GSJ: Volume 9, Issue 8, August 2021, Online: ISSN 2320-9186
www.globalscientificjournal.com

# AGILE MANUFACTURING AND PERFORMANCE OF SMALL AND MEDIUM FACTORIES IN UGANDA

*Nickson Nagaaba, Faculty of Management Science*

*Muni University- Arua (Uganda)*

## ABSTRACT

A framework was developed to examine the agile manufacturing and performance of small and medium factories in Uganda. Three hypotheses derived from this framework were tested on a sample of 103 factories located in Kampala Capital City and western Uganda, as the largest industrial hubs in the country. Hierarchical regression analysis was used to exam the strength of relationship. Findings suggest that small and medium factories that adopt agile manufacturing have improved their performance. The study indicates that factories that have successfully benefited from agile manufacturing emphasize more of process and information integration. Although the other two agile metrics were not pronounced as very significant (Customer sensitivity and collaborative strategies) in this particular context, appropriate collaborative mix and differentiation strategies are suggested.



**Key words: Agile Manufacturing, Factory Performance**

## INTRODUCTION

For many years, business environment has been changing due to evolving market needs, changing technologies, intensive competition and narrowing market segments (Abanis, 2013; Aggrey, Eliab, & Joseph, 2010). As result of these changes, there has been a shift from producer-driven markets to consumer-driven markets (Sambamurthy, Bharadwaj, & Grower, 2015; Ali, Gholamhossein, Forouzandeh, & Hamid, 2013; Thaeir, 2014). For the manufacturing firms operating in producer-driven markets, access to resources, suppliers and market knowledge enables them to compete simultaneously on quality and product variety. For example, these firms tend to improve their performance through process mechanization, buffering their inventories and mass production (Qiang, Mark, Rogu, & Nathan, 2010). Finished-goods inspection is the primary source of quality maintenance and is a responsibility of the separate function. The supplier-selection criterion is fundamentally based on purchase price, while maintenance of machines is done when it is needed.

In contrast however, as markets shift to customer-driven markets, the focus is on serving the customers at less cost in the quickest possible way. This requires a change in the management thinking and all other aspects of a supply chain including, distribution, supply, and production shipping, among others. In this era, manufacturing companies deal proactively with changes in market by increasing their flexibility. The fact that lead-times can change due to sudden break-down of supply chain component; it is the responsibility of the firm to limit that variability. Stalk &Hout(1990) connotes that when firms engage in squeezing time, performance improves by 20 percent. Quick delivery is a metric of great importance and production schedules are also synchronized for the specified delivery lead time (Petri, Shamsuzzoha, & Petri, 2012).

In addition, as customer-driven markets become globalized, raw materials continue to be more and more expensive (Daniel, Markus, Kristian, Olivier, & Yew, 2018). As a result, manufacturers and other components of manufacturing supply chain resort to other avenues of reducing manufacturing costs; amongst, is waste minimization (Marie-Joelle & Sandra, 2012). Even though there are number of ways in which performance of small and medium factories has been measured, evolving markets continue to press more responsibility to the managers to focus on conversion cost, lead time, delivery and reliability rather than price (Faizal, 2011; Andries & Gelders, 1995). Indeed, price is no longer a crucial competitive factor. It is a market entry enabler rather than market leadership tool in customer driven markets (Andries & Gelders, 1995).

In this regard, various strategies emerged and have been associated with achieving fast value delivery, such as concurrent engineering (Yusuf, Sarhadi, & Gunasekaran, 1999), partnerships (Dowlatshahi & Cao, 2006; Williamson, 2002), business process outsourcing (Denise, 2012; Petri, Shamsuzzoha, & Petri, 2012) and time-based manufacturing practices (Blackburn, 1991; Yong, Shihua, & Li, 2001). The most recent and relevant in this era where businesses no longer operate in isolation rather, as a supply chain, is time-based manufacturing whose origin is traced in Just-In-Time (Stalk & Hout, 1990). This paradigm aims at meeting and satisfying consumers by reducing the lead time in an environment with a high product variety and minimizing conversion cost on production floors (Jafar & Yousef, 2016). Although existing literature associates factory performance with time-based manufacturing practices, a few focus on role of agile practices in Uganda.

Indeed the existing literature attributes poor performance of small and medium factories to other factors like inaccessibility to finance (Turyahikayo, 2015; Kagame, 2014), inadequate technical knowledge (Abanis, 2013) and inventory management (Conrad, Simon, Ibrahim, & Jummai, 2013). Regardless of the context, as quick deliveries and cost reduction continue to be most pressing concerns (Michael & Bruce, 2016), the agile manufacturing is considered the most reliable practices to enable firms to quickly and cheaply manufacture a variety of products in response to varying and unpredictable market needs (Anabela, Jose, Rui, & Sousa, 2012; Carlo, 2015). This practice focuses on firms' ability and flexibility to respond to demand variability (Helio, Goran, & Vaibhav, 2012; Ramasesh, Kulkarni, & Jayakumar, 2001).

Even though there are number of contradicting debates regarding the benefit of agile manufacturing, central to this practice is a principle of "nimbleness" a notion that emphasizes quickness in all aspects of manufacturing. This notion is borrowed from Blackburn's (1991) famous words that *"Speed kills,...it kills the competition"*. Even though squeezing time (as emphasized in time-based manufacturing practices) enables firms to quickly dispose products in turbulent and competitive market, the key drivers in this regard need to be considered for its success. Therefore enabling factors is a strategic choice of management (Mattias & Jan, 2009).

In a different context of Uganda, where manufacturers operate with inadequate resource, with a number of constraints hampering their global competitiveness, little is known in regard to the benefit of adopting agile manufacturing practices. Instead, manufacturers operate with low labor productivity, high tariffs on inputs like electricity and delayed logistic exercise (United Nations Economic Commission for Africa, 2017). According to World Development Indictors (2014) published by World Bank, small and medium factories in Uganda have higher production lead time of 19.08 days, than its peers within the region. For instance, Tanzania has 10.23 days, Kenya (8.88 days) and South Africa (5.53 day). The report of 2016 on doing business in Uganda also indicate that average production lead time of manufacturing is 19.03 day, an indication that there is insignificant reduction in production lead time regardless of substantial improvement in entire manufacturing business (US commercial Service, 2016). In addition, small and medium factories in Uganda increasingly incur high conversion costs. These costs are attributed to declining labor productivity in manufacturing sector 7 percent in 1991-2002 to 3 percent in 2002-2013.and high power costs (East Africa Community Secretariat, 2017). For the later, report on industrial competitiveness and growth indicates that, small and medium factories are less efficient and use labor-intensive technologies to compensate for the lack of technical capacity yet over stressed by increasing electricity tariffs and load shedding. As a result, they resort to the use of generators besides increasing fuel prices. For instance, the cost of a liter of diesel in Uganda rose from $ 0.94 to $1.1 between 2015 and 2018.

Therefore, appropriate manufacturing practice that focuses on quick response on every node of entire supply chain needs to be reinforced to avoid negative spiral of increasing cost and decreasing lead-time in manufacturing business. Probably, small and medium factories can successfully enjoy better results as they fully leverage their resources within corporate boundaries (Mattias & Jan , 2009; Aggrey, Eliab, & Joseph, 2010). This argument is further echoed in the dynamic capability theory where the organizational capabilities are considered pertinent in an agile system.

This article therefore, contributes to existing knowledge by pragmatically examining the benefit of three major agile dimensions: customer sensitivity, information and process integration, and collaborative strategies manufacturing practice in a unique context of Uganda using data collected from small and medium factories located in western Uganda and Kampala Capital City. The study focused on. From a value chain point of view, key dimensions of factory performance were utilized. These include; lead time and cost of conversion. These dimensions were developed based on the insightful knowledge of Abraham, Mark, Subba, & Ragu-Nathan (2006).The null hypotheses were developed in relation to the phenomenon under investigation. These are: $H_{01}$: Customer sensitivity does not positively affect performance of small and medium factories in Uganda.$H_{02}$: Process and information integration does not positively affect performance small and medium factories in Uganda.$H_{03}$: Collaborative strategies do positively influence performance of small and medium factories in Uganda.

