

Technology Adaptation and Survival of SMEs: A Longitudinal Study of Developing Countries

Supriyo Das, Amit Kundu, Arabinda Bhattacharya

“ When true technology adoption is achieved, the life of the user is improved. ”

Dannah Kahn
WalkMe Blog

In the current era of internationalizing business activities and globalizing markets, technology has become an essential tool for enhancing market competitiveness. With globalization, a country's economic and business scenarios can change drastically. Many companies have seized on opportunities to pursue, and sometimes achieve economies of scale. Especially in some countries, however, the technological revolution creates significant challenges for small business entrepreneurs. Technological development plays a pivotal role in making small and medium enterprises (SMEs) competitive, as well as leading to sustainable growth. Under such circumstances, it is relevant to consider a country's technological environment for ways that can lead SMEs towards sustainable development. In the present study, we explore the impact of volatility in technological environments on the sustainability of SMEs in developing countries with emerging economies. We use the Global Competitive Index Report for the period 2012-2016, in which six parameters were applied to define the technological environment of developing nations. Two factors, namely, institutional capabilities and external capabilities emerged as significant factors according to factor analysis. We also studied the impact of emerging factors in new technological environments on the sustainability of SMEs in the specific time period using a regression analysis. The results indicate that both institutional capabilities and external capabilities become significant when time is taken as a selection variable. The high significance of the time variable indicates the dynamism of today's technological environments. As well, institutional capabilities were found to have a strong impact on a business' sustainability, in comparison with external capabilities and the high level of technological volatility.

Introduction

Economic growth requires participation from small businesses, which also act as an important tool for equitable development. The World Bank (2012a) calculated that around 200 million people are currently unemployed, while 600 million jobs need to be created by 2020, mainly in developing countries. A number of those jobs are expected to be generated by small and medium enterprises (SMEs), given their high labour intensity. SMEs thus have a key role to play in facilitating the development of the global economy. SMEs constantly provide a significant contribution to the economy through the creative process, encouraging the advancement of technology, organizational innovation, job creation, income generation, economic

competitiveness, and other aspects of social development in general, along with industrial expansion, in particular.

Though SMEs represent the backbone of an economy, a very common problem with SMEs is their high sensitivity to market change. It is a challenge for SMEs in the present environment to keep pace with the turbulent technological advances. This requires constant coordination with global clients to understand their changing demands in order to produce products that reach global standards. It also demands detailed real time information regarding product and service offerings from foreign industries, as a way to keep market competitive.

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The technological environment, and more specifically digitisation initiatives support the advancement and absorption of new technologies, which plays a pivotal role in making SMEs competitive as well as sustainable. Under these circumstances, it is very much relevant to revisit the technological environment in developing countries. Recent policy recommendations from various countries are encouraging digitisation of SMEs and their use of technology-driven platforms. In India, where the authors are based, as with many countries, digitisation is both expected to improve the governance of enterprises, and also reduce their costs of operation (Government of India, 2015). When the right environment is created by policy makers, we believe that peoples’ entrepreneurial spirit finds expression, and as a consequence, economic activity, may boom (Dubey, 2014).

Innovative and technology-based SMEs can now turn their attention to think about expanding outside of domestic borders to enter intra-regional and international markets as well as compete with multinational companies to capture higher market share in domestic market. In recent years, many firms

have elected to focus their efforts on gaining differentiation through developing capabilities. Very often these capabilities come in the form of specific technologies (Claudia Ogrian et al., 2009).

As globalization takes place, economic and business scenarios have changed drastically and many countries have seized on opportunities to achieve economies of scale. In developing countries, despite high inherent growth capabilities, SMEs are facing a number of problems like sub-optimal operation scale, technological obsolescence, supply chain inefficiencies, increasing domestic and global competition, funding shortages, changes in manufacturing strategies, and a turbulent, uncertain market scenario. At this juncture, current day technologies have changed both perspectives on uncertainty for new ventures, as well as estimates of outcomes (Tripathi & Brahma, 2018)

The majority of SMEs in developing and transitional countries, however, have been either less than able, or even unable to take advantage of the benefits of globalization. These SMEs find that they cannot compete with foreign goods that are sometimes better in terms of

