*International Journal of Business and Management Invention (IJBMI)*
*ISSN (Online): 2319-8028, ISSN (Print):2319-801X*
*www.ijbmi.org || Volume 11 Issue 5 Ser. II || May 2022 || PP 30-53*

# The Mediating Effect of Innovative Capability on the Relationship between Technology Innovation Adoption and Firm Performance in the Ghana's Manufacturing Industry

Abena Asor Boateng [1], Cai Li[2*]

1. *Masters Student, School of Management, Jiangsu University, Zhenjiang 212013, China.*
2. *Professor, School of Management, Jiangsu University, Zhenjiang 212013, China.*

***ABSTRACT:*** *The highly competitive and sophisticated nature of the manufacturing industry puts business owners on their toes to constantly roll out and implement innovative strategies to stay afloat and subsequently boost firm performance. Achieving superior firm performance through innovation is made more convenient thanks to technology. However, various factors come into play and must be considered if a firm must achieve firm performance through the adoption of innovative technology. This study therefore assessed the mediating role of innovative capability in the relationship between technology innovation adoption (relative advantage, financial resources, and top management support) and firm performance in Ghana's manufacturing industry. Data was collected from 325 managers in the various manufacturing firms included in this study. The Hayes process macro version 4 function in SPSS is then used to analyse and test the direct and indirect relationships hypothesized in the study. Results indicate that the factors of the TOE framework (relative advantage, financial resources, and top management support) have a positive impact on the innovative capability of Ghanaian manufacturing firms. Also, in the face of innovative capability, top management support and financial resources significantly improves firm performance in Ghana's manufacturing industry but relative advantage does not. However, innovative capability has a direct positive effect on firm performance. It is also found that innovative capability partially mediates the relationship between top management support and performance, as well as financial resource and firm performance. However, it fully mediates relative advantage and firm performance nexus. Management teams of global manufacturing firms are advised accordingly to pay a critical attention to assessing and improving their innovative capabilities.*

***KEY WORD****: Technology adoption, innovative capability, firm performance*

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Date of Submission: 13-05-2022 Date of Acceptance: 27-05-2022

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## I. Introduction

The ability of companies to develop and remain competitive greatly depends on critically and constantly thinking about industry problems and finding new ideas and technologically innovative solutions. Operating without technology and innovation position companies at the risk of losing their competitive positioning and even fold up (Ober, 2020). Twumasi-Baffour et al., (2018) explained that technology innovation is a primary source of economic growth and general morale booster for many firms to adopt technology innovation especially in developing countries like Ghana as it has a significant relationship with employment. The adoption of innovation has continually remained a topical issue over the years as a result of its tremendous contribution to socio-economic growth and development and competitiveness (Kuzior, Kwilinki, and Tkachenko, 2019). Adopting innovation in a more positive way by employees promotes cohesiveness in organizational culture and modus operandi thereby boosting level of trust by means of employee integration which as well translates into organizational growth (Caron-Fasan et al., 2020). In the same vein, Dost et al., (2020) re-emphasized that organizations are better placed to overcome performance challenges and capitalize on new opportunities both internally and externally when employees accept and adopt a new technology innovation.

From the point of view of sustainable development and the relationship between industry 4.0 and society 5.0, Ober (2020) considers the aforementioned aspects of innovation adoption as critically important. It is important for companies to treat issues surrounding innovation adoption (a well-researched with extensive but somewhat fragmented literature) with utmost priority as it determines how best to utilize strategies to survive in recessions and economic melt downs like the recent one meted out by COVID-19 to all industries the world over (Von Oorschot et al., 2018). Typically, innovations that are introduced at the organizational level has

instant effects on employment (Harrison et al., 2014): however, this considered in public discourse as pessimism birthed from fear that innovation and technology have the tendency to destroy jobs and leave many people unemployed even though many strategies and mechanisms of compensations have been propounded (Twumasi-Baffour et al.,2018). Harrison et al., (2014) suggests that, there is some considerable evidence to show on an average that firms that are highly innovative stand a relatively higher chance of survival compared with firms that do not adopt any forms of technology innovation even though they believed the relationship between innovation and employment is still quite unclear.

The U.S. census bureau (2012) explained that, the manufacturing industry "comprises establishments engaged in the mechanical, physical, or chemical transformation of materials, substances, or components into new products," as well as those engaged in "assembling of component parts of manufactured products" for purposes other than construction. Berman (2012) acknowledged that this is the era of digital manufacturing and described it as a disruptive technology. When manufacturers adopt and innovate technologies, they are likely to reap benefits like reduction of set up time and cost, flexibility of design, product optimization, reduced waste and better inventory taking (Ganesh et al., 2021; Shahrubudib, Lee, and Ramlan, 2019; Kamble, Gunasekaran, & Sharma, 2018).

After Ghana's independence from colonial rule in 1957, successive governments have put lots of policies, structures, frameworks, and institutions in place to help develop science and technology across all aspects of the economy including the manufacturing industry. One of such institutions is the national board of small-scale industries, the Ghana regional appropriate technology service, and the president's initiative among others. All these are geared towards developing science and technology acceptance and adoption. However, Afful and Owusu (2017) noted that irrespective of all these policies and institutions put in place by government, Ghana seems to be lagging in the adoption of technology and innovation in many of its industries.

Owusu-Mensah et al., (2020) stated that government gives a percent grant to top alcoholic beverage manufacturers like GIHOC distilleries to be able to apply more technologies and be innovative in their operations. Irrespective of this, technology and innovation adoption in the manufacturing industry of Ghana has not shown significant progress. Manufacturers in Ghana like Kasapreko distilleries, GTP (Ghana textiles printing), and Atona foods among others have received funding from the central government under the flagship one district one factory (1D1F) program to be able to operate to the highest level while leveraging technology and innovation. Even though this has resulted in some progress in Ghana's manufacturing industry, there are still challenges of inability to meet demand and logistics shortage among others. This study in light of this seeks to assess the effectiveness of technology and innovation adoption in the manufacturing industry of Ghana and its effect on firm performance in order to make the required scientific recommendations for improvement. Specifically, it examines the mediating effect of innovative capability of firms on the relationship between technology innovation adoption and firm performance, using empirical evidence from the manufacturing firms in Ghana.

The novelty of this study resides in the intuitive interplay of theoretical application of technology-organization-environment model (TOE), innovative capability assessment measures and firm performance, to assessing the effectiveness of advanced technology adoption in the manufacturing industry of a developing economy like Ghana. Technology innovation adoption and implementation research in developing countries especially in Africa is far-fetched. A few studies on technology and innovation implementation in the manufacturing industry in Africa tend to focus on exploring the various technologies deployed in the industry over the years and its impact on growth (Abdu & Jibir, 2018; Bogliancino & Codagnone, 2019). A substantial number of studies have paid less attention to the critical mediating drivers of technology adoption effectiveness and firm performance.

The remaining part of the study report entails an empirical review of literature, formulation of hypothesis and design of conceptual model as presented in sections 2. Section three (3) presents the sampling methods, the measurement of variables in the study, mediation model formulation and data analysis methods. The results of the study are presented in section 4. The results are discussed along with general conclusion and recommendations in section 5. Finally, the limitation and future research implications are presented in section 6.

## II. Empirical Review of Literature and Hypothesis formulation

### 2.1. Variables of the study

#### *2.1.1 Technology innovation adoption*

Technology is considered as any form of physical device or information technology that is applied to improve the efficiency of human, machine and management processes by firms in the manufacturing industry in Ghana. Two primary components of technology are explained in Bozeman (2000) as physical component such as products, tools and equipment and the informational component such as management skills, marketing, production and quality control (Wahab et al., 2012). According to the Oslo Manual (2007), "an innovation is the implementation of a new or significantly improved product (good or service), or process, a new marketing

method, or a new organizational method in business practices, workplace organization or external relations". The nature of this implementation process involves the practical application and translation of information, imagination, invention, ideas or available resources into products and services that satisfy a particular need or create value at an economical cost for which people are willing to pay for (Mamasioulas et al., 2020). Adoption can be explained as the conscious act or process to accept and use something new or different. Innovation adoption therefore involves the generation, development and adaption of novel ideas that facilitates organizational processes (Ali & Soar, 2016).