## THEORETICAL FRAMEWORK

Theoretical explanations regarding what companies must do to gain advantage over others, is an interesting puzzle. In this regard, theories must be evaluated in terms of how well they inform the studied phenomenon. In addition, theories provide a broad spectrum from which concepts of the study relate. Judging by this standard, a dynamic capability theory as advances by Teece (2000) was utilized to understand the level of performance of small and medium factories attributed to agile manufacturing practice. In this regard, the theory of dynamic capabilities provides when organizational resources and capabilities are identified, selected and exploited, performance is likely to improve (Gary, 2015; Teece, 2000). Teece, Pisano & Shuen (1997) also assert that performance improvement in turbulent environments is a function of dynamic capabilities "the capacity to reconfigure resources so as to accomplish congruence with the changing environment".The theoretical connotations of Teece (2000) highlight the importance of extending or deepening organizational competences in manufacturing business. "As firms possess a repertoire of finite capabilities, the choice lies on deepening their existing capabilities or broadening them". The firm can do both, but the fact that there are bottlenecks, it must make a choice. It is from this knowledge, that theory of dynamic capability presses firms to quickly involve employees in strategy building, integrate customers in strategic asset development, and involve suppliers and distributors in transforming strategic assets into customer value.

Crucial for this theory is the assumption that even though some capabilities may be focused on adaptation, learning and change, it is important to note that all supply chain components must have a potential for introducing changes (Kazimierz, 2014). Therefore, the theory supports the notion of corporate agility (Teece, Pisano, & Shuen, 1997). In addition, dynamic capability theory is based on the assumptions of population ecology and the theory of evolution. In this case, organizations make habits and create sets of routine behaviors which constitute the main cause of organizational inertia.

Despite the wide usage of the dynamic capability theory among researchers, the theory is viewed differently by researchers. Critiques of the theory indicate that key dynamic capabilities differ in context and achievability. For instance, Eisenhardt & Martin (2000), looks at dynamic capabilities in terms of processes that vary based on the degree of market dynamism. Williamson (2002) also criticized the theory saying that, dynamic capabilities lack precise definition and empirical grounding; therefore, their measurements are by proxy. In addition, though the theory is important to the organizations, it does not bring out guiding principles by which managers make capability investment commitment and possible outcomes thereof in a more uncertain environment, other than the obvious fact that a flexible firm will improve performance (Williamson, 1975).

Based on the dynamic capability theory, three key capabilities that manifest in agile system were identified and the conceptual framework developed. These include customer sensitivity, process and information integrations and collaborative strategies as shown in Fig.1. Operational definitions of each agile dimension are provided in Table 1.

**Table 1: Operational definitions of concepts**

| **Study variables** | **Operation definition** | **Reference** |
|---|---|---|
| ***Construct of Agile Manufacturing*** | | |
| ***Process and information integration*** | Operational information sharing, collaborative product design and co-managed inventory. Integrating information technologies, staff, business process organization, innovation and facilities into main competitive attributes. | Sambamurthy, Bharadwaj, & Grower(2015) Marcus, (2010) Ali, Gholamhossein, Forouzandeh, & Hamid, (2013) |
| ***Customer sensitivity*** | Involving customers in the exploration and exploitation of opportunities | Sambamurthy, Bharadwaj &Crower(2015) |
| ***Collaborative strategy*** | Building network of strategic, extended or virtual partnerships with suppliers, distributors and other partners. | Sambamurthy, Bharadwaj, & Grower (2015) |

GSJ: Volume 9, Issue 8, August 2021
ISSN 2320-9186

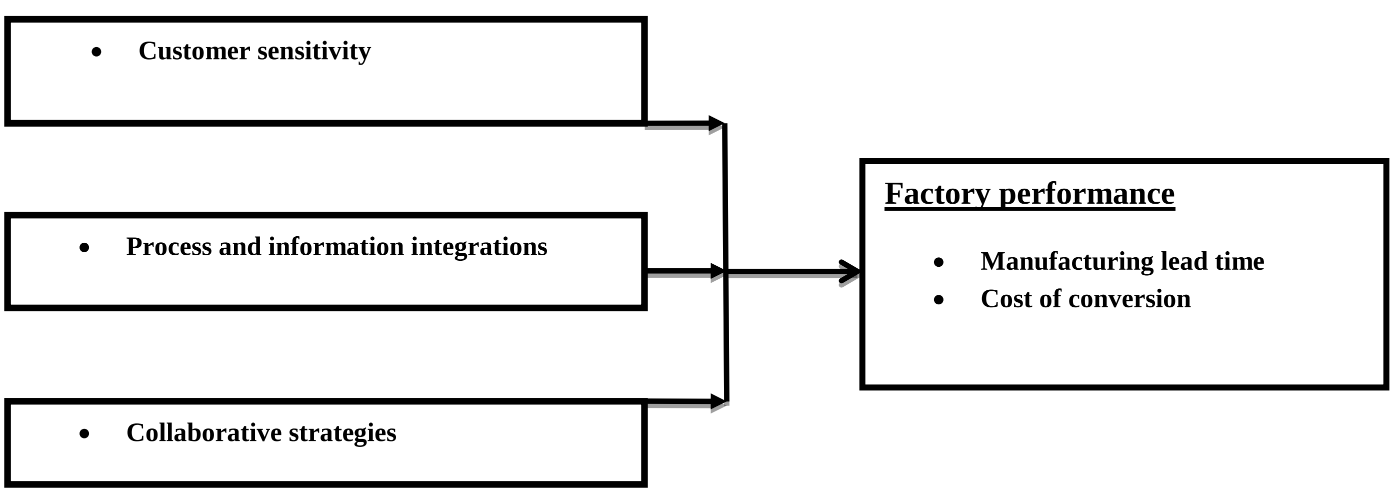

| | | |
|---|---|---|
| | Successful involvement and engagement of suppliers into the success of supplier's operations and instilling an invaluable level of trust in the buyer-supplier relationship. | Luis, Verda, & Daniel (2012) |
| ***Factory performance*** | | |
| ***Lead time*** | Lead time consists of three components: setup time, production time and shipping time. | Leng & Parlar (2009) |
| ***Cost of conversion*** | These are all manufacturing costs with exception of the cost of raw materials. | Steven (2017) |

The dimensions of agile manufacturing practice were defined while taking into account characteristics of the market and environment in which small and medium factories operate. However, the big question is whether manufacturers in a developing country like Uganda successfully achieve cost and lead time reduction by employing the agile strategies in Table. I. In this case, the conceptual framework was developed to demonstrate the relationship between agile manufacturing and factory performance. A number of extant researches in regard to contribution of agile have been useful in developing conceptual framework in Fig.I. The framework suggests that three major agile manufacturing dimensions have direct and positive effect on factory performance.



**Figure: 1: The effect of time-based manufacturing practices and factory performance**

**Agile manufacturing**



***Source: Adopted fromAbraham, Mark, Subba, & Ragu-Nathanb(2006) and modified by researcher***

## Agile Manufacturing

Agile manufacturing was envisioned in a report from Lacocca Institute at Lehigh University (USA) in 1991 (Hormozi, 1994; Goldman , Nagel , & Preiss, 1995).From then, different authors have provided a number of philosophical connotations about agility. For instance, Abiar & Civerolo (2012) interprets agility from managerial perspective as a combination of organization, people and technology into an integrated system to meet the rapid changes in the products and services. From this thinking, the design of a manufacturing system must consider the technical, physical, human and information technology that limit the ability of the system to achieve the desired goals (Koste, Malhotra, & Sharma, 2004). As a contribution to the notion of agility in manufacturing, system view of Yusuf, Sarhadi, & Gunasekaran (1999) points at how resources can be reconfigured to improve speed, flexibility, innovation and profitability. This is in agreement with organizational view of Goldman, Nagel, & Preiss (1995) that emphasize utilization of all existing resources regardless of their location with other companies by changing organizational structures under rapid reconfiguration.



From the market perspective, where changes are readily unpredictable, Gunasekaran, Marri, &Yusuf (2002) and Naylor, Naim, & Berry, (1999) describe agility as capability to survive by reacting quickly and effectively to such changes. Other scholars construe agility from operational manufacturing perspectives as a facility with manufacturing nodes organized for customized production (Evan, 1991; Chowdiah, 1996; Hormozi, 1994; Ramasesh, Kulkarni, & Jayakumar, 2001; Thaeir, 2014).

In many occasions, adoption of agile manufacturing practice has been constrained by a number of factors as highlighted by Crowder & Friess (2013). Firstly, Dowlatshahi & Cao (2006) puts it clear that since agile manufacturing is a multi-disciplinary endeavor, synergy and interaction could be more of a determining factor for its success rather than the individual competences. Notwithstanding this claim, individual accountability to the teams is also crucial to the overall success of agile manufacturing practices. Secondly, lack of commitment of top management can be very frustrating throughout the entire effort. Top management commitment propitiously provides the proper management training on agile manufacturing. Thirdly, just being efficient at production and being adaptable to changes doesn't mean agile manufacturing is successful; rather teams need to be trained in how to collaborate effectively and how to deal with generational, cultural, and other differences that can cause change in environment. Lastly, many practitioners feel that agile manufacturing gives them the freedom not to worry about documentation and accuracy. However, the right amount of documentation is essential in order for the members to understand and integrate work processes. These limitations for agile manufacturing can result in conflicting trade-offs in terms of productivity, quality, efficiency and cost; thus causing laxity on principles of agile manufacturing practices (Koste & Malhotra, 2000). Despite these limitations, agile manufacturing continues to manifest in the following themes.

