



UNIVERSITY OF AGDER

**Virtual Manufacturing Technology as a Determinant of
Internationalization of Firms:**

A Dynamic Capability through Nations' Competitiveness across Countries

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This master's thesis is carried out as a part of the education at the University of Agder and is therefore approved as a part of this education. However, this does not imply that the University answers for the methods that are used or the conclusions that are drawn.

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DEDICATION

This work is dedicated to God and my loving mother whose love and passion for me is immeasurable. For she told me and I never knew but now I know that:

Hard work

With commitments

Brings immeasurable success

ACKNOWLEDGEMENT

Many writers have written on different ways in which firms can achieve internationalization. I have also chosen to write on this aspect by examining how virtual manufacturing technology can affect internationalization of firms. I have decided to write on this aspect to contribute my quota to the knowledge needed in academics for development and discovery. I do believe that a constructive criticism from people who have interest on this work is a very welcome approach that will help the usefulness of this study. I have not positioned myself to mean that people with different ideology who looked at this topic from different perspectives are on the wrong track but only derived an academic research to show that knowledge is an infinite horizon which can be built upon. I have argued not to embarrass any existing research work on internationalization of firms but to distinctively differentiate my position on what I conceived as what can affect internationalization of firms due to the dynamic nature of the contemporary world.

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ABSTRACT

The study used resource based theory/dynamic capabilities to examine virtual manufacturing technology as a determinant of internationalization of firms across countries. Descriptive research design was used for the study and the research observed 144 countries of the world. The study made use of secondary data set in the world economic forum from the global competitiveness report of 2013-2014 and were analyzed with regression (Ordinary Least Square) method to test hypothesis. Findings show that virtual manufacturing technology has a positive association with nations' competitive capabilities and nations' competitive capabilities is positively correlated with internationalization of firms across countries. Also, nation's competitive capabilities mediates the relationship between virtual manufacturing technology and internationalization of firms while managerial competencies completely moderate the association between virtual manufacturing technology and nation's competitive capabilities. The implication for firms and management was identified with more effective and efficient performance but regardless of this effect, there is associated risk with the adoption of virtual manufacturing technology for production and investigating how to manage this risk is needed.

Keywords: virtual; manufacturing; firm; internationalization; technology; competitiveness; mediation; managerial, competencies.

TABLE OF CONTENTS

ACKNOWLEDGEMENT	v
ABSTRACT.....	vi
TABLE OF CONTENTS	vii
LIST OF TABLES	ix
LIST OF FIGURES	x
APPENDIX.....	x
CHAPTER ONE	1
INTRODUCTION.....	1
1.1 The phenomenon	1
1.2 Motivation of study	3
1.3 Problem definition	4
1.4 Purpose of the study	6
1.5 Research problem.....	6
1.6 Research gap.....	6
1.7 Research disposition.....	7
CHAPTER TWO	9
THEORETICAL PERSPECTIVES	9
2.1 Theories and theoretical framework	9
CHAPTER THREE.....	17
Research model, Hypothesis and Literature review	17
3.1 Research model.....	17
3.2 Firms and internationalization process.....	18
3.3 Virtual manufacturing technology, IT, technology and innovation.....	21
3.3.1 Virtual manufacturing technology	21
3.3.2 IT and virtual manufacturing	23
3.3.3 Technology and innovation	25

3.4 Managerial competencies, education and performance	27
3.5 Competitiveness as a concept	31
3.5.1 Market efficiency.....	33
3.5.2 Business sophistication.....	35
3.5.3 Macroeconomic environment	36
3.6 Related literature	39
CHAPTER FOUR.....	43
Research methods.....	43
4.1 Research design and instrument	43
4.2 Population of study	43
4.3 Data and sources	43
4.4 Variable and measures	45
4.4.1 Internationalization of firms	45
4.4.2 Virtual manufacturing technology	45
4.4.3 Managerial competencies	47
4.4.4 Nation’s competitive capabilities	47
Control variables.....	48
4.4.5 Domestic market size.....	48
4.4.6 Port infrastructure	49
CHAPTER FIVE.....	51
Data analysis	51
5.1 Research model.....	51
Concept 1.....	51
Model I	51
Model II.....	51
Concept 2.....	51
Model III.....	51

Model IV	51
Model V.....	52
5.2 Test, reliability and validity assessments	53
5.2.1 Descriptive statistics and test for multicollinearity.....	53
5.2.2 Normality, linearity and homoscedasticity check.....	55
5.3 Test results of the theoretical model and interpretation	57
Concept 1: Analysis for effect on nations' competitive capabilities	58
Concept 2: Analysis for effect on internationalization	59
CHAPTER SIX	63
Discussion, summary and concluding remarks, recommendation, limitations and suggestions for further Research.	63
6.1 Discussion.....	63
6.2 Summary and Concluding Remarks	67
6.3 Limitations and Suggestions for Further Research.....	68
REFERENCES.....	69

LIST OF TABLES

Table 1: Notation.....	52
Table 2 : Interpretation of regression coefficients	52
Table 3: Descriptive statistics and correlation for all independent variables	54
Table 4: Condition number for multicollinearity diagnostic	54
Table 5: Heteroskedasticity test using Cameron & Trivedi's decomposition of IM-test and Breusch-Pagan / CookWeisberg test.....	56
Table 6:(Model I and II) - Regression results for the impact of virtual manufacturing technology and the interaction effect of managerial competencies on nations' competitive capabilities.....	57
Table 7: change in R2 between model 1 and model	57
Table 8:(model III, IV &V) - Regression results for the effect of control variables, nations' competitive capabilities and its mediation role on internationalization.....	58
Table 9: Change in R2 between model III and IV	58

Table 10- Bootstrap results	61
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LIST OF FIGURES

Figure 1: Virtual manufacturing technology’s capability for internationalization of firms....	17
Figure 2: The Internationalization Process of the firm, (Andersen 1993, p.212).....	20
Figure 3: Virtual manufacturing, adaptation from Dépincé et al (2004)	21
Figure 4: Improved GDP with Moderately Strong Knowledge Improvement (Hanushek and Wößmann 2007, p.45).....	30
Figure 5: Porter’s diamond of business clusters (Njecovan 2006, p.205).....	38
Figure 6: Graph A and B: Normality check with kernel density plot with the normal option and standardized normal probability (P-P) plot.....	55
Figure 7: Graph C- Residual vs fitted plot	55
Figure 8: Graph d - interaction effect.....	59
Figure 9: 6j and 6k (Direct effect and mediation effect model).....	61

APPENDIX

Appendix 1	- Variable measurement and computation
Appendix 2	- Entrepot countries
Appendix 3	- Result for model I & II
Appendix 4	- Interaction result
Appendix 5	- Mediation result

CHAPTER ONE

INTRODUCTION

1.1 The phenomenon

In the contemporary business environment, firms are striving for growth and expansion in order to increase profitability and sustain the going concern of their business. To achieve this, firms try to look beyond their primary market and extend production, sales and supply of products to other markets outside their countries referred to as internationalization. Today, internationalization looks like a feasible opportunity for all kinds of firms (small and large companies), as a simple and quick way to enter foreign markets (Monteiro, 2013). Surviving this strategic move requires a lot of competitive struggles among many competitors in the area of production techniques and input, majorly virtual manufacturing technology as related to this study to achieve greater efficiency, effectiveness and competitive advantage. According to Dana and Wright (2004), studies focusing on new technology-based firms propose that they are able to build up networks that elevate the probability of selecting a joint venture to penetrate the foreign market. This relationship is necessitated due to the fact that some firms are unable to carry out the complete line of production and marketing activities required in international business since it involves locations and markets beyond local level.

Within international marketing or international management, internationalization is a very important concept that must be taken into consideration for the achievements of global competitiveness: "It may be thought of as a process, an end result or a way of thinking" (Gerald Albaun & Edwin Duerr 2011, p.24). It was generally believed by scholars that internationalization is broad, confusing and has many applicability. On this note, it was said to be a difficult phenomenon to define. Nevertheless, internationalization is not without some definitions. Taking one of these, Welch and Luostarinen (1999), noted that researchers were conceptualizing internationalization as an "outward movement towards firms' engagement in international operations". According to them, "internationalization is not just an outward movement, but a process that could assume both directions: inward and outward." They positioned that, internationalization is, "the process of increasing involvement in international operations." An international operation refers to the production of goods and services in international locations and markets. Therefore internationalization is a marketing activity that is carried out further than national border.

Some researchers have apparently looked at how virtual manufacturing technology (VMT) can affect firms' internationalization in different ways. Virtual Manufacturing is a system, in which the intangible models of manufacturing objects, processes, activities, and principles evolve in a computer-based environment to improve one or more features of the manufacturing process (Marinov, 2000). Sinkovics et al. (2013) in their quest to exploring virtuality trap in internationalization process fostered internet as an alternative path. Shi and Gregory (2005) saw this phenomenon in the perspective of emergence of global manufacturing virtual networks and establishment of new manufacturing infrastructure for faster innovation and firm growth. Even though the term virtuality exist in the study of Sinkovics et al. (2013) and Shi and Gregory (2005), virtual manufacturing technology as a determinant of internationalization have not been properly coined for research study. Since there are many channels to internationalization process of firms, their study have not found an empirical evidence of how virtual manufacturing technology can dynamically affect the internationalization of firms across countries. Therefore, this study focuses on this phenomenon to improve on firms' internationalization research studies.

Brown (2000), argues that if a firm wants to remain in business, there is no choice between whether to invest in technology or not. It can only make decisions about the type and extend of process technological investment. The adoption of the automated systems has been one of the available alternatives for companies to compete within this new reality (Boyle, 2006; Zhang et al., 2006). Mechling, Pearce and Busbin, Muscatello, Small and Chen (1995), noted that a number of small firms have been incorporating advanced manufacturing technologies (AMT) that permit them to attain a competitive advantage in terms of quality, flexibility, time-to-market and quick response to changes in the market. This adoption is an inbound type of open innovation which support the use of external sources of innovation within a firm (Chesbrough & Growther 2006). This suggest that internationalizing firms will have to take into consideration the combination of the application of virtual manufacturing technology and managerial competencies from firms resource based perspective/dynamic capabilities to achieve efficiency, effectiveness and improved competitiveness. Dynamic capabilities have been defined as "the capacity to renew competencies so as to achieve congruence with the changing business environment" by "adapting, integrating, and reconfiguring internal and external organizational skills, resources, and functional competencies" (Teece et al., 1997, p. 515).

In order to properly reflect on virtual manufacturing technology as a determinant of internationalization of firms, this paper uses empirical data to provide a groundwork and theorize a model founded on resource based theory/dynamic capabilities to determine this phenomenon.

Consequently, I aspire to make some contributions. First, to properly theorize and investigate firms' dynamic capabilities associated with virtual manufacturing technology as a determinant of internationalization of firms across countries. Second, this study in relation to nations' competitiveness contributes to Shi and Gregory (2005) assertion that a firm which can manage a global manufacturing virtual network (GMVN) effectively will be in a much stronger competitive position. As defined by Michael Porter as cited in Robert D. Atkinson (2013, p.2), "the only meaningful concept of competitiveness at the national level is productivity." Atkinson (2013, p.2), noted that it is how an "economy manages the totality of its resources and competencies to increase the prosperity of its population". Following Atkinson's definition, this study will determine how nations' firms can achieve internationalization with virtual manufacturing technology through the intervention of nation's competitive capabilities (NCC). This value creation from resource based perspective is the major objective of the study.

Following an appropriate estimation procedure, reliability and validity assessments of data was conducted to test whether the variable constructs and the resulting distribution fit the requirements for ordinary least square (OLS) regression used in this study. Test result evidently show that there was a presence of heteroscedasticity which affects the Best Linear Unbiased Estimation. Going by a heteroscedasticity-consistent standard error (HCSE), the estimator of OLS parameter estimates, White correction was used to estimate the regression with robust standard errors to correct for errors associated with heteroscedasticity. The regression results show that virtual manufacturing technology positively affects nation's competitive capabilities and nation's competitive capabilities affects internationalization of firms positively. Also nations' competitive capabilities completely mediate the relationship between virtual manufacturing technology and internationalization of firms while managerial competencies moderates the association between virtual manufacturing technology and nation's competitive capabilities.

1.2 Motivation of study

Many scholars have researched the internationalization of firms from different perspectives with different variables but seems research has rarely been able to examine the impact of virtual manufacturing technology as a potential predictor. As pointed out in section 1.1, Sinkovics et al. (2013) and Shi and Gregory (2005) are examples of few researchers who have written a bit closely on virtual manufacturing as a determinant factor. Another researcher to be considered is Sharon Loane (2006) on the role of the internet in the internationalization of small and medium

sized companies. It is evident that their main focus is on the use of internet but the element of virtuality has reflected in their studies. The concept of virtual manufacturing or virtual manufacturing technology have been researched by some researchers in the field of engineering on how it affects production and the understanding of its dynamics but it is no doubt that these scholars both in management and other fields have not directly modelled virtual manufacturing technology as a function of internationalization of firms and therefore it suggests that there is a gap yet to be filled by not going this direction.

Studies on virtual manufacturing technology application in determining internationalization could be considered as a new research area. As conceived by some researchers in the field of engineering, ‘Virtual manufacturing (VM) is a new kind of manufacturing technology’ (Heping Li & Xiaoqiu Zheng, 2010, p.279). Based on this assertion, this study have been motivated to explore, discover and contribute new knowledge to ongoing research area of firms’ internationalization. Most research studies on internationalization is found with studies on SMEs at firm level with predictor variables different from virtual manufacturing but the unique difference in this study is that internationalization of firms encompasses all firms (big and small) and it is carried out at the country level. The study aims to show how the capabilities of virtual manufacturing technology can affect internationalization of firms at the country level and how countries’ competitiveness plays a mediation role on the effect. Managerial competencies in turn is presumed to strengthen the association between virtual manufacturing technology and internationalization. A significant considerable contribution of this study is the country level approach from which virtual manufacturing technology is conceived in order to investigate whether the capabilities embedded in this type of technology contribute a more sustainable competitive advantage.

1.3 Problem definition

Internationalization of firms all over the world seem to depend on virtual manufacturing technology .The major challenge is that most firms have not taken a proper account of the necessity of this vital tool for the actualization of internationalization process and improved competitiveness . Many firms operating in their own business environment in different countries with the opinion to becoming international companies could take giant steps by seeing the need to operate heavily with virtual manufacturing technology application tools for this achievement. To compete in the international market, a competing product production process must be cost effective and efficient to survive competition. One of the benefits of virtual manufacturing

technology as noted by Philippe Dépincé, Damien Chablat, Peer-Oliver Woelk (2007,p.7) is that, “from the production point of view it will reduce material waste, reduce cost of tooling, improve the confidence in the process, lower manufacturing cost,...: in the production phase.” These benefits are no doubt part of the competitive capabilities in internationalization process. However, for virtual manufacturing technology of nations’ firms to be effective in the internationalization process, managerial competence is presumed to moderate the relationship between virtual manufacturing technology and nation’s competitive capabilities in order to effectively affect internationalization. Also, it is presumed that the presence of domestic market size and port infrastructure as control variables should be present in the model.

It seems many firms worldwide are not internationalized efficiently due to lack of implementation of virtual manufacturing technology in combination with other factors within the firm and nations as identified in this study. From the perspective of resource based theory/dynamic capabilities, virtual manufacturing technology, managerial competence and nations’ competitiveness as a mechanism will provide opportunity for growth. As management attempts to judiciously use the obtainable resources, a dynamic interacting process transpires and boosts a continuous, but limited, rate of growth of the firm. To focus attention on the fundamental role of the firm’s inherited resources, the environment is treated primarily as an image in the entrepreneur’s mind of the possibilities and restrictions with which it is confronted. (Penrose 1959).

The inability of firms to leverage on the dynamic interacting process as noted by Penrose in the foregoing in relation to virtual manufacturing technology application could lead to inefficiency and this inability has a reverse multiplier effect on the nations’ economic growth and internationalization of firms. Specifically, if there is an increase in the use of virtual manufacturing technology in combination with other identified variables, it is perceived that it will lead to the achievement of internationalization and improved performance. For example, it will lead to high export activities of firms in a country due to improved productivity level which in turn will lead to more economic growth. As noted by Welch and Luostarinen (1999), internationalization is associated with series of activities that add to participation in international operations. High export activity in general has a potential multiplier effect on the economy but on the contrary, it will lead to downward or reverse multiplier effect. To improve the multiplier effect of a nation through its competitiveness, internationalization of firms should be taken into

proper account and implemented with the use of virtual manufacturing technology in combination with other factors proposed in this study.

1.4 Purpose of the study

The main purpose of the study is to determine how internationalization of firms can be accomplished by the use of virtual manufacturing technology and the relationship between virtual manufacturing technology and internationalization of firms being mediated by nation's competitive capabilities. In order to achieve the main objective of study, the following superficial objectives are identified as to:

- (i) Analyze the concept of virtual manufacturing technology and its dynamic capabilities
- (ii) Analyze nations' competitiveness as a concept and its mediation role
- (iii) Evaluate the moderating role of managerial competencies on the studied model
- (iv) Analyze the concept of internationalization as a measure of performance of firms across countries.

1.5 Research problem

In order to properly investigate the phenomenon under study, the research problem is identified as three connected parts to form one entity as follows:

Research problem 1 - Does virtual manufacturing technology has an impact on nations' competitive capabilities?

Research problem 2 - Does nations' competitive capabilities has impact on the degree of internationalization and mediate the relationship between virtual manufacturing technology and internationalization?

Research problem 3 - Does managerial competencies moderate the association between virtual manufacturing technology and nations' competitive capabilities?