Technology innovation adoption constitute the recognition, acceptance and use of new technological possibilities and mobilizing the requisite human resources to transform them into developing new products and services (Todorovic et al., 2022), new components of production processes (Schere, 2001) and for sustained competitiveness (Subrahmanya, 2011). A widely applied and empirically tested theory of technology innovation adoption (Oliveira & Martins, 2011), adopted for this study is the technology-organization-environment (TOE) framework. This theory was proposed by Tornatzky and Fleisher (1990) to describe factors that influence the likelihood of technology innovation adoption. This framework details the process firms go through to adopt and implement technological innovations: this process of deciding whether or not to adopt a technology innovation is determined according to the framework by three key areas namely, the technological context, the organizational context, and the environmental context (Tornatzky & Fleisher, 1990).

The technological context details the internal and external technologies (equipment and processes) that are important to firm growth. The organizational context holistically consists of features and resources of a company like its size, extent of centralization and formalization, structure of management, relationship among employees, and human resources among others. The third dimension, which is the environmental context, is mainly the industry size and structure, competitors, macroeconomic dynamics, and internal and external regulations. It must be emphatically stated that the elements of technology, organization, and environment comes with "both constraints an opportunity for technological innovation" (Tornatzy and Fleisher,1990): this by necessary implication suggests that these factors determine the relevance and urgency a firm attaches to adopting a new technology.

Within this theoretical context including other technology adoption models such as the Technology Acceptance Model (TAM), Innovation Diffusion Theory and the Theory of Planned Behavior (TPB), this study adopts three main factors that influence technology innovation adoption in the manufacturing Industry as it's independent variables: relative advantage, top management support and financial resource capacity. Greenhalgh et al. (2004) explained relative advantage as the level of social and economic gains expected to be derived from adopting a particular technology innovation over existing systems, as perceived by the organization. It is implicit that if top managers in the manufacturing industry do not perceive explicit advantages of proposed technologies over existing production processes, they are most likely not to adopt them. Top management support in the context of this study constitute the extent to which senior managers in various firms accept to adopt and deploy advanced technologies to management critical aspect of their organization. They commit to providing the requisite resources including technical expertise and infrastructure whiles overcoming any form of internal change resistance (Low et al., 2011). Thus, may drive the pace of technology adoption and organizational efficiency and performance (Alshamaila et al., 2013). Financial resources of an organization concerns the various means of funding their operational activities and strategic goals, which may include working capital, cash, debtors and creditors, shareholders' capital, investors, bank credit facilities and government financial incentives (Johnson et al., 2008). This study explores the available means by which firms in the manufacturing industry fund technological innovation adoption. Attention is paid to bank credit facilities, internal budgetary allocations, investors and government financial incentives.

### *2.1.2 Innovative capability of firms*

Innovation capability has been widely described as the ingenuity displayed by a firm to transform its available knowledge, skill and resources, into develop new products, management processes, services, and target and enter new markets towards enhanced customer service experience, optimized profitability and sustained competitive edge (Calik et al., 2017). This transformational ability of firms coupled with their novel developmental focus can lead to achieving organizational goals if the appropriate technologies are adopted (Rajapathirana & Hui, 2018). Other critical success factors of innovative capability include enhanced leadership skill, human resources management endowments, partnership and organizational capability (Dahlgaard-Park & Dahlgaard, 2010). Essentially, innovation measurement encapsulates the measurement of innovation capability, innovation output, and innovation performance (Vicente et al., 2015).

Innovative capability of selected firms in Ghana's manufacturing industry constitute the mediating variable in this study. Based on the measurements scale developed in Calik et al. (2017), the study adopts three sub-variables for assessing the innovation capability of firms to include product innovation capability, process innovation capability and market innovation capability. Product innovation capability in the context of this study

is understood as a firm's ability to design and develop new products and services that have improved features, specifications, materials and functional components relative to existing ones (Atalay et al., 2013), and as well improves quality and customers experience (Ferrari & Rocca, 2010). Process innovation capability refers to a firm's ability to deploy novel and improved production methods that significantly implies using advanced techniques, equipment, tools and machines to ensure enhanced products quality and optimal production cost reduction (Obeng & Boachie, 2018; Expósito & Sanchis-Llopis, 2019). Market innovation capability is explained in the contest of this study as a firm's ability to deploy novel marketing mix strategies to successfully target new products to new market segments and penetrating existing markets using existing products for enhanced sales performance and customer satisfaction (Ganzer et al., 2017). These marketing innovation strategies is reflected in the firm's product differentiation, promotion, pricing and distribution efficiency (Yusheng & Ibrahim, 2019).

### *2.1.3 Firm performance*

Firm performance has been described as the inherent ability of a firm to effectively and efficiently allocate and use available resources to satisfy target customers and achieve organizational goals (Taouab & Issor, 2019). Firm performance is usually assessed in four main dimensions including innovative performance, production performance, market performance and financial performance (YuSheng & Masud, 2020). In this study, firm performance constitute the dependent variable and it is measured from the operational and financial perspectives.

## 2.2. Relative advantage and innovative capability of firms

Salah, Yusof, and Mohamed (2021), explored the determining factors of CRM adoption in Palestinian SMEs with firm size as a moderator. The study adopted a quantitative approach to examine the relationships between compatibility, IT infrastructure, complexity, relative advantage, security, top management support, customer pressure, and competitive pressure as the main variables of the study. They developed a questionnaire to collect data from 420 SMEs in Palestine. Partial least square structural equation modeling (PLS-SEM) is used to test the relationships and it was found that relative advantage significantly determines the innovative capability of firms. Previous studies have explored relative advantage and identified it as one of the main variables that cannot be overlooked in innovation adoption (Alshamalia, Papagianidis, and Lif, 2013; Frygell, Jonas Herdman, and Carlsson, 2017). As one of the main factors of the TOE and DOI frameworks, it has been variously reported to have a positive effect of innovation adoption (Chavitoshi, Tze, and Jee, 2015). A clear observation of these findings indicates that the relative advantage of one innovation over the other is a pivotal consideration in the adoption of any innovation hence influence the innovative capability of firms. Mairura (2016) examined relative advantage as a determinant of technology adoption among micro and small enterprises in Kenya's automobile industry. The overarching aim of the study is to identify which factors influence technology adoption among mechanics in the aforementioned industry. However, the study specifically looked at establishing the role of relative advantage in technology adoption. The researcher employed a binary logistics regression method for analysis on data entered into SPSS. Findings indicate that the adoption of various forms of innovation or technology is determined by the attitudes and perceptions of mechanics relative advantage of a particular innovation.

$H1_a$: Relative advantage has a significant effect on the innovative capability of firms.

$H1_b$: Relative advantage has a significant effect on the firm performance.

## 2.3. Top management support and innovative capability of firms

Innovation is very important for economic viability of organizations ranging from private to public. It must however be mentioned that innovation cannot be adopted in an organization without the support of top management as that is where all the strategies and decisions emanate. Hsuan et al., (2018) studied the relationship between openness of technology, top management support, and service innovation through a social innovation perspective. Data for their study was collected from 176 Taiwanese information technology (IT) firms: respondents were mainly IT managers. Data was analyzed using partial least square analysis. It was found that top management support enhances the relationship between openness of technology adoption and service innovation. Kraiczy, Hack, and Kellermanns (2015) explored the mediating role of firm innovativeness in the relationship between top management team innovation orientation and firm growth. These researchers focused on SMEs, which are generally considered highly innovative firms. They found that there is a full mediation of firm innovativeness in the relationship between top management team innovation orientation and firm growth. This indicates that there is a relationship between top management support and firm innovativeness. Innovations come with technology accompanied with massive number of resources: therefore, it is impossible to for there to be innovation adoption if top management support is not in place (Hossain et al., 2011). In fact, when innovations are adopted by firms without top management support, there is a high likelihood of failure

stemming from poor technological resources. With top management support, the effect of lack of technology in innovation adoption is minimized and there is an increase in level of adoption. Based on this it is hypothesized that:

$H2_a$: Top management support has a significant effect on innovative capability of firms.

$H2_b$: Top management support has a significant effect on firm performance.

