Title: Towards an Integrative Framework for Predicting SME Cluster's Innovative Capability: the Case of SUAME Magazine Cluster Ghana

Abstract:

The paper clarifies the concept of innovative capability by identifying five measurable dimensions constituting it. An empirical framework is constructed from related configurations integrating transactional, social, and knowledge based networks determining innovative capability. The framework is tested using Hierarchical and Standard multiple regression techniques to predict Small and Medium Enterprises (SME) clusters innovative capability in a leading West African cluster. The study has contributed to the debates on entrepreneurship, innovation, and geographical clustering of SME's. It has also provided a practical framework guiding policy makers inclined to improving innovative capability in Africa

Key Words: Ghana, SME Clusters, Innovative capabilities, and Network configurations.

Introduction

The concept of *innovative capability* has become a buzz word being used in different contexts referring to different things. Sometimes it is used in the context of regional SME's ability to innovate (Mitra, 2000; Romijin and Albaladejo, 2002); or team based organisational capability to mobilise and create knowledge necessary for innovations (Un and Montoro-Sanchez, 2010); or even in the context of national innovative activities and outcomes leading to sales of product innovations or patent acquisitions (Faber and Hesen, 2003). As a concept, innovative capability appears to be vague (Kaplan, 1998), incoherent, and unclear. The aim of this paper is to: clarify the concept of innovative capability by identifying certain unified measurable dimensions constituting it; propose a coherent framework integrating concepts purportedly associated with it, such as network configurations; and conduct a systematic empirical research testing the assumptions underlying it as a construct.

Thus, the paper started by reviewing related literatures (particularly on network configurations), since the relationship between various forms of networks, innovation, and entrepreneurship is firmly established in the literature (Pittaway et al, 2004; Hoang and Antoncic, 2003). The review of related concepts has led to an operational definition of innovative capability. Afterwards, each network theoretical (transactional, social, knowledge based) was evaluated to identify their respective network effects on innovations as a basis for a coherent framework. The framework is tested using a family of regression techniques to predict innovative capability of a leading West African SME metal and automotive cluster in Kumasi Ghana. The framework has provided an alternative approach to SME development in Africa which was criticised as being solely biased to economic conceptualisations (Tukuori, 2007; Yoshino, 2007).

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Theoretical Framework

Network based research in entrepreneurship has evolved mainly in to three different broad aspects: These aspects are network content (relationships and exchanges), network governance (coordination of exchanges and trust), and network structure (pattern of relationships) (Hoang and Antoncic, 2003). However, in the case of Small and Medium Enterprise (SME) clusters where the market form of organising production typically supersede the advantages of organising internally (Oz, 2004), the different aspects of network manifest themselves more visibly in terms of nature of transactions, social and knowledge based linkages.

Thus, network configurations are defined as transactional, social, and knowledge network patterns and their interconnections that make up a cluster. A cluster then is a geographical agglomeration of those SME's configured via dense related transactional, social, and knowledge networks. These form of network configurations somewhat differ from resource based configurations which are normally induced by the presence of dynamic capabilities housed and controlled within a single firm (Teece et al, 1997; Eisenhardt and Martin, 2000) informing corporate level strategies (Bowman and Ambrosini, 2003) or determining firms behavioural orientations (Borj et al, 1999).

The difference is more obvious in a geographically dense co-located SME clusters whose mutual existence relied heavily on network configurations of related firms to innovate and achieve competitive advantage (Mitra, 2000; Foss, 1999). The assumptions of such Relational View RV are underpinned by the idea that network configurations are formed on the bases of idiosyncratic interfirm linkages (Dyer and Singh, 2004). Firms are increasingly finding the network in which they are embedded, to be their locus of innovations (Powell et al, 1996; Pittaway et al, 2004). Thus, one would assume that firms that elect to engage in certain form of network configurations *ceteris paribus* stands a better chance of building innovative capabilities. However, defining innovation itself is quite contentious let alone measuring and predicting its capability in African SME clusters. Such attempt is met by two sets of challenges: Firstly, a mismatch between "single firm perspective on capabilities, and the multiple organisation perspective on innovation" (Coombs and Metcalfe, 2000: 210); Secondly, contextualising innovation in African SME clusters (Pittaway et al, 2004).

Innovation in advanced countries is often defined in terms of successful exploitation of ideas product, process or service (Pittaway et al, 2004). Such definition in contradistinction to what is obtainable in African contexts emphasizes the exploitation of innovations (Pittaway et al, 2004). In such approaches *Patents* are normally a proxy for innovation (Powell and Grodal, 2006). Thus, in developed countries extant studies "focuses on the effects of networks on patenting, access to information, and the generation of novel ideas" (Powell and Grodal, 2006: 58). These streams of patent orientated approaches when applied in Africa are either incompatible or intractable so much that they almost always paint a grim picture of a laggard Africa. Critically, *Patent* counts approach has failed to capture the underlying processes and outcomes of innovative capabilities (Un and Montoro-Sanchez, 2010) in African SME clusters. Also the approach has been criticised for merely pooling and aggregating patent activities/innovations of different sectors together regardless of the variety that exists as a function of locational clustering (Scott, 2006).

