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?

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September 2017

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This systematic review was commissioned by LIRNEasia. This work was carried out with a grant from the International Development Research Centre (IDRC) of Canada and the Department for International Development (DfID) of the UK. The views expressed do not necessarily reflect the views of these departments.

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This report should be cited as:

Ilavarasan PV, Otieno A, Huang Y, Cabotaje C, Sahai G (2017) *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?* International Development Research Centre, Ottawa, Canada, and the Department for International Development, UK.

Contents

List of abbreviations

ACM	Association for Computing Machinery
AIS	Association for Information Systems
CDMA	Code Division Multiple Access
CI	Confidence intervals
CSCs	Common Service Centres
GDP	Gross Domestic Product
ICTs	Information and Communication Technologies
IDRC	International Development Research Centre
IEEE	Institute of Electrical and Electronics Engineers
MMS	Multimedia Messaging Service
MSMEs	Micro-, Small and Medium Enterprises
PCs	Personal Computers
PMS	Propensity Match Scoring
RCTs	Randomized Control Trials
SMD	Standardized Mean Differences
SMEs	Small and Medium Enterprises
SMS	Short Messaging Services
SSRN	Social Science Research Network
UNCTAD	United Conference on Trade and Development.
WLAN	Wireless Local Area Network

Abstract

The review question

Does access to business-relevant information through networked devices enhance the internal efficiency and business growth of the urban micro-, small and medium enterprises in low- and middle-income countries?

Who wants to know and why?

In the developmental-policy domain, micro-, small and medium enterprises (MSMEs) are treated as significant sources of employment and livelihood for the poor in low- and middle-income countries. It is argued that the rapid advancements in Information and Communication Technologies (ICTs) has made it possible for MSMEs to reach previously inaccessible goods and services, as well as the labour market. It is also argued that networked ICT devices, such as mobile phones, have resulted in positive outcomes for MSMEs in these countries. The present systematic review attempts to validate the above assumptions and the authors hope that it will be of benefit to policy-makers, academics and development practitioners and researchers.

Methods of the review

Using a set of keywords, electronic databases and grey literature were searched for the period 2000 onwards. From the initial results of more than 24,000, ten research studies were included for the final analysis. The following inclusion criteria were used: whether the study was conducted in urban localities; whether the study was conducted in the listed low- and middle-income countries; whether the study contributes to understanding of MSMEs (maximum of 250 employees and annual turnover of less than €50m for an enterprise); whether the study includes numeric data; whether the MSMEs studied use at least one networked device; whether the MSMEs studied process business-relevant information; and whether the study is published in English.

All the studies that used experimental and non-experimental designs were included. Access to business-relevant information by the MSMEs for business-related activities through networked devices was used as the intervention for inclusion. The review also considers as the outcomes causal linkage between ICT and the internal efficiency or the business growth of MSMEs. Studies also met inclusion criteria if they were conducted in low- and middle-income countries.

For synthesis, meta-analysis was conducted using the Stata software, where subgroup analysis was performed based on the outcome, internal efficiency or business growth of MSMEs.

Results

Of the final papers, the period of work is 2007-2014; the location of studies is split between India and the African continent. Five studies have followed the probability sampling method, with sample size ranging from 100 to 560 (except one study, with 3,691). All but one of the studies used self-reported data pertaining to the use of ICTs.

The review showed that the volume of business calls has increased with the increased use of mobile phones. ICT usage and possession predict the labour productivity of MSMEs.

Operational support, strategic development and process improvement and operational performance are enhanced by the use of networked devices. With increased purchase of mobile phones, there is an increase in the number of customers. The higher ICT expenditure results in greater turnover of the enterprises. The profits of the enterprises have increased with use of mobile money.

The meta-analysis shows that networked devices have a very small positive trend on the growth of MSMEs, with overall effect size of 0.047 and a confidence interval of (-0.513, 0.606). The meta-analysis results did not support the premise that the communication of business-relevant information through networked devices as an intervention led to improved internal efficiency. The pooled effect was 0.321 ($p = 0.837$).

Implications

The review showed that the impact of ICTs on the growth of MSMEs is small. The ICTD domain and the information-systems domain still lack adequate causal studies that link ICTs and access to business-relevant information to growth of MSMEs. Any theory of large-scale policy interventions of ICTs for MSMEs is in need of further evidences. The review highlights the gaps for future researchers to explore and underlines the policy relevance of the empirical research. The suggestions include: undertaking causal studies with rigorous methodology and reporting, including randomized control trials (RCTs); adapting probability-sampling techniques in order to avoid biases; moving beyond India- and Africa-based studies to improve understanding; considering networked devices other than mobile phones; testing for recursive relationships between ICTs and business growth; and performing disaggregated analysis of subgroups in relation to different business-relevant information.

1. Background

Outline of chapter

This chapter introduces the research question examined by the systematic review. It describes the definitional and conceptual issues confronted by the review. It presents the review of earlier work done in the selected domain, and highlights the need for the review. The background of the authors of the review are shared and the potential users of the review are indicated.

1.1 Aims and rationale for current review

The objective of this systematic review is to examine the evidence as to whether access to business-relevant information through networked devices enhances the internal efficiency and business growth of urban micro-, small and medium enterprises (MSMEs) in low- and middle-income countries (LMICs).

MSMEs play a crucial role in the economic growth and job creation of both developing and advanced economies (Stein et al. 2010). MSMEs offer a broad range of employment opportunities and play an important role in reducing urban poverty.

The studies of information and communication technologies (ICTs) in this space are moving from capturing adoption to understanding impact (see, for instance, Chew et al. 2011). The adoption studies are conclusive about the level of adoption of ICTs[1] by MSMEs; mobile phones lead the pack of ICTs and voice-based communication systems in the personal domain. The studies of the impact of ICTs, especially in relation to the growth of MSMEs, seem to be unclear (Chew et al. 2011).

For instance, Chowdhury and Wolf (2003) found that the investments made in ICT by small and medium enterprises (SMEs) in East Africa determines the market expansion through better access to information, but have no effect on enterprise return and export performance, and have a negative impact on labour productivity. To quote Murphy (2013), “While 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” (p. 1,770).

With the rise of networking capabilities, through widespread use of the internet and of low-cost technologies such as mobile phones, questions are being asked as to whether these networked technologies are resulting in overall economic growth, at least for MSMEs. With confusion persisting over the impact of information and knowledge mediated through networked devices on MSMEs, this review is the first of its kind to attempt a conclusion.

[1] According to the World Bank (n.a), “ICTs consist of the hardware, software, networks, and media for the collection, storage, processing, transmission and presentation of information (voice, data, text, images), as well as related services." (ICT Glossary Guide).

The review aims to identify the contexts in which information and knowledge disseminated through networked devices may or may not contribute to the growth, or even to increasing internal efficiency of, MSMEs. Some of the most commonly used types of indicator in the assessment of MSME's growth and internal efficiency include those related to: time saving, increase in sales, turnover, number of employees, branches, customers, suppliers, work locations, partnerships, products, services, business networks, and incoming referrals, diversification into new areas of business, and inventory management, among other areas.

The review focuses on urban MSMEs, since half of the world's 6.5bn people now live in cities and, over the next 30 years, almost all global-population increase is projected to occur in the urban areas of the developing world (United Nations Department of Economic and Social Affairs Population Division 2006). As the world movies towards greater urbanization, understanding of ICTs in urban MSMEs will provide evidence-based support for policy-making. Also, direct and positive correlation has been demonstrated between the urban percentage of population in low-income nations and higher scores on the UN's Human Development Index (United Nations Department of Economic and Social Affairs Population Division 2006). As MSMEs are populated by micro-enterprises, which are owned by either poor or low-income population groups (Stein et al. 2010), the findings from this review are directly applicable to the poor.

We hope that the outcome of this review will benefit the policy agents in LMICs to support or rethink their approaches in supporting or encouraging MSMEs and penetration of ICTs in their respective countries. **Error! Reference source not found.**

The present systematic review is important on many counts. MSMEs are a significant source of employment and channel of livelihood for the poor in LMICs across the world (Ghanem 2013). It is assumed or propagated in the development domains (see, for instance, Consoli 2012, Duncombe and Heeks 2005) that the rapid advancements in technology, particularly ICTs, have made it possible for MSMEs to gain access to some goods and services, as well as to the labour market, which may have previously been beyond their reach. Further, increased access to information and knowledge, as well as the opportunity to participate in knowledge networks through the use of ICTs and globalization, have led to increased opportunities for MSMEs to integrate into global markets. The review will examine these assumptions.

The review also attempts to validate the existing broad notion that networked devices such as mobile phones, computers with internet and internet cafes, result in positive outcomes for MSMEs in LMICs. This notion is widely propagated in the policy documents of national governments, international agencies[2], and even in the academic literature (Heeks 2008). Although we are not belittling the reveal attempts made by these players to create the evidences, a closer look at the field does not show repeated evidences. The most cited studies on the impact of mobile phones (Jensen 2007 and Aker 2008) are either not being replicated or there are other studies that are not widely visible to the researchers. The impact of ICTs on enterprises is debated as being between no impact (see, for instance, Carr 2004) and having both negative and positive impact (see, for instance, Chowdhury and Wolf 2003) due to the nature of MSMEs (Esselaar et al. 2007), or minimal

[2] See, for instance, http://www.infodev.org/infodev-files/resource/InfodevDocuments_19.pdf

impact (Chew et al, 2011). Duncombe and Heeks (2005) offered a valuable framework to examine the use of ICTs by MSMEs to alleviate poverty, but the empirical evidence is sparse.

Deducing inferences from macro studies (national-level data) (Katz 2012) that links mobile penetration or broadband subscriptions to GDP for micro-level (individual-level) impact is a case of ecological fallacy. For instance, deeper broadband penetration may result in an increase in GDP, but not necessarily increased revenue for micro-entrepreneurs. The review includes both macro and micro empirical studies.

It is needless to elaborate on the idea that the presentation of the importance of MSMEs to national development in terms of employment provision and related livelihood opportunities is abundant. MSMEs in LMICS experience higher mortality rates and suffer from many challenges, including lack of access to market information, an onslaught of global competition, infrastructure woes, poor manpower availability, lack of connectedness and technological obsolescence (Liedholm and Mead 2009). The emergence of ICTs appears to circumvent many of these challenges. With a gradual decrease in the cost of hardware and a blurring the line between computers and handheld devices, along with increasing access to broadband, the availability of previously privileged information to the market seems to have been achieved. Out of these much-discussed ICTs, mobile phones are leading the pack (Ilavarasan and Levy 2011, LIRNEasia 2014). The penetration of other networked devices, such as desktop computers and laptops with internet, is minimal among MSMEs (Ilavarasan and Levy 2010, 2012; Esselaar et al. 2007; LIRNEasia 2014). As a consequence, it is important to examine whether these devices, especially mobile phones, have enabled MSMEs to overcome the challenges and achieve better economic-growth status.

Among all the networked devices, the literature highlights the ubiquity of mobile phones, especially among the lower-class population categories or bottom of pyramid, and its positive impact on many domains[3], which include empowerment, economic-growth opportunities, and transparent governance (see Sen 2010). The review also looks at whether these phones have served the purpose of enabling access to information that is relevant to users such as MSMEs in achieving positive results.

The ownership of devices alone is inadequate to achieve the desired outcome, as the relevant usage determines the outcome of the device. For instance, studies of the use of mobile phones by micro-enterprises indicate dominance of the personal domain, rather than the business domain (Donner 2009, LIRNEasia 2014). Also, an understanding of the causality of the relationship between the device and outcome is important in deciding the primacy of the actor.

1.2 Definitional and conceptual issues

We attempted to examine whether access to business-relevant information through networked devices enhances the internal efficiency and business growth of urban MSMEs in LMICs.

[3] See here for detailed multi-country studies: http://lirneasia.net/projects/2008-2010/bop-teleuse-3/.

The extant literature is abundant and is consensual about adoption and diffusion of ICTs among MSMEs in LMICs. Cost barriers to ICTs are lowering, especially of the internet and mobile phones (Pew Research Center 2014, Qiu 2009). However, agreement emerging from the quantification of impact of ICTs on MSMEs, as explained above, seems to be unclear (see, for instance, Duncombe 2009). This review attempts to fill this gap.

We selected *access to business-relevant information through use and access of networked devices* as the intervention in the review. Any tool through which users can receive and send information to other users is treated as a networked device and should be electronic. Examples of networked devices include: mobile phones, computers, laptops, tablets and phablets[4]. Although the value of non-networked ICTs brings value to the enterprises, the networked nature of the devices or the interconnectedness of technologies generates higher value to MSMEs (Piscitello and Sgobbi 2004). For example, an invoice-generating software takes less time than does manual preparation, but the value to the enterprises increases when the invoice is sent to the buyers immediately, thereby possibly reducing the credit-cycle time.

