial behaviour. Generally, successful entrepreneurs are risk-takers. Miller (1983) argued that these three components of EO comprised a basic unidimensional strategic orientation.

### 2.3 Technological Entrepreneurship Concept

Technologies create value when they are transformed into new products, the new products rapidly introduced to the market, and extra profits for enterprises, appropriate returns for investors, rewards for inventors and ultimately benefits for the whole society are generated (Petti & Zhang, 2011). Thus, technological entrepreneurship is the transformation of promising technologies into value. More specifically, technological entrepreneurship consists of a set of behaviours and actions that drive the market process (and also a strategy) which is based on identifying high potential, technology-intensive commercial opportunities, gathering/assembling resources and managing rapid growth and significant risk with the final aim to exploit those opportunities for value creation (Cefis & Circcarelli, 2005).

In this regard, technological entrepreneurship concept is made of an entrepreneurial component, i.e., the enterprise's capabilities to recognize technologies' entrepreneurial and business opportunities, and a management component, i.e., the enterprise's capabilities to develop compelling value propositions and business models made to exploit those opportunities. These two capabilities make technological entrepreneurship capabilities, i.e., the capabilities to identify and exploit technological opportunities to create new or significantly improved products and to successfully commercialize them. There is also an environmental component to consider, i.e., the availability and the qualities of external institutions and resources that set the appropriate condition for technological opportunities to be discovered and exploited profitably (Petti & Zhang, 2011).

### 2.4 Open Innovation Success amongst Medium Enterprises (MEs)

Many medium enterprises face several constraints in differentiating their products and changing their business model, and thus a major liability is that MEs lack sufficient internal financial resources and technical capabilities (Vanhaverbeke, Venmeersch, & de Zutter, 2012). Therefore, MEs must collaborate with external partners so as to innovate successfully, to develop new sources of income, and to reach more profitable positions in the competitive landscape.

Available research shows that only a small fraction of MEs is responsible for the majority of innovative new product development, R&D, export and employment and wealth creation (Nesta, 2009). Moreover, amongst such innovative firms, only a small proportion have the desire, capacity and opportunity to actively and successfully pursue growth, expansion and diversification beyond their local boundaries (Wynarczyk, Piperopoulos, &

McAdam, 2013). Consequently, Vanhaverbeke et al (2012) opine that OI is a logical step for many MEs to take.

Open innovation is the use of purposive inflows and outflows of knowledge to accelerate innovation and to expand the markets for external use of innovation, respectively (Chesbrough, Vanhaverbeke, & West, 2006), and describes a cognitive framework for a firm's strategy to profit from innovation. Most research on OI differentiates bewteen two concepts of OI, i.e., inbound and outbound. Inbound is where new ideas flow into an organisation and outbound is where internally developed technologies and ideas can be acquired by external organisations with business models that are better suited to commercialise a given technolgy or idea (Chesbrough, 2003).

The use of OI has a number of benefits: faster time to market for products, access to unique knowledge external to the firm, reduced cost of innovation, better adaptation of poducts and services to customer needs, commercial utilisation of knowledge or technology that otherwise would have been wasted, shared risk in product and service development, and enhanced company image and reputation (Wallin & von Krogh, 2010). That said, OI scholars also agree that external sourcing of knowledge does not replace in-house R&D and highlight the importance of 'absorptive capacity', which allows firms to identify, absorb and make use of external knowledgge (Dodgson, Gann, & Salter, 2006; Zanchiri, Jalilian, & Mehrjardi, 2019). Also, availability of financial support is desirable so that firms in pursuit of OI can finance the requisite budgetary requirements, and an ownership structure that is supportive of pervasive knowledge transactions is an important factor that operates in the background and feeds the undercurrents on which OI initiatives ride.

#### *2.4.1 Absorptive Capacity*

Absorptive capacity – the ability to recognize the value of new, external information, assimilate it, and apply it – has been recognized as an important factor catalyzing OI adoption (Zahra & George, 2002; Zanchiri, Jalilian, & Mehrjardi, 2019). Ul Hameed, Basheer, Iqbal, Anwar and Ahmad (2018) showed that knowledge from a firm's environment has to be combined with internal innovation mechanisms in order to produce OI Success. Yet according to Newy (2010), different types of absorptive capacity may be required for inbound versus outbound OI. Similarity between partner firms' knowledge and knowledge processsing systems is also critical for them to learn from each other and take advantage of the collaboration (Holgersson & Granstrand, 2017).