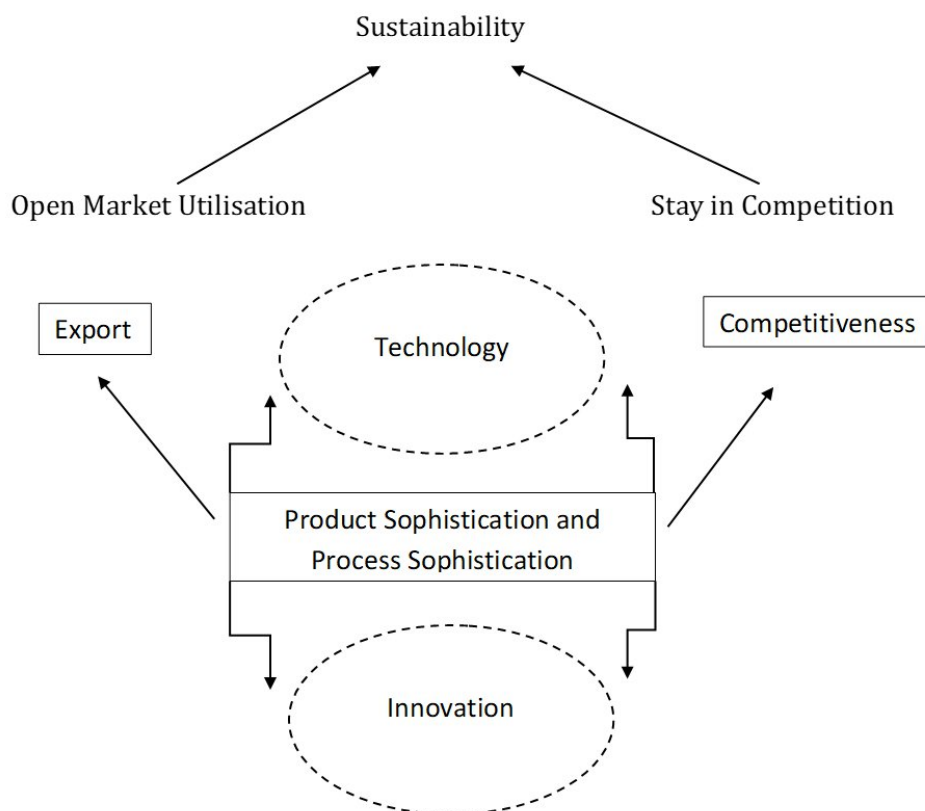


Figure 1. Theoretical Techno-Innovation Framework

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both quality and price. Our aim with this research was therefore to study how SMEs in developing countries may come to benefit from globalization. While various researchers have suggested valuable recommendations to make SMEs technologically competent, our approach is an in-depth study of technological attributes for developing countries. We focus on the interrelation between technology and the sustainability of SMEs.

The purpose of the present study is to uncover the critical factors relating to favourable technological environments in developing countries that positively influence the overall performance of SMEs. Accordingly, the paper presents a model that attempts to explain sustainable technological environments for emerging economies. Within what we call a **sustainable technological environment model**, a sustainability measure of enterprise is estimated by the ratio of percentage increase in new entrepreneurial venture and percentage discontinuation of existing one for a specific time period.

We will pursue the following aims in this research paper:

- To understand the overall impact of a technological environment on the sustainability of SMEs.
- To indicate the most significant factors of a technological environment for the sustainability of existing ventures.
- To capture the trend of emerging technological factors in explaining the sustainability of SMEs in a definite time frame.

Literature Review

Technological development is one of the main factors for a firm's competitiveness in national and international markets. Firms that want to develop and maintain a competitive advantage or enter new markets cannot avoid new technologies (Becheikh & Amara, 2006). Positive relationships have been found on export performance of the variables, for example, technological innovativeness, management's attitude toward risk taking, and aggressiveness (Aaby & Slater, 1989). In spite of great opportunity to assess open market, a number of factors hinder or discourage SMEs from fully utilising global market through technological development. Among the main factors are lack of knowledge, resources, and trust. SMEs have disadvantages related to the lower levels of technological and financial resources that can lead not only to problems in their ability to source technology,

but also in their capability to absorb it into their organisation and diffuse it into their industrial sector (Jones-Evans, 1998).