The focus here is on the networked nature of the intervention, which refers to the use of such devices as the medium of information exchange, or an interactive communication process, in spite of its ownership, electronic nature or one-way communicational impacts. In other words, only when the intervention fosters the "exchange" of information, can it be regarded as "networked". The users — that is, the MSMEs, need not necessarily own these networked devices. The devices can also be of public access. For instance, an MSME accessing a computer via an internet cafe will be treated as a networked device. Or, for example, the use of mobile phones to send business-related SMS should be included, while the use of the same device simply as a calculator should be excluded. Similarly, the use of a laptop or a computer will be included only when they are connected to the internet or an intranet. Television will not be included in this review, as an MSME receives the information from it and will not use it to send information.

The networking nature of the devices will be completely open, as it will either be restricted to a particular location or set of devices. The networking can be enabled by MSMEs themselves or by an external agency — government, private or a non-governmental organization (NGO). Access to the network can also be either paid, shared or non-paid.

The business-relevant information is any information that is used by the MSMEs for business-related activities. The information types are multiple and are often interrelated. The examples include communication from employees to owners and communication among employees that is related to the enterprise (simple examples include availability or non-availability of workers for work and location of owners), communication with customers, suppliers and partners (for example, conveying the status of orders to the customers or placing an order with suppliers), informal communication with business friends or networks to gauge the market, the market prices of inputs (raw materials, labour, transport, etc.) and products, and special services catering for MSMEs (for

[4] A smartphone having a screen that is intermediate in size between that of a typical smartphone and a tablet computer (Source: http://www.oxforddictionaries.com/definition/english/phablet).

example, government policies regarding business registration, tax incentives or other programmes).

We assume that MSMEs that receive business-relevant information through networked devices will use them to achieve greater internal efficiency and business growth of the enterprise (see, for instance, Donner and Escobari 2010). For example, intimation of the arrival time of a pick-up truck from the transporter will enable a micro-enterprise to inform the customers of the likely time of delivery, resulting in better customer-relationship management and increasing the likelihood of repeat sales.

Ilavarasan (2004) indicates that there is no universally accepted standard definition of an MSME. The definition of MSMEs varies between countries. Some of the factors used in definitions are: number of employees; nature of work contract of employees; annual turnover; investment; shareholders' fund; gross income; and value of fixed assets. If this review were to consider country-specific definitions, there is a risk of non-generalization of the findings. As a nominal definition, the review has retained a workforce of 250 employees as the outer boundary to defining a MSME. This outer boundary is taken from the definition of the European Union (EU), which defines a medium enterprise as one with fewer than 250 employees and annual turnover of less than €50m[5].

We acknowledge that the EU's definition may not be appropriate for LMICs. The review has made efforts to differentiate the conclusions on the basis of number of workers. The other factor in the definition, annual turnover, is also retained, allowing inclusion of small high-technology start-ups with fewer employees, who, nevertheless, are able to achieve this level of turnover.

The review includes only MSMEs that are operating out of urban locations. It did not differentiate the nature of industrial or business domain in which the MSME is operating (manufacturing, services or trade). Even MSMEs operating on a business related to agriculture, such as those selling fertilizers or seeds, will be included, provided they are located in an urban area. The literature indicates that the ICTs are used differently by different domains (Ilavarasan and Levy 2010, UNCTAD 2008).

The internal efficiency of the MSMEs in respect of the focus of the review, information and networked devices, are implied by multiple factors: the amount of time take by the enterprises while engaging in business (less travel due to networked devices); ability to manage home and work (particularly for women entrepreneurs); availability of market requirements to optimize the production or service-delivery process and inventory management; coordination with the employees and between different functional units within the enterprise, improving productivity; enhanced channels for customer feedback, improving customer-relationship-management practices; improvement in managing business networks, in respect of customers and suppliers; and increased access to finances due to inflow of information from various sources, etc. Heeks and Duncombe (2005) delineated four possible roles for ICTs in the internal processes of MSMEs, which can be extended to this review. The four major areas are: *value-chain core* (internal core operations of the business), *value-chain boundaries* (to contact current and new customers, suppliers, etc.), *value-chain support* (accessing information about supply and

[5] http://ec.europa.eu/enterprise/policies/sme/files/sme_definition/sme_user_guide_en.pdf

demand, and policy guidelines) and *networking support* (connecting with social networks and building social capital with other businesspeople).

Business growth is measured not just by increase in turnover or revenue. As the focus is on MSMEs, multiple facets of business growth are considered: increased sales, turnover, number of employees, number of customers, number of suppliers, expansion of work premises, moving to a larger premises, shifting from rented location to owned, number of branches, number of service offerings, number of products, business networks, new partnerships and inflow of referrals for business.

The impact of business-relevant information on the internal efficiency and business growth of MSMEs is enhanced by the use of networked devices. However, there are other intervening factors that influence this relationship. Some of the possible factors are the characteristics of MSMEs (age, size, industry domain, nature of employees, nature of customers and suppliers (walk-in, domestic, export, and ownership pattern etc.), characteristics of owners (age, education, ICT literacy and English-language capabilities, etc.), policy environment (protective of MSMEs, financial incentives for internationalization, and skill-development facilities, etc.), gender, and national-culture-specific factors such as paid-employment preferences, and labour participation-rate of women in poor demographics, etc.). These important external factors are context-specific and are taken into account in the review. However, these factors will not be used for filtering the literature, but in the synthesis of the findings. The review will attempt to sift the findings in the light of these external factors. While conducting analysis, the review will consider the assumption that the business-relevant information through networked devices might result in internal efficiency, which, in turn, will result in business growth.

1.3 Research background

To our knowledge, no systematic review in the proposed area has been performed to date[6]. There are some reviews of ICTs in MSMEs, but these suffer from inadequate rigour in the reviewing process. For instance, Barabara-Sanchez et al. (2007) and Ongori and Migiro (2009) claimed that they have done both a "critical review" and a "literature review", but failed to elaborate on how studies were chosen for review and examined, and how findings were synthesized. The approaches of these studies were ad-hoc, rather than systematic. One study, Donner and Escobari (2010), clearly followed systematic-review methodology, but restricted itself to mobile phones and omitted other networked ICTs. One more study (Donner 2008) reviewed an impressive 200 studies, but again focused on mobile phones, and failed to provide a numerical analysis of the literature. Given this inadequacy in the field and vigorous pursuit by policy-makers in pushing ICTs, especially networked ones, there is a dire need for a systematic review to support their claims and policy initiatives.

[6] An attempt is being made to conduct a systematic review of the impact of mobile phones on rural enterprises and households (see here for further details: http://www.3ieimpact.org/en/evidence/systematic-reviews/details/249/). Duncombe (2015) provided a systematic review of the role of mobile-phone use in agriculture and rural development. The proposed review differs in terms of the focus on networked devices, internal efficiency and business growth of micro-enterprises located in urban areas.

Rather than restricting ourselves to mobile phones, this review broadens the scope by including other networked devices, as there are possibilities of other handheld devices being made available by the market or the government in LMICs[7].

1.4 Authors, funders and other users of the review

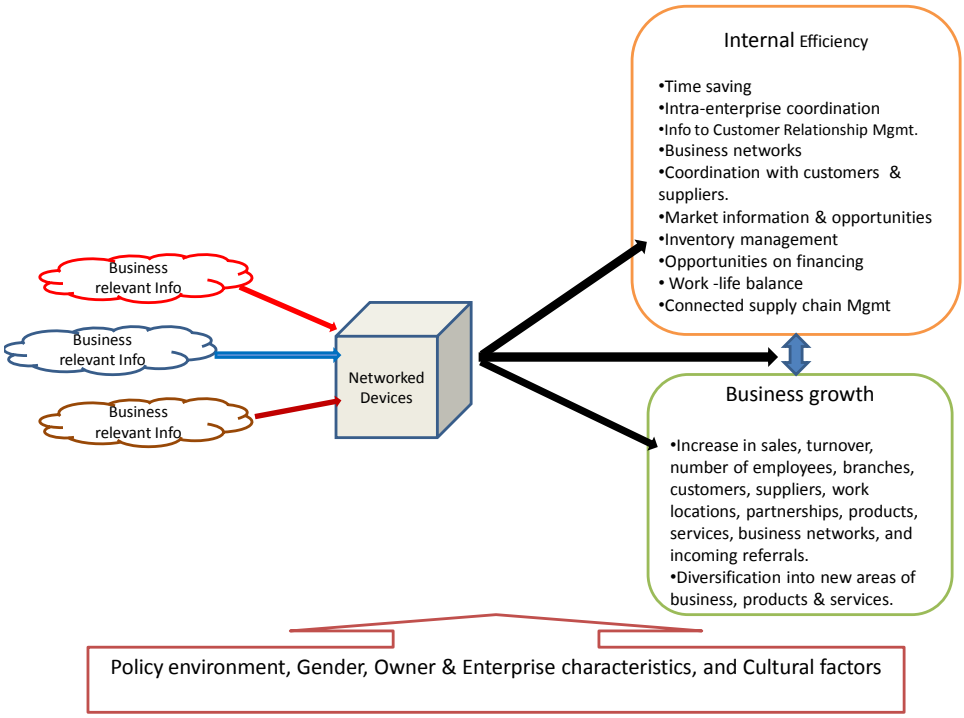
The review was carried out by P Vigneswara Ilavarasan (PVI), Albert Otieno (AO), Ying Huang (YH), Charlie Cabotaje (CC) and Garima Sahai (GS). PVI served as the project lead. All members undertook the study as an independent research, alongside their regular employment. None of the content in this review represents the views of the respective employing institutions or organizations. All the team members worked on the review on a part-time basis. The review was carried out in an independent manner. The output of the research is in the public domain and the research was undertaken for non-commercial reasons.

The review is intended for the use of policy-makers, academics and development practitioners who work in the area of ICTs and MSMEs.

1.5 Review questions

The present review aims to assess and synthesize research evidence on the impact of access to business-relevant information through networked devices on internal efficiency and business growth of the urban MSMEs in LMICs. This is presented schematically in Figure 1.1.

Figure 1.1: Role of networked devices in causal relationship between business-relevant information and its impact on MSMEs.



[7] For example, the Government of India is giving US$2bn-worth of free mobiles and tablets to the country's student community. http://www.financialexpress.com/news/rs-10000-cr-plan-in-the-works-to-give-free-mobiles-tablet-s/1165642

The review operationalized networked devices as electronic tools, through which users can receive and send information to other users. The business-relevant information is defined as any information that is used by MSMEs for business-related activities. The review used a nominal definition of MSMEs, adapted from the EU, with an outer boundary of 250 employees and annual turnover of less than €50m. The review included only MSMEs that are operating out of urban locations. The internal efficiency of the MSMEs is implied by multiple factors. Examples include the amount of time saved by the enterprises while engaging in business due to less travel, efficient management of home and work, and coordination with the employees, etc. Multiple facets of business growth are considered. Examples include increased sales, turnover, number of employees, customers, suppliers and expansion of work premises, etc. The list of LMICS as defined by the World Bank is used by the review.

2. Methods used in the review

Outline of chapter

The chapter presents the inclusion and exclusion (I/E) criteria by which relevant studies were defined and identified from all the possible sources. It describes the process by which sources were searched for and screened. It briefly explains the method by which quality was assured while identifying and describing the studies. The chapter also explains how the researchers reviewed and synthesized the evidence from the studies.

2.1 Identifying and describing studies

2.1.1 Defining relevant studies: inclusion and exclusion criteria

The review followed the following criteria to search for studies to be included:

Criteria for considering studies in this review

Population:

Studies should have been conducted in LMICs. The review used the list of countries provided by the World Bank.[8] The MSMEs in question should be located in urban areas, as reported by the authors of the study. The studies should have given a definition for MSMEs. The studies of MSMEs with no more than 250 employees and annual turnover of less than €50m or equivalent were included.

Interventions:

"Business-relevant information" is defined as any information that is used by MSMEs for business-related activities. The examples include, communication from employees to owners, and among themselves, which are related to the enterprise (simple examples include availability or non-availability of workers for work and location of owners), communication with customers, suppliers and partners (for example, conveying status of orders to the customers or placing an order with the suppliers), informal communication with business friends or networks to gauge the market, current market prices of inputs (raw materials, labour, transport, etc.), and products, and special services catering for MSMEs (for example, government policies regarding business registration, tax incentives or other programmes). The studies should explicitly mention that the information is being used for, or is relevant to, the business.

Any tool through which the user can receive and send information to other users is treated as a *device*. Examples of networked devices include: mobile phones, computers, laptops, tablets and phablets.

[8] http://data.worldbank.org/about/country-classifications/country-and-lending-groups#Low_income

Outcomes:

The review looked at the causal linkage between ICTs and the internal efficiency and business growth of MSMEs. The examples for the internal efficiency of MSMEs include the following: the reduction in the amount of time taken by the enterprises while engaging in business; availability of market information; coordination with the employees; receptivity to customer feedback, etc. The business growth is measured by an increase in turnover or revenue, increase in sales, number of employees, number of customers, number of suppliers, expansion of work premises, moving to a larger premises, shifting from rented location to owned, number of branches, number of service offerings, number of products, business networks, new partnerships, and inflow of referrals for business, etc.