## Customer sensitivity



The traditional supply chain approaches emphasize holding finished goods waiting for sale. In contrast, as the manufacturers become customer sensitive, the majority of stock nowadays is held as work in progress inventory awaiting configuration information from the final consumer (Meredith & Francis, 2000). This means that the customer information helps manufacturers to correctively speculate the market and reduce costs of conversion especially those associated with waiting (Mohdl, Banwet, & Ravir, 2006). In an attempt to reduce waiting time, the managers incorporate individualized demands with quicker delivery time and fast response based on quantity, quality and specifications. As the market continues to become more volatile, customer sensitivity initiatives dictate that collaborative strategies are driven by real customer demands (Yusuf, Sarhadi, & Gunasekaran, 1999). Key considerations of customer sensitivity are premised in agile manufacturing where emphasis is put on responding to real demand, fast introduction of new products, and. customer-based measures (Mohdl, Banwet, & Ravir, 2006).

## Process and information integration

Information and process integrations are vital among organizations. In the latter case, information integration and sharing binds the supply chain components (Childerhouse, Hermiz, Mason-Jones, Popp, & Towill, 2003). Lack of information causes panic among the teams and other variable costs (Mohdl, Banwet, & Ravir, 2006). With the advent of information technology, real time exchanges of information start with development of the products up to the end of the product life cycle. Proponents of information integration connote that information integration is associated with inventory holding costs and lead time (Lee, 2002). When information is shared in manufacturing, it results in substantial reduction in the transaction cost (Intaher, 2010). In addition, when process integration gets to the center in the manufacturing strategy, it forces common culture and discipline among teams at every stage of supply chain (Crawford, 1992). Process integrations however, can be effective if they are properly articulated and deliberated (John, 1995). Crawford(1992) also argues that the before processes are integrated, it important that managers use mechanism of benchmarking. This allows successful regimen of policies, structure and practices. However, from the dynamic capability point of view, different firms have different competences, this account for innovative integration differences among manufacturers unless they are accompanied by sufficient resources (Teece & Gary, 1994). A similar view is shared by Williamson (2002) who construes that the process and information integrations can be successful if there is a reconciliation of resource dependency and transaction cost analysis. To this end, internal competences will be developed thus reducing of internal transactions costs by using more efficient internal structures.

## Collaborative strategies

Modern manufacturing business can be effective when it is supported by strong collaborations (Mohdl, Banwet, & Ravir, 2006). To successfully compete in dynamic market, literature recommends collaborative arrangements. Collaborations enable the firm to exploit both internal and external opportunities (Olorunniwo & Hartfield, 2001; Mohdl, Banwet, & Ravir, 2006). Through close involvement of suppliers, the managers are able to negotiate favorably and equitable arrangements distributes the burdens and rewards among the of supply chain components. In the end they are able to mitigate risks successfully in a supply chain as they embrace closer relationships with key suppliers. Some scholars also claim that if a firm is to use its internal and its external resources in a competitive way, then it must support the business idea and desires of close suppliers. In today's business environment the success of close relationships are embedded in inter-organizational networks where trust and commitments are key aspects (Peng, Trappey, & Liu, 2005). In this case trust and commitment can be developed gradually based on consistent acts of key partner over certain period of time.

## Factory performance

The scholarly community has described performance enormously from different contexts at different level. Even, in manufacturing context, there exists no well-grounded and unique approach for explaining performance. Some economists contributing to this knowledge use different perspective to describe this phenomenon. Although scholars provide varying ways of understanding performance, to some degree, its conceptualization has remained complexbecause of heterogeneous nature of manufacturing industry (Kokkinou, 2010).

To provide an understanding on these performance measurements, scholars have postulated varying indicators of performance at a work station. A few that have looked at the notion of factory performance construe this phenomenon as the speed at which the equipment runs relative to its designed speed (Aggrey, Eliab, & Joseph, 2010; Brady, 2014; Kokkinou, 2010). At production floor, performance is interpreted as a relationship between work in progress, throughput and cycle time (Alok, Dangayach, Mittal, Milind, & Sharma, 2011). Given that satisfaction of customer demand is sole reason why manufacturing business exist, customer service without delay is a key (Jafar & Yousef, 2016). The fact that manufacturing processes are always not identical and human component in operation adds uncertainty; different manufacturing strategies have been employed to foster factory performance. For instance, the literature provides a fleet of reflective indicators of performance of factories which include: sales growth, return on investment, market share gain, manufacturing lead time and overall competitive position (Abraham, Y Nahm; Mark, A Vonderembse; Xenophon, A Koufteros, 2003). Although all these aspects lead to profitability, lead time and cost of conversion have remained pivotal and debatable from the factory perspective (Jafar & Yousef, 2016).

## Lead time

In any business environment, time is argued to be key indicators of a company's success. Therefore, manufacturing firms need to render greater efforts to respond quickly to market characterized with varying demand (Petri, Shamsuzzoha, & Petri, 2012). In this regard, lead time reduction is a crucial strategy in manufacturing business (Chang, Ouyang, & Wu, 2006). Jafar & Yousef (2016) describe manufacturing lead time as time required to manufacture the item, including order preparation, setup time, run time, inspection time and put away time. Different streams of research have investigated the various benefits of reducing lead time and highlight a number of them. These include; less shortage, lower safety stock, accurate forecasts, less obsolesces, smaller order sizes, and fewer inventories of finished goods (Chung, Talluri, & Narasimhan, 2014; Chang, Ouyang, & Wu, 2006). Although lead time reduction has been perceived as expensive venture, it can compensate for its costs (Jafar & Yousef, 2016). For instance, when manufacturers accelerate the manufacturing process, cost of production also increases. Therefore, manufacturers need to apply the appropriate production model to solve the trade-off. Amongst which, are traditional decision model, centralized decision model, coordination and incentive schemes.



## Cost of conversion

Conversion costs are those production costs required to convert raw materials into completed products. This concept is used to derive the value of ending inventory reported in the financial statements. The conversion costs are used to establish costs of creating a product, so as to appropriately set the final product price (Steven, 2017; Bhasin, 2015). In this case, conversion costs relate to all manufacturing costs with the exception cost of raw materials. They include direct labour, equipment depreciation and maintenance, factory rent, factory supplies, factory insurance, machining, inspection, production utilities and other manufacturing overheads. These costs are vital because they contribute to the final product price. Therefore, manufacturing companies around the world should explore the possible ways of reducing the conversion cost (Geiger & Markri, 2006). Globalized markets have kicked off with increasing cost of raw materials. The new trends in manufacturing require managers to continuously search for avenues of reducing conversion costs (Daniel, Markus, Kristian, Olivier, & Yew, 2018; Bhasin, 2015). Although firms have diverse and distinct resource base, factory managers should be able to better understand unique opportunities and challenges within their scope of manufacturing so as to tap full potential of reducing manufacturing costs. This means they must significantly ramp up their innovation efforts in areas of waste management and efficiency (Chia-Yen & Andrew, 2014; Anabela, Jose, Rui, & Sousa, 2012; McMahon, 2015).

## Effect of agile manufcturing on factory performance

Previous researchers have examined the benefit of adopting agile manufacturing. For instance, Lucia , Esteban & Daniel (2007) investigated the benefit of implementing agile manufacturing among 283 manufacturing firms in Spain. The results show that competitiveness in a turbulent environment is strengthened by adoption of agile manufacturing practices. Specifically, this study found that agile manufacturing results in better operational, market and financial performance. The greatest influence of agile approach however was noted in market performance. Other aspects of performance which include operational and financial dimensions of performance were not in any way influenced. On the other hand, Daniel, Sergio, Ariani & Dayse (2016) applied a combination of two techniques, systematic literature review and frame semantic analysis to identify the key elements of the agility construct for project management theory. A survey with 171 projects with different innovation levels and industry sectors show that the agility construct is cohesive and useful in different project management contexts. The results show that performance of the project is dependent upon a combination of organization, team and project factors. This can only be experienced when firms exhibit rapid project planning change and active customer involvement. Their study however focused on performance in general without considering the specific dimensions relevant to the factory.