1.6 Research gap

Researchers like Shi and Gregory (2005) and Sinkovics et al. (2013) have shown that internationalization of firms will improve performance. Shi and Gregory (2005) identified new type of manufacturing design called a global manufacturing virtual network (GMVN) to achieve internationalization. From the analysis of Shi and Gregory (2005), it is apparent that virtual manufacturing technology should be the proper identity for GMVN. Looking at the dynamics of GMVN as analyzed by Shi and Gregory (2005), some attributes of virtual manufacturing technology application is evident. However, the application of

virtual manufacturing technology is wider in scope and seem to have superior delivery in term of effectiveness and efficiency. It is innovation embedded and depend on supportive resource pool. In a GMVN, Shi and Gregory (2005, p.624) believe that major companies does not need to retain internal manufacturing resources to satisfy volatile market demand but will depend upon a co-operative resource pool—a virtual network as a means for supply network to deliver a customer essential solution i.e. dynamic capabilities. Contrary to Shi and Gregory (2005) assertion, this study posit that the association between virtual manufacturing technology and nations' competitive capabilities, particularly with the interaction of managerial competencies (internal manufacturing resource) will stimulate higher levels of firms' dynamic capabilities. Therefore, the inability to identify and properly theorize how virtual manufacturing technology can affect internationalization, improve firm's dynamic capabilities and sustained competitive advantage in the previous studies is the gap deemed fit to be filled in this study.

1.7 Research disposition

The research study is constructed to have six chapters in the following order. Chapter one is the introduction. The introduction contains the phenomenon, motivation of study, research gap and research problem. Chapter two is the theoretical perspectives. It contains theories and theoretical framework. Chapter three is Research model, hypothesis development and literature review. Chapter four is the research method. It contains the population of study, research design and instrument, sample, data and sources and variables and measures (dependent, independent and control variables). Chapter five is data analysis. It contains, research models, test, reliability and validity assessments and test results of the theoretical models and interpretation. Chapter six will incorporate the discussion, summary and concluding remarks, limitations and suggestions for further research.

CHAPTER TWO

THEORETICAL PERSPECTIVES

2.1 Theories and theoretical framework

In understanding firm innovation related processes, resource-based view (RBV) have been seen appropriate by many researchers (Rotefoss, 2001 & Dollinger, 1999). Conferring to RBV scholars, the firm can be conceived as a bundle of resources and capabilities (Barney, 1991, Barney, 1995, Barney, 2001, Conner, 1991, Mahoney & Pandian, 1992; Amit & Schoemaker, 1993). Resources refer to, “tangible and intangible assets (that) firms uses to conceive of and implement its strategies” (Barney & Arian 2001, p. 138). The word “resource” refers to something an organization can draw on to accomplish its goals; Barney and Hesterly (2012) suggest four main resource categories: physical, financial, human, and organizational which have capabilities. Capabilities are subsets of the firm’s resources, which represent “an organizationally embedded non-transferable firm specific resource whose purpose is to improve the productivity of the other resources possessed by the firm” (Makadok 2001, p.389). They are generally information-based, tangible or intangible processes that enable a firm to deploy its other resources more efficiently and therefore enhance the productivity of those resources. Capabilities have been identified to be special types of resources whose purpose is to improve the productivity of other resources possessed by the firm (Makadok 2001). Technological assets are identified as part of these resources. While there is an emerging market for know-how (Teece, 1981), much technology does not enter it. This is either because the firm is unwilling to sell it or because of difficulties in transacting in the market for know-how (Teece, 1980).

The resource based view is used as a theoretical framework to examine the relationship among virtual manufacturing technology, nations’ competitive capabilities as well as managerial competencies as predictor variables to achieving internationalization of firms across countries (see Figure 1). In order to properly develop the model, this study builds on theoretical works on resource based theory/dynamic capabilities developed by Teece et al. (1997) *Dynamic Capabilities and Strategic Management* and Peteraf (2003) *Cornerstones of Competitive Advantage*. Resource based theory (RBT) contends that sustainable competitive advantage (SCA) is generated only when resources are valuable, rare, imperfectly imitable, and the firm’s organization (VRIO) enables exploitation of the resources’ potential (Barney & Hesterly 2012). According to Peteraf and Barney (2003, p. 314), a firm achieves a competitive advantage when it is able to generate “more economic value than the marginal (breakeven) competitor in its product market.” A firm has achieved a sustained competitive advantage (SCA) “when it is creating

more economic value than the marginal firm in its industry and when other firms are unable to duplicate the benefits of this strategy” (Barney & Clark 2007, p. 52). Dynamic capabilities as introduced by Teece et al. (1997) can “continuously create, extend, upgrade, protect, and keep relevant the enterprise’s unique asset base,” in a changing environment (Teece 2007, p. 1,319). “The term 'dynamic' refers to the capacity to renew competencies so as to achieve congruence with the changing business environment” (Teece et al. 1997, p.515).

Internationalization is frequently accompanied by enhanced firm performance, growth and competitiveness (De Loecker, 2007). Since one of the objectives of internationalizing firms is to sustain performance and compete in a vantage position with rare, imperfectly imitable and valuable resources by continuously creating, extending, upgrading, protecting, and keeping relevant the enterprise’s unique asset base, resource based theory/dynamic capabilities has been identified to be appropriate for analysis in this study. Following this theory, the model focuses on variables at country level for analysis. Jones’s (1999) research work on the process of internationalization showed the value of cross-border activity in relation to small firm growth with performance. Bradley and O’Reagain (2001) stated that SMEs could internationalize to seek rapid growth. Growth can be measured in firm performance through export sales. They suggested that internationalization have a positive relationship with firm performance. Looking at internationalization of firms from the perspective of performance, internationalization is the performance of firms outside its home country i.e. across national boundary for competitive advantage. Barney (1986) argued that the economic performance of firms depends not only on the returns from their strategies but also on the cost of implementing those strategies. Meanwhile, without inadequacies in strategic factor markets, where the resources required to implement strategies are acquired, firms can only hope for normal returns. Therefore, to sustain competitive advantage in the competitive market place, the dynamic capabilities’ view of the firm would suggest that the behaviour and performance of a particular firm may be quite hard to replicate, even if its consistency and rationality are visible as related to replicability and imitability of organizational processes and positions (Teece et al., 1997).

The competences and capabilities (competitive advantage) of a firm is pivoted essentially on processes, shaped by positions and paths. Competences can provide competitive advantage and generate rents only if they are grounded on a pool of routines, skills, and complementary assets that are difficult to imitate Teece et al. (1997). To understand imitation, replication must be understood. Replication includes transferring or redeploying competences from one concrete economic background to another. Since productive knowledge is embodied, replication cannot

be accomplished by simply transmitting information. Therefore, unless firms have replicated their systems of productive knowledge on many previous occasions, the act of replication is possible to be difficult (Teece, 1976). Teece et al. (1997) posit that two types of strategic value will flow from replication. First, the ability to support geographic and product line expansion. It means that the extent that the capabilities in demand are relevant to customer needs elsewhere will make replication to convene value. Second, the ability to replicate indicates that the firm has the basics in place for learning and improvement.

Rumelt (1984) invented the term 'isolating mechanisms' to refer to phenomena which protect individual firms from imitation and preserve their rent streams. These include property rights to scarce resources and many quasi-rights in the form of lags, information asymmetries, and frictions which hinder imitative competition (Rumelt, 1987). Other isolating mechanisms include producer learning, buyer switching costs, reputation, buyer search costs, channel crowding, and economies of scale when specialized assets are required (Rumelt, 1987). Rumelt (1984) terms isolating mechanisms as mobility barriers. Mobility barriers, serve to isolate groups of similar firms in a heterogeneous industry, while entry barriers isolate industry participants from potential entrants. Yao (1988) refined a set of factors more basic than mobility barriers. He posit that failures of the competitive market are due more fundamentally to production economies and sunk costs, transaction costs, and imperfect information. Dierickx and Cool (1989) suggest an exceptional view on the topic of limits to imitation. They focus on factors which prevent the imitation of valuable but nontradeable asset stocks. In their view, how imitable an asset is depends upon the nature of the process by which it was accrued. The identified characteristics which serve to impede imitation include: time compression diseconomies, asset mass efficiencies, and interconnectedness of asset stocks, asset erosion, and causal ambiguity. Going by resource based theory, these nontradeable assets seems to be found with virtual manufacturing technology since it is still a very valuable and scarce resource of the firm.

A firm's technological assets may or may not be protected by the standard instruments of intellectual property law but the ownership protection and application of technological assets are evidently key differentiators among firms (Teece et al., 1997, p.521). Therefore, virtual manufacturing technology can be identified as a non-transferable (nontradeable asset), tangible resource of the firm required for enhancement of the productivity of other resources possessed by firms. Virtual manufacturing is “an integrated, synthetic manufacturing environment exercised to enhance all levels of decision and control” (Philippe Dépincé, Damien Chablat &

Peer-Oliver Woelk, 2004). Relating virtual manufacturing technology's capabilities to Johanson and Vahlne, (1977, 1990) internationalization model, based on the assertion of Dépincé et al, (2004), in the foregoing, it may be reasonable to say that virtual manufacturing technology incorporates the capacity for innovation and therefore the fulfilment of 'market knowledge', 'market commitment', 'market decision' and current business activities can be seen as an all-inclusive function of the scope and socio – economics factors of virtual manufacturing enumerated by Lin et al. (1994). "Virtual manufacturing is a capital intensive technology and a lot of small and medium enterprises do not have the wherewithal to integrate them" (Philippe Dépincé, Damien Chablat, E. Noel & Peer-Oliver Woelk, 2004, p.7). This shows that virtual manufacturing technology is rare, valuable and may not be easily imitated. Thus sustainable competitive advantage can be achieved with virtual manufacturing technology by firms that have been able to integrate it into their production system.

Going by resource based theory, sustainable competitive advantage can be generated looking into the scope and socio – economics factors of virtual manufacturing (VM) which according to Lin et al. (1994) refers to as paradigms and expected benefits respectively. The capabilities aspect can be linked to three paradigms(scope) :(1) Design-centered VM which provides manufacturing information to the designer during the design phase (2) Production-centered virtual manufacturing which uses the simulation capability to model manufacturing processes with the purpose of allowing inexpensive, fast evaluation of many processing alternatives and (3) -Control-centered VM: which is the addition of simulations to control models and actual processes allowing for seamless simulation for optimization during the actual production cycle(Lin et al., 1994). The dynamic aspect can be linked to the socio – economics factors: (1) Quality: Which is the design for manufacturing and higher quality of the tools and work instructions available to support production (2) Shorter cycle time: This increase the ability to go directly into production without false starts (3) Producibility: This optimize the design of the manufacturing system in coordination with the product design; first article production that is trouble-free, high quality, involves no reworks and meets requirements. (4) Flexibility: This is the ability to perform product changeovers rapidly, mix production of different products, return to producing previously shelved product.(5) Responsiveness: This is the ability to respond to customer "what-ifs" about the impact of various funding profiles and delivery schedule with improved accuracy and timeless. (6) Customer relations: This is improved relations through the increased participation of the customer in the Integrated Product Process Development process

(IPPD) (Lin et al., 1994). IPPD is a management technique that simultaneously integrates all essential acquisition activities through the use of multidisciplinary teams to optimize the design, manufacturing and supportability processes. IPPD facilitates meeting cost and performance objectives from product concept through production, including field support (Department of Defence, 1998).

One of the conditions of VRIO framework relates to the organization. Even if a resource is valuable, rare, and imperfectly imitable, a firm must be “organized to exploit the full competitive potential of its resources and capabilities” (Barney & Hesterly 2012, p. 94). That is, poor organizational processes, policies, and procedures may undermine a resource’s potential competitive advantage (Barney & Clark 2007). Thus, the organization acts as an “adjustment factor” that either enables or prevents a firm from fully realizing the benefits embodied in its valuable, rare, and costly to imitate resources (Barney & Clark 2007). “Resources which are immobile because of their idiosyncratic or firm-specific nature are certainly heterogeneous” and “the productivity of superior resources depends upon the nature of their employment and the skill with which a strategy based on resource superiority is implemented” (Peteraf 2003, p. 185). Following these arguments, managerial competencies of firms can be seen as organizational process, policies and procedures that enhances virtual manufacturing technology’s potentials while the nation’s competitive capabilities is considered as a larger picture of the organizational processes which will also increase these potentials at the country level. Considering that virtual manufacturing technology application is rare and costly, applicable managerial competencies for its operational enablement would also be unique and scarce to imitate which makes it heterogeneous and superior.

Resource-based perspective considers managerial strategies for developing new capabilities (Wernerfelt, 1984). Woodruff (1991) defined managerial competency as "a set of employee behaviours that must be used for the position that the tasks arising from this position competently mastered." According to Woodruff (1991), the competent manager must fulfil three basic conditions at the same time to fulfil their tasks: (1) possess the knowledge, skills and abilities, which are needed to this behaviour, (2) be motivated to this behaviour and be willing to spend the necessary energy, (3) have the possibility to use this behaviour in business environments. Therefore, if control over rare resources is the source of economic profits, then it follows that such issues as skill acquisition, the management of knowledge and know-how (Shuen, 1994), and learning become ultimate strategy. The aspect that include skill acquisition, learning, and build-up of organizational and intangible or 'invisible' assets (Itami & Roehl,

1987), describes the ultimate potential for contributions to firms' strategy. Managerial competencies are human resources (HR) and according to Ksenofontova Khalidia (2012), HR competencies are assurances of success of firms' position in the market, as competition in the modern business environment is not a struggle of material resources, but of new forms of marketing strategies, innovation ideas and intuitive abilities of the personnel. From resource based perspective, these HR competencies must be valued, scarce to replicate, not easily imitated, and the firm's organization must be willing to fully exploit its potential to achieve sustainable competitive advantage i.e. competitiveness.

De Loecker, (2007) attribute one of the objectives of internationalizing firms to competitiveness. In a less competitive environment, managerial competencies are applied through the inactive adaptation of the organization to the market changes. In a very competitive market, the promotion of goods is relatively a tough process. Therefore, managerial competencies tend to become a strategic resource that affects the position of business on the market (Khalidia 2012). Competitiveness is a multidimensional construct (both quantitative and qualitative) and dynamic: an indication that a firm has sustainable competitive advantage (Depperu & Cerrato, 2005). Depperu and Cerrato (2005) maintain that competitiveness can be evaluated by firm-specific, industry-specific, and country-specific factors which affect the dimensions of competitiveness. Focusing on the country specific factors, the dynamics of this factors can be termed the 'nations' competitive capabilities'. Porter (1980), posit that the competitive forces approach views the essence of competitive strategy formulation as relating a firm to its environment. However, environment cannot be described in terms of markets alone but must be extended to nations' institutions (Teece et al., 1997). Conceiving that this business environment are country specific factors and these factors are nations' institutions (nations' competitive capabilities) , it is proper to draw on Depperu and Cerrato (2005) assertion that a country's competitiveness factors will cause its firms to sustain competitive advantage internationally (i.e. international competitiveness) which is its firms' competitiveness in comparison to other countries' firms.

Factors that determines competitiveness is established on comparison, it is a relative concept in the sense that criteria and variables used to measure such construct cannot be applied irrespective of specific time and spatial conditions (Depperu & Cerrato 2005). These factors measures institutions of nations, policies, and factors that set the sustainable current and medium-term levels of economic prosperity which in essence is referred to as global competitive index (GCI). On this assertion, if the objective of internationalizing firms is to sustain

competitive advantage internationally, then firms' international competitiveness is a function of nations' competitive capabilities .Therefore, nations' competitive capabilities is a required resource of the firm to compete in the international market for sustainable competitive advantage. Going by resource based theory, the degree of internationalization of firms across countries will be determined by the uniqueness of nations' competitive capabilities.

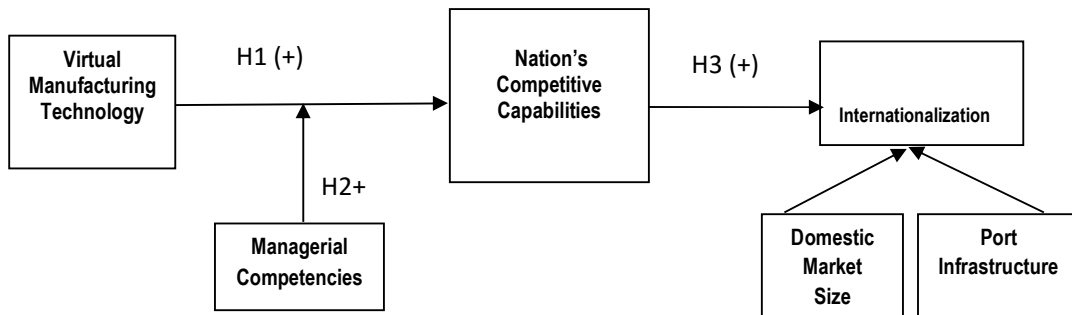
CHAPTER THREE

Research model, Hypothesis and Literature review

3.1 Research model

This study explore how virtual manufacturing technology can determine internationalization of firms on a country level through the intervention of nations' competitive capabilities while managerial competencies will moderate the association between virtual manufacturing technology and nations' competitive capabilities as presented in the conceptual framework in Figure 1.

Figure 1: Virtual manufacturing technology's capability for internationalization of firms



A conceptual framework is defined as the system of concepts, assumptions, expectations, beliefs, and theories that supports and informs a research. It is a key part of the research design (Miles & Huberman, 1994; Robson, 2011). Conceptual framework is in form of a network and in a network, there are connections amongst entities which can be characters, clusters, systems, fields, ideas or communities, with a set of general guiding statements (Downes, 2005), which can be referred to as networks of organized interaction. This implies that, in a network, structure of connections (connectivity) is the basis for its meaningful existence as presented in a specified directional statement. Therefore, the link of identified variables in a country level built on resource based theory/dynamic capabilities is modelled in this study as the research conceptual framework. Virtual manufacturing technology is perceived to positively affect nation's competitive capabilities. Nation's competitive capabilities is presumed to mediate the association between virtual manufacturing technology and internationalization and positively affect internationalization while managerial competencies is presumed to moderate the association between virtual manufacturing technology and nation's competitive capabilities. According to

Jean (2007) and Jean et al. (2008), resource based value (RBV), maintains that IT resources unaccompanied cannot contribute to a firm's competitive advantage. Therefore, domestic market size and port infrastructure are both included in this model as control variables to complement virtual manufacturing technology capabilities(IT driven) in order to determine the internationalization(performance) of firms across countries.

