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Agile Enablers And Outcomes: Empirical Validation Of Agile Manufacturing Model In Developing Countries Context-Ugandan SME's Experience

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Abstract

This article focuses on the extent to which agile mnufaccturing enablers contribute to factory performance of small and medium enterterprises enaged in manufacturing business. This study was aimed at establishing the influence of technological adaptive capabilities, efficient transaction processes and systems and organizational and politicl ties on factcory performance..
A questionnaire based survey was conducted in Western region of uganda and Kampala Capital City with a population 148 SMEs engaged in manufacturing. A sample of 129 SMEs was selected and data were successfully and effectively collected from a 103 SMEs. Care was taken to ensure reliability and validity of data. hypothesized relations were tested usins correlations and hierarchical regression. Result indicate that organizational and political ties and efficient transaction processes appear as most important agile enablers because they significantly influence the level of factory performance. Technological adaptive ability appear not to give advantage to SMEs in improving factory performance. The findings add an important aspect of involving politics in ties and alliances in fostering factory performance. In addition more insight was provided on how internalization can provide a more efficient mode of manufacturing that further enhances factory performance. The study shades light of the more robust agile manufacturing model that mangers of SMEs should embrace to remain competitive.

Key words: *Agile manufacturing, factory performance, Flexibility and Responsiveness, cost reduction*

Introduction

The industrial environment has changed over the past two decades due to unprecedented global competition. This situation is characterised by changing customer requirements and global market conditions that are difficult to foresee. In addition, the rising market composition diversity has caused tremendous pressure on manufacturers to shift from dilapidated manufacturing culture in preference for global manufacturing innovation (Lubica, 2014). These developments, have been much realized in developed countries and only limited in developing countries thus leaving thier firms less competetitive in the global market. In a developing country context, a number of specific factors exist that have limited the necessary shift among the local firms in comparison to developed nations. For instance, researchers underscore lack of market knowledge, employee commitment, customer involvement and flexible innovation as key impediments to exploitation of profitable opportunities within and outside developing countries'markets (Apolot, 2012; Christopher, 2000; Hines, 2004; Thaeir, 2014; Lubica, 2014; Mark & Jonathan , 2016). Other schools of thought have focused on high operational costs of firms and their failure to circumvent turbulences in the market. The intent of this paper is to draw more light on how agile enablers in the context of Uganda can influence the levels of factory performance of SMEs.

In the related studies addressing agility of firms in developed countries, flexible manufacturing system, business process re-engineering, time-based competition, benchmarking, organizational reconfiguration, leveraging human capital and integrated information systems are identified as core agile enablers of successful manufacturers firms (Cho, Jung , & Kim, 1996; Daniel, Lucıa, & Esteban, 2007; Goran & Zlata , 2012; Stephen, 2012; William , Samson , & Taonga , 2013).

With a new wave of globl competition, many firms may choose different paths to achieving competiveness, of which agility is prevalent (Christopher, 2000; Daniel, Lucıa, & Esteban, 2007; Naylor, Mohamed , & Danny , 1999; Gunasekaran & Yusuf, 2002). However, comprehensive analysis of firms in developed countries shows that the feasibility of agile manufacturing depends on radical organizational re-designs, technology and automation, inflastracture development, skilled and committed human capital, alliances, contractual systems and other supportive institutions (Gunasekaran & Yusuf, 2002; James, 2000; Abraham, Y Nahm; Mark, A Vonderembse; Xenophon, A Koufteros, 2003; Goran & Zlata , 2012; Daniel, Lucıa, & Esteban, 2007; Thaeir, 2014). In contrast, fundamental building blocks for agile system in the context of Uganda are still fuzzy. This paper contributes to the discussion of agile manufacturing by developing and validating a model with the focus on the factory performance

Agile manufacturing-origin and overview

The concept of agility has its origin in flexible manufacturing systems such as machine and routing flexibility (Nurzatul, Nurul, Anis Fadzlin, Juriah, & Suzaituladwini, 2012). This flexibility proliferated into business context when external shocks became more unpredictable in the global economy. Though there is common misconception about flexibility and agility as similar phenomena, Gunasekaran and Yusuf (2002) and William (2013) describe flexible manufacturing systems as a reactive appraoch, unlike the agile manufacturing system, which is considered proactive. In this regard, innovative approaches of agility emerged in the USA in 1990 with intent to enhance competitiveness of the manufacturers (Goran & Zlata , 2012; Gunasekaran & Yusuf, 2002;

Shannon, Anna, & Franz-Josef, 2012; Christopher, 2000). In the publication made during 1997, agile manufacturing featured as the main manufacturing tool in a technology driven enviromemt (Lawler, 1997). It was around the same time that simultaneous product design, customized production, virtual manufacturing, intelligent processes and enterprise integration manifested in most manufacturing businesses.

Nowadays, manufacturing companies focus more on delivering products at more value than their competitors in the shortest possible time at lowest cost. To this end, manufacturers have identified capabilities to achieve this goal within the domains of agile manufacturing (Shannon, Anna, & Franz-Josef, 2012). This is most experienced among manufacturing firms in developed countries like USA, Netherland and HongKong. In these countries, agile manufacturing is known for its two major attributes: quick response and quality focus.Yet, this has left un-ending argument and conflicting connotations on perspectives from which these attributes are appreciated.

In contrast adaptation of agile manufacturing in developing countries remain constrained by unskilled human capital, weak supportive institutions, insufficient infrastructureand inadquate innovative research programs. Yet, both global and local markets continue to demand quick deliveries of quality products. In this article, the question of whether agile manufacturing enablers translate into factory performance of SMEs in a developing country like Uganda is key. Arguments have been guided by theory of constraints and transaction cost theory along with rigorous review of literature. In consideration of theoretical connotations, the key assumption is that firms in developing countries can still achieve agility in their own unique way. According to the theory of constraint, all resources contributing to the firms' competences must be utilitzed. The theory suggests that every manufacturing firm has finite resources and multiple activities that are linked and one of which acts as a constraint that must be identified and exploited. With this underlying theory, critical limiting factors and measures considered in elevatingthe constraints are identified (Don & Maryanne, 2006). The theory of constraint provides the fundamental thinking process that identitifies what to change, what to change to and what resources are needed for change. It is from this theoretical understanding that implementation of agile manufacturing in developing countries would depend on the firms' ability to re-craft their capabilities using their limited resources.