Study types:

All the studies that used experimental and non-experimental designs are included. Among the non-experimental designs, exclusive qualitative studies were omitted. The exclusive qualitative studies are not excluded, if they present the causal relationships in numerical forms. As the review is focusing on causal relationships, studies that use only descriptive statistics are excluded. The studies that did not include networked devices or business-relevant information as part of investigation are excluded. The review included only studies that are published in English.

Time period:

The review included studies, both published and grey literature, that are available from 2000, the year in which the Millennium Development Goals of the United Nations were set. Goal 8 has Target 8F: "... to make available benefits of new technologies, especially information and communications."[9] The literature was scanned in multiple databases up to June 2014.

2.1.2 Identification of potential studies: search strategy

A set of keywords for each of the components was prepared on the basis of the requirements of the review. The list was shared with an external information scientist to search for studies. After testing out different combinations, the scientist used a set of keywords that are slightly different from the one proposed. See Appendix 1.2 for the keywords used by the scientist. The terms related to urban location were not used, as they excluded a greater number of studies, and the research team wanted to have wider coverage of studies for the screening. The databases searched were: Acad Search, Business Source, Econlit, Scopus and Web of Science.

In addition to the above databases, the following institutional databases and collections were used; these were searched using the search option in the respective databases, or through the Google search engine using keywords such as www.idrc.ca+SMEs: Infodev, World Bank, DIME, JOLIS, IMF, DFID's Research for Development, IDRC's Digital Library, IDEAS, J-PAL, ELDIS, British Library of Development Studies, Millennium Challenge, USAid, FAO, UK Theses Ethos, US/Canada Dissertations and SSRN. Each database or collection was assigned to a single team, which searched using the keywords, both individually and in

[9] http://www.un.org/millenniumgoals/global.shtml

combination: MSMEs, SMEs, microenterprises, enterprises, ICTs, mobile phones and computers.

Further, a third set of databases, comprising ACM Press, IEEE Xplore Digital Library and AIS Electronic Library, was also searched using the search option. The keywords were the same as above.

2.1.3 Screening studies: applying I/E criteria

The search results from the information scientist were uploaded to the EPPI Reviewer 4.0 (Thomas et al. 2010), a web-based application that managed and processed the literature review.[10] All the studies were divided across five members of the review team. The following set of filters was used to select the studies for the next stage of screening:

- Whether the study is conducted in an urban area.
- Whether the study is conducted in the listed LMICs.
- Whether the study offers something on MSMEs (maximum of 250 employees and annual turnover of less than €50m for an enterprise).
- Whether the study has numeric data.
- Whether MSMEs examined in the study use at least one networked device.
- Whether MSMEs examined in the study process business-relevant information.

The reviewers read the titles and abstracts and excluded the studies that did not meet the criteria. The studies for which a decision was not made due to inadequacy of information were moved to the next stage. In the second stage, studies were redistributed to the reviewers (PVI, AO, GS) in such a way that a study was reviewed by at least two reviewers. At this stage, two additional criteria were included: publication in or after 2000, and duplication of studies. In the next stage, full texts were downloaded from the relevant sources. The methodology sections of the studies were read by the reviewers to select the final studies (PVI, GO, GS). At least two reviewers reviewed each of the full papers.

The results from the second and third sets of databases were screened directly by the respective member by reading the titles and abstracts.

2.1.4 Identifying and describing studies: quality-assurance process

The screening of three datasets resulted in a total of 30 papers being selected. All the papers either met the criteria or were unclear on some parameters. The senior member (PVI) wrote to the authors of the papers or studies directly, seeking further clarification, mostly on the location of the studies. The studies that were clearly identified as urban-based were included for the full screening. Few studies had mixed locations and did not present disaggregated data for urban or rural. After failing to get a satisfactory response from the authors, they were discarded. The discarding of papers was done after discussion between the two review members (PVI, AO). After this entire process, a final set of ten studies was included for full-text screening and data extraction. The list of papers is given in Appendix 2.2.

[10] Further details are available here: http://eppi.ioe.ac.uk/cms/Default.aspx?tabid=2967

2.2 In-depth review

2.2.1 Moving from broad characterization (mapping) to in-depth review

Two senior members (PVI, AO) of the team extracted data from each of the final papers. The research question was broken down into small components, for which information was extracted from each of the studies. An Excel spread sheet was used for data extraction, with the following column headings:

- Paper-identification number
- Authors; year of publication
- Title of the article chapter
- Other publication details (journal name, book, editor details, issue no, page numbers, etc.)
- Summary
- MSME location
- MSME nature of business
- MSME number of employees
- MSME turnover
- MSME business domain
- MSME age
- MSME ownership
- MSME export intensity
- MSME owner gender
- MSME owner age
- MSME owner literacy
- MSME owner Mathematical skills
- MSME owner first-generation entrepreneurship
- Country
- Sample size
- Sampling technique used
- Year of study
- Nature of statistics used in analysis
- Information on policy environment
- Information on cultural factors
- Exclusivity of quantitative method in the study
- Nature and type of ICTs used
- Nature and type of networked devices used
- Nature and type of business-relevant information processed by MSMEs
- Impact on internal efficiency
- Impact on business growth
- Role played by networked devices
- Dependent variables; predictor variables

2.2.2 Detailed description of studies

After data extraction for each of the components listed above, PVI and AO compared notes. When there was a disagreement, they discussed and finalized the findings. One final Excel spreadsheet was prepared for further use in the review.

2.2.3 Assessing quality of studies and weight of evidence for the review question

AO took the lead in conducting the risk-of-bias assessment for the final studies. The extant research (for example, Higgins et al. 2003, Kjaergard et al. 2001) argued that studies that have questionable methodological quality are prone to a number of biases, which may include overestimation of the positive effects, underestimation of the negative effects, or systematic error. To assess the risk of bias for the included studies, the *Cochrane Handbook for Systematic Reviews of Interventions* by Higgins and Green (2008) was adapted. The adaptation is necessary, as the final studies are survey-based and the actual framework is intended for use with experimental designs. The following domains were used to assess the risk of bias among the final included studies: *selection bias* (whether respondents/research subjects were allocated to control and experimental groups at random), *incomplete outcome data* (how the incomplete outcome data were handled), and selective reporting (reporting of selected outcomes) (Table 3.1).

The final studies were retained if there was some information on the components related to the research question. These studies met the I/E criteria that were used to screen the studies earlier: studies conducted in urban locations of LMICs, on MSMEs, that discussed at least one networked device, used numeric data and MSMEs processing some business-relevant information.

2.2.4 Synthesis of evidence

The data were extracted from the final studies and compared to answer the research question under scrutiny. First, a narrative analysis of the final papers was presented, followed by meta-analysis of the quantitative data. The Stata (version 12) software was used to analyse the data. Since most studies reported continuous outcomes, standardized mean differences (SMDs) with 95%-confidence intervals (CIs) were calculated as the differences in means, and $\alpha = 0.05$ was used as the statistically significant level. I^2 was calculated based on a fixed-effect model to test for the heterogeneity between the studies. Lack of heterogeneity of below 50% was noted for the values of I^2. A funnel plot was used to estimate the risk of publication bias, along with other tests for significance to check the publication bias in the final papers. Details of computation of the effect size is presented in Appendix 2.2.

2.2.5 In-depth review: quality-assurance process

The final ten papers were reviewed and data were extracted independently by two reviewers (PVI and AO). The two data-extraction Excel spread sheets were combined. Whenever there was a disagreement, the two reviewers discussed and finalized the findings. For each study, the risk of bias was assessed to be either *high-risk*, *unclear risk* (for studies with insufficient information to be used in judging the bias), or *low-risk*. For final analysis, only one Excel spread sheet of data extraction was used.

3. Identifying and describing studies: results

Outline of chapter

The chapter details the number of citations resulting from the search process and how the final set of studies was arrived at. It provides a detailed descriptive account of the final studies. It shares the outcomes of quality assurance by calculating the risk of bias. It also gives a brief summary of the final studies.

3.1 Studies included from searching and screening

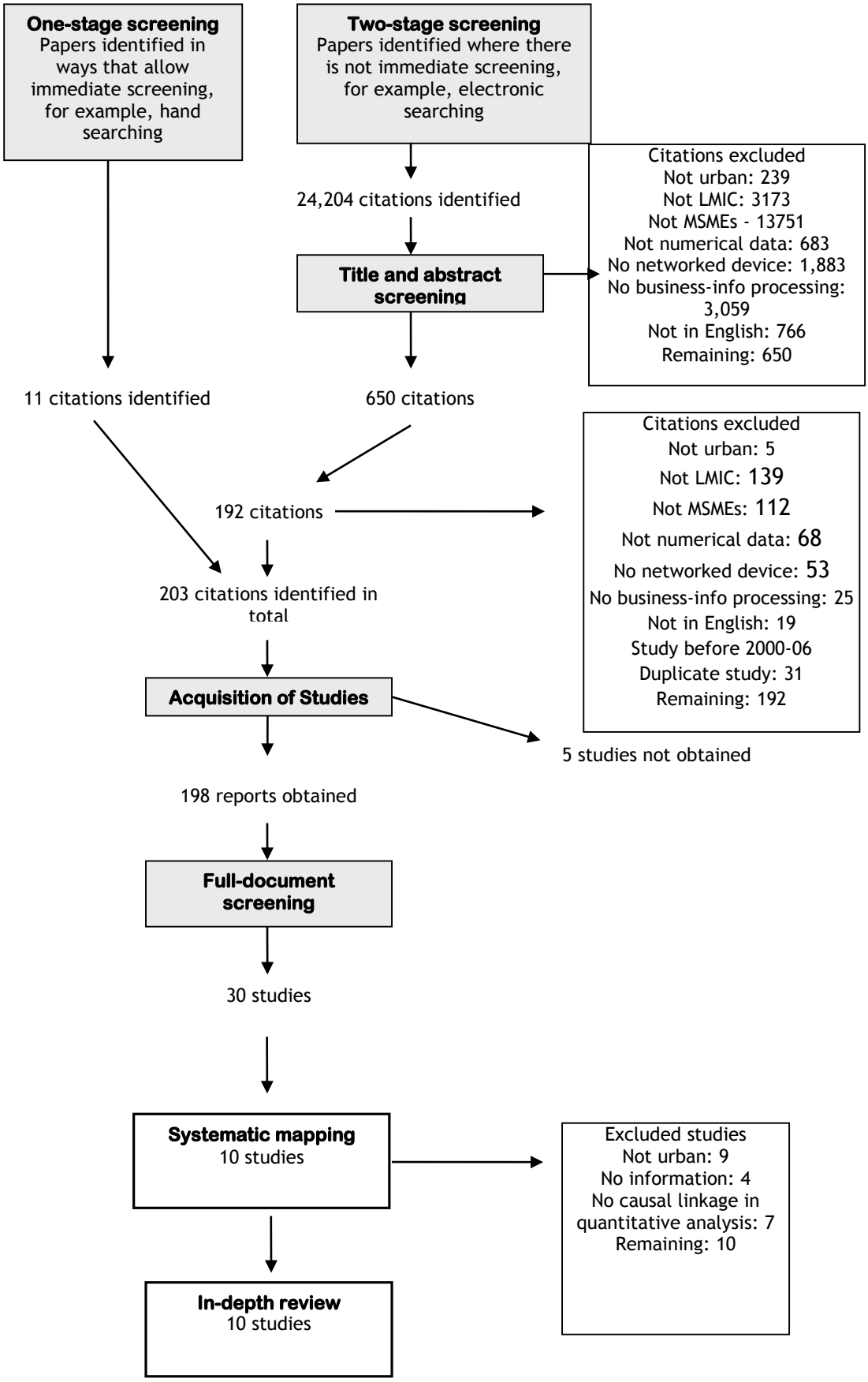
A total of 23,926 citations were found by the information scientist using the keyword search. The reviewers read the title and abstract and excluded the studies that did not meet the criteria. The studies for which decision was not made due to inadequacy of information were moved to the next stage. In the second stage, we had 650 studies. These 650 studies were redistributed to the reviewers in such a way that a study has been reviewed by at least two reviewers. In this stage, there were 192 studies remaining. In the third stage, for these 192 studies, full text was downloaded from the relevant sources. At least two reviewers reviewed each of the studies. Nineteen studies were shortlisted by this process. A manual search using key words in institutional databases was followed by screening of keywords and abstracts, resulting in nine studies. Screening of search results from the databases that formed dataset 3 resulted in two studies. A total of 30 papers were found after the above processes were completed. All the papers either met the criteria or were unclear on some parameters. Studies for which there was no clarity on location or on statistical parameters used in the analysis, even after receiving the responses from the authors, were discarded. After completion of this entire process, a final set of ten studies was included for full-text screening and data extraction. The list of final papers is given in the References chapter of the report. The entire screening process to arrive at the final papers is summarized in Figure 3.1.

3.2 Characteristics of the included studies (systematic map)

For the final ten papers, the period of work is 2007-14 and the location of studies is split between India and the Africa. Although these studies are not representative of all LMICs, the final list indicates the need for undertaking rigorous empirical studies in other countries.