3.2 Firms and internationalization process

Internationalization has been noted to be a means for firms' survival, flourishing (Majocchi et al., 2005) and stimulate their economic growth (Archarungroj & Hoshino, 1998) while export give the impression of a sustainable opportunity for different firms as a modest and fast way to enter foreign markets (Monteiro 2013). Albaun and Duerr (2011, p.24), says, "internationalization is most effective when developed as a carefully planned process for increasing penetration of international markets." They stressed that small firms always go about internationalizing differently in a different manner than larger companies. Internationalizing firms attempt to go beyond their primary market in order to be competitive and competitiveness is often times believed to be productivity. The measurement of the degree of internationalization and the relationship between degree of internationalization and performance are key issues in international business research (Sullivan, 1994). The connection between firm size and export performance looks as if they are inconsistent but firm size according to research can affect export behaviour in the exploration for economies of scale and to distribute common expenses over expanded markets (Majocchi et al 2005). L. S. Welch, G. R. G. Benito and B. Petersen (2007), categorized the foreign operation approaches as contractual and see it from the perspective of exporting or investment activities. The contractual activities includes franchising, licensing, subcontracting and alliances while export activities can be indirect or direct via an agent or distributor, and through a subsidiary or sales office. In investment activities, foreign direct investments (FDI) are the most influential way of entering the foreign market and the control level are different from minority share, to 50/50, to majority share or 100% ownership. However, trade is the oldest means of foreign operation associated with exporting and importing goods and services to and from different markets in the countries of the world.

Characteristically, exporting is traced with a low risk and a cheap way of entering the foreign markets and permits and therefore fits concurrently into a greater number of markets. Its main drawbacks are extra transport costs, supply and marketing costs (this is country dependent) and additional financial and legal risks factors. While some costs differ with the volume

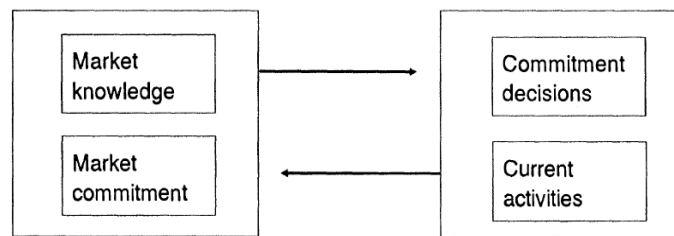
exported, some are not. If the firm does not thrive internationally, approximate fixed costs can be recouped but may not apply to the sunk costs (Owen Gabbitas & Paul Gretton, 2003). “Fixed costs associated with entry are an important factor in the decision to export. If exports become a success some activities may be internalized” (Monteiro 2013, p.3).

The internationalisation of firms is said to be an essential key for increasing the competitiveness of firms and to reduce the degree of susceptibility to the changes in demand conditions attributed to competitors who are new entrants (Pereira et al., 2009). The argument put forward by Uppsala School is that the internationalization process took a pathway in a consecutive and incremental stages, in such a way that firms’ participation in the market, is likely to ascertain four stages: (i) absence of steady activities of exporting (ii) exporting through agents, (iii) formation of profitmaking subsidiaries, and (iv) creation of production divisions. On this premise, the time of the change from export to the creation of subsidiaries is incompletely determined by the type of competitive advantage of the firm, and the process of internationalization is understood as a process of organizational education and positive changes that take the knowledge as relevant descriptive factor. This theory is said to focus on four parts that firms should face when going global: ‘market knowledge’, ‘market commitment’, ‘commitment decisions’, and ‘current activities’; which are divided into stage and adjustment features that relate with each other (Johanson & Vahlne, 1977).

In the explanation of internationalization across country markets, firms’ new market entry mode was hypothesized with consecutively greater psychic distance. The concept, psychic distance, has been defined as factors inhibiting or upsetting the flow of information between firm and market, as well as factors such as differences in language, culture, political systems, level of education, or level of industrial progress (Johanson & Vahlne 1977, p. 24). In a study conducted by Johanson and Wiedersheim-Paul (1975), firms appear to enter new countries in succession with greater psychic distance. Johanson and Vahlne refined this work by their dynamic model as shown in Figure 2 below. This model is a one in which the expectations of one cycle of events set up the input for the next. The main structure is presented by the difference between state and change features of internationalization variables. The state features are the market commitment (resource aimed for foreign markets), and knowledge about foreign markets and operations. The change features are decisions to deploy resources and performance of current business undertakings (Johanson & Vahlne 1990). According to Andersen:

A basic assumption is that market knowledge and market commitment affect both commitment decisions and the way current decisions are performed-and these, in turn, change market knowledge and commitment. The concept of market commitment is assumed to be composed of two factors-the amount of resources committed and the degree of commitment. The amount of resources could be operationalized as the size of investment in the market (marketing, organization personal, etc.), while the degree of commitment refers to the difficulty of finding an alternative use for the resources and transferring them to the alternative use. The latter concept seems to be close to the concept of sunk cost. (Otto Andersen 1993, p.211.)

Figure 2: The Internationalization Process of the firm, (Andersen 1993, p.212)



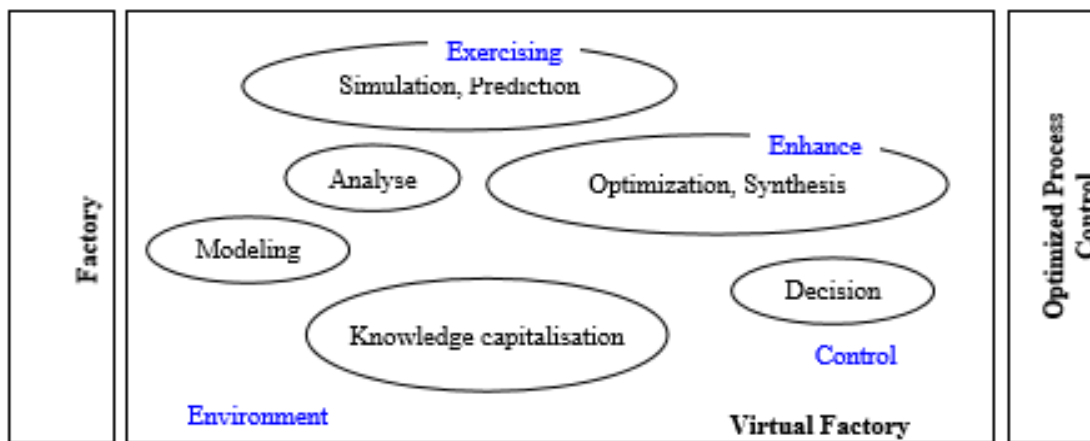
International activities require both general knowledge and market-specific knowledge (Andersen, 1993, p.211). Andersen note that market-specific knowledge is anticipated to be gained predominantly through experience in the market earned over time while knowledge of the operations can be transmitted from one country to another in which whereby the knowledge will later enable lateral growth. He further maintain that a direct relation between market knowledge and market promise is suggested and in way that knowledge can be reflected as an element of human resources. Accordingly, greater knowledge about a market will result in more valuable resources and stronger commitment to the market which is presumed to be particularly true of pragmatic knowledge (Andersen, 1993). Johanson and Vahlne (1977), as emphasized by Andersen believe that current business activities are the primary source of knowledge. The commitment decisions involves the decisions to use current resources for foreign operations. Presumptuously, if these decisions are made in response to perceived problems and/or opportunities in the market, using these resources will depend on experience and will be related to the operations presently implemented in the market (Andersen 1993). Internationalization of firms is basically the experience of market activities in foreign countries which is an after effect of the degree of competitiveness of a nation by absorbing AMT and socioeconomic factors to gain sustainable competitive advantage.

3.3 Virtual manufacturing technology, IT, technology and innovation

3.3.1 Virtual manufacturing technology

According to Dépincé, et al. (2004, p.3), the universal inspiration one can find following most definitions is that “Virtual Manufacturing is nothing but manufacturing in the computer” They classified this definition into first, ‘the process’ (manufacturing) and second, ‘the environment’. They defined virtual manufacturing technology as “manufacture of virtual products defined as an aggregation of computer-based information that provide a representation of the properties and behaviors of an actualized product”. As noted by Dépincé et al. (2004, p.3), the most inclusive definition for virtual manufacturing technology is the one by the Institute for Systems Research, University of Maryland who defined virtual manufacturing technology as “an integrated, synthetic manufacturing environment exercised to enhance all levels of decision and control” as shown in Figure 3. They analyze the components of the models as follows:

Figure 3: Virtual manufacturing, adaptation from Dépincé et al (2004)



- **Environment:** This supports the creation, provides tools, models, apparatus, methodologies and organizational principles.
- **Exercising:** This factor has to do with constructing and executing precise manufacturing simulations using the environment which can be a collection of real and simulated objects, activities and processes,
- **Enhance:** This is a component that amplify the value, precision and validity

- **Levels:** This component starts from product perception to disposal, from factory apparatus to the enterprise and beyond, from material transformation to knowledge transformation,
- **Decision:** This is a comprehension of the impact of change (visualize, organize, and identify alternatives).

Dépincé et al (2004, p.3) opined that one can also define virtual manufacturing technology by concentrating on obtainable methods and tools that permit a continuous, experimental representation of production processes and equipment using digital models. According to them, the areas that are involved are (i) product and process design, (ii) process and production planning, (iii) machine tools, robots and manufacturing system and virtual reality applications in manufacturing.

Virtual technology according to Lin and Fu (2001), has been defined as the modeling and simulation of manufacturing systems, of manufacturing processes (Offodile & Abdel-Malek, 2002) and of prototype manufacture (Waller, 1999). As noted by Webster and Sugden (2003, p.451), most researchers views it as the manufacture of a tangible product using a network of geographically isolated, autonomous manufacturing partners. “A virtual manufacturing network, while consisting of separate partners, gives the appearance of acting as a single enterprise” (Rupp & Ristic, 2000; Rautenstrauch & Turowski, 1999; Lackenby & McBain, 1999). This according to Chesbrough is called open innovation. Open innovation is the use of purposive inflows and outflows of knowledge to increase internal innovation, and expand the markets for external use of innovation, respectively (Chesbrough, 2003). Open innovation can be accomplished through either “inbound open innovation,” which is reflected to be a way for a firm to attain new knowledge by forming networks with other firms in order to create and develop new products or technologies, or “outbound open innovation,” where a firm licenses its knowledge to other firms (Chesbrough, 2003).

Webster and Sugden (2003), believed that researchers have been able to propose success factors for virtual manufacturing. These according to him include the efficient administration of order flow, production planning and scheduling (Richards et al., 1997; Rupp & Ristic 2000; Schumacher et al. 1996); trust and co-operation among partners (Lackenby & McBain, 1999; Marshall et al., 2001; Katzy & Dissel, 2001); and collective purpose, risk and

benefit (Marshall et al.2001).Upton and McAfee, (1996); Schultze and Orlikowski, (2001); Rautenstrauch and Turowski, (1999); Martinez et al., (2001), believe that appropriate use of refined IT is vital to successful performance of virtual technology. While some researchers agreed with the use of IT in virtual manufacturing, some are of the opinion that it will not make any meaning (Quereshi & Zigurs, 2001; Panteli & Dibben, 2001; Katzy & Dissel, 2001).

In the application of virtual manufacturing, Katzy and Dissel (2001), argue that there is a need to shift away from traditional decision and planning systems, such as MRP/ERP. These, according to them, prevent fast reactions (essential to agility/virtuality), and lead to the need for novel processes in order to guarantee success. They referred to virtuality as the pursuit of agility and defined agility as “the capability to succeed in situations of unpredictable change.” Harrison (1997) noted that the ability to momentarily and agreeably configure resources and competencies from a geographically dispersed set of connections of independent partners provides the means to bring products to market in least time. This process actively become applicable with the use of information technology (IT) based equipment.

3.3.2 IT and virtual manufacturing

According to Albaun and Duerr (2011, p.48), “advances in information technology and other areas of technology has affected international marketing.” In conjunction with operations strategy, acknowledged technology and innovation strategies are seen as essential parts of a general strategic design to inform and equip an organization for operating within the new international business environment (Banerjee, 2000; Phaal et al., 2001). As stated by Webster and Sugden (2001a, b), “a virtual manufacturing system is fluid and re-configurable. It has the agility to be both highly responsive and highly flexible in the light of dynamic customer needs.” They maintained that by means of this approach to technology exploitation, the technology inventor could design and develop “own-label” products, but use a network of autonomous suppliers and subcontractors for manufacture. From the perspective of ex ante manufacturing companies, the adoption of a virtual approach is said to benefit small and medium sized firms by facilitating the development of the critical mass normally associated with a larger firm (Lackenby & McBain, 1999) and to benefit original equipment manufacturers (OEMs) by providing advantages associated with margins, capital, time-to-market, geographic expansion, flexibility and specialization (Ansley, 2000).

It is expected that the employment of advanced manufacturing technology into the manufacturing process of firms brings about reduction in processing time and fast delivery of

products to suppliers as against the traditional way of production process in firms that cannot afford modern technologies in production. However, common strategic standing on speeding up all sectors of the firm's operation is becoming frequent (Brian Dumaine, 1989). This according to Milgrom and Roberts (1990, p.512), is manifested in shorter product development times, quicker order processing, speedier delivery as well as producing products faster. Technology is a veritable tool in the manufacturing sector to become efficient and effective. It is said that in the contemporary competitive market where technological improvement and its development are very significant, on-time delivery is a very essential part, among many other things, for the achievement of a product (Karim et al., 2010). Mahmoud-Jouini et al. (2004), asserts that reducing the delivery time of products from supplier to buyer reduces costs and creates value. Also, Maia and Qassim (1999), says a modern development in manufacturing is to reduce inventory and supply the right quantity on-time. They maintained that if delivery times can be correctly approximated for implementation of delivery plans, the obligation for safety stocks diminishes.

The operations of virtual manufacturing technology are characterized by partnership, strategic alliances and the use of IT. For firms to effectively manage its production process and compete in the contemporary market, the use of IT must be given a priority. In the view of Kettinger and Teng:

The assimilation of an IT innovation such as e-business is intertwined with the firm's business strategy, be it to reduce costs and reengineer business processes, to increase product/service differentiation, to achieve growth by developing new products/services and entering into new markets, or to develop strategic alliances. (Kettinger and Teng, as cited in Raymond et al., 2005, p.108).

However, small and medium sized firms' strategic goals are encapsulated in the owner-manager's aspiration to grow by establishing the firm's networks through partnerships, products through innovation, and markets through internationalization (Raymond & Blili, 1997).

The manufacturing perspective or production setting represents a primary phase of the organizational framework of small and medium sized firms (Raymond et al 2005, pg.108). Raymond and his colleagues further stressed that the basic type of the manufacturing process preferred by a firm is influenced by its resources, by its competitive point and by the nature of the goods to be produced (Raymond et al 2005). The production environment then determines different characteristics necessary in terms of production and information processing capabilities (Grover & Malhotra 1999). Hence, mass production ('make-to-stock') as noted by Subash Babu

(1999), requires supplementary standardization, while discrete production ('make-to-order'), the category of production most frequently found in small and medium sized firms, requires superior manufacturing and IT flexibility.

Based on desired results planned to be achieved by firms, the specific manufacturing process adopted will be affected by IT either it is virtual or not. As noted by Mechling et al. (1995), improved necessities for competitiveness, innovation and quality, have led many firms to formulate substantial investments in computer-based manufacturing technologies such as computer-aided design and manufacturing. They have also invested from business associates, in advanced computer-integrated manufacturing applications such as MRP II and now ERP to plan, dominion and run manufacturing assets and operations and connect them with other intra and inter-organizational systems (Kathuria & Igarria, 1997). These technologies and applications represent advanced manufacturing technologies that are well-suited, in terms of enterprise incorporation, to a varying extent with the firms' use of Internet and Web-based IT (Olhager and Rudberg 2003).

3.3.3 Technology and innovation

According to De Mel et al. (2009, p.2). "Innovation is a key to technology adoption and creation." "The adoption and assimilation of IT has been analyzed most often in terms of innovation" (Raymond et al 2005, p.107). This is to say that innovation and technology are both synthetic in the operations of firms for competitiveness. Yusuf (2013, p.105), assert that "technological orientation is viewed as an instrument of strategy." He believed that strategic product development can be used with technology for management of the competition and with the assumption that as more advanced technology is used, there will be increasingly innovative products produced and superior prospect of success will be achieved. The adoption and assimilation of IT and of the Internet especially, are deemed to be predisposed by a number of environmental, organizational, technological and individual factors. While IT adoption is associated with whether or not an organization uses a technology, IT assimilation fundamentally is associated with the extensiveness and intensity of the use (Agarwal et al. 1997; Armstrong & Sambamurthy 1999; Dholakia & Kshetri 2004).

"Innovation is a tool or instrument used by entrepreneurs to exploit change as an opportunity" (Drucker, 1985). "Innovation is the successful exploitation of new ideas" (Yusuf 2013, p.104). Yusuf believed that entrepreneurs should implement more effective operations and

meet the realities of their anticipated market. Putting SME's in this position, innovation is the need to improve processes that facilitates competitive advantage in the market. Humphreys, McAdam and Leckey (2005), note that innovations necessitate some supporting elements that are indispensable for their implementation and can advance the performance of firms. These elements according to them are: (1) leadership, (2) empowerment, (3) culture, (4) technology, (5) learning, (6) structure, and (7) management. In this segment, technology can be seen as the focus for innovation.

As classified in the Bogota and Oslo manuals (OECD, 2005), the general definition of innovation, can be divide into four subcomponents of innovation as: (1) Product innovation: the introduction of a good or service that is new or substantially improved. (2) Process innovation: the introduction of a new or significantly improved production or delivery method. (3) Marketing innovation: the implementation of a new marketing method involving significant changes in product design or packaging, product promotion or pricing. (4) Organizational innovation: involves the creation or alteration of business practices, workplace organization, or external relations. Economic models of innovation have in general focused on product innovation, and additionally differentiate two distinctive types (Gancia & Zilibotti, 2005).The first type as noted by Suresh de Mel, David McKenzie and Christopher Woodruff (2009,p.6), is horizontal innovation, which entails the production of new product that does not dislodge existing products, in so doing increasing the diversity of products produced. The second type is vertical innovation, where the introduction of one product makes an existing product outdated. De Mel et al. (2009) assert that this form of innovation explains the process of creative destruction advocated by Schumpeter, and underlies the growth model of Aghion and Howitt (1992).

