

Introduction: What Do We Know About ICT Impact and How Best Can That Knowledge Be Communicated?

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Abstract

There is considerable interest in assessing the impact of information and communication technologies (ICTs). This Special Section presents four systematic reviews (SRs) that synthesize findings from the most robust studies of impacts from different ICT interventions. These microlevel studies provide better guidance for evidence-based policy actions than macrolevel correlations. This introduction explains what SRs are, including the measures that are taken to ensure rigor and replicability. The challenges of applying SR findings to policy are discussed. The significance of having the searchable Web as a metaphorical shelf from which relevant SRs may be retrieved when policy windows open is highlighted.

Keywords: information and communication technologies, impact, research, synthesis, systematic reviews

Why Systematic Reviews on ICT Impacts?

There is little concern about measuring the “impact” of refrigerators on development. Companies make and sell refrigerators. People keep buying them. There are a few writings on the effects (e.g., Ituna-Yudonago, Belman-Flores, & Pérez-García, 2015), but nothing on the scale of attention attracted by the question of the impact of ICTs. Why?

Perhaps it is because ICTs involve a core aspect of being human, which is our need and ability to communicate over time and space. They are fundamentally more important and interesting than refrigerators. Perhaps it is also because we are living in the midst of a massive ICT-driven transformation of the economy and society. It is natural to be concerned about impact in such a context.

But the strongest explanation may be that, in many instances, ICTs are promoted through public funds, public policy, or both. The need for justification is always much stronger when government decisions to allocate public funds are involved. Purchasers of refrigerators do enjoy health and convenience benefits, but their purchase and use decisions are not subsidized or strongly influenced by public policy or funds, other than perhaps through standards and taxes, which are generally marginal. ICTs appear to involve more government action and funds. Perhaps an extreme example is the US\$36 billion broadband project initiated by the Australian government in 2009 (Gunaratne, Ilavarasan, Fernando, & Rohman, 2015). So there is a demand for a demonstration of positive impact.

Beginning with Hardy (1980), efforts were made to establish correlations and, in some cases, causal relationships between investments in or spread of ICTs and economic growth based on macro data. In this line of research, the study by Qiang and Rosotto (2009) is perhaps the most referenced in policy contexts. But these macro studies say nothing about specific technologies or interventions. Increasingly, as new ICTs proliferate, there is a justified interest in microlevel demonstrations of impact.

This Special Section seeks to address this lacuna and presents systematic reviews (SRs) on the impact of ICTs at the micro level. They address impacts at varying levels of specificity, ranging from the integration of ICTs into classrooms (Gamage & Tanwar, 2018) to the impact of mobile phones on rural livelihoods (Stork, Kapugama, &

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Samarajiva, 2018). In the former, the focus is on teachers in the classroom and on several technologies that have been deployed in classrooms and whose impact has been researched. In the latter, only one ICT, the mobile phone, is included. But a wide range of economic and productive outcomes that have been subjects of research are examined.

The policy recommendations that may be extracted from work along the lines of Qiang and Rosotto (2009) would be very broad: for example, “encourage or spend more money on broadband” or “do not excessively tax telecom services.” SRs hold the potential for more specific policy recommendations. For example, it may be shown that a particular intervention is futile or that, among several interventions, one is more impactful than the others. Because most government interventions are specific, it is likely that these insights will be more helpful in policy design and evaluation than broad-brush recommendations.

But SRs are capable of generating insights of broad relevance as well. For example, both the macrolevel correlation/causation studies, such as Qiang and Rosotto (2009), and microlevel SRs on the impacts of mobile phones in rural areas, such as Stork et al. (2018), support a policy recommendation that the imposition of mobile or telecom-specific taxes is likely to depress demand for ICT services.

The difference is that Stork et al. (2018) can support finer distinctions. The SR shows that general use of mobile telecom services has a demonstrable positive impact. Stork et al. (2018) also show that such positive impacts are not demonstrable from extant research with regard to information services provided over mobile networks. The policy recommendations would be to desist from service-specific taxation (reinforcing the recommendations that flow from Qiang and Rosotto [2009]) and to be cautious about pumping public resources into new information services without further interrogation of impact claims through well-designed research studies.