All the studies adapted a survey as a method for data collection. RCT studies are not present in the domain undertaken for this systematic review. According to Banerjee and Duflo (2009), RCTs reduce the gap between researchers and policy implementers. The paradigm of systematic reviews and evidence-based summaries in the field of medicine is enriched by the RCTs. Not belittling the survey designs, which are *ex post facto* driven, the causal relationships are best captured by the experimental designs (Babbie 2013).

Figure 3.1: Filtering of papers from searching to map to synthesis.



The domain under examination, impact of ICTs on micro-enterprises, is likely to gain more credibility if the studies follow more appropriate study designs to capture the cause-and-effect relationships.

A rigorous sampling technique ensures that the generalization from the sample is possible. Although there are adequate numbers of probability-sampling techniques, only three studies had followed a three-stage random sampling. Two studies (Jahanshahi et al. 2011, Wamuyu and Maharaj 2011) had reported stratified sampling, but did not provide adequate details of the sampling process.

Apart from one study (Esselaar et al. 2007), whose sample size is large at 3,691, the final studies are small-scale surveys, with sample sizes ranging from 100 to 560. The rationale for the sample size and decision making on number of respondents to be interviewed is not reported in any of the studies. In one study (Jahanshahi et al. 2011), details about the nature of respondents is not reported.

We had anticipated some mixed-design studies, but the final papers are exclusively quantitative studies. As the requirement of the protocol, all the studies had followed either regression models and regression-based structural-equation models. A descriptive summary of the final papers is given in Appendix 3.1. Appendix 3.2 provides a summary of each of the final studies.

3.3 Identifying and describing studies: quality-assurance results

Selection bias: Out of the final studies, six studies reported that the selection of participants was random and are rated as low-risk-of-bias. However, of the six studies that reported random selection, only one study (Fredrick 2014) shared sufficient information about the methods and procedures that were adapted by the study. Four of the studies used non-random selection of participants in the survey, such as convenience or purposeful-sampling technique. Therefore, these studies are gives a high-risk-of-bias rating.

Incomplete outcome data: none of the studies reported handling drop-outs and missing data, hence little or no attempts were made to control for missing data. As the required information is not available, unclear risk of bias is reported for all the studies.

Selective reporting: The research team was unable to find published protocols for any of the ten studies, and it was therefore difficult to check for selective-reporting bias. All the studies have used questionnaires specifically designed by them to meet their objectives. There are possibilities of bias related to validity and reliability of the factors used by the studies. Six of the studies have reported on the reliability or validity of the factors or instruments used to measure the predictors or outcomes. These are given low risk of bias. Unclear risk of bias was assumed for the studies that did not report any assessments of validity or reliability.

3.4 Summary of results of map

For the final papers, the period of work is 2007-2014 and the location of studies is split between India and Africa. All the studies adapted a survey as a method for data collection. Only three studies followed three-stage random sampling and two studies had reported stratified sampling, but without many details. Except for one study, with a

sample size of 3,691, they are small-scale surveys, with sample sizes ranging from 100 to 560. The rationale behind the sample size is not reported in any of the studies.

Table 3.1: Risk-of-bias assessment of final studies

Risk-of-bias assessment			
Studies	**Selection bias**	**Handling incomplete data**	**Selective reporting**
Chadha SK and Saini R (2014)	High	Unclear	Unclear
Donner J (2006)	High	Unclear	Unclear
Chew HE et al. (2011)	Low	Unclear	Unclear
Jahanshahi AA et al. (2011)	Low	Unclear	Unclear
Mwangi GW and Acosta FR (2013)	High	Unclear	Unclear
Fredrick LI (2014)	Low	Unclear	Unclear
Chew HE et al. (2012)	Low	Unclear	Unclear
Chew HE et al. (2013)	Low	Unclear	Unclear
Esselaar S et al. (2007)	High	Unclear	Unclear
Wamuyu P and Maharaj M (2007)	Low	Unclear	Unclear

All but one of the studies used self-reported data about the use of ICTs for processing business-relevant information. Use of a composite index that covers all possible activities using ICTs in an enterprise is observed in four papers. Two studies focus on mobile phones with voice-based activities (calling and receiving calls for business) and SMS are observed. Two studies are not specific to mobile phones and indicate processing of significant business-relevant information other than voice-based, and business communication beyond customers, employees and suppliers.

Four studies report MSMEs' using mobile phones exclusively to achieve either internal efficiency or business growth. Four other studies show mobile phones being used in tandem with other networked devices. Two papers mention advanced networked devices, such as database-management systems, e-document-management software and e-commerce applications, etc., but failed to report usage adequately. There is no disaggregated analysis, if multiple-networked devices are used by the businesses.

Out of the final ten studies, half of them discuss the impact of networked devices on internal efficiency, buy only two are explicit. The number of business calls has increased with greater use of mobile phones, ICT usage and possession indexes, which are combinations of multiple-networked devices that predict the labour productivity in MSMEs. The other three studies include composite factors, namely operational support, strategic development and process improvement and operational performance, which is improved by the use of networked devices.

4. In-depth review: results

Outline of chapter

The chapter provides an in-depth review of the final papers. Each of the major components of the research question: business-relevant information, networked devices, internal efficiency and business growth of MSMEs, as well as subgroup analysis, is presented in detail. Quantitative meta-analysis for two outcomes, business growth and internal efficiency, was conducted and presented separately.

4.1 Selecting studies for the in-depth review

The review included only those studies that had explicitly discussed the causal linkage between ICTs and internal efficiency or business growth, or both, of MSMEs. Each of the studies was reviewed in depth to arrive at this selection. Three studies did not mention the location of the fieldwork, whether urban or not. The respective authors were contacted for more information, based on the selection of papers made.

4.2 Comparing the studies selected for in-depth review with the total studies in a systematic map

Of the ten studies included for final data extraction, three studies (Chadha and Saini 2014, Fredrick 2014 and Esselaar et al. 2007) had data missing. As a result, seven studies are included for the meta-analysis stage. The publication period of the seven studies ranged between 2007 and 2013, and all the seven studies used regression analysis. A total of 2,457 MSMEs were interviewed in the seven studies. All the seven studies employed cross-sectional design and used a survey questionnaire as a tool for data collection. However, for narrative analysis of the studies, all ten were used.

4.3 Further details of studies included in the in-depth review

We will follow the major components present in the research question, while describing the studies. The section will start with the business-relevant information, then networked devices and the impact on internal efficiency and business growth. A detailed summary of each of the studies is given in Appendix 3.2.

4.3.1 Business-relevant information

The data extracted from the final papers about business-relevant information are presented in **Table** . Except for Donner (2006), all the studies used the self-reported data about the use of ICTs for processing business-relevant information. Four studies (Chadha and Saini 2014, Jahanshahi et al. 2011, Mwangi and Acosta 2013 and Esselaar et al. 2007) used a composite index, from which processing of business-relevant information can be deduced. The index covers all possible activities that an enterprise can undertake involving ICTs, as implied by the list reported in the papers. Each of these items contributes to an index, and is implied to be influencing the impact on business growth or any other parameter under study. It is important to note that the detailed information on each of the items is given only in Esselaaar et al. (2007).

The studies by Chew et al. (2011, 2012 and 2013) and Donner (2006) focused on mobile phones, but do not provide adequate details of the nature of the business-relevant

communication undertaken. Only voice-based activities (calling and receiving calls for business) and SMS are observed. However, these studies indicate that the phones are basic-feature phones, in which high-value-added services are either difficult or impossible to undertake. Fredrick (2014) divided the sample into two: one company that uses mobile money and one that does not.

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

Table 4.1: Business-relevant information processed by the MSMEs

Studies	Inferences for processing business-relevant information
Chadha and Saini (2014)	Information Technology (IT) is used in the knowledge-management practices of the organization: facilitating the processes of capturing, categorizing, and retrieving knowledge and ideas; accessing external information and knowledge of competitors and market changes; facilitating communications effectively when face-to-face communications are not convenient; enhancing the visibility of knowledge; quickly finding documents and people in the organization who have specific knowledge; supporting collaborative work regardless of the time and place.
Chew et al. (2012)	The entrepreneurs made and received calls to customers, employees and suppliers using mobile phones.
Chew et al. (2013)	The entrepreneurs called the customers, employees and suppliers using mobile phones.
Chew et al. (2011)	The entrepreneurs called the customers, employees and suppliers using mobile phones.
Donner (2006)	The entrepreneurs communicated with customers, employees, colleagues/partners and suppliers through any one of the three: incoming call plus outgoing call, incoming call plus SMS, and outgoing call plus SMS. In the second part of the analysis, emphasis was put on the new call partners with whom communication occurred after purchase of mobile phones.
Esselaar et al. (2007)	The SMEs used landlines, mobile phones, faxes, computer and internet to communicate with clients and customers and to order supplies. They sent and received SMS or text messages for business purposes. They also used the internet for business purposes.
Fredrick (2014)	Usage of mobile money by micro-entrepreneurs.
Jahanshahi et al. (2011)	Twenty-one items related to five areas of e-commerce: *e-marketing*, *e-advertising*, *e-CRM*, *e-order* and delivery, and *e-payment* systems operated by the enterprises. These items are taken as a single factor in further analysis. The relevant activities are: handling customers

Studies	Inferences for processing business-relevant information
	feedback/queries online; online application/registration; personalized email communication; allowing a customer to contact a sales office; sharing information with competitors, customers and suppliers; using the internet to find out customers' needs and wants; using the internet for anticipating customer needs; achieving customer satisfaction through the electronic channel; electronic funds transfer; online credit-card processing; coordinating procurement with suppliers online; on-line ordering of software products; tracking incoming and outgoing goods delivery; online order entry and delivery and electronic-data interchange.
Mwangi and Acosta (2013)	Mobile phones were used by the entrepreneurs in three broad areas: income, profitability and customer base in which the following activities are relevant: getting better market prices and information for products and services; obtaining increased support from the government; 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; reducing time to make business arrangements; increasing the speed of communication with customers and suppliers; enhancing frequency of contact with customers; responding quickly to customer queries and complaints; maintaining customer loyalty, even if the customer relocates; and allowing customers to contact the enterprise at any time to report problems and enquire about visiting outlets.
Wamuyu and Maharaj (2007)	Usage of mobile technologies, which include mobile Internet services and mobile money-transfer services. They help the entrepreneurs in accessing up-to-date information to meet their needs and getting information quickly and easily.

4.3.2 Networked devices

The set of devices found to be used by the MSMEs in the final list of papers seems to be limited (Table 4.2). Four studies (Donner 2006, Chew et al. 2012, Fredrick 2014; Mwangi and Acosta 2013) reported MSMEs' using mobile phones exclusively to achieve the outcomes. Four other studies (Chew et al. 2011, 2013; Esselaar et al. 2007; Wamuyu and Maharaj 2007) showed mobile phones being used in tandem with other networked devices.

In three studies (Chew et al. 2011, 2013; Esselaar et al. 2007), faxes, computers and landlines, are combined to form a single index of networked devices, which is then used for analysis. Wamuyu and Maharaj (2007) have also studied the combination of mobile phones with other devices, but did not make the effort to quantify the use of networked devices, and only one term, "mobile technologies", is used in the analysis. Two papers (Chadha and Saini 2014, Jahanshahi et al. 2011) mention advanced networked devices, such as database-management systems, e-document-management software and e-commerce applications, etc., but usage of these networked devices is not reported in the paper. Overall, seven studies give clarity on the nature of networked devices and how

they are used in the cause-and-effect relationships. However, there is no disaggregated analysis in the case of multiple networked devices being used by the businesses.

Table 4.2: Networked devices used by MSMEs

Studies	Networked devices
Chadha and Saini (2014)	The questionnaire contains: intranets, internet, portals, database-management systems/knowledge-based systems, groupware, data-warehousing/mining, e-document-management system, dedicated knowledge-management software.
Chew et al. (2012)	Mobile phones
Chew et al. (2013)	Mobile phones, personal computers, laptops, internet for home and business, use of public calling offices, employees' phone use for business, computers in the workplace, internet connection at business, computers for employees.
Chew et al. (2011)	Mobile phones, personal computers, laptops, internet for home and business, use of public calling offices, employees' phone use for business, computers in the workplace, internet connection at business, computers for employees.
Donner (2006)	Mobile phones
Esselaar et al. (2007)	Telephone, mobile phones, computers, fax, internet
Fredrick (2014)	Mobile phones
Jahanshahi et al. (2011)	Different applications of e-commerce: e-marketing, e-advertising, e-CRM, e-order and delivery, e-payment systems.
Mwangi and Acosta (2013)	Mobile phones
Wamuyu and Maharaj (2007)	Mobile technologies consist of mobile internet services and mobile money-transfer services. Mobile telephones, smartphones, personal digital assistants, public hotspots, desktop systems, laptops connected to Wi-Fi systems.