## METHODOLOGY

This paper endeavours to investigate the benefit of adopting agile manufacturing in improving performance of small and medium factories. The hypotheses were developed based on the empirical and theoretical review of literature. In order to test the prevailing assertions, a questionnaire-based survey was done among small and medium factories located in Kampala Capital City and western region of Uganda. These two regions were chosen because they form the biggest industrial hubs in the country. The survey targeted 148 registered small and medium factories as they constitute a largest share of investment by sector and industry close to one third of economic activities in Uganda (African Development Bank Group, 2014). According to Uganda investment Authority (2018), small and medium factories are only those that employ 5 to 100 workers. Visits were made to SMFs to collect first-hand information in regard to the phenomenon under investigation. On the basis of input from the factory managers and in-depth literature review, an attempt was made to develop the questionnaire for pilot survey of five factories. The pilot study provided valuable information about the reliability and validity of the scale measurements. On the basis of pilot results, a number of tests were made to develop an appropriate instrument. These tests included: Reliability and Exploratory factor analysis. First; the results show that coefficients of Cronbach's of the constructs were all higher than 0.7(Table.2). This indicated an acceptable internal consistency of measurements (Nunnaly, 1978).

Secondly, factor analysis was performed to test whether there was common method bias in the data set and convergence of constructs. 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 17 factors explaining 70.29 percent of variance and the first factor explaining 7.8 percent of variance.

In order to establish the dimensions underlying the set of variables in each scale and to explore the underlying theoretical structure of the phenomenon exploratory factor analysis was also done. This test involves examining the variance of factors extracted and the pattern of Eigen values of measurement items for the study constructs. The scale items for the three dimensions of agile manufacturing practice and for the factory performance measures were used in computing factor solutions. The test revealed that the pattern of the loadings of measurement items converged for each distinct construct. In particular, two-factor solution accounted for 67.58 percent of the variance in factory performance emerged. For the agile manufacturing, three factors emerged explaining 65.186 percent of variance. In all cases, the eigen values were greater than one and items whose factor loading was below 0.5 were eliminated. The items that were retained for the current study are provided in Table 2.

## Table 2: Factor analysis and reliability

| Constructs | Measurement items | Standardised coefficients (loading) | Eigen Values | Percentage variance explained | Cumulative percentage variance explained | Cronbach's |
|---|---|---|---|---|---|---|
| **Factory performance** | | | | | | 0.726 |
| *Cost of conversion* | Our firm does not find it costly to introduce new product line | 0.700 | 1.769 | 35.192 | 35.192 | |
| | Cost of holding inventory has reduced | 0.845 | | | | |
| | Cost of staff training programmes has reduced | 0.751 | | | | |
| *Manufacturing lead time* | Our company has short lead time | 0.881 | 1.619 | 32.392 | 67.583 | |
| | We fulfil orders in the shortest possible time | 0.885 | | | | |
| **Agile manufacturing** | | | | | | 0.718 |
| ***Process and information integration*** | In our firms, there is smooth flow of information | 0.783 | *2.573* | ***23.208*** | ***23.208*** | |
| | Our products are classified into groups with similar process requirement | 0.770 | | | | |
| | Our processing units are integrated to improve performance | 0.737 | | | | |
| | Our firm has a plant that can be set to produce new products quickly | 0.804 | | | | |
| ***Customer sensitivity*** | Our products are differentiated regularly | 0.712 | 1.496 | 22.197 | 45.405 | |
| | Our firm changes internal processes and products quickly | 0.703 | | | | |
| | In our firm product life cycle is very short | 0.546 | | | | |
| *Collaborative strategies* | Our firm has reliable suppliers in terms of quality | 0.688 | 1.146 | 19.781 | 65.186 | |
| | Our firm has reliable suppliers in terms of delivery time | 0.696 | | | | |
| | Our firm has partnership with suppliers and | 0.660 | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| | distributors of the final product | | | | | |
| | Our suppliers are involved in new product development | 0.721 | | | | |
| | Our employees quickly develop new manufacturing strategies | 0.532 | | | | |

The final version of the questionnaire was administered to a sample of 129factory managers. Krejcie &Morgan (1970) table was utilized in determining the appropriate sample size shown in Table 3. For each category of the factories, a random sample was selected and managers asked to rate the intensity of each factor for their respective factories on a five-point Likert scale (1 – strongly disagree, 5 – strongly agree). A total of 103 responses were received from survey accounting 79.8 per cent response rate. This response rate is far above 70% as recommended by the Guttmacher Institute (2006). Guttmacher Institute recommended that for a study to have satisfactory results, the response rate must be above 60% -70%. This is because adequate response rate guarantees accuracy and minimizes bias in cross sectional studies. Although there are vast numbers of classifications of manufacturing firms discussed in the literature, the choice of grouping highly depends on the objectives of the study. In this case, durability of the products was considered appropriate vector in reporting statistics of industrial category.



**Table 1: Sample for the study**

| **Industrial category** | **Target population** | | | **Sample size determined using Krejcie and Morgan Table** | | |
|---|---|---|---|---|---|---|
| | **Kampala** | **Western Uganda** | **Total Population** | **Kampala** | **Western Uganda** | **Total sample** |
| Food and Agro processing | 42 | 12 | 54 | 34 | 10 | 44 |
| Soft drinks | 26 | 8 | 34 | 24 | 4 | 28 |
| Furniture | 19 | 6 | 25 | 22 | 2 | 24 |
| Chemicals | 9 | 3 | 12 | 7 | 3 | 10 |
| Metal works and fabrications | 4 | 1 | 5 | 4 | 1 | 5 |
| Clay products | 8 | 2 | 10 | 8 | 2 | 10 |
| Cosmetics | 8 | 0 | 8 | 8 | 0 | 8 |
| **Total** | **115** | **33** | **148** | **107** | **22** | **129** |

***UBOS, Statistical abstract (2017)***

This aggregation taxonomy is based on Thomas & Stephen, (1990) who argue that factories that use diverse material inputs are closer together than those that use one input. In addition, they connote that condensed classification of subsets lessens sum of squared deviations within the clusters while preserving the hierarchical structure of the data collected. Table 4 presents the profile of the factories in the sample.

**Table 4: Profile of small and medium factories included in the Sample**

| Factory characteristics | Percentage of firms |
|---|---|
| ***Industry (based on material input)*** | |
| Durable products | 16.5 |
| Non-Durable products | 83.5 |
| *Firm size by number of employees* | |
| From 6 to 20 employees | 11.7 |
| From 21 to 35 employees | 27.2 |
| From 36 to50 employees | 14.6 |
| From 51 to 65 employees | 29.2 |
| From 66 to 80 employees | 7.8 |
| From 86 to 95 employees | 1 |
| From 96 to 110 employees | 8.5 |
| *Firms age (years)* | |
| 4- 13 | 20.4 |
| 14-23 | 28.2 |
| 24-33 | 34.0 |
| 34-43 | 9.7 |
| 44-53 | 4.9 |
| More than 53 | 2.8 |
| Production stage | |
| Growth stage (Primary demand just starting to grow) | 28.1 |
| Maturity stage (Demand growing at 10% or more annually) | 51.5 |
| Decline stage (Product familiar to vast majority) | 20.4 |

***Source: Primary Data***

A score for each scale of agile constructs has been determined by summing the values for those items and dividing by the number of items in the sub-dimension. The means and standard deviations for each dimension of agile manufacturing and factory performance are provided in table 4. The items for these scales are measured on a five-point Likert Scale.

**Table 4: Descriptive statistics for time-based manufacturing practices and factory performance**

| Variables | Constructs[1] | Mean | SD |
|---|---|---|---|
| Factory performance | | 3.4067 | 1.0624 |
| | Cost of conversion (3) | 3.3771 | 1.07825 |
| | Manufacturing lead time (2) | 3.4363 | 1.32041 |
| Agile manufacturing | | 3.1845 | 1.0982 |
| | Process and information integration (4) | 2.9353 | 1.29189 |
| | Customer sensitivity (3) | 2.9175 | 1.18010 |
| | Collaborative strategies (5) | 3.4417 | 1.09824 |



## Measurement of the variables

### Factory performance

In this study, perceptual data was utilized to measure factory performance. Although perceptual data is perceived to be subjective, it has been widely used in most empirical studies in business studies. This measure was adopted in this study because most manufacturers in developing countries are not willing to disclose detailed information about their resources and output for  fear of devulging information to the competitors (Garg, Walters, & Priem, 2003). In addition, as indicated by Mattias & Jan (2009) and Ketokivi & Schroeder (2004) in absence of hard data or secondary ratio data, perceptual data is the next best alternative as long as rigorous examinations of reliability and validity are performed.  Therefore, the following dimensions of factory performance were utilized. 1) Cost of conversion and 2) Manufacturing lead time. These dimensions were developed based on previous studies ofAbraham, Mark, Subba& Ragu-Nathan (2006) and the scale items were modified to fit the manufacturing context

[1]Composite measures: Numbers in parentheses are number of items in each construct. Individual items can be found in Table 2

of a developing country. Respondent were requested to evaluate scale items on a five-point Likert scale where 1=strongly disagree and 5=strongly agree.

