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Policy Issues of e-Commerce Technology Diffusion in Southeast Nigeria: The Case of Small Scale Agribusiness

Aleke Bartholomew¹, David Wainwright² and Gill Green³

ABSTRACT

The benefits brought about by the emergence of e-commerce, e-business and other Information Communication Technologies (ICTs) applications have not been fully explored in the developing economies of the world. The less developed economies are still struggling to catch up with ICT application as opposed to its heavy deployment in the developed economies.

Empirical evidence suggests that ICTs and other related technologies are increasingly emerging in the communities of the developing economies such as Nigeria. Rural actors engaged in the Agricultural industries (Agribusiness) feel that the implementation of ICTs can influence the development of new business processes and the way existing processes are organised. In the Southeast of Nigeria, which is a typical example of a less developed community, the impact of e-business technologies has yet to be determined.

This paper identifies two classical traditional agribusiness supply chains and hence reports on the impact of e-commerce technology diffusion along the equilibrium of the supply chains, focusing on the elimination of intermediary actors from the chain. It provides an assessment of the Governments' policies and strategies on e-commerce adoption for the sustainability of small-scale agricultural businesses.

The paper examines the politics surrounding ICT implementations by actors engaged in the agribusiness sector. This research has motivated The South East State Government, in collaboration with the Federal Government, to give closer attention to their earlier policy of making Nigeria an ICT-enabled country.

Keywords: E-commerce, E-business, Agriculture, Southeast Nigeria, Innovation Diffusion

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INTRODUCTION

South-eastern Nigeria where this study was conducted has a population of about sixteen million people (Federal Republic of Nigeria, 2007). It is primarily an agricultural region, with the vast majority of the population being rural. South-eastern Nigeria is the region with the highest population density in the country. For this reason, the region is engaged in more intensive farming than other regions in the country (Okafor, 1986). It also has relatively to other regions in the country, a higher proportion of SMAEs, although its operators compared to entrepreneurs in other countries expend fewer hours in their businesses (Benzing and Chu, 2009). Studies by Awoke and Okorji (2004), estimate that as much of 85% of the agricultural community in this region can be classified as SMAEs. This is slightly higher than Nigeria's national average of about 70%.

This study is seen as essential because of the change in focus of entrepreneurship research from concepts relating to definitions of the entrepreneur towards an articulation of the constituent parts of entrepreneurial context and process (Ucbsaran *et al.*, 2001), which forms of crucial element of entrepreneurial studies with a high family impact (Klyver, 2007).

ICT Adoption by Small Scale Agribusiness Enterprises

Similar to other business ventures, SMAEs do face similar challenges that are associated with parameters such as financial constraints and dramatic changes in ICT. For this reason, decisions on how to embrace, utilize and exploit ICT can seriously impact on the viability of any SMAEs.

Literature has already established two crucial facts. In the first place, without innovation, the existence of any enterprise can only be regarded as temporary (Schumpeter, 1934). The second is that although ICT (as a crucial innovative parameter), plays a monumental and significant role in the viability of enterprises (Zahra, 1996), the rate of ICT adoption for Small Scale Agribusinesses (SMAEs) appears substantially less than other SMEs (Warren, 2004).

Studies on the adoption of ICT are complimentary to numerous disciplinary antecedents ranging from marketing, agronomy and agriculture (see Warren, 2004), to entrepreneurship (see Lawson *et al.*, 2003; Jones *et al.*, 2003; Matlay and Addis, 2003). Based on this, the rationale of this study is embedded on four arguments:

- The psychology of farming (see Richards, 1973) which argues the need for an emphasis on enhancing the vocational psychology of agriculture in areas such as openness to new ideas in areas such as ICT.
- That majority of ICT adoption studies appear to focus on 'adoption rate'.
- The role of ICT in agricultural development cannot be overemphasized. Activities such as market transactions cannot take place without ICT.
- Agric-based ICT adoption levels in developed countries much higher than those of developing countries. A plausible explanation of this according to Lio and Liu (2006), is the lack within developing countries for ICT adoption parameters such as human capital and a lack of supporting infrastructure. The reality however is that empirical evidence from few studies that have explored ICT adoption by Small Scale Agribusinesses (SMAEs) in developing countries such as Nigeria (Okafor, 1986; Polson and Spencer, 1991; Oladele and Fawole, 2007), do provide evidence to imply that ICT adoption does in fact have significant national economic and development benefits.

This study is therefore seen as important, especially when taken into the context of earlier work by Rogers (1995) and Venkatesh *et al.* (2003) which highlight how crucial it is to understand ICT adoption within national cultures.

A Conceptual Framework for *Agripreneurship*

From a classical perspective, within Entrepreneurship scholarship, there is still an on-going debate about the exact definitions of an entrepreneur (Hartman, 1959; Carland *et al.*, 1984; Parker, 2006). We have

however adopted a perspective of the entrepreneur as a business owner who is self employed and seeks to create wealth. This conceptualisation enables this study to incorporate small business owners of agribusinesses into the entrepreneurial context (what we have termed as *Agripreneurship*).

Choosing an appropriate conceptual foundation to examine ICT adoption within the context of SMEAs is difficult due to the existence of many competing adoption frameworks (see Rogers, 1995; Kautz and Larsen, 2000; Baskerville and Pries-Heje, 2001; Mustonen-Ollila and Lyttinen, 2003). This study is however based on three frameworks (see Table 1.0 and Figure 1.0, below).

Table 1.0, Research Framework

Framework	Key Consideration	Impact on Study
Rogers (1995)	considerations of the context and content of innovation	Enables insight into the complexities of ICT adoption.
Kautz and Larsen (2000)	The decision to partly adopt this framework was based on the fact that this framework moves slightly away from the classic diffusion process which has been criticised for its sequential nature and accompanying high level of instrumentality.	Appears to emphasise communication between actors during adoption. This was of interest to our research as a key element resided on an exploration of patterns of communications and relationships between actors in ICT adoption in Nigerian SSAs.
Gallivan (2001)	Utilises well-explained approach to explore how contingent authority impacted on ICT adoption.	Although this will be shown to not necessarily be the case, our study argues that the high level of 'encouragement' by both government and non-governmental organisations (NGOs), in the forms of rewards for ICT adoption by SSAs could be construed to represent a form of contingent authority forcing through the adoption of ICT.

