Research Article

Tiny Impact of ICTs and Paucity of Rigorous Causal Studies: A Systematic Review of Urban MSMEs in the Developing World

P. Vigneswara Ilavarasan

Indian Institute of Technology Delhi, India

Albert Otieno

Kenya

Abstract

This systematic review examines whether access to business-relevant information through networked devices enhances internal efficiency and business growth of urban micro, small, and medium enterprises (MSMEs) in low- and middle-income countries. Starting from 24,000-plus records, rigorous screening yielded a set of 10 research articles from which data were extracted and a meta-analysis conducted. All were observational studies; none used an experimental or quasi-experimental design. Only five reported a probability sampling method, and the sample size ranged from 100–3,691. Except one, all had used self-reported data about ICT use. The review found: The numbers of business calls increase with the longer use of the mobile phones; ICT use and possession predict labor productivity; network devices improve operational support, strategic development, process improvement, and operational performance. Also, after the purchase of mobile phones, the number of customers increases. Higher ICT expenditure results in increased turnover. Profits increase with the use of mobile money. The quantitative meta-analysis shows that the impact on business growth and internal efficiency is statistically small. The research field lacks rigorous causal studies that link ICTs and MSME growth.

Keywords: MSMEs, ICTs, systematic review, business growth, internal efficiency, urban

Need for a Systematic Review

Micro, small, and medium enterprises (MSMEs) play a crucial role in economic growth and job creation in developing and developed economies (Stein, Goland, & Schiff, 2010). With more than half the world's 7.4 billion people now living in cities, and that proportion projected to increase over the next 30 years (UN DESA, 2014), MSMEs are expected to play a significant role in reducing urban poverty in the developing world (Ghanem, 2013). MSMEs in low- and middle-income countries experience higher mortality rates and face many challenges, including lack of access to market information, global competition, infrastructure woes, poor availability of human resources, lack of connectivity, and technological obsolescence (Liedholm & Mead, 1999).

Information and communication technologies (ICTs) have the potential to help meet many of these challenges. A decrease in costs and convergence of computers and handheld devices, along with increasing access to broadband, have occurred. Availability of market information has improved (Consoli, 2012; Duncombe, 2009). With a greater possibility of networking through the Internet using low-cost technologies like mobile phones, questions are being asked whether networked technologies contribute to the growth of MSMEs.

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The extant literature is rich in studies of ICT adoption and diffusion among MSMEs in low- and middle-income countries and reduction of cost barriers to ICTs, especially Internet and mobile phones (Qiu, 2009). Among ICTs, mobile phones are the most common devices, and voice-based activities in the personal domain are the most frequently undertaken (Donner, 2009; Donner & Escobari, 2010; LIRNEasia, 2014). Internet-enabled computers and laptops are rare among MSMEs in low- and lower-middle-income countries (Donner & Escobari, 2010; Esselaar, Stork, Ndiwalana, & Deen-Swarray, 2007; LIRNEasia, 2014).

There is no consensus on the impact of ICTs on MSMEs (Walsham & Sahay, 2006). Robust quantitative evidence is needed (Duncombe, 2009). For instance, Chowdhury and Wolf (2003) found that ICT investments by SMEs in East Africa contributed to market expansion through better information, but did not affect enterprise return and export performance, and had a negative impact on labor productivity. Another study stated,

> [W]hile new ICTs have enhanced communication practices, they have generally not enabled SMEs to develop better connections to outside ideas, markets, and investors, nor have they helped SMEs to upgrade significantly their manufacturing systems such that they might more proactively, productively, and flexibly respond to market trends. (Murphy, 2013, p. 1770)

The research question addressed in the review (Figure 1) is: Does access to business-relevant information through networked devices enhance the internal efficiency and business growth of urban MSMEs in low- and middle-income countries?

A systematic review[1] (SR) has its origins in the field of medicine and strives to comprehensively identify, appraise, and synthesize all the relevant studies on a given topic. In an SR, the processes by which literature is searched, filtered, and analyzed are replicable. SRs are useful when sufficient prior research exists, but there is uncertainty about the conclusions or an accurate picture related to past research is required to promote the development of new methodologies or new ways of asking questions (Petticrew & Roberts, 2006). The resultant policy recommendations or suggestions from the SRs are solely grounded on the findings of an SR, rather than on studies selected in an ad hoc manner as in conventional academic reviews.

No SR on the causal linkage between ICTs and the growth of urban MSMEs in low- and middle-income countries exists. Earlier attempts to establish the linkage have fallen short. For instance, Barabara-Sanchez, Martinez-Ruiz, and Jimenez-Zarco (2007) and Ongori and Migiro (2010) claimed to have completed a "critical review" or a "literature review," but do not describe how the studies were chosen and analyzed. Donner and Escobari (2010) followed SR methodology, but focused only on mobile phones. Donner (2008) reviewed an impressive number of studies of mobile phones, but did not conduct a quantitative meta-analysis. Given this lacuna and policymakers' interest in promoting ICTs, especially networked ICTs, an SR to validate claims and support policy initiatives is justified.

The second section of this article explains the concepts used in the review. The third section presents the methodology. The fourth section describes the articles that survived the screening. The fifth section elaborates on the impact of networked devices on internal efficiency and business growth. The sixth section presents the quantitative meta-analysis. The final section contains suggestions for research and policy.

Concepts

A *networked device* is any electronic tool that enables a user to receive and send information. Examples include mobile phones, computers, laptops, and tablets. The interconnectedness of technologies generates higher value to MSMEs (Piscitello & Sgobbi, 2004). The networking of the devices is enabled by the applications, earlier called system software or application software. The applications in mobile phones are called *mobile applications.* For instance, invoice-generating software or applications can be found in computers or mobile phones that are faster than manual invoice preparation, but the value increases when the invoice can be emailed immediately, reducing credit-cycle time.