**Agile manufacturing**

An agile manufacturing practice is a dynamic alliance of competencies. In this study, the agile manufacturing has been operationalized to include customer sensitivity, process and information integration and collaborative strategy in the process of manufacturing. These agile dimensions in the manufacturing process have been developed based on conceptualization of Ali, Gholamhossein, Forouzandeh, & Hamid (2013). Indeed, agile manufacturing is all about customer responsiveness, fitting people, information and resources for change and firm networking in a supply chain (Intaher, 2010). The study drew on the previous research on agile supply chain and agile manufacturing to identify items for each dimensionof the construct (e.g., Abiar & Civerolo, 2012; Conforto, Salum, Amarl, & Silva, 2014; Lucia, Esteban, & Daniel, 2007). The respondents evaluated these items on a five-point Likert scale where 1=strongly disagree and 5=strongly agree.



**Control variables**

To control for any possible confounds, three control variables were captured. First, data on production dummy variable was collected to capture any systematic difference in factory's production activities. The dummy variable measured whether the factory manufactured durable or non-durable products. This criterion was based on Thomas & Stephen classification of industries. Thomas & Stephen (1990) argue that firm's flexible innovative strategies are determined by how resources are leveraged and the durability of the products. The fact that sampled factories were engaged in production of more than one product, it was important to organize and condense vast amount of data collected into smaller and manageable subset (Thomas & Stephen, 1990;Maxwell & Harold, 1955). Consequently, a dummy variable: whether factory is manufacturing durable and non-durable products was used to categorise small and medium factories to capture any systematic industrial difference. If a firm traded in durable products, it was assigned a score of '1' and '0' otherwise.

The second control variable captured, was factory/firm's age (years since incorporation) to control for experience effect. The age of the factory was considered to an important control variable because experience-based competences come along with innovative changes that enhance factory performance. Thirdly, the size of the factory (number of employees) was collected to control for economies and diseconomies of scale in production and their influence on performance.

Lastly, stage of development was also controlled for market effect. In this study, the stages of development were characterised with the demand levels. It is argued that as performance level is a function of market structure. Stages of development were of ordinal nature and coded 1 for growth stage, coded 2 for maturity stage and coded 3 for decline stage.

## DATA ANALYSIS

Data collected were coded, edited and captured by EpiData software to ensure a concise and logical order. Later, the data was imported to SPSS version 22 for transformation and arithmetic computations. Descriptive statistics such as frequencies, percentages, means and standard deviation were generated to describe factory performance and agile manufacturing as shown in Table 4. It is evident in the Table. 4 that the entire mean values of the dimensions of constructs of agile manufacturing and factory performance are in excess of 2.5, implying that the respondents are positive about the measurement items.

Data analysis was performed using hierarchical multiple regression analysis and specifically by applying the ordinary least square procedure to test the hypotheses. Hierarchical Linear regression was used to analyze relationship between factory performance and time-based manufacturing practices. The fact that time-based manufacturing practices were at varying hierarchical levels, their individual contribution was only possible to be assessed using hierarchical regression (Heather, Christine, Andrea, & Meredith, 2012). In the same vein, least square method statistical procedure was used to find the best fit and prediction of the behavior of depend variable, factory performance (Anderson & Gerbing, 1982; Andy, 2009).

Although it is intuitively appealing to conclude that Pearson's correlations coefficients to show relationship, they do not reliably indicate the direction and strength of causality (Andy, 2009). Therefore, the hypothesised relationships were tested by assessing the significance of estimated model. Therefore, adjusted $R^2$ was determined to estimate the proportion of factory performance accounted for as if the model had been derived from the entire population (Andy, 2009, p. 221). In addition, $R^2$ change is used to assess the contribution of additional practices in model in predicting factory performance. In assessing the goodness of fit and improvement in the model in predicting the factory performance, the F-statistic was interpreted. In this case, the difference between the model and the observed data is represented by the F-ratio statistic.

In regression analysis, it is important to determine the change in dependent variable resulting from the unit change in either of the independent variables practices (Cooper & Schindler, 2011; Olive & Abel, 2011). The coefficient of independent (beta) described as β is used to represent the amount of change in factory performance resulting from unit improvement in agile manufacturing. In this case the t-statistic was used to test the null hypothesis that value of beta is zero (Andy, 2009). In case if the t-statistic is significant at given significance level, then it is conferred that agile manufacturing contributes significantly to factory performance of small and medium factories. For purposes of precision, standardised beta coefficients were used in this analysis to inform about standard deviations in the factory performance resulting from standard deviations within agile manufacturing. A great deal of care was taken in selecting and entering the variables in the model based on the previous researches and order of importance of the predictors as expected in hierarchical regression analysis (Andy, 2009).

## RESULTS

Before linear regression analysis was performed, a number of tests were performed to ensure that assumptions of Ordinary Least Square were not violated. First, care was taken to ensure that all missing values are replaced with mean as recommended by Anderson & Gerbing (1982). Secondly, data was checked for possible outliers and any value with absolute z-score greater than 2 was ignored and replaced with mean plus three times the standard deviations (Andy, 2009). Thirdly, multi-collinearity was examined using bi-variate correlations in table 5 and variance inflation factors as provided in Table 7.

**Table 5: Correlation matrix**

| | Factors | | | | | | |
|---|---|---|---|---|---|---|---|
| **Variables** | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| **Factory performance (1)** | 1 | | | | | | |
| Cost of Conversion (2) | .617** | 1 | | | | | |
| Lead time (3) | .501** | .003 | 1 | | | | |
| **Agile manufacturing (4)** | .416** | .038 | .358** | **1** | | | |
| Process and information integration (5) | .408** | .069 | .213* | .700** | 1 | | |
| Customer Sensitivity (6) | .180* | -.07 | .250** | .641** | .13 | 1 | |
| collaborative strategy (7) | .224* | .079 | .254** | .646** | .193* | .154 | 1 |

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

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

From the correlation matrix, it is evident that there is no such case of multi-colinearity. In all cases correlation coefficients between constructs of agile manufacturing are within the acceptable level of less than 0.6. The results in Table 5 also indicate that the predictors have no a strong linear relationship with the other predictors given that the VIF was between 1 and 10 as recommended by Myers (1990). Taking a look at tolerance (Table 6), Menard (1995) suggests that the values less than 0.2; are worth worrying. In this study all values were greater than 0.2. Homogeneity of variance was another important test performed on categorical variables. Given that factories were categorised into durable and non-durable producers, it was important to test the null hypothesis that the variances in different groups are equal (Andy, 2009).On the basis of the one-way ANOVA test, Levene test was used to examine whether product type is actually homoscedastic to factory performance on assumption that the probability is above 0.05.In this case there was no such problem. The variances were not significantly different for different product types given that the p-value of F-statistic (3.806) is less than 0.05 at 95% confidence level. Lastly, the assumption of normality was checked using skewness and kurtosis. In this case, all the data were skewed within plus or minus 3. The implication is that; the variables of the study are approximately normally distributed along their means.

On confirming non-violation of assumptions of Ordinary Least Square regression, care was taken in selecting and entering the variables in the model based on the previous researches and the order of importance of the predictors (Andy, 2009). A four-stage hierarchical regression was used to determine the predictive power of individual variables in the regression equation. In the first stage, factory performance was regressed on a set of control variables in model I. After controlling for all factory characteristics, dummy variables of agile manufacturing practices were entered in the progressive stages of analysis to examine their individual effect on factory performance. The results of regression are presented in Table 6

**Table 6: Results of Hierarchical Regression Analysis for Factory Performance**

| Variable | Model I | | Model II | | Model III | | Model IV | | Collinearity Statistics | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Beta | t | Beta | t | Beta | t | Beta | t | Tolerance | VIF |
| **Product Type** | -.161 | -1.583 | -.009 | -.096 | -.016 | -.182 | -.035 | -.385 | .837 | 1.195 |
| **Firm age** | -.056 | -.453 | -.154 | -1.440 | -.146 | -1.360 | -.151 | -1.414 | .617 | 1.622 |
| **Stage of development** | .102 | .826 | .222 | 2.073** | .195 | 1.774 | .176 | 1.580 | .570 | 1.756 |
| **Firm size** | .144 | 1.425 | .162 | 1.885* | .145 | 1.649 | .147 | 1.672 | .918 | 1.090 |
| **Processand Information integration** | | | .551 | 6.161*** | .534 | 5.858*** | .510 | 5.440*** | .805 | 1.242 |
| **CustomerSensitivity** | | | | | .090 | 1.012 | .083 | .929 | .888 | 1.126 |
| **Collaborative Strategy** | | | | | | | .096 | 1.065 | .870 | 1.149 |
| | | | | | | | | | | |
| **Model summary** | | | | | | | | | | |
| | | | | | | | | | | |
| **R** | | 0.21 | | 0.56 | | 0.57 | | 0.57 | | |
| **R Square** | | 0.044 | | 0.313 | | 0.320 | | 0.328 | | |
| **Adjusted R Square** | | 0.005 | | 0.278 | | 0.278 | | 0.279 | | |
| **F** | | 1.13 | | 8.84*** | | 7.54*** | | 6.63*** | | |
| **R Square Change** | | 0.044 | | 0.269 | | 0.007 | | 0.008 | | |
| **F Change** | | 1.13 | | 37.96*** | | 1.02 | | 1.13 | | |