This study contributes to the ever developing theory of *Agripreneurship*. Over the last few years, to enhance research viability and rigour, we have seen scholars (see Singh and Krishna, 1994; de Lauwere, 2005), adapting theories applicable to the general area of entrepreneurship and applying them to the study of the agricultural entrepreneur, although in some cases grounding of these theories are in are grounded in alternative business and management disciplines.

The authors are of the opinion that this study contributes to this learning culture. This is achieved by bearing in mind earlier work by Zahra (2007), who highlights the need to incorporate detailed and intimate exploration of unique contextual scenarios in entrepreneurship studies. In this case, this is achieved by adopting a philosophical position firmly rooted in social *constructionism* (Burr, 1995), which is popular in ICT research (see Mitev, 2005). Such an approach enabled the development of social realities that are derived from the entire environmental context of which the study is conducted within.

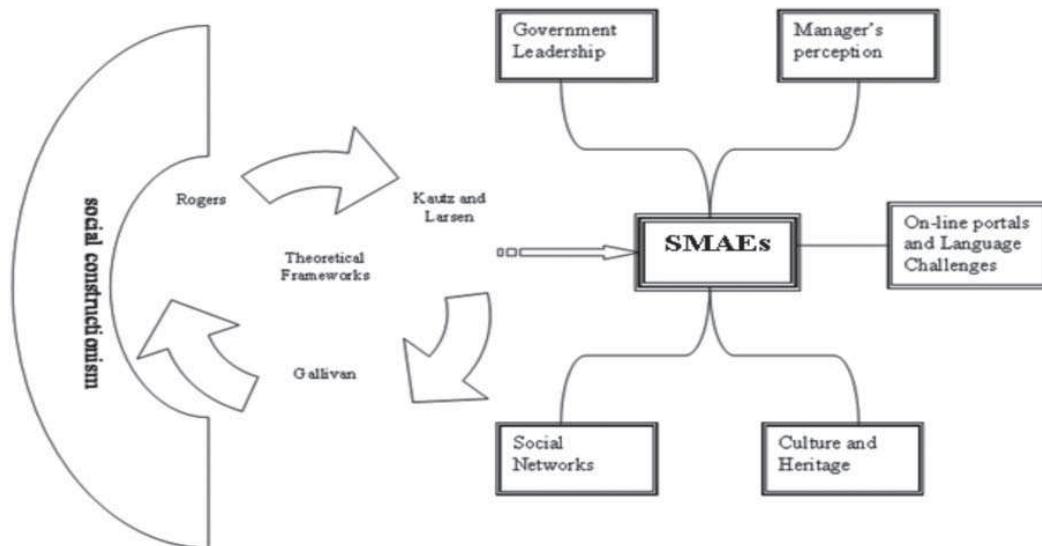


Figure 1.0, Research Philosophy

Although there is a strong tradition in using questionnaires in entrepreneurship research (Schad, 2009), in this study, we used a focus group to gather data. As a research methodology, Focus groups have been successfully used in *Agripreneurs*hip research (see Brandth, 1994; Goldstein and Udry, 2008). In particular, Focus groups are known for their ability to stimulate interaction between group members. The use of focus groups in this study ensured that conceptualisation of phenomena being discussed was captured (Stewart and Shamdasani, 1990).

AGRICULTURAL MARKETING AND E-COMMERCE DEVELOPMENT IN SOUTH EAST NIGERIA

The history of agricultural marketing in Nigeria shows that the British government created a national marketing board in 1946, immediately after the Second World War. (Ubakamma 2000) The Board has undergone a series of changes but the primary objective for its creation remained:

- Purchase the produce from rural farmers and export to the western world. In other words provide ready markets to the farmers.
- Appoint and issue licence buying agents who then buy from the real farmers, store produce for them and transport it to ports in readiness for export by the marketing board.

Hence the licensed buying agents were acting as intermediaries where they were responsible for stabilizing the price of commodities.

Before the deregulation of the Nigerian economy this Board held massive responsibility for marketing agricultural produce – controversially, the farmers are still impoverished. Recently more effort has been channelled towards finding more effective solutions to agricultural marketing.

Government initiatives have resulted in the realisation of improved yields of agricultural produce such as rice, maize, vegetable, cassava, fish, livestock etc. This increase in production has compounded further the marketing problems in the agricultural sector (Obamiro *et al* 2003). According to Obamiro *et al* (2003),

marketing the produce has remained problematic to these rural farmers who are hindered by poor support services such as: poor road networks, inadequate storage facilities, skeletal tractor hiring services, and more especially access to market information. Gambo (2002) pointed out that whilst these problems were identified long ago they still persist. Therefore a clarion call for the process re-engineering of Nigerian agricultural marketing has been made in order to emancipate the rural farmers. He further suggested that integration of e-commerce into agricultural marketing may likely be the answer to these persisting problems.

Prior to the advent of e-commerce, agricultural produce has been solely marketed and exported traditionally from the market niches and through the Agricultural Marketing Board. Both Oluyemi and Roberts (1981) and Olayide and Idachaba (1985) have pointed out that although this marketing board helped to develop Nigerian agricultural commodities for local and export markets, the Board suffered setbacks and the agricultural commodity markets experienced failures which ultimately led to the scrapping of the Board. The major problems as outlined by Ubakamma (2000) were

- Inability to widen the market
- Non uniformity in taxation
- Prices were set before harvest and as such may fall above or below the margin
- Misuse of reserve funds
- Political instability and politics within the frame work of the board itself

Following the dissolution of the marketing board the next trend in agricultural marketing in Nigeria was the birth of commercial agricultural SMAEs known as Licensed Buying Agents (LBA) and Un-Licensed Buying Agents (ULBA). These SMAEs which had structures of co-operative societies took up similar functions to those of the marketing board (Okunmadewa 1999), especially in the arrangement for the purchase and onward export of agricultural produce, development and rehabilitation of commodity producing areas or the market niches, maintenance of grade standard on exported produce and the stabilization of producer prices through minimum pricing scales. The persistence of problems in agricultural commodity marketing despite the existence of these LBAs and un-LBAs gave rise to the uptake of electronic mediums for agricultural marketing (e-commerce).