Obviously the above approach could generate fewer insights when applied in African SME clusters. A more fruitful approach would be to use *Capabilities View* to investigate the capability of African SME's having the potential to engage in thriving innovations. Some SME clusters in Africa have shown the tendency to potentially innovate and compete. Therefore, in the context of such African SME clusters and for the purpose of this study, innovative capability is defined as the extent to which African SME clusters can innovate and potentially compete internationally. The definition seeks to parameterise innovative capability by innovative: *speed, frequency, diffusion, radicalness, and protection* as embedded in the existing network configurations. One advantage of such capabilities view when applied to African SME clusters, is that it would enable us identify the knowledge mobilisation and creation process associated with the cluster innovations (Un and Montoro-Sanchez, 2010; Arikan, 2009).

This research has focused on innovative capabilities for two reasons: Firstly, research in other areas of capability (knowledge creation and technological) of SME clusters are well documented (Arikan, 2009; Caniels and Romijn, 2003; Maskell, 2001). Secondly, most studies of African SME clusters focused on cost reductions arising from collective efficiency with little or no attention to innovative capabilities (Naude and Krugell, 2002; Schmitz and Nadvi, 1999). Thus, the goal here is to integrate different network theoretical and the language they use respectively in their domains to predicting overall innovative capability of a cluster (Randolph, 2006; Foss and Foss, 2000). Therefore, the extant literatures regarding transactional, social, and knowledge networks were critically reviewed as below:

Transactional Networks and Cluster Innovative Capability:

Several empirical studies of African clusters supported the hypothesis of joint action leading to collective efficiency and reduction in transaction costs (Schmidz and Nadvi 1999). This notion has challenged the presumption of cost advantages associated with vertical integration since the cost disadvantages associated with market form are diminished by geographical proximity (Oz, 2004). For the purpose of this study transactional network is defined as sets of *subcontracting* relationships undertaken to overcome the disadvantages of market form in a manufacturing based SME cluster. These disadvantages could be of knowledge, financial, or physical resource's enabling the SME's to concentrate in core production activities and subsequently their innovative capabilities. However, assuming that SME's "motivations are rooted in a single desire to minimise transaction costs" has been criticised (Bell et al, 2009; Foss, 1999).

Furthermore, reductionism and treating transactions as discrete independent events occurring in ahistorical context were labelled as shortcomings of transaction cost economics approach (Gulati, 2004). It is also obvious from the literature that African empirical researchers have overplayed the portion of governance framework dealing with transaction attributes and governance costs while the portion of the governance framework desirable for African SME clusters which deals with organisation of for example *speedy innovation* is underplayed (Bell et al, 2009). What we tend to see are African SME clusters that have succeeded in minimising transaction costs (Naude and Krugell, 2002; Brautigam, 1997) but still organise production on a lower levels of vertical disintegration, specialisation, and subcontracting (Pedersen, 1997; Oyeyinka, 2004). Such market form might have the tendency to negatively affecting the speed of innovations in African SME clusters.

Therefore, it was argued that hierarchical governance mechanism which is underpinned by explicit patterns of authority and decision rights could enhance *speedy innovation* (Bell et al, 2009). Also the extent to which property rights are observed and enforced within the governance framework determines the *protection of innovations* (Grant, 2010).

Social Networks and Cluster Innovative Capability:

Social networks are underpinned by social capital supporting trust and cooperative relationships between and among cluster firms (Breschi and Malerba, 2001; Beccatini, 1990; DaRocha, 2009; Markusen, 1996). Also the cooperativeness and trust may be seen as fostering both entrepreneurial dynamism (Julien, 2007) and labour mobility which could include: localised employee mobility and "repatriation of scientists, engineers, and managers trained elsewhere" (Breschi and Malerba, 2001: 821). Therefore, social networks could be defined in terms of nodes linking persons or organisations in social relationships (Gulati, 2004). In some African SME clusters such relationships are dominated by family kinships structures passed on from one generation to another (Oyeyinka, 2004).

It is argued here that social networks established on the basis of mutual benefits and labour mobility in a cluster could facilitate *diffusion of innovations*. Research on contagion supported this assertion arguing that social conformity could influence the extent to which firms adopt new innovations (Davis, 1991). Therefore, within a certain geographic proximity of firms, formal and informal arrangements could assist in the diffusion of innovations (Parto, 1990). For example in an atmosphere full of mistrust, healthy diffusion of innovative ideas doesn't take place. To be sure it is not clear whether or not the kind of kinship and family ties in some African clusters facilitate diffusion of innovation. This is because often where family member's spinned out to set up their own businesses the motive is normally driven by desire to be autonomous and expand rather than pursuance of a genuinely innovative idea.

Knowledge Networks and Cluster Innovative Capability:

Firms could be differentiated by their ability to mobilise and convert knowledge for innovative purposes (Un and Montoro-Sanchez, 2010: 416). At higher level of aggregation studies have shown that knowledge spill over is the primary purpose for geographical clustering (Breschi and Malerba, 2001; Freeman and Soete, 1997). This perhaps is because most SME's often have insufficient resources, knowledge, and capabilities to develop innovations solely by themselves (Hulsink et al, 2009). Therefore, economic geographers particularly emphasized the underpinning localised variations in learning, peculiar to geographical regions leading to innovations (DeMartino et al, 2006; Maskell, 2001).