For all groups N =103, Dependent variable: Factory performance. One tailed significance level

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

The overall regression equation in model I was not statistically significant (F=1.13, P>.05) and the set of independent and control variables explain only 4.4 percent of the variance in factory performance. The results in table 6 also reveal the effect of process and information integration in model II, on factory performance. The overall model is very significant in explaining factory performance (F=8.84, P<0.001) and the change in squared multiple correlation coefficient ($R^2$) of 0.269 is also statistically significant (ΔF=37.96, P<0.001). The prediction that when factories embrace process and information integration, their performance would improve, is strongly supported as the coefficient is very statistically significant (β=0.551, P<0.001). Hypothesis II predicted that when factories adopt customer sensitivity, they are likely to improve their performance. This hypothesis is not supported as the coefficient is not statistically significant (β=0.09, P>0.05) and the change in $R^2$ of 0.007was not statistically significant (ΔF=1.02, P>0.05). Hypothesis III stated that collaborative strategies positively will lead to improvement in the performance of small and medium factories. When collaborative strategies were correlated with factory performance, results revealed a significant relationship (r = .224). However, when collaborative strategies were entered into the regression equation, the change in squared multiple correlation coefficient $R^2$ of 0.008 was not statistically significant (ΔF=1.13, P>0.05). The data does not support the prediction that collaborative strategies have the positive and significant effect on factory performance, as the coefficient is also not statistically significant at 95 percent significance level (β=0.096, P>0.05).

In summary, results provide additional insight into the role of agile manufacturing process among small and medium factories. The output of regression analysis shows that process and information integration is the only agile manufacturing dimension that is significant in predicting performance of small and medium factories in Uganda.

## DISCUSSION

This research provides knowledge on the benefit of adopting agile manufacturing among small and medium factories in Uganda. The results support the claim that factories with high levels of agility have superior performance compared to factories with low levels of this practice. Three hypotheses were developed for each agile manufacturing dimesion.

In the first hypothesis, it was predicted that process and information integration positively influence performance of small and medium factories. The focus was on smooth flow of information, extent of classification and integration of products and processes; and the ability of the factory to set the equipment so as to produce new products quickly. In examining these aspects, the findings revealed that when process and information are integrated, small and medium factories are able to improve their performance especially lead time. From the wider perspective, smooth flow of information and integrations of processes are undeniable when a manufacturer intends to reduce stock out risks. In other words, when there is no smooth flow of information, an entire supply chains may suffocate from delay complaints. To ensure timely and efficient deliveries to the market, various elements must be integrated with a clear path of information flows (Jafar & Yousef, 2016, p. 1).

Literature provides that process and information integrations are widely seen in terms of technology aided designs; computer aided manufacturing to facilitate production with short life cycles and integrated information systems (Pranav, 2014). However, in this study context where indigenous innovative technology is not sufficient (African Development Bank Group, 2014), small and medium factories are likely to be relying on imitative technologies instead of innovative ones. In addition, due to emerging social platforms, vital information could be shared amongst supply chain partners (Vikas, Esinaulo, Jose, Archana, Luis, & Gabriela, 2017).



In addition, even though factories in this context of developing countries are disadvantaged in terms of research and development especially in the area of IT, managers need to exhibit excellence in implementation of adaptive technologies. This alternative technological strategy could ostensibly be responsible restating competence of small and medium factories in Uganda in servicing their customers in quickest and timely manner.

Lastly, small and medium factories in Uganda do not have capacity to configure their equipment for the new product release, it is likely that they outsource parts of products to guarantee steady supply. The theory of dynamic capability recognizes the importance of information sharing in outsourcing parts when internal resources are limited; more intensively when business environment is competitive. Although more theoretical underpinning is required, empirical evidence in this research, confirms that length of lead time in manufacturing business reduces by streamlining the flow of information and integration of processes; thus; accepting the first hypothesis.

The second hypothesis predicted a positive and significant effect of customer sensitivity on performance of small and medium factories. In examining this phenomenon, the focus was on production processes and differentiation routines. The influence of customer sensitivity on factory performance was not supported in the study. The findings do not support the fact that performance is associated with differentiation capabilities and ability to change production processes. Lack of support probably raises from the fact that differentiation strategy; require certain competences that could be missing among small and medium factories in developing countries of which Uganda forms part(Christopher, Christopher & Joe, 2007). Never-the-less, Preet, Masaaki, & Hildy (2000) construe that differentiation competences are anchored on how firms concentrate resources for standardization approaches. Little of this in Ugandan context could be some reasons why differentiation is some-what weakly supported in improving factory performance. Preet, Masaaki, & Hildy (2000, p. 258) add that differentiated product manufactured by small and medium factories especially in developing countries are negatively perceived and generally equated with low price and quality. These perceptions may not allow factories to create a differentiated brand with a premium price. Therefore, as managers think of differentiating their products in this context, they need to know that this may likely not to attract a big portion of potential customers. Probably this could be a plausible reason why small and medium factories lightly consider the relevance and importance of customer sensitivity in improving factory performance.

However, from the finding of this study, one should not make explicit conclusion that differentiation strategy attracts little improvement in performance of small and medium factories. Instead, the focus should be on the costs associated with production of differentiated products which would give manufacturers an advantage over their rivals in the market. Intuitively, study revelations, could be due to fragmented market with a lot of cultural differences that are being served. As provided in the previous studies, strong benefit for differentiation can only be realised when marketing strategies across customer segments are consistent (Preet, Masaaki, & Hildy, 2000). This would only be possible when markets are characterised with insignificant culture differences. In this study context, although customer base is enlarged under the theme of regionalization (Ayebale, 2017), small and medium factories have not realized very significant improvement from differentiation competences. Probably aspect of culture has not been catered for by the factories in Uganda as they strive to differentiate their products. This could be underlying reason why differentiation strategy is not supported in improving factory performance.

The third hypothesis predicted that collaborative strategies positively and significantly influence performance. Collaborative strategies were conceptualised to represent the extent to which small and medium factories build ties with suppliers, distributors and employees in delivering customer value. In this regard, when correlations were tested, data supported significant relationship with factory performance. Regression analysis results did not support significant relationship between collaborative strategies and performance although the relationship was positive. Obviously, one would expect manufacturers in the developing country context like Uganda where resources are limited, to save resources by partnering with suppliers and distributors. In fact, as inducted by Sambamurthy, Bharadwaj, & Grower (2015), through partnerships, manufacturing firms would improve their performance! However, literature holds this ideological truth for firms in developed countries.

In this particular study, a different contextual reality is revealed. When collaborations are adopted, performance of small and medium factories is not realised even though factory managers agree having collaborative strategies with the average score of 3.4417 on a 5-point Likert scale. As construed by Mats & Mike (2003, p. 6), the logic behind manufacturers entering close collaborations is settings large opportunities in the future. Through collaborative strategies, small and medium factories in Uganda could be drawing strategies for complementary reason in the future as their scale of operation broadens other than focusing at improving their performance. The insignificant degree of support for improving performance, in this study could be arising from lack trust among the business participants as pointed out in African Development Bank Group report (2014). Indeed, studies have showed that contract enforcement, property right and intellectual rights greatly affect manufacturing sector (Sambamurthy, Bharadwaj, & Grower, 2015). Non-adherence to these policies and regulations could deter collaborations with suppliers, distributors and other stakeholders. Companies with collaborations are able to exploit large opportunities, which they would not achieve individually (Mats & Mike, 2003). It is probable that through collaborations, small and medium factories in Uganda develop competence and strength to accept larger responsibility or contracts. Therefore, as Ugandan government continue to establish institutions to enforce contracts and regulations, their intermediating role could also be an area for further research.