In June 2005 there was a strategic inflection point in the uptake of e-commerce in the launch of cash card by Standard Trust Bank Nigeria plc. As rightly put by the CEO of this bank;

"In its determined effort to bring banking convenience to Nigerian traders across the country, particularly the petty traders and the rural community who are predominantly farmers, Standard Trust Bank Nigeria plc one of the leading banks will formally launch its brand of Master cards, credit cards and Maestro debit cards today". (This Day Newspaper, Tuesday June 14 2005)

Another strategic policy, according to Adubi and Okummadewa (1999), was the launch of a mobile Internet unit (MIU). This policy and the implementation of the project is to enable the nomadic farmers, whose settlement is always outside the urban cities, the opportunity to access market information for their live stock market. The mobile internet unit is a motor van with computers and internet facilities installed. The van is taken to strategic centres in the remote villages where the nomadic farmers camp. Such nomadic farmers will be offered training to enable them to access the Internet and to therefore take advantage of e-commerce technology in marketing their livestock.

RESEARCH METHODOLOGY

This study was informed by the social constructionist stance (Crotty 1998). The constructionist as opposed to the positivists, according to Crotty, believes that "meaning" or "value" can be constructed from interplays of actions may be as result of long standing or cognitive experience instead of trying to discover through scientific experiments "meaning or value" as an existing discrete object

The exploratory method suggested by Miles and Huberman (1984) was adopted to frame the main factors influencing the owner-managers decisions on implementing e-commerce technologies, including their future intentional use. The data analysis undertaken was based on Template analysis (King 2004). Where according to King;

"The essence of template analysis is that researchers produce a list of codes representing themes identified in their textual data. Some of these, will be identified a priori, they will be modified and added to as the researcher reads and interprets the text", see appendix 1 for the themes.

The advantage of template analysis is that it allows the researcher to develop codes that are relevant to the particular study instead of being unnecessarily generalistic in approach. It works well when comparing the perspective of different individuals within a unit or individual units within a social context (King 2004). The template is comprised of the pre-defined codes. King (2004) pointed out that template should be moderate not being too ambiguous or too marginal, otherwise it will prevent exploration of more pertinent issues. The initial codes developed are as shown in appendix 1.

Firstly we consulted the Ebonyi State Federation of Cooperatives asking whether the organisation would be willing to serve as a commissioned partner for the pilot study. This organisation monitors the activities of Agricultural SMEs in Ebonyi State. Ebonyi state is one of the states in Southeast Nigeria where the study was conducted. It is currently coordinating the Ebonyi State-UNIDO ICT centre project. The IT centre is a project designated to enhance ICT in agribusiness across the Southeast Nigeria, helping the SMEs to get connected and do business online. The aim is to extend Internet connectivity to more remote villages where the SMEs operate. The management of the commissioned organisation required a copy of our research proposal, which was eventually given to them defining our sample frame.

The Focus Group

It was important to select a focus group that represented key actors that would positively contribute to the research. For this reason, only SMAEs that fitted the below profile (See Table 2.0, below), were contacted:

Table 2.0 Desired Focus Group Profile

Criteria	Detail	Measure
Collaboration	Demonstrated willingness to collaborate	e.g. with other SSAs, institutions etc
ICT Use	Demonstrated an ability to use ICT	Using presence in the government launched website as our criteria, or advertising in other websites.
Involvement	Had previous involvement in specific ICT projects and initiatives such as the Ebonyi- UNIDO IT project.	Has previous involvement in specific ICT projects and initiatives such as the Ebonyi-UNIDO IT project.

Based on these criteria, the following organisations and institutions formed part of the focus group:

- SMAEs
- Ebonyi State Federation of Cooperatives
- Department of Agricultural Economics, Ebonyi State University.

- Federal Ministry of Commerce and Industry.
 - UNIDO (United Nations Industrial Development Organisation)
 - South East Nigeria Chambers of Commerce
 - The World Bank Agricultural Development Programme.
 - Nigerian Agricultural, Cooperative and Rural Development Bank South East Regional Office, Enugu.
- Focus groups usually consist of between five and twelve group members (de Ruyter, 1996). An abridged version of the five step focus group process (de Ruyter, 1996), was adopted. This involved:
- Step 1: Presentation of study topic to group by moderator (the lead researcher in this study). Moderator also ensures participants were fully aware of the objectives of the session through brief clarifications.
 - Step 2: Participants are randomly asked to identify parameters that have impacted agricultural ICT adoption in Southeast Nigeria. Each participant was asked to put forward one parameter at a time.
 - Step 3: Recordings of all parameters are on a white board. Exercise was repeated until all participants had exhausted their list. To ensure process control and integrity of ideas, no discussions were allowed during this session.
 - Step 4: Moderator reviews all identified parameters. Duplicates are eliminated from the list.
 - Step 5: Participants identify top parameter and record (see Table 3.0, below).

FINDINGS

A total of five parameters (representing the five highest scoring factors impacting ICT adoption/Diffusion in Southeast Nigeria, were identified. These parameters include Social Networks, Culture and Heritage, Government Leadership and Intervention (incorporating Availability of Credit Facilities and Legislation), Manager's perception and finally On-line portals and Language Challenges

In our study, we found composition of the social network being made up of groups such as the Abakaliki Co-operative Farmers Society which is a long standing co-operative society and the Rice Millers and Marketers who form the Rice Millers Association. Other members of this network include the Timber Dealers Association (with offices in the Enugu) and the Small Quarry Industry Cooperative (an organisation representing stone crushers), Table Salt, Palm and Vegetable Oil Co-operatives (mainly representing producers and sellers in the South-eastern state of Abia) and Poultry Cooperatives in surrounding villages.

Another very sensitive parameter which was identified as having a major impact on the success of ICT adoption within Southeast Nigeria is related to culture and heritage of the predominant ethnic (The Igbo), grouping in the Area. Specifically, the focus group were mainly of the opinion that their cultural and social heritage had influenced their openness to new ideas in the area of technological innovation.

We found evidence that partly due to the crucial role of the agriculture industry in Southeast Nigeria, the state governments continue to play the most crucial role in developing and supporting agribusiness ventures in the state. This interest however no doubt leads to SMEs operators facing challenges of not only how to engage government in partnerships without losing control of their business agenda which is as for all financial (Benzing and Chu, 2009), but also how to successfully contend with adopting externally driven ICT (Zahra, 1996).

The state government has for example established a state agricultural development programme. This programme has amongst other initiatives sought to improve agricultural production output through for example a recent (September 2008), production ICT training initiative with the United States Agency for International Development (USAID).