According to Albert N. Link (2007,p.6),'' if technology is an innovation put into use, then in a broad sense technology is the physical representation of knowledge.'' Understanding the background and cost of entrepreneurship and innovation is significant because technological change is associated with improvements in economic performance in the firm and among firms in industry (Link 2007, p.1). Link refers to technology in a narrow sense as a specific physical or tangible tool, i.e. an innovation. He stressed that technology in a broader sense refers to indefinable tools such as ''technological ethic or organizational technology'' and that technological change explains an entire collective process. The technological context of small

manufacturing firms is characterized by the nature, flexibility and assimilation of the manufacturing technology used to manufacture goods and deliver services to customers. Therefore, improved necessities for competitiveness, innovation and quality, have led many firms to formulate sizable investments in computer-based manufacturing technologies such as computer-aided design and manufacturing (Mechling et al. 1995).

Firms' quest for competitive advantage in relation to competitors is a fundamental subject matter in strategic management (Teece et al., 1997). Technological innovation as noted by Petra Andries and Dirk Czarnitzki (2011, p.1) is seen as a support for achieving competitive advantage and the uniqueness or factors that influence firm performance in innovation (or innovativeness). They stress that it is extensively acknowledged that an organization's potential to innovate is directly attached to its intellectual capital, i.e. to its capacity to exploit its entity knowledge resources. If innovation is knowledge entity, therefore, knowledge and technology can be discussed in place of innovation and technology (Andries & Czarnitzki, 2011). According to Greenhalgh and Rogers (2010), technology is comprised of the contemporary set of production strategies used to design, create, package, and distribute goods and services in the economy. They stressed that technology is the application of preferred parts of the knowledge accumulation to production process. The technology used specifically by a firm will determine the productive potential when pooled with other input and that inventions and discoveries add to the accumulation of knowledge that can be used in production (Greenhalgh & Rogers 2010). Therefore, virtual manufacturing technology as firms' resource with capabilities is proposed to affect countries' competitiveness since technological innovation is an entity of knowledge. Hence the first hypothesis:

H1- Firms adoption of virtual manufacturing technology has a positive impact on nations' competitive capabilities.

3.4 Managerial competencies, education and performance

The concept of competency is based on the theory of performance. Management performance is the extent and quality of managers' contribution in realizing the objectives of the organization (Shirazi & Mortazavi, 2009). Hellriegel et al. (2008) defined managerial competencies as a set of knowledge, skills, behaviours and attitudes that contribute to personal effectiveness. Bosma et al. (2004) argue that an entrepreneur's specific competencies positively impacts on firm performance. Using managerial capacity index (MCI) as a composite measure of managerial experience and activity, the SME Financing Data Initiative (2009) assert that a high score in the

managerial capacity index is positively associated with both strategic planning practices (planning sophistication, ability to communicate business intentions) and high firm performance and growth. The use of competencies serves to enhance an organization's performance and hence a competitive advantage (Lawler, 1994).

Hormiga et al. (2011) argue that managerial competencies as measured by education, managerial experience, start-up experience and knowledge of the industry positively impact on the performance of small and medium enterprises. Focusing on education, Magoutas et al. (2011, p.141) believe that the utilization of employees with a high educational level is a necessary tool for any enterprise. The high educational level employees employed are University graduates. "These graduates are able to produce knowledge and to contribute decisively to the development of research and innovation, while they simultaneously support the financial performance of the organization they work for" (Magoutas et al. 2011, p.142). According to Schultz (1971), the outcome of education on the economic performance of firms is related or connected to the field of economics that deals on human capital. Schultz (1971) note that education is a venture in knowledge and, as a result, it intensifies labour output. "The first studies which investigated the economic effects of knowledge investment revealed a positive influence of human capital on growth for individuals, firms and nations" (Schultz, 1961). As regards Becker (1962), these studies revealed that economies with well-educated employees demonstrated faster development and a more speedy increase in output than those with lower levels of education.

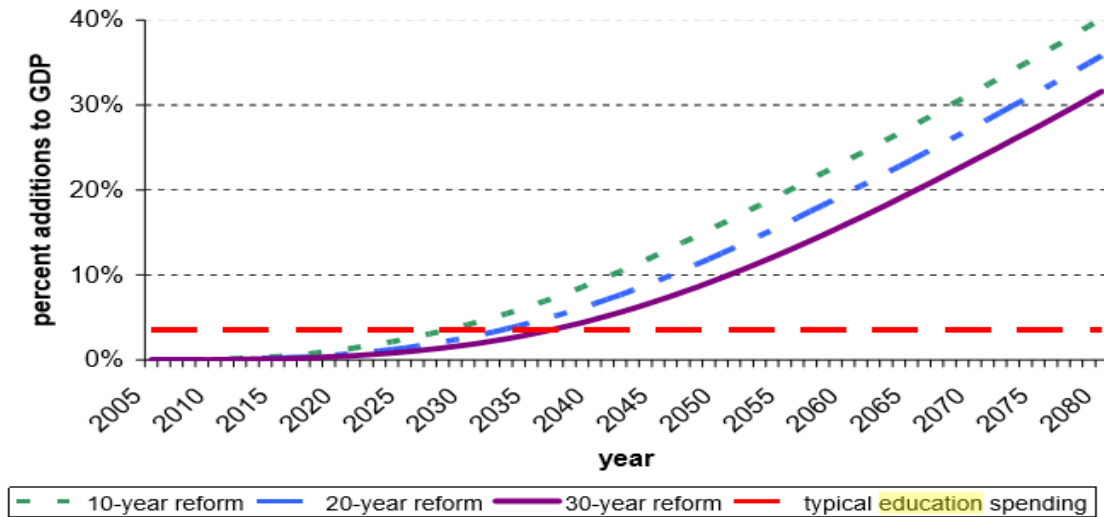
In the view of Eric Hanushek and Ludger Wößmann (2007, p.1) "education is the driving force, or merely one of several factors that are correlated with more fundamental development forces." They pointed out that economic consequences of education are that educational quality, measured by mental skills, has a strong influence on individual remunerations and that educational quality has a resilient and vigorous impact on economic growth. From a theoretical perspective, Hanushek and Wößmann (2007, p.20) saw three mechanisms through which education may possibly affect economic growth. First, in the micro perspective, they believe that education increases the human capital in-built in the labor force, which increases labor output and intermediate growth in the direction of a higher equilibrium level of production. Second, education according to them might increase the innovative dimensions of the economy, and the novel knowledge on new technologies, products and developments that stimulates growth. Third, education may expedite the diffusion and spread the

knowledge required to fathom and develop new information and to productively implement new technologies invented by others, which yet again stimulates economic growth.

“The effect of educational quality on economic growth may differ depending on the economic institutions of a country” (Hanushek & Wößmann 2007, p.41). Institutional structure plays a very significant role in determining the relative profitability of piracy as against productive activity (North as cited in Hanushek & Wößmann 2007, p.41). North note that if the accessible knowledge and skills are used in the profitability of piracy; rather, instead of productive activity, the expected effect on economic growth will greatly be different, and may likely turn negative. In the same direction, Murphy, Shleifer, and Vishny (1991), reveal that the distribution of talent between rent-seeking and entrepreneurship matters for economic growth. They opined that nations with relatively more engineering college specialists grow faster than nations with relatively more law concentrators. Easterly as cited in Hanushek and Wößmann(2007,p.41) contends that education may not have much influence in less developed countries with shortage of other enabling factors such as operational institutions for markets and legal systems. In the same vein, it was suggested that due to shortages in the institutional setting, mental skills might have been applied to socially fruitless activities in many emerging countries, making the average effect of education on growth across all countries insignificant(Pritchett 2001,2006).

As shown in Figure 4 below, the impact of improved educational level on the economy as simulated by Hanushek and Wößmann indicates how much larger the level of GDP is at any point after the reform policy is begun as compared to that with no reform. According to Hanushek and Wößmann (2007, p.45),”for any magnitude of achievement improvement, a faster reform will have larger impacts on the economy, simply because the better workers become a dominant part of the workforce sooner.” Better workers as used in this context are employees with higher education level and knowledge. It means their contribution to economic activities will produce a superior output. (See details in Hanushek &Wößmann, 2007, page 43-44).

Figure 4: Improved GDP with Moderately Strong Knowledge Improvement (Hanushek and Wößmann 2007, p.45).



This simulation according to Hanushek and Wößmann (2007, p.46), shows that the forgoing evaluations of impacts of educational quality on growth indeed have large impacts on national economies. They pointed out that while the rewards are large, they also indicate that policies must be well-thought-out across extended time periods and require patience which is not always clear in national strategy building. They believe that educational policy reforms must be put in a broader perspective since other types of institutional changes and investments will also take considerable time.

Romer (1994), on the theory of endogenous growth states that investment in technological enquiry, as well as in education and specialized training, reinforces endogenously the growth rate by accumulating labor quality and output. “Endogenous growth is long-run economic growth at a rate determined by forces that are internal to the economic system, particularly those forces governing the opportunities and incentives to create technological knowledge” (Durlauf & Blume, 2008, p.1). Empirical investigation of the endogenous growth theory supports the fact that economies with higher percentages of well-educated employees were the ones which demonstrated the higher rates of growth. Also it was evident that higher labor specialization was connected with higher degrees of growth in competitiveness and productivity (Schultz1993, Blundell 1999). Magoutas, Agiomirgianakis and Papadogonas (2011), assert that education, an investment in human capital is the ability to generate, allocate

and achieve knowledge and has been recognized as one of the main preconditions for gaining a competitive advantage internationally. This knowledge acquisition enhances managerial competencies and competitiveness. Hence the second hypothesis follows:

H2: The positive relationship between firms' adoption of virtual manufacturing technology and nations' competitive capabilities will be stronger in the case of high level of managerial competencies compared to the case of low level of managerial competencies.

3.5 Competitiveness as a concept

It is imperative for an individual, firms and nations to be competitive in order to be able to sustain or maintain survival in the business world. Competitiveness is derived from the word "competition." The word competition according to Business Dictionary (2015), is "rivalry in which every seller tries to get what other sellers are seeking at the same time: sales, profit, and market share by offering the best practicable combination of price, quality, and service." It was stressed in this definition that where the market information flows without restrictions, competition becomes a governing function in harmonizing demand and supply of goods and services. This governing role of competition is simply an incentive to achieve competitive advantage by the actors involved to attain a vantage position for profitability and sustainability. In the aggregate, when competition occurs between nations or among nations of the world to achieve competitive advantage, it becomes nation's competitiveness struggle. According to Klaus Schwab (2013), "competitiveness is the set of institutions, policies, and factors that determine the level of productivity of a country" (p.4). He opined that this level of productivity will set the level of prosperity that can be achieved by an economy and the productivity level will likewise determine the degrees of yield achieved by investments in an economy, which precisely are the necessary drivers of its growth proportions. However, productivity is economic yield per unit of input. The component of input can be labor hours (labor productivity) or all production factors including labor, machines and energy (Atkinson 2013, p.4).

As noted by Atkinson (2013) competitiveness as seen by many is identified with productivity (p.2). Porter as cited in Atkinson (2013), says "The only meaningful concept of competitiveness at the national level is productivity" (p.2). While these terms are connected, Atkinson believe that competitiveness should not be compared with productivity or GDP growth. He explained this reason by differentiating between traded and non-traded sector industries. In

his analysis, a traded industry is one where the firms sell a substantial portion of their output outside a specific geographical zone while a software firm that sells software throughout the world would be a traded firm from the government and national standpoint (Atkinson 2013, p.2). In this context, Atkinson affirmed that competitiveness transmits only to the economic value, addition of a region's or nations' traded sectors while he refers to the term "region" as both national and subnational economies. Nevertheless, the proper definition of competitiveness is "the ability of a region to export more in value added terms than it imports" (Atkinson 2013, p.2.). From Atkinson's perspective:

This calculation includes accounting for "terms of trade" to reflect all government "discounts," including an artificially low currency, suppressed wages in export sectors, artificially low taxes on traded sector firms and direct subsidies to exports. It also controls for both tariff and non-tariff barriers to imports. (Atkinson 2013, p.2).

According to Pereira et al. (2009, p.5), Pereira is of the opinion that business competitiveness is linked with the ability of a firm or industry to advance in a sustainable way to bring a prosperous relationship with the environment and as noted by Lanca (2000), it is the ability of a firm or industry to compete in markets and sustain or achieve a position on these markets. Leveraging on characteristics and behavior of firms is a result of the formation of collaborations at the industry level and the environment setting brought about by competitiveness. The most evident aspect of a country's international competitiveness is represented by its firms' competitiveness in comparison to other countries' firms (Donatella Depperu & Daniele Cerrato, 2005, p.4).

According to Schwab (2013), the concept of competitiveness includes stationary and vigorous components (p.4). Schwab opined that the productivity of a country controls its ability to withstand a high level of revenue and it is also one of the dominant factors of its returns on investment, which is one of the significant factors explaining an economy's growth potential. Productivity and competitiveness does not just occur in isolation but are made possible through the combination of some economic components that are interdependently functional. This as noted by Schwab (2013) reveals that numerous determining factors drive productivity and competitiveness (p.4). According to him, these factors includes "education and training, technological progress, macroeconomic stability, good governance, firm sophistication, and market efficiency, among others." Schwab emphasized that even though these factors are expected to be essential for competitiveness and growth, they are not mutually exclusive (Schwab 2013, p.4). This means that for productivity, competitiveness and growth to be

achieved, two or more of these factors must be present and significant. The implication is that no one single factor can single handedly affect competitiveness or growth without the presence of one or two other factors combined for this purpose. There is no clear agreement on what determines competitiveness; on the contrary, describing the pillars of competitiveness is in practice a process of making a choice between different criteria (Jorge Benzaquen, Luis Alfonso Del Carpio, Luis Alberto Zegarra & Christian Alberto Valdivia, 2010, p.74). There are variables that describes Global competitiveness index as listed by World Economic Reports which will not be fully covered since it is not the major focus of study. Therefore emphasis will be placed on market efficiency, business sophistication and macroeconomic environment in analyzing competitiveness index without undermining its meaning. In this study, competitiveness index will be leveraged to mean nation's competitive capabilities (NCC) which is perceived to mediate the association between virtual manufacturing technology and firms' internationalization at the country level.

3.5.1 Market efficiency

Market efficiency is a concept that explains or describe the operations of the market through the availability of important information in terms of price and assets in financial terms and human resources as well as favorable conditions to enter and leave the market. Fama (1970) says "an efficient market is one in which trading on available information fails to provide an abnormal profit." According to Dimson and Mussavian (2000), a market can be considered to be efficient only if a model is suggested for returns. From this argument they believe that market efficiency must be tested and jointly tested in term of market behaviour and models of asset pricing. It means that market efficiency is highly related to speculations and calculations in monetary terms which requires mathematical formulation models for logical conclusions. Bachelier on the concept of market efficiency says:

Past, present and even discounted future events are reflected in market price, but often show no apparent relation to price changes. If the market, in effect, does not predict its fluctuations, it does assess them as being more or less likely, and this likelihood can be evaluated mathematically(Bachelier as cited in Dimson & Mussavian 2000, p.1).

The efficiency of market is structured into two major components. The goods market efficiency and the labor market efficiency. Schwab (2013, p.6), says nations with efficient goods markets are well situated to produce the right combination of products and services given their

specific supply-and-demand conditions, as well as to guarantee that these goods can be maximally transacted in the economy. Schwab maintained that strong market competition, both internal and external, is essential in driving market efficiency as well as business productivity, by guaranteeing that the most efficient firms, manufacturing goods required by the market, are those that succeed. For a market to be efficient, it also requires a good environment brought about by good governance. This is the function of the government to ensure that there are favorable conditions in the market where the exchange of goods and services can be carried out smoothly without too much of impact on productivity and profitability. These favorable conditions includes reasonable taxes on producing firms, absence of war or provision of security for life and properties, availability of infrastructural facilities like electricity among others. The absence of these conditions will impede the competitiveness of a nation.

“Market efficiency also depends on demand conditions such as customer orientation and buyer sophistication” (Schwab 2013, p.6). According to the definition of Business Dictionary(2015), “customer orientation is a group of actions taken by a business to support its sales and service staff in considering client needs and satisfaction of their major priorities.” Buyer sophistication can be explained as the quality possessed by consumers or buyers for the economics of their buying behavior in the market to minimize their spending and maximize consumption. Hassel et al. (2003), argue that internationalization of firms does not only take place in the area of production, but there is also a corporate governance dimension of internationalization which focuses on the type of investors that firms look at and whose interests they take into account. If consumers are well informed such that they have opportunities to choose among alternatives with ease and the sellers of products are competing to sell their products and retain these customers by putting in place adequate customer orientation system among other factors, this will lead to competitiveness in a nation. On this premise if for cultural or historical reasons, customers are more demanding in some nations than in others this can result in an essential competitive advantage, as it compels companies to be more innovative and customer-oriented and thereby imposes the discipline required for efficiency to be attained in the market (Schwab 2013, p.6).

The efficiency of the market in terms of labor can be understood according to Schwab (2013), as the efficiency and elasticity of the labor market in ensuring that workers are apportioned to their most effective use in the economy and provided with motivations to put in

their best effort in their jobs. Schwab posits that labor markets is necessitated flexibly to move workers from one economic activity to another quickly and at a reduced cost in order to permit wage variations without much social interruption. This means that an efficient labor market is one where wage setters or employers are given the opportunity to determine wages that can attract workers in form of motivation or incentive to work. In the same vein, it is a market where workers has the potential to shift and adapt to more than one type of job specification. These characteristics will no doubts lead to a sustainable growth and development through competition. Efficient labor markets as noted by Schwab (2013), must also ensure clear strong motivations for employees and efforts to promote meritocracy at the workplace, and they must provide fair play in the business environment between women and men. Schwab maintained that these factors all together have a positive effect on workers' performance and the attractiveness of the nation for capacity to develop.