#### *2.4.2 Availability of Financial Support*

As technologies become more complex and sophisticated, firms need more resources including financial resources and human resources, to develop and improve them (Gnyawali & Park, 2009). Prochnik and Dias (2005) argue that economic cost and the lack of finance are among the most seriours obstacles to innovation among small and medium enterprises. The availability of financial support will facilitate provision of required resources needed for partners to share upon collaboration.

#### *2.4.3 Ownership Structure*

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Frenz and Grazia (2007) posit that there is a significant positive relationship between multi-nationality and performance, and that superiour innovation performance is associated with predominant international linkages within the value chain. International interaction has become paramount for enterprises that want to stay at the cutting edge of innovation. Ebersberger, Herstad and Lehtoranta (2011) explain that employees of multi-national companies are exposed to richer knowldedge flows and broader social networks than their conterparts in uni-national firms. They consequently conclude that operationg in more than one country and/or inflow of employees with multinational backgrounds has a positive impact on innovation performance and success.

### *2.5 Technology and Entrepreneurial Orientation (EO)*

Among the various roles it plays, technonolgical know-how improves communication, information and knowledge sharing, inter-organisational exchange and processes of organisational learning, which underpin the innovation process (Kmieciak, Michna, & Meczynska, 2012). Furthermore, the use of technology in new product design and development process is expected to shorten the development cycle, reduce development cost, increase the number of alternative designs, and improve prodcut design quality (Carbonara, 2005). Finally, customers may be a source of innovative ideas and provide valuable comments on products and services. To achieve this, technological literacy comes is quite handy.

### *2.6 Technology and Open Innovation Success*

In OI, the strategy that expands sharing information and using the resource from supplier to customer for the innovation is highly required. Consequently, the use of technological knowledge and competencies is *sine qua non* for the promotion of OI (Idota, Bunno, & Tsuji, 2010). Indeed, the use of cheap and instant information flows facilitated with information technology places even more emphasis on the linkages and relationships of firms and makes it easier to practice OI (Osdemir, Trott, & Hoecht, 2007).

Technology is a tool that improves the productivity of firms and achieves innovation activities (Idota *et al,* 2010). In other words, technology is viewed as an effective tool for innovation (Dodgson, Gann, & Salter, 2006). Therefore, information technologies are useful for supporting OI.

In this regard, the following hypothesis is made:

**$H_1$:** Technology influences OI Success in Medium Enterprises in Kenya.

### *2.7The Moderating Role of EO on Technology and OI*

According to Joseph Schumpeter's analysis of the great depression (Schumpeter, 1934), the most effective strategy for surviving a major economic downturn is for organizations to exhibit an entrepreneurial orientation (Chaston & Scott, 2012). Subsequently, Drucker (1985) posited that post-war business survival rates were likely to be highest among firms which engaged in innovation. Other studies have also concluded that innovation will assist firms to emerge from an economic downturn in a much stronger position than their competitors who choose to cut costs or improve internal efficiencies (Ghemawar, 1993).

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Most organizations traditionally seek to retain ownership of proprietary knowledge by using a "closed approach" to innovation (Cooper & Kleinschmidt, 1995). Chesbrough (2003), who coined the phrase "open innovation", posited that firms in the 21st centrury are more likely to be successful by entering into collaborative relationships with other organisations when seeking to exploit innovation. This is because OI provides access to new knowledge, permitting the evolution of new strategies which are more appropriate for responding to turbulent conditions that exist in world markets (Chesbrough, 2007). Indeed, Chesbrough (2003) proved through individual case studies that EO promoted OI of firms, and that it had a moderating effect of connecting it with the firms' performance. Hung and Chiang (2010) confirmed that EO moderated the relatioship between the OI of the firms and their performance.

Open innovation, however, comes with its own unique set of isues and challenges. Business leaders must eventually depart from those processes, reward systems and cultural attributes that were once viewed as desirable but which, in reality, work against the very idea of OI (Sloane, 2011). In other words, only when company leaders convert the existing procedure of company management, compensation system or the cultural factors through EO to be suitable for OI, can the OI of the firms be connected to their performance.