4.3.3 Internal efficiency and business growth

The outcomes of processing business-relevant information through the networked devices are summarized in Table 4.3. Out of the final ten studies, half of them discuss the impact of networked devices on internal efficiency. In this set of five studies, only two (Donner 2006; Esselaar et al. 2007) are explicit about the internal efficiency. The volume of business calls has increased with increased use of mobile phones (Donner 2006), which is an indicator of internal efficiency. Esselaar et al. (2007) found that ICT usage and possession indexes, which are combinations of multiple-networked devices, predict the

labour productivity of MSMEs. These two studies used either the call logs or the turnover values of the enterprises, as opposed to subjective/self-reported data.

The other three studies used composite factors, namely, *operational support*, *strategic development* and *process improvement* (Chadha and Saini 2014), operational performance (Jahanshahi et al. 2011), and operational performance (Wamuyu and Maharaj 2007). The respondents were asked for one of the Likert-type responses for a list of items. A disaggregated analysis for each of the factors is not undertaken in these three studies. However, the statistical analysis proves that the networked devices are, overall, improving the above factors in the enterprises.

The impact of the networked devices on the business growth of MSMEs seems to be more positive than on their internal efficiency. Eight papers have proved that there is change in the rate of growth of enterprises. Donner (2006) showed evidence that, following the purchase of mobile phones, business-related call partners are new entrants, with half of these being customers, implying an increase in the number of customers. Esselaar et al. (2007) identified that the higher ICT expenditure resulted in an increase in the turnover of the enterprises. Fredrick (2014) showed that profits increased with the use of mobile money. These three studies did not use subjective/self-reported data, as were used in other studies. In all three studies reported by Chew et al. (2011, 2012, 2013), the business growth of micro-enterprises is defined as the percentage increase in income year-on-year. Studies by Jahanshahi et al. (2011) and Mwangi and Acosta (2013) used a Likert-type response set to measure the business growth in terms of market share, profits, profitability and increase in customer base, and found to be positively influencing.

Table 4.3: Internal efficiency and business growth of MSMEs

Studies	Internal efficiency	Business growth
Chadha and Saini (2014)	Improves operational support (reliability, content visibility, security, documentation, completeness, systematic storage); strategic development (improvement of the knowledge-management process, employee participation, decision support, cross-unit performance, competence, integration of systems); and process improvement (speed and accuracy, ease, cost-effectiveness, control and operational efficiency).	NIL
Chew et al. (2012)	NIL	Volume of mobile-phone use for personal and business use leads to growth of micro-enterprises.

Studies	Internal efficiency	Business growth
Chew et al. (2013)	NIL	Business use of mobile phones results in business growth.
Chew et al. (2011)	NIL	Business growth.
Donner (2006)	Mobile-phone use increases the proportion of business calls made by entrepreneurs.	After purchase of mobile phones, business-related call partners are more likely to be new entrants, with almost half of them customers.
Esselaar et al. (2007)	ICT usage and possession leads to an increase in labour productivity.	Higher ICT-usage expenditure leads to increase in turnover of SMEs.
Fredrick (2014)	NIL	Use of mobile money leads to increase in profits (measured by monthly profit log).
Jahanshahi et al. (2011)	Application of e-commerce enhances the operational performance of MSMEs. New-product/service introduction, product/service delivery, marketing effectiveness, customer satisfaction.	Application of e-commerce application increases market share.
Mwangi and Acosta (2013)	NIL	Use of mobile phones induces growth in income, profitability and customer base.
Wamuyu and Maharaj (2007)	Mobile usage leads to increase in organizational performance.	NIL

4.3.4 Subgroups analysis

Out of the ten papers that met the I/E criteria set by the protocol, four papers did not report any subgroup analysis as a part of the findings (Table 4.4). Nevertheless, Chadha and Sainin (2014) and Wamuyu and Maharaj (2007) have information on the micro-entrepreneurs that would allow subgroup analysis across different sizes of MSMEs, education of owners and industrial domains.

The subgroup analysis is clearly presented in only one study (Esselaar et al. 2007), which showed that the question of whether an enterprise is registered with the government (in other words, formality of the businesses) differently influences the relationship between ICTs and business growth. ICT-usage expenditure is highest for informal enterprises.

In the multiple-regression models used by Chew et al. (2011, 2012 and 2013), along with ICTs there are other variables that predict business growth. These variables may not be

presented as subgroup analysis, but provide insight into intervening factors. These are followed by the variables observed: gender, number of hired workers or size of the enterprise, age and education of the entrepreneurs, all of which positively predict business growth.

However, the results are not uniform. Business growth is likely to be higher among the women-owned enterprises in Chew et al. (2012), but an inverse relationship is presented in Fredrick (2014). The education of the respondents is a positive predictor for growth in Chew at al. (2013), but negative in Donner (2006).

Table 4.4: Subgroup analysis for outcomes reported in the final papers

Studies	Subgroup analysis
Chadha and Saini (2014)	No subgroup analysis is performed on the data and reported in the paper. The sample description contains information on three industrial segments of the sample: textiles, software and pharmaceutical. The sizes of the enterprises is not discussed.
Chew et al. (2012)	Apart from volume of mobile-phone use and business use of mobile phones, other predictors — gender, number of hired workers, and age — are positive predictors of business growth. All the micro-enterprises had fewer than ten employees.
Chew et al. (2013)	Apart from business use of mobile phones and its interaction with entrepreneurial expectations, caste, education, and number of children of employees are all predictors of business growth. Only women micro-entrepreneurs were interviewed for the study. All the micro-enterprises had fewer than ten employees.
Chew et al. (2011)	Apart from total ICT access, the formality status of business negatively predicts business growth. All the micro-enterprises had fewer than ten employees.
Donner (2006)	The greater the volume of mobile-phone use, the more business calls are made. The higher the level of education of the micro-entrepreneurs, the lower the number of business calls made. The older owners are less likely to have call partners as new entrants while making business calls. Better-educated owners are more likely to have call partners as new entrants while making business calls. All the micro-enterprises had fewer than five employees.
Esselaar et al. (2007)	Formality/registration status of the enterprises differently predicts the impact of ICTS on turnover.

Studies	Subgroup analysis
Fredrick (2014)	Log of profits for each month is positively predicted by mobile-money usage and market location, and negatively by gender. Being a female entrepreneur, one is likely to earn less revenue than a male counterpart.
Jahanshahi et al. (2011)	No subgroup analysis is performed on the data and reported in the paper. The paper does not report on the size or gender of the owners, or any other details of the sample.
Mwangi and Acosta (2013)	No subgroup analysis is performed on the data and reported in the paper. The paper reports on the nature of the business as a part of sample description.
Wamuyu and Maharaj (2007)	No subgroup analysis is performed on the data and reported in the paper. The paper reports on the number of employees, number of computers, availability of local-area network and owners' age and education as a part of sample description.

4.4 Synthesis of evidence

4.4.1 Business growth

The first meta-analysis focuses on the business growth of MSMEs as the dependent variable. Six studies (Donner 2006; Chew et al. 2011, 2012 and 2013; Mwangi and Acosta 2013; Wamuyu and Maharaj 2007) looked at the impact of business-relevant information through networked devices on the growth of MSMEs (Table 4.5).

Studies	Sample size (n)	Beta	Standard Dev.	Std. Mean Diff.	t
Donner (2006)	277	0.948	2.97915	0.31821157	2.58
Chew et al. (2011)	231	0.154	0.36	0.43	1.861
Mwangi and Acosta (2013)	100	0.49	1.72	0.284883721	1.6
Chew et al. (2012)	560	0.073	0.833	0.087635054	2.082
Chew et al. (2013)	598	0.02	0.72	0.027777778	0.3
Wamuyu and Maharaj (2007)	570	0.419	0.44416	0.943353746	10.01

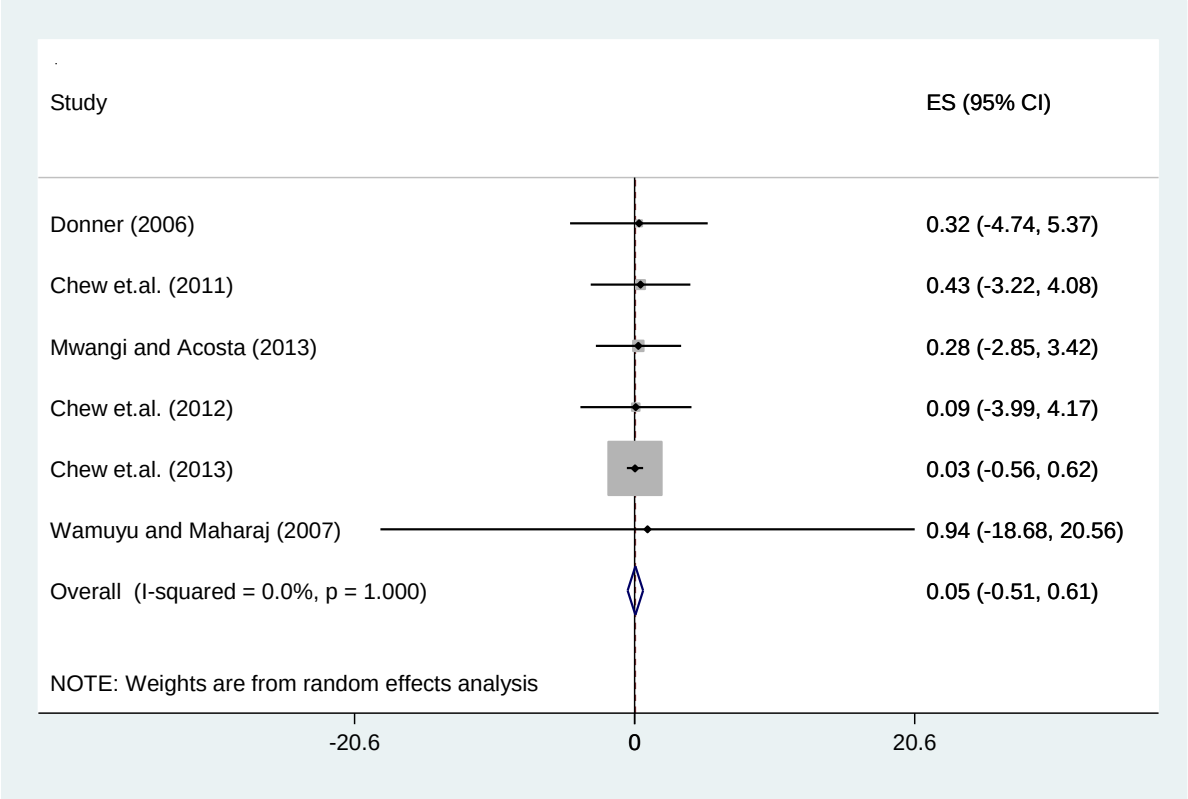
Meta-analysis showed that networked devices have a positive effect on the growth of MSMEs; that is, networked devices as an intervention lead to the growth of MSMEs (Table 9). The overall effect size for the six studies is 0.047, with a confidence interval of (-0.513, 0.606). This effect size is very small. According to Higgins and Green (2008), a small effect is represented by 0.2, 0.5 for moderate effect and 0.8 for large effect. However, the authors also argued that interpretations such as these are problematic, as the importance of the findings is context-dependent and not amenable to generic statements.

There was no evidence of variation in effect sizes attributable to heterogeneity (I^2 = 0.0%) (**Figure 4.1:** Forest plot of impact on business growth **Table 4.6**). Therefore, we are 95% confident that the effects of the intervention (networked devices) being tested are accurate.

Table 4.6: Results for the combined effect size on business growth

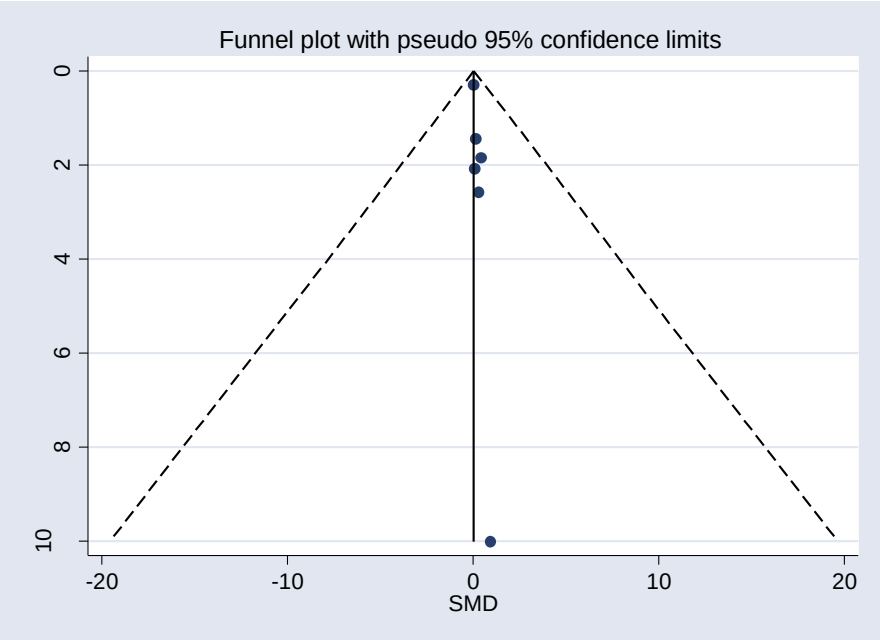
```
. metan  smd t, fixedi lcols(author)

           Study     |     ES    [95% Conf. Interval]     % Weight
---------------------+---------------------------------------------------
Donner, J. (2006 )   |  0.318      -4.738     5.375          1.22
Chew.et.al (2011)    |  0.430      -3.217     4.077          2.35
Mwangi and Acosta (2 |  0.136      -2.690     2.962          3.92
Chew.et.al (2012)    |  0.088      -3.993     4.168          1.88
Chew.et.al (2013)    |  0.028      -0.560     0.616         90.54
Wamuyu and Maharaj ( |  0.943     -18.676    20.563          0.08
---------------------+---------------------------------------------------
I-V pooled ES        |  0.047      -0.513     0.606        100.00
---------------------+---------------------------------------------------

  Heterogeneity chi-squared =   0.07 (d.f. = 5) p = 1.000
  I-squared (variation in ES attributable to heterogeneity) =   0.0%

  Test of ES=0 : z=   0.16 p = 0.869
```

Figure 4.1: Forest plot of impact on business growth



As a part of the analysis, we tested for publication bias. According to Dickersin (2005), those studies that exhibit significant results are more likely to be published than those studies that report non-significant results; this may lead to publication bias. In this study, we plotted a funnel plot to check for publication bias in the study (Figure 4.2). As the studies are not scattered evenly in the funnel, it is deduced that there is the presence of publication bias.