**2.4. Financial resources and innovative capability of firms**

It is acclaimed in the literature that financial inclusion of a firm becomes possible when there is access to financial services or resources (Fungáčová, & Weill, 2015; Ozili, 2020). Moreso, the availability of financial resources hence financial inclusion in firms has been found to influence firm growth, modes of entry, and firm innovation (Chaivet and Jacolin, 2017; Lakuma et al., 2019; Vries, 2020). In a much older finding, Ayyagari et al. (2011) identified that having access to formal financial institutions has a positive influence of firm innovation of SMEs in emerging markets. It is further reiterated that, many firms in emerging markets do not have access to financial resources (Bellens, 2018) and this implies that these firms are unable to invest in new technologies and innovations. In essence, there is a limited ability to pursue new business avenues and roll out new innovations (Ullah, 2019). Aside from this situation, the fast pace of growth of emerging markets requires that innovative projects are implemented in a similar fashion. It is in this vein Arun and Kamath (2015) believed that having access to financial resources gives a firm the needed innovative capabilities to rise above its competitors especially in emerging markets. Leyva-De la Hiz, Ferron-Vilchez, and Aragon-Correa (2019) sort to find out whether or not slack resources influence the relationship between focused environmental innovations and financial performance with an understanding that "more is not always better". They analyzed a sample of 5845 longitudinal environmental patents from 75 companies who are considered the largest across the world in the electrical components and equipment industry. They found that a positive relationship between focused environmental innovation and firm performance but this is reduced by slack resources. This is an indication of a strong effect of financial resources on firm innovative capability hence the following hypothesis:

$H3_a$: Financial resources has a significant positive influence on firm innovative capability.

$H3_b$: Financial resources has a significant positive influence on firm performance.

**2.5. The Mediating Role Innovative Capability of Firms**

***2.5.1 Relative advantage and Performance of firms***

Hwang, Choi, and Shin (2019) examined the mediating role of innovation capability in the impact of entrepreneurial competencies on firm performance. They found that entrepreneurial competencies have indirect effects on competitive advantage of firms but it becomes stronger through organizational innovation capabilities. It is further stated that innovative capability is needed in organizations in in order to have advantage over competitors and sustain competitive advantage and performance. It has been widely acclaimed in research over the years that gaining competitive advantage and sustaining it hinges largely on technological innovation and organizational learning capabilities in order to improve firm performance ( Onağ, et al., 2014; Camisón & Villar-López, 2014). Hailekiros and Renyong (2016) however noticed a significant gap, which was the fact that technology innovation capability of firms could act as a mediator variable in many instances to lead to performance but this was not very much explored. Therefore, using a survey data from 243 SMEs in the Ethiopian manufacturing industry, they employed structural equation modeling and the principal component analysis to analyze the data. Their results indicates that technological innovation capability mediates the relationship between organizational learning capability and firm performance. Further, a direct and significantly positive effect of innovative capability on firm performance was found. In this context it can be said that for the right kind of innovation to be adopted by manufacturing firms in Ghana and consequently translate into superior performance, the must be a considerable level of innovative capability of firms. Therefore, it is hypothesized that:

$H4_a$: Innovative capability mediates the relationship between relative advantage and performance of firms.

***2.5.2 Top management support and Performance of firms***

Ferreira, Coelho, and Weersma (2019) studied the mediating roles of strategic orientation, innovation capabilities, and managerial capabilities in the relationship between exploration and exploitation, competitive advantage, and firm performance. To examine the relationship between the aforementioned variables, they adopted a dynamic capability perspective. Structural modelling was then used for hypothesis testing on data collected from 387 Portuguese SMEs. Results show a positive mediating effect of innovation capability and managerial capabilities in the relationship between strategic orientation and performance. Strategic orientation of firms has everything to do with its top management therefore these findings indicates that top management support has impacts on firm performance but the effect becomes stronger which innovative capability is

introduced as a mediator. Kraiczy, Hack, and Kellermanns (2015) looked into the relationship between top management team innovation orientation and firm growth through firm innovativeness. Their findings indicate a full mediation effect of innovativeness in the relationship between top management innovation orientation and organizational growth.

Mostafiz et al., (2021) conducted a study to test the mediating role of innovative capability in the relationship between dynamic managerial capability and performance of export manufacturing companies. Based on the dynamic capability theory, they tested hypothesis from data collected from 336 clothing export manufacturers in Bangladesh. A clear mediating effect of innovation capability on the relationship between dynamic managerial capabilities and performance was found. Based on this, an intellectual guess is made that:

$H4_b$: Innovative capability mediates the relationship between top management support and performance of firms

### *2.5.3 Financial resources and Performance of firms*

Gunday et al., (2011) focused on the effects of various types of innovation on various aspects of firm performance including financial, innovative, and market performance. Relying on empirical data from 184 Turkish manufacturing firms, they tested the relationships between innovation and firm performance amid financial resources. Results intimates positive effects of innovation on firm performance while financial capital is present. Kijkasiwat and Phuensane (2020) sought to find out whether or not product and process innovation in organizational performance is affected by financial capital in any way. The partial least square structural equation modeling method is used and it was found that financial capital not only moderates but also mediates the impact of innovation on firm performance. By implication, financial resources cannot have a full impact on firm performance unless innovative capability of the firm is at a considerably high level.

Hussain and Waheed (2019) applied the resource-based view to the relationship between strategic resources and firm performance firms listed in the personal goods sector of Pakistan Stock Bourse, for the period of 2005 to 2014. Results from this study shows that intellectual capital significantly affects operating and financial performance of organizations. In addition, financial resources have a significant positive effect on firm performance. However, in terms of innovation adoption, organizations must have the capability of selecting the right innovation (innovation capability) to adopt otherwise financial resources may not have the needed effect on firm performance.

$H4_c$: Innovative capability mediates the relationship between financial resources and firm performance.

### 2.6. Innovative capability and Performance of firms

Yu Sheng and Ibrahim (2020) explored the effects of innovation adoption on performance in Ghanaian banks. A total of 450 bank workers and customers in the Kumasi metropolitan area were interviewed. Exploratory factor analysis and structural equation modelling were employed for data analysis through SmartPLS and SPSS. They found a direct positive relationship between innovation dimensions (organizational, product, and marketing) and bank performance. Yuan et al., (2016) tested the effects of innovation capability and marketing capability on firm performance in China and Korea. With the institutional theory and the strategic fit paradigm as theoretical foundations on 385 Chinese and 280 Korean firms, it was found that innovative capability has a positive impact on firm performance in both the Chinese and Korean markets. Hoang and Ncog (2019) aimed to examine the determinants of the innovative ability of firms and how they impact firm performance among Vietnamese electronic companies. To deal with this research objective, they employed the partial least square structural equation modeling (PLS-SEM) to test relationships. With data analyzed from 374 firms, institution factors, marketing leadership attitude, technology, and combination factors are identified as the driving factors of innovation capability of firms. All these factors are further revealed to have positive effects on financial performance of firms which translates into overall growth. Noordin and Mohtar (2013) studied the role of Innovation Capability in determining firm performance and found it to increase economic value and profit hence firm performance.

H5: Innovative capability has a significant positive effect on firm performance

## III. Methods and Materials

### 3.1. Study Population, Sampling and Data Sources

The study targeted top managers in various manufacturing companies in Ghana because the researcher is interested in the role of innovative capability in technology innovation adoption and firm performance in the manufacturing industry of Ghana. From this population, the purposive sampling technique was used to sample top management and leadership of the various manufacturing companies. Data was collected from respondents on all the variables mentioned above to enable rigorous analysis. The sample size was determined using the following formula. Based on a report by commonwealth of nations (2020), Ghana had 25,000 manufacturing companies. It is further elucidated in the report that 80% (20,000) of these companies are small sized

organizations. For the purpose of generalizability of findings, this study focuses on the remaining 20% (5000) firms who are operating on a large scale. The derived sample size for the study is calculated using the proposed model of Vaardini (2016) as shown below;

$$SS = \frac{\frac{Z^2 \times P\,(1-P)}{e^2}}{1 + (\frac{Z^2 \times P\,(1-P)}{e^2 N})}$$

*Where SS = Sample size;*

*Z = the statistical value for the confidence level used example (2.575, 1.96, and 1.645, for 99%, 95%, and 90% confidence levels, respectively);*

*P = Value of the population proportion which is being estimated; usually 50% (0.50)*

*e = margin of sampling error (estimated as 0. 05).*

*N = Size of population*

The sample size therefore calculated at a 95% confidence level with 1.96 $Z_{score}$ as shown in the solution below;

$$SS = \frac{\frac{1.96^2 \times 0.5\,(1-0.5)}{0.05^2}}{1 + (\frac{1.96^2 \times 0.5\,(1-0.5)}{0.05^2\,(5{,}000)})} = \frac{384.16}{1.076832} = 356.75 \approx \mathbf{357}\ \boldsymbol{participants}$$

### 3.2. Data Collection Instrument and Measurement of Constructs

Data collection procedures for this study followed ethical research survey practices. During each session with research participants, the purpose of the study was explained as purely for academic purposes. In addition, the processes of anonymizing data and ensuring confidentiality were clearly discussed. Finally, participants indicated their concern to take part in the survey by completing a consent form submitted to them, right after which the survey got started. The main tool for data collection in this study is a structured questionnaire, which was distributed to top managers in selected manufacturing firms. The questionnaire comprise of four sections: demographic information (section A), technology innovation adoption, innovation capability and firm performance. Sections B, C and D constitute the main construct items for the study variables, which were all answered on a 5-point Likert scale ranging from strongly disagree (1) to strongly agree (5). Constructs variables were constructed and operationalized as measured in existing literature and described as follows (appendix A).