Therefore, the following hypothesis is postulated:

**$H_2$:** EO moderates the relationship between Technology and Open Innovation Success.

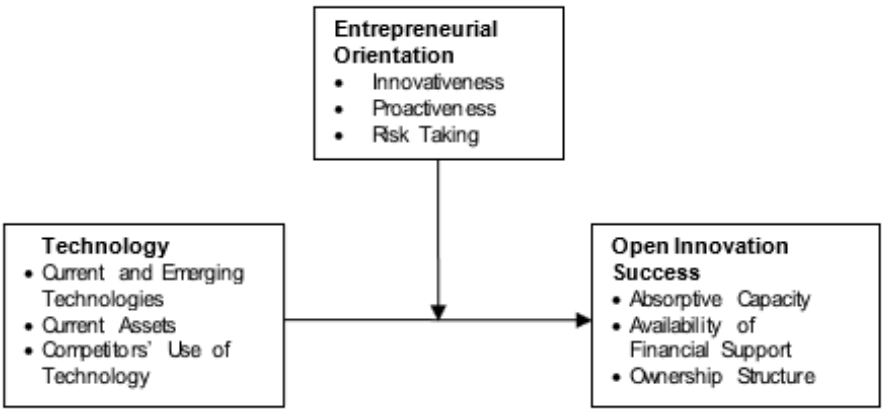


Figure 1: Conceptual Model

## 3 Research Methodology

The study employed a cross-sectional survey; a cross-sectional technique enhances generalizability of findings. Researchers used the list of firms in the Klynveld Peat Marwick Goerdeler (KPMG) 2017 Top 100 Survey of Kenyan service and manufacturing firms in the ME sector. Focus on the top 100 firms was motivated by the interest to examine how the technological capacity of firms at the ME economic frontline engenders their open-mindedness

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and vibrancy. A total of 68 firms were identified and contacted. After piloting, primary quantitative data were collected by means of a structured self-administered questionnaire and personal interviews with top management of the ME firms. Top management was targeted as respondents because firm officials in this position have the most knowledge regarding the firms' strategic orientation. Where respondents were interviewed, all the interviews were carried out by the researchers in person.

Data collection was carried out from October 2018 to March 2021. At the end of data collection, 32 questionnaires were returned, constituting an effective response rate of 47%. The low response rate was attributable to hesitance of the respondents to proffer the requested data, especially as the data collection process ran into the period of Covid-19 pandemic access restrictions. For the purposes of this study, such a response rate is considered acceptable (Baruch, 1999).

The primary quantitative data obtained were subjected to analysis through structural equation modelling by using correlation and partial least squares path modelling technique as suggested by Hair, Hult, Ringle and Sarstedt (2017). The software used to perform analysis were SPSS Version 23 and Smart PLS 3 developed by Ringle, Wende and Becker (2015). Data analysis included interrogation of the proffered data to ensure compliance with the necessary assumptions of reliability, correlation, common method bias, outliers, normality and homoscedasticity.

The Technology construct had a stable factor structure composed of the dimensions current and emerging technologies, current assets, and competitors' use of technology. As Table 1 shows, construct validity for the Technology sub-construct, and also its dimensions, were demonstrated.

**Table 1**: Confirmatory Factor Analysis, Construct validity for Technology

| Construct/ Sub construct | Factor loadings | | AVE | SMC | KMO | Bartlett's Statistics |
|---|---|---|---|---|---|---|
| | Initial | Retained | | | | |
| **TECHNOLOGY** | 0.783 | 0.783 | 0.845 | 0.669 | 0.672 | Chi sq. = 28.121 Sig. = 0.000 |
| Current Emerging technologies | 0.731 | 0.731 | 0.630 | 0.553 | 0.533 | Chi sq. = 9.824 Sig. = 0.045 |
| Current Assets | 0.876 | 0.876 | 0.707 | 0.691 | 0.598 | Chi sq. = 25.264 Sig. = 0.000 |
| Competitor's use of technology | 0.714 | 0.714 | 0.758 | 0.691 | 0.641 | Chi sq. = 37.163 Sig. = 0.000 |

The outcome variable was OI Success, which was decomposed into three sub-variables, viz absorptive capacity, financial support and ownership structure. Table 2 shows compliance with the construct validity thresholds for OI Success and its dimensions.

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**Table 2**: Confirmatory factor Analysis, Construct validity for OI Success

| Construct/ Sub construct | Factor loadings: Initial | Factor loadings: Retained | AVE | SMC | KMO | Bartlett's Statistics |
|---|---|---|---|---|---|---|
| **OI SUCCESS** | 0.69 | 0.810 | 0.810 | 0.608 | 0.500 | Chi sq. = 2.807<br>Sig. = 0.094 |
| Absorptive Capacity | 0.891 | 0.891 | 0.916 | 0.218 | 0.803 | Chi sq. = 108.97<br>Sig. = 0.000 |
| Financial Support | 0.871 | 0.871 | 0.709 | 0.312 | 0.658 | Chi sq. = 82.967<br>Sig. = 0.000 |
| Ownership Structure | 0.88 | 0.88 | 0.844 | 0.312 | 0.634 | Chi sq. = 97.822<br>Sig. = 0.000 |

Entrepreneurial Orientation was the moderating variable, and it was decomposed into its three dimensions of innovativeness, proactiveness and risk taking. Its factor structure is shown in Table 3; the table also demonstrates fulfilment of the construct validity requirements for EO and its dimensions.