Figure 2.2: Funnel Plot with pseudo 95% confidence limits



Further, Egger's Test was performed to check whether there is significant publication bias in the study (Table 4.7). The test confirmed the results of the funnel plot; that is, that there exists a publication bias (P = 0.008) in the study.

Table 4.7: Eggers's Test for publication bias in reporting business growth

```
. metabias  smd t, egger

Note: data input format theta se_theta assumed.

Egger's test for small-study effects:
Regress standard normal deviate of intervention
effect estimate against its standard error

Number of studies =  6                                  Root MSE      =   .0704
```

Std_Eff	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
slope	-.0068525	.0263074	-0.26	0.807	-.0798936	.0661885
bias	.1192626	.0376231	3.17	0.034	.0148042	.223721

```
Test of H0: no small-study effects          P = 0.034
```

4.4.2 Internal efficiency

In the final set of studies, three reported the impact of networked devices on the internal efficiency of MSMEs (Mwangi and Acosta 2013, Wamuyu and Maharaj 2007, Jahanshahi et al. 2011) (Table 4.8).

Table 4.8: Quantitative meta-analysis for internal efficiency

Author	Sample size (n)	Beta	SD	SMD	T
Mwangi and Acosta (2013)	100	0.49	1.72	0.284884	1.6
Wamuyu and Maharaj (2007)	570	0.58	0.71502	0.811166	14.24
Jahanshahi et al. (2011)	121	0.98	0.869	1.127733	8.32

The meta-analysis results of the three studies showed that business-relevant information through networked devices as an intervention leads to improved internal efficiency, although the overall effect size is not statistically significant, at 5% (Z=0.21, p=0.837). The overall pooled effect is 0.321, with a 95% confidence interval of -2.740 to 3.382 (Table 4.9). Similarly, as in the case of business growth, there was no evidence of variation in effect sizes attributable to heterogeneity (I^2 = 0.0%).

Table 4.9: Results for the combined effect size on internal efficiency

```
. metan  smd t, fixedi lcols ( author)

           Study     |     ES    [95% Conf. Interval]     % Weight
---------------------+---------------------------------------------------
Mwangi and Acosta (2 |  0.285      -2.851     3.421          95.27
Wamuyu and Maharaj ( |  0.811     -27.099    28.721           1.20
Jahanshahi.et.al  (2 |  1.128     -15.179    17.435           3.52
---------------------+---------------------------------------------------
I-V pooled ES        |  0.321      -2.740     3.382         100.00
---------------------+---------------------------------------------------

  Heterogeneity chi-squared =   0.01 (d.f. = 2) p = 0.994
  I-squared (variation in ES attributable to heterogeneity) =   0.0%

  Test of ES=0 : z=   0.21 p = 0.837
```

The above-detailed analysis indicates that the impact of business-relevant information through networked devices does not have any significant impact on the internal efficiency of MSMEs.

4.5 Summary of results of synthesis

Six studies reported on business growth. Meta-analysis showed that networked devices have a positive trend on the growth of MSMEs, with overall effect size as 0.047 and a confidence interval of (-0.513, 0.606). This effect size is very small, and much lower for the standard low impact of 0.2.

The value of I^2 implied that the effects of the intervention being tested are accurate in the funnel plot, studies are not scattered evenly, implying the presence of publication bias. Egger's Test results have also confirmed this.

In the final set of studies, three reported the impact of networked devices on the internal efficiency of MSMEs. The meta-analysis results did not support that the business-relevant information through networked devices as an intervention led to improved internal efficiency. The pooled effect was 0.321 (p = 0.837).

5. Implications

Outline of chapter

This chapter examines the strengths and limitations of the review. The implications of the review for different shareholders are given.

5.1 Strengths and limitations of this systematic review

The question examined for the review is focused and the answering process is intended to fill many important gaps in the extant understanding of causal linkage between ICTs and growth MSMEs. Rather than examining mere ownership of ICTs, the review looked at the important use, processing of business-relevant information and its impact on MSMEs. Even in terms of impact, the review is focused on the internal efficiency and business growth of MSMEs. The location of MSMEs, in urban locations and in LMICS, is also specific. The boundaries of the review are clearly drawn to avoid any ambiguity, which facilitates discourse for evidence-based policy-making in the ICTD domain.

This systematic review has a few limitations. First, the meta-analysis shows that this review suffers from publication bias. The findings from the data extraction should be treated cautiously. The review includes only those that are published in English. There is a possibility that relevant studies in a non-English language have been left out. We also limited our search to articles from 2000 and onwards, keeping the year of the setting of the Millennium Development Goals of the United Nations as a cut-off point. This might have left out some relevant studies completed before 2000. The review also focused on quantitative studies. The field under review is populated by social-science researchers who also use qualitative methods extensively and the inclusion of qualitative studies would have provided insights into the impact of the intervention.

5.2 Implications

The systematic review, as described above, shows that the number of studies that meet the I/E criteria is only ten, despite the large number of results arrived at initially during the literature search. The ICTD domain and the information-systems domain still lack adequate causal studies that link the ICTs and access to business-relevant information, and growth of MSMEs. The findings of this review are useful to the policy-makers of ICTs, whose decisions are influenced by many other factors, including the evidence base in the field. The reader may wish to use these findings more cautiously, as the review lacks RCTs and is based on only ten cross-sectional survey-based studies. The implications of the present systematic review can be approached from two perspectives: that of researchers and that of policy-makers.

5.2.1 Policy

The review shows that the impact of networked devices, through which business information is processed, on the business growth of urban MSMEs seems to be marginal. The business growth of MSMEs is also determined by other sets of factors in addition to ICTs. It appears that any ICT-driven strategy to strengthen MSMEs might be ahead of time. The policy-makers might like to take these findings cautiously, as the review is of studies with publication bias and is based on ten cross-sectional survey-based studies. The policy-

makers should support or encourage RCT-based or longitudinal studies to support their decision making.

5.2.2 Practice

The review highlights the lack of rigorous evidences on the impact of ICTs. It appears to be time for the development practitioners to consider the findings from this review in developing future plans and ICT strategies in MSMEs. Practitioners, especially those who are observing the impact of the intervention examined by this review, should encourage researchers to study and document the evidences. The required rigour in reporting, as implied for the researchers, as below, shall serve as adequate guidelines while documenting the evidence. They should also be invited to be part of research investigation that informs future debate and dialogue in developing ICT strategies for MSMEs.

5.2.3 Research

The review is able to highlight the following gaps in the field for future researchers to explore:

We found only ten studies that meet our I/E criteria and follow rigorous methodology and reporting. If one were to follow the methodologies that attempt to unravel causal linkages, the future research should move away from surveys as the dominant survey method. The appropriate methods from the experimental-design domain should be adapted. It is difficult, but possible, to carry out RCTs in international development, so it is surprising not to find a single RCT study for the research question raised by this review.

The sampling techniques followed by the survey-based studies have not attempted to use a probability-sampling technique. Not belittling the efforts made by the extant researchers, an attempt to scrutinize the methods to increase the generalizability or representativeness of the sample is met with unsatisfactory results. However, there is a possibility that studies that followed rigorous sampling techniques are not included in the review due to weak reporting or non-use of inferential statistics. Despite having the rigour, if one does not establish the causal linkages, the reach of the studies to convince the policy-makers will be minimal.

The location of studies is predominantly in India and the Africa. The list for LMICs contains about 100 names that are not present in this review. There is a need for understanding the impact of ICTs on MSMEs in these countries. For instance, in the ICT Development Index 2015 of the International Telecommunication Union (ITU 2015), there are other LMICs better ranked than India (131) and other African countries better ranked than those in the review. These include: Iran (91), Indonesia (108), Egypt (100) and Sri Lanka (115). These ranks indicate that ICT access is already in place, and there is a need to study the impact.

Among ICTs, mobiles phones are the focus of the studies. Some ICTs, such as PCs, predate the mobile phone. Not all the business functions can be performed using only mobile phones, however. Future research can look, in a disaggregated manner, at the use of other ICTs, and its impact on the internal efficiency and business growth of MSMEs. There is a good likelihood that medium-sized enterprises are using ICTs such as laptops, computers, tablets and phablets, among others. The number of studies on adoption is relatively large, as implied by the initial results of the literature search. There is a need

for understanding the impact of these ICTs after adoption. These “post-adoption studies”, that is, impact studies, are still required, as deduced by this review.

The relationships between ICTs and economic growth or internal efficiency can be recursive in nature. In other words, an increase in business growth could result in the purchase and use of ICTs. Except for Chew et al. (2011), the final studies did not investigate this. The studies have assumed that ICTs lead to business growth or internal efficiency, which is questionable. For instance, an increase in the income of an enterprise could result in the purchase of mobile phones. Also, the purchase of mobile phones could result in an increase in the income of the same enterprise. Both the directions of the relationships, in respect of time, should be examined by the studies. There is a need for the untangling of these complicated relationships.

The nature of business-relevant information that is processed by networked devices is still unclear. The review deduced the information from the nature of ICTs used. All of the possible business-relevant information and its processing, and its linkage with the internal efficiency or business growth of MSMEs, should be investigated in future studies.

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Appendices

Appendix 1.1: Authorship of this review

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Conflicts of interest (if any)

The team members do not have any conflict of interest in conducting this systematic review.

Acknowledgements

We would like to thank Ms Nilusha Kapugama of LIRNEasia for her tireless assistance in refining the protocol, assisting with the EPPI-Reviewer and pushing us to complete this review. Many thanks also to Dr Hilary Thompson, University of Glasgow, for training us in systematic reviewing and patiently answering questions. Mr Jorge Hombrados of Poverty Action Lab trained us in the quantitative aspects of the review. We also greatly appreciate his help in improving the protocol. Mr John Eyers, the information scientist, undertook the literature search required for this review and uploaded it to the EPPI-Reviewer. The participants of CPR South 2014 and ICTD 2015 gave valuable feedback. Dr Rohan Samarajiva, Ms Helani Galpaya, and Mr Sriganesh Lokanathan of LIRNEasia for providing us invaluable advice. Thanks are also due to the other review-team members, Dr Sujata Gamage and Dr Erwin Alampay, who shared their notes with the authors on request. We are grateful to the EPPI-Centre and to the reviewers who have been helping us throughout the project. If this report has any weaknesses, we, the authors, are fully responsible.

This research was carried out with the aid of a grant from the International Development Research Centre, Ottawa, Canada, and the Department for International Development, UK.

Appendix 1.2: Inclusion criteria

Components	Description
Participants	Countries: Low- and lower-middle-income countries, as defined by the World Bank. Target group: Micro-, Small and Medium Enterprises (MSMEs) – maximum 250 employees and annual turnover of less than €50m. All MSMEs, irrespective of size, domain of business (agriculture or not; manufacturing or not) and ownership characteristics (gender, etc.) will be included. The studies should have provided segregated analysis for the MSMEs. Location: Urban.
Interventions	Business-relevant information enabled by networked (ICT) devices. Business-relevant information includes communication between employees and owners, and among themselves, which is related to the enterprise; communication with customers, suppliers and partners; informal communication with business friends or networks to gauge the market; current market prices of inputs and products; and special MSME policy-related information. Networked devices include any electronic tool used by MSMEs that are connected to other similar devices either through internet or intranet.
Comparisons	Among the selected studies, comparison groups will be delineated for analysis. These include, personal vs non-personal networked devices; male- vs female-owned MSMEs; micro- vs small and medium enterprises; and Asian vs African countries.
Outcomes	Internal efficiency of MSMEs; business growth of MSMEs.
Study types	All the studies that have experimental and quasi-experimental design are included in the analysis. Exclusive qualitative studies will be omitted. The analysis of the studies should include at least inferential statistics. The studies that do not include networked devices or business-relevant information as part of their investigation shall not be included.
Time frame	Published in 2000 and after.