Knowledge network is defined as a structure linking actors (firms/institutions etc) in the process of innovation (Zeng, 2008). A distinguishing feature of knowledge based networks is knowledge mobilisation and creation (Foss, 1999; Arikan, 2009) arising from "regular pattern of interfirm interactions that permits the transfer, recombination, or creation of specialised knowledge" (Dyer and Singh, 2004: 355). It is this defining feature of knowledge networks that is capable of transforming a cluster in to a regional incubator of innovations or a learning region (DeMartino, 2006). It is also argued that SME cluster interfirm knowledge exchanges with universities, research institutes, and science parks increases the chances of breakthrough *radical innovations* (Arikan, 2009). Also the relatedness of knowledge bases in a cluster is argued as vitally important in facilitating *innovative frequencies* (Arikan, 2009).

Network Configurations

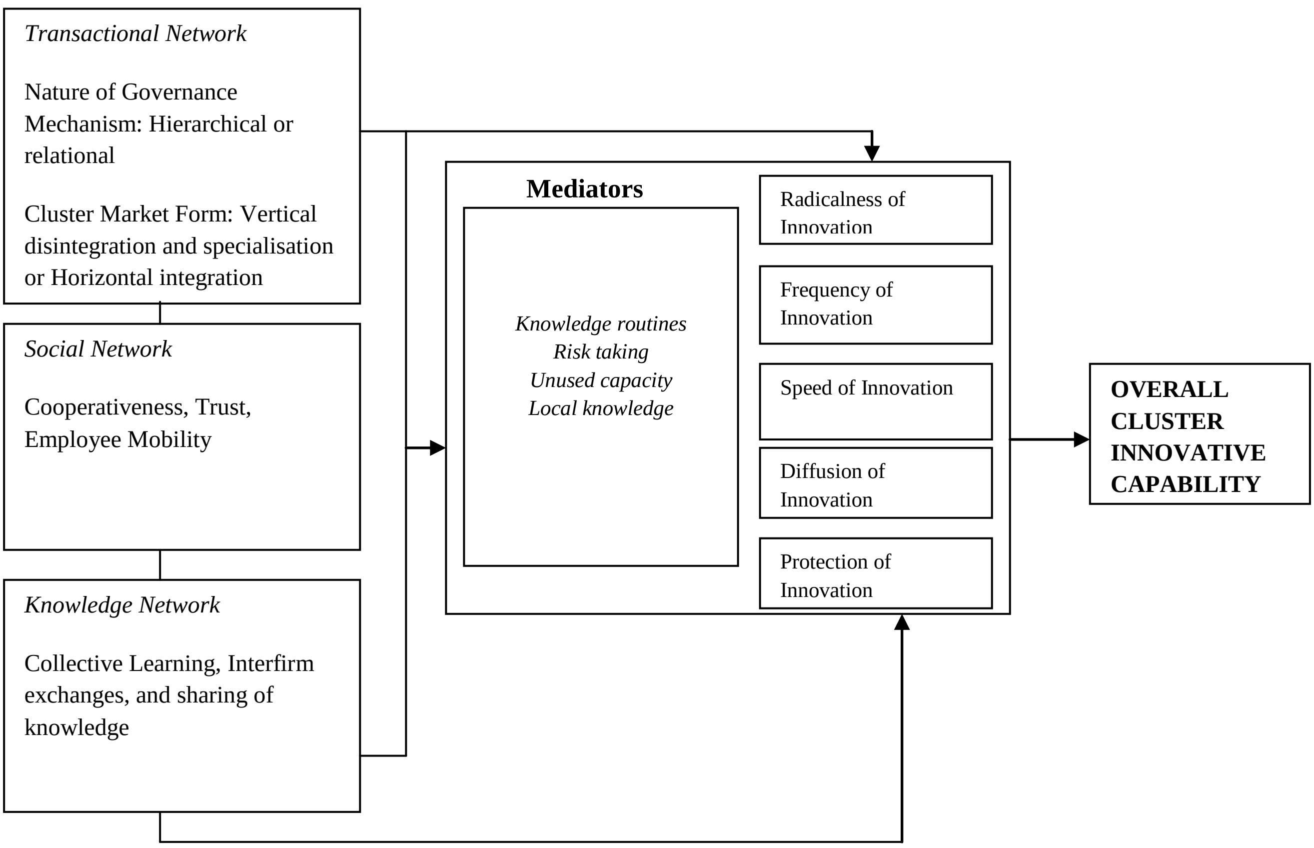
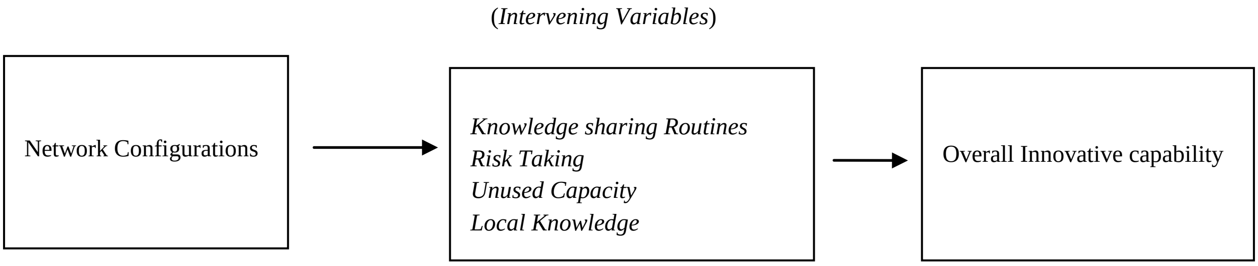