MSMEs that receive business-relevant information through networked devices are expected to use them to achieve better internal efficiency and business growth of enterprises (Donner & Escobari, 2010).

Business-relevant information is operationalized as any information used by MSMEs for business-related

1. Please see the guest editor's introduction in this issue for a detailed discussion on SRs.

activities. Examples include communication from employees to owners and among themselves; communication with customers, suppliers, and partners; informal communication with business friends; or networks to gauge the market, market prices of inputs, and information on government policies, etc.

A universally accepted standard definition of MSMEs is not available (Donner & Escobari, 2010; Ghobakhloo & Tang, 2015). For this article, 250 employees is the outer boundary that defines an *MSME*. This is adapted from the European Union, for which a medium enterprise is one with fewer than 250 employees and an annual turnover of fewer than €50 million.[2] The review included only MSMEs operating in urban locations. Even MSMEs related to agriculture such as those selling fertilizers or seeds are included if based in an urban location.

The internal efficiency of an MSME is operationalized as the capacity of the organization to make use of internal resources to produce outputs with reduced costs or efforts. Internal efficiency is inferred from multiple factors: the amount of time taken for business processes, reduced travel, ability to manage home and work (especially for women entrepreneurs), optimized production or service delivery processes and inventory management, coordination with employees and between different functional units within the enterprise, enhanced channels for customer feedback, improvement in managing business networks, and increased access to finances due to inflow of information from various sources. Multiple facets of business growth are considered: increased sales and turnover; growth in numbers of employees, customers, and suppliers; expansion of work premises; shifting from rented location to owned premises; growth of branches, service offerings, the range of products, business networks, and partnerships; and inflow of referrals for business.

Business-relevant information obtained over networked devices may improve MSMEs' internal efficiency and business growth. However, there could be other intervening factors. Some possibilities are characteristics of MSMEs (e.g., age, size, industry domain), owners' characteristics (e.g., age, education, ICT literacy), policy environment (e.g., financial incentives for internationalization and skill development facilities, etc.), gender, women's labor force participation, etc.

It is also possible[3] that business-relevant information and other factors of internal efficiency and business growth might lead to negative outcomes. For instance, enhanced channels of customer feedback could result in negative externalities, if not executed properly. The SR is expected to capture this as well.

Methodology

An information scientist, following a detailed protocol, searched the literature. The initial screening based on title and abstract was followed by a detailed review of the articles that remained by at least two reviewers. The final articles were identified based on the methodology sections. At least two reviewers analyzed each of the remaining full articles. When justified, the lead researcher wrote to the authors of the studies seeking further clarification. A final set of 10 studies was included for full-text screening and data extraction. A schematic representation of the search process is presented in Figure 2.

Risk of Bias Assessment

The final sets of articles were examined for risk of bias. Higgins, Thompson, Deeks, and Altman (2003) and Kjaergard, Villumsen, and Gluud (2001) argue that studies with questionable methodological quality are prone to a number of biases, which may include overestimation of the positive effects, systematic errors, or underestimation of the negative effects. To assess risk of bias for the included articles, methods adapted from Higgins and Green (2008) were used. The adaptation was necessary because the final studies are survey-based. Selection bias (whether respondents/research subjects were allocated randomly for control and experimental groups), incomplete outcome data (how the incomplete outcome data were handled), and selective reporting (reporting of selected outcomes) were assessed.

Six articles reported that participant selection was random and were rated as having low risk of bias. Of the

2. €50 million roughly equals US$61.3 million. http://ec.europa.eu/enterprise/policies/sme/files/sme_definition/sme_user_guide_en.pdf

3. Many thanks to the referee who pointed this out.

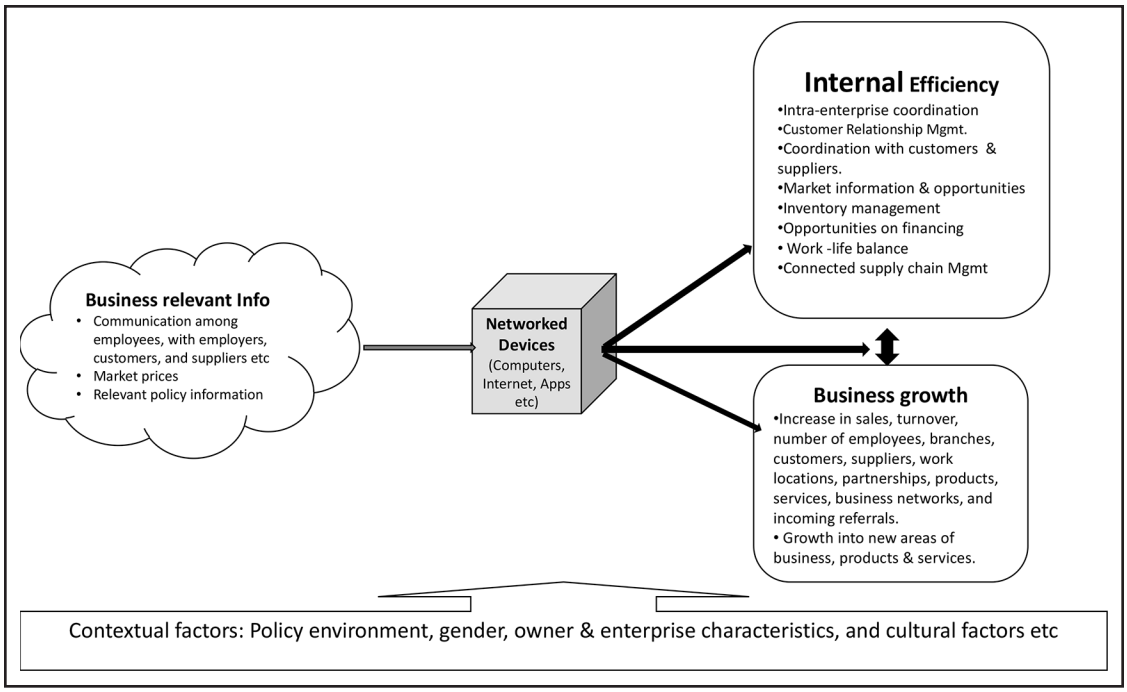

Figure 1. Causal linkage between ICTs and MSME growth.
Source: Authors.