Appendix 2.1: Search strategy for electronic databases

1. (Afghanistan or Angola or Albania or "American Samoa" or Argentina or Armenia or Armenian or Azerbaijan or Bangladesh or Belarus or Belize or Benin or Bolivia or Bosnia or Herzegovina or Botswana or Brazil or Bulgaria or Burkina Faso or Burkina Fasso or Burundi or Urundi or Cambodia or Cameroon or Cameroons or Cameron or Camerons or Central African Republic or Chad or China or Colombia or Comoros or Comoro Islands or Comores or Congo or Costa Rica or Cuba or Zaire or Cote d'Ivoire or Ivory Coast or Djibouti or Dominica* or East Timor or East Timur or Timor Leste or Ecuador or Egypt or United Arab Republic or El Salvador or Eritrea or Ethiopia or Fiji or Gabon or Gambia or Gaza or Georgia Republic or Georgian Republic or Ghana or Grenada or Guatemala or Guinea or Guiana or Guyana or Haiti or Honduras or Hungary or India or Indonesia or Iran or Iraq or Kazakhstan or Kenya or Kiribati or Korea or Kosovo or Kyrgyzstan or Kirghizia or Kyrgyz Republic or Kirghiz or Kirgizstan or Lao PDR or Laos or Lebanon or Lesotho or Liberia or Libya or Macedonia or Madagascar or Malagasy Republic or Malawi or Malaysia or Maldives or Marshall Islands or Mali or Mauritania or Mauritius or Agalega Islands or Mexico or Micronesia or Moldova or Moldovia or Moldovian or Mongolia or Montenegro or Morocco or Ifni or Mozambique or Myanmar or Myanma or Burma or Namibia or Nepal or Nicaragua or Niger or Nigeria or Pakistan or Palau or Palestine or Panama or Paraguay or Peru or Philippines or Philipines or Phillipines or Phillippines or Romania or Rwanda or Ruanda or Samoa or Samoan Islands or Sao Tome or Senegal or Serbia or Seychelles or Sierra Leone or Sri Lanka or Solomon Islands or Somalia or South Africa or St Lucia or St Vincent or Grenadines or Sudan or Suriname or Swaziland or Syria or Tajikistan or Tadzhikistan or Tadjikistan or Tadzhik or Tanzania or Thailand or Tonga or Togo or Togolese Republic or Tunisia or Turkey or Turkmenistan or Tuvalu or Uganda or Ukraine or Uzbekistan or Uzbek or Vanuatu or Venezuela or New Hebrides or Vietnam or Viet Nam or West Bank or Yemen or Zambia or Zimbabwe).hw,ti,ab,cp.

2. ((developing or less* developed or under developed or underdeveloped or middle income or low* income or underserved or under served or deprived or poor*) adj (countr* or nation? or population? or world)).ti,ab.

3. ((developing or less* developed or under developed or underdeveloped or middle income or low* income) adj (economy or economies)).ti,ab.

4. (low* adj (gdp or gnp or gross domestic or gross national)).ti,ab.

5. (low adj3 middle adj3 countr*).ti,ab.

6. (lmic or lmics or third world or lami countr*).ti,ab.

7. transitional countr*.ti,ab.

8. exp Developing Countries/

9. or/1-8

10. (SMEs or MSMEs or enterprise* or business* or microenterprise* or microbusiness* or entrepreneur* or microentrepreneur* or self-employ* or owner* or businessman or businessmen or businesswoman or businesswomen or "self-help group*" or cooperative* or "social enterprise*" or Start-up* or incubators or "born global*").ti,ab,sh.

11. (Laptop* or computer* or PC or Internet or landline* or telephone* or mobile* or phone* or cell or cellphone* or smartphone* or CSCs or telecenter* or telecentre* or Wifi or WLAN or GDPRS or messaging or digital or ipad* or iphone* or apple or android or windows or broadband or wireless or wireline or CDMA or SMS or text* or MMS or facebook or linkedin or network* or Intranet or "discussion list*" or contacts or "online forum" or "discussion thread*" or "online feedback" or ICT or ICTs or "communication technolog*" or "information systems").ti,ab,sh.

12. 9 and 10 and 11

13. limit 12 to yr="2000 -Current" –

Appendix 2.2: Computation of effect size

A key step in meta-analysis is the computation of the effect size. This is used to determine the scope of the relationship between networked devices and internal efficiency and business growth of MSMEs.

The effect size for each study was computed for the papers where data were available. We followed Petrosino et al. (2012) in the use of standardised mean differences (SMDs) for synthesising the continuous outcomes. The formula used to compute the effect sizes is as below:

Computation for the standardised mean difference, SMD =

SMD = (Beta (ß))/s_p

Where ß is the standardised coefficient for the independent variable (for example, use of mobile phones) and s_p is the standard deviation of the whole sample population.

In cases where s_p was not given, we computed the value based on standard error (SE):

SE = (Standard deviation (s_p))/√n

Standard deviation (s_p) = SE√n

Appendix 2.3: Databases searched manually

Institutional databases available online

- Infodev (http://www.infodev.org/publications)
- World Bank (http://www.worldbank.org/en/publication/reference)
- DIME (http://data.stanford.edu/DIME)
- JOLIS (http://external.worldbankimflib.org/external.htm)
- IMF (http://www.imf.org/external/research/index.aspx)
- DFID's Research for Development (https://www.gov.uk/government/publications)
- IDRC's Digital Library (https://idl-bnc.idrc.ca/dspace/)
- IDEAS (https://ideas.repec.org/)
- J-PAL (https://www.povertyactionlab.org/)
- ELDIS (http://www.eldis.org/)
- British Library of Development Studies (https://blds.ids.ac.uk/)
- Millennium challenge (https://www.mcc.gov/resources)
- USAid (https://www.usaid.gov/reports-and-data)
- FAO (http://www.fao.org/publications/en/)
- UK Theses Ethos (http://ethos.bl.uk/Home.do;jsessionid=879A8F9CC4F061B00BC359A718B07EE3)
- US/Canada Dissertations (http://guides.main.library.emory.edu/c.php?g=50031&p=324219)
- SSRN (https://www.ssrn.com/en/)
- ACM Press (http://www.acm.org/publications)
- IEEE Xplore Digital Library (http://ieeexplore.ieee.org/Xplore/home.jsp)
- AIS Electronic Library (http://aisel.aisnet.org/)

Appendix 2.4: EPPI-Centre keyword sheet, including review-specific keywords

Review-specific keywords

ICTs
Information and communication technologies
Laptop, computer, personal computer, Internet, landline, telephone, mobile, phone, cellphone, smartphone, common service center, telecentre, telecentre, Wifi, WLAN, GPRS, messaging, digital, ipad, r iphone, apple, android, windows or broadband, wireless or wireline, CDMA or SMS, text, MMS, Facebook, Linkedin, Intranet, discussion list, contacts, online forum, online feedback, communication technologies, and information systems.

Micro-, small and medium enterprises
SMEs, MSMEs, enterprises, business, microenterprise, microbusiness, entrepreneur, microentrepreneur, self-employment, owner, businessman, businessmen, businesswoman, businesswomen, self-help group, cooperative, social enterprise, start-up, incubators, and born global.

Internal efficiency
Time saving, less journey, travel, intra-enterprise coordination, better customer relationship management, customer feedback, business friends, associations, business networks, social capital, coordination with customers and suppliers, customer interaction, market rates, goods, services, opportunities, inventory management, opportunities on financing, work -life balance, supply chain management, efficiency, staff productivity, communication, mobility, Production growth, productivity growth, output growth, storage/warehouses, and access to finance and credit.

Business growth
Increase in sales, turnover, number of employees, branches, customers, suppliers, work locations, partnerships, products, services, business networks, and incoming referrals, Diversification into new areas of business, products & services, business scale / size, market value, and reputation.

Business relevant information
Calling and receiving calls from employees, customers, suppliers, distributors, government officials, partners, order, supplies, delivery, despatch, market prices, selling price, buying price, raw materials, labor supply, power, electricity, tax, registration, transport, products, services, closure, timing, reminders, list, reminders, account balance, savings, and interest rate.

Low- and middle-income countries
Developing countries, underdeveloped countries, less developed countries, low income countries, lower middle income countries, middle income countries. Afghanistan, Gambia, The Myanmar, Bangladesh, Guinea, Nepal, Benin, Guinea-Bissau, Niger, Burkina, Faso. Haiti, Rwanda, Burundi, Kenya, Sierra, Leone, Cambodia, Korea, Dem, Rep, Somalia, Central African Republic, Kyrgyz Republic, South Sudan, Chad, Liberia, Tajikistan, Comoros, Madagascar, Tanzania, Congo, Dem Rep, Malawi, Togo, Eritrea, Mali, Uganda, Ethiopia, Mozambique, Zimbabwe, Armenia, India, Samoa, Bhutan, Kiribati, São, Tomé, Principe, Bolivia, Kosovo, Senegal, Cameroon, Lao, PDR Solomon Islands, Cape Verde, Lesotho, Sri Lanka, Congo, Rep. Mauritania, Sudan, Côte d'Ivoire Micronesia, Fed. Sts. Swaziland, Djibouti Moldova, Syrian, Arab Republic, Egypt, Arab Rep. Mongolia, Timor-Leste, El Salvador Morocco, Ukraine, Georgia, Nicaragua, Uzbekistan, Ghana, Nigeria, Vanuatu, Guatemala, Pakistan, Vietnam, Guyana, Papua, New Guinea, West Bank and Gaza, Honduras, Paraguay, Yemen, Rep, Indonesia, Philippines, Zambia.

Urban

Urban, city, town, semi urban, metropolitan, metro, township, metropolis, central business district, city center, industrial area, non-agriculture area

Appendix 3.1: A summary of the final studies

	Authors	Summary	Country	Data collection	Sample	Sampling technique	Only quantitative method	Statistical Analysis
1	Chadha S and Saini R (2014)	Information-technology tools enabled better knowledge-management practices in organisations.	India	Survey	260 C-level executives of SMEs	Convenience sampling	Yes	Structural-equation model
2	Chew HE, Ilavarasan PV, Levy, MR (2012)	After three years, use of mobile phones in business results in stronger business growth.	India	Survey	560 micro-entrepreneurs	Three-stage random-cluster sampling	Yes	Multiple-regress-ion analysis
3	Chew HE, Ilavarasan PV, Levy, MR (2013)	Mobile phones when used for business by entrepreneurs with high entrepreneurial expectations results in greater business growth.	India	Survey	335 micro-entrepreneurs	Three-stage random-cluster sampling	Yes	Hierarchical multiple-regression analysis
4	Chew HE, Levy M, Ilavarasan PV (2001)	Impact of ICTs on growth of female-owned micro-enterprises is present, but in a small or limited amount.	India	Survey	231 micro-entrepreneurs	Three-stage random cluster sampling	Yes	Structural-equation model

	Authors	Summary	Country	Data collection	Sample	Sampling technique	Only quantitative method	Statistical Analysis
5	Donner J (2006)	Mobile-phone ownership influences the proportion of business-related calls and enhances the business network for micro-entrepre-neurs.	Rwanda	Survey	277 Micro-entrepreneurs	Convenience sampling	Yes	Fraction-al logit model and logistic regression.
6	Esselaar S, Stork C, Ndiwalana A, and Deen-Swarray M (2007)	ICT-usage expenditure, ICT usage and possession influences turnover and labour productivity of SMEs.	13 African countries	Survey	3,691 SME entrepreneurs	Convenience-sampling method	Yes	Kruskal-Wallis test and regress-ion analysis.
7	Fredrick LI (2014)	Use of mobile money results in marginal increase in profits among micro-enterprises	Zambia	Survey	430 micro-entrepreneurs	Cluster sampling	Yes	Multiple-regress-ion analysis
8	Jahanshahi AA, Gashti A, Khaksar SMS, Pitambar BK (2011)	Use of e-commerce applications improves the operational performance of SMEs.	India	Survey	121	Stratified random sampling	Yes	Path analysis

	Authors	Summary	Country	Data collection	Sample	Sampling technique	Only quantitative method	Statistical Analysis
9	Mwangi GW, Acosta R (2013)	Mobile-phone usage increases growth of micro-enterprises measured by income, customer base and profitability.	Kenya and Tanzania	Survey	100 micro-entrepreneurs	Purposeful sampling method	Yes	Regression analysis and descriptive statistics
10	Wamuyu P, Maharaj M (2007)	Use of mobile internet services and mobile money-transfer services facilitates adoption of e-commerce application, which results in better organizational performance.	Kenya	Survey	530 entrepreneurs or key managers	Proportionate stratified sampling	Yes	Structural equation model

Appendix 3.2: Details of studies included in the systematic map and review

Chadha SK, Saini R (2014). Information-technology support to knowledge-management practices: a structural-equation modelling approach. *IUP Journal of Knowledge Management* 12(1): 39-52.	
Summary	Information-technology tools enabled better knowledge-management practices in organizations.
Country	India
Method of data collection	Survey
Sample	260 C-level executives of SMEs
Sampling technique	Judgemental-cum-convenience sampling
Only quantitative method	Yes
Statistical Analysis	Structural-equation model
Inferences for processing business-relevant information	Information technology (IT) is used in the knowledge-management practices of the organization: facilitating the processes of capturing, categorizing and retrieving knowledge and ideas; accessing external information and knowledge on competitors and market changes; facilitating communications effectively when face-to-face communications are not convenient; enhancing the visibility of knowledge; quickly finding documents and people in the organization who have specific knowledge; supporting collaborative work, regardless of the time and place.
Networked devices	The questionnaire covers intranets, internet, portals, database-management systems/knowledge-based systems, Groupware, data warehousing/mining, e-document-management system, dedicated knowledge-management software.
Internal efficiency	Improves operational support (reliability, content visibility, security, documentation, completeness, systematic storage); strategic development (improvement of the knowledge-management process, employee participation, decision support, cross-unit performance, competence, integration of systems); and process improvement (speed and accuracy, ease, cost-effectiveness, control and operational efficiency).