**Table 3**: Confirmatory factor Analysis, Construct Validity for Entrepreneurial Orientation

| Construct/ Sub construct | Factor loadings: Initial | Factor loadings: Retained | AVE | SMC | KMO | Bartlett's Statistics |
|---|---|---|---|---|---|---|
| **ENTREPRENEURIAL ORIENTATION** | 0.851 | 0.851 | 0.769 | 0.778 | 0.594 | Chi sq.= 15.31<br>Sig. = 0.002 |
| Innovativeness | 0.735 | 0.735 | 0.723 | 0.601 | 0.694 | Chi sq. = 18.022<br>Sig. = 0.000 |
| Proactiveness | 0.805 | 0.805 | 0.804 | 0.601 | 0.463 | Chi sq. = 30.034<br>Sig. = 0.000 |
| Risk Taking | 0.907 | 0.907 | 0.925 | 0.302 | 0.745 | Chi sq. = 59.427<br>Sig. = 0.000 |

The validity of the study is strengthened by controlling the variables in the model: firm size and age. Firm size, which is a control variable, was measured by the number of employees, which is one of the most common measures (Kimberley, 1976). The other control variable, firm age, was measured by the number of years passed since the firm's foundation (Da Rocha et al, 1998). To control common method bias (CMB), due diligence was exercised during the study design and data collection phase. Specifically, the study questionnaire was carefully interrogated by experts and pilot respondents; the feedback obtained was used to improve its structure and content so that it could be totally self-administered with minimal, if any, CMB effects.

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## 4 Results and Discussion

The results of the empirical analysis are presented in this section. The study hypothesized that Technology influences OI Success (H1), and that EO moderates the relationship between Technology and OI success (H2).

H1: Technology influences OI success in Medium Enterprises in Kenya.

H2: EO moderates the relationship between Technology and OI success in Medium Enterprises in Kenya.

Table 4 shows the MMR model coefficients for the relationship between Technology and OI Success. The results indicate that Model 1, relating Technology and OI Success, showed a positive relationship that was significant (p<.001), thus indicating that Technology influences OI Success in MEs in Kenya.

**Table 4**: MMR Model Coefficients for Technology and Open Innovation Success

| | | Un-standardized Coefficients | | Standardized Coefficients | | |
|---|---|---|---|---|---|---|
| **Model** | | **B** | **Std. Error** | **Beta** | **t** | **Sig.** |
| 1 | (Constant) | .000 | .148 | | .000 | 1.000 |
| | X1_ Technology | .608 | .150 | .608 | 4.049 | .000 |
| 2 | (Constant) | .000 | .150 | | .000 | 1.000 |
| | X1_ Technology | .668 | .205 | .668 | 3.258 | .003 |
| | Z_EO | -.090 | .205 | -.090 | -.437 | .665 |
| 3 | (Constant) | .099 | .173 | | .576 | .570 |
| | X1_ Technology | .721 | .209 | .721 | 3.447 | .002 |
| | Z_EO | -.103 | .204 | -.103 | -.507 | .617 |
| | X1Z | -.154 | .135 | -.178 | -1.138 | .266 |

In addition to proving the relationship between Technology and OI Success, Table 5 shows the model change statistics for these variables. It indicates that each unit change in Technology results in a 36.9% change in OI Success (p<0.001).

**Table 5**: MMR Model Summary Statistics for Technology and Open Innovation Success

| **Model** | **R** | **R Square** | **Adjusted R Square** | **Std. Error of the Estimate** | **R Square Change** | **F Change** | **df1** | **df2** | **Sig. F Change** |
|---|---|---|---|---|---|---|---|---|---|
| 1 | .608a | .369 | .347 | .808 | .369 | 16.392 | 1 | 28 | .000 |
| 2 | .611b | .374 | .327 | .820 | .004 | .191 | 1 | 27 | .665 |
| 3 | .635c | .403 | .335 | .816 | .030 | 1.294 | 1 | 26 | .266 |

This finding agrees with Dodgson, Gann and Salter (2006) who found that technological changes facilitate OI strategies; specifically, "information and communications technologies enable the exchange of distributed sources of information in the open innovation process" (Dodgson, Gann & Salter, 2006 p. 333). It is advisable for companies to scout for and acquire external technology through identification and absorption of capabilities located outside an organization (Zanchiri *et al,* 2019). In the modern era, the greater ability of an organization to enhance service to their clients is not located in its internal R&D activities, but in the wider business ecosystem.