The importance of accumulated knowledge and expertise is an important factor determining whether firms are likely to adopt new technology or to act as sources of innovation (Gurisattiet al., 1997). SMEs will likely benefit if governments take initiatives to create a conducive business environment. In addition, internal barriers will be resolved by motivated owners, and this motivation will come from owners' trust of IT and their knowledge to use it. Research suggests that SME business owners and managers with a positive technological attitude are inclined to be more successful in adopting and implementing new technology (Ogbonna & Harris, 2005).

There is considerable evidence showing that technological development in a country and its adoption among small firms is the most important determinant for sustainability in an ever-changing competitive market. Previous research has assumed that short term growth is largely driven by capital investment, while long term growth is attributed to exogenous technological change (Corelyet al., 2002).

It is evident that governments around the world today regard technology diffusion as an important route to increased competitiveness, especially as it diffuses into SMEs. In emerging economies, the development of IT infrastructure has lagged behind that in developed countries, often because of poor policies and insufficient investments in the IT sector (Laryea, 1999). Governments of these countries acknowledge the need and importance of IT, yet have so far managed only to take little concrete action in this area (Enakrire & Onyenania, 2007).

The development of a technological environment can arise through a variety of mechanisms. On the firm level, an entrepreneur's motive is to make profit. The easiest way to do this is either to increase market share or aim for direct export. Strategic technological development may help with either of these tasks. A technologically developed firm has the potential to initiate growth of individual enterprise at the micro level, while spurring to new heights of industry growth at the macro level.

Technological innovation is a key factor in a firm's competitiveness (Becheikh et al., 2006). In global markets, the interplay between globalization and

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technology innovation has created a worldwide competition for market share, pushing larger corporate enterprises and smaller innovative entrepreneurial ventures toward profitability and survivability (Cartwright & Craig, 2006). Gunasekaran et al. (2011) researched some characteristics of small businesses, including new strategies, techniques, and technologies that could help create competitive advantage and growth in global sales. Fadahunsi (2012) found that small business owners who had acquired greater levels of technological sophistication had more growth than similar firms that do not.

A key question that policy makers in developing countries face is how to improve the technological competence of owners and employees of SMEs. Recent studies emphasize low level utilizing of improved technologies by SMEs as a critical challenge confronting SMEs in developing countries. This has held back enhancing their opportunities and participation in world trade (Asare et al., 2015; World Trade Report, 2016; Ntwoku et al., 2017).

Some experts suggest a major factor of SMEs in developing countries remains traditionally low levels of productivity, poor quality products, and limited local markets. In many developing countries, a large number of micro enterprises are also fighting for survival. Nelson and Phelps (1966) show that the facilitation of new knowledge is only possible with a sufficient level of human capital present in a developing country.

Research Gap

Researchers like Kozubikova and Kotaskova (2019) have concentrated on finding out the parameters for technological environments in order to start or hinder starting a venture. Others like Intarakumnerd and Goto, (2016) have focused on specific technology-related policies or programmes in a city, region or country, and examined their effectiveness. Many papers have mainly highlighted a framework to successfully implement the latest technology.

Yet very few studies have been done to access the overall technological-environmental factors of entrepreneurship sustainability in developing countries. Mapping the technological environment, in general, is necessary for identifying significant factors contributing to favourable business opportunities. In general, realising the patterns of changing technological environments may also be useful to understand the present situation and judge future conditions.

Technological environments are characterised by the availability of the latest technologies, including firm-level technology absorption, foreign direct investment (FDI) and technology transfer, individuals using the Internet, fixed broadband Internet subscriptions, and international Internet bandwidth.

Sources of Data

The analysis has been made on the basis of identified parameters of technological environment taking developing nations as an experimental unit. The main source of data used was the Global Competitive Index Report (GCIR), 2012-2016. The research also encompasses secondary data from the Global Entrepreneurship Monitor (GEM) report, 2012-2016.