The SR on the impact of mobile financial services (Alampay & Moshi, 2018) examines a range of impacts from a single intervention, the use of mobile financial services, including mobile remittances (m-money). In addition to collating the most rigorously researched articles on the subject, it allows comparison of the magnitude of impacts from the same “treatment.” For example, Alampay and Moshi (2018) show that although individual studies indicate positive impacts from m-financial services on both savings and consumption, the impacts on consumption are stronger when multiple studies are subjected to meta-analysis.

What Are Systematic Reviews?

Literature reviews are conducted so that “dwarfs” (researchers) may find themselves, in the words of Bernard of Chartres (but attributed to Isaac Newton), “standing on the shoulders of giants.” They are indispensable and well-known elements in the process of creating new knowledge.

When required to quickly explain SRs, we say, not completely accurately, that they are literature reviews on steroids. SRs and literature reviews share the essential components of search, screen, assess, and synthesize. But they are done for different purposes, and, as described next and demonstrated in the SRs presented in this Special Section, each component is executed with an extraordinary degree of rigor. Unlike literature reviews, which are idiosyncratic and solitary adventures of intellectual exploration, SRs are conducted by teams following strict procedures (described as protocols), consume significant resources, and are designed to be replicable. Some aspects of the rigorous procedure may seep into academic practice, though a transformation of how literature reviews are done is unlikely.

The primary justification for spending significant amounts of time, money, and effort on SRs is not to ensure that the dwarf climbs on the shoulders of the tallest giant and sees the farthest; it is to ensure that the most robust research findings on a question of major significance are identified and that decision makers are provided with the best possible knowledge, stripped of bias to the extent possible. That is why development donors, most prominently, the UK Department for International Development, promoted SRs and why entities such as LIRNEasia, which were committed to take research to policy, were early to conduct them and explore their potential.

We have come to appreciate the strengths and the weaknesses of SRs over the course of conducting four reviews on impacts of ICTs, training large numbers of researchers across Asia and Africa on the technique and, most important, taking the findings to policy makers and the media. The objective of this Special Section is to

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provide a multifaceted picture of how SRs can be used to inform policy and practice in the ICT sector, in addition to sharing the results of four reviews.

SRs were developed in, and are well established in, the health-care domain. The institutional arrangements for their production and, most important, their consumption are in place. The Cochrane Collaboration was established in 1993. Its mission is “to promote evidence-informed health decision-making by producing high-quality, relevant, accessible systematic reviews and other synthesized research evidence” (Cochrane Collaboration, n.d.).

The Campbell Collaboration was established in 2000 as a response to a perceived need for systematic reviews in areas beyond health care. The Campbell Collaboration adapted the Cochrane methodology to issues of broader public policy. Its mission is that of promoting “positive social and economic change through the production and use of systematic reviews and other evidence synthesis for evidence-based policy and practice” (Campbell Collaboration, n.d.). The Evidence for Policy and Practice Information and Co-ordinating Centre (EPPI-Centre) at the Institute of Education of the University of London is a third organization focusing on SRs, with emphasis on education and social welfare.

In the social sciences, SRs are still at an early stage of development. The formal mechanisms for the registration of protocols and peer reviews exist, and some funding support is available. There was some degree of demand-side interest in SRs in the health-care field. By contrast, SRs dealing with social and economic issues are almost fully supply-pushed, perhaps with some exceptions in the United Kingdom and a few other countries. There is neither demand pull nor supply push for rigorous evidence on development issues within developing countries. The only push comes from development organizations. As a result, there is little awareness of SRs in developing countries. This Special Section seeks to contribute to filling that gap. It also provides an introduction to the method and explores its potential to contribute to evidence-based policy and practice in the ICT space.