Likewise, in a study conducted to evaluate the effects of factors affecting the fulfilment of OI in companies based in science and technology parks in Yazd in Iran, Zanchiri *et al* (2019) showed that external technology acquisition and exploitation, and an innovative firm culture had positive effects on OI, which in turn positively impacted on organizational performance and value creation. A study to establish the relationship between technology transfer as part of OI process on organizational innovation confirmed a positive relationship between technology transfer and organizational innovation (Sajpazidu-Wojcicka, 2020). The implication in the light of these findings is that technology makes an important contribution towards creating an organizational platform for OI, which manifests in willingness to make use of information obtained from stakeholders and the environment to improve the operational performance of an organization.

Results of the moderation effect of EO on Technology-OI Success relationship can be observed in both Table 4 and Table 5. For example, Model 2 in Table 4 shows that when Technology and EO were each entered as an independent variable, so that the two variables could jointly predict OI Success; the operation returned a finding that was not significant (Sig=.665). Likewise, Model 3 (Table 4) shows that when Technology and EO were entered along with their interaction effect (X1Z) before predicting OI Success, the result again was not significant (Sig=.266). Therefore, the findings do not support the hypothesis that EO moderates the relationship between Technology and OI Success; thus, the hypothesis was rejected. This implies that the study was not able to establish a moderating effect of EO on the relationship between Technology and OI Success.

This finding compares agreeably with Ndung'u, *et. al* (2017). While they observed a link between technology competence aspect and performance of medium-sized firms, they could not establish the moderating effect of EO on the relationship. However, they insightfully observed that the lack of EO moderation happens when technology competence is taken alone, but the moderation effect becomes effective when technology competence is synergized with other technical factors. It seems that it is needful to identify the factors necessary to be combined with technology so that the enabling function of a firm's EO can be exploited to enhance OI Success.

## 5 Summary

The study sought to determine the influence of Technology on OI Success, and whether EO moderates this relationship. The objective regarding the influence of Technology on OI Success related to current and emerging

technologies, current assets, and competitors' use of technology. The study found that Technology influences OI Success. With respect to current and emerging technologies, the findings showed that during the period under study, the organizational culture of the firms enabled them to interact intensively and extensively with their stakeholders to facilitate inbound and outbound information flow for exploitation of the potential in current and emerging technologies.

The unique combination of assets originating from R&D activities enabled the firms to develop fast-moving products and services, and this attracted firms with similar offerings to benchmark with them. This was further evidenced through competitors' attempts to mimic their organizational design to update and maintain their own competitiveness. The implication in the light of these findings is that Technology makes an important contribution towards creating an organizational platform for OI, which manifests in willingness to make use of information obtained from stakeholders and the environment to improve the operational performance of an organization.

The study also tested whether EO moderates the influence of Technology on OI Success. It was not able to establish any such moderating effect.

## 6 Conclusion

The study established that Technology has an influence on OI Success, as it is instrumental in generating OI Success. It is therefore important to strategically apply technology as an important factor that can help MEs to exploit opportunities for enabling them to benefit from knowledge transactions. According to the findings, technology foments an appropriate organizational culture and a unique combination of assets borne of R&D activities; the culture and assets combination facilitate a comprehensive interaction with environmental players to enable firms to exploit the resources availed by an OI platform. Firms develop a give-and-take relationship in the platform; this then generates an expanded opportunity space so that all environmental players can tap into the opportunities which correspond to their unique organizational asset configurations.

One significant conclusion from this and extant studies is that different factors influence open innovation success. Such a conclusion has theoretical, methodological as well as practical implications. Theories must consider how the same factors will often not be important for open innovation success. From a research view, this implies that it is important to separate different approaches of enhancing open innovation success to better understand the relationships of firm and inter-firm factors. In practice, this conclusion implies that the leadership style of medium sized firms in Kenya must adjust their technological strategies to generate entrepreneurial intensity with the desired type of firm culture.

## 7 Recommendations

In the light of these findings, the study makes the following recommendations. Firms should use their technology endowments as a reference point to reconfigure their organizational culture; this will enable them to operationalize a strategy for beneficial engagement with various stakeholders in the business environment, so that they can tap into knowledge and other resources embedded in this environment. This will raise their appropriation of OI practices. Thus, they should ensure timely technological upgrades considering the modern technological advancements, and then fitting their organizational culture to harness the advancements.

