CDC
Investment works

Handbook

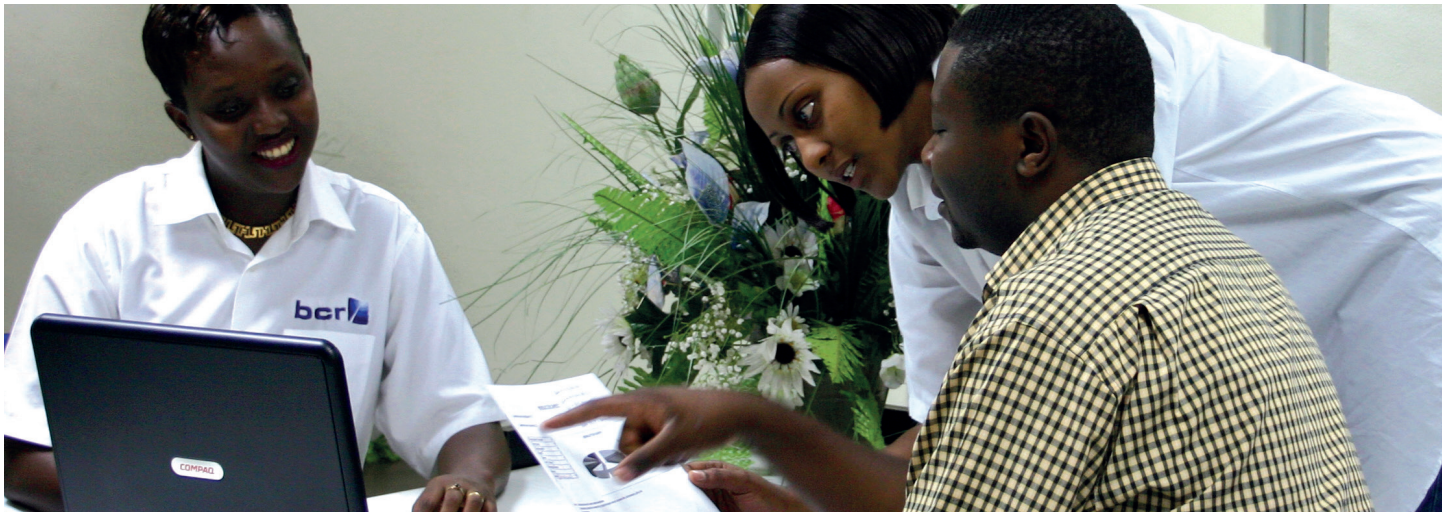
Impact measurement

A practical guide to data collection

Published: 29 October 2019

Report author:
Claudia Simler
CDC Group
csimler@cdcgroup.com

Contents



Executive summary

This handbook provides investors, businesses and private sector development practitioners with an overview of tools and methods for effective and appropriately tailored data collection for impact measurement and management. It builds on the recognition that the methods of larger, independent impact evaluations of, for example, government-funded programmes rarely lend themselves well to a private sector context. In reviewing select private sector-relevant tools and methods, it draws out how such tools can deliver impact insights while often feeding valuable business intelligence back into companies.

Why should we care about how to collect data?

Impact measurement and management is a defining feature of impact investments.[1] Beyond the need to demonstrate impact to shareholders and other relevant stakeholders, however, impact data can also be used to inform value creation for a company. This can be done by better understanding the voices of customers, suppliers and employees or the physical and environmental realities that a company is operating within and trying to influence.

This handbook is designed to help:

- **understand the context** for good data collection;
- **guide selection** of data collection tools/methods that can measure impact, reveal business-critical insights and create value for companies and, by extension, people and/or planet; and
- **bolster the knowledge** of the broader impact investing community around innovative and well-established tools and methodologies in impact measurement and management and thus contribute to a nascent and rapidly evolving space.

Using data to demonstrate and drive impact

Recent advances in technology have enabled quick, low-cost and valuable impact measurement on a scale not possible before; examples are satellites, mobile phones and sensors. There is potential and interest in leveraging such new tools, with providers beginning to specialise in their deployment, but less clarity on when and how they might be appropriate.

To strengthen the data collection repertoire for impact measurement, much more testing and refining is needed of how technology can augment or complement traditional data collection with insights to drive better decision-making – or produce the same quality results faster and/or cheaper.

Through practical guidance, this handbook aims to contribute to the testing of new tools while recognising that more traditional tools might still prove the most useful in some cases. We have deliberately not tried to be exhaustive but have focused on a review of eight tools/methods that CDC has actively used for our own insights pipeline. The strengths and weaknesses of the different tools are made explicit, and practical use cases are included throughout to demonstrate how data collection tools and techniques for impact measurement can at the same time become an ingrained part of a business's value creation strategy.

1 IFC's Operating Principles for Impact Management (2019) integrates impact measurement and management principles throughout the investment cycle; the Global Impact Investors Network (GIIN) lists 1) using evidence and impact data in investment design and 2) managing impact performance as two of four core characteristics of impact investing (https://thegiin.org/characteristics)

Figure 1: Data collection tools to help demonstrate and drive impact (ordered alphabetically)

Tool/method	Description	Use case
Company data *Read more on page 11*	Public and/or proprietary commercial data, administrative data and key performance indicators (KPIs) (eg. number of customers, credit reports.)	The Global Off-Grid Solar Association (GOGLA) uses number of products sold or deployed to end users for impact estimations of customers' economic activity and income generation.
Diaries *Read more on page 13*	Data collected continuously over a longer period, from a few weeks up to several months, either directly by respondent or assisted by enumerator	Diaries were used across rural sites in India to understand what more optimal energy products could look like and levers to drive higher adoption rates of clean energy products among consumers.
Focus groups *Read more on page 15*	Data collected via group interview format	As part of an exercise to understand barriers to adoption of mobile phones among women, the GSMA conducted focus group research to understand social and contextual barriers to product usage and adoption.
In-person surveys *Read more on page 16*	Data collected in person via enumerators	A food retailing company in Zambia conducted more than 1,700 in-person surveys across customers and non-customers to plan store expansion to underserved areas and adapt pricing to financial realities of consumers.
Macro data *Read more on page 19*	Aggregated micro-level/meso-level data collected by governments or national and global institutions (eg. population data, GDP data)	Macro data derived from various public and proprietary databases is used to calibrate the model that estimates market-level impacts of CDC Group's investments and helps inform future investment strategies for maximising impact.
Mobile surveys *Read more on page 22*	Data collected remotely via call centres, SMS or interactive voice response (IVR)	Using call-based mobile surveys, a commercial animal feed mill based in Ghana understood the need to change its marketing, pricing and distribution strategy to better reach underserved segments to strengthen the business.
Satellites *Read more on page 24*	Image data collected remotely via satellites	In an agricultural context, satellite imagery in combination with ground samples can identify which inputs have the greatest impact on yields across large land areas, making it a powerful tool to measure impact of a company's products and services.
Sensors *Read more on page 27*	Data collected via installed sensor devices (eg. temperature, proximity, pressure, light, humidity, touch)	Coupling sensors with a range of connected technologies, an Indian dairy technology solutions company is providing data on milk quality improvements, unlocking higher revenues for customers by allowing businesses to engage in tailored interventions in their livestock value chain.

Practical considerations and trade-offs

The choice of data collection tool must be made in the context of the kind of questions being asked as well as the resources and skills available for implementation. There is no one-size-fits-all solution that can be mapped categorically to different use cases. Decision-makers must consider a handful of dimensions to assess which approach will be best suited to inform their questions at hand.

We map and segment the tools along five key dimensions:

- **Time:** we refer to a 'quick' total turnaround time when data can be collected and used for decision-making in less than one week (for sensors and satellites, once installed/set up, data for decision-making can indeed be pulled rapidly and in less than one week; for the sake of the distinction drawn in this handbook, we have categorised using the assumption that the technology is not yet installed/set up for analysis).
- **Cost:** we refer to a tool being 'low cost' when total costs for setting up/structuring the data collection and subsequent analysis do not exceed $15,000 (while recognising that costing will often depend on in-house capacity versus the need to hire external consultants; for the sake of the distinction drawn in this handbook, we have categorised using the assumption that external support is needed).
- **Skills:** some of the data collection tools need technical proficiency, either to set up and install an actual data collection device (eg. a sensor) and/or subsequently in the ability to properly calibrate, analyse and use the data (eg. for satellites and to some extent for macro datasets).
- **Breadth:** some of the tools lend themselves well to capturing large amounts of quantitative, representative data (and can be useful for capturing breadth of impact).
- **Depth:** some of the tools lend themselves well to capturing rich, qualitative data but will lack the ability to capture representative data (they can be useful for capturing depth of impact).

This segmentation is meant to provide high-level guidance. We acknowledge that especially the cost and time dimensions represent rough indicators that are meant to draw out relative differences between the tools rather than being accurate for every single use case.

Moving the field forward

CDC has committed to doing a dozen impact studies in the next two years, using the range of tools described in this handbook, to share the results and to update the handbook based on what we learn about the tools. We call on other impact investors to actively engage with the various tools for impact measurement and to share lessons learned, particularly from using the newer tools, to collectively build the field's knowledge for the future.

Figure 2: Practical considerations around choice of data collection tool/approach

	COST Low cost (<$15K)	**TIME** Quick turnaround time on insights (<1 week)	**SKILLS** Requires technical support	**BREADTH** Quantitative, representative data	**DEPTH** Rich, qualitative data
Company data	✓	✓			
Diaries					✓
Focus groups	✓				✓
In-person surveys				✓	(✓)
Macro data	✓	✓	✓	✓	
Mobile surveys	✓	✓			
Satellites			✓	✓	
Sensors			✓	✓	

Data collection throughout the investment and business life cycle

In line with the Operating Principles for Impact Management[2] developed by the International Finance Corporation (IFC) in consultation with a range of asset managers, development banks and development finance institutions, a robust impact investing process – from strategy, origination and portfolio management, all the way to exit and independent verification – relies on relevant *data* to inform decision-making at each stage (see Figure 3).

Although impact measurement is now fully accepted as a defining feature of impact investments, the reality is that defining *what* to measure and, subsequently, defining *how to collect the appropriate data* are questions that many impact investors struggle with. Not having robust or relevant data points to inform decision-making comes with the risk of making suboptimal decisions, limiting chances of success and, ultimately, impact. Three-quarters of respondents in the GIIN 2019 Annual Impact Investor Survey[3] view sophistication of impact measurement and management practice as either a significant or moderate challenge to the growth of the impact investing industry.

This handbook seeks to overcome some of the measurement challenges in the space by making explicit both strengths and weaknesses of different tools and by using practical use cases to demonstrate how the same tools that can be used to assess impact by measuring changes experiences by people or planet over time have the potential to become deeply integrated into companies' value creation strategies as business intelligence tools.

Key goals of data collection

- **Assess impact:** enhance ability to measure impact to understand whether the intended positive changes to people and/or planet are taking place.
- Generate **insights that are useful** in a timely and relevant way to inform key strategic decisions (eg. product design, marketing strategy, pricing, market entry).
- Open **new avenues for greater impact** (eg. reach new customers, expand customer base via better products, adjust overall investment strategy).

Considerations around data for impact measurement versus business intelligence

Having access to data is the starting point for assessing the five dimensions of impact as defined by the Impact Management Project (https://impactmanagementproject.com/) - i.e. understanding *what* outcomes are contributed to, *who* experiences those outcomes, *how much* those outcomes affect people or planet, what the intervention's *contribution* was to impact, and what *risks* exist to impact being different than expected. Some of this data might be attainable through existing data sources, either via public datasets or via company administrative and operational data. Often, it is necessary to collect additional data to assess change over time and to measure the impact of an investment.