SRs are defined as a summation of best available evidence of a specific research question. They use transparent and replicable procedures (protocols) to identify, evaluate, and synthesize the relevant research results. Procedures are explicitly defined in advance to ensure that the exercise is transparent and can be replicated. They are reviewed, modified if necessary, and registered. This practice is also designed to minimize bias.

Studies included in a review are screened for quality so that the findings of a large number of studies can be combined. Peer review is a key part of the process; qualified independent researchers ensure the quality of the systematic reviewers’ methods and results. Currently, the Cochrane Collaboration, the Campbell Collaboration, and EPPI-Centre, all based in the United Kingdom, serve as peer reviewers and process auditors.

As in any systematic inquiry, the foundation of an SR is a clear definition of the problem. This takes the form of a research question that is expanded into a set of components described as PICOCS—population, intervention, context, outcome, comparison, and study design—and a theory of change.

PICOCS are the attributes that must be defined at the outset of the study. The research question should clearly indicate the population or the unit of analysis, the intervention, and the outcomes expected. The context or rationale may or may not be mentioned within the research question itself. The last two items in PICOCS, comparison and study design, determine whether the included studies are amenable to a synthesis of results. Experimental or quasiexperimental study designs are amenable to statistical synthesis or meta-analysis of results. Observational study designs may permit statistical analysis if the intervention was included as a dichotomous variable in the research design.

The PICOCS for the four studies are shown in Table 1. The research question may be read off the tabulated PICOCS. For example, Stork et al. (2018) set out to investigate “economic and productive outcomes of use of mobile phones by rural enterprises in low and middle income countries.”

At the outset, it is necessary to postulate the relationship between intervention and outcome. This is the theory of change. In its simplest form, the theory of change would hypothesize how an intervention will cause a certain outcome. In some cases, the links would be obvious. It was reasonable to postulate that the ability to instantaneously communicate over distance through a newly extended mobile telecom network would integrate hitherto isolated markets, contributing to market clearing (reduced wastage of perishable goods) and reducing price dispersion (Stork et al., 2018).

Table 1. PICOCS of the Systematic Reviews in This Special Section.

	<u>Stork et al.</u>	<u>Ilavarasan & Otieno</u>	<u>Alampay & Moshi</u>	<u>Gamage & Tanwar</u>
Population (or unit of analysis)	Rural people enterprises	Urban MSMEs	Individuals, households, and communities	K–12 teachers
Intervention	Use of mobile phones	Use of networked devices	Use of m-finance services and m-money	Training and support for teachers
Context	Low- and lower-middle-income countries	Low- and middle-income countries	Low- and lower-middle-income countries	All countries
Outcomes	Economic and productive outcomes	Internal efficiency and business growth	Multiple indicators of financial empowerment	ICT use in the classroom
Comparison	Between intervention/phenomenon and its absence			
Study designs	Experimental or quasiexperimental studies assessing impact Observational studies assessing impact or cause			

Notes: MSMEs = Micro, Small, and Medium Enterprises; PICOCS = Population, intervention, context, outcome, comparison, and study design.

In other cases, there may be several intermediate steps that are labeled as primary outcomes, secondary outcomes, and so on. Sometimes the intervention may lead to outcomes that are related. For example, Ilavarasan and Otieno (2018) postulated that use of networked devices would increase the sending or receiving of business-related information, which may lead to business efficiencies and to business growth. Alampay and Moshi (2018) developed multiple theories of change that were then narrowed down based on the results of the SR.

The details of the searching and screening steps are described in the individual SRs reported in this Special Section. When compared with the number of records gathered through search (more than 10,000 in all but one SR), the number of studies that survived the screening and were subject to appraisal was quite low (an average of 11). The strict inclusion/exclusion criteria specified in the governing protocols led to this outcome. The prevalent research practices within the social sciences that did not mesh with the rigorous criteria were responsible.

In the health-care field, where SRs originated, most, if not all, of the studies were randomized controlled trials (RCTs). Among the topics that were the subjects of the SRs reported in this section, the great majority of the studies were case studies and evaluations that did not meet the criteria. In the case of the micro, small, and medium enterprises (MSMEs) study, not even one experimental or quasiexperimental study could be located. The criteria had to be relaxed. But even then, the number was still very low.