***Relative advantage***

Relative advantage in this study was measured using the constructs applied in Oliveira et al. (2014), Alshamaila et al. (2013), Gutierrez et al. (2015) and Abdekhoda et al. (2019). It consist of four (4) construct items, which include "adopting technology innovations improves job performance and productivity"

***Top management support***

Top management support in this study is measured with construct items adapted from Oliveira et al. (2014), Alshamaila et al. (2013), Gutierrez et al. (2015) and Abdekhoda et al. (2019). It consist of four (4) construct items, which include "Management provide the requisite resources for technology innovation adoption"

***Financial Resources***

Financial resources in this study is measured with construct items adapted from Johnson et al. (2008). It consist of four (4) construct items, which include "Internal budgetary allocations are adequate to fund technology innovation adoption".

***Innovative Capability***

Innovative capability in this study is measured with construct items adapted from **(**Calik et al., 2017). It consist of fourteen (14) construct items, which is sub categorized into five (5) items for product innovation, four (4) items for process innovation and five (5) items for market innovation. Example of construct item include "We enhance the range of our products and services with not previously released products and services".

***Firm performance***

Firm performance in this study is measured with construct items adapted from (Azubuike, 2013). It consist of eight (8) items, which include four items each for financial and operational performance of firms as compared to their competitors over the last four years. Example of construct item include "production cost efficiency" and "return on sales".

### 3.3. Formulation of the mediation model

The mediation model (figure 1) and its parameters applied in this study is formulated as shown in the equations below.

$$IC = i_{IC} + a1RA \ldots\ldots\ldots\ldots\ldots\ldots equ\ (1)$$
$$IC = i_{IC} + a2TMS \ldots\ldots\ldots\ldots\ldots\ldots equ\ (2)$$
$$IC = i_{IC} + a3FR \ldots\ldots\ldots\ldots\ldots\ldots equ\ (3)$$
$$FP = i_{FP} + c'RA + b_1IC + c'TMS + b_2IC + c'FR + b_3IC \ldots\ldots\ldots\ldots equ\ (4)$$

Where,

$$a1, a2, a3 = effect\ of\ RA, TMS\ and\ FR\ on\ IC$$
$$b1, b2, b3 = the\ mediating\ effect\ of\ IC\ on\ FP\ through\ RA, TMS\ and\ FR$$
$$RA = Relative\ Advantage\ (Independent\ variable)$$
$$TMS = Top\ Management\ (Independent\ variable)$$
$$FR = Financial\ Resources\ (Independent\ variable)$$
$$IC = Innovative\ Capability\ (Mediating\ variable)$$
$$FP = Firm\ Performance\ (Dependent\ variable)$$

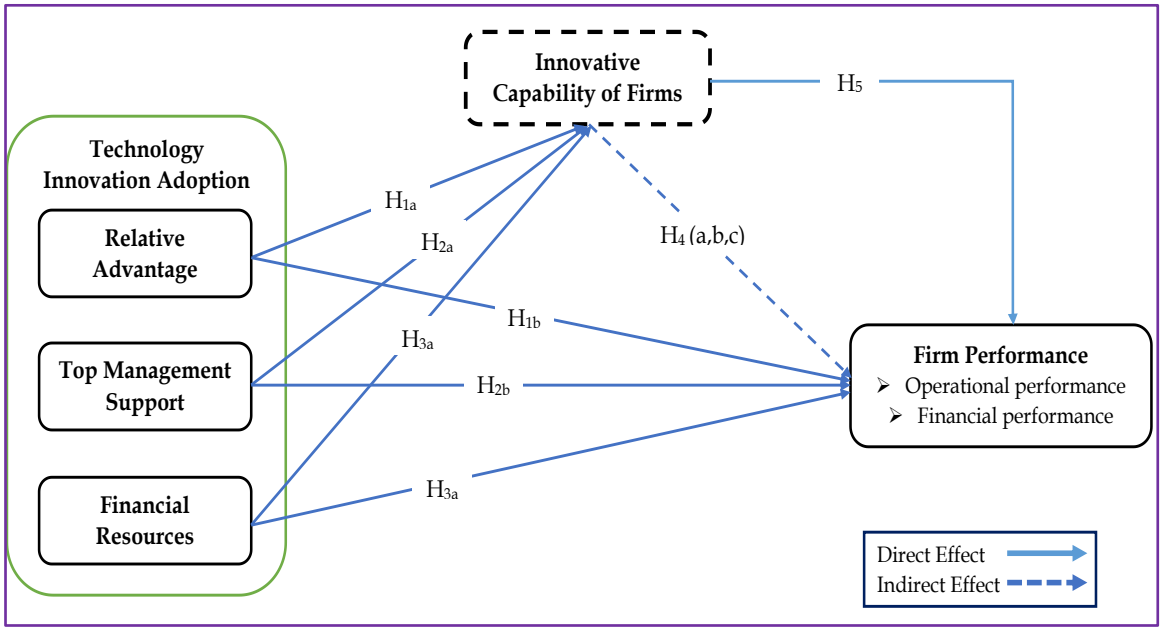


**Figure 1: Conceptual Model of the Study**

### 3.4. Data analysis methods

The data collected in this study is analyzed using the Statistical Package for Social Sciences (SPSS) Software version 22. The responses of participants were screened for errors before coding and analyzing them statistically. The Hayes Process Macro functionality of SPSS version 4 coupled with the bootstrap inference method with 5000 bootstrap samples were applied to test the formulated mediation model. In addition, the proposed hypothesis of the study were also tested using multiple regression analysis, factor analysis, correlation coefficient analysis, confidence interval analysis and assessment of *p-value*. Moreover, descriptive statistical analysis was used to analyze the demographic data, educational attainment and the departments of participants. The manufacturing sector in which selected firms were classified was also analyzed in this regard.

## IV. Results and Findings of the Study

### 4.1. Characteristics of study participants and survey response rate

For this study, 357 questionnaires were distributed to participants. After the survey was completed and response screened, 325 questionnaires representing 91.04% were considered as complete response to all items, which were then further included in the data analysis. Essentially, 10 of the questionnaires were not returned and the remaining 22 questionnaires were either not completely answered or had errors. As reflected in the data of this study, top managers who took part in this survey are dominantly males, mostly young adults within the age of 31 to 50 years and about 70% of them have attained a bachelor and master's degree educational qualification in management and manufacturing operations (table I).

**Table I: Characteristics of study participants**

| Variable | Frequency | Percentage |
|---|---|---|
| ***Age range of respondents*** | | |
| 15 – 30 | 50 | 15.4 |
| 31 – 50 | 196 | 60.3 |
| 51 and above | 79 | 24.3 |
| ***Gender distribution of respondents*** | | |
| Male | 224 | 68.9 |
| Female | 101 | 31.1 |
| ***Academic qualification of Respondents*** | | |
| Vocational & Technical Skills | 30 | 9.2 |
| High School Certificate | 1 | 0.3 |
| Bachelor's degree | 49 | 15.1 |
| Master degree | 177 | 54.5 |
| PhD | 68 | 20.9 |
| ***Department of Officers*** | | |
| Production | 118 | 36.3 |
| Marketing and Sales | 19 | 5.8 |
| Transport | 44 | 13.5 |
| Warehousing | 65 | 20 |
| Information Technology | 79 | 24.3 |
| ***Manufacturing Sector Classification*** | | |
| Agro processing | 71 | 21.8 |
| Mining | 44 | 13.5 |
| Oil and Gas Exploration and Production | 15 | 4.6 |
| Petroleum Refining | 34 | 10.5 |
| Food and Beverage | 77 | 23.7 |
| Pharmaceutical | 84 | 25.8 |

### 4.2. Reliability and validity assessment

#### 4.2.1. Convergent validity and reliability

As widely acclaimed in previous empirical research studies, the Cronbach's alpha (CA), Composite Reliability (CR) and Average Value Extracted (AVE) scores were deployed to examine the convergent reliability and validity of the statistical associations between variables of the mediation model formulated in this study (Ahmed & Omar, 2019). The results indicate that the construct variables formulated have strong convergent validity and reliability, thus statistically rigorous. As shown in table II, Cronbach's alpha and composite reliability values of all constructs exceed 0.70, with the least score of 0.9.6 for CA and approximately

0.76 for CR. This indicates a high internal consistency of construct items. In addition, the average variance extracted values for four (4) out of five (5) constructs exceed 0.50, with only relative advantage (RA) construct scoring 0.441. This indicate that a majority of construct items influence the internal variance of items rather than errors in variables.