Depite organizational ability to identify and optimize its limited resource base, the competitiveness of the firms in developing countries is also said to rest with costs associated with transactions (Don & Maryanne, 2006). The transaction cost theory also explains how firms in an agile system can improve performance. The transaction cost theory asserts that firms provide a relatively more efficient method of manufacturing by internalizing transactions in uncertain situations. This is only possible when thecosts of conducting transactions through the market arerelatively higher compared to when they are internalized.

In addition to constraints and costs of transactions in developing countries, implementation of agile manufacturing in developing countries requires an understanding of the contribution that social network plays. Therefore, in order to streamline agile practices without losing focus on cost reduction, the manufacturing firms need to exhibit exclusive affiliations and significant ties with other partners.With much diversity in the market, these affiliations would play a big role in

knowledge transfer and innovative research. It is also important to note thatmost developing countries are characterized by inadequate research and innovative technologies caused by weak education systems. Therefore to cope with competitive storms in the global markets, SMEs in developing countries need to pay attention to imported technologies.

Manufacturing behavior in developing countries

The manufacturing sector has become the central part of the developing countries owing to its anticipated potential to contribute to the development of these economies (Turkay, Koray, Adem, & Alptekin , 2012; James, 2000). This sector is characterized by a limited menu of domestically produced intermediate inputs and capital equipment. In order to gain competitive edge in the global market, manufacturing firms have undergone a paradigm shift that spans from craft industry to mass customization. In pursuit of this dramatic shift, the focus is on improving performance (William , Samson , & Taonga , 2013).

Despite new paradigms being accredited in developed countries, the experience shows that their SMEs engaged in manufacturinglargely maintain old technologies. Notwithstanding this observation, there areempirical findings showing that some few firms in developing countries exhibit characteristics of agile manufacturing. For instance, James (2000) identifies responsiveness as a key element to provide qualitative success as well as quantitative success of the firms. He adds that firms in developing countries respond to changes and disturbances using distictive tools in comparision to developed countrys' firms. Empirical studies in Zimbabwe on manufacturing companies indicates that reductions on flow-time and work in progress, and adaptation to irregular shopfloor disturbances are born by the integrationof process planning and scheduling (William , Samson , & Taonga , 2013). However this integration is much dependant on professional off-shelf softwares which are not affordable by most of the manufacturing firmsthat form the biggest portion of economic sector in developing countries (James, 2000). In contrary, studies made by Nagesh and Siddharthan (1993) on 13 manufacturing firms in developing countries show that innovative technology does not foster flexibility and responsiveness, rather they deploy technical knowledge since there is limited learning-by-doing attributed to weak education system.

In countries like Nigeria, Industrial Training Fund and other institutions with productivity related objectives have been established to enhance industrial competitiveness through training of theworker. However these programs are constrained by lack of budgetary commintemt to enable such institutions fulfil their mandate (Adeola, 2005). It is also observed that some of the multinational companies with affiliates in developing countries try to reduce these constraints by transferring their expertise under the umbrella of foreign direct investment. Experience with sub-saharan countries also shows that infrastrature services are missing if not inadquate, causing limited access to the consumer markets. In such instances, many manufacturing firms have devised their own transportation and communication services to reach the country side customers (World Bank , 1994).

Finally, the work force is a foundation stone for the success of agile manufacturing. In developing countries, where markets are not properly regulated, frequent subcontracting in manufacturing and

stringent contracts are pathways. It is from this understanding that Conrad, Simon, Ibrahim, & Jummai (2013) argues that most employees are doing work for compliance in the fear of being reprimanded. This is blamed on weak labour laws, untrained workforce and failure to align organaizational interest with those of individuals. Other scholars shift the blame to the ethnic behavior and culture where certain attitudes, values, norms, style in which people are embedded, determine amount of enthusiasm and engagement attached to any manufacturing business (Jeffery, James, Oscar, & Brad, 2017). For example, cultures like Ibo culture in Nigeria is receptive to change and is achievement-oriented. This ethenic group is eminent for its fierce individualistic struggles and ruthless determination to success. Certainly, such long term orientations need to be considered in building a strong work force that aims at achieving greatest fame for their achievement. As further stressed by Conrad, Simon, Ibrahim, & Jummai (2013), these traits need considerable attention in an agile system. On contrary, Farrell (2004) and Stephan (1994) argue thatwork force has no significant influence on implementation of agile manufacturing, rather it is attributed to how employees are socially linked with organizations.

From the policy point of view, though some developing countries have policies that encourage innovative and scientific research program, their implementation has fallen short of the expectation (Adeola, 2005). In a country like Uganda, the rapid changes in study curriculum tailored to science has not even beentranslated to corresponding increase in the quality of research personel.Manufacturers in such country have rather extended their hand towards on-job training and skill-development initiatives whilst adaptation of imported technologies. In conclusion, collectively these arguments point to some opportunities to implement agility but certainly in ways that would not be similar to those in developed nations. The section that follow provides a more detailed description of key factors that are likely to stimulate the implementation of agile manufacturing in a developing context (see figure 1).