FIGURE 1: Integrative Framework for Predicting African SME's Cluster Innovative Capability

Transactional, Social, and Knowledge Network Configurations Vs Overall Cluster Innovative Capability:

In reality all the three network configurations: transactional, social, and knowledge based networks overlapped with one another in contributing to SME cluster's capability to innovate. Crucially important is the notion that overall shared beliefs in a cluster could influence both how *transactions* are organised and *social* capital built on the norms of cooperativeness and trust (Bell et al, 2009; Beccatini, 1990; DaRocha). However, although, cooperativeness and trust under both sociological and economic perspectives of relational governance differ individually with regards to enforcement (Bell et al, 2009). They collectively configure a certain macro culture allowing for distinct forms of governance influencing what *knowledge* to share, specialised assets to develop, relation specific investment to be made, and enforcements to deploy (Dyer and Singh, 2004; Bell et al, 2009). In SME clusters such macro culture is embedded in a social structure sharing collective history leading to routinisation and stabilisation of linkages among members (Marsden, 1981).

The routinisation and stabilisation of linkages in a cluster is manifested in the form of a social network were the social condition of SME's determines the *diffusion* of technology adoption by firms in a geographical cluster (Hall, 2006; Davis, 1991; Parto, 2008); knowledge network underpinned by knowledge exchanges resulting in *radical* and *frequent* innovations in the cluster (Arikan, 2009); and transactional network underpinned by transactional governance mechanism and attributes determines the *speed* and *protection* of innovations (Bell, 2009; Grant, 2010). Nonetheless, all these dimensions of innovation collectively resulting from various network configurations are mediated by intervening factors as explained below. The intervening variables provide explanatory leverage on the relationship between network configurations and the overall innovative capability of a cluster (Bryman and Cramer, 2009) as shown below:



1) Investments in knowledge exchange and sharing routines: Arguably the most important investment with established links to innovations, thus mediating overall innovative capability of a cluster (Dyer and Singh, 2004; Arikan, 2009; Foss, 1999; Grant, 2010); 2) Risk taking by the owner-entrepreneurs: Is also a primary intervening factor and is argued to be embedded in a social context (Aldrich and Zimmer, 1986; Bygrave and Minniti, 2000) facilitated or inhibited by the business climate (Ayittey, 1999; Fick, 2002); 3) Unused Capacities: Also play a key intervening role especially in a geographical cluster were the significance of asset specificity is clearly visible regarding – *site specificity* (immobile production stages located close to each other); *Physical asset specificity* (capital intensive investments and the sharing of physical assets and equipments); *Human asset specificity* (human accumulated know how, and information) (Williamson, 1985; Dyer and Singh, 2004).

In a geographical cluster, innovative capability is mediated by endless opportunities for owner-entrepreneurs to recombine slack human and financial resources to their advantage (Penrose, 1959; Hulsink et al, 2009; Danneels, 2003; Helfat and Peteraf, 2003). 4) The localised sticky (tacit) knowledge (Polanyi, 1966) also vitally intervene in affecting cluster innovative capability, since the new codified external knowledge that can be learned in the cluster is crucially affected by what is already known- sometimes referred to as *absorptive capacity* (Powell, 2006; Dyer and Singh, 2004; Freeman and Soete, 1997; Guiliani, 2005).

Methodology:

Data Collection methods

The data collection activity was carried out by the BUSAC Fund II staff and consultants (Business Advocacy Challenge Fund Phase II) in Ghana. The BUSAC Fund is a project funded and led by Danida with additional support from USAID and the European Union as part of a larger project funded by the Danish Government called Support for Private Sector Development Phase II. However, views expressed in this research activity using this data so collected are the opinions and conclusions of the researcher and do not in any way reflect the official stand of Danida, USAID, EU or the BUSAC Fund. A total of 211 SME's were contacted out of which only 194 met the criteria of the study - to being manufacturing based and located geographically in the areas of Suame Magazine Ghana. Questions were asked regarding network configurations and innovative capability.

Unit of Analysis

The data collected is related to an embedded unit of analysis (innovative capability) within the broad cluster (Yin, 2009). Although, innovative capability could simply mean the ability of SME's to innovate, its intangibility makes it elusive. Often capabilities do not lend themselves to easy measurement and analysis not least because the processes of building them are not fully understood (Un and Montoro-Sanchez, 2010), but also because as constructs, they are labelled as vague (Kraatz & Zajac, 2001) even intractable (Daneels, 2008). Normally, when dealing with broad concepts like innovative capability there tend to be a possibility that "it comprises underlying dimensions which reflect different aspects of the concept" (Bryman and Cramer, 2009: 72). In particular it was suggested that capabilities are multi dimensional constructs with a sum of equal weights (Bareto, 2010).