**Table II: Convergent validity result of the study**

| NO. | VARIABLES | CA | CR | AVE |
|---|---|---|---|---|
| 1 | RA | 0.951 | 0.759 | 0.441 |
| 2 | TMS | 0.961 | 0.888 | 0.667 |
| 3 | FR | 0.906 | 0.801 | 0.505 |
| 4 | IC | 0.980 | 0.896 | 0.896 |
| 5 | FP | 0.974 | 0.905 | 0.547 |

***Label:*** *RA Relative advantage, TMS = Top management support, FR = Financial resources, IC = Innovative capability, FP= Firm performance.*

### 4.2.2. Discriminant validity

Furthermore, the discriminant validity of constructs used in this study is assessed using the Fornell-Larcker test and the Heterotrait-Monotrait (HTMT) ratio test, which mainly examines the distinctiveness of each variable construct. As shown in table III, Fornell-Larcker test results indicate that only one (1) out of five (5) constructs meet the criterion that the square root of the average variance extracted value loads highest on its associated correlation with other constructs (Fornell and Larcker, 1981). This reflects a weakly established discriminant validity.

**Table III: Fornell-Larcker Test**

| | RA | TMS | FR | IC | FP |
|---|---|---|---|---|---|
| **RA** | **0.664** | | | | |
| **TMS** | .787** | **0.817** | | | |
| **FR** | .697** | .763** | **0.711** | | |
| **IC** | .790** | .702** | .775** | **0.620** | |
| **FP** | .717** | .662** | .760** | .889** | **0.739** |

***Label: **: p < 0.001; *: p < 0.05.*** *RA = Relative advantage, TMS = Top management support, FR = Financial resources, IC = Innovative capability, FP= Firm performance.*

This therefore calls for a further stringent assessment of discriminant validity using the HTMT ratio test. The results show that the value of each construct variable range between 0 and 1 (Henseler *et al*., 2015), thus indicating a well-established discriminant validity of the construct model that is reliable for further analysis (table IV).

**Table IV: Fornell-Larcker Test**

| | RA | TMS | FR | IC | FP |
|---|---|---|---|---|---|
| **RA** | | | | | |
| **TMS** | 0.865 | | | | |
| **FR** | 0.774 | 0.819 | | | |
| **IC** | 0.842 | 0.859 | 0.778 | | |
| **FP** | 0.808 | 0.802 | 0.765 | 0.968 | |

***Label:*** *RA = Relative advantage, TMS = Top management support, FR = Financial resources, IC = Innovative capability, FP= Firm performance.*

### 4.2.3. Multicollinearity assessment

In another assessment of the fitness of the construct measures used in this study, the multicollinearity test is conducted to assess the level of correlation explained by predictor variables on the dependent in this study. As reflected in the variance inflation factor (VIF) values, RA, TMS, FR and IC have VIF values of 2.656, 1.971, 2.508, and 2.508 respectively. Therefore, there are no multicollinearity issues in the data according to the proposed thresholds of 5 or a maximum of 10 (Aiken *et al.*, 1991).

### 4.3. Hypothesis test results (Direct Effects)

In this sub section, results on the direct effects of the various independent variables namely relative advantage (RA), top management support (TMS), and financial resources (FS) on innovative capability (IC) of manufacturing firms in Ghana. According to hypothesis testing results as seen in table V and figure 2, H1a, which states that, relative advantage has a significant effect on innovative capability of firms, is supported. The decision to support the hypothesis is based on ($\beta = 0.652$, t-value = 24.748, p-value = 0.000). It is also worthy of mention that a unit increase in relative advantage results in 62.3% variance ($R^2 = 0.623$) in the innovative capability (IC) of manufacturing firms. Also, with an effect size of 0.034 and upper and lower-level confidence interval levels being -0.38 and 0.106 respectively, the direct effect of relative advantage on firm performance in the face of the mediator (innovative capability) is considered insignificant as zero falls between the upper and lower boundaries: therefore, $H1_b$ is not supported. Hypothesis two (H2a) tested the effect of top management support on innovative capability of firms. The results ($\beta = 0.507$, t-value = 15.685, p-value = 0.000) shows that, top management support has a significant impact on innovative capability of firms hence it is supported. Also, the $R^2$ value of 0.493 indicates that a unit increase in top management support explains 49.3% variance in innovative capability. The effect size of top management support on innovative capability of firms is 0.56 and upper and lower boundary scores of 0.006 and 0.106 respectively, $H2_b$, which states that top management support has a significant effect on firm performance, is supported. H3a states that financial resources (FR) have a significant impact on innovative capability (IC) of firms: results confirm this significant effect ($\beta = 0.691$, t-value = 26.064, p-value = 0.000) and therefore the hypothesis is supported. An increase in financial resources was also found to explain 60.1% variance in innovative capability of firms. The direct effect size of 0.162 and upper and lower-level interval confidence levels of 0.96 and 0.229 respectively: based on this it is confirmed that financial resources have a significant effect on firm performance and therefore $H3_b$ is supported. H5 also tested the direct effect of innovative capability (IC) on firm performance (FP) which is the outcome variable of this study. Results of this hypothesis ($\beta = 0.906$, t-value = 34.803, p-value = 0.000) shows that innovative capability actually has a significant effect on firm performance and therefore this hypothesis is supported. Also, the extent of change in firm performance through the effect of innovative capability is 78.9 % ($R^2 = 0.789$): the upper and lower bound interval limits are 0.854 and 0.957 respectively confirming the significance of the relationship between innovative capability and firm performance.

**Table V: Hypothesis Test results for Direct Effects**

| Label | Hypothesis Statement | $\beta$ | $R^2$ | $p$ - value | Decision |
|---|---|---|---|---|---|
| $H1_a$ | RA→ IC | 0.652 | 0.623 | 0.000 | Supported |
| $H1_b$ | RA→ FP | 0.340 | 0.790 | 0.000 | Not Supported |
| $H2_a$ | TMS→ IC | 0.507 | 0.493 | 0.000 | Supported |
| $H2_b$ | TMS→ FP | 0.560 | 0.792 | 0.28 | Supported |
| $H3_a$ | FR→ IC | 0.691 | 0.601 | 0.000 | Supported |
| $H3_b$ | FR→ FP | 0.162 | 0.802 | 0.000 | Supported |
| H5 | IC→ FP | 0.906 | 0.789 | 0.000 | Supported |

***Label:*** *RA = Relative advantage, TMS = Top management support, FR = Financial resources, IC = Innovative capability, FP= Firm performance.*

**4.4. The Mediating role of innovative capability (Indirect Effects)**

The main objective of this study is to assess the mediating role of innovative capability (IC) on the relationship between technology innovation adoption and firm performance as stated in hypothesis (H4a, $H4_b$ and H4c). Table VI shows the result summary of the mediation analysis. As proposed that IC significantly mediates the relation between RA and FP, the results revealed that IC has significant indirect effect on the relationship between RA and FP. In that, zero (0) does not fall within the lower and upper limits of the confidence interval (0.496 and 0.648) as well as an effect size of ($\beta$ = 0.569), where IC accounts for 94.36% of the total effect of RA on FP (0.603) as shown in the process-macro result output. Moreover, IC fully mediates RA and FP since the direct effect of RA on FP in the presence of the mediator is not significant ($p$ = 0.352). Finally, it is also observed that the mediating effect of IC between RA and FP is complementary as the direct and indirect effects of RA through IC to FP is a positive integer.