On the point of additional, primary data collection, it is important to understand to what extent this new data is helping inform operational questions and to what extent the data is allowing to ascertain the extent of (positive or negative) impact created. All the tools and techniques for data collection reviewed in this guide can inform both dimensions – but without proper intent to capture data on impact, they will remain tools for business intelligence and not by default feed into an impact measurement process.

Figure 3: Operating Principles for Impact Management (IFC, 2019)

Strategic Intent

1. Define strategic impact objective(s), consistent with the investment strategy.
2. Manage strategic impact on a portfolio basis.

Origination & Structuring

3. Establish the Manager's contribution to the achievement of impact.
4. Assess the expected impact of each investment, based on a systematic approach.
5. Assess, address, monitor, and manage potential negative impacts of each investment.

Portfolio Management

6. Monitor the progress of each investment in achieving impact against expectations and respond appropriately.

Impact at Exit

7. Conduct exits considering the effect on sustained impact.
8. Review, document, and improve decisions and processes based on the achievement of impact and lessons learned.

Independent Verification

9. Publicly disclose alignment with the Principles and provide regular independent verification of the alignment.

2 IFC (2019)
3 Covering 266 impact investors that collectively manage $239 billion in impact investing assets (GIIN, 2019)

The degree of overlap between data that is operationally useful and at the same time able to inform questions around impact depends on the business in question. In some cases, the two spheres will be heavily overlapping and, in other cases, less so. Investors are encouraged to find ways to maximise the amount of overlap to align incentives between company operational needs and accountability needs around impact reporting. In the absence of complete overlap, however, it is the responsibility of the impact investor to ensure the right questions are asked for any of these tools to support impact measurement in addition to support running and managing a business to maximise impact.

Answers to the following questions should be clearly articulated before engaging in any data collection effort:

1. What questions are we trying to answer?
2. What overlap exists between data needed to assess impact and data needed to drive better business decisions?
3. What decisions do we have to make in the short or medium term and what data is needed to make these decisions?
4. What additional data points do we need to collect to assess impact?
5. Does the data already exist through publicly available sources?
6. Do we have the capacity to integrate lessons into our operations over time?

Purpose of this handbook

Objective

This handbook is designed for impact investors and their impact measurement leads, commissioners of impact studies within private sector development and businesses to:

- **understand the context** for good data collection;
- **guide selection** of data collection tools/methods that can measure impact, reveal business-critical insights and create value for companies and, by extension, people and/or planet; and
- **bolster the knowledge** of the broader impact investing community around innovative and well-established tools and methodologies in impact measurement and management and thus contribute to a nascent and rapidly evolving space.

Scope

This handbook recognises that measuring the impact of investments in a private sector context is different from independent impact evaluations of government- or grant-funded programmes. Due to commercial, legal or logistical reasons surrounding the nature of their investments, neither development finance institutions nor other private-sector investors are in a position to systematically implement time-consuming and resource-intensive experimental approaches such as randomised controlled trials (RCTs) to measure impacts across their portfolios.[4] The vast amount of literature that exists on government- or grant-funded programmes[5] has not been properly adapted to the realities of private sector-focused impact measurement, neither from a resource nor process perspective.

The handbook builds on the need for more rapid, low-cost ways to generate valuable impact insights to drive learning as well as accountability. In doing so, it builds on and aligns with some existing initiatives in the private sector impact investing industry. These include IFC's Operating Principles for Impact Management, the Global Impact Investing Network (GIIN)'s Core Characteristics of impact investing and comprehensive system for impact measurement and management, IRIS+, and the Impact Management Project (IMP)'s guidance for integrating impact considerations into investment or business management decisions. Taken together, these initiatives provide practical norms, conventions and frameworks for how companies and investors manage their impact. In relation to these, this handbook aspires to operationalise the 'how to' of collecting relevant data points that can feed into robust impact measurement and management.[6]

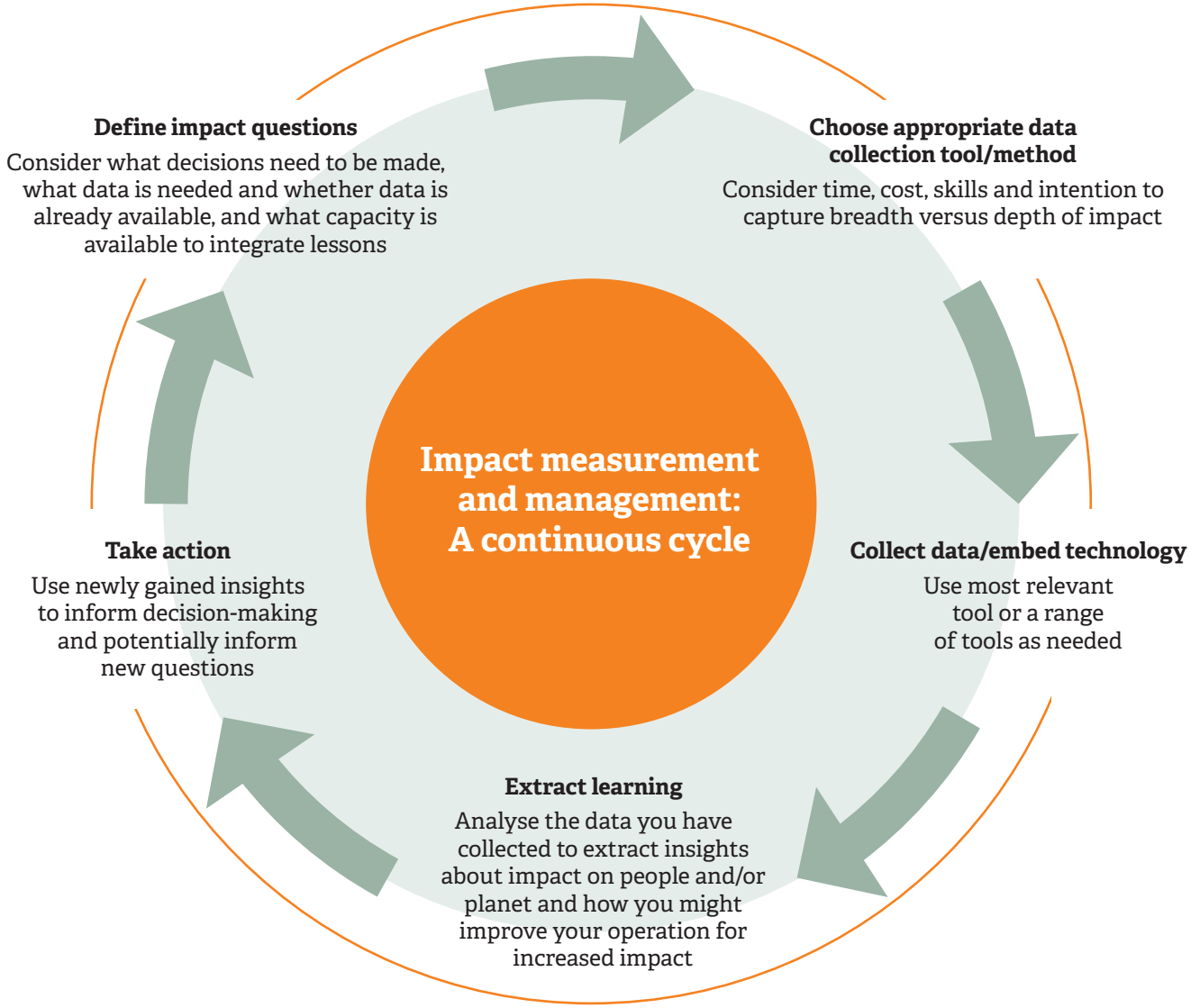
Approach

We conducted a review of the literature alongside interviews with independent subject matter experts and specialists within CDC and other development finance institutions, research institutions and data collection providers. The intention was to capture best practice as well as practical limitations and considerations around both established and newer data collection tools and approaches.

The handbook draws on academic research and literature from a more traditional development context when insights or conclusions have been deemed relevant and/or applicable to the private sector context that it seeks to address. A good example is IPA's Goldilocks Toolkit which, while not developed for the private sector impact investing community, still has many valuable insights on data collection tools for impact measurement that can add value for private sector investors.

4 Attridge et al. (2019)
5 Gertler et al. (2011); Glennerster and Takavarasha (2013); Khandker et al. (2010)
6 The handbook also supports and aligns with existing measurement indicator frameworks such as IRIS+ (https://iris.thegiin.org), GRI (www.globalreporting.org/Pages/default.aspx), Sustainability Accounting Standards Board (SASB) (www.sasb.org) and Harmonized Indicators for Private Sector Operations (HIPSO) (http://indicators.ifipartnership.org/about).

Figure 4: Data collection as an integral part of the impact measurement and management process



01

Data collection tools for impact measurement

Before you start: Looking at the existing evidence base

A useful starting point for any impact measurement exercise is to look at the existing evidence base for a given area of interest.

- Existing evidence that can be publicly accessed often takes the form of published studies, research reports and evaluations. Across key sectors such as **agriculture**, **health** and **financial inclusion** but also across more bespoke intervention areas, there is a rapidly growing body of evidence on the **effectiveness of programmes and business models, market gaps** and **challenges**, even within emerging markets.
- Existing evidence can be **useful in pointing to what has been proven to work** in different contexts and regions – which can inform **what to test** in a project that aims to build on what has worked elsewhere. It can also inform **how to think about measuring** impact for a given intervention. A rapid evidence assessment conducting key informant interviews and a targeted review of existing literature can produce a good overview in a few days or weeks.
- While much evidence relates to large-scale, publicly funded programmes, many industry bodies and associations that represent a sector also publish research reports.

Impact evaluations and systematic evidence reviews

- The Abdul Latif Jameel Poverty Action Lab (J-PAL), a global research centre working to reduce poverty): A wide range of evaluations and public policy publications as well as research resources are available, covering sectors such as agriculture, health and finance.
- Innovations for Poverty Action (IPA), a research and policy nonprofit that promotes solutions to global poverty): Resources for Finding and Using Evidence Reviews and Evaluations: It provides impact evaluation reports on topics such as agriculture, education, financial inclusion, governance, health and small and medium-sized enterprises (SMEs).
- International Initiative for Impact Evaluation (3ie), a global membership organisation funding and producing studies for inclusive development in low- and middle-income countries): Its Evidence hub covers a range of impact evaluations, systematic reviews and evidence gap maps across a broad range of sectors.
- IRIS+ (comprehensive system for impact measurement and management managed as a public good by the GIIN): includes an evidence base connecting common impact investing goals across a wide number of impact themes with specific outcomes. The evidence base includes collated resources based in field and academic research. Each resource is assigned a rating according to the NESTA standards of evidence.

Private sector-focused industry mappings, reports and resources

- GSMA, representing the global mobile communications industry, has multiple resources on a wide variety of topics around mobile services driving impact in emerging markets across agriculture, health, financial inclusion and more.
- SME Finance Forum operates a global membership network to expand access to finance for SMEs and has a large database of publications across market segments, financial infrastructure and different financial products and services.
- GOGLA, representing the off-grid solar industry, provides various publications on the off-grid solar industry and its impacts.
- Private Infrastructure Development Group (PIDG) provides resources and publications on the impacts of private sector infrastructure development.
- While not uniquely private sector focused, the Institute for Health Metrics and Evaluation (IHME) and Disease Control Priorities (DCP3) have resources and publications on global disease burden data, country profiles, cost-effectiveness analysis and more.