In some instances, the model fits social science problems poorly. The terms *treatment* and *control* are central to RCTs and, thereby, to SRs. They are obviously derived from the research practice in health care, where a treatment is a drug or other procedure administered to a population of patients. The patients are compared with a control population that is deemed to be similar in all significant aspects to the population receiving the treatment. The model works well with some social interventions, such as impregnating mosquito nets with insecticide (Wilson et al., 2014), which is easy to conceptualize as a treatment. However, this is not so for many ICT interventions.

Stork et al. (2018) examined the impact of mobile networks being extended to areas that were hitherto lacking coverage. The researchers cannot decide which area gets coverage. They cannot decide that a control group with similar characteristics will not get coverage until the study is completed. Decisions regarding which areas get coverage and when involve millions of dollars and are made in company boardrooms. Given competitive dynamics and propagation characteristics of the frequencies that are the basis of mobile telecom services,

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it is difficult even to define a control group that can be studied alongside a treatment group that has just received coverage. So the only option is a quasiexperimental design or a natural experiment such as that conducted by Jensen (2007). If one were to apply treatment and control concepts rigidly, studies such as this would be excluded. Even with relaxed exclusion criteria, the research papers that survived the screens were small in number.

In the health-care field, where SRs originated, it is possible to synthesize the results of clinical and similar trials into one meta-analysis. Here, the studies are about one specific “treatment,” and the impacts are a limited set of outcomes. As the SRs reported in this Special Section demonstrate, both the outcomes and the interventions are far from homogeneous in the ICT space. Absent that essential condition, it is not possible to complete the meta-analysis step to merge the findings from similar studies to arrive at a single definitive result, as can be done with results of clinical trials. In some cases, such as the SR by Alampay and Moshi (2018), workarounds were implemented. But even here, not all studies could be meta-analyzed. In the case of Stork et al. (2018), the studies that remained after the various screens were applied were so heterogeneous that general conclusions could be drawn only in narrative form.

Deviation from the classical SR model was greatest in the research on ICTs and MSMEs by Ilavarasan and Otieno (2018). Here, none of the studies that survived the screens were based on experimental or quasi-experimental designs. Observational studies pose significant challenges for quantitative meta-analysis, but it has been attempted.

Current standards applied to SR protocols exclude qualitative studies. Obviously, it would not be possible to merge the conclusions into one, as are done with the results of clinical trials. Another reason is that qualitative studies rarely include complete descriptions of the method used, making systematic assessment difficult. Currently, efforts are being made at EPPI-Centre to include qualitative studies within the SR methodology.

Taking Research Findings to Policy and Practice

The intricacies of research design and the challenges of identifying bias may excite researchers. But in the end, SRs are about informing policy and practice. The results of an SR must be communicated to decision makers capable of changing policy or practice. Ideally, the recipients of the evidence will take the actions indicated by the evidence.

Taking research to policy in an effective manner requires understanding and exploiting policy windows (Kingdon, 1984). Some windows are predictable (e.g., a politician assuming office after an election), and others are not (e.g., a crisis). In some cases, evidence may be mobilized to shape new policy actions. In perhaps a greater number of instances, evidence is needed to beat back, or minimize the damage from, bad policy changes.

Rarely is there adequate time to commence research from scratch. Effective exploitation of policy windows requires some kind of prescience in guessing what kinds of research would be required for the kinds of policy windows that are likely to open up. One may conduct the research, repurpose research done for another reason, or assemble existing research done by others. But the action must be completed before the policy window closes.

Given the time required to complete an SR, including peer reviews of the protocol and the final results, the work cannot commence during the period in which the policy window is open. It has to have concluded, or at least commenced, before the opening of the window. If one could predict the kinds of policy questions that would benefit from a robust compilation of research findings and command the necessary resources, one could presumably develop a stockpile of systemic reviews to draw from when the need arises. But as Yogi Berra said, “It’s tough to make predictions, especially about the future.” And resources are always limited. What is spent on SRs is not spent on primary research or for some other meritorious purpose. Time is required to raise the necessary funds and assemble the appropriate teams.