Agile manufacturing:Developing countries expereience

Despite many agile manufacturing models that have been implemented in developed countries, evidence has shown thatthese models provide little impetus to the survival of SMEs in a different context of Uganda. Some scholars explaining this phenomenon have focused on identifying enablers of agile manufacturing from core competencence perspective. Dowlatshahi & Cao (2006) for example, claim that aligning vertual enterprise and information technology have a significant effect on the organization performance in an agile manufacturing enviroment. Their claim is augmented with finding of Vinodh & Kuttalingam (2011) from developing countries indicating that agile manufacturing practices are enabled by information technology proto-types. Wang, Koc, & Nagi (2004) also argue that agile manufacturing capabilities can only be fostered with in-built managerial competences which include total production management. In their model for computer aided manufacturing assemblies, they point total quality management, total productive maintenance, supply chain management, enterprise resource planning, Kanban, Kaisen and 5S[1] as fundamental building blocks for the success of agile manufacturing.

[1] Sort, shine, set in order, standardize and Sustain

While investigating new mode of manufacturing, Sharp, Irani, & Desai (1999)also identify multi-skilled and flexibile human capital and empowerment of teams as core drivers towards factory performance. Their recommendations, also point to information technology as determining factorfor implementation of agile manufacturing especailly in creating multiple product designs.

Other success stories concerning agile modeling in developing countires reveal a number of factors that anchor firms in this new era of tabulent market. Shibani & Ahmed(2015) for example, underscores organisational infrastructure, trade agreements that smoothen business transactions and the organizational culture and structures that appreciate environmental change and finally top management commitments as fundamental factors for any competetive manufacturing strategies.

As firms in developing countries navigate in a more challenging environment, characterized by changing demands, they continuously develop new and unique approaches. This paper therefore, seeks to broaden this area of knowledge by unveiling real picture of agile manufacturing competences with empirical data from small and medium enterprises in Uganda as one of the developing country in Africa.

Agile manufacfuring model

Building on the previous agile models and thorough review of several case studies, the study provide an addendum to previous discussions on agile enablers in unique context of Uganda help SMEs in manufacturing businessachiev better factory performance. Agile literature provides an insight that agile manufacturing be viewed from three perspectives: outcome, operational or implementation and a combination of both (Daniel, Lucia, & Esteban, 2007). A numbers models have been drawn up expressing emphasis on these perspectives. This paper addresses the question as to whether operational perspectives of agile manufacturing translate into factory performance. In the first part of the discussion, explanations regarding the key enabling factors are provided.In addition, insight on the most feasible way of achieveing agile manufacturing have also been highlighted. The later part of this section addresses the key result of implementing agile practices insightfully looking at flexibility, responsiveness and cost reduction.

From the operational point of view, agile manufacturing framework developed in this paper (Figure 1) considers three critical areas: Internalization and participation in infrastructural development, utilization of networks and ties and lastlybuilding technological adaptive competences and abilities in the local firms operations. Each of these areas are expounded in the sections that follow.

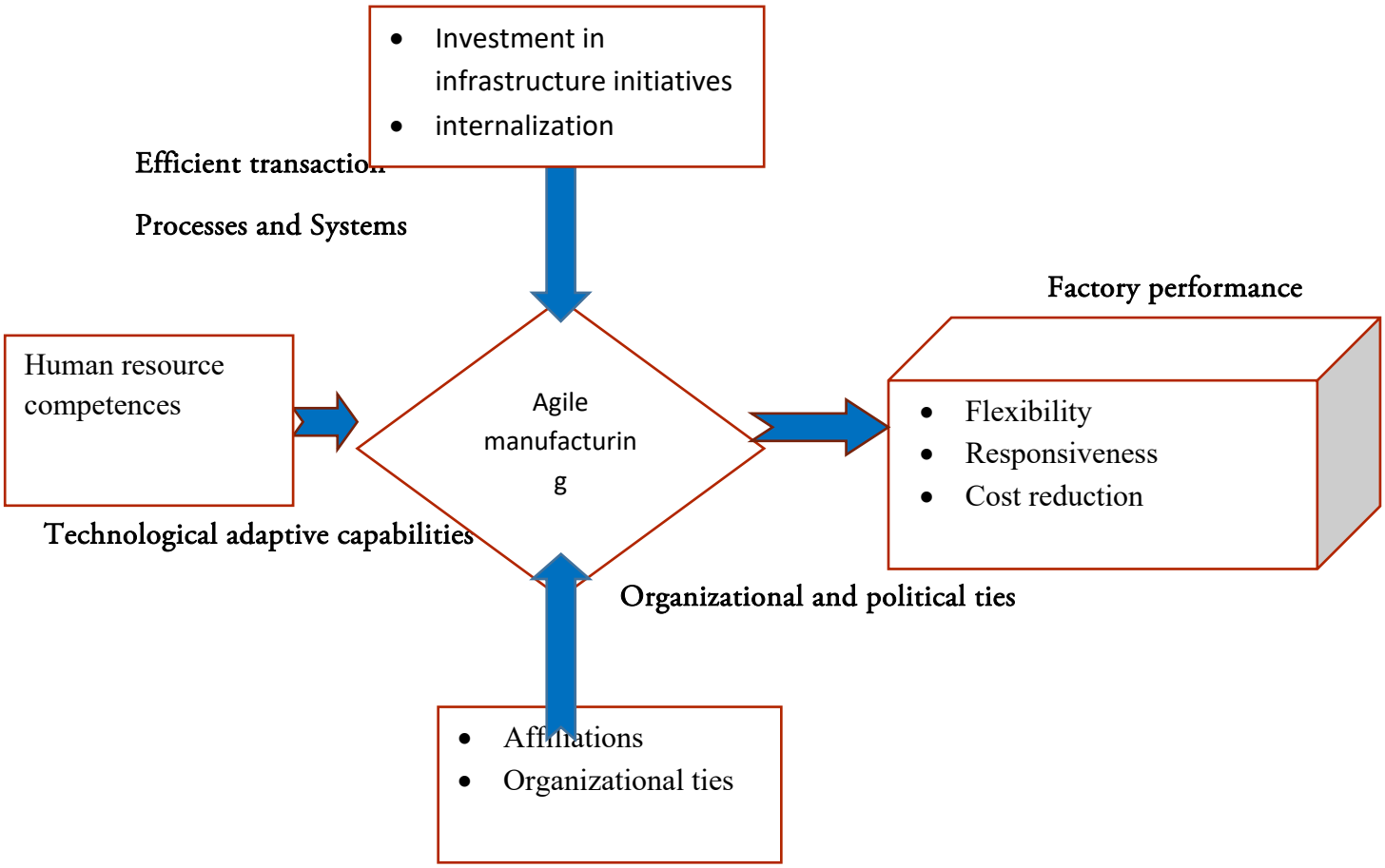
Internalization and participation in infrastructure development: Transaction processes forms a significant part of the supply chain. Researchers have shown that firms prefer internalization to externalization of transactions in developing country contexts for three reasons (Rodrigo, Fernando, Andreda, Manuel, & Dan, 2010). Firstly, it may be difficult to guarantee the execution of the contract and suppliers may have opportunistic behavior that impairs the customers interests. Secondly, the bargaining power of the suppliers may increase if they posses specific equipment replenish the activity. Thirdly, if manufacturing firm buys in large quantities from a single supplier, normally, the supplier demands better terms and conditions. This consequently increases the production costs.