3.5.2 Business sophistication

Business sophistication as noted by Parul Sethi (2013), is favorable to higher efficiency in the production of goods and services and increase productivity to enhance nation's competitiveness. She claimed that business sophistication involves the quality of a country's overall business linkages as well as the quality of individual firms' operations and strategies. According to Schwab (2013), the quality of a country's business networks and associate industries, as determined by the quantity and quality of local suppliers and the degree of their collaboration, is essential for many reasons. As reported by Schwab, when companies and suppliers from a particular sector are interconnected in geographically close groups, called clusters, efficiency is intensified, better opportunities for innovation in processes and products are generated, and barriers to entry for new firms are minimized. Separate firms' innovative operations and strategies (branding, marketing, distribution, advanced production processes, and the production of unique and sophisticated products) transformed into the economy and lead to sophisticated and contemporary business practices across the country's business sectors (Schwab 2013, p.8).

Porter as cited in Jin and Moon (2006), says in most countries, "a nation succeeds because it combines some broadly applicable advantage with advantages that are specific to a particular industry or small groups of industries" (p.205). These advantages could be market size or population size of a nation, human resources, and capital resources among others with specific

advantages which is particularly referred to as clusters. Clusters as earlier noted are the availability of related and supporting industries. Related and supporting industries refer to the availability of competitive supplying and supporting industries' (Ozgen, 2011). Porter (1990), argues that competitive advantages can be achieved when industries coordinate activities and form clusters of supporting industries within the value chain. He claimed that cluster fosters an environment where innovation, learning and operation can flourish. He further argues that these clusters are the backbone of developed economy and are often lacked by developing economies which limits them from performing well. The "Business sophistication" sub-indexes are: (1) Local supplier quantity (2) Local supplier quality (3) State of cluster development (4) Nature of competitive advantage (5) Value chain breadth (6) Control of international distribution (7) Production process sophistication (8) Extent of marketing (9) And Willingness to delegate authority(Parul Sethi 2013).

3.5.3 Macroeconomic environment

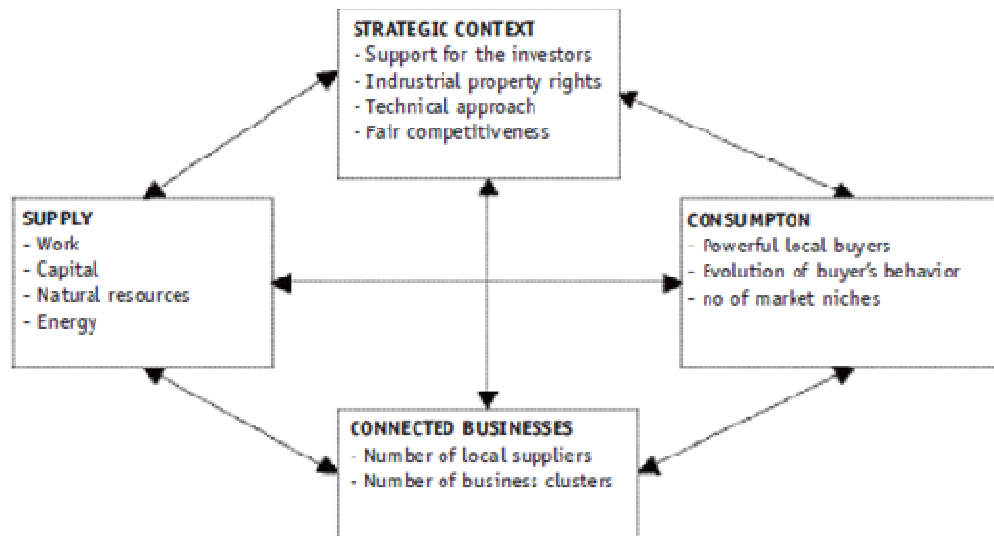
Some countries have been noted to be treating competitiveness as a macroeconomic issue and are using a high level of GDP per capita, robust national currency, low level of interest rates, comparatively high yields on investments, etc., as indicators for determining the level of competitiveness (Zoran Njecovan2006, p.200). Njecovan (2006), posit that there are numerous new competitiveness indicators tied to the innovative, knowledge, or science-based development approach. These indicators according to Njecovan signify the development factors within recent technology development trend on a global level. As noted by him, they expedite the global development trends thus generating a very different business environment than in the past (p.200). Njecovan (2006), says "the business competitiveness index is complementary to the growth competitiveness index since it includes microeconomic fundamentals of prosperity" (p.203). He maintained that the concept of the business competitiveness index is centred on the postulation that macroeconomic and institutional steadiness are crucial, but not sufficient, because they offer the background for the generation of wealth for enterprises in the microeconomic level. He further note that the Business Competitiveness Index lay emphasis on the strategy of an enterprise and the quality of a business environment and only if microeconomic performance is enhanced, macroeconomic, political, legal, and social reforms will be completely operational. Schwab (2013), confirmed this assertion that firms cannot function efficiently when inflation rates are beyond control and therefore the economy cannot grow in a supportable means except the macro environment is steady(p.6).

According to Pereira et al (2009), Pereira says business and industrial competitiveness is connected to the capacity of a firm or industry to advance, in a supportable way that lead to a positive relationship with the environment while Lança, sees this as the ability of a firm or industry to participate in markets and sustain or achieve positive position in these markets, depending on several factors like the features and behaviour of firms, the formation of collaborations at the industry level, and the environment perspective. In Michael Porters' famous "diamond" as noted by Njecovan:

There are four interrelated factors of the business environment: (1) specialised factors of production (human resources, capital, infrastructure –physical, administrative, informative, and scientific– and natural resources), (2) competitive and strategic context (intellectual property rights, healthy competitiveness, and technocratic attitude towards institutions), (3) demand (demanding local customers, evolution in customers' behaviour, coverage of market niches) and (4) coherent support branches (local suppliers, branch clusters, etc.)(Njecovan 2006, p.204).

Based on Porter's diamond in Figure 5 below, competitiveness is dependent on the level of economic progress. The availability of the four components of Porters' diamond models put a nation's competitiveness into a high functional level for competitive advantage. As represented in figure 5, supply (Factor condition) are the basic factors of production like population and natural resources peculiar to a nation as well as advanced factors like technology, capital etc. of a nation. Strategic context (Firm strategy, structure and rivalry) are "the conditions in the nation governing how companies are created, organized, and managed, as well as the nature of domestic rivalry"(Porter 1998,p.107). Consumption (Demand condition), refers to the nature of home market demand for an industry's product or service that can be the impetus for progressing competitive advantage (Porter, 1990). Connected businesses (Related and supporting industries), is the accessibility and ease of competitive supplying and subsidiary industries. As noted by Njecovan (2006), Michael Porter categorize countries in three groups, in respect to the level of economic progress and by relating the GDP adjusted by purchasing power index PPP per capita,: (1) low income countries, (2) average income countries, and (3) high income countries.

Figure 5: Porter’s diamond of business clusters (Njecovan 2006, p.205).



The competitiveness of low-income countries is said to be based on rich natural resources and inexpensive labour force. The low level of competitiveness measured by brain computer interface (BCI) is seen to be a result of insufficient infrastructure, capital constraint, poor system of education, absence of branch clusters, and very poor innovative capabilities. Average income countries correspondingly depend on low costs, which are the outcomes of investments in enhancement of the obtainable technology. Adding to progress of the existing technology, these countries ventured into brand development strategies, extension of business models to a greater number of segments in the chain of values, and development of their own sales networks. These countries are branded by efforts to impede diverse social deviations (e.g. corruption). However, high-income countries concentrate their efforts on technological innovations (Njecovan 2006, p.204). In this study, the competitiveness of nations is specifically termed nations’ competitive capabilities. Nations’ competitive capabilities is a function of global competitiveness index (GCI) in which few component variables have been operationalized in this study. When these variables are unique to a country, they are resources with capabilities for achieving a sustainable competitive advantage and performance for internationalizing firms. Therefore, hypothesis three and four follows:

H3 – Nations’ competitive capabilities has a positive impact on internationalization of firms

across countries.

H4- Nations' competitive capabilities mediates the association between virtual manufacturing technology and internationalization

3.6 Related literature

In the explanation of internationalization process of the firm, there are different perspective of writers. Andersen (1993), on an aspect, focused on internationalization as an innovation for the firm. Johanson and Vahlne (1977), believe that 'internationalization is the product of series of incremental decisions'' (p.23). They maintained that decision to start exporting to a country, to create export networks, to start a sales subsidiary among others made up internationalization process. In Johanson and Vahlne (2003), the function of the main firm is said to be collectively operated with other players in the market. In the actual sense, internationalization is said to be tacitly dealt with as an accomplishment originated and supported by the main firm in partnership with its partners in the network. However, Gabriel B. Awuah, Desalegn A. Gebrekidan and Aihie Osarenkhoe (2007), says "it is an inside—out process where the focal firm plays an active, decisive and significant role in cooperation with other firms in the network'' (p.4). They maintained that internationalization is carried out as an internally induced course of action which is decided and effected through relations among the home country activities and foreign country activities. On the premise of the relations approach (Hägg & Johanson, 1982; Håkanson, 1989 & Laage-Hellman, 1989), players/firms functioning in manufacturing markets produce or carry out activities exploiting or using assets that they own autonomously or cooperatively through their relationships with other players in the market.

New development suggests that researchers should look at internationalization processes as ways to handle exchange interactions and/or to build maintainable competitive advantage that enable the establishment of value and customers' needs satisfaction (Vahlne & Johanson, 2003; Hammond & Groose, 2003). Additional challenges are attributed to firm's ability to have knowledge in and understanding for the prospects and limitations stemming from, for example, the political, legal, social, economic, and the technological systems or infrastructures obtainable in a specific foreign market (Awuah et al., 2007). As noted by Mattsson, (1985); Håkansson and Snedhota, (1995), different economic, technological, organizing, social, legal and knowledge-related links exists together and are all viewed as indispensable in inter-organisational interactions. Awuah et al., (2007), in their research posits that the most essential foundation of experience for firms and their markets are the firm's current

business activities. Leveraging on the Uppsala model of Johanson and Vahlne, (1977), Awuah and his colleagues maintained that there are two means to obtaining this experience – either by hiring people with this experience or by seeking the intelligence of other experienced personnel. This can be explained from the perspective of the education level of employees.

The internationalization of firms (small and large companies) can be anticipated to achieve extra drive because the world economy is becoming more and more cohesive with continuous declines in government-imposed barriers on trade relations and continued developments in technology (Jane W. Lu & Paul W. Beamish 2001). In the extension of Levitt's (1983) argument about worldwide congregating demands, Bent Petersen , Torben Pedersen & Deo Sharma, (2003), advanced the impression that the Internet has the potential for taking the advantage of this conjunction to its full magnitude (Petersen et al., 2003). The improvements of information and communication technology embrace the prospect of essentially changing the role of knowledge in firms' internationalisation process. A lot of services, like business consulting and higher education, has unlimited possibilities for international conversation on the Internet, but the concern is that to what degree of the utilisation of these opportunities necessitate 'knowledge-intensive modification' to the local needs(Petersen et al 2003). As argued, Petersen and his colleagues believe that there is an economic value in codified knowledge and codification improves due to improvements in information technology through improved infrastructure (Petersen et al, 2003).

In the early periods of internationalization, performance drops as the firm try to tidy up the liability of foreignness. Performance recovers as new knowledge and competences are developed, as competitiveness is boosted and as market prospects are seized by the firm's venture activities in international markets. In due course, performance deteriorates as the costs connected with the complication that build up from handling several subsidiaries and in unrelated markets which increases more than the inherent benefits of internationalization (Jane W. Lu & Paul W. Beamish 2001). Oviatt and McDougall (1994), argued that in the contemporary new competitive background, the internationalization of small, high-technology firms does not follow the slow, incremental route of internationalization as advocated by Johanson and Vahlne (1977).They posit that, firms could be either new or well-known, and their possibility of sales could be either national or international. This is determined by the availability and presence of advanced manufacturing technology. In a supplementary development, Sumit K. Kundu and Jerome A. Katz (2003), posits that the most extensively studied managerial distinguishing feature is the

educational level of the decision maker. They argue that an educated entrepreneur with a specialized degree will be more "outward looking," and consequently be willing to discover foreign market. However, empirical studies have established that features such as "managerial tenure, education level and professionalism" are forecasters of innovation absorption for firms (Damanpour 1991; Fichman & Kemerer 1997).

CHAPTER FOUR

Research methods

This section discusses the methods adopted for the research. Research design and instrument, the population of study, sample and sources and variable and measures of the data were described.

4.1 Research design and instrument

The method adopted for this study is descriptive with a quantitative approach. Creswell (1994) stated that the descriptive method of research is to collect information about the present existing condition. Descriptive research involves gathering data that describe events and then organizes, tabulates, depicts, and describes the data collection (Glass & Hopkins, 1984.) This study therefore employed descriptive method to identify the influence of virtual manufacturing technology on nations' competitive capabilities to affect internationalization as well as identifying the moderation effect of managerial competencies on the relationship between virtual manufacturing technology and internationalization. In this study, secondary data set in the world economic forum from the global competitiveness report, 2013-2014 was used to analyse the established relationships in the research.

4.2 Population of study

The targeted population of study consisted of the whole of 197 independent states (countries) in the world (www.countries-ofthe-world.com). The countries for sample selection (sample frame) were the 144 countries in the world economic forum covered by the global competitiveness report, 2013-2014. The research was carried out using all the available countries covered by the global competitiveness report, 2013-2014. A total number of 53 countries not covered by global competitiveness report 2013-2014 is missing out in this study and therefore, the test result may be affected with the inclusion of the rest countries in a related study on this topic.

4.3 Data and sources

To analyse the study model, country level data retrieved from data set in the world economic forum from the global competitiveness report, 2013-2014 was used. Data from the report were constructed using Executive Opinion Survey (EOS). The Survey ask respondents to evaluate, on a scale of 1 to 7, one particular aspect of their operating environment. At one end of the scale, 1 represents the worst possible situation; at the other end of the scale, 7 represents the best (See detail computation of variables in appendix 1) .The Survey captures the opinions of

business leaders around the world on a broad range of topics for which data sources are scarce or, regularly, missing on a global scale. It helps to capture aspects of a particular area such as the extent of the skills gap, the level of corruption, or the intensity of market competition that are more qualitative than hard data can provide. The survey was structured into (I) About Your Company (II) Overall Perceptions of Your Economy (III) Infrastructure (IV) Innovation and Technology Infrastructure (V) Financial Environment (VI) Foreign Trade and Investment (VII) Domestic Competition (VIII) Company Operations and Strategy (IX) Government and Public Institutions (X) Education and Human Capital (XI) Corruption, Ethics and Social Responsibility (XII) Travel & Tourism (XIII) Environment and (XIV) Health (Global competitiveness report, 2014-2015).

The indicators derived from the Survey are used in the calculation of the Global Competitiveness Index (GCI) and other Forum indexes, including the Networked Readiness Index, the Enabling Trade Index, the Travel & Tourism Competitiveness Index, and the Gender Gap Index, as well as in a number of regional studies. In the administration of the Survey, about 160 Institutes worldwide were partnered. Partner Institutes are asked to follow detailed sampling guidelines to ensure that the sample of respondents is the most representative possible and is comparable across the globe and in a specific timeframe. The Survey sampling guidelines specify that the Partner Institute build a “sample frame” that is, a list of possible business executives from small and medium-sized enterprises and large companies from the various sectors of activity. The Survey for this report captured the opinions of over 14,000 business leaders in 148 economies between February and June 2014; because of data issues, out of the 148 economies surveyed, 144 are included in the GCI report used for this study (Global competitiveness report, 2014-2015). The dataset was retrieved from the internet from the Global Competitive Index Report for this study in September 2014 and the term of use was properly followed. After information and data have been retrieved from the report, it was processed to determine the purpose of the study. The dependent variable is internationalization of firms while the independent variables are virtual manufacturing technology, managerial competencies and nations’ competitive capabilities. Control variables included in this study are domestic market size and port infrastructure. The result was analysed using descriptive statistics. Hypothesis were tested with regression analysis using ordinary least square (OLS) method.

4.4 Variable and measures

4.4.1 Internationalization of firms

Internationalization of firms in this study as earlier discussed is the dependent variable. I measured internationalization of firms using export as a proxy. Exporting has been conventionally considered as the first phase to entering international markets, functioning as an avenue for prospective international expansions (Kogut & Chang, 1996). I obtained this measure directly from the data set of the world economic forum, the global competitiveness report 2013-2014 for all the 144 countries observed in the study. Export was computed as a percentage of gross domestic product (GDP) and total exports is the sum of total exports of merchandise and commercial services while GDP was Gross domestic product valued at purchasing power parity in billions of international dollars (Global competitiveness report, 2013-2014)

4.4.2 Virtual manufacturing technology

This is the main independent variable which is expected to affect internationalization of firms in this study with the intervention of nations' competitive capabilities. "Virtual Manufacturing (VM)" is the use of information technology and computer simulation to model real world manufacturing processes for the purpose of analyzing and understanding them (Dépincé et al 2004). According to Li Liu (2011, p.888), virtual manufacturing technology refers to and realizes its unique functions through complete applications of several technological fields, including virtual reality technique, emulation technique, modeling technique, manufacturability evaluation, computer graphics, visualization technique and multimedia technology etc. Liu (2011, p.888) posit that virtual reality technique is a synthesized technique that combined human's imagination with electronics in order to develop interactive mode between people and computer and promote computer's feasibility, which systematically use computer graphics system, interface equipment with various displays and controls and multi-media computer simulation technique to form a kind of special and interactive three-dimensional environment (called virtual environment) in computer. This application can be diffused into technological, human resource and environmental synthesis. From a comparative view, national innovative capacity "is the capacity of a country as both a political and economic unit to produce and commercialize a stream of new-to-the world technologies over the long term" (Jeffrey L. Furman, Michael E. Porter & Scott Stern, 2002, p.900). Going by this definition, Furman et al. (2002) definition of innovation capacity by their analysis can be viewed from three perspectives: science and technology, innovation or institutional environment and human capital development.