The study further assessed the mediating role of IC in the relationship between top management support (TMS) and FP. The results revealed that IC has significant indirect effect on the relationship between TMS and FP. In that, zero (0) does not fall within the lower and upper limits of the confidence interval (0.367 and 0.501) as well as an effect size of ($\beta$ = 0.431), where IC accounts for 88.32% of the total effect of TMS on FP (0.488). Moreover, IC partially mediates TMS and FP since the direct effect of TMS on FP in the presence of the mediator is also significant. Finally, the mediating effect of IC in TMS and FP is complementary as the direct and indirect effects of TMS through IC to FP is a positive integer.

Finally, the study sought to test whether IC mediates the relationship between FR and FP. The results revealed that IC has significant indirect effect on the relationship between FR and FP. It is seen that zero (0) does not fall within the lower and upper limits of the confidence interval (0.468 and 0.595), with an effect size of ($\beta$ = 0.529), where IC accounts for 76.56% of the total effect of FR on FP (0.691). Moreover, IC partially mediates FR and FP since the direct effect of FR on FP is also significant. Consequently, the mediating effect of IC in TMS and FP is deemed complementary, as the direct and indirect effects of FR through IC to FP is a positive integer.

**Table VI: Mediation Analysis Results**

| Label | Hypothesis Statement | *Effect (β)* | *Boot (SE)* | *Boot (LLCI)* | *Boot (ULCI)* | Decision |
|---|---|---|---|---|---|---|
| H4a | RA→ IC→ FP | 0.569 | 0.038 | 0.496 | 0.648 | Supported |
| H4b | TMS→ IC→ FP | 0.431 | 0.034 | 0.367 | 0.501 | Supported |
| H4c | FR→ IC→ FP | 0.529 | 0.032 | 0.468 | 0.595 | Supported |

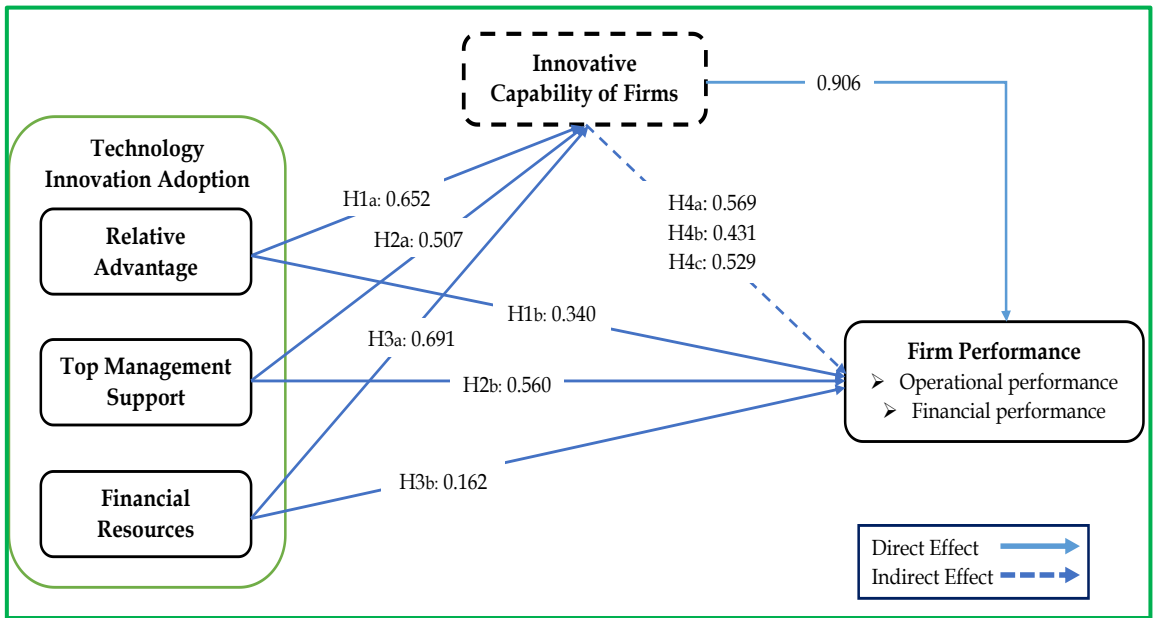


**Figure 2: Structural Model of the Study**

**4.5. Discussion of Findings**

The analysis of this study is based on data collected from 325 purposively selected managers from various departments of the major Ghanaian manufacturing companies used in this study. These managers have different levels of education ranging from a bachelor's degree to a doctorate degree. A questionnaire was designed to collect data on relative advantage, top management support, and financial resources that are technological innovation adoption factors in order to examine the relationships that exist between these variables and firm performance and how these relationships are mediated by innovative capability of manufacturing firms in Ghana. With this aim, various hypotheses are developed and tested and results presented above.

Throughout the literature, relative advantage is reported as a key factor in the TOE framework that greatly supports the adoption of innovation and this is confirmed in the current study as relative advantage is found to have a significant effect on innovative capability of manufacturing firms in Ghana. The findings of this hypothesis indicates that if manufacturing firms in Ghana perceive an innovation as giving them relative advantage and are able to identify the right kind of innovation to adopt, their innovative capability is mostly likely to increase. This finding is in tandem with those of (Salah, Yusof, and Mohamed, 2021; Carlsson, 2017) who also found significant impacts of relative advantage on firm innovative capability. In fact, Mairura (2016) insisted that it is only when there is relative advantage of an innovation that the innovation can be eventually adopted to boost performance.

H2a and $H2_b$ proposed a significant impact of top management support on innovative capability of firms translating into firm performance and findings scientifically proved this position right as it is seen that an increase in top management support in Ghana's manufacturing industry increases firm innovative capability by 49.3%. The findings of this study are congruent with the work of Hsuan et al., (2018) who also intimated that top management support enhances openness of technology adoption and service innovation. By necessary implication, when top management is exposed to the important role of innovation in organizational performance and give the necessary support for technology to be adopted, the innovative capability of the manufacturing company is boosted. This is why Kraiczy, Hack, and Kellermanns (2015) emphasized that in contemporary business, an innovative-sensitive sensitive management is the bane of a thriving organization.

Findings from H3a and H3b are also congruent with the intellectual guess that financial resources have a significant impact of innovative capability of firms in Ghana's manufacturing industry leading to superior firm performance. Specifically, the results show that when financial resources go up by a single unit, there is a 69.1% variance in the innovative capability of firms. This finding suggests that, relative advantage and top management support may be in place but financial resources play a pivotal role in whether or not a Ghanaian manufacturing firm is innovatively capable as this covers all the needed logistics and infrastructure to adopt the actual innovation and boost their performance. Results are consistent with those of (Ozili, 2020; Vries, 2020; Lakuma et al., 2019) who all agree that, the availability of financial resources influences firm growth and innovation.

For the hypothesis that tested the effect of innovative capability on firm performance, findings indicate a significant positive effect. This is in line with the findings of Yu Sheng and Ibrahim (2020), and Hoang and Ncog (2019 who found innovative dimensions to be very highly positive on its effect on the performance of an organization. The implication of this result is that, when an organization is innovatively capable, there is an increase in the likelihood of a boost in its performance. According to the model in this study, innovative capability of manufacturing companies in Ghana improves their performance by 78.9%. Top management must therefore be open to innovation in order to understand which one is the best fit for their companies and assign financial resources, which in turn increases innovative capability and leads to superior performance.

The mediating effect of innovative capability in the relationship between technology innovation adoption and firm performance is assessed in this study. Clearly, innovative capability of firms in the manufacturing industry in Ghana plays a crucial role in transforming the perceived relative advantage of adopting advanced technologies, top management support activities and the availability of financial resources into realizing optimal firm performance. The study showed that innovative capability fully meditates the relationship between relative advantage as perceived by top managers in Ghana's manufacturing Industry and its ramifications for firm performance. This implies that the perceived relative advantage of technology innovation adoption compared to existing manufacturing systems does not necessarily translate into improved firm performance unless top managers possess innovative skills to identify and assess the appropriate technologies for managing product, process and market development strategies that leads to increased and sustainable profitability. This relates to the findings of Camisón & Villar-López (2014).

Again, it is shown that innovative capability of firms is a significant mediator of the impact of top management support on firm performance. Although top management support for technology innovation adoption have shown significant relationship with enhanced operational and financial performance of firms in Ghana's manufacturing industry, the innovativeness of with which firms adopt and implement these

technologies influence the level of impact it has on performance. In essence, innovative skills of firms must surely complement the positive input of top managers in order to achieve sustained competitive edge in Ghana's manufacturing industry, which is consistent with the findings of Kraiczy, Hack, and Kellermanns (2015).