On the other hand, the ability of the firm to compete on delivery time and low cost is highly dependant on infrastructure policies within the country (Ali, Gholamhossein, Forouzandeh, & Hamid, 2013). Policy reforms in respect of the infrastructure should shift their frontiers to private sector involvement especially in developing countries. This can only be possible if bureaucracy is associated with investment activities and where the public would incur high cost to provide infrastructure service. It is worth to conclude that for SMEs in developing countries toimprove factory performance, there is need to orient themselves with massive internalization and participation in infrastructural development initiatives.

Utilization of affiliations and/or organizational ties: In the pursuit of agility in the context of developing country, firms can reduce transaction costs when services and raw materials are provided by their affiliates (Kumar, 1987). Previous research on multi-national enterprises offer evidence that these companies enjoy inherent competetiveness because of their in-house-ability to provide service and monitor standards. This ability however is embedded in the organizational structure and can only achieved when firms have built strong and valuable ties with other organizations and political entities (Ho-Dae, 2012). Given that network ties play a big role in quick deliveries and cost reduction, it tantamount to the fact that agile manufacturing can be beneficial when there are strong ties with suppliers and government agencies. Indeed these ties have strong bearing on whether or not a firm succeeds at any one point in supply chain.

Adaptive technology: Research and development has remained one of the weakest links in the industrial sector in developing countries. Literature confirms that most firms in developing countries appreciate the importance of technology in manufacturing (Cho, Jung , & Kim, 1996; African Development Bank Group, 2014; Apolot, 2012). However, these countries are apparently disadvantageous as much of technonologies are adaptive rather than creative in nature. Therefore developing countries' SMEs are likely not to benefit from innovative technologies, because of shorter product life cycles, unskilled human capital, inadequate capital and firm's specific nature of knowledge. It is therefore important for the SMEs to re-oreint themselves with imitative capabilities to allow agile manifestation in the manufacturing systems. Importation of high technology product in developing countries require product specifications services such as installations, maintainance, repairs and instructions. This allows imitative and creative designs that cause change in the face of the customer.

Inspite of this, as previously stated human behavior is prudent in influencing the necessary imitations at a firm level (Jeffery, James, Oscar, & Brad, 2017). Therefore attitudes, values, norms, style by which people are distinguished from others greatly determine the enthusiasm and engagement attached toany change. Studies have shown that some culture attributes respect tradition and fulfill social obligation. As stressed by Conrad, Simon, Ibrahim, & Jummai (2013), these traits need considerable attention when applying adaptive technologies and in turn when implementing agile manufacturing in a developing country context.



Source: *Adopted from Daniel, Lucia, & Esteban, 2007; Christopher & Towill, 2001; James R. T., 2000 and modified by researcher.*

Factory performance

Literature provides that the outcomes of agile manufacturing are not only responsiveness and flexibility but also costs (Daniel, Lucia, & Esteban, 2007). Infact, agile manufacturing model is concerned with producing customized products whilst lean efficiency (Gunasekeran & Yusu, 2002). In developing countries context, there has been little empirical evidences on the influences of agile manufacturing onresponsivesness, cost reduction and flexibility. The existing literature only associates agile manufacturing with ability to survive in a constantly changing market environment (Dove, 2001; Ali, Gholamhossein, Forouzandeh, & Hamid, 2013; Denise, 2012). It does not offer ability of agile manufacturing model to improve factory performance. In this article, insight is provided on agile manufacturing as a holistic manufacturing model that would give advantage to SMEs in Uganda. In this particular context, flexibility from operational landscape is construed as the extent to which firms' resources can be leveraged to produce different products. In addition,

responsiveness is characterized by delivery of services while low costs are associated with coversion proceedings and logistics.

Much of the literature focusing on developed countries argues for a match between factory performance and enablers of agile manufacturing . In a unique context of Uganda , as one of the Africa's developing contries, it is important to verify the consistence of similar assumption by constructing the null hypothesis. If the hypotheses are rejected, then data provides sufficient evidence to support the influence of agile enablers on factory performance in a unique context of Uganda.