The GEM research project was designed as a long-term multinational endeavour with the purpose of providing a database to study the complex relationship between entrepreneurship and economic growth (Reynolds et al., 1999) and facilitate evidence-based policies that enhance entrepreneurship (Reynolds et al., 2005).

Parameters taken from the GCIR (2012-2016) reflecting the external technological environment are taken as independent variables in the model to measure impact on sustainability for businesses in developing nations.

The identified parameters are as follows:

1. Availability of latest technologies: In a country, to what extent are the latest technologies available?
2. Firm-level technology absorption: In a country, to what extent do businesses adopt the latest technologies?
3. FDI and technology transfer: To what extent does FDI bring new technology in the country?
4. Individuals using Internet: Percentage of individuals using the Internet
5. Fixed broadband Internet subscriptions: Fixed-broadband Internet subscriptions per 100 population
6. International Internet bandwidth: International bandwidth is the contracted capacity of international connection between countries for transmitting internet traffic.

The Global Competitiveness Index (GCI), elaborated by

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World Economic Forum (WEF) was widely applied to evaluate and rank countries based on their level of global competitiveness.

GEM reports for the period 2012-2016 were used to construct sustainable measure of enterprise. This measure is estimated by the ratio of percentage increase in new entrepreneurial ventures and the percentage discontinuation of existing ventures for the time period 2012-2016. It can be used for mapping the overall business environment of a specific country. The sustainable measure of enterprise is taken as a dependent variable to indicate a favourable business environment for developing the model.

Methodology

The GCIR (2012-2016) identified the six most crucial parameters to define the technological environment of a developing country in the time period 2012-2016. A factor analysis was performed considering all six proposed parameters of a technological environment in order to identify the most significant attributes mainly responsible for a technological environment's dynamism.

A regression analysis was performed considering the sustainability measure of enterprise as a dependent variable. Several factors emerged that define the technological environment were treated as independent variables in the time period (2012-2016). The emerged factors are also taken as moderating variable, to study the dominant factor of technological environment in each year of the mentioned period and to capture the trend of the above said environment.

Analysis - Stage I:

These six parameters are generally taken as parts of a technological environment: Availability of the latest technology, firm level technology absorption, FDI and technology transfer, individuals using the Internet, fixed broadband Internet subscriptions, and international Internet bandwidth. In our study, these parameters were used to calibrate the models. There was a strong feature of multicollinearity in all the proposed models among the independent variables.

The construct's validity was tested applying Bartlett's test of sphericity and the Kaiser-Mayer-Olkin (KMO) measure of sampling adequacy analyzing the strength of association among variables. The results reveal that the value of KMO is 0.72 which is above 0.5. The results

Table 1. Validity check of factor analysis: KMO and Bartlett's Test

Kaiser –Meyer –Olkin-Measure of Sampling Adequacy		0.745
Bartlett's Test of Sphericity	Approx Chi -square	703.104
	df	15
	Sig	0.000

for Bartlett's test of sphericity and KMO both were highly significant. Thus, we conclude that factor analysis is suitable.

Analysis - Stage II:

A factor analysis was performed on the basis of the six parameters of technological environments identified above, which in combination form two factors, namely, "institutional capabilities" (F₁) and "external capabilities" (F₂). These two factors were obtained by a factor analysis based on six independent parameters with high multicollinearity. Justification of cluster formation was made based on differences in factor loading value across all values of the identified

parameters. The factor loading values of all the perceptual parameters in F₁ have higher values than in F₂ (see Table 2).

Analysis - Stage III:

Model I

A regression analysis was performed with sustainability measure of enterprise as dependent variables on institutional capabilities (F₁) and external capabilities (F₂) which are treated as independent variables for different years (2012-2016).