## 8 Limitations and Future Research

This study used a cross-sectional research design and a relatively small sample from one country. These limitations can affect the generalizability of the findings since only the Top 100 medium-sized firms were considered in both manufacturing and service sectors. While this study included firms in both sectors, future studies might consider a longitudinal approach comprising different sub-sectors in only one sector. Also, it will also be insightful to identify the factors necessary to be combined with the Technology factor so that the moderating role of a firm's EO can be exploited to enhance OI Success, as this understanding harbours pointers for wiser investment and strategic employment of a firm's asset configurations.

## 9 Acknowledgment

The researchers of this study are indebted to the National Research Fund for the finances provided to fund this research through the National Council for Science, Technology and Innovation (NACOSTI) Kenya. No funds were received from any other organization.

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## 11 References

Adamides, E., & Karacapilidis, N. (2017). Information Technology for Supporting the Development and Maintenance of Open Innovation Capabilities. *Journal of Innovation & Knowledge*, 1-10. doi:doi.org/10.1016/j.jik.2018.07.001.

Baruch, Y. (1999). Response Rate in Academic Studies - A Comparative Analysis. *Human Relations, 52*(4), 421-438. doi.org/10.1177/001872679905200401.

Bigliardi, B., Ferraro, G., & Filippelli, S. (2020). The Influence of Open Innovation on Firm Performance. *International Journal of Engineering Business Management, 12*, 1-14. doi:0.1177/1847979020969545.

Buhler, P. A., & Vidal, J. M. (2005). Towards Adaptive Workflow Enactment Using Multi-agent Systems. *Information Tecchnology and Management, 6*(1), 61-87. DOI:10.1007/s10799-004-7775-2.

Carbonara, N. (2005). Information and Communication Technology and Geographical Clusters, Opportunities and Spread. *Technovation, 25*(3), 213-222. DOI:10.1016/S0166-4972(03)00095-6.

Cefis, E., & Circcarelli, M. (2005). Profit Differentials and Innovation. *Economics of Innovation and New Technology, 14*(5), 43-61. DOI:10.1080/1043859042000232160.

Charmjuree, T., Badir, Y. F., & Safdar, U. (2021). External Technology Acquisition, Exploitation and Process Innovation Performance in Emerging

Market Small and Medium Sized Enterprises: The Moderating Role of Organizational Slack. *European Journal of Innovation Management, 25*(2). doi.org/10.1108/EJIM-07-2020-0263.

Chaston, I., & Scott, G. J. (2012). Entrepreneurship and Open Innovation in an Emerging Economy. *Management Decision, 50*(7), 1161-1177. doi.org/10.1108/00251741211246941.

Chesbrough, H. W. (2003). *Open Innvation: The New Imperative for Creating and Profiting from Technology.* Boston, MA: Havard Business School Press.

Chesbrough, H. W. (2007). Why Companies Should Have Open Business Models. *Sloan Management Review, 48*(2), 22-28.

Chesbrough, H. W., Vanhaverbeke, W., & West, J. (2006). *Open Innovation: Researching a New Paradigm.* Oxford: Oxford University Press.

Cooper, R. G., & Kleinschmidt, E. J. (1995). Benchmarking the Firm's Critical Success Factors in New Product Development. *Journal of Product Innovation Management, 12*(5), 374-391. doi.org/10.1111/1540-5885.1250374.

Covin, J. G., & Slevin, D. P. (1991). A Conceptual Modelof Entrepreneurship as Firm Behaviour. *Entrepreneurship Theory and Practice, 16*(1), 7-25.

da Rocha, A., Christensen, C. H., & Eduardo da Cuncha, C. (1990). Aggressive and Passive Exporters: A Study in Brazillian Furniture Industry. *International Marketing Review, 7*(5). Retrieved from https://doi.org/10.1108/EUM0000000001531.

Desouza, K. C., Awazu, Y., Jha, S., Dombrowski, C., Papagari, S., Baloh, P., & Kim, J. Y. (2008). Customer-driven Innovation. *Research Technology Management, 51*(3), 35-44. DOI:10.1080/08956308.2008.11657503.

Dodgson, M., Gann, D., & Salter, A. (2006). The Role of Technology in the Shift towards Open Innovation: the Case of Proctor and Gamble. *R&D Management, 36*(3), 333-346. doi.org/10.1111/j.1467-9310.2006.00429.x

Drucker, P. F. (1985). *Innovation and Entrepreneurship: Practice and Principles.* New York, NY: Harper & Row.