Thus, in this study the overall innovative capability of a cluster is assumed to be multi dimensionally embedded in transactional, social, and knowledge networks. These respective networks manifest themselves in equal weights of radicalness, frequency, speed, diffusion, and protection of innovations arising from the cluster. This study follows the suggested illustration from a synthesis by Bryman and Cramer (2009) to specify the concept, its dimensions, and measurements as shown below:

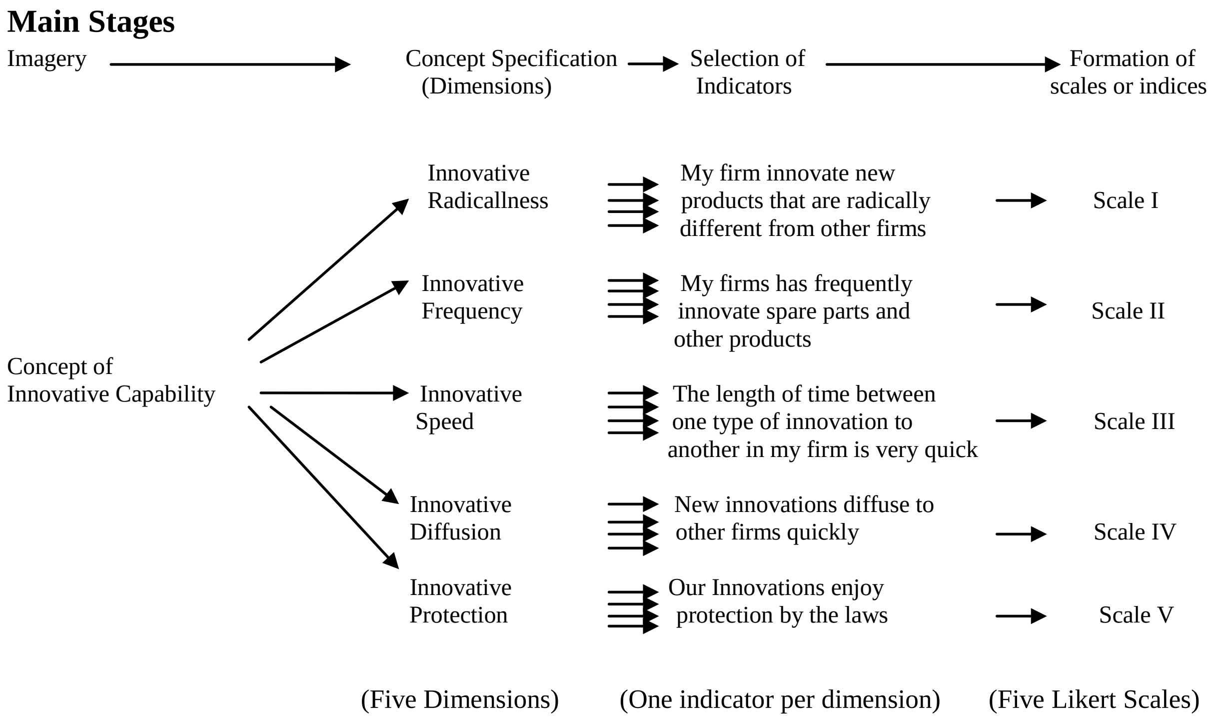


FIGURE 2: Concepts, Dimensions, and Measurements

Empirical Data Analysis of Results

Scale Reliability and Data Transformations

Since the specification of dimensions making up the construct of innovative capability are proposed *a priori* (Bryman and Cramer, 2009), it is vital at this stage to determine the internal consistency of the underlying scales. Internal consistency of scales refers to “the degree to which the items that make up the scale ‘hang together’” (Pallant, 2005: 90). This is not an attempt to measure ‘unidimensionality’ (Field, 2009), but an attempt to weigh a ‘multidimensional’ construct with a sum of equal weights (Bareto, 2010). Thus, in this case a Cronbach alpha coefficient is computed to determine the extent to which “the questionnaire consistently reflects what it is measuring” (Field, 2009:673). The alpha values computed for Transactional, Social, and Knowledge predictors are 0.763, 0.595, and 0.624 respectively while for the overall innovative capability is 0.716 indicating relative reliable scales (See Appendix A). It should also be noted that overall innovative capability of the cluster is formed from adding up and transformation of five dimensions including (Innovative: Frequency, Speed, Diffusion, Knowledge, and Protection).

Predicting overall Innovative Capability of a Cluster: Controlling for Intervening Variables using Hierarchical Multiple Regression

Preliminary analyses were conducted to ensure that no violations regarding the assumptions of normality, linearity, and multicollinearity occurred. Hierarchical Multiple Regression (see Appendix C) is used to predict overall innovative capability of the SME cluster (R Square value). After the variables in Block 1 (Total Transactional Networks TKNetwork, Total Social Network TSNetwork, and Total Knowledge Network TKNetwork) have been entered the overall model explains 26% (.268*100). After Block 2 variables (Investment in knowledge sharing routines, Risk taking, Unused capacities, and Local knowledge) have been included, the model as a whole explains 36.2% (.362*100). Finally, after Block 3 variable (National innovation policy) has been included the model as a whole explains 45.9% (.459*100).