Company data

Summary

Strengths

- ▲ Does not require collection of new, primary data (likely already forms part of a company's data collection processes)
- ▲ Can provide a starting point for estimating impact of a business (eg. how many consumers benefitted from a given product or service, how many patients underwent treatment) and inform direction of subsequent data collection

Weaknesses

- ▼ Potentially biased (due to deliberate over- or underreporting); over-reliance on administrative or commercial data can risk over-estimation of positive impact
- ▼ Cannot answer questions around *why* certain indicators look like they do
- ▼ Might not contain indicators needed to assess impact

Tapping into existing data sources might be a good starting point for understanding the impact of a business. For example, aggregating a portfolio of microfinance companies' clients and looking at dimensions such as loan sizes and repayment rates can be a good way to start estimating company impact with data that already exists. If not replacing additional data collection altogether, the data that has already been collected by the company as a natural part of its operational processes should at minimum precede further data collection – and sometimes has the potential to act as a proxy for a business's impact footprint.[7]

Examples of administrative and commercial company data include:

- Commercial data such as sales numbers, retail price, product lifetime value.
- HR data such as headcounts, wages, retention rates.
- Health data such as vaccination rates, patient visits, hospital re-admission rates.
- Education data such as student attendance, test scores.
- Financial institutions data such as loan disbursement information, loan sizes, credit reports, default rates on loans.
- Tax filings.
- Other data points such as trainings conducted, number of claims.

7 An example of this can be found in the Global Off-Grid Solar Association (GOGLA)'s Metrics Calculator, which uses company commercial data (eg. sales data) to estimate impact on end customers' lives

Strengths

One of the key strengths of using data that is already being collected to run operations of a company is that it can provide insights into a company's impact without adding extra time or cost for additional data collection.[8] Companies are often sitting on a wealth of administrative data that could be used as a starting point for understanding and enhancing the impact of their products or services.

Using administrative data can overcome the issue of sample size as this data will usually cover 100 per cent of an organisation's patients, clients, students and so on.[9] It has the potential to be more accurate than self-reported data, especially in cases where perceived impact is less obvious or measurable by the beneficiary (eg. education or health outcomes) or where self-reporting tends to be less reliable than administrative data (eg. around loans). Finally, because the data is being captured as a regular part of a company's operations, it can be a useful historical data source that can help draw comparisons across different periods in time (eg. to establish a pre-investment trend up to baseline).

A complete and practical checklist for using administrative data for measuring and assessing impact, from identifying data sources to various quality, sample size and legal considerations, can be found in IPA's Goldilocks Toolkit Deep Dive.[10]

Case study: Using company commercial data to estimate impacts of off-grid solar

The Global Off-Grid Solar Association, GOGLA, established an Impact Working Group in 2013 to create a standardised set of impact metrics for the wider sector to "enhance knowledge, streamline reporting and attract investment, working capital, and regulatory support".[11] While great caution needs to be taken to apply this framework as a perfect measure of impact, it gives a starting point for estimating impact by using number of products sold or deployed to end users and sales numbers. GOGLA has recently launched a metrics calculator that feeds on company financial data points to estimate impact on customers' economic activity and savings on energy expenditure as well as CO_2 emissions avoided. While empirically tested with sector data, such a metrics calculator would still need to be complemented with other data sources to give a full view of a company's impact.

8 Rawlings (2013)
9 IPA (2016a)
10 IPA (2016a)
11 GOGLA (2018)

Weaknesses

Due to the nature of the operational and/or financial purpose of collecting administrative data, these types of datasets will be limited in their ability to cover non-customers and uncover these stakeholders' barriers to engage with the product or service in the first place. With few exceptions, administrative datasets will rarely contain socioeconomic data points, nor will they provide the ability to look at long-term impacts after a certain customer or user group is no longer engaging with the product or service.[12]

Administrative data is not an exhaustive source for impact measurement and management but might be a useful starting point for estimating *what* impact is created and *how much*. Its value is mainly unidirectional in estimating impact from data but less valuable to inform *why* outcomes look like they do and subsequently *how* to better manage a company's impact. Complementary data is needed for a company to iterate towards a greater impact.

Implementation risks and considerations

Inconsistent or poor data quality is a potential risk of relying on administrative datasets as data might have been recorded and reported in different formats or with different definitions attached to the data (one example would be inconsistency in how 'jobs' are counted, for example whether counting only full-time employees or including consultants and temporary employees). Another risk might be related to how people inside or outside the organisation are incentivised on reported numbers, which might lead to over- or underreporting for some figures. Data cleaning and/or validation might thus be an important part of turning administrative data into valuable insights.

In addition to data quality, getting access to administrative data might be challenging,[13] especially in emerging markets where digitisation of records is still less prevalent, and where various data sources might need to be processed and harmonised before they can be used for relevant insights. Time and resources often need to be set aside before value for impact measurement and management can be extracted from such datasets.

12 IPA (2016a)
13 Ibid.

Diaries

Summary

Strengths

- ▲ Can reveal deeper insights into usage patterns and behaviours over longer periods, including data on changes in consumption/usage patterns, and can be useful in informing product or service design
- ▲ Allow for participants to report data while in their own environment and as close to the occurrence of the behaviour as possible
- ▲ Can overcome issues of recall and produce more accurate data than surveys and focus groups, especially for variables with daily or weekly fluctuations, such as agricultural output, income and consumption
- ▲ Can capture rich impact stories and point to areas that need attention

Weaknesses

- ▼ More time-consuming and resource intensive from a planning and execution perspective; require follow up and continuous management to keep data collection on track
- ▼ More difficult to keep participants engaged over a longer period; require strong incentive schemes and incentive management
- ▼ Less useful for capturing representative data

While diaries are not a recent invention,[14] their visibility grew with their use in the 2009 Portfolios of the Poor[15] initiative, a large-scale project that aimed to better understand the financial lives of poor households across India, Bangladesh and South Africa. Financial diaries record financial transactions at regular intervals, typically once a week or fortnight. This approach recognises that for people on low incomes, income and consumption can be quite volatile day to day and week to week. It captures both 'typical' patterns and those that deviate, whether leading up to a big expense (like a wedding) or showing how transactions change when a household is coping with a shock. Since long recall periods are not necessary, smaller changes may be picked up. Beyond informing product innovation and adaptation in the financial inclusion space,[16] diaries have also been used more recently in areas such as food and agriculture, SME studies and energy.[17]

Diaries can be administered as physical diaries that require participants, directly or with the assistance of an enumerator, to make notes at desired intervals. For illiterate populations, visual pictograms can be used to help record, for example, spending or consumption patterns.[18] Technology can also be used to support use of diaries, through participant audio recordings[19] or enumerators collecting data from respondents via tablets[20] or mobile.[21]

Case study: Using diaries to reveal market gaps and improvement opportunities

Kenya Financial Diaries was an ambitious and large-scale diary project commissioned by FSD Kenya,[22] covering 298 selected households across the country for an entire year (2012–2013). While not necessarily replicable in scale and duration for individual businesses, the way in which the diary study was able to record detailed money management for low-income households reveals valuable insights for financial institutions targeting poorer customer segments. Key insights revolved around major gaps in areas like health finance and options for investing in, for example, assets, business and education as well as large improvement opportunities in product structure, marketing, price/fee transparency and service experience. Because of the long-term nature of data collection via diaries, the approach unearthed rich insights that have the potential to spur better and more targeted product development in the financial sector, ultimately increasing the impact it can have on the lives of consumers with low incomes.

Strengths

Because diaries can record how users interact with a certain product or service or what pain points they experience in a real-world environment and over time, one of their core strengths is to yield insights that shape initial product or service design or refinement during later stages. By understanding daily needs and pain points of people, diaries can help spot market gaps and inform product innovation, which may in turn improve customers' access to value-added and impactful products and services. For individual businesses, small (non-representative) samples of diaries can thus be a valuable way to 1) gain rich business intelligence and 2) capture qualitative impact stories.

While extensive studies, often commissioned by larger institutions, are usually beyond the practical feasibility of individual businesses, their relevance and applicability in informing subsequent product and service design across an entire sector is very high, and so individual business can benefit from paying attention to conclusions from larger, externally commissioned studies in their field.

14 Wiseman et al. (2005)
15 Collins et al. (2009)
16 Clarke (2016); Anderson and Wajiha (2015); FSD Kenya (2014); Bankable Frontier Associates (2013)
17 L-IFT (2018)
18 Wiseman et al. (2005)
19 Crozier and Cassell (2015)
20 FSD Kenya (2014)
21 Chang (2018)
22 FSD Kenya (2014)

Because diaries allow for respondents to report on specific activities (eg. consumption or spending) close to the actual time of the event, they have the potential to overcome both recall error (ie. where consumption or spending is over- or underestimated) and telescoping (ie. where consumption or spending is reported as having happened in a shorter timeframe than in reality)[23] – two common reporting errors of surveys.

Finally, capturing data from the same person over time can help place events in a larger social, economic and political context. For instance, when collecting data on consumption or expenditure, it is vital to be able to look at the effects of seasonality, especially in poor and rural communities.[24]

Weaknesses

A general weakness of diaries is that they are unlikely to be practical or feasible to roll out at scale for any individual business. This weakness should not limit the use of diaries per se but just acknowledge in what format they are most likely to add value to decision-making processes and impact measurement (ie. the value for an individual business will likely come from collecting smaller samples that capture rich, qualitative data points that deliver insights on specific topics and can be used as 'impact stories').

As diaries put a lot of work on the respondent to systematically engage with an enumerator or complete records, they can have the drawback of high non-completion rates or high attrition rates over the diary period. In the case of, for example, illiterate populations needing assistance to fill out a diary, a weakness might be that the line between data collected via diary as opposed to recall interview is blurred[25] (most of the big diaries studies in the financial inclusion space are interview based). "The implications of variation in literacy, motivation, and other factors, although not well-documented, implies that it can be quite difficult to conduct a high-quality diary survey, regardless of issues related to respondent recall bias".[26]

In a study comparing household data using different survey methods in rural Tanzania,[27] the diary method was found to dramatically underestimate consumption if the household is illiterate and receives infrequent supervision. The traits of the respondent group, particularly literacy levels, must be considered when deciding whether to use self-reported written data or interviews for data collection via diaries. For low-literacy settings, it is recommended to use in-person interview format for collecting the data, which will impact costs (while frequent supervision can minimise recall error and other types of reporting errors, it is estimated to cost 6–10 times as much as a recall format and twice as much as infrequently supervised diaries).[28]

Case study: Using diaries to understand customer pain points and design better products

Developed under USAID's Renewable Energy Microfinance and Microenterprise Program (REMMP), a pilot with energy diaries was conducted across three rural sites in India to understand the daily realities of consumers who are energy poor.[29] Through the daily recording of energy consumption and choices over a six-month period, diaries yielded rich insights into differences in behaviour across different types of households, gender and age as well as cultural and financial circumstances impacting the use of energy sources. Diaries proved a useful market intelligence tool to give a clearer view into what more optimal energy products could look like and levers to drive higher adoption rates of clean energy products among consumers and, ultimately, increased social and environmental impact.

Implementation risks and considerations

Because the diary method relies on data capture over longer periods of time, attrition is an inherent risk of the method. The time frame for collecting data via diaries can vary from a few weeks up to several months. This decision needs to balance the requirement for data with how to manage attrition over prolonged periods (although the Kenya Financial Diaries project only showed 15 per cent attrition over a period of 12 months,[30] it was a highly resource-intensive project and so suggests that considerations around time period for any diary effort should have a clear view on the resources needed to manage respondents). Their advantages need to be considered against the additional time and cost such research would require and may not be fit for purpose if the same question can be answered by a single survey or interview process without substantial loss of insight.

Another risk is to use diaries as a stand-alone tool for impact measurement; even with large studies like the Kenya Financial Diaries study, there is often not enough data to rigorously infer impact. However, they can be useful to unearth impact stories and to gain business intelligence that can feed into an impact management process.