six that reported random selection, only one (Frederick, 2014) shared sufficient information about methods and procedures. Chadha and Saini (2014), Donner (2006), Mwangi and Acosta (2013), and Esselaar et al. (2007) have high selection bias, but used a nonrandom selection of participants. None of the articles reported handling drop-outs and missing data; hence, little or no attempt had been made to control for missing data. Also, the research team was unable to find additional material for any of the 10 studies; thus, it was difficult to check for selective reporting bias. Risk of bias is unclear for all the studies on two parameters: incomplete outcome data and selective reporting.

Description of the Final Articles

The final 10 articles were based on research conducted in India and Africa in 2007–2014. All the articles were based on surveys. Randomized controlled trials (RCTs) had not been used. A rigorous sampling technique ensures that the generalization from the sample is possible. While there is an adequate number of probability sampling techniques, only three studies had followed three-stage random sampling. Jahanshahi, Gashti, Khaksar, and Pitambar (2011) and Wamuyu and Maharaj (2011) reported stratified sampling, but did not provide adequate details on the sampling process.

Except for Esselaar et al. (2007), whose sample size was 3,691, the final articles are small-scale surveys, with sample sizes ranging from 100–560. The rationale for the sample size and number of respondents is not reported in any of the studies. Jahanshahi et al. (2011) did not report the nature of respondents.

The final articles were exclusively quantitative studies. The included studies had followed either regression models or regression-based structural equation models. Brief article summaries are presented in Table 1.

Findings

Business-Relevant Information

Except for Donner (2006), all studies used self-reported data about the use of ICTs for processing business-relevant information (Table 2). Chadha and Saini (2014), Jahanshahi et al. (2011), Mwangi and Acosta (2013),

Table 1. Brief Summary of the Final Articles.

Authors	Country	Sample	Sampling technique	Statistical Analysis
Chadha & Saini (2014)	India	260 C-level executives of SMEs	Judgmental-cum-convenience	Structural equation model
Chew, Ilavarasan, & Levy (2012)	India	560 microentrepreneurs	Three stages random cluster	Multiple regression
Chew, Ilavarasan, & Levy (2013)	India	335 microentrepreneurs	Three stages random cluster	Hierarchical multiple regression
Chew, Levy, & Ilavarasan (2011)	India	231 microentrepreneurs	Three stages random cluster	Structural equation model
Donner (2006)	Rwanda	277 microentrepreneurs	Convenience	Fractional logit model & logistic regression
Esselaar, Stork, Ndiwalana, & Deen-Swarray (2007)	13 African countries	3,691 SME entrepreneurs	Convenience	Kruskal-Wallis test & regression
Frederick (2014)	Zambia	430 microentrepreneurs	Cluster	Multiple regression
Jahanshahi, Gashti, Khaksar, & Pitambar (2011)	India	121 SMEs (reporting about the respondents is unclear)	Stratified random	Path analysis
Mwangi & Acosta (2013)	Kenya & Tanzania	100 microentrepreneurs	Judgmental	Regression
Wamuyu & Maharaj (2011)	Kenya	530 entrepreneurs or key managers	Proportionate stratified	Structural equation model

Source: Authors.

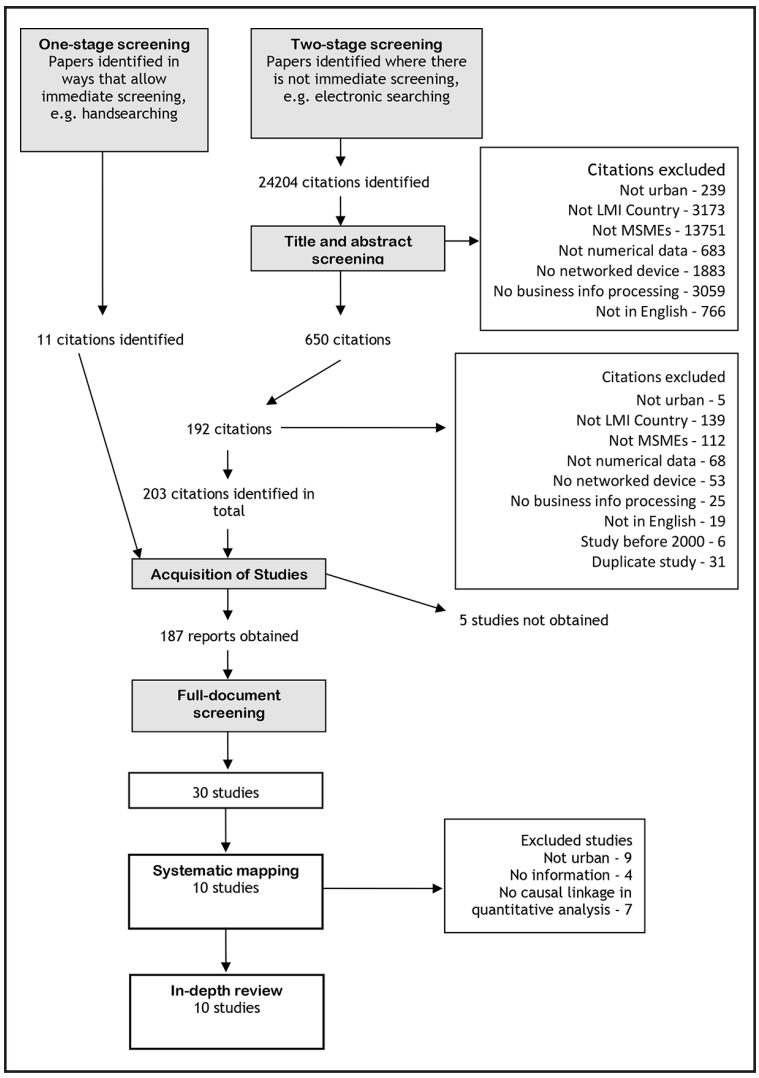

Figure 2. Filtering of articles from searching to map to synthesis.
Source: Authors.

and Esselaar et al. (2007) used a composite index through which processing of business-relevant information can be deduced. The index covers all possible things one can do using ICTs in an enterprise. The index serves as cause for either business growth or internal efficiency. Detailed information on each item is given only in Esselaar et al. (2007).