Furthermore, overall variance is explained by the following variables: (TTNetwork, TSNetwork, and TKNetwork) after the effects of (Investments in knowledge sharing routines, Risk taking, Unused capacities, Local knowledge, and National innovation policy) are removed. Thus, in model 3 the, R Square change value is .096 meaning (TTNetwork, TSNetwork, and TKNetwork) explained additional 9.6% (.096*100) of the variance in Overall innovative capability when the effects of (Investment in Knowledge sharing routines, Risk taking, Unused capacities, Local Knowledge and National innovation policy) are statistically controlled for. Thus, 9.6% is a significant contribution as indicated by Sig.F change value (.000) and ANOVA [F (8, 184) = 19.49, P < .0005).

The coefficient table reveals the unique contribution of each individual variable after statistically controlling for the overlapping effects of all other variables (Pallant, 2000). In this case only Total knowledge networks TKNetwork beta=.325; Investment in interfirm knowledge sharing routines beta = .214, Local knowledge beta = -.305, and National Innovation policy beta = .427; makes a statistically significant contribution. All other variables have not made significant contributions.

Finally, five separate results were generated regarding innovative radicalness, frequency, speed, diffusion, and protection individually using Standard Multiple Regression (See Appendix D). Interestingly, the results show that transactional networks and social networks have beta=.309 and beta= .254 regarding innovative protection, and diffusion respectively.

Background History of SUAME Magazine SME cluster and Discussion of Results

It is imperative to reflect briefly on the background history of the cluster prior to discussing the results. Through, the evolutionary historical processes of variation, selection, and retention (Martin and Sunley, 2007), a group of local artisans in related metal and vehicle repairs self-organised themselves in the 1930's to form a cluster around a former colonial army barrack in Ghana called Magazine (Yoshino, 2011; Zeng, 2008). Specialisations in manufacturing, vehicle repair, and metal work enables Suame SME's to develop fruitful subcontracting relationships (McCormick, 1999; Zeng, 2008). There are estimated 9,000 engineering SME's located in the SUAME Magazine area out of which at least (4000 focused on metal product manufacturing and 5000 focused on vehicle repair services) talk less of other firms involved in mainly sales and trade (Adeya, 2008). From the field work data gathered in this study, some of the SME's manufacture automotive parts (car shafts, roofs, and bodies, trailer shafts, trailer tail locks, gears, bumpers, exhaust pipes, axles, articulator trailers, U cramp, wheel bolts etc); Agricultural and other domestic facilities (Milling machines, block machines, containers etc), and range of many other metal fabrications.

Interestingly, the results in this study show that knowledge networks, knowledge sharing routines, and local knowledge all significantly contributed to the variance predicting the innovative capability of the cluster. Also a preliminary correlation matrix indicates that they all are positively correlated to overall cluster innovative capability (See Appendix B). This result indicates that Suame Magazine SME's engages in knowledge networking activities with (knowledge based institutions, customers, and suppliers) and also invests in interfirm knowledge sharing routines contributing to the innovative capability of the overall cluster. Thus, this finding corroborates other studies emphasising the significance of knowledge towards development of a region to becoming an incubator for innovations (Arikan, 2009; DeMartino, 2006; Guiliani, 2005). Also in line with previous studies investment in knowledge mobilisation, creation, and sharing routines could yield fruitful outcomes (Foss, 1999; Dyer and Singh, 2004).

Nonetheless, the local knowledge in this case appeared to be making a significant negative contribution (beta = -.305) as a statistically controlled intervening variable. The negative contribution of local knowledge towards the innovative capability of Suame Magazine cluster must be interpreted with great caution. It does not in any way indicate that local knowledge is inferior as would be argued (Porter, 1998). In support of regional local economics Porter (1998; 2000) argues that local indigenous circumstances primarily determines a regions potential to develop and compete internationally. However, if a region were to build its domestic capability from local sources of advantage (including local knowledge) emphasis on absorptive capacity is imperative (Guggler and Brunner, 2007; Goto and Odagiri, 2003). In this case the result implies a very low level absorptive capacity in terms of Suame cluster's ability to utilise its local knowledge to absorb, diffuse and exploit extra cluster knowledge for innovative purposes (Guiliani, 2005).

Perhaps the above is partly due to the level of human capital development of most entrepreneur-owner's in the cluster (Hussein, 2009). Majority are educated below secondary school level. This is crucially important to note, for a knowledge intensive cluster specialised in technical metal manufacturing and automotive spare parts. The significance of founder's knowledge in such technical oriented businesses had been well established and empirically supported in the subfields of technical and technological entrepreneurship (Cooper, 1971; Cooper, 1973; Watkins, 1973; Hulsink et al, 2009).

It is also very interesting to see from the results that the Ghanaian National system of innovation is very significant in predicting the overall innovative capability of Suame Magazine Cluster. Further, issues regarding policy implications are raised in the conclusion.