23 Beegle et al. (2010)
24 Wiseman et al. (2005)
25 Beegle et al. (2010)
26 Ibid.
27 Ibid.
28 Ibid.

29 Arc Finance (2016)
30 FSD Kenya (2014)

Focus groups

Summary

Strengths

- ▲ Format provides a way to assess the extent to which there is a shared and consistent view on how impact is experienced across a group
- ▲ Group dynamics can help focus conversation on the most pressing issues or prominent themes (sometimes even taboo subjects, depending on context), and participants might share thoughts that are stimulated by comments from the group, leading to deeper insights

Weaknesses

- ▼ The number of questions covered is more limited
- ▼ Focus group members are more susceptible to bias caused by more vocal people dominating the conversation; factors like status might conflict with the conversation

Focus groups have their origin in market research and came about from the realisation that many consumer choices are made in a social context.[31] Companies interested in discovering consumer perceptions, specifically when these are likely to be influenced by social or cultural norms, can use focus groups to drive greater impact of their products or services via a better understanding of adoption drivers in a community, or to unearth issues that particular stakeholder groups face in their everyday lives.[32]

Strengths

A key strength of focus groups is their inclusive nature in that they "do not discriminate against people who cannot read or write and they can encourage participation from people reluctant to be interviewed on their own or who feel they have nothing to say".[33] The group dynamics of the method can be an advantage when trying to capture shared experiences and norms[34] or when people are encouraged to discuss difficult or taboo issues due to mutual support within the group.[35] Focus groups can be a very effective technique for gathering qualitative data as the range and amount of data collected at the same time is greater. Focus groups can be useful in an initial data collection phase, for instance as a precursor to developing a more structured data collection process (eg. providing insights into which questions to ask or how to phrase questions) or can be useful in combination with other data collection methods such as surveys or in-depth interviews to amplify and understand the findings from a survey.[36] Lastly, focus groups can also be used to help bring about change in a group and among its members.[37]

31 Robson and McCartan (2016)
32 Practical guides for how to design and conduct focus groups are referenced in Acumen's Lean Data Update 2016
33 Kitzinger (1995) in Robson and McCartan (2016, p. 298)
34 Copestake et al. (2019)
35 Robson and McCartan (2016)
36 Ibid.
37 Ibid.

Case study: Using focus groups to assess impacts of off-grid refrigeration

M-KOPA Solar is a Kenyan-based off-grid solar company with sales across multiple African countries. To better address consumer needs, M-KOPA is looking into a variety of value-added products and services – one of these being off-grid powered refrigeration products. As part of an exercise to understand impacts of refrigeration in off-grid communities, M-KOPA conducted a mix of large-scale surveys, in-depth interviews and focus groups (male-only, female-only and mixed focus groups). The discussion format was able to capture a richer picture of social dynamics and social value associated with the product offering as well as the perceived relative value of a fridge compared with other products. Given the early stage of product development, focus groups were able to inform how to iterate the new product towards customer needs and product-market fit. The discussion format across different groups provided rich statements around how customer's lives are impacted by owning a fridge. By uncovering nuanced and shared sentiments around price sensitivity, social value and utility, focus groups helped the company gain insights that can lead to better addressing consumer needs (through better product functionality and utility) and, ultimately, better business outcomes and greater impact.

Weaknesses

Because focus groups are aimed at getting deeper and richer insights from multiple people at the same time, the number of questions that can be asked is more limited and power dynamics and hierarchies in the group might influence who speaks and who dominates the conversation.[38] While there is an element of efficiency as focus groups allow for data collection from more people at the same time, they still require in-person facilitation and thus resources to travel to relevant locations, which can be a weakness if respondents are in hard-to-reach or remote locations. While internet-based focus groups that allow for remote data collection do exist,[39] this format is unlikely to be feasible in an emerging markets context where factors like internet connectivity and access to computers are likely to pose barriers.

Implementation risks and considerations

By its very nature, a main risk of running focus groups relates to the way in which group dynamics influence results; caution should be taken to not interpret absence of nonconforming views as an indicator of group consensus. For this reason, focus groups require considerable experience and sensitivity to manage group dynamics and resulting output, which should therefore be considered as part of such a data collection strategy. Finally, because focus groups explore collective phenomena, and not individual ones, caution should be taken not to infer individual impact from group impact or generalise more broadly from findings of a focus group.[40]

38 Robson and McCartan (2016)
39 Ibid.
40 Ibid.

In-person surveys

Summary

Strengths

- ▲ Can capture nuanced dimensions of feedback that can be key to inform product or service iterations
- ▲ Have the potential to observe respondents in their local context, giving additional richness in understanding impacts of a product or service and consumption patterns
- ▲ Overcome issues of illiteracy and lack of technology access

Weaknesses

- ▼ Require travel to sometimes remote or dispersed locations, driving up costs
- ▼ Are more difficult to run on a repeated basis
- ▼ Prone to different types of respondent bias

While in-person surveys have been a key component of social change and development impact efforts for decades, technology advances and the proliferation of mobile phones globally has broadened the avenues for survey data collection, even in poorer and less developed regions of the world.[41] Which survey data collection tool to choose should be highly adapted to the local context and account for bias as a pure result of data collection tool choice. For example, in many developing countries, the choice of a technology-driven approach requiring interaction with either an online or mobile survey might skew results towards a male, more affluent and urban population. For such markets, in-person surveys, especially for bottom-of-the-pyramid populations, might still be the only viable route to data collection.

Much literature exists on the topic of traditional in-person and more extensive surveys,[42] and we refer to the World Bank's Open Knowledge Repository for comprehensive resources on in-person survey design and methodology. While not developed for an emerging markets context per se, Qualtrics' online guide repository provides practical steps and considerations around how to design surveys and may be a useful starting point.

Strengths

Surveys are a useful tool for capturing and assessing evidence of impacts that can be accurately self-reported (eg. improved income from a job, changes in consumer surplus or increased quality of life from a product). An obvious strength of the in-person survey format is its ability to capture more data points and longer-format responses.

Because an enumerator will be collecting survey responses in real time, in-person surveys have the potential to minimise misunderstandings as both parties are able to ask for clarification on questions and answers, ask follow-up questions or probe deeper on certain answers given. This can be key to businesses trying to get a more nuanced understanding of how a certain product or service is being consumed across different local contexts, the underlying reasons why a product or service might not be performing as expected, or what dimensions of a product or service are particularly important to end users.

From a sampling perspective, the strength of the in-person survey is its ability to capture insights from respondent groups who are both customers/consumers and non-consumers of a company's products or services; the latter can be equally important to survey to understand how to adjust and iterate value propositions.

Especially in the context of emerging markets businesses catering to low-income populations, one of the core strengths of the in-person survey is that it overcomes issues of illiteracy and technological barriers that still exist across many of the more remote, rural and poor regions of the world.[43] With many emerging market providers specialising in survey design and implementation, even large-scale surveys can today be turned around quickly through large teams of enumerators.

Case study: Using in-person surveys to assess demand and potential impacts of store expansion

Zambeef Products plc is a food retailing company in Zambia. As part of its store expansion planning and product pricing strategy, large-scale in-person surveys were undertaken to understand consumer demand and perceptions around animal food products. More than 1,700 in-person surveys were conducted across both Zambeef customers and non-customers to drive insights from areas served by Zambeef as well as underserved areas. The in-person survey data collection was key to inform questions around product preferences, willingness and ability to pay, access to refrigeration and commercial outlets[44] (in contrast, mobile surveys would not have been able to reach non-customers and obtain valuable insights from underserved groups). The data collected through the in-person survey effort allowed the company to get a better sense of low-income customer priorities and willingness/ability to pay and thus not only served as market intelligence for business decisions but also to assess potential positive impacts of expanding to underserved areas and adapting pricing to financial realities of existing and new consumers (and thereby enhancing access and affordability of protein-rich foods).

41 Dabalen et al. (2016)
42 Iarossi (2006); Robson and McCartan (2016)
43 Leo et al. (2015)
44 Cheelo et al. (2018)

Weaknesses

Surveys are less useful for capturing evidence of impact that is either difficult, sensitive or impossible for people to articulate accurately (eg. improved civil society engagement, soil quality or nutritional levels). In such cases, surveys might need to be coupled with different types of data collection to tell a fuller story about the impact of a business.

For in-person surveys, the process requires enumerators to travel to collect the responses, sometimes in remote and difficult-to-reach areas. This usually makes the data collection process more resource consuming (in terms of time, capacity and/or budget). If using specialist consultancies with large on-ground enumerator teams, in-person surveying need not come with a long turnaround time but might need a more substantial budget to execute. If unstructured and qualitative in nature, survey data can be hard to analyse and it can be difficult to extract signal from noise. Text coding and machine learning methods can be ways of overcoming that weakness and can even be designed with a view to flexibility, accessibility and low cost.[45]

Implementation risks and considerations

A risk associated with any in-person data collection effort revolves around the inherent human bias that is introduced in the process (affecting the so-called *internal validity* of the data,[46] ie. whether we are obtaining valid information about what respondents think or feel). Whether related to the respondent wanting to 'please' the enumerator through a certain type of response (so-called *social desirability response bias*), the respondent not feeling comfortable sharing sensitive or candid responses, or the enumerator being biased in his or her approach, these are aspects to be considered. Such biases have various root causes and can be related to differences in gender, age and perceived or real difference in social status and more. The Qualitative Impact Assessment Protocol (QuIP)[47] is a method designed to mitigate against response bias in qualitative interview settings by using methods such as blindfolding (ie. where the field researcher does not know about the intended impact being assessed and instead collects data about what the respondent reports to be prominent in their lives).

A further general survey risk revolves around recall bias (respondent not adequately remembering and misstating facts, exaggerating sentiments or simply not knowing the facts if the wrong person is asked), non-response bias or bias related to people not willing to participate (especially in emerging markets, where there is a trend for decreasing response rates to surveys,[48] likely linked to general survey fatigue, and so in any case incentives need to be considered for survey participation). Conversely, voluntary response bias (ie. particularly satisfied or dissatisfied respondents who want to voice their opinion) also needs to be considered. Although impossible to remove human bias from any in-person survey process, carefully considering and designing any survey is crucial (to maximise not only validity but also reliability of results, ie. the extent to which the survey was consistent across respondents, settings and so on).[49] Data collection errors (either because of fraud or simple human error) are a risk that should be considered, and that can be mitigated via strategies such as data back checks, survey piloting, data collection via tablets and enumerator-specific hiring practices and incentive structures.

45 Copestake et al. (2019)
46 Robson and McCartan (2016)
47 Copestake et al. (2019)
48 Ibid.
49 Iarossi (2006); Robson and McCartan (2016)

Spotlight: Employee and worker surveys

Especially in emerging markets and across labour-intensive sectors such as agriculture, manufacturing and construction, a special type of survey category relates to employees/workers as a key stakeholder group. As shown by numerous studies, productivity and overall business health rely heavily on overall workforce conditions[50]. However, while there is a strong business case for securing decent working conditions for all company employees/workers, there are still strong and entrenched perceptions that improving working conditions leads to higher costs. Many companies, especially in poorer regions of the world, are thus not always willing to or do not feel they are able to align their business practices with providing better working conditions for their staff.

From a survey perspective, this creates a reality in which employee or worker groups are often not able to articulate how they might be dissatisfied with working conditions for fear or repercussions and/or losing their job. Because of this inherent tension often found between management and employee interests, especially in low-income and labour-intensive industries, employee and worker surveys should be approached with far greater sensitivity than other types of stakeholder survey. At the same time, it is important for business leaders to recognise the massive business opportunity that can be reaped from implementing employee/worker surveys in the right way – from improved productivity, attendance and staff retention to better capacity utilisation rates and ultimately higher-value buyers and investors.