Finally, innovative capability of firms in Ghana's manufacturing industry also influence the effect of financial resource endowment on their operational and financial performance. Similarly, when firms have access to credit facilities, government investment, stakeholder investment, or even have adequate budgetary allocation for innovative technology adoption, it is important for top managers to devise novel approach for managing industry processes, product differentiation strategy and marketing mix strategy towards providing customized products and services, as well as improved customer service experience. This would ensure optimal firm performance and profitability, which commensurate with those in Gunday et al., (2011).

## V. Conclusion

Undoubtedly, technology innovation adoption is a non-negligible part of the growth and competitiveness of firms in Ghana's manufacturing industry. Advanced technologies are driving efficient production processes, distribution cost efficiencies, marketing and sales strategy, product design effectiveness and customer service relationship, experiences, and the overall operational stability and financial performance of firms. However, at the crux of achieving optimal firm performance is the innovative capability of firms. Notwithstanding the relative advantage perceived by firms to adopt any particular technology, the support of top managers as well as the availability of financial resources, firms in Ghana's manufacturing industry cannot attain sustainable and competitive performance levels if they do not possess the relative innovative prowess to even adopt the right technologies and implement them. It can be derived therefore that building a buoyant innovative capability of employees in manufacturing firms in Ghana is a strategic approach to enhancing performance and gaining competitive edge in the industry. Management teams of manufacturing firms are advised accordingly to pay a critical attention to assessing their innovative capabilities and improving it.

## VI. Implication for Practitioners

This study provides immense benefits for manufacturing firms in Ghana, foreign investors, the Ghanaian government and the extended group of management science and engineering research scholars. Findings of this study not only addresses the gap of lack of innovation studies in Ghana's manufacturing industry but also expands knowledge and informs big manufacturing firms in Ghana on what to focus on in order to grow their companies through technological innovation adoption. This study also provides a practical and hands-on approach to assessing and improving the innovative capabilities of firms in order to adopt advanced technologies effectively for competitive performance in the global manufacturing industry. Top management support and financial resources should be channeled towards training employees and improving their technological innovation and management skills. Specific recommendations include promoting innovation as part of organizational core values, ensure continuous assessment of innovation capabilities of the firm with effective feedback systems, ensure prompt implementation of novel ideas and encourage collaboration among employees and the sharing of innovative ideas

## VII. Limitations and Future Research Implications

The current study has few shortcomings that should potentially drive future research for knowledge expansion. First, the study used innovative capability as a mediator of the relationship between technology innovation adoption and firm performance. Future researchers can focus on the mediating and moderating roles of other variables like different aspects of innovative capability of firms as they might have different (direct/indirect) effects on the relationship under consideration in this study. Also, future researchers should consider replicating this study in other industries in Ghana. For the purpose of further scientific rigor, future research can include psychological variables like motivation, emotion, salary, and job satisfaction among others and include lower-level employees in interviews to see the effects on firm performance from thus perspective.

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## Appendix A: Questionnaire and Measurement of Construct

### SECTION A: Demographic Profile of Respondents

1. Gender.
   a) Male [ ]
   b) Female [ ]
2. What is your age range? a) 15-30years [ ] b) 31-50years [ ]
   c) 51 years and above [ ]
3. What is your highest level of formal education? Please tick one of the

a) Vocational & Technical Skills
b) Secondary school [ ]
c) First degree [ ]
d) Master's degree [ ]
e) PhD degree [ ]
f) Others……..

4. Department of Officer.
   a) Production [ ]
   b) Marketing and Sales [ ]
   c) Transport [ ]
   d) Warehousing [ ]
   e) Information Technology [ ]
   f) Others……..

5. Manufacturing sector in which the firm operates.
   a) Agro processing [ ]
   b) Mining [ ]
   c) Oil and Gas Exploration and Production [ ]
   d) Petroleum Refining [ ]
   e) Food and Beverage [ ]
   f) Pharmaceutical [ ]
   g) Textile, Leather and Clothing
   h) Printing and Paper Production [ ]
   i) Automobile Assembly [ ]
   j) Electronic Manufacturing
   k) Others……..

**SECTION B: Technology Innovation Adoption**

Please rate the following factors as they influence technology innovation adoption in your organization by selecting the appropriate box on the five-point Likert scale, where (***Strongly Disagree = 1, Disagree = 2, Neutral = 3, Agree = 4, Strongly Agree = 5***)

| **RA** | **Relative Advantage** (Oliveira et al., 2014), Alshamaila et al., 2013; Gutierrez et al. (2015; Abdekhoda et al., 2019) | **1** | **2** | **3** | **4** | **5** |
|---|---|---|---|---|---|---|
| 1 | Adopting technology innovations improve job performance and productivity | | | | | |
| 2 | Adopting technology innovations provide competitive advantage | | | | | |
| 3 | Adopting technology innovations provide more benefits than current infrastructure | | | | | |
| 4 | Adopting technology innovations provide minimal upfront investment | | | | | |
| **TMS** | **Top Management Support** (Oliveira et al., 2014), Alshamaila et al., 2013; Gutierrez et al. (2015; Abdekhoda et al., 2019) | **1** | **2** | **3** | **4** | **5** |
| 1 | Adopting technology innovations is important to top management. | | | | | |
| 2 | Management support the adoption of technology innovations | | | | | |
| 3 | Management train and encourage employees to accept and use adopted technology innovations. | | | | | |
| 4 | Management provide the requisite resources for technology innovation adoption. | | | | | |
| **FR** | **Financial Resources (**Johnson et al., 2008) | **1** | **2** | **3** | **4** | **5** |
| 1 | Bank credit facilities are easily accessible to the organization to fund technology innovation adoption | | | | | |
| 2 | Internal budgetary allocations are adequate to fund technology innovation adoption | | | | | |
| 3 | Investors show adequate interest in funding technology innovation adoption | | | | | |
| 4 | Government provide adequate financial incentives to enhance technology innovation adoption | | | | | |

**SECTION C: Innovative Capability of the Firm (IC)**

Please rate the Innovative Capabilities of your organization in the last four years compared to those of your competitors by selecting the appropriate box on the five-point Likert scale, where (***Strongly Disagree = 1, Disagree = 2, Unknown = 3, Agree = 4, Strongly Agree = 5***)

| **PDI** | **Product Innovation (**Calik et al., 2017) | **1** | **2** | **3** | **4** | **5** |
|---|---|---|---|---|---|---|
| 1 | The firm provide our clients with services that offer unique benefits superior to those of competitors | | | | | |
| 2 | Our firm actively carries out its work on developing existing products and creating new products. | | | | | |
| 3 | We enhance the range of our products and services with not previously released products and services. | | | | | |
| 4 | We try to acquire new products by differing technical specifications and functionalities. | | | | | |
| 5 | Our company sees creating new products and services as critical tools. | | | | | |
| **PRI** | **Process Innovation (**Calik et al., 2017) | **1** | **2** | **3** | **4** | **5** |
| 1 | Our firm reduces the developing time of new products and services. | | | | | |
| 2 | Our company is flexible to provide products and services according to the demands of the customers. | | | | | |
| 3 | Our company develops in-house solutions to improve our manufacturing processes. | | | | | |
| 4 | Our company actively works to adjust its business processes constantly. | | | | | |
| **MKI** | **Marketing Innovation (**Calik et al., 2017) | **1** | **2** | **3** | **4** | **5** |
| 1 | It is important for our company to make changes in appearance, packaging, shape, and volume of our products. | | | | | |
| 2 | Our company constantly looks for new ways to deliver our products to our customers. | | | | | |
| 3 | We implement new marketing methods to promote our products. | | | | | |
| 4 | We make improvements in the manner of customer relationships to obtain customer satisfaction. | | | | | |
| 5 | New ideas that come from customers and suppliers are evaluated continuously, and we try to include them into product development activities. | | | | | |

**SECTION D: Firm Performance (FP)**

Please rate the level of achievement of the following Operational and Financial Performance Items in your organization in the last four years compared to the previous years by selecting the appropriate box on the five-point Likert scale, where (***Strongly Disagree = 1, Disagree = 2, Neutral = 3, Agree = 4, Strongly Agree = 5***)

| **OP** | **Operational Performance** (Azubuike, 2013) | **1** | **2** | **3** | **4** | **5** |
|---|---|---|---|---|---|---|
| 1 | Conformance quality Assurance | | | | | |
| 2 | Production cost Efficiency | | | | | |
| 3 | Production flexibility | | | | | |
| 4 | Production and delivery speed | | | | | |
| **FNP** | **Financial Performance** (Azubuike, 2013) | **1** | **2** | **3** | **4** | **5** |
| 1 | Return on sales (Profit/Total Sales) | | | | | |
| 2 | Return on Assets (Profit/Total Assets) | | | | | |
| 3 | Cash flow excluding investment | | | | | |
| 4 | General profitability of the firm | | | | | |