Business Growth	NIL
Sub-group analysis	No subgroup analysis is performed on the data and reported in the paper. The sample description contains information on three industrial segments of the sample: textiles, software and pharmaceutical. Size of the enterprises is not discussed.

Chew HE, Ilavarasan PV, Levy MR (2012). A latency effect for mobile-phone investments by micro-entrepreneurs. *Media Asia* 39(2): 99-10.	
Summary	After three years, use of mobile phones in business results in stronger business growth.
Country	India
Method of data collection	Survey
Sample	560 micro-entrepreneurs
Sampling technique	Three-stage random cluster sampling
Only quantitative method	Yes
Statistical Analysis	Multiple-regression analysis
Inferences for processing business-relevant information	The entrepreneurs made and received to and from customers, employees and suppliers, using mobile phones.
Networked devices	Mobile phones
Internal efficiency	NIL
Business growth	Volume of mobile-phone use and business use of mobile phones leads to growth of micro-enterprises.
Subgroup analysis	Apart from volume of mobile-phone use and business use of mobile phones, other predictors are gender, number of hired workers, and age, which are positive predictors of business growth. All the micro-enterprises had fewer than ten employees.

Chew HE, Ilavarasan PV, Levy MR (2013) When there's a will, there might be a way: the economic impact of mobile phones and entrepreneurial motivation on female-owned micro-enterprises. *Proceedings of the Sixth International Conference on Information and Communication Technologies and Development*, Cape Town, South Africa Vol. 1: 196-204.	
Summary	Mobile phones, when used for business by entrepreneurs with high entrepreneurial expectations, result in stronger business growth.
Country	India
Method of data collection	Survey
Sample	335 micro-entrepreneurs
Sampling technique	Three-stage random-cluster sampling
Only quantitative method	Yes
Statistical analysis	Hierarchical multiple-regression analysis
Inferences for processing business-relevant information	The entrepreneurs called the customers, employees and suppliers using mobile phones.
Networked devices	Mobile phones, personal computers, laptops, internet in home and business, use of public calling offices, employees' phone use for business, computers in the workplace, internet connection at business, computers for employees.
Internal efficiency	NIL
Business growth	Business use of mobile phones results in business growth.
Subgroup analysis	Apart from business use of mobile phones and its interaction with entrepreneurial expectations, caste, education, and number of children are predictors of business growth. Only women micro-entrepreneurs were interviewed for the study. All the micro-enterprises had fewer than ten employees.

Chew HE, Levy MR, Ilavarasa PV (2011) The limited impact of ICTs on micro-enterprise growth: a study of businesses owned by women in urban India. *Information Technologies and International Development* 7(4): 1-16.	
Summary	Impact of ICTs on growth of female-owned microenterprises is present, but to a limited extent.
Country	India
Method of data collection	Survey
Sample	231 micro-entrepreneurs
Sampling technique	Three-stage random-cluster sampling
Only quantitative method	Yes
Statistical Analysis	Structural-equation model
Inferences for processing business-relevant information	The entrepreneurs called the customers, employees and suppliers using mobile phones.
Networked devices	Mobile phones, personal computers, laptops, internet for home and business, use of public calling offices, employees' phone use for business, computers in workplace, internet connection at business, computers for employees.
Internal efficiency	NIL
Business growth	Business growth
Subgroup analysis	Apart from total ICT access, formality status of business negatively predicts business growth. All the micro-enterprises had fewer than ten employees.

Donner J (2006) The use of mobile phones by micro-entrepreneurs in Kigali, Rwanda: changes to social and business networks. *Information Technologies and International Development* 3(2): 3-19.	
Summary	Mobile ownership influences the proportion of business-related calls and enhances the business network for micro-entrepreneurs.
Country	Rwanda
Method of data collection	Survey
Sample	277 micro-entrepreneurs
Sampling technique	Convenience sampling
Only quantitative method	Yes
Statistical Analysis	Fractional logit model and logistic regression
Inferences for processing business-relevant information	The entrepreneurs communicated with the customers, employees, colleagues/partners and suppliers through any one of the three methods: incoming call plus outgoing call, incoming call plus SMS, and outgoing call plus SMS. In the second part of the analysis, emphasis was put on the new call partners with whom communication occurred after purchase of mobile phones.
Networked devices	Mobile phones
Internal efficiency	Mobile-phone use increased the proportion of business calls made by entrepreneurs.
Business growth	After purchase of mobile phones, business-related call partners are more likely to be the new entrants, with almost half of them customers.
Sub-group analysis	The longer the mobile phone is used, the more business calls are made. The higher the level of education of micro-entrepreneurs, the lower the number of business calls made. The older owners are less likely to have call partners as new entrants while making business calls. Better-educated owners are more likely to have call partners as new entrants while making business calls. All the micro-enterprises had fewer than five employees.

Esselaar S, Stork C, Ndiwalana A, Deen-Swarray M (2007) ICT usage and its impact on profitability of SMEs in 13 African countries. *Information Technologies and International Development* 4(1): 87-100.	
Summary	ICT-usage expenditure, ICT usage and possession influences turnover and labour productivity of SMEs.
Country	13 African countries
Method of data collection	Survey
Sample	3,691 SME entrepreneurs
Sampling technique	Convenience-sampling method
Only quantitative method	Yes
Statistical analysis	Kruskal-Wallis test and regression analysis.
Inferences for processing business-relevant information	SMEs used landlines, mobile phones, faxes, computers and internet to communicate with clients and customers, and to order supplies. They sent and received SMS or text messages for business purposes. They also used the internet for business purposes.
Networked devices	Telephone, mobile phones, computers, fax, internet.
Internal efficiency	ICT usage and possession lead to increase in labour productivity.
Business growth	Higher ICT-usage expenditure leads to increase in turnover of SMEs.
Subgroup analysis	Formality/registration status of the enterprises differently predicts the impact of ICTS on turnover.

Frederick LI (2014) Impact of mobile-money usage on micro-enterprise evidence from Zambia. Master's thesis, University of San Francisco, Paper 92. Retrieved 10 July 2014 from: http://repository.usfca.edu/cgi/viewcontent.cgi?article=1099&context=thes	
Summary	Use of mobile money results in marginal increase in profits among micro-enterprises.
Country	Zambia
Method of data collection	Survey
Sample	430 micro-entrepreneurs
Sampling technique	Cluster sampling
Only quantitative method	Yes
Statistical analysis	Multiple-regression analysis
Inferences for processing business-relevant information	Usage of mobile money by micro-entrepreneurs.
Networked devices	Mobile phones
Internal efficiency	NIL
Business growth	Use of mobile money leads to increase in profits (measured by monthly profit log).
Subgroup analysis	Monthly profits are positively predicted by mobile-money usage and market location, and negatively by gender. Being a female entrepreneur, one is likely to earn less revenue than a male counterpart.

Jahanshahi AA, Gashti MA, Khaksar SMS, Pitambar BK (2011) Electronic-commerce applications among Indian small and medium enterprises. *Information Management and Business Review* 2(6): 276-286.	
Summary	Use of e-commerce applications improves the operational performance of SMEs.
Country	India
Method of data collection	Survey
Sample	121 (unclear about the respondents)
Sampling technique	Stratified random sampling
Only quantitative method	Yes
Statistical Analysis	Path analysis
Inferences for processing business-relevant information	Twenty-one items related to five areas of e-commerce: e-marketing, e-advertising, e-CRM, e-order and delivery, and e-payment systems used by the enterprises. These items are taken as a single factor in further analysis. The relevant activities are: handling customer feedback/queries online; online application/registration; personalized email communication; allowing a customer to contact a sales office; sharing information with competitors, customers and suppliers; using the internet to find out customers' needs and wants; using the internet for anticipating customer needs; achieving customer satisfaction through the electronic channel; electronic funds transfer; online credit-card processing; coordinating procurement with suppliers online; on-line ordering of software products; tracking incoming and outgoing-goods delivery; online-order entry and delivery and electronic-data interchange.
Networked devices	Different applications of e-commerce: e-marketing, e-advertising, e-CRM, e-order and delivery, e-payment systems.
Internal efficiency	Application of e-commerce enhances the operational performance of MSMEs. New product/service introduction, product/service delivery, marketing effectiveness, customer satisfaction.
Business growth	Application of e-commerce application increases market share.
Subgroup analysis	No subgroup analysis is performed on the data and reported in the paper. The paper does not report size, gender of the owners or any other details of the sample.

Mwangi G, Acosta F (2013) Mobile phones and growth of micro-enterprises: a case of Safaricom's "Zidisha Biashara" customers. *Business & Economic Review* 23(1): 105-135.	
Summary	Mobile-phone usage increases growth of micro-enterprises measured by income, customer base and profitability.
Country	Kenya and Tanzania
Method of data collection	Survey
Sample	100 micro-entrepreneurs
Sampling technique	Purposeful sampling method
Only quantitative method	Yes
Statistical analysis	Regression analysis and descriptive statistics
Inferences for processing business-relevant information	Twenty-one items related to five areas of e-commerce: e-marketing, e-advertising, e-CRM, e-order and delivery, and e-payment systems used by the enterprises. These items are taken as a single factor in further analysis. The relevant activities are: handling customer feedback/queries online; online application/registration; personalized email communication; allowing a customer to contact a sales office; sharing information with competitors, customers and suppliers; using the internet to find out customers' needs and wants; using the internet for anticipating customer needs; achieving customer satisfaction through the electronic channel; electronic fund transfer; online credit-card processing; coordinating procurement with suppliers online; on-line ordering of software products; tracking incoming and outgoing-goods delivery; online-order entry and delivery and electronic-data interchange.
Networked devices	Different applications of e-commerce: e-marketing, e-advertising, e-CRM, e-order and delivery, e-payment systems.
Internal efficiency	Application of e-commerce enhances the operational performance of MSMEs. new product/service introduction, product/service delivery, marketing effectiveness, customer satisfaction.

Business growth	Application of e-commerce application enhances market share.
Subgroup analysis	No subgroup analysis is performed on the data and reported in the paper.

Wamuyu P, Maharaj M (2011) Factors influencing successful use of mobile technologies to facilitate e-commerce in small enterprises: the case of Kenya. *The African Journal of Information Systems* 3(2): 48-71.	
Summary	Use of mobile internet services and mobile money-transfer services facilitates adoption of e-commerce application, which results in better organizational performance.
Country	Kenya
Method of data collection	Survey
Sample	530 entrepreneurs or key managers
Sampling technique	Proportionate stratified sampling
Only quantitative method	Yes
Statistical analysis	Structural-equation model
Inferences for processing business-relevant information	Mobile phones were used by the entrepreneurs in three broad areas: income, profitability and customer base, in which the following activities are relevant: getting better market prices and information for products and services; obtaining increased support from the government; providing 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; reducing time to make business arrangements; increasing the speed of communication with customers and suppliers; enhancing frequency of contact with the customers; responding quickly to customer queries and complaints; maintaining customer loyalty, even if the customer relocates; and allowing customers to contact the company at any time to report problems or enquire about outlets.
Networked devices	Mobile phones
Internal efficiency	NIL
Business growth	Use of mobile phones induces growth in income, profitability and customer base.
Subgroup analysis	The paper reports on the nature of the business as a part of sample description.

The authors of this report were supported by the Evidence for Policy and Practice Information and Co-ordinating Centre (EPPI-Centre).

The Evidence for Policy and Practice Information and Co-ordinating Centre (EPPI-Centre) is part of the Social Science Research Unit (SSRU), UCL Institute of Education, University College London.

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This systematic review was commissioned by LIRNEasia. The work was carried out with the aid of a grant from the International Development Research Centre, Canada, and the Department for International Development, UK. However the views expressed do not necessarily reflect these departments' official policies.