Like with regular surveys, employee and worker surveys need to be attuned to the local context but come with an additional set of considerations:

- What is the country and industry context in which this survey is taking place? Questions around job quality in low-income countries, where basic standards are often still only just evolving, need to be attuned to local realities. Most employee/job satisfaction questionnaires that have been established in the context of highly developed workplaces cannot be readily imported into an emerging markets context. Tailoring to what is appropriate and realistic to ask about in a low-income setting is crucial to avoid backlash.
- How does the company plan to build trust and address the findings of the survey? Newly introduced tools or technology (eg. mobile surveys) require a period of trust building with the workforce before useful information about workplace conditions will be provided.
- Are resources in place to manage survey findings? Even more pronounced than in the case of customer surveys, asking employees or workers for feedback that is *not* acted on can create cynicism, disengagement or even backlash towards management. To develop trust, mitigation or responsive steps to feedback and complaints need to be taken and demonstrated to or communicated with workers.
- How does the company plan to address and manage sensitive issues that might come to the fore, such as discrimination or sexual harassment?

Newer providers on the market have begun to leverage the rise of mobile technology for their employee and worker surveys – and so both in-person and mobile surveys can work as feasible ways to collect data (often in combination) but either way need to be grounded in the considerations above.

50 ILO and IFC (2016); EDFI and FMO (2019)

Macro data

Summary

Strengths

- ▲ Does not require collection of new, primary data – many datasets are available as free, public goods
- ▲ Various datasets can provide useful calibration input for measuring impact on a household, sector or market level (eg. how many direct and indirect jobs investment in a certain sector has created; estimation of how large a reduction in CO_2 emissions a certain business has created)

Weaknesses

- ▼ Depending on the type of impact measurement of interest, might need advanced data analytics skills to decode and/or turn into useful insights (eg. in the case of modelling indirect or induced impacts)
- ▼ Less suited for understanding impact at the individual level
- ▼ Cannot answer questions around *why* certain indicators look like they do

Macro data refers to aggregated, system-level data that provides information about properties of a region, state or political system. It is derived from microdata by statistics on groups or aggregates, such as counts, means or frequencies.[51] For clarity, macro data in our definition thus encompasses both aggregated micro-level datasets such as household surveys and meso-level datasets such as enterprise surveys. Macro data can often provide a useful starting point for go-to-market strategies as well as a generally useful picture of a certain market, sector or region to contextualise measurement of impact as well as subsequently to manage impact against the existing market.

Examples of public and freely available macro datasets include:

- **World Bank:** The **World Development Indicators Databank** is a primary collection of development indicators (such as GDP per country, electric power consumption per country and gross fixed capital formation per country), which are compiled from officially recognised international sources. It presents the most current and accurate global development data available, and includes national, regional and global estimates.
- **World Bank: Enterprise Surveys** provide aggregate survey data at the firm level across a representative sample of an economy's private sector. They cover a broad range of topics such as access to finance, corruption, infrastructure, crime, competition and performance measures.
- **Penn World Table:** A set of **national accounts data measuring real GDP** across countries and over time. Successive updates have added countries (currently 167), years (1950–2017) and data on capital, productivity, employment and population. The database allows for comparisons of relative GDP per capita, as a measure of standard of living, the productive capacity of economies and their productivity level. Compared with other databases, such as World Development Indicators, the time period covered is larger and there's more data that is useful for comparing productivity across countries.
- **Food and Agriculture Organization (FAO): FAOSTAT** provides free access to food and agriculture data for over 245 countries and territories and covers all FAO regional groupings from 1961 to the most recent year available. Data is available longitudinally, across countries and with decent levels of comparability (but with limited data breakdown for urban/rural regions).
- **UN/Oxford Poverty & Human Development Initiative (OPHI): Multidimensional Poverty Index (MPI) database** – an international measure of acute multidimensional poverty covering over 100 developing countries. It complements traditional monetary-based poverty measures by capturing education, health and living standards. It can be broken down by rural/urban and region/state (some data might not be comparable across countries due to year of collection or instruments used).
- **International Labour Organization:** The **ILOSTAT database** is the world's leading resource on labour statistics across subjects such as employment and unemployment rates by country, productivity rates, earnings and labour costs and consumer prices.
- **National statistics:** Country-based statistical information compiled and produced by national statistical offices and central banks (such as total employment per sector, total GDP per sector, credit to private sector). Census data is generally comparable across years and potentially across countries (but might be limited to only a few population-specific variables).
- **UN Department of Economic and Social Affairs Population Division:** Datasets cover **population indicators** such as life expectancy and age groups as well as mortality, fertility and migration indicators.
- **International Energy Agency (IEA):** The **IEA Energy Statistics** is a database with statistical information on energy production, consumption and prices across various regions and countries.

Examples of proprietary datasets, available on licence include:

- **Global Trade Analysis Project (GTAP): GTAP** is a global database describing bilateral trade patterns, production, consumption and intermediate use of commodities and services consisting of over 100 tables for individual countries or a group of countries and 57 sectors. The database uses input from a global network of institutes, researchers and policy makers conducting quantitative analysis of international policy issues.

51 OECD (2005)

- **Eora:** The **Eora global supply chain database** consists of a multi-region input–output table (MRIO) model; Eora features a balanced global MRIO table linking sectors across 190 countries, a complete timeseries for 1990–2015, environmental indicators covering greenhouse gas emissions, labour inputs, air pollution, energy use, water requirements, land occupation and more.
- **Bloomberg: Database** of global company real-time and historic price data, financials data, trading news and analyst coverage.

Strengths

While macro datasets will unlikely be able to inform any impact measurement effort in an empirical way, such data can be a useful starting point to inform go-to-market strategies, understand baselines/end lines and calibrate models that try to capture and estimate large-scale effects.

Quick and relatively low-effort ways of using macro data usefully include consulting one or several data sources to generate a baseline for impact measurement as well as specific defining areas for further intervention and/or data collection.

Case study: Using macro data to establish yield baselines

Measuring agricultural yields is notoriously a difficult process, especially if done remotely. A way to manage this uncertainty is to triangulate yields measurements from different macro data sources. For example, estimating rice yields in Nigeria can be done by combining data from publicly available agricultural research stations such as YieldGap.org, free and publicly available farmer-level survey data (World Bank Living Standards Measurement Study - Integrated Surveys on Agriculture (LSMS-ISA)) and geospatial information (eg. from HarvestChoice). In the case of rice yields, looking at such different data sources can provide a useful baseline estimate that can drive decision-making for concrete interventions as well as areas to focus on in subsequent impact measurement efforts.

Macro data can also be used for more complex impact measurement exercises such as measuring indirect jobs created across a portfolio,[52] estimates of the induced effects of wages and economy-wide employment from power and loans, carbon emissions and carbon reductions.[53] In such cases, more sophisticated modelling is needed, in which macro data will be a useful input to calibrate, for example, employment multipliers used in a given model. Although such models can be expensive to build, once they are up and running, they are low cost and easy to update and maintain. In this way, macro datasets can support insights around more systemic or market-level aggregate impacts, which become particularly relevant to understand when large investments are made into specific countries or sectors.

52 FMO (2019); MacGillivray et al. (2017)
53 FMO (2019)

Case study: Using macro data to measure direct and indirect job creation

Development finance institutions like the UK's CDC Group and the Netherlands' FMO use macro datasets to calibrate models that aim to capture market-level and indirect impacts of their investments. CDC uses headcount and financial data from portfolio companies to feed into a "set of multipliers derived from social accounting matrices and labour force data to yield an estimate of the total number of jobs and livelihoods likely to have been supported by the financial flows through the business and its supply chain in a given year".[54] To inform its jobs model, it uses a combination of GTAP, World Bank Development Indicators, ILO, IEA and national statistics macro datasets.[55] FMO uses the same model as CDC Group to capture the impact of its investments and also seeks to capture overall greenhouse gas emission reductions for certain parts of its portfolio.[56] Macro datasets are used to shape impact measurement for reporting and accountability purposes but at the same time add value to portfolio-shaping strategies.

Weaknesses

Certain proprietary macro datasets can be quite expensive as they often require a licence to access as well as specialist consulting support to model and extract insights from their data.[57] While macro data is valuable for high-level impact estimation or planning, it's by nature limited in its ability to provide insights on more qualitative nuances of impact, such as insight on the *quality* of jobs and livelihoods supported. Generally, macro data will not be able to answer questions around *who* is benefitting or *why* a certain product or service is or isn't performing as expected.

There typically exists a trade-off between granularity, coverage, consistency and access in macro datasets. While GTAP presents an example of a proprietary macro database where data is entirely consistent (and hence comparable) across sectors and formats, these advantages come at the cost of some data being left out of the database altogether if it does not conform to the way GTAP codifies its datasets (eg. in cases where certain reporting formats are country specific and do not allow for standardisation of the data). Bloomberg is an example of a proprietary and licence-based macro database representing the opposite use case: here, almost any global macro dataset can be found, often with tens or hundreds of variations of the same indicator, submitted according to each country's or entity's definition. The richness in availability of datasets comes at the expense of consistency and ready comparability across datasets, making comparisons across multiple sectors and markets difficult and impractical.

54 MacGillivray et al. (2017, p. 1)
55 Ibid.
56 FMO (2019)
57 IFC (2018a)

National statistics, regional datasets and member-specific databases such as Eurostat or the OECD database offer some of the most granular and consistent cross-country data available, yet country coverage is by definition limited.

Implementation risks and considerations

When it comes to national statistics, dataset quality varies widely across countries, with challenges present especially in emerging markets at both national level and as reported by businesses to foreign investors in Africa and South Asia.[58] Depending on the country or region, publicly available macro datasets can thus be of limited reliability and use. Further, diligence is needed when comparing data across markets, especially if datasets are not consistent across sectors and data formats (the GTAP database presents one example that helps overcome this issue as all its data is consistent across dimensions).

58 MacGillivray et al. (2017)

Mobile surveys

Summary

Strengths

- ▲ SMS/IVR: Good for check-ins on very specific questions that can be answered in short format (eg. general customer satisfaction, whether stakeholders understand where to collect/buy a solar lamp) – maximum of 7–10 questions
- ▲ Voice calls: Can capture more complex or qualitative questions
- ▲ Ability to easily survey stakeholders across vast geographical areas and/or in remote areas
- ▲ Low-cost and quick
- ▲ Light-weight on the respondent

Weaknesses

- ▼ Can introduce bias if there are significant gaps (eg. social, economic) in access to mobile phones in the respondent group (particularly so in very poor and fragile countries)
- ▼ Can be more challenging to get responses from a representative sample
- ▼ For SMS and IVR-based surveys, limitation in depth of impact data captured
- ▼ Rely on access to stakeholder phone numbers (ie. surveying non-customers or customers when phone number lists are not available is not feasible)

With the proliferation of mobile phones (and increasingly smartphones), not only in developed markets but also in low-income countries where even remote and rural populations often have access to mobile phones,[59] surveying customers, suppliers and other stakeholder groups via mobile has become a feasible and valuable route for getting insights to advance business goals and impact. Pioneered by Acumen under the service mark Lean Data℠ (today owned by the impact data company 60 Decibels), mobile surveys via call centre, online, SMS or interactive voice response (IVR) have been tested across a wide range of businesses and sectors, with lessons learned captured in practitioner-oriented Lean Data guides published by Acumen.[60]

Lean Data uses a specific set of principles in the survey design, which revolves around the data collection being business value driven, short and quick by format, and predominantly enabled by mobile technology.[61] These principles provide a useful framework for how to think about the design of any mobile survey, so we heavily draw on the principles of Lean Data in this handbook's approach to mobile surveys.