H_{o1}:Affiliations and organizational ties have no positive and significant influence on the factory performance of SMEs in Uganda.
H_{o2}: Building efficient transaction processes and systems does not positively influences factory performance of SMEs in Uganda
H_{o3}:Adaptive technology capabilities do not positively and significantly influence on factory performance of SMEs in Uganda

METHODODOGY

To examine the influence of agile enablers on factory performance in uganda, it is important to use valid and reliable data. The data used to validate the hypotheses forms part of wider survey conducted in Uganda for establishing the effect of lean, agile and leagile manufacturing practices on plant performance of manufacturing SMEs in developing countries (Nagaaba, 2018). The target population was made up of 148 SMEs in manufacturing business located in Western region of Uganda and her Capital city; Kampala. These two areas form the biggest industrial hubs in Uganda. SMEs (with employees ranging from 5 to 100) were chosen as they form the biggest portion of the manufacturing sector in Uganda upto 90 percent (Marios, Isaac, & Julius, 2016). In addition, these SMEs have surfaced in vast number of studies on manufacturing business in Uganda. Of the 148 manufacturing SMEs targeted, a sample of 129 was determined using Slovins formula[2]. Sample selection began with creating a database of SMEs in Kampala and Western Uganda. These SMEs were later categorized into two based on the products produced: Non-durable and Durable (Thomas & Stephen, 1990). Systematic sampling was deemed appropriate for this particular study.

Data Collection

The questionnaires were physically delivered together with a covering letter explaining the purpose of the study, the benefits for participating and the confidentiality statement. The questionnaires were addressed to the factory managers and a manufacturing unit was identified as the unit of analysis. A total of 103 questionares were collected back representing a valid response rate of 80 percent. The mean, standard deviations and reliability of the construsts are presented in table I.

Validity of the Instrument

[2] Sample size: $n = N/(1 + N \times e^2)$. Where, N is the target population and e is margin of error at 95% level of confidence.

Although survey research has been useful in studying performance , in certain contexts, it may raise concerns related to the validity of data collection methodology. In this particular study, dimesionality reliability and validity of the data were taken care of. In designing the survey, the measures of dependent variables related to enablers of agile manufacturing preceed factory performance. All questions were rated on a five-point Likert scale on which 1-strongly disagree, 2-disagree, 3-nuetral, 4-agree and 5-strongly agree.

Before survey, reliability test was first performed and in all cases Cronbach's Alpha (α) was exceeding the value of 0.6 (Table 1). This limit is recommended by Hair, Anderson, & Tatham (1998) in exploratory studies and is considered appropriate to recognize strict internal consistency (Nunnally, 1978).

Table 1: Mean, Standard Deviations and Reliability

Study variables	Mean	SD	Skewness	Kurtosis	Alpha coefficient
Enablers of agile manufacturing					
Organizational and political ties	2.733	1.641	0.044	-0.546	0.74
Technological adaptive ability	3.423	1.319	-0.504	-0.705	0.67
Efficient transaction process and systems	3.422	1.320	-0.386	-0.613	0.66
Factory performance					
Flexibility	2.978	1.485	-0.182	-0.914	0.83
Responsiveness	3.442	1.321	-0.877	-0.654	0.74
Cost reduction	2.737	1.640	-0.877	0.254	0.69

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In addition, to ensure that construct meanings were consistent, further empirical tests after collecting the data were performed. First; Harman's one factor test was used to examine whether data collected was dependant on discretionary knowledge of the factory manager. Accordingly, when responses are limited to single participant, common method variance normally occurs (Martina, John, & Deepak, 2010; Ishengoma & Kappel, 2011). If one factor emerges,accounting for most of the covariance in the independent and dependent variables, then there is a common method variance. But in this case, the test revealed non-existence of such problem.This was revealed by 14 factors explaining 75.16 percent of variance and the first factor explaining 24.84 percent of variance. Secondly, confirmatory factor analysis was also carried out using verimax rotation to establish the unidimensionality of the items. The scale items were used in computing factor solutions..All items loaded with a standardized coefficient of atleast 0.5 with exception of one item that was considered very crucial in explaining efficient transaction processes and systems that correlated upto 40 percent. Three factors emerged accounting for 54 percent variance in agile manufacturing enablers. Unidimensionality of factory performance was also examined and three factors explainig 58 percent variance in factory performance emerged. In all cases, the derived factors were with eigen values greater than one. The results of factor analysis are presented in table 2 below.

Table 2: Factor analysis

Scale	Component			Eigen Values	Percentage of variance	Cummulative percentage of variance
Agile enablers	1	2	3			
Organizational and political ties (1)				3.405	21.039	21.039
Our firm partners with government in infrastructure development	0.668	-0.101	-0.336			
Our firm is affiliated to other organizations to allow smooth flow of resources	0.652	-0.039	-0.408			
We have improved our creativity and innovattion using immitative technolog	0.561	0.319	-0.46			
In our firm, we have IT facilities that links stake holder like governement and othe	0.717	-0.285	-0.011			
In our firm, we prioritize internal sourcing	0.664	-0.202	0.129			
Technological adaptive ability (2)				1.845	18.196	39.235
Conducive communication channels have improved performance	0.292	0.527	0.168			
Our most important tasks are operated by machines and computers	0.221	0.671	0.425			
Our tasks are done through cross-functional teams to have better performa	0.379	0.587	0.481			
In our firm, we have imported technologies to improve customer value	0.238	0.583	-0.446			
Efficient transaction process and systems				1.804	15.029	54.264
In our firm, we have modular production systems	0.379	-0.314	0.401			
We partner with suppliers and distributors	0.343	-0.372	0.569			
we have shorttime contracts and tenders	0.417	-0.151	0.600			
Factory Performace						
Responsiveness				3.14	23.727	23.727

Our employees quickly develop new manufacturing strategies	0.15	0.773	0.123			
Our firm changes internal processes and products quickly	0.06	0.811	-0.01			
Cost reduction				1.895	17.718	41.449
Cost of production is key performance indicator	0.13	0.039	0.735			
Our firm does not find costly to introduce new product line	0.13	0.053	0.703			
Cost of holding inventory has reduced	0.18	0.302	0.799			
Flexibility				1.40	17.119	58.563
Differentiation is possible in our firm	0.7	0.165	0.257			
Our customers always request for new product	0.77	-0.03	0.245			
Our equipment can be adjusted to produce other products	0.77	0.149	0.233			
Our company has short lead time	0.65	0.074	-0.269			
Orders are fulfilled in the shortest timeand without hinderance	0.65	0.034	-0.254			

Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.