Contribution: Predictability and SME's Cluster Complexity

African SME clusters are quite complex as they embody elements of causal ambiguity, cumulative causation, and history (Naude and Krugell, 2002). Therefore, any attempt to statistically predict the innovative capability of an African cluster is likely going to be criticised on grounds of spuriousness. Spuriousness happens when a causal relationship between variables is not a true relationship (Bryman and Cramer, 2009). Thus, in order to avoid spuriousness the variables in the construction of the framework were carefully chosen based on studies embodying robust conceptualisations of clusters (Arikan, 2009; Bell, 2009; Foss, 1999; McCormic, 1999; Schmidz and Nadvi, 1999; Mytelka and Farinelli, 2005; Brautigam, 1997; Markusen, 1996; Maskell, 2001; Guiliani, 2005; Van Dijk and Sverisson, 2003) and comprehensive systematic reviews of empirical studies relating to network configurations, innovations, and entrepreneurship (Pittaway et al, 2004; Powell, 2006; Powell, 1996; Hoang and Antoncic, 2003).

Overall the framework predicted innovative capability of the cluster by an R square value of 45.9% after controlling for all intervening variables. This percentage is quite respectable in social sciences (Pallant, 2000) and more so, were causally ambiguous factors are involved. Thus, the framework has contributed in an attempt to measure and predict a uniquely complex phenomenon of geographical clustering and innovation. It has further, responded to the criticism labelled against the lack of predictive power inherent in Knowledge based view (Foss, 2005). The framework could open a completely new frontier of possibilities to predicting cluster range of outcomes (performances, strategies, internationalisations etc) using certain predictors. Also the framework could be used in comparative studies for different clusters sharing certain similarity of specialisations. It has also contributed to the debate establishing a relationship between industrial clustering, entrepreneurship, and SME innovations (McCann, 2008; Breschi and Malerba, 2001; Mitra, 2000; Asheim and Geitler, 2006).

Conclusions and Regional Policy Implications

Clearly, the results have indicated that Ghanaian policy makers have not given adequate attention to the nature of socio-cultural and local knowledge of SME's. This fact has previously been identified in a study of SME's in other Sub Saharan African countries (Tukuori, 2007). Therefore, in terms of axiological value, this study could help guide policy makers in identifying priority aspects of innovative capability to be targeted. For example Ghanaian government could formulate policies addressing speed, frequency, diffusion, radicalness, and protection of innovations individually building overall innovative capability of clusters on one hand. On the other hand, a pragmatic approach could be adopted addressing overall innovative capability of a cluster concurrently.

To apply this framework a government has to consider her national innovation system and the stage of development of clusters in the region. In relatively mature economies such as UK, the innovation system encourages the diffusion of radical innovations across sectors (Pittaway eta l, 2004). In developing counties like Ghana having less sophisticated national innovation system and were the clusters are industrializing or striving to become innovative and full blown industrially (McCormic, 1999; Van Dijk and Sverisson, 2003) the policy implications are different. Two key policy concerns in such transitional clusters are as follows: the government should give emphasis on *Innovative protection* by regulating *copying and imitation* behaviour which discourages healthy diffusion of innovative activities; also *the* government should take advantage of reverse engineering activities to *diffuse* new technologies adapted by some firms in the cluster.

Thus, from the above it can be concluded that although, it is knowledge networks that overwhelmingly contributed to the overall innovative capability of the cluster, also transactional and social networks are very vital when individual dimensions of innovative capability are considered. This has important policy implications regarding the priorities to be pursued by Ghanaian policy makers. Practically, more investments in the development of local knowledge and institutional support for effective governance would help towards the cluster development.

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Appendix A: Descriptive Statistics and Cronbach's Alpha Tests

	Mean	Std. Deviation	Cronbach Alpha
TRANSACTIONAL NETWORK			.763
My firm networks with other firms in the designining and manufacturing of products	3.9897	.91044	
My firm subcontract (form network with other firm's so that they can produce on our behalf)	3.2216	1.15051	
Subcontracting (making other firms to produce some aspects of our products) enable my firm to concentrate	3.6082	.95556	
We only subcontract (engages other firms to produce some aspects of our products) due to limited financial resources	3.8196	.92374	
We only subcontract (engage other firms to produce some aspects of our products) where they are more knowledgeable	3.9175	.95136	
My firm subcontract (engages with other firms to produce some aspects of our products) because they have better physical assets, equipments or facilities	3.8660	.95634	
My firms rights when engaged in a manufacturing transaction are governed by a third party (lawyers/accountants)	2.1289	.88094	
My firms rights in a manufacturing transaction is governed by norms of mutual understanding	4.2165	.90739	

	Mean	Std. Deviation	Cronbach's Alpha
SOCIAL NETWORK			.595
My firm establish networks with other firms based on trust and cooperation	4.3627	.63168	
Trust and cooperation between my firm and other firm's encourages mobility (eg exchange of engineers or technicians)	4.2539	.69432	
Trust and cooperation between my firm and other firms encourages the exchange of engineers and technicians	4.1762	.65356	
Trust and cooperation between my firm and other encourages the sharing of physical assets, equipments, or facilities	4.1969	.69417	
Trust and cooperation between my firm and other firms facilitates the informal exchange of information and knowledge	4.1347	.63121	
Lack of trust between firms has discouraged the capability to learn from each other	3.3627	1.14248	
The common culture of copying and imitating from each other discourages innovations from thriving	2.8549	1.05064	
Social and cultural barriers prevent my firm from adopting new technologies	3.2124	1.19524	