State Government intervention in terms of the facilitation of ICT diffusion has also been manifested by

Table 3.0, Factors impacting ICT adoption/Diffusion in Study Area

Theme	Role: Owner-Managers	Role: Marketing Managers	Role: Field Workers
Innovation	Mobile technology New use of bar-coding machine Internet and websites Relationships Prodigy and Heritage Managers view	Internet Mobile Technology The Community Norms Website Adverts E-mail Culture	Computers What managers see
Task	Management decisions Team Building Networks Culture of the community Perception of owners	Market coordination Interfacing with Managers Interface with other farmers Our heritage Templates	Farm records [diary] Manual labour Relationships with other farmers
Individuals	De-skilling/ re-skilling Targeted better livelihood through larger sales Community More financial incentives	E-mail at work Limited networks Limited training poor financial incentives Owners view	under-employment of labour Language Networks Managerial perception
Environmental	No real understanding of strategy Culture In-security of properties The community Instable government policies Limited communication Infrastructure Cost of consultancy Language	No real understanding of strategy Less culture of knowledge sharing Challenges to Norms	Limited understanding of business strategies
Organisational	SME-Owner manager Networks Heritage Change in response to new technologies Managers perception	No real team working No real sharing of experience Community Practices New work related skill [Computer literacy] Community	New labour wage Direct access to Communication Managers experience

Table 4.0, Overview of Nigerian SMEs by Region (Oseni and Winters, 2009)

	Nigeria	South-South	South-east	South-west	North-central	North-east	North-west
Household Characteristics							
Average household size	6.7	6.2	5.8	4.8	6.5	7.2	7.5
Average age of household head	48.5	49.8	54.8	53.3	44.7	45.4	46.9
Female headed household (%)	8.0	17.2	22.7	10.8	3.1	2.5	0.5
Average household labour (ages 12–60)	3.8	4.0	3.6	2.6	3.7	3.9	3.9
Average highest household education	7.2	9.9	10.0	7.6	7.3	5.5	5.6
Average wealth index	-0.08	-0.03	0.38	-0.09	-0.21	-0.22	-0.20
Land							
Own land (%)	76.5	62	72.1	62.4	74.0	82.8	85.3
Value of land owned (thousands of Naira)	93.7	71.3	131.0	103.1	110.7	67.9	90.8
Instruments							
Participation in community projects (%)	43.2	54.3	48.8	35.6	56.2	37.7	34.3
Literacy rate (ability to read English)(%)	33.1	59.8	57.2	37.6	38.4	22.5	11.2
Migration network (%)	1.5	2.7	4.5	1.5	0.9	0.6	0.2
Agricultural Production							
Average crop expenses	5,633	3,116	3,245	6,143	7,240	5,714	7,387
Income Generation							
Average household annual net income (naira)	126,895	125,317	113,782	94,700	143,390	126,227	133,374
Average household annual net farm income (naira)	92,534	64,903	52,830	68,387	125,451	99,902	112,988
Average household net nonfarm income (naira)	34,361	60,414	60,951	26,313	17,939	26,325	20,386
Nonfarm wage employment (%)	6.8	13.0	11.5	2.7	4.3	5.6	3.8
Nonfarm self-employment (%)	17.1	19.5	24.1	16.8	5.9	14.5	18.2
Transfers (%)	5.5	8.2	10.5	7.5	3.8	4.0	2.7
Other (%)	5.5	4.9	6.8	8.0	3.1	6.2	5.2
Any nonfarm activity (%)	30.7	42.2	40.4	35.1	17.2	26.5	27.1
Number of households	11,788	1,708	2,040	776	1,671	2,585	3,008

the provision of a Mobile Internet Unit (MIU) to serve the Nomadic Farming Community. The MIU is a motor van built with desktop computers (connection is via Satellite dish mounted on the van for signals). Mobile Internet Units (MIUs), are innovations which emerged from the *techmobile* concept which has been made popular in rural parts of the US.

The use of these MIUs in the region has enabled local SMAE owners to exchange instant market information about cattle a scenario. The decision to make a journey (which can be expensive, especially when transporting livestock), is negated or at least only absolutely necessary when there is a high probability of a sale. The government has also sought to intervene in the industry through both the provision of credit facilities and also through legislation.

The focus group were asked how they perceive ICT and whether they would like to deal directly with customers instead of routing them through intermediaries. The result was encouraging even though they created an impression that ICT is only suitable for large organisations. The majority of the respondents were positive about the adoption of ICT provided the following were addressed:

- Privacy and security of their business transactions are assured.
- Internet service providers are readily available.
- Costs of web-based operations are less than those of traditional ways of doing business.
- Managing online customers are easier and safer.
- Speed and reliability (broadband or dial-up connectivity).
- Training on knowledge and competence was available.

These factors create a picture of what constitutes the barriers to diffusion and implementation of the application of ICT into agribusiness.

The persistence of problems in the country's agricultural commodity market (despite the existence of these cooperatives) is one of the contributory factors that led to more interest in electronic mediums for agricultural marketing. The portals in existence include the e-cattle programme (Olatubosun, 2007), which seeks to enable nomadic farmers (whose settlement is always outside the urban cities), to access markets outside their traditional trade paths.

Although plagued by constant service failures, at the time the research was being conducted, www.ebonyionline.org was one of the few online portals available for SME owners in Nigeria. It was also the only one dedicated to SMAE owners in the South-eastern part of the country. The site was launched in early 2005, the objective being to facilitate the auctioning of agricultural products such as, special animal breeds and hybridised crop species. In addition, the portal was meant to enable relevant information of interest to the agricultural community to be disseminated. Initial usage of the site was however mainly administrative. For example, the various SMAEs used the website as a portal to facilitate their communication. As a majority of Nigerian's do not have access to the internet (Ajayi *et al.*, 2008), access to this online portal was primarily provided by the establishment of a Tele and Technology Resource Centre (The UNIDO-Southeast Nigeria Tele and Technology Resource Centre), a ICT-based community centre established in designated areas within Southeast Nigeria farming communities. These centres provided telecommunications and Internet connectivity and access not only to the Farming community, but also to other users

Discussions

The following section of the paper explores the theoretical concepts which support the findings of the study.