ANALYSIS

The hypotheses were tested through ordinary least squares (OLS) regression analysis. Collinearity diagnostics were first performed by examining the bivariate correlations and variance inflation factors (VIFs); reported. Furthermore, assumptions of equality of variance, independence of error, and normality of the metric variables in the model were met for all regression equations. Levene test was also performed to establish the homoscedasticity of categorical independent variables. The effect categorical data depicted insignificant relationship ($p>0.05$). Hierarchical regression across control variables AND three models for each agile enablers was performed. Before testing effect of agile manufacturing onfactory performance, control variables of product type, firm size and age were first regressed.Control variables included in Model 1 form the basis for validating agile model in this study context.Subsequent models examines how dimesions of agile manufacturing impact on factory performance. To assess model significance, differences in F-stat and adjusted-R^2 values were tested. High adjusted R^2 value of the model indicates that variation in independent variables accounts for change in factory performance. The coefficients for the degree of change in factory performance caused by unit change in agile manufacturing enabler were also determined.

RESULTS

On verifying that the regression assumptions are not violated, relationships between factory performance and metrics of agile environmentas depicted in Figure I were tested. The relationship between the agile enablers and factory performance was tested using correlation as shown in Table 3. Ordinary least square method of hierarchical regression was used to test the strength of the influence. The results of the analysis are presented in Table 4 in which four models were considered robust to estimate factory performance using data collected from Ugandan SMEs.

Table 3: Correlation Matrix

Variables	Correlations			
	1	2	3	4
Technological adaptive ability (1)	1			
Organization and political ties (2)	.203*	1		
Efficient transaction processes and systems (3)	.211*	.194*	1	
Factory peformance (4)	0.063	.280**	0.271**	1

*. Correlation is significant at the 0.05 level (1-tailed).
**. Correlation is significant at the 0.01 level (1-tailed).

Table 4: Results of hierarchical regression analysis

	Model 1		Model 2		Model 3		Model 4		
	B	t	β	t	B	t	β	t	VIF
Control Variables									
Firm age	-0.01	-0.1	-0.022	-0.18	-0.022	-0.179	-0.009	-0.072	1.507
Stage of development	0.136	1.32	0.12	1.194	0.119	1.182	0.1	1.01	1.047
Firm size	0.115	0.92	0.071	0.579	0.067	0.536	0.045	0.371	1.597
Indepeendent variables									
Organizational and Political ties			0.26	2.597*	0.257	2.536*	0.192	1.842	1.152
Technological adaptive ability					0.033	0.324	0.061	0.615	1.057
Efficient							0.216	2.098**	1.129

transaction process and systems									
Model summary									
R		0.16		0.301		0.303		0.365	
R Square		0.03		0.091		0.092		0.133	
Adjusted R Square		-0		0.052		0.043		0.077	
R Square Change		0.03		0.065		0.001		0.066	
F Change		0.83		6.745		0.105		4.4	
F		0.83		2.34*		1.8788		2.356**	

*p<0.05, **p<0.01, Dependent variable: Factory performance

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From the results, model I points to collective contribution of control variablesin predicting factory performance. When entered into the regression equation, the role of control variables in model I in explaining factory performance was not supported with 90 percent level of confidence (F=0.83,P>0.1).

As prescribed in the heorarchical regression, the extent to whichenablers of agile manufacturing individually impact on factory performance can only be assessed by the change in the statistical power of the original model. Subsequent models were thereforeentered in the regression equationsequentially to observe the change in R^2.

In particular, the first hypothesis had predicted a positive influence of organization and political ties on factory performance. When the correlation coefficient was determined, the results indicate that organization and political ties significantly explain the level of factory performance (r=.280) with 90 percent confidence. This variable in model II was further regressed on factory performance. The overall model was found statisticallysignificant (F=2.34,P<0.05). The coefficient for orgnazational and political ties was positive and significant with the value of 2.597. Implying that a unit increase in organizational and political ties would cause improvement in factory performance by approximately 2.6 units. The adjusted R^2 of the model indicate that organizationl and political ties account for 5.2 percent of variation in factory performance and the change in R^2 is 0.065 which is statistiacally significant.

Model III assesses the role of technological adaptive ability in improving factory performance of SMEs. The correlation results indicate that technological adaptive ability has insignificant relationship at 90 percent significance level. This prediction was also not supported as the change in the statistical power of R^2 =0.001 was insignificant (ΔF = 0.105, P>0.1). The coefficient of the technological adaptive ability was positive but lacks significance.

Hypothesis three state that efficient transaction process and systems will positively influence levels of factory performance. The relationship was first examined with the correlation coefficient and results show that there is a significant relationship (r=0.271) with 99 percent confidence. This prediction was also assessed by entering model IV in the regression equation.From the results,the overall modelwas statistically significant (F=2.356, P<0.00). The improvement of adjusted R square statistics (from 0.043 to 0.077) suggests a better fitting model once efficient transaction process and sytems was added to the regression equation. On examining the coefficients, the data reveals support for the positive relationship (β=0.216, P<0.01).In sum, the empirical data supported two of the three hypotheses. The analysis provides evidence for two agile enablers to translate into factory performance.

DISCUSSION

The model presented in this paper suggestedthat firms ability to adopt and implement agile manufacturing in developing countries context is by three noble laureates.The results from the hierarchical regression however support organizational and political ties and efficient transaction processes and systems in influencingfactory performance of SMEs. Even though the current business situation is characterized by streams of innovative technologies due to globalized technological changes (Ali, Gholamhossein, Forouzandeh, & Hamid, 2013), the adaptive capability of SMEs in Uganda is not supported. After controlling for the firm characteristics, the results show three principle findings.