There are two additional problems. Research becomes stale because of events and because of advances in theory and research methodology. Time-constrained decision makers tend to use heuristics to decide what

research they give a hearing to. An SR where the most recent primary study is several years old may cause a decision maker to decline to pay attention on the grounds of obsolescence.

The References sections in this Special Section illustrate the problem. A policy maker being presented with the findings of Alampay and Moshi (2018) in the year of publication may think that much has happened in m-financial services since 2014, the publication year of the most recent papers included in the review. Stork et al. (2018) may be criticized not only for presenting stale research (the most recent study covered by this SR was published in 2013) but also for focusing on voice and SMS services over mobile networks and making no mention of Internet services. It is, of course, possible to explain the inherent lag caused by the need to conduct rigorous reviews and so on, but in the policy world, one rarely gets to reopen a door once it has been shut. Even the short answer—that the SR can only present data on rigorous studies that have been completed—may not suffice.

The publication dates of studies included in the SRs are the most obvious manifestation of the obsolescence problem. Given the rhythms of academic life and the time taken by peer-reviewed journals to publish submitted articles, most of the actual research that the SR is based on will have been conducted two to three years before the actual publication date. A decision maker in Bangladesh looking for studies on mobile financial services in her country in 2018 is unlikely to find any because services were launched only in 2011 and gained momentum and research attention a few years after that.

The second problem is the possible lack of contextualization. Basic principles do not vary from country to country. However, policy-relevant knowledge is not abstract. With regard to policy-relevant knowledge, context matters. If systematic reviews in the stockpile lack country context, it is easier to use them in multiple countries where policy windows may open up. But in each case, it will be suboptimal because the bridge connecting the findings to the conditions specific to the policy window would be missing. The decision makers in a particular country may want the research to connect to their reality through some supplemental research.

In some instances, decision makers capable of influencing policy and practice are resistant to making time to listen to the findings of SRs that appear to be based on work done in faraway countries. All 10 studies that were included by Alampay and Moshi (2018) were African, and six of them were from Kenya. None were from Asia. This proved to be a barrier to efforts to disseminate the findings in Bangladesh, a large Asian country where m-financial services have grown rapidly.

If a systematic review is conducted for a specific country context, it will be somewhat difficult (but not impossible) to use it in another country where a policy window may open up. It is more economical to develop SRs that can be used in multiple countries in response to different policy windows than in only one specific window in one country. One solution is to continue to conduct SRs that are not country specific, but to supplement them with “bridging studies” that connect the SRs to the specific context of the policy window.

The mentioned problems of perceived obsolescence and lack of country relevance that affect SRs dealing with social and economic matters in a fast-changing field such as ICT are not as significant in the field of health care, where SRs originated. A medical procedure or even a drug does not become obsolete as quickly as an ICT application. The country specificity for medical research is less significant than it is for the kinds of research covered in this Special Section.

The true significance of an SR lies in unearthing an unexpected side effect or in showing that a commonly accepted conclusion is wrong (e.g., Hemila & Chalker, 2013). This is what is likely to attract media attention, and even the attention of busy lawmakers or policy makers. After all, the unexpected is at the heart of every good story.

In the case of the SRs within domains normally subject to social science analysis such as those reported in this issue, it was rare for surprises to be generated. The findings generated by the SRs restated with authority what was known within the domain or, in some cases, concluded that robust evidence was not available despite the plethora of studies. It was not possible to conclude, for example, that information services provided over mobile networks did not have a beneficial effect on rural livelihoods (Stork et al., 2018). All that could be said was that there was no evidence either way.