Chew et al. (2011), Chew et al. (2012, 2013), and Donner (2006) focus on mobile phones, but do not provide adequate details on the nature of the business-relevant communication. Only voice-based activities (calling and receiving calls for business) and SMS are observed. These studies indicate that complex tasks are difficult to undertake on basic feature phones. Frederick (2014) divides the sample into two: one that uses mobile money and another that does not.

Two studies that are not specific to mobile phones (Chadha & Saini, 2014; Jahanshahi et al., 2011) indicate that processing business-relevant information is much more than voice-based, and business communication goes beyond customers, employees, and suppliers.

Networked Devices

The networked devices used by the MSMEs in the final list of articles are limited (Table 3). Donner (2006), Chew et al. (2012), Frederick (2014), and Mwangi and Acosta (2013) report on MSMEs that use mobile phones exclusively. Chew et al. (2011), Chew et al. (2013), Esselaar et al. (2007), and Wamuyu and Maharaj (2011) show mobile phones being used in tandem with other networked devices.

Chew et al. (2011), Chew et al. (2013), and Esselaar et al. (2007) combined other devices such as fax machines, computers, and fixed phones to form a single index of networked devices, which was then used for analysis. Wamuyu and Maharaj (2011) also combined mobile phones with other devices, but did not quantify the extent to which entrepreneurs used networked devices, and the article uses only one term, mobile technologies. Chadha and Saini (2014) and Jahanshahi et al. (2011) mention advanced networked devices such as database management systems, e-document management software, and e-commerce applications, but do

Table 2. Business-Relevant Information Processed by the MSMEs.

Studies	Inferences for processing business relevant information
Chadha & Saini (2014)	Information technology is used in the knowledge management practices of the organization.
Chew, Ilavarasan, & Levy (2012, 2013)	Using mobile phones, the entrepreneurs called and received calls from customers, employees, and suppliers.
Chew, Levy, & Ilavarasan (2011)	
Donner (2006)	The entrepreneurs communicated with the customers, employees, colleagues/partners, and suppliers.
Esselaar, Stork, Ndiwalana, & Deen-Swarray (2007)	The MSMEs used landlines, mobile phones, faxes, computers, and Internet to communicate with clients and customers and to order supplies. MSMEs also used SMS and Internet for business purposes.
Frederick (2014)	The microentrepreneurs used mobile money.
Jahanshahi, Gashti, Khaksar, & Pitambar (2011)	Five areas of e-commerce: e-marketing, e-advertising, e-CRM, e-order and delivery, and e-payment systems were used by the enterprises. These items are taken as a single factor in the analysis.
Mwangi & Acosta (2013)	Entrepreneurs used mobile phones in these areas: getting better market prices and information for product and services, obtaining increased support from the government, acquiring information about new products and their use and application, receiving payments from customers in the form of mobile money, advertising through SMS to inform customers about products and services, and allowing customers to contact anytime to report problems and enquiring about visiting the shops.
Wamuyu & Maharaj (2011)	Entrepreneurs used mobile Internet services and mobile money transfer services.

Source: Authors

not report on their use. Overall, seven articles shed light on the nature of networked devices and how they are used, but no disaggregated analysis concerning individual devices or applications is provided. It is possible that qualitative studies would have provided details about the nature of ICTs, both hardware and applications, and their use by MSMEs. Our SR focuses only on quantitative studies.

Internal Efficiency and Business Growth

Of the final 10 studies, half discuss the impact of networked devices on internal efficiency (Table 4). In this set of five studies, only Donner (2006) and Esselaar et al. (2007) explicitly address internal efficiency. The numbers of business calls increased with the longer use of mobile phones (Donner, 2006), which is an indicator of internal efficiency. Esselaar et al. (2007) find that ICT use and possession indexes that are combinations of multiple networked devices predict labor productivity in the MSMEs. These two studies use either the logs of calls or the turnover values of enterprises, not perception-based responses.

Three studies use composite factors, namely, operational support, strategic development, and process improvement (Chadha & Saini, 2014), operational performance (Jahanshahi et al., 2011; Wamuyu & Maharaj, 2011). The respondents are asked to respond to a list of items on a Likert scale. A disaggregated analysis for each factor is not undertaken in these studies. However, the statistical analysis shows that networked devices were improving the above factors in the enterprises.

The impact of the networked devices seems to be greater on business growth of MSMEs compared to internal efficiency. Eight articles prove there is a change in growth of the enterprises. Donner (2006) shows that after the purchase of mobile phones, business-related call partners are new. Half are customers; thus, an increase in customer numbers can be inferred. Esselaar et al. (2007) shows that higher ICT expenditure led to an increased turnover. Frederick (2014) shows that profits increased with the use of mobile money. These three studies do not use self-reported perceptual data. *Business growth of microenterprises* is defined as the percentage increase in income over the previous year as perceived by the respondents in the studies of Chew et al.

Table 3. Networked Devices Used by the MSMEs.