First, organization and political ties appear to predict the levels of factory performance. As other researchers have argued, alliances and ties can influence factory performance of SMEs (Daniel, Lucia, & Esteban, 2007). These findings provide empirical evidence of a long anecdotally examined association between ties and factory performance. These findings reinforce transaction cost theory which asserts that alliances play a big role in knowledge transfer and innovative research (Williamson, 1979). When SMEs engage in ties with other organizations whose performance rates have begun to plateau, they are likely to improve their performance by shortening their learning cycle, expediting product development, and reducing R&D costs (Chinho, ChiaChi, Ya-Jung, Weihan, & Cheng-Yu, 2012).On the other hand, other researchers SMEs encounter difficulties in learning due to lack novelty (Lunnan & Sven, 2008). The current empirical results provide new insight in regard to ties, where SMEs claim that such relationships allow smooth flow of information and transfer of knowledge.

Secondly, the results of the empirical analysis in this research does not support the hypothesis that technological adative ability influences facctory performance. Even though Hormozi (2001) argues that successful realization of agilemanufacturing is contingent toIT enabling environment, the evidance provided shows that such environment does not translate into factory performance. In adition, being agile in a developing country like Uganda means being responsive, cost efficient,productive and producing with consistent high qualityArnab (2012).This cognitive viewpoint of thtis study sheds new light on the validity of the argument in the context of Uganda. Probably SMEs included in the sample have not realized great importance of manifestation of IT in an agile system. Perhaps, identification of practical adaptation-framework uniquely addressing factory performance would yield supportive results.Never the less SMEs in Uganda could be

encountering challenges in learning especially when there is a big technological gap between imported technologies and innovative capabilities. While alignment of other agile enablers would require suitable technologies and skills as connoted by (Gunasekeran & Yusu, 2002), full potential of IT has not been intergrated in manufacturing systems.Therefore SMEs need to take necceasary steps to adapt to imported technological menus in case the technology available has limited scope in its application. In addition for the technologies to translate into factory performance, adaptability of SMEs should be less costly and feasible so that the benefits of translation out way the cost.

Finally, consistent with hypothesis III, the results demonstrate that there a significant and positive influence of efficient transaction process and systems on factory performance.The results point to the validity of the transaction cost theory where it is connoted that the cost of manufacturing is fuction of transaction costs, contracting costs, coordination costs, and search costs (Rodrigo, Fernando, André da Silva, Manuel, & Dan, 2010). Essentially this theory illustrates the decision of internalization and consideration of other value holders in the system.
The results indicate that building efficient transaction process and systems is a major nodeof strategic resource network that creates an agile value chain. Therefore the major premise of confirmation in this study is that a firm's ability to successfully implement agile methods is attributed to key systems that allow smooth flow of products. In addition to internalilzation, infrasture development involvement results into that effectivecoordination with suppliers and other logistics agencies.Thus owing to the greater diversity of market knowledge within an entire supply chain.This finding supports the idea of Torben, Christine, & Timothy (2002) that efficient transaction processes contributes to extent to which SMEs can be flexible and responsive.

Theoretical and managerial implication

This study has important implications for both theory and practice. The first finding sheds light on the importance organiazational and political ties in improving factory performance. While alliances and ties appear to influence factory performance in an agile system, the study adds a another dimension of political ties to earlier evidences provided in agile literature (Gunasekeran & Yusu, 2002; Daniel, Lucia, & Esteban, 2007). Although ties and alliances tend to influence levels of factory performance, SMEs in a developing country like Uganda, envisage their success in government and political influenceespecially in responsiveness and cost reduction.The government agencies indeed have strong bearing on whether or not SMEs succeeds along this path. This finding could be due to the fact that SMEs do not enjoy economies of scale both in local and international markets. In addition, while SMEs may enter into alliances and ties, the benefit accruing to such strategies depend on the the way they are structured and managed. This in turn influences the flow of knowledge among the partners. And the fact that the Government of Uganda has the strong hand in the manufacturing industry, national support of these SMEs remain a fact of strategic importances in improving their factory performance. Therefore Industrial Training Fund and other institutions with productivity related objectives should be established to enhance competitiveness of SMEs.

The second major finding regarding the influence of technological adaptive ability was not supported. In contrary, previous studies show that agile manufacturing needs automatically performing systems aided by information technologies. When tasks are excuted quickly, firms are

able to quickly offer low-cost products to the market in a flexible and quickest mode. The fact that SMEs in a developing country like Uganda are not equipped with skilled human capital, abilty to adapt to lated technologies may be difficult. This may hinder factory performance of SMEs in Uganda.Sharifi & Zhang (2001) also insists that for firms tobecome flexible and responsive, they must adopt thelatest IT and be innovative in businessprocesses. He adds that the success of firms in developing countries is premised on the extent to which they are adaptive to imported Technogies and how employees are and ready for challenges that come along with certain taks.

Finally, it was found that SMEs with efficient transaction process and systems are able to improve their factory performance. The is possible when SMEs internalize their transactions and engage in infrastrature development projects. This finding is consistent with the findings of Ali, Gholamhossein, Forouzandeh, & Hamid(2013) who argue that the ability of the firm to compete on delivery time and low cost is highly dependant on infrastructure policies within the country. The point in case is the extent to which policy reforms in respect of the infrastructure shift to private sector involvement especially. However, this study adds another dimesion of internalization that give advantage to SMEs in reducing cost of manufacturing and enhancing responsiveness and flexibility.