Furthermore, small and medium factories benefit from collaborative strategies due to the fact that they can easily identify and select reliable distributors and suppliers as connoted bySambamurthy, Bharadwaj, & Grower(2015). The theory of dynamic capabilities provides that when resourceful components are properly identified, selected and exploited (Gary, 2015; Teece, 2000), the company would have an advantage of product market. The incense of this theory is that when ties with suppliers and distributors are carefully selected, collaborations would be of an advantage. In a business environment like of Uganda, strong ties with suppliers and distributors and other government agencies have been heavily emphasized to facilitate easy distribution of products (Uganda Investment Authority, 2008). These policies are intended to expedite transaction processes of local firms. It is therefore surprising that collaborative strategies do not give advantage to small and medium factories in improving performance. This is contrary to the insights of Steffen, Pinar & Jon(2015) who argue that cost advantage can also be achieved by forming inter-organizational alliances. Basically, when factories form alliances with potential competitors, buyers and sellers, they are likely to be improving their performance. They add that through collaboration, combined costs of purchase and buying transactions are lower than the cost of operating alone. What is missing in Uganda could probably be concreteness of alliances with other companies.



## MANAGERIAL AND THEORETICAL IMPLICATION

The study has both managerial and theoretical implication. The focus of the study was to examine the effect of agile manufacturing practice on performance of small and medium factories in Uganda. The revelation from the study indicates that improved performance in only pronounced when factories embrace more of process and information integrations. Although, agility is a key competitive dimension that any factory manager should be aware of, understanding its manifestation with intent to reduce costs of conversion and lead time is paramount. In implementing agile manufacturing practices, the managers need to know the agile metrics that are relevant and pertinent in improving performance for small and medium factories in terms of cost and lead-time reduction.

In this regard, the study suggests a more realistic understanding of agile manufacturing practice and the way manufacturers take advantage of it to improve their factory performance. The findings show that the most feasible way in which small and medium factories can improve factory performance with an agile manufacturing practice is to emphasize efficient process and information integrations. Consequently, this allows manufacturing factories to quickly dispose of products to the market. Even though previous researches claim that efficient process and information flows require deployment of advanced information technologies, adaptive technologies is observed to provide appropriate solution. Therefore, factory managers are recommended to pay attention to technological menus that come along with the imported equipment and other technological innovations that are within their reach.



The second major finding regards the benefit customer sensitivity characterised by differentiation as one of the key elements. The results revealed that the contribution of customer sensitivity in improving factory performance was not supported in manufacturing environment of Uganda. It is therefore important to note that when factories become more customers sensitive, then excellence should be exhibited on how and when certain economic tasks are performed both on the market and on the manufacturing floor. In this respect, managers should recognize the boundaries of their firms as a function of the governance structure, most especially when they seek to benefit from the optimal adaptability to differentiation in response to customer need.

Lastly, the relevance and contribution of collaborative strategy was also investigated. As explained in previous research, this strategy appears to be important manufacturing aspects of creating prerequisites for handling the unpredictable and insecure market environment (Mats & Mike, 2003). This strategy expeditescustomer service and therefore reduces lead time through ties and partnerships with suppliers and distributors. However, this strategy fails to work in developing country like Uganda because weak contractual engagements and luck trust. The revelation is that although collaborations are essential in Uganda, they are not exclusively for cost reduction. They could be for other development intention other than cost and lead-time reduction. Nevertheless, neglecting collaborations with business partner (like manufacturers of complements, substitutes) would still be misleading. Rather, small and medium factories in Uganda should assess their competitive edge and ascertain strategic collaboration mix that improves performance in context.

## REFERENCES

Abanis, T. (2013). Business Efficiency in Small and Medium Enterprises In Selected Districts of Western Uganda. *Research Journal of Finance and Accounting, 4* (13), 1-29.

Abiar, B., & Civerolo, J. (2012). *Agile Manufacturing Not Just Anotherr Buzz Word, Partners for Excellence.* Retrieved from http//www.partneringforexcellence.com/95art3.

Abraham, Mark, V. A., Subba, S. R., & Ragu-Nathanb, T. S. (2006). Time based manufacturing improves business performance. *oprational management* , 281–306.

Abraham, N., Mark, V., & Xenophon, K. (2003). The impact of organizational structure on time based manufacturing and plant performance. *The journal of operations management, 21*, 281-306.

African Development Bank Group. (2014). *Eastern Africa's manufacturing sector,promoting technology, innovation,productivity and linkage-uganda country report.* Nairobi: African Development Bank Group – Eastern Africa Regional Resource Centre (EARC).

Aggrey, N., Eliab, L., & Joseph, S. (2010). Size and teachnical efficiency in East African manufaturing firms. *Current research journal of economic theory* , 69-75.

Ali, R. G., Gholamhossein, M., Forouzandeh, Z., & Hamid, R. R. (2013). Developing a Model for Agile Supply: an Empirical Study from Iranian Pharmaceutical Supply Chain. *Iranian Journal of Pharmaceutical Research, 12* , 193-205.

Alok, M., Dangayach, S. G., Mittal, M. L., Milind, & Sharma, K. (2011). Performance measurement in automated manufacturing. *Measuring business excellence* , 77-91.

Anabela, A. C., Jose, D.-C., Rui, & Sousa, M. (2012). Lean production as promoter of thinkers to achieve companies' agility. *The learning organization* , 219-237.

Anderson, J., & Gerbing, D. (1982). Some methods for respecifying measurement models to obtain unidimensional construct measurement. *Journal of marketing research, 19*, 453-460.

Andries, B., & Gelders, L. (1995). Time-based manufacturing logistics. *Logistics Information Management*, *8* (3), 30-36.

Andy, F. (2009). *Discovering statistics using SPSS* (Third Edition ed.). SAGE Publication Ltd.

Ayebale, D. (2017). Competing in the emerging East-African community market: How can local SMEs strategically position themselves in this market.

Bhasin, S. (2015). *Lean management beyond manufacturing: A holistic approach.* London: Springer international publishing.

Blackburn, J. (1991). *Time based competition: The next battle ground in manufacturing.* Iwin Homewood I L.

Carlo, S. (2015). *lean discipline: Value stream management, Value stream mapping*. Retrieved February 22, 2016, from http://www.scodabbio.com.

Chang, H. C., Ouyang, L. Y., & Wu, H. (2006). Integrated vendor–buyer cooperative inventory models with controllable lead time and ordering cost reduction. *European Journal of Operational Research 170(2): ., 170* (2), 481-495.

Chia-Yen, L., & Andrew, L. J. (2014). *Operational efficiency*. Tainan City: Institute of Manufacturing Information and Systems, National Cheng Kung University.

Childerhouse, P., Hermiz, R., Mason-Jones, R., Popp, A., & Towill, D. R. (2003). Information flow in automotive supply chains – identifying and learning to overcome barriers to change. *Industrial Management & Data Systems,, 103* (7), 491-502.

Chowdiah, M. P. (1996). Agile manufacturing for global competitiveness. *Souvenir of international conference on agile manufacturing*, (pp. 37-46). Bangalore.

Christopher, A. B., Christopher, W. C., & Joe, B. H. (2007). Postponement: an evolving supply chain concept. *International Journal of Physical Distribution & Logistics Management, 37* (8), 594-611.

Chung, W. S., Talluri, & Narasimhan, R. (2014). Quantity Flexibility Contract in the Presence of Discount Incentive. *Decision Sciences, 45* (1), 49-79.

Conrad, M. M., Simon, M., Ibrahim, M. J., & Jummai, M. (2013). Leadership Style and Performance of Selected Manufacturing. *European Journal of Business and Management, 5* (13).

Crawford, C. M. (1992). The Hidden Costs of Accelerated Product Development. *Journal of Product Innovation Managenment, 9*, 188- 199.

Crowder, J., & Friess, S. (2013). *Sytematic engineering agile design mothodologies.* New York: Springer.

Damodar, G. N. (2004). *Basic econometrics* (Fourth Edition ed.). McGraw- Hill Companies.

Daniel, K., Markus, L., Kristian, K., Olivier, B., & Yew, Y. L. (2018, April 18). Artifical intelligence in the factory of the future. *The Ghost in the Machine* .

Denise, R. (2012). Lean production and agile organization: the link supply chain and sustainable development. *HAL Id: hal-00691694* .

Eisenhardt, K. M., & Martin, J. A. (2000). Dynamic capabilities: what are they? *Strategic Management journal, 21*, 1105-1121.

Evan, J. S. (1991). Strategic flexibility for high technology manoeuvers: A conceptual framework. *Journal of management studies, Vol. 28* (1), 69-89.

Faizal, B. (2011). *Performance and survival of Ugandan manufacturing firms in the context of East African Community*. Kampala: Economic Policy Research Centre.

Gary, P. P. (2015). *A Normative Theory of Dynamic: connecting strategy, know -how and competition.* Harvard Business School.