We found that institutional capabilities became dominant over time. This was reflected in the year wise

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Table 2. Justification of two factor formation

Factor Name	Component variables	Factor loading
Factor I (F₁) Institutional Capabilities	Availability of latest technologies	0.91
	Firm-level technology absorption	0.89
	FDI and technology transfer	0.75
	Individuals using Internet	0.72
	Fixed broadband Internet subscription	0.71
Factor II (F₂) External Capabilities	International Internet bandwidth	0.36

Table 3. Summarized year wise results of Model I

Year	R square value	Significance	Significance of the factor score
2012	0.228	Significant at the level of 5%	F ₁ (sig at 10%) F ₂ (sig at 10%)
2013	0.184	Significant at the level of 5%	F ₁ (sig at 5%)
2014	0.297	Significant at the level of 5%	F ₁ (sig at 10%) F ₂ (sig at 5%)
2015	0.215	Significant at the level of 5%	F ₁ (sig at 5%)
2016	-	Not significant	-

regression from 2012 to 2015, as well as in the general case.

External capabilities emerged as an important factor in some years (2012 and 2014). Nevertheless, the data shows a high level of inconsistency. In 2016, a regression analysis indicated that the turbulence of the technological environment is so high that both factors become insignificant.

Analysis - Stage IV: Model II

In the case of model II, a regression analysis was performed for sustainable measure of enterprise as a dependent variable with respect to the emergent factors F₁ and F₂. Here, the time period was not taken as a moderating variable.

From the results of our research study, it is clear that only institutional capabilities (F₁) play a significant role for the sustenance of SMEs in dynamic technological business environments. The research output also justifies the results of model 1.

Analysis - Stage V: Model III

In the case of model III, a regression analysis was performed that considered sustainable measure of enterprise as a dependent variable with respect to the emergent factors F₁, F₂, and year (2012-2016).

From the results, it is clear that both factors of technological environment (F₁ and F₂) and the time period are highly significant. It may be concluded that sustainable SMEs in developing countries are strongly

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Table 4. Summarized results of Model II

Year	R square value	Significance	Significance of the factor score
2012-2016	0.08	Significance at the level of 1%	Factor F ₁

Table 5. Summarized results of Model III

Year	R square value	Significance of the Factor Score and Year
2012-2016	0.17	Factor F ₁ (at the level of 1%) Factor F ₂ (at the level of 5%) Year (at the level of 1%)

dependent on technological environments that are resilient and adaptive to the high level of technological volatility at the present time.

Conclusions

Past research on this topic has mainly focused on specific technology-related policies of a country's environment and examined the effectiveness or impact of policy on one specific dimension. The present study has explored research on the topic of constructing technological environments for the benefit and sustainability of SMEs.

From the preliminary research findings, both institutional capabilities and external capabilities emerged as significant factors toward creating sustainable technological environments for entrepreneurs. The research demonstrates that technological environment is defined by both "institutional capabilities" and "external capabilities". Institutional capabilities (F₁), controllable parameters, measured in terms of availability of latest technology: firm level technology absorption, FDI and technology transfer, individuals using internet, fixed broadband internet subscription, and international internet bandwidth have significant impact on sustainability whereas, in contrast, the impact of external capability stands out as not significant.

Limitations of the study

We find it interesting that both the factors of institutional capabilities and external capabilities become significant when time is taken as a selection variable. The high significance of a time variable proves the dynamism of technological environments. As well, institutional capabilities have a strong impact on the sustainability of businesses, in comparison with external capabilities that have a high level of technological volatility.

The study was conducted in international level where model was developed considering all the developing countries on the basis of same technological environmental parameters. The results may be used cautiously in the case of region specific cases where technological environments are not structurally defined or may have some other dimension of the said environment which is not considered in this research. Volatility measures of technological environment may also be taken into consideration to understand the country specific external capabilities of the SMEs.

Future Scope of the Study

This study is rare in that it not only addresses the most influential variables of technological environments in developing countries, generally speaking, but also establishes three separate models that indicate the

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impact of turbulent technological environments for entrepreneurial sustainability and long-term business stability.

The results can be used for assessing overall business environments and also, exploring the impact of critical business issues related to technology on the sustainability of SMEs developing countries. This study shows the role of several important parameters in creating favourable environments to sustain emerging businesses seeking to internationalize with the help of digitisation. It may further be used by the policy makers of a country to enable a specific country to embrace overall a more entrepreneurial technological environment for business.

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