59 Dabalen et al. (2016)
60 The Lean Data Field Guide 2015, Innovations in Impact Measurement (2015) and Lean Data Update 2016
61 Adams et al. (2015)

Strengths

Mobile surveys' main strength is their ability to reach customers where they are via either SMS, online surveys, voice calls or IVR, which drives cost-effectiveness, efficiency and speed as surveys can be run remotely. SMS and IVR are well-suited for capturing answers to relatively simple and specific questions such as product satisfaction or factual questions on household characteristics (best practice suggests no more than 7–10 questions). Voice calls are well-suited for capturing answers to more complex questions that might need probing along the way (best practice suggests no more than 15 minutes).

The mobile survey's strength for businesses lies in its ability to tailor survey administration to align with existing touchpoints with customers (eg. where mobile phone engagement already forms a natural part of the business-customer interaction for payments) or, if existing stakeholder touch points are not necessarily mobile-driven, the imperative to keep surveys short and light-weight for respondents to engage with. Provided there is good mobile phone penetration, the mobile-first methodology can provide quick, direct communication with stakeholders and give valuable business insights.[62]

Because mobile surveys provide a relatively low-cost option compared with in-person surveying in the field, and offer a high degree of flexibility and short turnaround times, they have the potential to mobilise demand for impact measurement and management among businesses that might have shied away from such efforts previously due to the perceived burdensome nature and lack of 'pragmatic' providers – contributing to a broader culture of curiosity and learning about development impact.[63] A further strength is the ability to survey people in volatile and high-risk environments, where face-to-face engagement would simply not be feasible. For example, during the West Africa Ebola virus outbreak in 2014, mobile-enabled surveys were used to collect data to monitor the Ebola crisis and its effects on food security and to provide estimates of its socioeconomic toll.[64]

Weaknesses

While mobile surveys can provide enhanced value for businesses in quickly and efficiently understanding their impact by using standard questions (such as net promoter score) and in understanding otherwise-uncaptured metrics (such as percentage of customers using a product who are poor), an inherent limitation in the SMS or IVR format is that fewer questions can be covered and less richness and detail can be captured. There is also limited potential for clarifying misunderstandings and varying interpretations of the questions asked, hence question testing and refinement may be crucial for SMS- and IVR-based surveys.

62 Adams et al. (2016)
63 Dichter et al. (2016)
64 Dabalen et al. (2016)

This is not the case for phone-based surveys, where a well-trained enumerator can clarify questions just as they would during an in-person interview, and a range or complex quantitative and qualitative questions can be asked. Some genuinely sensitive topics may not be appropriate for phone surveys (eg. questions about sensitive health matters or personal security), and surveys are best kept to 10 to 15 minutes in length to avoid survey fatigue.

Relying on access to respondent phone numbers as a prerequisite for the data collection can sometimes be a challenge. This is especially the case if the partner does not have a well-maintained database of customer contact details. It can also make it difficult to capture non-customer feedback or feedback from stakeholders where phone number access is not possible. Even if people are encouraged to share their phone numbers (eg. via a radio campaign rewarding people who share phone numbers with different incentives), the sample of numbers may result in some selection bias.[65]

Case study: Using mobile surveys to capture economic impacts across customers and suppliers

Agricare is a commercial animal feed mill based in Ghana, with poultry feed as its main product line. It sells animal feed directly to farmers and via a network of sales agents in Ghana and Togo and has established an out-grower scheme to secure local access to raw materials. Through call centre surveys with both consumers and suppliers, Agricare was able to generate valuable business insights that ended up driving changes in areas like marketing strategy and packaging.[66] While gaining these valuable insights to improve its business, Agricare was able to understand what types of customers were served and/or underserved and thus the impact it was having on farmers' lives. From this, Agricare understood how it might change its marketing, pricing and distribution strategies to better reach underserved segments thereby strengthening the business and, ultimately, its impact on poorer customers.

Implementation risks and considerations

In contrast to in-person surveys where sample sizes and representativeness can be managed, mobile surveys have the risk of not capturing a large enough sample to get high-quality and unbiased responses and/or capturing only the views of particularly satisfied or dissatisfied stakeholders[67] (ie. response bias). The clear recommendation if unable to get a representative sample of phone numbers is to go with in-person interviews/surveys.[68]

Another risk, especially in poorer and more rural areas, is of collecting data that is skewed towards a male population as women in many countries still represent the most disconnected of groups when it comes to mobile phone access.[69] Further to the risk of introducing gender bias, the notion of near ubiquity of mobile phones is still not accurate for many of the poorest and most fragile regions in the world. Overall in Sub-Saharan Africa, only 50 per cent of the population are mobile subscribers,[70] with numbers varying dramatically between markets. Even within countries these averages are invariably lower for the poorest people and in such contexts, the mobile-first mentality may be inappropriate as a means of collecting relevant data. Where mobile phones are present, often only one phone is used per household, and so knowing exactly who responds to a survey can be difficult and needs to be considered in both its design and analysis of responses. Properly understanding mobile penetration rates and gender access to mobile phones in a given country is a useful first step to minimise biased results.

Risks to accuracy (ie. measurement error) – which are present in all surveys – may also be accentuated by certain types of questions in mobile-based surveying. Specifically, responses to questions about generally stable indicators such as household size, land size or education levels have shown to be robust via SMS or IVR whereas metrics that may have high variability over short-time periods (eg. fuel spending or daily consumption rates) – are often more effectively collected by call centres and in person.[71] Matching the most appropriate mobile channel to the types of questions at hand is a key consideration to ensure that the data collected is both accurate and useful.

Case study: Using mobile surveys to measure impacts on farmer yields and income

SunCulture sells affordable solar-powered water pumps and customised irrigation systems, bundled with ongoing support and financing. It was the first company to commercialise solar-powered irrigation in Africa and provides on-farm training, soil analysis and agronomy support by mobile phone, and next-day delivery and installation anywhere in Kenya. Using a call-based survey approach to collect data from customers, the SunCulture team was able to put in place a process for the company to generate repeated customer insights, using data points from the research that were found to be the most powerful.[72] This is now helping SunCulture measure and understand what impact its products are having on farm yields and farmer income in addition to helping track satisfaction and opinion across its customer base.

65 This can be corrected with appropriate reweighting if required.
66 Adams et al. (2017)
67 Adams et al. (2015)
68 Detailed guidance on mobile survey design considerations can be found in Acumen's Innovations in Impact Measurement (2015)
69 GSMA (2019b)
70 GSMA (2019a)
71 The Impact Programme (2018)
72 The Impact Programme (2018)

Satellites

Summary

Strengths

- ▲ Avoid bias inherent in self-reporting
- ▲ Allow for collection of objective data on one-time occurrences (eg. whether a farming plot was cleared) and continuous occurrences (eg. changes in greenness over a region)
- ▲ Enable remote, large-scale and high-frequency data collection
- ▲ Can inform market-level analysis across a wide range of sectors and application areas (eg. improving customer segmentation, identifying physical and social distribution barriers, informing go-to-market strategies)
- ▲ Can lower risks of reporting error (avoiding manual processing; data consistency over time; credibility through general tamper-proof nature)

Weaknesses

- ▼ Do not deliver data on perceptions of impact, for example data that often requires consulting individual consumers or stakeholders
- ▼ Require technical skills for data collection design, analysis and interpretation
- ▼ Where satellite data is used to infer outcomes (eg. measuring agricultural productivity or poverty reduction), it still relies on robust, high-accuracy ground data collection to calibrate and validate models before they can be applied at scale
- ▼ Cloud cover may lead to erroneous predictions on key outcomes in high-resolution applications

Through a mix of large, government-owned and smaller, low-cost privately owned satellites circling the planet, the surface of the Earth is today mapped out through frequent image capture.[73] The use of satellite data (often in combination with other data sources linked to geographical coordinates) can help improve customer segmentation,[74] identify distribution barriers, inform go-to-market strategies, quantify economic and environmental impacts[75] and conduct infrastructure assessments.[76]

Satellite imagery can be used for a wide range of purposes, from simple ones (eg. identifying roads, rivers and other infrastructure) to more complex ones where certain impacts need to be *indirectly* derived from imagery and through triangulation with other data sources (eg. estimating poverty levels[77] or crop yields). In the case of crop yields, for example, satellite data has the potential to overcome issues of scale, cost and inaccuracy of self-reported data – but only once a careful and robust calibration and validation of this data using ground data has been performed.[78]

Uses of satellite data in an impact measurement context are nascent, and academics and private providers are still refining and validating the accuracy of the descriptive and predictive power of models that rely on satellite imagery. In their current form, impact estimation models using satellite data can only be reliably applied at scale once calibrated, requiring both diligence and expertise in the process.

Strengths

The biggest strength of using satellite data is that it can help overcome key constraints of access, time, scale and costs associated with collecting sub-national market and business intelligence in environments where information is scarce, because sub-national data collection systems are rudimentary or non-existent. It can help overcome some of the difficulties businesses face when expanding into or within developing countries, including physical (terrain, accessibility or conflict), financial (eg. costliness of scaling and reaching rural areas) or managerial impediments (time and project management associated with field agents).

Public sources for frequently collected satellite data are available, and avoid relying on a national authority's data collection processes and timing.[79] Costs are decreasing as more businesses enter the satellite market, and there is a willingness by providers to be creative and innovate in the methodologies for data analysis and integration.

Because data can be collected on a continuous basis without human intervention it can powerfully complement, and in some cases replace, the need for on-ground data collection. In recent years, advancements in satellite technology have significantly improved available resolutions, with leading-edge imagery now at 0.5m resolution or less,[80] enabling very precise insights into events on the ground. The publicly available 10m resolution imagery from the Sentinel-2 satellite, capturing imagery for the entire surface of the Earth every 5 days, is a useful source for practitioners.

For some data sources, historical data is available going back to as early as the 1980s, which can be useful for companies and other stakeholders interested in comparing results with historical baselines.[81] In managing climate change impact, and generally in sustainably managing the environment, particularly water sources and lakes, forestry, coastal zones, national parks and crop yield prediction, geospatial mapping can be a powerful tool that enables better measurement and change monitoring and planning of mitigation efforts.[82]

73 IPA (2016c)
74 FSD (2015)
75 Goldblatt et al. (2019), Perez et al. (2017); Burke and Lobell (2017)
76 Oshri et al. (2018)
77 Jean et al. (2016); Castelan et al. (2019)
78 Lobell et al. (2018); IPA (2016d)
79 There are numerous free data resources covering satellite imagery and other geospatial data such as UNEP Environmental Data Explorer (GIS data on climate, disasters and ecosystems), NASA Earth Observations (daily satellite imagery of Earth) and Terra Populus (integrates census data, land use data and climate data). However, these resources require technical skills to properly extract and interpret data.
80 IPA (2016c)
81 IPA has consolidated an overview of publicly available and free satellite image resources, including NASA and Google
82 UN and World Bank (2018)

Case study: Using satellite data to maximise impacts of crop insurance

Satellite data has helped innovative companies like Pula, a company that develops agricultural services like crop insurance for smallholder farmers,[83] to more accurately forecast weather-related risks. Pula uses cloud cover imagery to monitor and predict weather changes, thereby allowing for risk to be priced accurately. Through satellite data, coupled with remote sensing and on-ground yield assessments, Pula can provide farmers with right-priced insurance products for crops and livestock, positively impacting both vulnerable, drought-prone farmers and large-scale irrigated farming operations.