Goldman , S. L., Nagel , R. N., & Preiss, K. (1995). *Agile Competitors and Virtual Organizations: Strategies for Enriching the Customer.* New York: Van Nostrand Reinhold.

Goldratt, E. M. (1990). *What is this thing called the Theory of Constraints?.* NewYork: North River Press, Croton-on-Hudson.

Heather, W., Christine, M. J., Andrea, F., & Meredith, R. (2012). An introduction to hierarchical linear modeling. *Tutorials in Quantitative Methods for Psychology, 8* (1), 52-69.

Helio, C., Goran, P. D., & Vaibhav, S. (2012). A review of agile and lean manufacturing as issues in selected international and national research and development programs and roadmaps. *The learning organization, 19* (3), 267-289.

Hormozi, A. M. (1994). Agile manufacturing. *International conference proceedings of APICS* (pp. 216-18). San Deigo: APICS.

Intaher, M. (2010). Agile supply chain: strategy for competitive advantage. *Journal of Global Strategic Management, 4* (1), 5-17.

Jafar, H., & Yousef, N. (2016). Coordination of pricing, ordering, and lead time decisions in a manufcturing supply chain. *Journal of Industrial and Systems Engineering, 9* (1), 1 – 16.

Kagame, V. S. (2014). Enterprenueral performance and small business enterprises in Uganda. *International Journal of Small Business and Entrepreneurship Research, 2* (4), 1-12.

Kazimierz, K. (2014). The Strategic Dimension of dynamic capabilities of entreprises. *Management , 18* (2), 1-18.

Kokkinou, A. (2010). A Note on Theory of Productive Efficiency and. *European Research Studies, III* (4).

Koste, L. L., & Malhotra, K. M. (2000). Tade-offa among the elements of flexibility: A comparision from the automotive industry. *International journal of management science, Vol. 28* (6), 693-710.

Krejcie, V. R., & Morgan, W. D. (1970). Determining Sample Size for research activities. *Educational and Psychological measurement, 30,* 607-610.

Lee, H. L. (2002). Aligning supply chain strategies with product uncertainties. *Management Review., 44* (3), 105-120.

Leng, M., & Parlar, M. (2009). Lead-time reduction in a two-level supply chain: Non-cooperative equilibria vs. coordination with a profit-sharing contract. *International Journal of Production economics, 118* (2), 521-544.

Lucia, A., Esteban, F., & Daniel, V. B. (2007). Agility drivers, enablers and outcomes: Empirical test of an integrated agile manufacturing model. *International Journal of Operations & Production Management, 27* (12), 1303-13.

Luis, B., Verda, D. E., & Daniel, S. (2012, June 2). *Six steps to successful supply chain collaboration.* Retrieved October 30, 2018, from supplychainquartery.com.

Marcus, I. (2010). Agile supply chain: strategy for competitive advantage. *Journal of Global Strategic Management, 4* (1), 5-17.

Marie-Joelle , B., & Sandra , F. (2012). Lean and agile: an epistemological reflection. *The Learning Organization, 19* (3), 207 - 218.

Mark, V., Subba, R., Ragu-Nathanb, & Abraham, N. (2006). Time based manufacturing improves business performance. *oprational management* , 281–306.

Martina, M., John, F., & Deepak, K. D. (2010). The influence of international networks on internationalization speed and performance: A study of Czech SMEs. *Journal of world business, 45*, 197–205.

Mats, W., & Mike, D. (2003). Linking Manufacturing Strategies to Design of Production Systems in collaborative manufacturing network society. *14th Annual Conference of the Production and Operations Management* (pp. 4-7). Georgia, USA: Savanna.

Mattias , H., & Jan , O. (2009). Lean and agile manufacturing: internal and external drivers and performance outcomes. *International Journal of Operations and production management, 29* (10), 976-999.

Maxwell, R. C., & Harold, T. G. (1955). Census principles of industry and product classification, manufacturing industries. *Business Concentration and Price Policy* , 15 - 55.

Menard, S. (1995). Applied logistic regression analysis. *Sage university paper series on quantitative applications in the social sciences* , 07-106.

Meredith, S., & Francis, D. (2000). "Journey towards agility: the agile wheel explored". *The TQM magazine, 12* (2), 137-143.

Michael, S. R., & Bruce, M. T. (2016). Rooting Out the Causes of Inefficient Product Creation. New York: Arthur D Little's technology and innovation management activities.

Mohdl, N. F., Banwet, D. K., & Ravir, S. (2006). Mapping supply chains on risk and customer sensitivity dimensions. *Industrial Management & Data Systems, 106* (6), 878-895.

Myers, R. (1990). *Classical and modern regression with applications.* (2, Ed.) Boston MA: Duxbury.

Nunnally, J. C. (1978). *Psyochomatric theory* (2 ed.). New York: McGraw-Hill.

Olorunniwo, F., & Hartfield, T. (2001). Strategic partnering when the supply base is limited: A case study. *Industrial Management & Data Systems,, 101* (1), 47-52.

Petri, K., Shamsuzzoha, A. H., & Petri, T. H. (2012). Quantifying time-based manufacturing strategy; Empirical analysis from the electrical appliances industries. *Business Process Management Journal, 18* (5), 792-814.

Preet, S. A., Masaaki, K., & Hildy, T. (2000). Export Strategies and Performance of Firms from Emerging Economies: Evidence from Brazil, Chile and Mexico. *The Academy of Management Journal, 43* (3), 342-361.

Qiang, T., Mark, A. V., Rogu, T. S., & Nathan. (2010). The impact of time based manufacturing practices on mass customization and value to customer. *Journal of operations management* .

Ramasesh, R., Kulkarni, S., & Jayakumar, M. (2001). Agility in manufacturing system: an exploratory modeling framework and simulation. *integrated manufacturing systems, Vol.12*, 534-548.

Sambamurthy, Bharadwaj, & Grower. (2015). Shaping agility through digital options reconceptualing the role of information technology in contemporary firms. *MIS quarterly, 27*, 237-263.

Stalk, G., & Hout, T. (1990). *Competing against time.* New York: The Free Press.

Steffen, H., Pinar, B., & Jon, G. S. (2015). Business Strategies for Competition and Collaboration for Remanufacturing of Production Equipment. *Berlin University of Technology, Germany* (pp. 715-915). ResearchGate.

Steven, B. (2017, September 6). Accounting CPE Courses and Books. *Accounting tools* .

Teece, D. J. (2000). *Managing intellectual capital.* Oxford: Oxford Univeristy Press.

Teece, D., & Gary, P. P. (1994). The Dynamic Capabilities of Firms: An introduction. *Industrial and Corporate Change, 3* (3), 537-556.

Teece, D., Pisano, G., & Shuen, A. (1997). Dynamic capabilities and strategic management. *Strategic Management Journal, 18* (7), 509-534.

Thaeir, A. S. (2014). Modeling lean, agile, leagile manufacturing strategies: An fuzzy analytical hierarchy process approach ready for ready made ware( clothing) in Mosul, Iraq. *International Journal of Advances in Engineering & Technology* .

Thomas, A. A., & Stephen, H. A. (1990). *The classification of manufacturing industries: an input-based clustering of clustering.* Washington, D. C: Rutgers University.

Turyahikayo, E. (2015). Challenges faced by small and medium enterprises in raising finance in Uganda. *International Journal of Public Administration and Management Research (IJPAMR), 3* (2), 21-33.

Uganda Investment Authority. (2017). *Small and Medium Enterprises-Business Guide*. Kampala: ICEIDA.

United Nations Economic Commission for Africa. (2017). *An ABC of Industrialisation in Uganda: Achievements, Bottlenecks and Challenges.* Kigali: Economic Commission for Africa.

US commercial Service. (2016). *Doing Business in Uganda:Country Commercial Guide for U.S. Companies.* United states of America economics department.

Vikas, K., Esinaulo, N. C., Jose, A. G.-R., Archana, K., Luis, R.-L., & Gabriela, C. L.-T. (2017). The Impact of Supply Chain Integration on Performance: Evidence from the UK Food Sector. *27th International Conference on Flexible Automation and Intelligent Manufacturing, FAIM2017* (pp. 814 – 821). Modena, Italy: Elserver.

Williamson, O. (1975). *Markets and hierarchies, analysis and antitrust implications: A study in the economics of internal organization.* New York: Free Press.

Yong , L., Shihua , M., & Li , Z. (2001). Manufacturing strategies for time based competitive advantage. *International Journal of Operations and production management*, *5* (4), 407-419.

Yusuf, Y. Y., Sarhadi, M., & Gunasekaran, A. (1999). Agile manufacturing: The drivers, concepts and attributes. *International Journal of Production Economics*, *62*, 33-43.