Studies	Networked Devices
Chadha & Saini (2014)	Intranets, Internet, portals, database management systems/knowledge-based systems, groupware, data warehousing/mining, e-document management systems, dedicated knowledge management software
Chew, Ilavarasan, & Levy (2012); Donner (2006); Frederick (2014); Mwangi & Acosta (2007)	Mobile phones
Chew, Levy, & Ilavarasan (2011); Chew, Ilavarasan, & Levy (2013)	Mobile phones, personal computers, laptops, Internet in home and business, use of public calling offices, employee phone use for business, computers in the workplace, Internet connection in business, computers to employees
Esselaar, Stork, Ndiwalana, & Deen-Swarray (2007)	Telephone, mobile phones, computers, fax, Internet
Jahanshahi, Gashti, Khaksar, & Pitambar (2011)	Several e-commerce applications: e-marketing, e-advertising, e-CRM, e-order and delivery, e-payment systems
Wamuyu & Maharaj (2011)	Mobile Internet service and mobile money transfer services

Source: Authors.

Table 4. Internal Efficiency and Business Growth of MSMEs.

Studies	Internal Efficiency	Business Growth
Chadha & Saini (2014)	Improves operational support (reliability, content visibility, security, documentation, completeness, systematic storage); strategic development (knowledge management process improvement, employee participation, decision support, cross-unit performance, competence, integration of systems); process improvement (speed and accuracy, ease of use, cost-effectiveness, control and operational efficiency).	
Chew, Ilavarasan, & Levy (2012)		Length of mobile phone use and business use of mobile phones lead to microenterprise growth.
Chew, Ilavarasan, & Levy (2013)		Business use of mobile phones results in business growth.
Chew, Levy, & Ilavarasan (2011)		Business growth
Donner (2006)	Mobile phones increase the proportion of business calls made by entrepreneurs.	After the purchase of the mobile phone, business-related call partners are more likely to be the new customers, with almost half of them as customers.
Esselaar, Stork, Ndiwalana, & Deen-Swarray (2007)	ICT possession and use increase labor productivity.	Higher ICT use expenditure leads to an increase in turnover of MSMEs.
Frederick (2014)		Mobile money use increases profits (measured by the log of profits last month).
Jahanshahi, Gashti, Khaksar, & Pitambar (2011)	E-commerce application use enhances MSMEs' operational performance, new product/service introduction, product/service delivery, marketing effectiveness, and customer satisfaction.	E-commerce application use increases market share.

Table 4. (Continued)

Studies	Internal Efficiency	Business Growth
Mwangi & Acosta (2013)		Use of mobile phones leads to income growth, profitability, and increase in customer base.
Wamuyu & Maharaj (2011)	Mobile phone use improves organizational performance.	

Source: Authors.

Table 5. Subgroup Analysis of Outcomes as Reported.

Studies	Subgroup Analysis
Chadha & Saini (2014)	The sample description contains information only on three industrial segments of the sample: textiles, software, and pharmaceutical. Enterprises' size is not discussed.
Chew, Ilavarasan, & Levy (2012)	Apart from the length of mobile phone use and business use of mobile phones, other variables (gender, number of hired workers, age) predict positive business growth. All microenterprises had fewer than 10 employees.
Chew, Ilavarasan, & Levy (2013)	Apart from the business use of mobile phones and thier interaction with entrepreneurial expectations, caste, education, and number of children predict business growth. Only women-owned enterprises with fewer than 10 employees were surveyed.
Chew, Levy, & Ilavarasan (2011)	Apart from total ICT access, the formality of a business predicts negative business growth. All microenterprises had fewer than 10 employees.
Donner (2006)	The longer the mobile phone was used, the more business calls are made. The higher the microentrepreneurs' education level, the lower the number of business calls. Older owners are less likely to have call partners as new customers while making business calls. Better-educated owners are more likely to have call partners as new entrants while making business calls. All microenterprises had fewer than five employees.
Esselaar, Stork, Ndiwalana, & Deen-Swarray (2007)	Formality/registration status of the enterprises differently predicts the impact of ICTs on profitability.
Frederick (2014)	Log of profits last month is positively predicted by mobile money usage and market location, and negatively by the owner's gender. A female entrepreneur is likely to earn less revenue.
Jahanshahi, Gashti, Khaksar, & Pitambar (2011)	The article does not report the size, owners, gender, or other details.
Mwangi & Acosta (2013)	The article does not support the subgroup analysis.
Wamuyu & Maharaj (2011)	The article reports the number of employees, number of computers, availability of local area network, and owners' age and education.

Source: Authors.

(2011) and Chew et al. (2012, 2013). Studies by Jahanshahi et al. (2011) and Mwangi and Acosta (2013) use Likert-type responses to measure business growth in market share, profits, profitability, and increase in customer base, finding all to be a positive influence.

Subgroup Analysis

Of the 10 articles, four report no subgroup analysis as part of the findings (Table 5). Chadha and Saini (2014) and Wamuyu and Maharaj (2011) had information on the microentrepreneurs for subgroup analysis by MSME size, education of owners, and industrial domains, but these are not reported.

The subgroup analysis is clearly presented only by Esselaar et al. (2007). When an enterprise is registered

Table 6. Results for Combined Effect Size on Impact of Networked Devices on MSMEs.

Studies	Effect Size (ES)	[95% Confidence Interval]	
Business Growth			
Donner (2006)	0.318	−4.738	5.375
Chew, Levy, & Ilavarasan (2011)	0.430	−3.217	4.077
Mwangi & Acosta (2013)	0.285	−2.851	3.421
Chew, Ilavarasan, & Levy (2012)	0.088	−3.993	4.168
Chew, Ilavarasan, & Levy (2013)	0.028	−0.560	0.616
Wamuyu & Maharaj (2011)	0.943	−18.676	20.563
Subtotal			
D + L pooled ES	0.051	−0.510	0.613
Internal Efficiency			
Mwangi & Acosta (2013)	0.285	−2.851	3.421
Wamuyu & Maharaj (2011)	0.811	−27.099	28.721
Jahanshahi, Gashti, Khaksar, & Pitambar (2011)	1.128	15.179	17.435
Subtotal			
D + L pooled ES	0.321	−2.740	3.382
Overall			
D + L pooled ES	0.060	−0.492	0.612

Source: Authors.

with the government (formal status of the business), there is a positive effect on business growth. ICT expenditure is highest for informal enterprises.