Subsequent to the foregoing, Augusto López-Claros and Yasmina N. Mata (2010, p.18) identifies innovation capacity index (ICI) from five pillars: (1) Institutional environment (2) Human capital, training and social inclusion (3) Regulatory and legal framework (4) Research and development (5) Adoption and use of information and communication technologies. The innovation capacity index model can also be categorized into first; technological, second; institutional or innovation and third; human perspectives. As posited by Liu (2011), if virtual manufacturing technology combines human's imagination (innovative tendencies) with electronics, it is ideal to examine the relationship between innovation capacity and virtual manufacturing technology since they both have analogous definition parameters and functionalities if juxtaposed.

There seem to be a degree of association between virtual manufacturing technology and capacity for innovation. According to Helmuth Ludwig and Eric Spiegel (2014), the ability to model, visualize and test in the world of virtual-to-real manufacturing (virtual manufacturing technology application) is changing the nature of innovation. Ludwig and Spiegel (2014) further posit that innovation will thrive and speed-to-market will increase as virtual-to-real manufacturing becomes more conventional. However, under the informational new century environment, virtual team is fundamental for industry-university-research co-innovation (Wang Linna & Zhu Konglai 2011, p.46). According to Linna & Konglai (2011), virtual teams are information network-based (uses information technology) to make up for the uneven distribution of innovation knowledge and information by effectively dealing with the flow of people, goods, capital and knowledge globally. Lipnack and Stamps as cited in Linna & Konglai (2011) assert that virtual teams are linked by computer network and communicational technology. If virtual teams operates with the elements of virtual manufacturing technology (computer network and information technology) to bring about innovation knowledge while innovation is said to thrive as virtual - to - real manufacturing is fully adopted, it appears reasonable to measure virtual manufacturing technology with capacity for innovation as operationalized in this study. Therefore capacity for innovation is used as proxy for virtual manufacturing technology. Capacity for innovation was obtained from the data set of the world economic forum from the global competitiveness report 2013-2014 for all the 144 countries observed. It was measured on the scale of 1 to 7(1 = not at all; 7 = to a great extent) based on 2013–2014 weighted average to address the question of to what extent do companies have the capacity to innovate across countries?

4.4.3 Managerial competencies

Managerial competencies are expected to moderate the association between virtual manufacturing technology and nation's competitive capabilities according to this study. Managerial competencies as a human capital is a very important resource to a firm. Kraaijenbrink et al. (2010) point out that resources can help a new firm to gain and sustain competitive advantage. According to Spencer and Spencer (1993), managerial competencies are a specialized subset of the competencies, conveying the intention to have certain specific effects. Hogg (1993) argues that managerial competencies lead to the demonstration of skills and abilities, which result in effective performance within an occupational capacity. To construct this variable, I adopted reliance on professional management as proxy. The subject of managerial competencies categorically according to Freidson, (1994) is a matter of professionalism: Professionalism is being committed "to practicing a body of knowledge and skill of special value and to maintaining a fiduciary relationship with clients" in case of "esoteric, complex, and discretionary" work that "requires theoretical knowledge, skill, and judgement that ordinary people do not possess, may not wholly comprehend, and cannot readily evaluate" (Freidson, 1994). Boyatzis (1982) defined competencies as a human ability to perform in a way to meet job requirements in parameters given by the organization's environment and thus to accomplish the required results. Following Freidson's notion and Boyatzis' argument, management's professionalism is used to measure managerial competencies. This measure was directly obtained from the data set of the world economic forum from the global competitiveness report of 2014-2015 for the entire 144 countries observed. Reliance on professional management was constructed on the scale of 1-7 (1 = usually relatives or friends without regard to merit; 7 = mostly professional managers chosen for merit and qualifications) based on 2013-14 weighted average to address the question of who holds senior management positions across countries (Global competitiveness report, 2013-2014).

4.4.4 Nation's competitive capabilities

The nation's competitiveness in this study is modelled as a mediating or intervening variable between virtual manufacturing technology and internationalization. A country's competitiveness factors are determinants of its firms' international competitiveness (Depperu. & Cerrato 2005). Competitiveness is the set of institutions, policies, and factors that determine the level of productivity of a country. The level of productivity, in turn, sets the level of prosperity that can be obtained by an economy. The productivity level also determines the rates of return achieved by investments in an economy, which in turn are the ultimate drivers of its growth

rates. Therefore, a more competitive economy is one that is likely to grow faster over time (Schwab (2013). Nations' competitiveness is the ability of a country to create, produce, distribute or service products in international market while earning increasing returns on its resources (Scott & Lodge 1985). This is simply the competitiveness index of countries. If firms' environment as noted by Teece et al. (1997) is extended to nations' institutions (nation's competitive capabilities), then to derive nation's competitive capabilities, this study adopted Global competitiveness index (GCI) across countries as proxy as reported in the global competitiveness report 2013-2014 for all the 144 countries observed in the .

The computation of the GCI is based on successive aggregations of scores from the indicator level (i.e., the most disaggregated level) all the way up to the overall GCI score. An arithmetic mean was used to aggregate individual indicators within a category. For the higher aggregation levels, the percentage shown next to each category was used. This percentage represents the category's weight within its immediate parent category. Reported percentages are rounded to the nearest integer, but exact figures are used in the calculation of the GCI. To make the aggregation possible, the indicators are converted to a 1 to 7 scale in order to align them with the Survey results: a min-max transformation, which preserves the order of, and the relative distance between, country scores. Indicators that are followed by the designation "1/2" enter the GCI in two different pillars. In order to avoid double counting, a half-weight to each instance was assigned (Global competitiveness report, 2013-2014).

Control variables

4.4.5 Domestic market size

Domestic market size is considered to affect the degree of internationalization process of firms as well as influence firms' dynamic capabilities. Freeman et al. (2006) ascertain several variables that increase the degree of internationalization of small and medium firms. Such variables are a small domestic market, unique knowledge or technology, and different forms of relationships and alliances. In this study, it is presumed that domestic market size will negatively affect internationalization if the market size is large. Firms in small markets might be forced to expand internationally to achieve economies of scale, scope, and learning (Li & Yue, 2008: Kogut, 1985). Franko (1976) has argued that the small national markets of some European countries induce heavy foreign investment because the narrow domestic market base provides successful firms with only limited opportunities to diversify their risks .Country-specific resources are generally difficult to imitate or substitute across cultural boundaries

(Bartlett/Ghoshal 1998, Kogut 1991, Porter 1990). The surrounding domestic cultural and social environments imprint certain perspectives and routines on organizations (Stinchcombe, 1965), and the routines further influence managerial capabilities and strategic choices (Nelson/Winter, 1982). This indicates that domestic market size as a resource of a country has the capacity to influence firms' internationalization. This measure was directly obtained from the data set of the world economic forum from the global competitiveness report of 2013-2014 for the whole of 144 countries observed. Domestic market size is the sum of gross domestic product plus value of imports of goods and services, minus value of exports of goods and services, normalized on a 1–7 (best) scale. The size of the domestic market is calculated as the natural log of the sum of the gross domestic product valued at purchasing power parity (PPP) plus the total value (PPP estimates) of imports of goods and services, minus the total value (PPP estimates) of exports of goods and services. Data are then normalized on a 1–7 scale. PPP estimates of imports and exports are obtained by taking the product of exports as a percentage of GDP and GDP valued at PPP (Global competitiveness report, 2013-2014).

4.4.6 Port infrastructure

The effect of port infrastructure on the internationalization of firms is also controlled in this study. Ports, as the architects of flows shows a 'bridge' between the outputs of the economic system and the movement of these outputs within international trade. Ports have grown to be a key component of competitiveness (Sánchez & Wilmsmeier, 2010, p.24). One of the main determinants of international transport costs is port efficiency. It is said to be most important among six different port characteristics, including port infrastructure, private sector participation and inter-port connectivity (Wilmsmeier et al. 2006). Limao and Venables (2001) compute that if a country with comparatively poor infrastructure (around the 75th percentile) were to upgrade to the 25th percentile, it would reduce transport costs by between 30% and 50%. According to Martinez-Zarzoso et al. (2003), an improvement of 10% in the port infrastructure of a destination country lowers transport costs by 1.4%; and an increase of port infrastructure of one standard deviation reduces the freight rate by USD 225 subsequent to the computations of Wilmsmeier and Hoffmann (2008). Wilmsmeier and Sanchez (2009) asserts that if a country doubles its centrality in liner shipping networks, meaning a significant increase in direct liner services to a wider range of countries, transport costs can decrease up to 15.4%. An increase of connectivity of one standard deviation implies a potential reduction of the freight rate of 287 USD (Wilmsmeier & Hoffmann, 2008).

It is said that high trade costs inhibit a country from taking advantage of potential gains from specialization and trade in order to promote economic development (Markusen & Venables, 2007). If reduced cost of transport is brought about by a good port infrastructure or port efficiency, movement of economic output will be affected positively in international trade. It means that internationalization activities of firms is supported by port infrastructure as a tangible country's resource to influence firms' capabilities in order to perform efficiently and internationally. This measure was obtained from the data set of the world economic forum from the global competitiveness report, 2013-2014 for the entire 144 countries observed. Quality of port infrastructure was measured on the scale of 1 to 7 (1 = extremely underdeveloped among the worst in the world; 7 = extensive and efficient among the best in the world) constructed on 2013-14 weighted average to address the question of how seaports can be assessed across countries (For landlocked countries: How accessible are seaport facilities was used for the construction) (Global competitiveness report, 2013-2014).

CHAPTER FIVE

Data analysis

In this study, this section presents the research model, test, reliability and validity assessments and the test results of the theoretical model and interpretation.

5.1 Research model

To examine whether virtual manufacturing technology determined the internationalization of firms across countries through nations' competitive capabilities and whether nations' competitive capabilities has an impact on the degree of internationalization while managerial competencies moderate the association between Virtual manufacturing technology and nations' competitive capabilities, I formulate two concepts to test these relationships. Concept (1) has two models: Model I tested the impact of virtual manufacturing technology on nations' competitive capabilities. Model II tested the interaction effect of managerial competencies on the association between virtual manufacturing technology and nations' competitive capabilities and the predictors in model II are mean centered to avoid collinearity problem. Concept (2) has three models i.e. models III, IV and V: Model III tested the impact of the control variables on the internationalization of firms. Model IV tested the impact of nations' competitive capabilities on internationalization in the presence of control variables and Model V tested if nations' competitive capabilities mediate the association between virtual manufacturing technology and internationalization. The two concepts in an econometric model are therefore presented below:

Concept 1

Model I

$$NCC = \beta_0 + \beta_1 VMT + \varepsilon$$

Model II

$$NCC = \beta_0 + \beta_2 VMT + \beta_3 VMTMANCOMP + \varepsilon$$

Concept 2

Model III

$$INT = \beta_0 + \beta_4 DOMKT + \beta_5 PORTINF + \varepsilon$$

Model IV

$$INT = \beta_0 + \beta_6 NCC + \beta_7 DOMKT + \beta_8 PORTINF + \varepsilon$$

Model V

$$INT = \beta_0 + \beta_9VMT + \beta_{10}NCC + \varepsilon$$

Where:

Table 1: Notation

Type of variable	Symbol	Interpretation	STATA variable
Dependent	INT	firms internationalisation	INT
Independent	VMT	virtual manufacturing technology	VMT
	NCC (mediator)	nations competitive capabilities	NCC
	MANCOMP(moderator)	Managerial competencies	MANCOMP
	VMTMANCOMP	Interaction between VMT &MANCOMP	VMTMANCOMP
Control variable	DOMKT	Domestic market size	DOMKT
	PORTINF	Port infrastructure	PORTINF

Table 2 : Interpretation of regression coefficients

Parameter	Interpretation
β_0	Autonomous expected NCC and internationalization of firms in models I, II, and III, IV, V respectively.
β_1	Change in expected nations' competitive capabilities as a reaction to a marginal change in VMT in model I.
β_2	The effect of VMT on the outcome when interaction VMTMANCOMP is present in model II.
β_3	The effect of the interaction VMTMANCOMP on the outcome when VMT is present in model II.
β_4	Change in expected internationalization of firms as a reaction to a marginal change in domestic market size if PORTINF is present in model III.
β_5	Change in expected internationalization of firms as a reaction to a marginal change in port infrastructure If DOMKT is present in model III.
β_6	Change in expected internationalization of firms as a reaction to a marginal change in nations' competitive capabilities if regressors PORTINF and DOMKT are in model IV.
β_7	Change in expected internationalization of firms as a reaction to a marginal change in domestic market Size if regressors PORTINF and NCC are in model IV.
β_8	Change in expected internationalization of firms as a reaction to a marginal change in port infrastructure If regressors NCC and DOMKT are in model IV.
β_9	The effect of VMT on the outcome when mediation variable NCC $\neq 0$ in model V

β_{10}	The effect of NCC on the outcome when independent variable VMT $\neq 0$ in model V
ϵ	Error term

5.2 Test, reliability and validity assessments

Multiple regression was used to explain the internationalization of firms across countries as specified in section 4.1 under two concepts. The variable constructs and the resulting distribution, fit the requirements for ordinary least square (OLS) regression having fulfilled the following test and the necessary correction.

5.2.1 Descriptive statistics and test for multicollinearity

To access the validity of the model predictions, 144 countries of the world were observed for the research. Cross sectional data obtained from the database of The World Economic Forum; Global Competitiveness Report 2013 – 2014 was used to analyze the result. 0.84 alpha coefficient indicates that the phenomenon under study is reliably measured in this study as reproduced in table 3. All items within the scale reasonably measured the same construct as predicted. The least mean value is 3.568425 and the highest mean value is 4.55. The standard deviation for the variables is spread between 0.68 and 1.20. Virtual manufacturing technology has minimum and maximum scale between 2 and 6, port infrastructure and domestic market size has minimum and maximum scale between 1 and 7 respectively. Managerial competencies has minimum and maximum scale between 2 and 7. For internationalization, the minimum scale is around 1 and the maximum is 245 which may be due to an entrepot effect (i.e. there are countries used for the data computation which has excess of trade over GDP) See appendix 2 for hint. Pairwise correlation matrix of the variables was computed to test for multicollinearity as shown in table 3. The magnitude of the correlation of relationships among the independent variables was significant for all variable at $p < 0.01$. To further test for multicollinearity problem, the condition number shown in table 4 was compared to establish a rule of thumb suitable for the relationships. The condition number under the value of 10 according to this study indicate that multicollinearity is not severe. Belsley, Kuh, and Welsch (1980) contend that condition number that lies between 10 and 100 respectively stand as a beginning and serious points that collinearity affect estimates.

Table 3: Descriptive statistics and correlation for all independent variables

	Alpha	Mean	SD	Min	max	vmt	mancomp	Ncc	domkt	portinf
vmt	0.79	3.86	.77	2.50	5.89	1.0000				
mancomp	0.81	4.55	.68	2.39	6.13	0.7469 (0.0000)	1.0000			
ncc	0.77	4.20	.68	2.79	5.70	0.8369 (0.0000)	0.7124 (0.0000)	1.0000		
domkt	0.87	3.56	1.19	1.00	7.00	0.4697 (0.0000)	0.2588 (0.0017)	0.5508 (0.0000)	1.0000	
portinf	0.80	4.11	1.20	1.28	6.81	0.6816	0.6421	0.7483	0.3424	1.0000
T. scale	0.84					(0.0000)	(0.0000)	(0.0000)	(0.0000)	

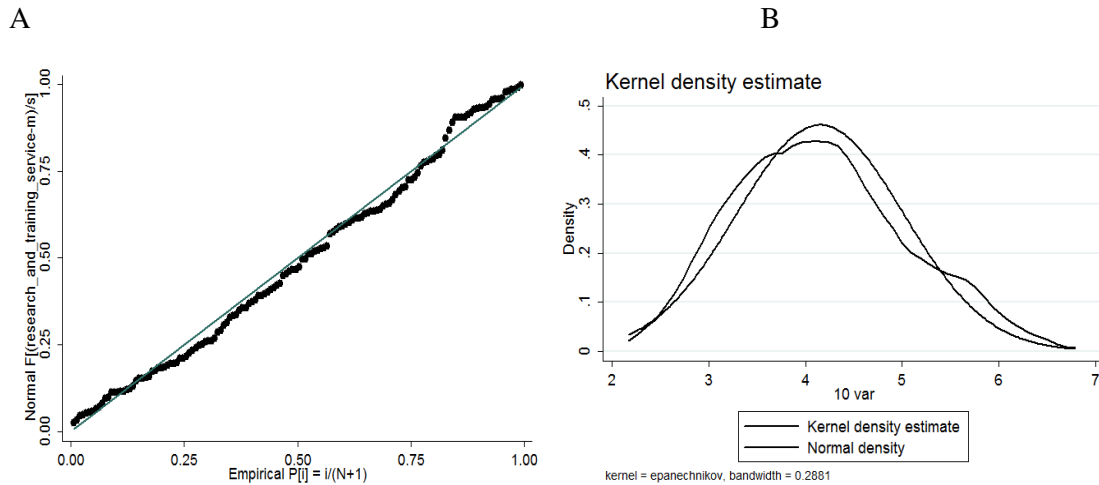
Note: all variables are significant at $p < 0.01$, p values are in parentheses

Also, the tolerance value of each variable is more than 0.1 which shows that multicollinearity may not affect estimate. As shown in Table 4, the condition number is 4.9084 and the VIFs are less than 5. The test results in Table 3 and 4 shows that multicollinearity is not severe and should not affect estimate in this study. Hence, the model was specified using all the variables in the regress model.