Ebersberger, B., Herstad, S., & Lehtoranta, O. (2011). Bridging the Global and the Local? Multinational Enterprises, Labour Market Mobility and Localised Learing. *ICSB 2011 World Conference.*

Fiala, P. (2005). Information Sharing in Supply Chains. *Omega, 33*(5), 419-24. https://doi.org/10.1016/j.omega.2004.07.006.

Frenz, M., & Grazia, I. (2007). Does Nationality Affect the Propensity to Be Innovative? An Analysis of the Third Community Innovation Survey. *International Review of Applied Economics, 2*(1), 99-117. DOI: 10.1080/02692170601035033.

Ghemawar, P. (1993). The Risk of Not Investing in a Recession. *Sloan Management Review, 34*(2), 51-59.

Gnyawali, D. R., & Park, B. R. (2009). Competition and Technological Innovation in Small and Medium-sized Enterprises: A Multi-level Conceptual Model. *Journal of Small Business Management, 47*(3), 331-347. doi.org/10.1111/j.1540-627X.2009.00273.x

Gunasekaran, A., & Ngai, E. W. (2004). Information Systems in Supply Chain Integration and Management. *European Journal of Operational Research, 159*(2), 269-95. doi:10.1016/j.ejor.2003.08.016.

Hair, J. F., Sarstedt, M., Ringle, C. M., & Gudergan, S. P. (2018). *Advanced Issues in Partial Least Squares Structrural Equation Modeling (PLS-SEM).* Sage.

Heunks, F. J. (1998). Innovation, Creativity and Success. *Small Business Economics, 10*, 263-272. Retrieved from http://dx.doi.org/10.1023/A:1007968217565.

Holgersson, M., & Granstrand, O. (2017). Patenting Motives, Technology Strategies, and Open Innovation. *Management Decision, Vol. 55*(No. 6), 1265-1284. doi.org/10.1108/MD-04-2016-0233.

Hughes, M., & Morgan, R. E. (2007). Deconstructing the Relationship between Entrepreneurial Orientation and Business Performance at the Embryonic Stage of Firm Growth. *Industrial Marketing Management, 36*, 651–661. doi:10.1016/j.indmarman.2006.04.003.

Hung, K.-P., & Chiang, Y. H. (2010). Open Innovation Proclivity, Entrepreneurial Orientation, and Perceived Firm Performance. *International Journal of Technology and Management, 52*, 257-274. DOI:10.1504/IJTM.2010.035976.

Idota, H., Bunno, T., & Tsuji, M. (2010). Open Innovation Success Factors by ICT Use in Japanese Firms. *21st European Regional ITS Conference.* Copenhagen 13 - 15 September 2010. http://hdl.handle.net/10419/44335.

Jensen, J. I., & Randoy, T. (2002). Factors that Promote Innovatio in Shipping Companies. *An International Journal of Shipping and Port Research, Vol. 29*(No. 2). doi.org/10.1080/03088830110078346.

Jensen, J. I., & Randoy, T. (2006). The Performance Effect of Innovation in Shipping Companies. *An International Journal of Shipping and Port Research, Vol. 33*(No. 4), 327-343. doi.org/10.1080/03088830600895485.

Kimberly, J. R. (1976). Organizational Size and the Structuralist Perspective: A Review, Critique and Proposal. *Administrative Science Quarterly, 21*, 571-597. https://doi.org/10.2307/2391717.

Kmieciak, R., Michna, A., & Meczynska, A. (2012). Innovativeness, Employment and IT Capability: Evidence from SMEs. *Industrial Management and Data Systems, 112*(5), 707-728. https://doi.org/10.1108/02635571211232280.

Kroon, B., Voorde, K., & Timmers, J. (2013). High Performance Work Practices in small Firms: A Resource-poverty and Strategic Decision-making Perspective. *Small Business Economics, 41*(7), 71-91. DOI: 10.1007/s11187-012-9425-0.

Liao, S., Fu, L. and Liu, Z. (2020). Investigating Open Innovation Strategies and Firm performance: The Moderating Role of Technological Capability and Market Information Management Capability. *J Bus Ind Mark, 35*(1), 23-39. doi.org/10.1108/JBIM-01-2018-0051.