Managerial implication

In conditions of globalised market, firms must adopt agile enablers to effectively compete on cost, responsiveness and flexibility (Ali, Gholamhossein, Forouzandeh, & Hamid, 2013). Today, firms encounter changing environment chararcterised by shorter product life cycles external rendering high level of uncertainty. In this situation, it is essential that manufacturering SMEs in Uganda pay attention to thier capabilities towards sustainability and feasibility of agile system. In addition every company should take initiative to identify the opportunities and challenges within in the environment they operate from (Omar, 2008). Specifically, critical attention should be paid to factors that enables them to achieve their success. In this particular context of the study,as SMEs adopt agile culture the following questions need to be addressed: *Is the firm's marketing capabilities fit enough to enhance demand for its offerings?Are firm's capabilities reliable to produce quality products at acceptable cost levels? Finally,is the capability bundle fit for changing globle competition?* Therefore while developing a plan to implement agile manufacturing practices, managers should pose their own unique approach for particular query. On the other hand, with the successful adoption of agile manufacturing, the firms need to verify what customers want and how to meet their needs in a most flexible, nimble and less costly manner. Even though most developing countires have built cost-based advantages, the glowing global competition calls for new models of manufacturing.This however depends how developing countries' firms orchestrate their resource and capability bases in transforming them into customersized products.The implication is that agile systemshould be grounded in intergral network of supply chain componentswhile exploiting new opportunities and improving on certain constraints.

Limitations

As the study provides insight on the contribution of enablers of agile manufacturing in improving factory performance, two main limitations have been sighted. First, variables included in agile model

are perceptualymeasured in determining suitability of the model.This implies that some other factual information and secondary data could have missedin testing the model in this study context.In addition the study targeted factory manager. The implication is that data was dependant on the discretionary knowledge of the factory manager. To reduce single response bias, one factor analysis was performed.

Conclusion and further research

This paper is builds on the literature of agile manufacturing practices and the manufacturing behavior of firms in developing countries. It presents the model that describes key enablers of agile manufacturing and their outcome interms of factory performance.The article further offers insightful explaination on the extent to which each enabler influences factory performance. Though previous researches have expounded and developed a numbers of agile models, evidence provided in this article provides a new insight.Even though agile enablers may vary from country to country, in this particular context of uganda, two enablers were found to translate into factory performance. Specifically, organizational and political ties and effieicnt transactions process and systems appear to be beneficial to SMEs in Uganda. Technological adaptive abilities was found not to influence factory performance. Probably, further investigation would bring new light in regard to the role of adaptive ability of the human resource in an agile system. However empirical verification of agile manufacturing model provide a new line of knowledge from its operational perspective. Based on the results, the adjusted agile frame work that appear inform managers of SMEs engaged in manufacturing business in a country like Uganda on how they can improve their factory performance is presented in the Fig. 2 below.

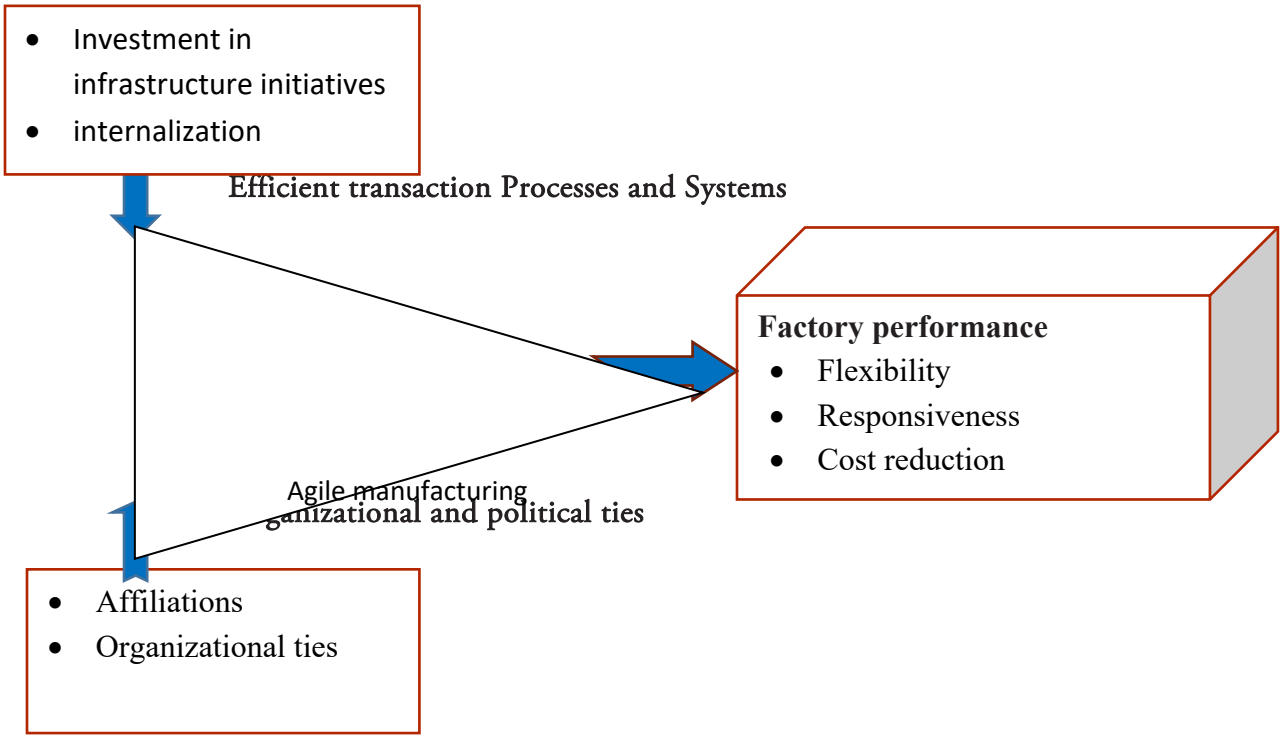


Figure II: Validated agile manufacturing model for SMEs in Uganda

As SMEs face new era of manufacturing, managers need to reorient themselves with new mode on manufacturing to cope up with global changes.In addition, even though technological adaptive abilities were not suppoted in influence factory performance,different industries need not undermind the global importance of Information technology.This provokes further research on specific industrial activities.

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