The multiple regression models used by Chew et al. (2011) and Chew et al. (2012, 2013) include ICTs, among other variables that predict business growth. These variables are not presented as a subgroup analysis, but the articles provide insights into intervening factors—gender, number of hired workers or size of the enterprise, age and education of the entrepreneurs—which positively predict business growth.

Results are not uniform across the studies. Business growth is likely to be higher among the women-owned enterprises, according to Chew et al. (2012), but the inverse relationship is presented by Frederick (2014). Education of respondents is a positive predictor of growth in Chew et al. (2013), but negative in Donner (2006).

Quantitative Meta-Analysis

Quantitative meta-analysis is used to derive a pooled effect size from individual studies. Six studies focused on the MSMEs' business growth and three on internal efficiency. Table 6 lists the studies under each category.

The meta-analysis showed that the impact of ICTs on business growth is positive, although the subtotal effect size (for business growth) is not statistically significant at a level of 5% ($p = 0.100$). Wamuyu and Maharaj (2011) show the largest effect size (0.943), while Chew et al. (2013) show the lowest (0.028). The pooled subtotal effect size for the six studies that report business growth is 0.051, with a confidence interval (–0.510, 0.613). This is lower than the small effect, 0.2, suggested by Higgins and Green (2011); however, the same authors caution that interpretations purely based on numbers are problematic as the importance of a finding is context-dependent.

Three studies on internal efficiency also show a positive effect. The pooled subtotal effect for the internal efficiency is 0.321, with a 95% confidence interval of –2.740 to 3.382 (Table 6). This is higher than small effect, but lower than medium effect, 0.5, suggested by Higgins and Green (2011); however, the subtotal effect size for internal efficiency is not statistically significant at a level of 5% ($p = 0.994$).

Table 7. Tests for Heterogeneity.

Impact	Heterogeneity Statistic	Degrees of freedom	P-value	I-Squared	Tau-Squared
Business growth	0.090	5	1.000	0.0%	0.000
Internal efficiency	0.010	2	0.994	0.0%	0.000
Overall	0.130	8	1.000	0.0%	0.000

Source: Authors.

The overall impact of networked devices on business growth and internal efficiency combined is modest, with an effect size of 0.060 (SE = 0.028) with a confidence interval of (–0.492, 0.612). In other words, the impact of networked devices is limited. Impact on internal efficiency is relatively stronger than on business growth.

About evidence of variation, there is no heterogeneity within the business growth group of studies (P = 1.000, I^2 = 0.0%). There is no evidence of variation in effect sizes attributable to heterogeneity (Table 7).

Similarly, there is no heterogeneity within the internal efficiency group (P = 0.994, I^2 = 0.0%; Figure 3). Overall results are P = 1.000, I^2 = 0.0%; therefore, it may be concluded with 95% confidence that the effects of the intervention (networked devices) being tested are accurate.

Subgroup Analysis of Impact of Type of Networked Devices on the MSMEs

Our second meta-analysis sought to investigate the effect of various networked devices used by the MSMEs (use of mobile phones, use of mobile phones plus other devices, and use of nonmobile phone devices) on business growth as well as MSMEs' internal efficiency. Three studies report on mobile phones, four on both mobile phones and other networked devices, and one did not report any specific device (see Table 9).

The effect size was highest in the study that did not specify the device (1.128). The overall subtotal pooled effect for the studies on mobile phones being used to receive business-relevant information was 0.250. It was 0.039 for those that used mobile phones and other networked devices.

Publication Bias

A funnel plot, together with associated Egger's tests, was employed to detect the presence of publication bias in the entire group of studies (Figure 4). Funnel plots are used to visually diagnose publication bias by observing whether there are gaps in the number of small studies that have small effects and a high likelihood of not being published (Jonathan & Matthias, 2001). According to Dickersin (2005), studies that exhibit significant results are more likely to be published than those studies that report nonsignificant results; this may result in publication bias. As the studies are scattered unevenly in the funnel, publication bias may be deduced.

Further, Egger's test was performed to identify significant publication bias in the studies (Table 9). The test is used to detect asymmetry in the funnel plot by examining the estimates of the standardized effects against their precision by determining whether the intercept significantly deviates from zero (Jonathan & Matthias, 2001). The test confirmed the results of the funnel plot that publication bias exists (P = 0.002).

Implications

The systematic review began with the identification of over 24,000 studies on ICTs and MSMEs. Despite the initially massive haul of studies, only 10 survived the screening. This indicates that the field lacks adequate emphasis on rigorous causal studies.