**Appendix B: Hayes Process Macro Output for the Study**

```
Run MATRIX procedure:

***************** PROCESS Procedure for SPSS Version 4.0 *****************

          Written by Andrew F. Hayes, Ph.D.       www.afhayes.com
    Documentation available in Hayes (2022). www.guilford.com/p/hayes3

**************************************************************************
Model  : 4
    Y  : FP
    X  : RA
    M  : IC

Sample
Size:  325

**************************************************************************
OUTCOME VARIABLE:
 IC

Model Summary
          R       R-sq        MSE     F(HC4)        df1        df2          p
       .790       .623       .391    612.460      1.000    323.000       .000

Model
              coeff    se(HC4)          t          p       LLCI       ULCI
constant       .784       .073     10.674       .000       .639       .928
RA             .652       .026     24.748       .000       .600       .704

Standardized coefficients
        coeff
RA       .790

Covariance matrix of regression parameter estimates:
           constant         RA
constant       .005      -.002
RA            -.002       .001

**************************************************************************
OUTCOME VARIABLE:
 FP

Model Summary
          R       R-sq        MSE     F(HC4)        df1        df2          p
       .889       .790       .227    947.689      2.000    322.000       .000

Model
              coeff    se(HC4)          t          p       LLCI       ULCI
constant       .372       .089      4.202       .000       .198       .546
RA             .034       .037       .931       .352      -.038       .106
IC             .873       .037     23.888       .000       .801       .945

Standardized coefficients
        coeff
RA       .040
IC       .857
```

```
Covariance matrix of regression parameter estimates:
           constant         RA         IC
constant       .008      -.002       .000
RA            -.002       .001      -.001
IC             .000      -.001       .001

************************** TOTAL EFFECT MODEL ****************************
OUTCOME VARIABLE:
 FP

Model Summary
          R       R-sq        MSE     F(HC4)        df1        df2          p
       .717       .514       .525    370.060      1.000    323.000       .000

Model
             coeff    se(HC4)          t          p       LLCI       ULCI
constant     1.056       .103     10.264       .000       .854      1.259
RA            .603       .031     19.237       .000       .542       .665

Standardized coefficients
        coeff
RA       .717

Covariance matrix of regression parameter estimates:
           constant         RA
constant       .011      -.003
RA            -.003       .001

****************** CORRELATIONS BETWEEN MODEL RESIDUALS ******************

           IC         FP
IC      1.000       .000
FP       .000      1.000

************** TOTAL, DIRECT, AND INDIRECT EFFECTS OF X ON Y **************

Total effect of X on Y
     Effect    se(HC4)          t          p       LLCI       ULCI       c_cs
       .603       .031     19.237       .000       .542       .665       .717

Direct effect of X on Y
     Effect    se(HC4)          t          p       LLCI       ULCI      c'_cs
       .034       .037       .931       .352      -.038       .106       .040

Indirect effect(s) of X on Y:
       Effect     BootSE   BootLLCI   BootULCI
IC       .569       .038       .496       .648

Completely standardized indirect effect(s) of X on Y:
       Effect     BootSE   BootLLCI   BootULCI
IC       .676       .044       .593       .765

*********** BOOTSTRAP RESULTS FOR REGRESSION MODEL PARAMETERS ************

OUTCOME VARIABLE:
 IC
```

```
Coeff   BootMean     BootSE   BootLLCI   BootULCI
.074       .642       .933
RA             .652       .652       constant       .784       .783       .027
.598       .702

----------

OUTCOME VARIABLE:
 FP

              Coeff   BootMean     BootSE   BootLLCI   BootULCI
constant       .372       .369       .089       .192       .541
RA             .034       .034       .037      -.039       .104
IC             .873       .874       .036       .804       .947

************************ ANALYSIS NOTES AND ERRORS ************************

Level of confidence for all confidence intervals in output:
  95.0000

Number of bootstrap samples for percentile bootstrap confidence intervals:
  5000

NOTE: A heteroscedasticity consistent standard error and covariance matrix
estimator was used.

------ END MATRIX -----
```

```
Run MATRIX procedure:

***************** PROCESS Procedure for SPSS Version 4.0 *****************

          Written by Andrew F. Hayes, Ph.D.       www.afhayes.com
    Documentation available in Hayes (2022). www.guilford.com/p/hayes3

**************************************************************************
Model  : 4
    Y  : FP
    X  : TMS
    M  : IC

Sample
Size:  325

**************************************************************************
OUTCOME VARIABLE:
 IC

Model Summary
          R       R-sq        MSE     F(HC4)        df1        df2          p
       .702       .493       .527    246.033      1.000    323.000       .000

Model
              coeff    se(HC4)          t          p       LLCI       ULCI
constant      1.554       .095     16.405       .000      1.368      1.741
TMS            .507       .032     15.685       .000       .443       .570

Standardized coefficients
         coeff
TMS       .702

Covariance matrix of regression parameter estimates:
           constant        TMS
constant       .009      -.003
TMS           -.003       .001

**************************************************************************
OUTCOME VARIABLE:
 FP

Model Summary
          R       R-sq        MSE     F(HC4)        df1        df2          p
       .890       .792       .225    919.004      2.000    322.000       .000

Model
              coeff    se(HC4)          t          p       LLCI       ULCI
constant       .387       .079      4.898       .000       .232       .542
TMS            .056       .026      2.202       .028       .006       .106
IC             .851       .034     25.180       .000       .785       .918

Standardized coefficients
         coeff
TMS       .076
IC        .835
```

```
Covariance matrix of regression parameter estimates:
           constant        TMS         IC
constant       .006       .000      -.002
TMS            .000       .001      -.001
IC            -.002      -.001       .001

************************** TOTAL EFFECT MODEL ****************************
OUTCOME VARIABLE:
 FP

Model Summary
          R       R-sq        MSE     F(HC4)        df1        df2          p
       .662       .439       .606    257.346      1.000    323.000       .000

Model
             coeff    se(HC4)          t          p       LLCI       ULCI
constant     1.710       .088     19.395       .000      1.536      1.883
TMS           .488       .030     16.042       .000       .428       .547

Standardized coefficients
         coeff
TMS       .662

Covariance matrix of regression parameter estimates:
           constant        TMS
constant       .008      -.002
TMS           -.002       .001

****************** CORRELATIONS BETWEEN MODEL RESIDUALS ******************

           IC         FP
IC      1.000       .000
FP       .000      1.000

************** TOTAL, DIRECT, AND INDIRECT EFFECTS OF X ON Y **************

Total effect of X on Y
     Effect    se(HC4)          t          p       LLCI       ULCI       c_cs
       .488       .030     16.042       .000       .428       .547       .662

Direct effect of X on Y
     Effect    se(HC4)          t          p       LLCI       ULCI      c'_cs
       .056       .026      2.202       .028       .006       .106       .076

Indirect effect(s) of X on Y:
       Effect     BootSE   BootLLCI   BootULCI
IC       .431       .034       .367       .501

Completely standardized indirect effect(s) of X on Y:
       Effect     BootSE   BootLLCI   BootULCI
IC       .586       .038       .512       .664

*********** BOOTSTRAP RESULTS FOR REGRESSION MODEL PARAMETERS ************

OUTCOME VARIABLE:
 IC
```

```
              Coeff   BootMean     BootSE   BootLLCI   BootULCI
constant      1.554      1.553       .096      1.361      1.739
TMS            .507       .507       .033       .442       .572

----------

OUTCOME VARIABLE:
 FP

              Coeff   BootMean     BootSE   BootLLCI   BootULCI
constant       .387       .386       .079       .233       .537
TMS            .056       .056       .025       .006       .104
IC             .851       .851       .034       .785       .916

************************ ANALYSIS NOTES AND ERRORS ************************

Level of confidence for all confidence intervals in output:
  95.0000

Number of bootstrap samples for percentile bootstrap confidence intervals:
  5000

NOTE: A heteroscedasticity consistent standard error and covariance matrix
estimator was used.

------ END MATRIX
```