Table 4: Condition number for multicollinearity diagnostic

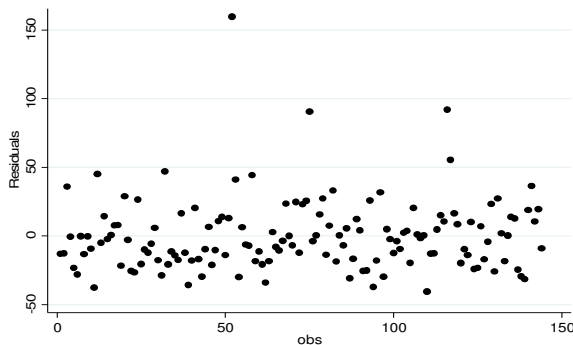
					Cond		
					Eigenvalue	Index	
		SQRT		R-	1	3.4604	1.0000
Variable	VIF	VIF	Tolerance	Squared	2	0.7987	2.0815
					3	0.3699	3.0585
vmt	4.03	2.01	0.2483	0.7517	4	0.2273	3.9015
mancomp	2.64	1.62	0.3787	0.6213	5	0.1436	4.9084
ncc	4.96	2.23	0.2018	0.7982	Condition	Number	4.9084
domkt	1.55	1.24	0.6459	0.3541	Correlation	matrix	0.0334
portinf	2.43	1.56	0.4109	0.5891			
Mean	3.12						
VIF							

Figure 6: Graph A and B: Normality check with kernel density plot with the normal option and standardized normal probability (P-P) plot



5.2.2 Normality, linearity and homoscedasticity check

Figure 7: Graph C- Residual vs fitted plot



In order to check whether the underlying assumption of OLS is violated, normality and homoscedasticity check for reliability of the model was performed as shown in graphs a, b and c. From the results presented in graphs (A) and (B) and Table 5 below, normality and homoscedasticity assumption is violated. Kernel density estimate clearly deviated from the normal density which is an indication of non-normality and the standardized normal probability (P-P) plot shows sensitivity to non-normality in every range of data. “A normal distribution is not skewed and it is defined to have a coefficient of kurtosis of 3 and a normal distribution will thus have a coefficient of excess kurtosis of zero” (Chris Brooks, 2008, p.161). In Cameron & Trivedi's decomposition of IM-test, skewness and kurtosis are greater than 0 and less than 3 respectively while in Breusch-Pagan / Cook-Weisberg test for heteroscedasticity, the Chi- square is very large ($\text{Chi}^2 = 82.15, p < 0.001$) with a significant test statistics against homoscedasticity.

Table 5: Heteroskedasticity test using Cameron & Trivedi's decomposition of IM-test and Breusch-Pagan / Cook-Weisberg test.

Source	chi2	df	p	Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
Heteroscedasticity	45.26	20	0.0010	Ho: Constant variance
Skewness	12.36	5	0.0302	Variables: mancomp vmt ncc domkt portinf
Kurtosis	1.38	1	0.2402	
Total	58.99	26	0.0002	chi2 (5) = 82.15 Prob > chi2 = 0.0000

These statistical values and significance shows an evidence against Normality and homoscedasticity assumption. The implication is that the OLS estimates are no longer the best linear unbiased estimate (BLUE) i.e. among all the unbiased estimators, OLS will not provide the estimate with the smallest variance. As shown in graph C, the variance across fitted values does change from around the middle towards the right end, confirming that the assumption of constant variation was violated. This shows that there is an element of heteroscedasticity in the model as confirmed in both the Cameron & Trivedi's decomposition of IM-test and Breusch-Pagan/Cook-Weisberg test for heteroscedasticity. Homoscedasticity could be violated, even if the degree of the error variances is not a function of the predictors in the regression model, a condition referred to as heteroscedasticity of unknown form (White, 1980). When the homoscedasticity assumption is violated, the typical OLS regression estimator of the partial regression coefficients is unbiased and strongly dependable under heteroscedasticity (White, 1980). Due to the large sampling variance caused by the heteroscedasticity, it is said to be less efficient. In order to correct the inefficiency of the estimator to achieve optimality, White correction was employed using a heteroscedasticity-consistent standard error (HCSE), the estimator of OLS parameter estimates (White 1980). With robustness in the standard errors to estimate the regression, the standard errors were corrected for accurate estimated standard errors for each model as produced below in Table 6 (See appendix 3 for detail). While models I, III, and IV were white corrected, the interaction term in model II was mean centered to avoid multicollinearity and model V was bootstrapped to correct biased standard errors as presented in section 4.3.

5.3 Test results of the theoretical model and interpretation

Table 6 :(Model I and II) - Regression results for the impact of virtual manufacturing technology and the interaction effect of managerial competencies on nations' competitive capabilities

Independent Variables	Model 1 b/se	Model 2, i~n b/se
Virtual manufactur~y	0.731*** (0.04)	0.715*** (0.04)
Interaction		0.094** (0.03)
Constant	1.379*** (0.15)	1.005*** (0.21)
r2	0.700	0.716
df_r	142.000	141.000
bic	130.916	128.267

* p<0.05, ** p<0.01, *** p<0.001

Note: Dependent variable: Nation' competitive capabilities. Upper number in a cell is a parameter estimate, numbers in the parentheses are robust standard errors.

Table 7: change in R2 between model 1 and model

Block	Block Residual				Change	
	F	df	df	Pr > F	R2	in R2
1	331.91	1	142	0.0000	0.7004	
2	7.66	1	141	0.0064	0.7158	0.0154

Table 8 : (model III, IV &V) - Regression results for the effect of control variables, nations' competitive capabilities and its mediation role on internationalization.

	Model 3 b/se	Model 4 b/se	Model 5 b/se
Domestic market size	-6.166*** (1.62)	-10.191*** (1.99)	
Port infrastructure	13.440*** (2.93)	5.817* (2.36)	
Nations' competitive		21.423*** (5.57)	29.637*** (6.69)
Virtual manufacturing			-10.878 (5.84)
constant	13.303 (11.06)	-31.081 (18.94)	-35.968* (15.62)
r ²	0.223	0.291	0.180
df _r	141.000	140.000	141.000
bic	1387.975	1379.740	1395.681

* p<0.05, ** p<0.01, *** p<0.001

Note: Dependent variable: Internationalization. Upper number in a cell is a parameter estimate, numbers in the parentheses are robust standard errors.

Table9: Change in R2 between model III and IV

Block	Block Residual				R2	Change in R2
	F	df	df	Pr > F		
1	20.24	2	141	0.0000	0.2231	
2	13.44	1	140	0.0003	0.2912	0.0681

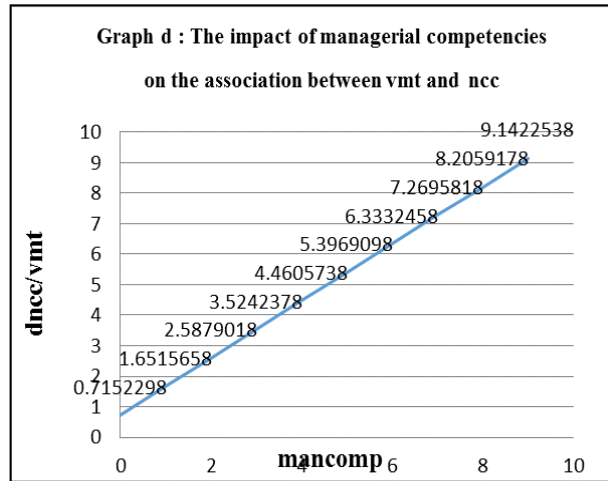
Concept 1: Analysis for effect on nations' competitive capabilities

Table 6 shows the result of the impact of virtual manufacturing technology on nations' competitive capabilities for model I and II. First, the F statistics is significant for model I with R² (Coefficient of determination) of 0.7. This indicates that 70% of the total variation in the nations' competitive capabilities about their mean value is explained by the variance in the virtual manufacturing technology in the model. H1: The first hypothesis which stated that firms' adoption of virtual manufacturing technology has a positive impact on nations' competitive capabilities is confirmed and supported in this model with a positive and statistically significant

coefficient (Coef. = 0.73, $p < 0.001$). It means there is 0.7 units increase in expected nations' competitive capabilities as a reaction to a one unit increase in virtual manufacturing technology.

Model II presents the effect of the interaction between virtual manufacturing technology and managerial capabilities on the nations' competitive capabilities. The model has a significant F statistics with an R^2 of 0.72. To test H2: the hypothesis that the positive relationship between firms' adoption of virtual manufacturing technology and nations' competitive capabilities will be stronger in the case of high level of managerial competencies compared to the case of low level managerial competencies, the interaction

Figure 8: Graph d - interaction effect



between virtual manufacturing technology and managerial competencies was added to model 1. To avoid possibly difficult high multicollinearity with the interaction term, the variables were mean centered (Aiken & West, 1991). The inclusion of the interaction term accounted for a significant proportion of the variance (Table 7) in nations' competitive capabilities, $\Delta R^2 = 0.02$, $\Delta F(1, 141) = 7.66$, $p = .006$, Coef. = .09, $t(141) = 2.77$, $p < .01$. (See detail result in appendix 4). Analysis of the interaction plot in graph (d) shows an enhancing effect that as managerial competencies increases, there is an increase in nations' competitive capabilities with respect to the impact of virtual manufacturing technology. It is evident from the graph that the degree of nations' competitive capabilities due to the impact of virtual manufacturing technology is stronger at higher levels of managerial competencies compared to lower levels. Therefore, hypothesis 2 is confirmed and strongly supported.

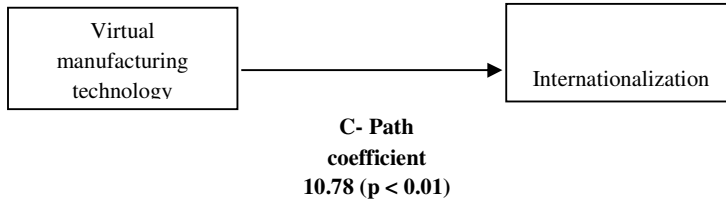
Concept 2: Analysis for effect on internationalization

Model III presents the control for the effect of domestic market size and port infrastructure on internationalization. As produced in Table 8, the model had a significant F statistics with an R^2 of 0.22 which shows that 22% of the total variation in internationalization of firms about their mean value is accounted for by the variance in the model by control variables. Domestic market size negatively (Coef. = -6.17, $p < 0.001$) affect internationalization, an

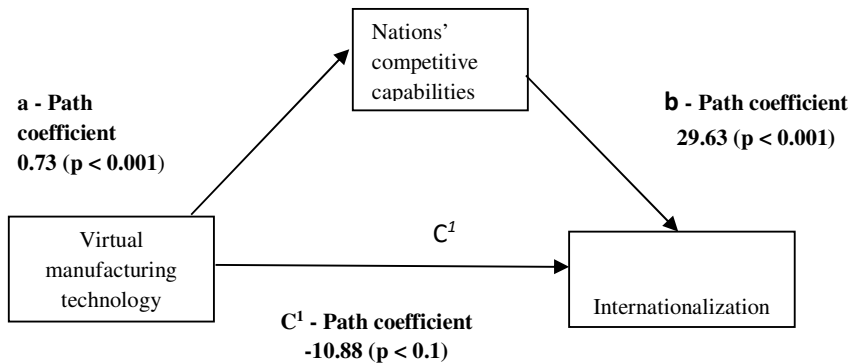
indication that a large home market may not encourage internationalization and when the market size of home country of firms are small, firms tend to internationalize to attain economies of scale, opportunity, and knowledge (Li & Yue, 2008; Kogut, 1985). With respect to port infrastructure, the positive impact (Coef. =13.44, $p < 0.001$) on internationalization indicate that internationalization of firms is supported as a tangible country's' resource to influence firms' capabilities to perform efficiently and internationally. To test for H3: which states that nations' competitive capabilities has a positive impact on internationalization of firms across countries, the variable, nations' competitive capabilities was added to model III to derive model IV. Model IV as presented in Table 8 had a significant F statistics with an R^2 of 0.29 which shows that 29% of the total variation in internationalization of firms about their mean value is accounted for by the variance in the model. A significant R^2 change ($\Delta R^2 = 0.07$) shown in Table 9 and a positive and statistically significant coefficient (Coef. = 21.4, $p < 0.001$) confirmed that the inclusion of nations' competitive capabilities in model IV makes the internationalization model more significant. The indication is that there is 21.4 units increase in expected internationalization of firms as a reaction to a one unit increase in nations' competitiveness when other variables in the model are held constant. The increase in the competitiveness of small firms in the national economy has been fundamental because of their influence on job creation and increasing scope for success in export markets (Ghanatabadi, 2005). This shows that hypothesis 2 is strongly confirmed and supported in this study.

Multiple regression was conducted to assess each component of mediation model V connoting H4: which predicts that nations' competitive capabilities mediates the association between virtual manufacturing technology and internationalization (of firms across countries). First, it was found that virtual manufacturing technology (C- path) was positively associated with internationalization of firms (Coef. = 10.78, $t(142) = 3.17$, $p = 0.002$). It was also found that virtual manufacturing technology (a - path) was positively related to nations' competitive capabilities (Coef. = 0.73, $t(142) = 18.22$, $p = 0.000$). Lastly, results show that the mediator, nations' competitive capabilities (b- path) was positively associated with internationalization (Coef. = 29.64, $t(141) = 4.43$, $p = 0.000$). In the application of the Test of Joint Significance (TJS), the TJS is a variant of the causal steps approach which requires only that the path from predictor to mediator and the path from mediator to outcome must both be statistically significant (Cohen & Cohen, 1983, p.366; Kenny et al., 1998).

Figure 9: 6j and 6k



Model 6j: Direct effect model



Model 6k: Mediation effect model

According to Brent Mallinckrodt, W. Todd Abraham, Meifen Wei, & Daniel W. Russell (2006), performing TJS involves examining the regression results, estimating the coefficients of paths a and b and if both coefficient are statistically significant, the conclusion is that $\alpha \neq 0$ and $\beta \neq 0$ and that there is a significant indirect effect. Following this significance, mediation analysis were treated using bootstrapping method with bias – corrected confidence estimates (Preacher & Hayes, 2005). For this study, the 95% confidence interval was obtained with 5000 bootstrapped resamples as presented in Table 10 below. Results confirmed the mediation role of nations' competitive capabilities on the relation between virtual manufacturing technology and internationalization (Coef. = 21.66, CI = 10.75444 to 36.7934).

Table 10- Bootstrap results

	Observed		Bootstrap			
	Coef.	Bias	Std. Err.	[95% Conf.	Interval]	
_bs_1	21.657944	-.266538	6.4900793	9.751809	35.12119	(P)
				10.75444	36.7934	(BC)

(P) percentile confidence interval

(BC) bias-corrected confidence interval

Additionally, results show that the direct effect of virtual manufacturing technology (c' - path) on internationalization is not significant (Coef. = -10.88, $t(141) = -1.86$, $p = 0.06$) when controlling for nations' competitive capabilities. Computing the ratio of the indirect effect over the total effect i.e. $P^{\wedge}_M = (a^{\wedge} \times b^{\wedge})/c^{\wedge}$, from model 6j and 6k for effect proportion mediated and setting upper bound of 1.00, total effect mediated is 2.009 which means there is no strong evidence that suppression exists and this suggest that there is complete mediation (See Appendix 5 and MacKinnon et al. (1995) for detail).

These results indicate that the hypothesized models as regards the coefficient of determination in the models explains significant percentage of variance by the independent variables at 0.05 level. The test results suggest that the use of virtual manufacturing technology affects internationalization of firms and nations' competitive capabilities in turn mediates the impact of virtual manufacturing technology on the internationalization of firms across countries. For virtual manufacturing technology to maximally affect nations' competitive capabilities, research result indicate that higher level of the interaction effect of managerial competencies is required.

CHAPTER SIX

Discussion, summary and concluding remarks, recommendation, limitations and suggestions for further Research.

After the analysis of data and test result in chapter five, this chapter presents the discussion of the study, concluding remarks, recommendations and limitations and suggestions for further studies.

6.1 Discussion

This study has concentrated on how virtual manufacturing technology can determine the internationalization of firms through the intervention of nations' competitive capabilities and managerial competencies moderating the association between virtual manufacturing technology and nations' competitive capabilities. In line with the predictions of the research model, there is a positive relationship between virtual manufacturing technology and nations' competitive capabilities. The research result also show that nations' competitive capabilities has a positive association with internationalization of firms and the relationship between virtual manufacturing technology and the internationalization of firms across countries is mediated by nations' competitive capabilities. The research result moreover indicate that increase in nation's competitive capabilities due to the impact of virtual manufacturing technology application is more achieved at higher levels of managerial competencies compared to lower level of managerial competencies. This suggests that the more internationalizing firms employs skilled professionals to manage business operations and applies latest technologies like virtual manufacturing technology to carry out their operations, it will lead to a more significant level of competitiveness of countries. This competitive environment therefore gives room for effective and efficient performance of firms in the international market place. However, virtual manufacturing technology, nations' competitive capabilities and managerial competencies are all resources that are expected to be unique to firms and countries in order to add more value and sustain competitive advantage.

Virtual manufacturing technology is the manufacture of virtual products which is as a result of combination of computer-based information system that deliver a demonstration of the properties and performances of a realized product (Dépincé, et al. 2004). This means, computer-aided manufacturing assets with its flexibility only requires that manufacturing can be done without physical presence of firms in the international market. Invariably, this is synonymous to open innovation. It can be found with coupled innovation process which combines the inbound

and outbound dimensions such that firms work together to develop new knowledge and solutions (Gassmann & Enkel 2004). Putting this into perspectives, the development of new knowledge with the application of virtual manufacturing technology is entrenched in innovation capacity which is invariably value creation. Since new knowledge is expected to be value added, the application of virtual manufacturing technology according to the research result will increase nation's competitive capabilities. It implies that with the application of virtual manufacturing technology, nations where firms operates becomes more an enabling business environment where performance can be sustained and firms becomes more competitive both at home country and international market. On this view, Atkinson affirmed that competitiveness transmits only to the economic value, addition of a region's or nations' traded sectors while he refers to the term "region" as both national and subnational economies (Atkinson 2013, p.2.). Also, Pereira is of the opinion that business competitiveness is linked with the ability of a firm or industry to advance in a sustainable way to bring a prosperous relationship with the environment (Pereira et al. 2009, p.5).