Social networks fundamentally represent conscious, interdependent and cooperating partnerships (Dennis, 2000), in areas such as costs sharing, storage and marketing. In agriculture, social networks can be used for the generation of trust (McDade and Spring, 2005) and knowledge (although research does indicate

that past experience rather than new information has a greater role to play in entrepreneurial learning, see Parker, 2006 for further details), in diverse areas such as ICT (Conley and Udry, 2001). Over the years, additional studies have also demonstrated that not only do social networks directly impact entrepreneurial activity (Zahra and Bogner, 2000; McCarthy and Torres, 2005), but that also that social networks do positively impact on ICT innovation adoption in farming communities (Warriner and Moul, 1992). This has lead to a thesis being put forward that entrepreneurship is not only embedded in a social configuration (Jack and Anderson, 2002), but that such networks do create viable transformational learning opportunities for agricultural enterprises (Pyysiainen *et al.*, 2006).

Earlier entrepreneurial studies (Benzing and Chu, 2009), with a regional focus have demonstrated that entrepreneurial motivation and as attitudinal constructs vary across ethnic, national and cultural boundaries. For the Igbo's who are the predominant ethnic grouping in Ebonyi State, cultural premiums on entrepreneurial ingenuity (Okafor, 1986), are seen to be as a result of various socio-political factors such as a lack of traditional social hierarchies (Brautigam, 1997), perceived marginalisation (Nnadozie, 2002) and difficulties of integration which arose after the Biafran war. These factors have encouraged people from this region to seek livelihood outside traditional domains. Manifestation of this trend is demonstrated both by a high migration rate and also by a high proportion of people from this area that seek non-agricultural forms of self-employment (see Table 4.0).

A number of researchers (see Nnadozie, 2002; Chavan and Agrawal, 2002), have explored the wider concept of how culture and ethnic peculiarities impacts on entrepreneurial behaviour. For example, Chavan and Agrawal (2002), found a beneficial relationship existing between ethnic entrepreneurial activity and the productive use of parameters such as language and ethnic skills. Specific studies have focused on cultural facilitated entrepreneurship of Igbo's (Madichie *et al.*, 2008). Consistent with studies (see Nnadozie, 2002; Hoxha, 2009), that infer that the existence of informal networks amongst minority and marginalised entrepreneurs creates more access to facilities such as credit and ICT, scholars such as Nnadozie (2002), attributes this factor as directly responsible for the growth of Igbo entrepreneurship in Nigeria in areas such as ICT. Empirical evidence however remains mixed. In the first place, there is the question in the mind of some scholars as to whether ethnically driven entrepreneurship emphasises innovation or imitation (Aldrich and Martinez, 2002). Secondly, there is a question as to whether such theories can be universally applied to people from specific ethnic backgrounds (Frederick, 2008). Evidence from these studies is closely aligned with studies which have focused on culturally driven entrepreneurship in the Igbo ethnic group (Madichie *et al.*, 2008).

In line with existing research (see Parker, 2006), the Nigerian government views information, training and awareness as a more effective means of improving the viability of SMEs as against simply awarding financial grants. For this reason, overall, there is no doubt that there is ample reason for the government (both the Nigerian Federal Government and the Southeast regional Government), to create an enabling legislative environment for the diffusion of ICT since both are stakeholders of diffusion.

The Nigerian government has maintained interest in Small Scale Agribusinesses primarily due to recognition of the crucial role of agriculture in national development (Abdu and Marshall, 1990). This is not surprising as there is a wealth of research which does demonstrate a relationship between entrepreneurial activity and national development within developing countries (see Satta, 2003). This interest can be traced from the creation of national marketing boards (Olayide *et al.*, 1974), to the provision of a legal framework which has encouraged the establishment of commercial agricultural co-operative societies (Kyereboah-Coleman and Osei, 2008). For example, in Ebonyi, the State legislature is making efforts to ensure that legislation enabling women to obtain title deeds to land is enforced (Toulmin, 2009), which is not surprising when one notes that the allocation of property rights does impact on entrepreneurship (Hellman, 2007). Recently, the government has also sought to enhance the legislative environment through provision of a regulatory framework that seeks to harmonise different approaches to tax regulations.

In the past, debates on the implications of financial constraints have served as a basis for various governments to justify intervening in policy that seeks to foster entrepreneurial activity (Minniti and Levesque, 2008). The Nigerian government recognises the need to provide bank credit (de Bettignies and Brander, 2007), and has in response established the Nigerian Agricultural, Cooperative and Rural Development Bank (NACRDB). Access to bank finance, as agains venture capital which can result in loss of business independence (Ueda, 2004; de Bettignies and Brander, 2007), remains a fundamental challenge of most SMAEs operating in Nigeria (Jabbar *et al.*, 2002). The impact is particularly challenging when it is taken into consideration that majority of SMAEs are family based (Ejemb *et al.*, 2006), and are as a result like most family based SMEs will most likely utilise family resources to finance their ventures (Wiborg and Landstrom, 2001).

Similarly, this remains the case in an agricultural context (see Jarvis, 1990). With this in mind, we observed the emergence of two categories of SMAE owner-managers during the focus group. For the purpose of the study, we have classed the managers as 'Assumed Manager' and 'Heritage Manager'. What we did observe during the focus groups is that the assumed managers appeared to have become part of the SMAE through some form of 'official' employment. Often (but not always), the assumed managers had secured their position was based on professional competency (supported by complementary academic qualifications). The second group of managers we identified as part of the SMAEs we classed as 'Heritage Managers'. In contrast to 'Assumed Managers', who were generally more educated, 'Heritage Managers' who represent the dominant element of SMAE operators (Venter *et al.*, (2006), by virtue of inheritance of land holdings (Oseni and Winters, 2009), were more resistant to ICT adoption. To an extent our observations is in line with existing theory which highlights the importance of socio-economic factors such as level of education in ICT adoption (Lio and Liu, 2006).

We could argue that the establishment of a SMAE owners dedicated website, although used by the social network primarily for the exchange of e-mails, was a success in various ways. In the first place, although illiteracy levels (see table 4.0, above), of Nigerian SMAE operators in South East Nigeria are high (Oseni and Winters, 2009), the demand for this service was high primarily as a result of a successful training programme funded by UNIDO and the state government at the Centre for Small Industry and Research Development (CENSIRT). This centre was established in 2001 to enable the SMAE owners to be exposed to the use of computers – at least to the extent of sending e-mail messages. The website also created an awareness of the potential of ICT among SMAE owners and other potential users of ICT who otherwise would not have been exposed to it.