The review found that the numbers of business calls increased with longer mobile phone use; ICT use and possession predicted labor productivity; and network devices improved the operational support, strategic development, process improvement, and operational performance of the MSMEs. After the purchase of mobile phones, the number of customers increases. Higher ICT expenditure results in an increased turnover. Profits increase with mobile money use; however, the quantitative meta-analysis shows the impact on business growth and internal efficiency is statistically small. In other words, the impact of networked devices, through

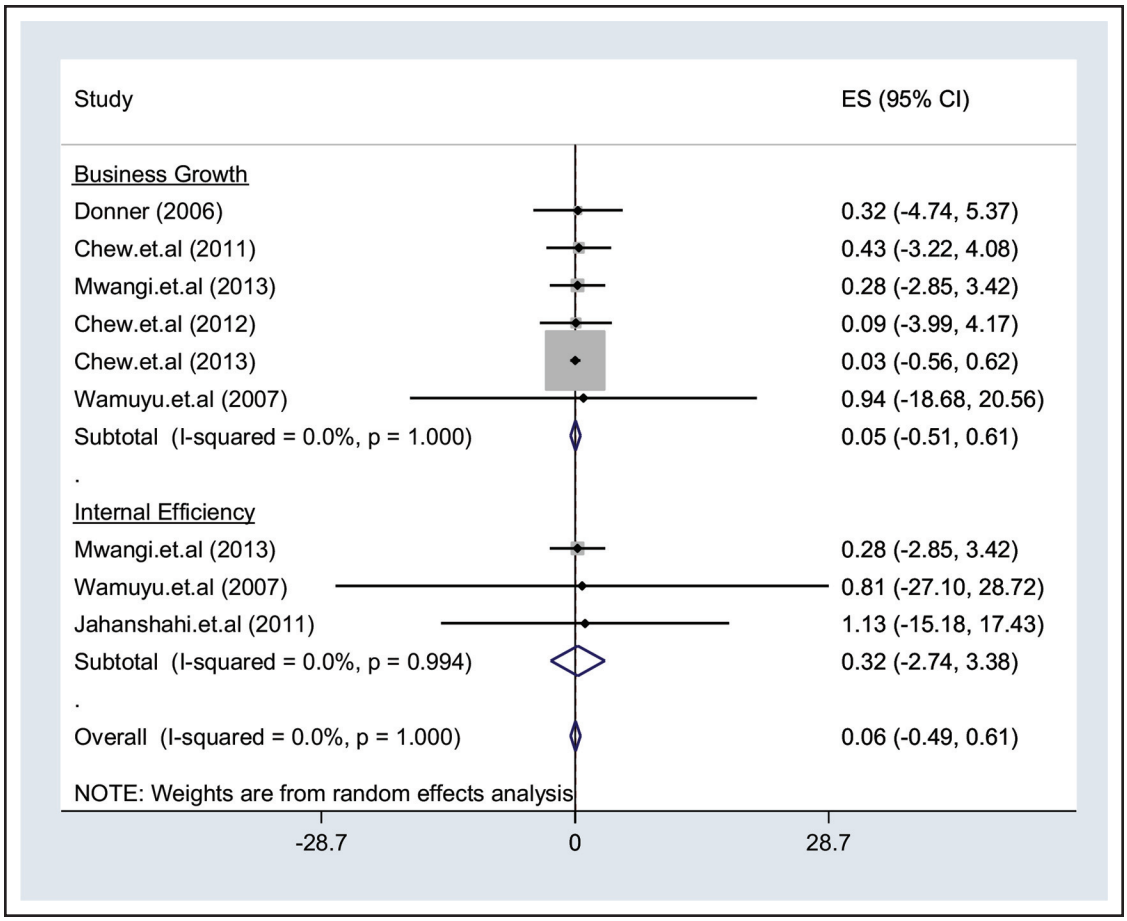

Figure 3. Forest plot based on impact (business growth and internal efficiency).
Source: Authors.

which business information is processed, on the business growth of urban MSMEs is not noteworthy. Hence, it may be wise for development practitioners who are promoting ICT-only interventions to contemplate whether to proceed further. As per the SR approach, the policy implications should emerge only from the review, and there are challenges in doing the same (see introduction to this Special Section).

It appears that any ICT-driven strategy to strengthen the MSMEs should not be a standalone one. There are supporting arguments (for instance, Toyama, 2010) for technology (especially ICTs) being unable to substitute for human intent and capacity. Business growth of the MSMEs is also determined by other sets of factors in addition to the ICTs, as well demonstrated as a general principle in World Bank (2016). The relationships among four different layers of ICT ecosystem (Fransman, 2010)—networked elements (all hardware manufacturers); networks providers; platforms, content, and applications; and consumers—are symbiotic and important.

The caution over ICT-led interventions applies predominantly to promotional programs funded by public or private resources. The cautions do not apply to ICT uptake by MSMEs on their own and with their own resources. Because the effects of ICTs are generally positive, according to the review, the government should avoid actions that would depress use such as excessive taxation of ICT services and devices.

The following gaps are identified for future research. A paucity of studies exists that follow rigorous methodology and reporting. Methodologies that attempt to unravel causal linkages should be emphasized. This

Table 8. Results for the Combined Effect Size on the Impact of Networked Devices on the Word drawing object 0001 removed by ALLMACSPREP.MSMEs.

Studies	Effect Size (ES)	[95% Confidence Interval]	
Mobile Phones			
Donner (2006)*	0.318	−4.738	5.375
Mwangi & Acosta (2013)***	0.285	−2.851	3.421
Chew, Ilavarasan, & Levy (2012)*	0.088	−3.993	4.168
Subtotal			
D + L pooled ES	0.250	−1.568	2.068
Mobile Phones +			
Chew, Levy, & Ilavarasan (2011)*	0.430	−3.217	4.077
Chew, Ilavarasan, & Levy (2013)*	0.028	−0.560	0.616
Wamuyu & Maharaj (2011)*	0.943	−18.676	20.563
Wamuyu & Maharaj (2011)**	0.811	−27.099	28.721
Subtotal			
D + L pooled ES	0.039	−0.541	0.619
Nonmobile Phones			
Jahanshahi, Gashti, Khaksar, & Pitambar (2011)**	1.128	−15.179	17.435
Subtotal			
D + L pooled ES	1.128	−15.179	17.435
Overall			
D + L pooled ES	0.060	−0.492	0.612

** Business growth; ** Internal efficiency; *** Both business growth and internal efficiency.*

suggests a move away from overreliance on survey methods,[4] whose datasets are cross-sectional in nature. Causal relationships are best captured by experimental designs (Babbie, 2013), where there are pre- and postperiod, longitudinal datasets for analysis. According to Banerjee and Duflo (2009), randomized control trials (RCTs) reduce the gap between researchers and policy implementers by clearly delineating the impact of intervention in quantitative terms. SRs, whose origins come from the health domain, tend to follow RCTs more than other methods. The domain under examination, the impact of ICTs on microenterprises, is likely to gain more credibility if the studies follow appropriate study designs to capture cause-and-effect relationships.