Lichtenthaler, U. (2008). Opening up Strategic Technology Planning: Extended Roadmaps and Functional Markets. *Management Decisions, 46*(1), 77–91. doi:10.1108/00251740810846752

Lumpkin, G. T., & Dess, G. G. (2001). Linking Two Dimensions of Entrepreneurial Orientation to firm Performance: The Moderating Role of Environment and Industry Life Cycle. *Journal of Business Ventures, 16*(3), 429-451. doi.org/10.1016/S0883-9026(00)00048-3

Lumpkin, G., & Dess, G. G. (1996). Clarifying the Entrepreneurial Orientation Construct and Linking it to Performance. *Academy of Management Review, 21*(1), 135-172. doi:10.2307/258632

Miller, D. (1983). The Correlates of Entrepreneurship in Three Types of Firms. *Management Science, 29*(7), 770-791. doi:10.1287/mnsc.29.7.770

Nesta. (2009, Nov). *The Vital 6 per cent: How High-growth Innovative Businesses Generate Prosperity and Jobs.* Retrieved from www.nesta.org.uk/library/documents/Vital-six-per-cent-Nov2010-v3.pdf.

Newy, L. (2010). Wearing Different Hats: How Absorptive Capacity Differs in Open Innovation. *International Journal of Innovation Management, 14*(4), 703-725. doi.org/10.1142/S1363919610002830

Osdemir, S., Trott, P., & Hoecht, A. (2007). New Service Development: Insights from an Explorative Study into the Turkish Retail Banking Sector. *Innovation, Management, Policy and Practice, 9*(3/4), 276-291. doi.org/10.5172/impp.2007.9.3-4.276

Petti, C., & Zhang, S. (2011). Factors Influencing Technological Entrepreneurship Capabilities: Towards an Integrated Research Framework for Chinses Enterprises. *Journal of Technology Management in China, 6*(1), 7-25. doi.org/10.1108/17468771111105631

Prochnik, V., & Dias, A. R. (2005). *Analyzing the Low Degree of Innovation in Brazillian Industry by Studying the Least Innovative Firms.* Retrieved from http://ssrn.com/abstract=1094305

Ringle, C. M., Wende, S., & Becker, J.-M. (2015). *SmartPLS .* Retrieved March 24th, 2017, from "SmartPLS 3." Boenningstedt: SmartPLS GmbH: http://www.smartpls.com

Sajpazidu-Wojcicka, K. (2020). Open Innovation Process via Technology Transfer and Organisational Innovation. *European Research Studies Journal, XXIII*(1), 52-61. DOI:10.35808/ersj/1535

Schumpeter, J. A. (1934). The Theory of Economic Development: An Inquiry into Profits, Capital, Credit, Interest and the Business Cycle. *Harvard Economic Studies, Vol. 46*.

Sloane, P. (2011). A Guide to Open Innovation and Crowdsourcing: Expert tips and advice. London: Material.

Tajudeen, F. P., Jaafar, N. I., & Sulaiman, A. (2019). External Technology Acquisition and External Technology Exploitation: The Difference of Open Innovation Effects. *JOItmC, 5*(4), 1-18. doi.org/10.3390/joitmc5040097

Thatcher, M. E., & Pingry, D. E. (2004). Understanding the Business Value of Information Technology Investments: Theoretical Evidence from Alternative Market and Cost Structures. *Journal of Management Information Systems, 21*(2), 61-85. doi.org/10.1080/07421222.2004.11045804

Vanhaverbeke, S., Venmeersch, I., & de Zutter, S. (2012). *Open Innovation in SMEs: How Can Small Companies and Start-ups Benefit*

*from Open Innovation Strategies?* Ghent, Belgium: Flandersdc. Retrieved from http://www.flandersdc.be

Wallin, M. W., & von Krogh, G. (2010). Organising for Open Innovation: Focus on the Integration of Knowledge. *Organisational Dynamics, 39*(2), 145-154. doi.org/10.1016/j.orgdyn.2010.01.010

Wynarczyk, P., Piperopoulos, P., & McAdam, M. (2013). Open Innovation in Small and Mediu Enterprises: An Overview. *International Small Business Journal, 31*(3), 240-255. doi.org/10.1177/0266242612472214

Zahra, S., & George, G. (2002). Adoptive Capacity: A Review, Reconceptualisation and Extension. *Academy Management Review, 27*(3), 332-352. doi.org/10.2307/4134351

Zanchiri, S. M., Jalilian, M., & Mehrjardi, M. S. (2019). Open innovation - From Technology Exploitation to Creation of Superior Performance. *Asia Pacific Journal of Innovation and Entrepreneurship, 13*(3), 326-340. DOI:10.1108/apjie-02-2019-0005