According to the Chairman of the Abakaliki Rice Millers and Marketers Association,

"One good thing about these innovations is that it is making the local farmers (SMAE owners) appreciate computer usage even though they are not using it as business strategy yet"...,

The result of this interest in ICT by local SMAE owners is that commercial agents once seen as crucial in driving e-commerce adoption in developing countries (Duncombe and Molla, 2006), are now experiencing a reduction in the demand for their services. For example, according to a manager of the Commodity Trader SMAEs

"Since they brought this white man screen, our customers have learnt to sit down here in the van and be sending messages to farmers in the bush. They wouldn't allow us do it"...,

The use of online portals (and ICT diffusion) also faces challenges because of internet content language (Gyamfi, 2005). As mentioned earlier, literacy levels of Nigerian SMAE owners are quite low, meaning that SMAE owners are highly unlikely to take pioneering positions in ICT, although important changes are taking place in agriculture (for example the transition toward sustainable agriculture). The local language (Igbo), also appears non-existent on the Internet (Kenny, 2002). Since the majority of these SMAE owners do not speak, read or write good English, language barriers become a source of internet exclusion. Of course one way round this challenge is to promote the creation of web-portals in the local

language (Igbo). However, the reality is that although such attempts have been successful in a number of African languages such as Hausa and Swahili, creating such content is particularly difficult in the Igbo language due to its tonal nature and difficulties developing a standard dialect of the Igbo language (Liberman *et al.*, 1993). Overall, it is important to note that local internet contents do not exist for the majority of African languages (Gyamfi, 2005).

CONCLUSIONS

In this study, we drew on numerous literature to advance knowledge of existence of numerous parameters that impact on ICT adoption in Small and Medium Agribusiness Enterprises in Nigeria. In line with existing entrepreneurship theory (Warren, 2004), the human factor is being regarded as an essential element of ICT adoption in small scale agricultural businesses. The challenge for SMAE owners remains on how to make complex decisions under uncertainty. Long established as a key challenge in entrepreneurship (Casson, 2005), this scenario is particularly accentuated by the lower level of literacy of SMAE owners in Nigeria.

One of the key parameters that had a significant impact on ICT adoption in this study was the existence of interactions, referred to as social networks. These networks can create advantages for both individuals and social groups. These social groups appear to be particularly influential because of its inherent dynamic nature. This dynamism was particularly interesting when contextualised with the emergence of the 'Assumed' and 'Heritage' managers

It must be noted that although there is no doubt a growth in the number of initiatives being set up to facilitate ICT adoption and diffusion in Nigeria, the reality is that some of these initiatives are associated with challenging problems relating to a high level of technological skills required to operate them.

The results from this study already confirm previous research. For agribusinesses in Nigeria, evidence does indicate that translation of ICT into positive acquisition is highly dependent on parameters such as users needs and circumstances (Nweke and Akorhe, 1983), age and disposition of adopters (Polson and Spencer, 1991) and the perception of relevance (Oladele and Fawole, 2007). Our finding also supports a conclusion that access to agricultural markets and related improvements in rural infrastructure and marketing institutions are essential for adoption of the ICT and transformation of subsistence-oriented smallholder agriculture.

Future Implications for diffusion of ICT

Challenges remain in trying to influence the small and medium sized agricultural enterprises' perception towards the adoption and diffusion of ICTs for commercial purposes.

Firstly, within the context of this study, there is a need for more in-depth diffusion research to identify ways to eliminate the adoption barriers identified. Future papers will explain how the DoI research combined with technology acceptance models will be used to inform the complex diffusion process with respect to the implementation of ICT in agribusiness within developing countries.

Secondly, there is a need to address structural issues relating to road network and transport logistics problems. In that this study identified that the adoption of e-commerce technologies into business strategies is opening up significant problems in terms of transport and logistics for product delivery. By implication the adoption of e-commerce technologies should be a nested project with the widening of transport networks as well.

The findings of this particular research in Nigeria concur with the above assertions. Furthermore, to move website owners further towards Internet use, our research suggests that formal and informal grouping of SMEs be encouraged (community Action) because there is knowledge sharing when groups meet. Again an emphasis on social and business networking should shift from owner managers of SMEs down to Marketing secretaries who are more involved in the application of these ICTs for their daily tasks.

It is our belief that as the number of SMEs using websites for customer service and market research increase, it is likely that this will impact on their competitive advantage and further accelerate SMEs' customer relations. This will likely attract more customers to them and open larger markets for their products.

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REFERENCES

- Abdu, M and Marshall, R. (1985). Agriculture and development policy: A critical review of Nigerian experience in the period up to 1985. *Journal of Rural Studies*, Vol. 6, No. 3, pp. 311–323.
- Ajayi, A., Aderounmu, A., and Soriyan, H. (2008), 'Improving the Response Time of Online Buyers in Nigeria: The Way Forward', *Journal of Internet Banking and Commerce*, Vol. 13, No. 1, pp 1–10.
- Aldrich, H., and Martinez, M. (2002), 'Many are called but few are chosen: An evolutionary perspective of on the study of entrepreneurship', *Entrepreneurship Theory and Practice*, Summer, pp 41–49.
- Awoke, M., and Okorji, C. (2004), 'The Determination and Analysis of Constraints in Resource Use Efficiency in Multiple Cropping Systems by Small-Holder Farmers in Ebonyi State, Nigeria', *Africa Development*, Vol. 29, No. 3, pp 58–69.
- Baskerville, R., and Pries-Heje, J. (2001), 'Racing the E-Bomb: How the Internet Is Redefining Information Systems Development Methodology'. In B. Fitzgerald and N. Russo & J. DeGross (Eds.), *Realigning Research and Practice in IS Development: The Social and Organisational Perspective*, pp 49–68, New York.
- Benzing, C and Chu, H. (2009). A comparison of the motivations of small business owners in Africa. *Journal of Small Business and Enterprise Development*, Vol. 16, No. 1, pp. 60–77.
- Brandth, Berit. 1994. "Changing Femininity: The Social Construction of Women Farmers in Norway." *Sociologia Ruralis* 34:27–149.
- Brautigam, D. (1997), 'Substituting for the state: institutions and industrial development in eastern Nigeria', *World Development*, Vol. 25 No. 7, pp 1063–80.
- Burr, V. (1995), *An Introduction to Social Constructionism*, Pub. Routledge.
- Carland, J; Hoy, F; Boulton, W and Carland, J. (1984). Differentiating Entrepreneurs from Small Business Owners: A Conceptualization. *The Academy of Management Review*, Vol. 9, No. 2, pp. 354–359
- Casson, 2005 M. Casson, Entrepreneurship and the theory of the firm, *Journal of Economic Behavior and Organization*, Vol. 58, No. 2, pp. 327–348.
- Chavan, M and Agrawal, R. (2002), 'The changing role of ethnic entrepreneurs in Australia', *The International Journal of Entrepreneurship and Innovation*, Vol. 3, No. 3, pp 175–182.
- Conley, T and Udry, C. (2001), 'Social Learning through Networks: The Adoption of New Agricultural Technologies in Ghana', *American Journal of Agricultural Economics*. Vol. 83, No. 3, pp 668–673.
- de Bettignies, J and Brander, J. (2007). Financing entrepreneurship: Bank finance versus venture capital. *Journal of Business Venturing*, Vol. 22, No. 6, pp. 808–832.
- de Lauwere, C. (2005). The role of agricultural entrepreneurship in Dutch agriculture of today. *Agricultural Economics*, Vol. 33, No. 2, pp. 229–238