Rigorous probability sampling techniques should be adopted. Not belittling the efforts made by the research analyzed in this review, it was difficult to scrutinize the methods to increase the generalizability or representativeness of samples. It is possible that studies that followed rigorous sampling techniques were excluded because of weak reporting or non-use of inferential statistics.

The studies were predominantly from India and the African continent. Many low- and middle-income countries had no reported research, despite the wide net that was cast. Studies to understand ICTs' impact on MSMEs in these countries would be useful.

Among the ICTs studied, mobile phones were the most common. Some ICTs such as PCs predate mobile phones. Not all business functions can be performed using only mobile phones. Future research can look at the use of other ICTs, including the recent digital platforms, in a disaggregated manner, and each technology's impact on the internal efficiency and business growth of the MSMEs. Medium-sized enterprises are likely to use ICTs other than mobile phones.

4. A reviewer pointed out that the survey methods are useful in identifying the nature of ICTs used, including the applications. We agree with the observation. If MSMEs are not using ICTs and applications, causality would not be found in the survey or other methods. However, any use of ICTs and their impact could be better found through experimental designs. The survey methods involve post hoc analysis.

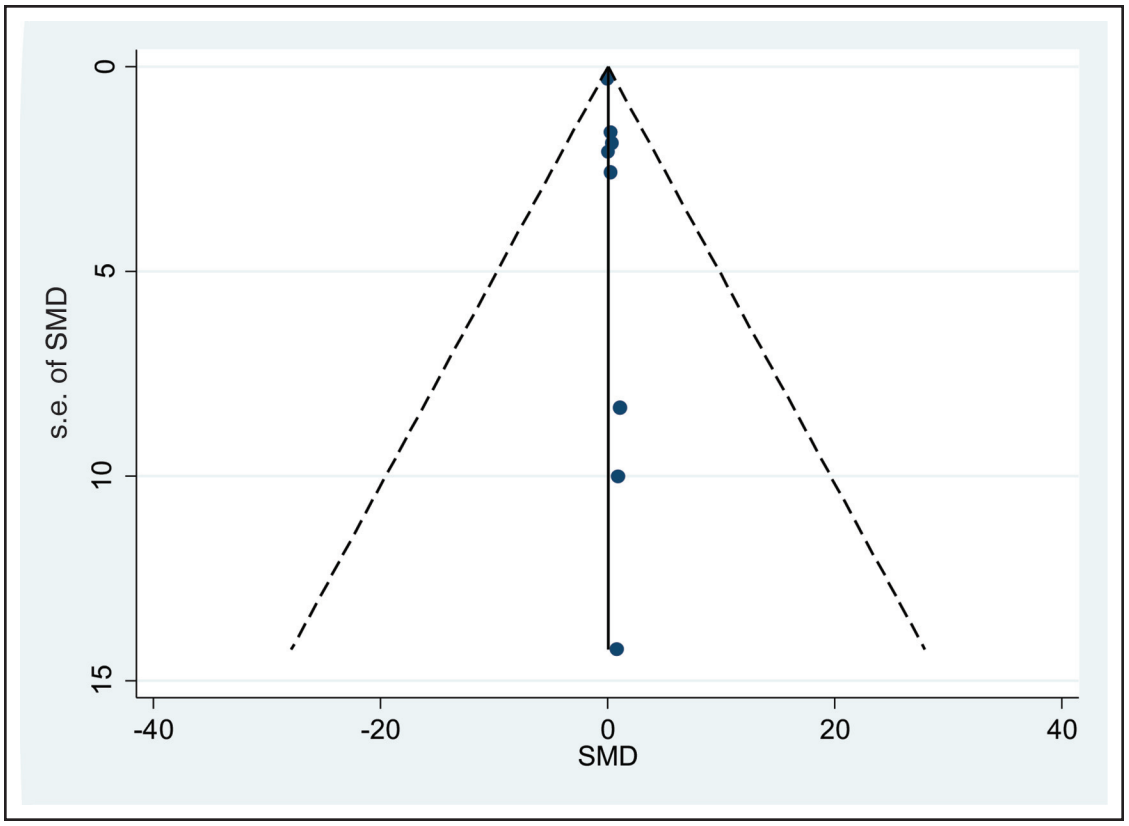

Figure 4. Funnel plot with pseudo 95% confidence limits.
Source: Authors.

Table 9. Eggers's Test for Publication Bias.

Std_Eff	Coef.	Std. Err.	t	P>|t|	[95% Conf. Interval]	
Slope	−0.004	0.023	−0.18	0.859	−0.058	0.050
Bias	0.129	0.027	4.750	0.002	0.065	0.193

Source: Authors.

The present SR focused only on the quantitative studies and was likely to miss the insights emerging from the qualitative studies. An SR focusing only on qualitative studies or mixed studies might reveal the use of different networked devices, including various ICT applications, by the MSMEs.

The relationships between ICTs and economic growth or internal efficiency can be recursive. In other words, an increase in business growth could result in investments in ICTs and their use. Except for Chew et al. (2011), the examined studies do not test this. The studies assume that ICTs lead to business growth or internal efficiency, which can be questioned. It is necessary to untangle these relationships. ■

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P. Vigneswara Ilavarasan, Associate Professor, Dept. of Management Studies, Indian Institute of Technology Delhi, India. vignes@iitd.ac.in

Albert Otieno, Independent Researcher, Kenya. otienoalbert1987@gmail.com

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