	Mean	Std. Deviation	Cronbach's Alpha
KNOWLEDGE NETWORK			.624
My firm establishes network with universities research centres and science laboratories	2.3763	1.22057	
My firm establishes network with local and governmental institutions in the region	2.6186	1.27506	
My firm establishes network with foreign partners	1.8557	.80142	
My firm engages in formal routine inter firm knowledge exchange activities	3.6546	.87528	
My firm establishes a long lasting network with customers and suppliers	4.2423	.61759	
My firm actively engages in inter firm interactions to create and transfer specialised knowledge (eg technical knowledge)	4.0361	.80396	

	Mean	Std. Deviation	Cronbach's Alpha
OVERALL CLUSTER INNOVATIVE CAPABILITY			.716
My firm normally innovate new products that are radically different from other firm's	3.73711	1.022019	
My firm frequently innovate spare parts and other products	3.77320	.887509	
The length of time between one type of innovation to another in my firm is very quick	3.47938	1.102088	
New innovations diffuse to other firms quickly	3.83505	.906858	
Our innovations enjoy protection by the laws	2.66495	.908286	

Appendix B: Pearson's Correlation Matrix

		Overall innovative capability of the cluster	Total Transactional Networks	Total Social Networks	Total Knowledge Networks	Investments on knowledge sharing routines	Risk Taking	Unused Capacities	Local Knowledge	National Innovation Policy
Pearson Correlation	Overall Cluster Innovative Capability	1.000								
	Total Transactional Networks	-.029	1.000							
	Total Social Networks	-.117	.263**	1.000						
	Total Knowledge Networks	.470**	.135	.157*	1.000					
	Investments on knowledge sharing routines	.372**	.143*	.229**	.524**	1.000				
	Risk Taking	.120	.216**	.417**	.324**	.120	1.00			
	Unused Capacities	.113	.244**	.328**	.356**	.297**	.576**	1.000		
	Local Knowledge	-.183*	.183*	.416**	.268**	.108	.273**	.412**	1.000	
	National Innovation Policy	.429**	.226**	-.211**	.374**	.166*	.220**	.479**	.149*	1.00

**. Correlation is significant at the 0.01 level (2 -tailed)
*. Correlation is significant at the 0.05 level (2-tailed)

Appendix C: Hierarchical Multiple Regression Results

MODEL	B	SEB	Beta	Sig	R Square	R Square change Values
STEP 1					26.8%	.260
(Constant)	2.901	.428		.000		
Total Transactional Networks	-.055	.073	-.049	.457		
Total Social Networks	-.284	.101	-.184	.005		
Total Knowledge Networks	.591	.074	.505	.000		
STEP 2					36.2%	.102
(Constant)	3.225	.417		.000		
Total Transactional Networks	-.057	.070	-.051	.413		
Total Social Networks	-.224	.111	-.145	.045		
Total Knowledge Networks	.507	.087	.434	.000		
Investments on knowledge sharing routines	.119	.044	.199	.007		
Risk Taking	.058	.049	.092	.243		
Unused Capacities	.019	.064	.024	.763		
Local Knowledge	-.234	.057	-.286	.000		
STEP 3					45.9%	.096
(Constant)	2.349	.414		.000		
Total Transactional Networks	-.151	.067	-.134	.025		
Total Social Networks	.089	.116	.057	.448		
Total Knowledge Networks	.380	.084	.325	.000		
Investments on knowledge sharing routines	.128	.041	.214	.002		
Risk Taking	.057	.046	.090	.215		
Unused Capacities	-.148	.066	-.184	.026		
Local Knowledge	-.249	.053	-.305	.000		
National Innovation Policy	.418	.073	.427	.000		

a) Dependent Variable: Overall Innovative Capability

Appendix D: Standard Multiple Regression Results

	B	SEB	Beta	Sig	R Square
Innovative Radicalness					17.1%
Constants	3.357	.699		.000	
T_Transactional Network	-.168	.120	-.097	.163	
T_Social Network	-.347	.165	-.145	.037	
T_Knowledge Network	.725	.121	.402	.000	
Innovative Frequency					22.2%
Constants	3.938	.588		.000	
T_Transactional Network	-.079	.101	-.052	.436	
T_Social Network	-.538	.139	-.260	.000	
T_Knowledge Network	.675	.102	.431	.000	
Innovative Speed					24.5
Constants	3.866	.719		.000	
T_Transactional Network	-.008	.123	-.004	.948	
T_Social Network	-.808	.170	-.314	.000	
T_Knowledge Network	.844	.125	.434	.000	
Innovative Difussion					13.5%
Constants	1.345	.634		.035	
T_Transactional Network	-.203	.109	-.132	.063	
T_Social Network	.537	.150	.254	.000	
T_Knowledge Network	.392	.110	.245	.000	
Innovative Protection					21.6%
Constants	3.538	.708		.000	
T_Transactional Network	.559	.121	.309	.000	
T_Social Network	-.976	.167	-.393	.000	
T_Knowledge Network	.361	.123	.192	.004	

Dependent Variable: a) Innovative Radicalness b) Innovative Frequency c) Innovative Speed d) Innovative Diffusion e) Innovative Protection