- de Ruyter, K. (1996), 'Focus versus nominal group interviews: a comparative analysis', *Marketing Intelligence and Planning*, Vol. 14, No. 6, pp 44–50.
- Dennis, C. (2000), 'Networking for marketing advantage', *Management Decision*, Vol. 8, No. 4, pp 287–292.
- Duncombe, R., and Molla, A. (2006), 'E-commerce development in developing countries: Profiling change-agents for SMEs', *The International Journal of Entrepreneurship and Innovation*, Vol. 7, No. 3, pp 185–196.
- Ejembi, E., Omoregbee, F., and Ejembi, S. (2006), 'Farmers' Assessment of the Training and Visit Extension System in Central Nigeria: Evidence from Barkin Ladi, Plateau State', *Journal of Social Science*, Vol. 12, No. 3, pp 207–212.
- Federal Republic of Nigeria. (2007), 'Federal Republic of Nigeria', *Official Gazette*, No. 24, Vol. 94, Pub. Federal Government Printer.
- Frederick, H. (2008), 'Introduction to special issue on indigenous entrepreneurs', *Journal of Enterprising Communities: People and Places in the Global Economy*. Vol. 2, No. 3, pp. 185–191.
- Gallivan, M. (2001), 'Organizational adoption and assimilation of complex technological innovations: development and application of a new framework', *Data Base*, Vol. 32, No.3, pp 51–85.
- Goldstein, M and Udry, C. (2008). The Profits of Power: Land Rights and Agricultural Investment in Ghana. *Journal of Political Economy*, 2008, vol. 116, no. 6, pp. 981–1022.
- Gray, C., and Gonsalves, E. (2002), 'Organizational learning and entrepreneurial strategy', *The International Journal of Entrepreneurship and Innovation*, Vol. 3, No. 1, pp 27–33.
- Gyamfi, A. (2005), 'Closing the Digital Divide in Sub-Saharan Africa', *Information Development*. Vol. 21, pp 22–30.
- Hartman, H. (1959). Managers and entrepreneurs: A useful distinction! *Administrative Science Quarterly*, Vol. 3, pp. 429–451.
- Hellmann, 2007 T. Hellmann, When do employees become entrepreneurs?, *Management Science*, Vol. 53, No. 6, pp. 919–933.
- Hoxha, D. (2009), 'The nature of entrepreneurship under extreme and marginalized conditions – the case of Kosova', *The International Journal of Entrepreneurship and Innovation*. Vol. 10, No. 1, pp 73–76.
- Jabbar, M; Ehui, S and Von Kaufmann, R. (2002). Supply and Demand for Livestock Credit in Sub-Saharan Africa: Lessons for Designing New Credit Schemes. *World Development*, Vol. 30, No. 6, pp. 1029–1042.
- Jack, S.L., Anderson, A.R. (2002), "The effects of embeddedness on the entrepreneurial process", *Journal of Business Venturing*, Vol. 17 No.5, pp.467–87.
- Jarvis, A. (1990). Computer adoption decisions. Implications for research and extension: the case of Texas rice producers. *American Journal of Agricultural Economics*, 1388–1394
- Jones, C; Hecker, R and Holland, P. (2003). Small firm Internet adoption: opportunities forgone, a journey not begun. *Journal of Small Business and Enterprise Development*. Vol. 10, No. 3, pp. 287–297.
- Kautz, K and Larsen, E. (2000), 'Diffusion theory and practice: Disseminating quality management and software process improvement innovations', *Information Technology & People*, Vol. 13, No. 1, pp 11–26.
- Kenny, C. (2002). Information and communications technologies for direct poverty relief: Costs and benefits. *Development Policy Review*, Vol. 20, No. 2, pp. 141–157.
- Klyver, K. (2007). Shifting family involvement during the entrepreneurial process. *International Journal of Entrepreneurial Behaviour & Research*, Vol. 13, No. 5, pp. 258–277.