Weaknesses

An inherent weakness of satellite data is that it will not reveal impact as experienced by various stakeholder groups. It can thus often complement but rarely entirely replace other forms of data collection; it provides additional information to be layered with other data sources (eg. consumer data, economic data and competitor data) to be useful for impact measurement. Depending on the impact measurement question at hand, the use of satellite data might need technical expertise and data modelling and/or calibration to critically interpret, and the statistical methods used to analyse satellite data can be complex, particularly for indirect measurement of variables like crop yields[84] or poverty levels.[85]

The overarching question in any application that is looking to leverage satellite imagery (potentially combined with remote sensing and machine learning approaches) to derive high-resolution estimates of a wide range of development outcomes, including poverty and agricultural productivity, is the extent to which their estimates are *validated to be accurate*. The path to calibrating and validating models before they can accurately be applied at scale still has to go through high-accuracy ground data collection. In this way, satellite data only overcomes the constraints of access, scale and time once on-ground data collection has enabled validation of data models to assess impact at scale.

Because many businesses lack the internal capacity and tools to source, process and integrate satellite data into their decision-making, innovations by private providers in geospatial information systems are addressing these pain points. Specialist firms are emerging that help businesses and investors gather and analyse large datasets in an increasingly cost-effective way. The type of validation described above requires information that is not yet available for most products and services currently on the market and that only few commercial players integrate.[86]

Because ground data is needed to produce models that aim to accurately infer outcomes from satellite data, engagement with providers operating in this space should adequately probe for how they validate their models.

From a cost perspective, most companies may not have the internal capacity to engage in the calibration and validation efforts to reap the benefits of large-scale modelling based on satellite data, so engaging providers needs to take into account sustainability of projects and recurrent cost implications.

Case study: Using satellite data to measure yields

Increasing smallholder farmer productivity is recognised as a key component of poverty reduction, but there is a lack of systematic data at the subnational level.[87] A study was conducted in Uganda on the effectiveness of using satellite-based measures for detecting agricultural productivity, compared with field-based surveys.[88] The researchers tracked smallholder maize yield variation and positive responses to fertiliser and hybrid seed inputs; the satellite imagery was shown to be as accurate as survey-measures and can be conducted more frequently with minimal field training. In an agricultural context, and provided models have first been accurately calibrated using ground data, satellite imagery can provide useful insights on yields and thus constitute a core component of how to assess impacts of agricultural inputs.

Implementation risks and considerations

Where satellite data is used to inform predictive models, a general implementation risk relates to the still outstanding need to clearly define the scope of and approach to collection of minimum-required ground data that is needed for model calibration and validation purposes, which will vary by topic (eg. poverty versus crop yield estimations). Especially for crop yield applications, using ground data is instrumental for calibration since uncalibrated remote sensing purely based on crop models have shown to systematically overestimate yields at the plot level.[89]

In practice, satellite imagery is affected by cloud cover and other weather variations, so data may need to be verified for reliability. Potential for inaccuracy due to different data sources and resolutions being used for analysis can also be a risk, and so care should be taken in how data sources are chosen and processed.

83 CGAP (2018)
84 Lobell et al. (2018)
85 Jean et al. (2016)
86 Anchored in peer-reviewed, high-impact academic research, leading researchers in the field David Lobell, Stefano Ermon and Marshall Burke from Stanford University have recently launched a start-up specialising in geospatial analysis, Atlas AI
87 Burke and Lobell (2017); Lobell et al. (2018)
88 Lobell et al. (2018)
89 Lobell et al. (2018)

If can be difficult for users to assess the quality of a satellite-based spatial analysis; for instance, "when data from different spatial scales or different sources are combined (for example when geographic features from LandSat data, at 30m resolution, are combined with aerial image data on roads, at 1m precision), it is easy to introduce errors due to misalignment, correlations, or variation in instrument calibration".[90] Since combining multiple sources of data is often crucial to conducting spatial analyses, resource allocation for adequate staff expertise or consultants should be considered.

While current satellite images are provided at resolutions that do not typically allow for recognition of people, when combined with survey data or other sources of information, satellite images can be used to identify individual households. Engaging in geospatial mapping can thus give rise to concerns over privacy issued and will require the continued protection of individual or household-level data that is identifiable by location.[91]

90 IPA (2016c)
91 IPA (2016c)

Sensors

Summary

Strengths

- ▲ Avoid bias inherent in self-reporting
- ▲ Allow for collection of objective data points and can complement self-reported data for a richer evidence base (eg. which disease markers are present and which are not, how much non-revenue water goes to waste, what minerals are lacking in soil)
- ▲ Enable remote, unobtrusive, cost-efficient, high-frequency data collection that can be used for business optimisation and prediction (good for capturing frequency of predictable events, such as usage patterns and rates)
- ▲ Can lower risks of reporting error (avoidance of manual processing; data consistency over time; credibility through general tamper-proof nature)
- ▲ Can reduce costs of data collection and management through automation; once deployed, some types of sensors can be maintained and used with minimal technical expertise

Weaknesses

- ▼ Do not deliver data on customer or stakeholder sentiments (eg. how customers perceive a product, why a product is not performing well)
- ▼ Require engineering support for placement, maintenance and potentially data analysis

Sensors can capture a wide array of dimensions such as temperature, proximity, pressure, light, humidity and touch, lending themselves to be a useful data collection tool across applications such as energy, water, agriculture, transportation and health.[92] In the rapidly growing field of internet of things (IoT) applications, sensors are considered a cornerstone technology.[93]

While not traditionally associated with impact measurement and management, the wide array of sensor technologies and their application cases have the potential to change how we think about the collection of impact-related data. In the right context, sensors can enable businesses to better understand actual consumption patterns and usage rates. They can be a useful pre-cursor to customer surveys that can unpack *why* certain patterns are present or a follow-up mechanism to such. Beyond smartly monitoring impacts in the physical environment, IoT interventions such as sensors can ultimately help companies improve efficiency (achieving impact with fewer resources) as well as effectiveness (increasing impact with similar levels of resources).[94]

92 See, for example, Libelium, 50 Sensor Applications for a Smarter World: www.libelium.com/resources/top_50_iot_sensor_applications_ranking

93 McKinsey Global Institute (2015); total economic impact of IoT applications and their interoperability is expected to reach $4 trillion to $11 trillion a year by 2025

94 ITU and Cisco (2016)

See 'Spotlight' table at end of section for how sensor data can help businesses iterate towards a better value proposition while powerfully demonstrating impact.

Strengths

Being relatively affordable, with the cost continuing to come down (with retail sensor prices ranging from $3–200 for a wide range of functions),[95] sensors allow companies and organisations to deploy them over large areas of interest. Beyond being relatively cheap themselves and reducing the costs of sending people into remote areas for data collection, sensors in certain use cases have the potential to be cost-efficiency drivers in pointing to, for example, product defects as soon as they occur[96] and guiding action on the ground.

Their small size makes them relatively intrusive, which is particularly useful when trying to monitor individual or community-level behaviour,[97] for instance assessing how much of a certain product or service is being used or consumed. Sensors' ability to collect objective, real-time data in a variety of conditions can help overcome some of the shortcomings of surveys and other traditional data collection methods. This is useful where respondent answers provide overestimation of adoption and usage rates due to reporting or recall bias, which has often been demonstrated to be the case in areas such as water storage, hand washing and sanitation.[98] Conversely, and to help address this point, "behavioral patterns such as how and when a system is being used can be analyzed to help develop a sustainable system by integrating the user's behaviors into the design and modification of the system".[99] In this respect, sensor data can help shed light on where in the value chain of a certain product or service improvements can be made or at least point to usage patterns or areas that might need further probing or redesign.

Furthermore, sensors can be a powerful tool to monitor environmental or structural dimensions that cannot easily be captured and communicated by individuals and have the advantage of being able to record recurring phenomena (eg. usage, rainfall, light) remotely and, if needed, at high frequencies.[100]

95 ITU and Cisco (2016)

96 IPA (2016b)

97 IPA (2016b)

98 Thomas (2013)

99 Thomas and Mattson (2013)

100 It is important to note that collecting more data, although technically feasible, might not always be necessary (IPA, 2016c) so the frequency with which data is collected through sensors should be clearly linked to what the data is meant to inform.

Case study: Using sensors to detect health markers for early intervention

Niramai is an Indian healthcare company that uses a high-resolution thermal sensing device coupled with a cloud-based analytics solution to perform affordable and non-invasive breast cancer detection. Results from trials have shown the solution having around 30 per cent more accuracy than mammography and 70 per cent higher predictive value than interpretation of reports by human doctors.

The ability to easily collect health data through sensor technology in a non-invasive manner allows Niramai to detect breast cancer at much earlier stages than traditional methods. Beyond providing a major leap in preventative healthcare to patients, Niramai's sensor data can be used to understand health impact on an aggregated level. By being able to quantify, across all its patients, the number of early cancer cases detected as well as potential post-treatment data in the case of patients needing treatment, Niramai as well as individual doctors or clinics using the sensing technology could use already collected patient data to demonstrate health impact results of high value to both customers and investors.

Niramai is working with the Bill & Melinda Gates Foundation to leverage its technology to detect the presence of live adult worms that cause blindness and significant disability in Africa. Similar powerful impact data could be provided via Niramai's sensor technology being applied in this context.

Weaknesses

As most sensors are built to be deployed in industrialised settings with good network connectivity and infrastructure, local constraints in emerging markets mean that sensor devices might either need customisation or that there might be trade-offs between data quality and quantity.[101] Hence companies need to be clear on what level of precision or what amounts of data are necessary to make relevant decisions and to understand additional resource implications around technical adaptation/calibration as well as data logging, storage and power requirements. Any value gained from IoT sensor technology is estimated to be realised within four to six months post-deployment[102] so a weakness of sensors is that they do not lend themselves well to immediate decision-making needs from time of installation. This weakness, however, is overcome by the long-term value that sensor data can provide (both from a cost and insight perspective).

Sensors are a great source of objective data but they cannot unearth underlying reasons for *why* or in some cases *how* customers engage with or feel about a certain product or service. Depending on the context, sensors will thus rarely be able to function as a stand-alone data collection tool throughout the life cycle of a company or organisation looking to gather business intelligence and impact data.

101 IPA (2016b)
102 ITU and Cisco (2016)

Case study: Using sensors to monitor and manage food product quality

Indian-based Stellaps is an 'end-to-end dairy technology solutions' company that leverages sensors as a key component of its IoT solution for the dairy sector. Stellaps uses sensors embedded in milking systems, animal wearables, milk chilling equipment and milk procurement peripherals. Coupling sensors with a range of connected technologies, Stellaps is able to drive better business outcomes for milk producers. For instance, a study conducted in partnership between Stellaps and Mysore Milk Union Limited[103] points to how milk producers were able to improve the quality of their milk using Stellaps' sensor and IoT systems for their cold chain systems. They were able to unlock higher revenues by being able to enter premium product segments as well as cost reductions due to operational improvements from better monitoring.

Stellaps is an example of how operational sensor data that is already helping to improve commercial outcomes for milk producers can simultaneously be used to drive impact. Because sensor data can be used to understand product quality over time, businesses can engage in tailored and specific interventions in their livestock value chain (eg. animal feed, water) to improve product outcomes.[104] This data can simultaneously be used to measure and demonstrate impact: Stellaps can use aggregated sensor data to show milk quality improvement across its customer base, and with that better financial outcomes for farmers.