The absence of newsworthy findings along the lines of “man bites dog” posed a challenge in terms of dissemination. The following excerpt from a senior Indian journalist’s email response to a request for coverage of

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Stork et al. (2018) illustrates this: “I thought the impact of mobile phones on economy by now was a well-established fact. I saw the documents you sent. Didn’t find anything new” (T. K. Thomas, personal communication, November 4, 2014).

Way Forward

One may conduct an SR on an innovative medical treatment, at the end of which the robust evidence that has been compiled may lead to the approval of the treatment, and perhaps even the treatment being made mandatory—or being discontinued. These kinds of unambiguous and immediate effects are unlikely to result from SRs that are conducted in the “softer” social science domains, exemplified by the studies reported on in this Special Section.

In the case of health-care SRs, the institutional arrangements are well established—at least in the developed countries for the regular commissioning of SRs—for their management and, most important, for communication of the findings to those who make final decisions on medical treatments and to end-user practitioners. In the case of the softer, social science domains, especially in developing countries, there is no demand at this time. The existing institutional arrangements are possibly hostile to, and at most indifferent to, SRs that are being funded and promoted by external actors.

One could imagine a time in the past when RCTs were not woven into routine practice in the health-care sector. One could also imagine a time, less distant, when SRs that systematically consolidated the findings of RCTs were uncommon. What were the factors that led to RCTs becoming routine in health care? What led to SRs being similarly embedded in institutional practice, at least in some countries? How can those conditions be replicated in the socioeconomic policy domains?

The promotion of SRs at this time on all kinds of topics where decisions may be improved by the use of good evidence is supported by one factor. The qualitatively superior information-retrieval capabilities of the World Wide Web, combined with the momentum behind open publication of research, provides the strongest rationale for conducting SRs. When decision makers are looking for solutions or evidence to support solutions, a relevant SR may play a decisive role. Initiating a new SR is not realistic within the timeframes that govern the policy process. But if a completed SR can easily be taken from a metaphorical shelf constituted by the Web, it can have a powerful impact. The search engines and associated information-retrieval functions help realize fully the conception of solutions “looking for issues to which they might be an answer,” proposed by Cohen, March, and Olsen (1972, p. 1).

The larger question is thus the motivations of decision makers with regard to evidence-based solutions. In some countries, in some sectors, during certain time periods, evidence is given a major role; in others, it is not. The truly sustainable condition for utilization of SRs is the development of demand for robust evidence among decision makers in policy and practice. It is hoped that this will gradually emerge in the developing countries in the same way that evidence was given greater weight over time in the policy processes in the developed countries.

Or perhaps it will not. Perhaps even the developed countries will regress. Recent political developments such as the Brexit vote in the UK and the victory of Donald Trump in the U.S. presidential election are ominous portents. During the course of the Brexit referendum campaign, UK Justice Secretary Michael Gove declined to answer a question about any economists supporting withdrawal from the European Union by saying, “People in this country have had enough of experts” (Mance, 2016, para. 1). The issue is not that he said it, but that the campaign he represented won—and this, in the redoubt of evidence-based policy. Regardless of the pros and cons of Donald Trump and Hillary Clinton, many observers saw the 2016 election as a plebiscite on policy-based governance in which policy and evidence lost. If the winds shift in these influential countries, the concern is not only that resources will dry up for evidence-centric research such as SRs, but also that the intellectual currents will shift against demand being built up for SRs and other evidence within governments of developing countries.

Even if these pessimistic prognostications do not come to pass, it will take time for busy policy makers and

politicians in the developing world driven by multiple incentives to become receptive to SRs. But few have patience. The challenge is that of accelerating the process.

It is unrealistic to expect some kind of central directive to do the job. Adoption is likely to occur bottom up, in different domains at different times, depending on the quality of the evidence on offer, the efficacy of those bringing evidence to the policy process, and openness to new ways of doing things on the part of decision makers. Crises that destabilize old ways of doing things are likely to help. But the most important thing is to keep stocking the metaphorical shelf with rigorous, policy-relevant SRs that are easy to access, like these articles being published in an open-access, peer-reviewed online journal. ■

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