- Kyereboah-Coleman, A and Osei, K. (2008). Outreach and profitability of microfinance institutions: the role of governance. *Journal of Economic Studies*, Vol. 35, No. 3, pp. 236–248.
- Lawson, R; Alcock, C; Cooper, J and Burgess, L. (2003). Factors affecting adoption of electronic commerce technologies by SMEs: an Australian study. *Journal of Small Business and Enterprise Development*, Vol. 10, No. 3, pp. 265 – 276.
- Lberman, M; Schultz, J; Hong, S and Okeke, V. (1993). The phonetic interpretation of tone in Igbo. *Phonetica*, Vol. 50, No. 3, pp. 147–160.
- Lio, M and Liu, M. (2006). ICT and agricultural productivity: evidence from cross-country data. *Agricultural Economics*, Vol. 34, No. 3, pp. 221–228.
- Matlay, H and Addis, M. (2003). Adoption of ICT and e-commerce in small businesses: an HEI-based consultancy perspective. *Journal of Small Business and Enterprise Development*. Vol. 10, No. 3, pp. 321–335.
- McCarthy, B., and Torres, A. (2005), 'A study of network typology in relation to the performing arts', *The International Journal of Entrepreneurship and Innovation*, Vol.6, No.3, pp 168–176.
- McDade, B and Spring, A. (2005). The 'new generation of African entrepreneurs': networking to change the climate for business and private sector-led development. *Entrepreneurship & Regional Development*. Vol. 17, No. 1, pp. 17 – 42.
- Minniti, M and Levesque, M. (2008). Recent developments in the economics of entrepreneurship. *Journal of Business Venturing*, Vol. 23, No. 6, pp. 603–612.
- Mitev, N. (2005), 'Are social constructivist approaches critical? : the case of IS failure', In: Howcroft, Debra A and Trauth, Eileen M, (eds.) *Handbook of critical information systems research : theory and application*. Edward Elgar, pp. 70–103.
- Mustonen-Ollila, E., and Lyytinen, K. (2003), 'Why Organisations Adopt Information System Process Innovations: A Longitudinal Study Using Diffusion of Innovation Theory', *Information Systems Journal*, Vol. 13, No. 3, pp 275–297.
- Nnadozie, E. (2002), 'African indigenous entrepreneurship: determinants of resurgence and growth of Igbo entrepreneurship during the Post-Biafra period', *Journal of African Business*, Vol. 3 No. 1, pp 49–80.
- Nweke, F., and Akorhe, J. (1983), 'Determinants of adoption of new technologies among smallholders and implications for administration of transfer programmes: A case study of rice production in the plateau state of Nigeria', *Agricultural Administration and Extension*, Vol. 12, No. 2, pp. 77–90.
- Okafor, F. (1986), 'The adaptive strategies of smallholders in parts of South-Eastern Nigeria: Implications for agricultural planning', *Journal of Rural Studies*, Vol. 2, No. 2, pp 117–126.
- Oladele, O., and Fawole, O. (2007), 'Farmers Perception of the Relevance of Agriculture Technologies in South-Western Nigeria', *Journal of Human Ecology*, Vol. 21, No. 3, pp 191–194.
- Olatubosun, O. (2007), 'Design of a Framework for the Implementation of Electronic-Cattle Transaction (E-Cattle) in Nigeria', *Research Journal of Applied Sciences*, Vol. 2, No. 10, pp 1036–1042.
- Olayide, O; Ogunfowora, O and Essang, S. (1974). Effects of marketing board pricing policies on the Nigerian Economy: A systems simulation experiment. *Journal of Agricultural Economics*, Vol. 25, No. 3, pp. 289–309.
- Oseni, G and Winters, P. (2009). Rural nonfarm activities and agricultural crop production in Nigeria. *Agricultural Economics*, Vol. 40, No. 2, pp. 189–201.
- Simon C. Parker, S. (2006). Learning about the unknown: How fast do entrepreneurs adjust their beliefs? *Journal of Business Venturing*, Vol. 21, No. 1, pp. 1–26.

- Polson, R., and Spencer, D. (1991), 'The technology adoption process in subsistence agriculture: The case of cassava in Southwestern Nigeria', *Agricultural Systems*, Vol. 36, No. 1, pp 65–78.
- Pyyssainen, J; Anderson, A; McElwee, G and Vesala, K. (2006). Developing the entrepreneurial skills of farmers: some myths explored. *International Journal of Entrepreneurial Behaviour & Research*, Vol. 12, No. 1, pp. 21–39.
- Richards, J. (1973). The psychology of farming: A review of twenty-five years of research. *Journal of Vocational Behaviour*, Vol. 3, No. 4, pp. 485–501.
- Rogers, E. (1995), *Diffusion of Innovations* 4th Edition, Pub. The Free Press, New York.
- Satta T. (2003), 'Enterprise characteristics and constraints in developing countries: Evidence from a sample of Tanzanian micro and small-scale enterprises', *The International Journal of Entrepreneurship and Innovation*, Vol. 4, No. 3, pp 175–184.
- Schade, C. (2009). Entrepreneurial decision making: A paradigm rather than a set of questions: Introduction to special section based on Lally–Darden–Humboldt Young Entrepreneurship Scholars' Retreat 2006. *Journal of Business Venturing*, In Press.
- Schumpeter, 1934. J. Schumpeter, *The Theory of Economic Development*, Harvard Univ. Press, Cambridge, MA 1934
- Singh,K and Krishna, K. (1994). Agricultural entrepreneurship: The concept and evidence. *Journal of Entrepreneurship*, Vol. 3, No. 1, pp. 97–111.
- Stewart, D and Shamdasani, P.N. (1990), *Focus Groups: Theory and Practice*, Sage Publications, London.
- Toulmin, C. (2009). Securing land and property rights in sub-Saharan Africa: The role of local institutions. *Land Use Policy*, Vol. 26, No. 1, pp. 10–19
- Ucbasaran, D; Westhead, P and Wright, M. (2001). The Focus of Entrepreneurial Research: Contextual and Process Issues. *Entrepreneurship theory and practice*. Vol. 25, No. 4, pp. 57–80.
- Ueda, M. (2004). Banks versus venture capital: project evaluation, screening, and expropriation. *Journal of Finance*, Vol. 59, No. 2, pp. 601–621.
- Venter, E., Boshoff, C., and Maas, G. (2006), 'Influence of owner-manager-related factors on the succession process in small and medium-sized family businesses', *The International Journal of Entrepreneurship and Innovation*, Vol. 7, No. 1, pp 33–47.
- Venkatesh, V., Morris, M. G., Davis, G. B., and Davis, F. D. (2003), 'User acceptance of information technology: Toward a unified view', *MIS Quarterly*, Vol. 27, No. 3, pp 425–478.
- Warren, M. (2004), 'Farmers online: drivers and impediments in adoption of Internet in UK agricultural businesses', *Journal of Small Business and Enterprise Development*. Vol. 11, No. 3, pp. 371–381.
- Warriner, G and Moul, T. (1992). Kinship and personal communication network influences on the adoption of agriculture conservation technology. *Journal of Rural Studies*, Vol. 8, No. 3, pp. 279–291.
- Winnborg, J and Landstrom, H. (2001). Financial bootstrapping in small businesses: examining small business managers' resource acquisition behaviors, *Journal of Business Venturing*, Vol. 16, No. 3, pp. 235–254.
- Zahra, S. (1996). Technology strategy and financial performance: Examining the moderating role of the firm's competitive environment. *Journal of Business Venturing*, Vol. 11, No. 3, pp. 189–219.
- Zahra, S. (2007). Contextualizing theory building in entrepreneurship research. *Journal of Business Venturing*, Vol. 22, No. 3, pp. 443–452.
- Zahra, S and Bogner, W. (2000). Technology strategy and software new ventures' performance: Exploring the moderating effect of the competitive environment. *Journal of Business Venturing*, Vol. 15, No. 2, pp. 135–173.