Virtuality is the quest for agility while agility is the competency to succeed in conditions of volatile change (Katz & Dissel 2001) found with make - to - order production system. Make – to – order, a production method adopted by some firms can be linked with the accomplishment of market decision and current business activities. This means that the adoption of virtual manufacturing technology will help many firms to meet with demand in the market through networking and help to shorten production and delivery time. This as posited by Milgrom and Roberts (1990) is demonstrated in shorter product development times, quicker order processing, prompt delivery and producing products faster. Manufacturing applications like computer- aided manufacturing assets which support virtual manufacturing is agile and has the propensity to enhance 'market commitment' both locally and foreign. The relevance of the flexible nature of virtual manufacturing technology applications indicated that the possibility of manipulative power of digital computer programs adapts virtual manufacturing to various 'market decision' processes. The adaptability and the flexibility enablement is therefore a mechanism which enables firms to adopt agility and succeed in time of volatile change which can be attributed to the fulfilment of what Johanson ,Vahlne (1977) called 'current business activities'. Virtual manufacturing has been seen to connect with entry mode of firms in term of exporting in different ways. If virtual manufacturing is linked with networks, it therefore means that Johanson and Vahlne, (2009) consideration of network as important in the internationalization of firms

supports the view that virtual manufacturing technology will help internationalizing firms to enter into foreign market.

The entry mode for firms' internationalization is commonly affiliated with exporting which means that with respect to control variables in this study, efficient port infrastructure is required. Since virtual manufacturing is network based, the type of export activity suitable for firms that has adopted virtual manufacturing technology as a determinant of internationalization is either indirect exporting or cooperative exporting and strategic alliances (majorly in term of logistics). Firms which operates virtually; exports and sell products indirectly via an intermediate firm in another country with the help of expertise in such countries. A successful marketing of this type allows for high return or increase profitability due to cost reduction through efficient port infrastructure in term of transport and fast delivery time. A virtual manufacturing focused firm adopts cooperative exporting by making use of piggyback exporting where the firm uses foreign network of company or companies operating either in domestic market or market of entry abroad to sell their products in foreign markets. Firms operating on virtual manufacturing technology will therefore form strategic alliances to operate internationally through logistic cooperation by offering their products and services to other companies in foreign market for distribution. This logistic cooperation will reduce cost associated with selling and market commitments in foreign market in term of physical resources but may involves high business risk due to incompatibility in operations and organisational behaviour of the partnered companies. Organizational structure has been shown to affect firms' effectiveness regarding the communication and processing of information (Galbraith & Nathanson, 1978; Mintzberg et al., 2003; Olson et al., 1995). It connects to the ability of a firm to innovate (Argyres & Silverman, 2004; Damanpour, 1991; Tidd et al., 1997), to absorb, proceed upon, and gain from external knowledge (Jansen et al., 2005; Van den Bosch et al., 1999), and relate to external parties (Lane & Lubatkin, 1998).

This study has shown that nations' competitive capabilities will completely mediate the relationship between the use of virtual manufacturing technology and internationalization of firms which may be due to and not limited to the following indicators. First, effective information flow is embedded in market efficiency (a component of competitiveness) as well as virtual manufacturing. For firms to access international market, domestic market, (especially small) as controlled in this study has to be efficient in term of information flow which is associated with the use of virtual manufacturing technology applications for networking. Second,

another component of competitiveness, business sophistication is related to linkages or networks. These linkages or networks are found with virtual manufacturing, an informational equivalence as noted by Iwata et al. (1997), which means that; for firms to achieve internationalization, operations of firms in a country has to be relatively sophisticated in terms of networks and clusters of business activities: a perception of open innovation. Firms with an open innovation orientation have the tendency to generate superior networking capabilities, which are valuable for international expansion (Bianchi M., Cavaliere A., Chiaroni D., Frattini F. & Chiesa V., 2011; Bishop, 2008). Third, macroeconomic environment of business tied to science-based development approach have helped firms to add and create chain of values in a number of segments and develop networks. High income economies at innovation driven stage of economic development have also been linked to high rates of social learning, particularly science based learning and have the capacity to shift to new technology (Michael Porter, Jeffrey Sachs, & John McArthur 2002). From the foregoing, there is an indication that for firms to achieve internationalization to a relevant degree with the use of virtual manufacturing technology, the competitive capacity of the country must be highly prioritized. This means that firms will adopt virtual manufacturing technology and well attain international market position on the condition that nations' competitiveness is highly significant.

Russell (2001), an advocate of the theory establishing the essentials of the use of an effective managerial competency system submits that managerial competency should have positive organizational effects. This view is supported in this study according to the research result which shows that at higher levels of managerial competencies of firms' management, higher level of nations' competitive capabilities are achieved due to the impact of virtual manufacturing technology than at lower levels of managerial competencies. The implication for firms seem to have both positive and negative effects. First, if internationalization is perceived from performance perspective, it will mean that combining high level managerial competencies with the application of virtual manufacturing technology is positively associated with internationalization of firms. Second, the application of virtual manufacturing technique has the capacity in term of resources to effectively reduce cost and efficiently reduce delivery time. Third, since the application of virtual manufacturing technology involves network of partners, it will lead to increase in new knowledge of the firms and if innovation is knowledge entity as argued by Andries and Czarnitzki (2011), then it means firms can achieve new innovation with the application of virtual manufacturing technology. This view supports Shi and Gregory (2005)

assertion that a firm which can manage a global manufacturing virtual network (GMVN) effectively will be in a much stronger competitive position. Fourth, the negative effect is that the application of virtual manufacturing technology makes it possible to involve networks of partners whose organizational structure, culture and behaviour are different. Therefore, the associated risk is that flow of business transactions could be hampered due to trust and transaction implementation issues. Since virtual manufacturing technology as modelled in this study has significant positive impact on nation's competitive capabilities and nation's competitive capabilities has a positive correlation with improved performance and internationalization of firms, it appears reasonable to suggest that virtual manufacturing technology as a resource of the firm would help to accomplish dynamic capabilities in achieving effective and efficient production system for sustainable competitive advantage.

6.2 Summary and Concluding Remarks

This study analyses virtual manufacturing technology as a determinant of internationalization of firms across countries. The model conceptualized positive impact of virtual manufacturing technology on nation's competitive capabilities and nation's competitive capabilities to positively affect internationalization while managerial competencies is hypothesised to moderate the positive association between virtual manufacturing technology and nation's competitive capabilities. The research result confirmed the positive relationships as conceptualized in this study. Virtual manufacturing technology according to this study has the capacity to create new knowledge for firms and hence can improve capacity for innovation. This effect has been shown in this study to have positive impact on nation's competitive capabilities. According to the research result and in line with existing theories, nation's competitive capabilities will help firms to perform effectively and efficiently both at home and in the foreign market. This performance in the foreign market is called internationalization. It is however evident in this study that at a higher level of managerial competencies, the impact of virtual manufacturing technology on nation's competitive capabilities is optimized than at a lower level of managerial competencies. The study model has some positive implications for firms and management in that; it may help to create new knowledge, new innovation and stronger competitive position, yet it is not without its weakness as flow of business transactions could be hindered due to risks associated with networks of partners involved in the production system.

6.3 Limitations and Suggestions for Further Research

This study is limited by the time frame of research since it is subject to change. Also, in many countries covered by the survey, information about economic structure was reported as not reliable or is subject to significant revision. Accordingly, special treatment applies to 10 countries for which the breakdown of industry between manufacturing and non-manufacturing is not obtainable (Global competitiveness report, 2013-2014). Therefore the data used for this study may not be completely unbiased. This study has been carried out with a cross-sectional data set which may not be representative enough to draw a generalized conclusion. Measurement of some of the variables in this study have been operationalized to draw inference from the data which may have changed the representation of the general opinion of other researchers by which the validity and reliability of the results can be questioned. This study has missed out a total number of 53 countries not covered by global competitiveness report 2013-2014 and therefore, the test result may be affected with the inclusion of the rest countries in a similar study on this topic. Studies on virtual manufacturing technology as a determinant of internationalization of firms is practically uncommon and therefore, this topic is researched at this point for knowledge contribution which could be further investigated. This means that with time, other research studies may prove that it may not necessarily determine internationalization of firms across countries. The strength associated with the method of research is that it saves time and cost efficient since there is no expense incurred to collect data for the study. Also, the adoption of the data set is due to the reliability associated with the source.

To probe further on this study, first, a research should be carried out using a longitudinal data set to analyze virtual manufacturing technology as a determinant of internationalization of firms in order to establish a more concrete result in comparison with this study. Second, a research study should be conducted by controlling for the degree of nations' competitive capabilities to test the effect of the association between nations' competitiveness and virtual manufacturing technology in determining internationalization of firms. Finally, the control effect on the level of nations' competitiveness as a mediator if significant; should be tested to ascertain the proportion of its mediation effect.

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Appendix

Appendix 1: (Variable measurement and computation)

Variable	Proxy	Description
Internationalization	Export	Sum of gross domestic product plus value of imports of goods and services, minus value of exports of goods and services, normalized on a 1–7 (best) scale.
Virtual manufacturing technology	capacity for Innovation	In your country, to what extent do companies have the capacity to innovate? (1 = not at all; 7 = to a great extent)
Nation’s competitive capabilities	Global competitive index	No description
Managerial competencies	Reliance on professional management	In your country, who holds senior management positions? (1 = usually relatives or friends without regard to merit; 7 = mostly professional managers chosen for merit and qualifications)
Domestic market size	Domestic market size	Sum of gross domestic product plus value of imports of goods and services, minus value of exports of goods and services, normalized on a 1–7 (best) scale

The variables above according to Schwab (2013, p.90), was computed for any given survey question as shown below:

For any given Survey question i , country c 's final score, $q_{ic}^{2012-13}$, is given by:

$$q_{ic}^{2012-13} = w_c^{2012} \times q_{ic}^{2012} + w_c^{2013} \times q_{ic}^{2013} \quad (1)$$

where

q_{ic}^t is country c 's score on question i in year t , with $t = 2012, 2013$, as computed following the approach described in the text;

q_{ic}^t is respondent n 's response (on a 1–7 scale) to question i in year t ; and

w_c^t is the weight applied to country c 's score in year t (see below).

The weights for each year are determined as follows:

$$w_c^{2012} = \frac{(1-\alpha) + \frac{N_c^{2012}}{N_c^{2012} + N_c^{2013}}}{2} \quad (2a)$$

and

$$w_c^{2013} = \frac{\alpha + \frac{N_c^{2013}}{N_c^{2012} + N_c^{2013}}}{2} \quad (2b)$$

where N_c^t is the sample size (i.e., the number of respondents) for country c in year t , with $t = 2012, 2013$.

Plugging Equations (2a) and (2b) into (1) and rearranging yields:

$$q_{ic}^{2012-13} = \frac{1}{2} \times \left[\underbrace{(1-\alpha) \times q_{ic}^{2012} + \alpha \times q_{ic}^{2013}}_{\text{discounted-past weighted average}} \right] + \frac{1}{2} \times \left[\underbrace{\frac{N_c^{2012}}{N_c^{2012} + N_c^{2013}} \times q_{ic}^{2012} + \frac{N_c^{2013}}{N_c^{2012} + N_c^{2013}} \times q_{ic}^{2013}}_{\text{sample-size weighted average}} \right]. \quad (3)$$

In Equation (3), the first component of the weighting scheme is the discounted-past weighted average. The second component is the sample size-weighted average. The two components are given half-weight each. The value for α is 0.6, which corresponds to a discount factor of 2/3. That is, the 2012 score of country c is given 2/3 of the weight given to the 2013 score. One additional characteristic of this approach is that it prevents a country sample that is much larger in one year from overwhelming the smaller sample from the other year.

The formula is easily generalized. For any two consecutive editions t_1 and t_2 of the Survey, country c 's final score on question i is computed as follows:

$$q_{ic}^{t_1-t_2} = \frac{1}{2} \times \left[(1-\alpha) \times q_{ic}^{t_1} + \alpha \times q_{ic}^{t_2} \right] + \frac{1}{2} \times \left[\frac{N_c^{t_1}}{N_c^{t_1} + N_c^{t_2}} \times q_{ic}^{t_1} + \frac{N_c^{t_2}}{N_c^{t_1} + N_c^{t_2}} \times q_{ic}^{t_2} \right]. \quad (4)$$

As quoted below, the report made some exceptions to the approach above:

Exceptions

As described in the text, there are a number of exceptions to the approach described above. In describing them below, we use actual years—rather than letters—in equations for the sake of concreteness.

In the case of Survey questions that were introduced in 2013, where, by definition, no past data exist, the weight applied is $w_c^{2012} = 0$ and $w_c^{2013} = 1$. Equation (1) simply is $q_{ic}^{2012-13} = q_{ic}^{2013}$. The same is true for those countries that are newly covered (Bhutan, Lao PDR, and Myanmar) and reinstated (Angola and Tunisia) in 2013. For these countries too we use $q_{ic}^{2012-13} = q_{ic}^{2013}$.

In the case of countries that failed the inter-year robustness check, the weight applied is $w_c^{2012} = 1$ and $w_c^{2013} = 0$, so that Equation (1) simply becomes $q_{ic}^{2012-13} = q_{ic}^{2012}$. In the case of countries that failed the inter-year robustness check last year and for which the 2012 data were discarded, we use the Survey data from 2011 instead, and combine them with those of 2013 to compute the scores. Equation (1) then becomes $q_{ic}^{2011,2013} = w_c^{2011} \times q_{ic}^{2011} + w_c^{2013} \times q_{ic}^{2013}$.

Example

For this example, we compute the score of Panama for indicator 7.03 *Hiring and firing practices*, which is derived from the following Survey question: "In your country, how would you characterize the hiring and firing of workers? [1 = heavily impeded by regulations; 7 = extremely flexible]." This question is *not* a new question, and Panama did not fail the inter-year robustness test either this year or last year. Therefore, the general case of Equation (1) applies. Panama's score was 3.57 in 2012 and 3.82 in 2013. The weighting scheme described above indicates how the two scores are combined. In Panama, the size of the sample was 133 in 2012 and 130 in 2013. Using $\alpha = 0.6$ and applying Equations (2a) and (2b) yields weights of 45.3 percent for 2012 and 54.7 percent for 2013 (see Table 1). The final country score for this question is given by Equation (1):

$$\underbrace{0.453 \times 3.57}_{2012} + \underbrace{0.547 \times 3.82}_{2013} = 3.71.$$

This is the final score used in the computation of the GCI and reported in Table 7.03 (see page 490). Although numbers are rounded to two decimal places in this example and to one decimal place in the data tables, exact figures are used in all calculations.

Appendix 2 (entrepot countries)

```
. list country if INT > 100
```

	country
12.	Belgium
52.	Hong Kong SAR
58.	Ireland
75.	Luxembourg
93.	Netherlands
116.	Singapore

Appendix 3 (Result for model I & II)

```
. reg ncc vmt, robust
```

Linear regression

Number of obs = 144
 F(1, 142) = 389.57
 Prob > F = 0.0000
 R-squared = 0.7004
 Root MSE = .37088

ncc	Robust				
	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]
vmt	.730776	.0370249	19.74	0.000	.6575848 .8039671
_cons	1.378522	.1519926	9.07	0.000	1.078061 1.678982

```
. reg ncc vmt vmtmancomp
```

Source	SS	df	MS	
Model	46.6604513	2	23.3302256	Number of obs = 144
Residual	18.5254339	141	.131386056	F(2, 141) = 177.57
Total	65.1858852	143	.455845351	Prob > F = 0.0000
				R-squared = 0.7158
				Adj R-squared = 0.7118
				Root MSE = .36247

ncc	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]
vmt	.7152298	.0396034	18.06	0.000	.6369367 .793523
vmtmancomp	.0936336	.0338304	2.77	0.006	.0267533 .1605139
_cons	1.005061	.2052585	4.90	0.000	.5992792 1.410843

Appendix 4 (Interaction result)

```
. nestreg: reg ncc ( vmt) ( vmtmancomp)
```

Block 1: vmt

Source	SS	df	MS	Number of obs = 144		
Model	45.6539851	1	45.6539851	F(1, 142)	=	331.91
Residual	19.5319	142	.137548592	Prob > F	=	0.0000
Total	65.1858852	143	.455845351	R-squared	=	0.7004
				Adj R-squared	=	0.6983
				Root MSE	=	.37088

ncc	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]	
vmt	.730776	.0401119	18.22	0.000	.6514824	.8100696
_cons	1.378522	.1582596	8.71	0.000	1.065672	1.691371

Block 2: vmtmancomp

Source	SS	df	MS	Number of obs = 144		
Model	46.6604513	2	23.3302256	F(2, 141)	=	177.57
Residual	18.5254339	141	.131386056	Prob > F	=	0.0000
Total	65.1858852	143	.455845351	R-squared	=	0.7158
				Adj R-squared	=	0.7118
				Root MSE	=	.36247

ncc	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]	
vmt	.7152298	.0396034	18.06	0.000	.6369367	.793523
vmtmancomp	.0936336	.0338304	2.77	0.006	.0267533	.1605139
_cons	1.005061	.2052585	4.90	0.000	.5992792	1.410843

Block	Block F	Block df	Residual df	Pr > F	R2	Change in R2
1	331.91	1	142	0.0000	0.7004	
2	7.66	1	141	0.0064	0.7158	0.0154

Appendix 5 (Mediation result)

Sobel-Goodman Mediation Tests

	Coef	Std Err	Z	P> Z
Sobel	21.657944	5.0280006	4.307	.00001651
Goodman-1 (Aroian)	21.657944	5.0351464	4.301	.00001698
Goodman-2	21.657944	5.0208446	4.314	.00001606

	Coef	Std Err	Z	P> Z
a coefficient =	.730776	.040112	18.2184	0
b coefficient =	29.6369	6.68528	4.43316	9.3e-06
Indirect effect =	21.6579	5.028	4.30747	.000017
Direct effect =	-10.8783	5.8377	-1.86345	.062399
Total effect =	10.7797	3.39889	3.17153	.001516

Proportion of total effect that is mediated: 2.0091428
 Ratio of indirect to direct effect: -1.9909401
 Ratio of total to direct effect: -.99094005