Implementation risks and considerations

Emerging markets will often still struggle with limited technological expertise and people with IT skills in the local areas where sensor devices might need installation[105] so from a cost as well as quality perspective this is a key consideration that might drive the cost of deployment up (at least initially). While hardware costs themselves are fairly low, the decision around whether to integrate sensors into data collection strategies needs to weigh the upfront and recurring costs against the cost of other forms of data collection.[106]

On a purely technical level, problems with hardware or software can render data useless for further analysis and sensors might require some maintenance to secure sustained correct functioning and positioning. It is thus important to properly plan for sensor maintenance and packaging/protection, especially in harsh environmental conditions.[107] A further consideration relates to the accuracy and precision of the data collected, where different sensors come with varying levels of data precision; ultimately, the level of accuracy needed for meaningful decision-making should be defined before choosing a given type of sensor as data collection tool.[108]

103 Shivalingegowda et al. (2018)
104 Grant Thornton (2014)
105 ITU and Cisco (2016)
106 Ibid.
107 IPA (2016b)
108 Ibid.

Finally, for certain use cases (eg. in healthcare), sensors can be associated with ethical concerns related to sensitive and personal data, and so appropriate measures should be taken to make sure the data collection does not violate ethical and/or legal boundaries. For other use cases and depending on how close to people and communities sensors are installed, considerations around privacy protection and adverse responses such as suspicion and vandalism should be considered.[109]

Spotlight: Sensors and their wide application potential[110]

Sensor application area	Business value	Impact value
Sector: Healthcare		
Monitoring vital signs, disease markers, medication levels	Provide accurate and timely treatment to maintain quality standards of care	Understand patient health improvements over time
Sector: Food and agriculture		
Monitoring of soil moisture, fertiliser in soil, water salinity for aqua farming, crop monitoring, pest management, dairy product quality and more	Ensure appropriate and timely farming interventions for optimum output	Estimate agricultural productivity and/or agricultural output quality gains to further estimate increased farmer revenues and end consumer health
Sector: Energy		
Monitoring and management of energy consumption (eg. off-grid solar)	Capture customer usage levels and patterns to inform product pricing and optimisation	Estimate CO_2 emissions avoided and customer savings on energy expenditure[111]
Sector: Infrastructure		
Monitoring of vehicles and pedestrian levels	Inform pricing strategy (eg. toll roads) or ensure adequate infrastructure maintenance based on traffic levels	Estimate impact of public infrastructure projects on economic activity
Broader application areas: Environmental and social standards		
Monitoring of toxic gas and oxygen levels inside, for example, chemical plants	Reduce business risk by ensuring compliance with global health and safety standards (eg. IFC Performance Standards)	Ensure worker health and safety; improve working conditions for better satisfaction and worker productivity and reduced staff turnover
Detection of leakages and wastes of factories in rivers, soil and so on	Gain additional revenue (or reduced costs) as the result of the reuse or recycling of waste either at the company's facilities or in other industries; reduce business risk related to fines and penalties for non-compliance with national pollution prevention standards	Support biodiversity conservation and pollution prevention
Monitoring of CO_2 emissions of factories, construction, agricultural activity and more	Implement energy and water efficiency measures to reduce consumption and improve operational efficiencies and resilience to changes in energy and/or water supply	Support climate change mitigation efforts

109 Ibid.
110 Further application cases can be found across commercial as well as development-focused areas.
111 See the GOGLA Impact Metrics calculator for further examples of impact estimates

02

Conclusions

The purpose of this handbook was to provide a practical guide to new and traditional tools and methods in the data collection repertoire for impact measurement. It has sought to make explicit the context for good data collection, guide the selection of tools/methods appropriate to the situation and bolster the knowledge around the strengths and limitations of selected tools and methods.

Advances in technology have made available new and exciting routes for impact measurement, from sensors and satellites to mobile phones. Leveraged in the right way and in the right context, such tools have the potential to generate insights at a scale not possible before – or faster and/or cheaper than traditional impact measurement tools. With that said, some of the more traditional tools will still be best suited for certain use cases, particularly when it comes to collecting rich, qualitative impact data on how people themselves express how they benefit from products, services or other interventions.

Through practical use cases, the handbook seeks to demonstrate that impact measurement data can overlap with business intelligence data and thus feed into critical business decisions. In doing so, it aims to show that impact measurement can be much more than a reporting exercise and can become an integral part of a company's value creation strategy. Conversely, it must be noted that simply collecting data that is valuable to inform business decisions does not automatically capture the change experienced by people or planet. Investors need to be intentional about the type of questions they are asking and seek to optimise overlap between operationally useful data and impact data – while recognising where practical limitations in this overlap may require collection of data that is not necessarily answering a business question but that is crucial to say something about impact.

There is no one-size-fits-all solution when it comes to the choice of impact measurement tool. A range of practical considerations around time, cost and skills available must be made, and investors and other practitioners need to clearly define what questions they are trying to answer as part of their impact measurement process. In some cases, data will already be available in different formats to answer the questions at hand, and in other cases new, primary data will need to be collected. Knowing when and where existing data can inform key questions and when new data is needed is vital to an efficient and effective impact measurement process.

Much more testing of the newer tools is needed across the impact measurement space, and we welcome investors and private sector development practitioners to actively engage with the various tools for impact measurement and share their lessons learned from testing such tools.

Appendix A: Summary table of data collection tools and methods

Data collected via	Description	Useful for	Useful case
Company data	Company-reported data such as public and/or proprietary commercial data, administrative data and KPIs (eg. number of customers, credit reports)	– Providing a starting point for estimating impact (without adding extra time or cost for data collection) – Identifying possible product/service or market gaps needing further investigation	The Global Off-Grid Solar Association (GOGLA) has created a standardised set of impact metrics for the wider sector; company administrative data such as number of products sold or deployed to end users and sales numbers are used for impact estimations around customers' economic activity, income generation and financial inclusion. See GOGLA's Metrics Calculator. (https://www.gogla.org/impact/calculator)
Diaries	Data collected over a longer period, from a few weeks up to several months, either with the respondent directly recording data or assisted by an enumerator	– Capturing rich insights around day-to-day realities of people (including recurring themes, pain points and variables with daily or weekly fluctuations, eg. consumption rates) – Capturing impact stories	Diaries were used across rural sites in India to understand the daily realities of energy-poor consumers and yielded rich insights into differences in behaviour across types of households, gender and age as well as cultural and financial circumstances impacting the use of energy sources. Driving both business and impact insights, diaries proved a useful tool to give a better view into what more optimal energy products could look like and levers to drive higher adoption rates of clean energy products among consumers. See REMMP's Energy Diaries Fact Sheet. (http://arcfinance.org/wp-content/uploads/2016/05/Arc-Finance-REMMP-Energy-Diaries-Fact-Sheet.pdf)
Focus groups	Data collected via group interview format; optimum size between 6 and 12 people	– Testing and refining survey questions before larger-scale rollout – Assessing qualitative impact by teasing out perceptions that are tied to a social context; can be useful to bring out views on taboo or socially complex issues – Refining product or service features either pre- or post-launch and informing iterations towards social acceptability (and thus often commercial viability)	As part of an exercise to understand barriers to women adoption of mobile phones in a refugee context, the GSMA conducted focus group research to understand social and contextual realities for product usage and adoption. The discussion format of the focus group can help bring out a richer picture of social dynamics and barriers associated with the product offering and help understand social, cultural and economic barriers to ultimately improve product adoption. See GSMA's case study. (https://www.gsma.com/mobilefordevelopment/wp-content/uploads/2019/04/M4H_GenderGapRefugeeContexts.pdf)

In-person surveys	Data collected via enumerators; allows for longer, more complex responses	– Capturing how people perceive a given product, service, intervention or problem area/context – Understanding nuanced views and perceptions – Collecting insights into deeper issues and indicating where and how to implement changes	As part of its store expansion and product pricing strategy, a food retailing company in Zambia conducted more than 1,700 in-person surveys across customers and non-customers. In-person surveys allowed the company to get a better sense of low-income consumer priorities and not only served as market intelligence for business decisions but also as insights to maximise the business's impact footprint by expanding to underserved areas and adapting pricing to financial realities of existing and new consumers. See CDC's report Affordability of Protein-Rich Foods: Evidence from Zambia. (https://assets.cdcgroup.com/wp-content/uploads/2018/12/14110951/Affordability-of-Protein-Rich-Foods-Evidence-from-Zambia.pdf)
Macro data	Aggregated micro-level/meso-level data collected by governments or national and global institutions such as the UN, World Bank and International Labour Organisation (ILO). Covers free and licence-based datasets	– Informing general go-to-market strategies – Contextualising/ benchmarking impact measurement and informing impact estimations (eg. used as input for models that aim to capture impacts such as job creation or CO2 reduction) – Understanding trends at national, regional or sectoral level	As a development finance institution, CDC Group is interested in capturing not only the direct but also the indirect impacts its investments create across countries and sectors. Macro data derived from various public (eg. World Bank, ILO and IEA) and proprietary (eg. GTAP) databases is used to calibrate the model that estimates market-level impacts of CDC Group's investments and helps inform future investment strategies for maximising impact footprint. See CDC's paper Measuring Total Employment Effects. (https://assets.cdcgroup.com/wp-content/uploads/2018/06/25150849/Methodology-for-measuring-total-employment-effects.pdf)
Mobile surveys	Data collected remotely via either call centre, SMS or IVR (interactive voice response); short-format, simple responses Requires access to respondent phone numbers	– Quickly getting a sense of stakeholder perceptions on simple questions across a large sample – Informing further probing on issue areas or emergent themes (eg. market testing) – Capturing simple or high-level dimensions (eg. general satisfaction levels)	Using call-based mobile surveys, a commercial animal feed mill based in Ghana was able to capture insights on what types of customers were served and/or underserved by its product line. Through the relatively simple surveys, the company understood the need to change its marketing, pricing and distribution strategy to better reach underserved segments to strengthen the business and, ultimately, the impact on poorer customers. See this Deep Dive on impact measurement. (http://www.theimpactprogramme.org.uk/wp-content/uploads/2018/07/Impact-Programme-Deep-Dive-AgriCare-1.pdf)

Satellites	Image data collected remotely via satellites	– Monitoring physical changes on the ground – Understanding topographical dimensions – Capturing large-scale impacts that affect entire regions or sectors; can give precise views on physical changes and patterns over time	USatellite imagery, once carefully calibrated with precise ground data, has shown to be as accurate as survey measures for crop yield variation and responses to fertiliser inputs. In an agricultural context, satellite imagery in combination with smaller numbers of ground samples can help explore what inputs have the greatest impact on yield across large land areas, making it a powerful tool to measure impact of a company's products and services. See this World Bank working paper. (https://openknowledge.worldbank.org/handle/10986/29554?locale-attribute=fr)
Sensors	Data collected via installed sensor devices (eg. temperature, proximity, pressure, light, humidity, touch)	– Measuring usage rates over time (eg. water, electricity) – Monitoring levels/physical attributes, including changes in quality and quantity	Coupling sensors with a range of connected technologies, an Indian dairy technology solutions company is providing data on milk quality improvements. Sensor data has the potential to simultaneously unlock premium segments and higher revenues for customers, drive greater impact by allowing businesses to engage in tailored interventions within its livestock value chain, and demonstrate a clear impact case on areas like the financial health of stakeholders. See the Stellapps case study. (http://www.stellapps.com/casestudies.html)

Appendix B: Additional resources

The following private sector-focused resources may provide useful references for investors and private sector development practitioners seeking further guidance:

Acumen

- The Lean Data Field Guide
  https://acumen.org/wp-content/uploads/2015/11/Lean-Data-Field-Guide.pdf
- Lean Data Update 2016
  https://acumen.org/wp-content/uploads/2016/07/Lean-Data-Update-Report_2016.pdf

DCED (The Donor Committee for Enterprise Development)

- The 2018 Reader on Results Measurement
  https://www.enterprise-development.org/wp-content/uploads/DCED_Reader_RM.pdf

GIIN

- IRIS+ – An interactive online platform providing guidance on impact measurement and management, impact metrics, and an extensive repository of resources and reports on the topic
  https://iris.thegiin.org/
- The Business Value of Impact Measurement – Guidance note that includes a section on 'Deep Dives on the use of Impact Data throughout the Investment Process'
  https://thegiin.org/research/publication/business-value-im

GRI

- GRI Standards
  https://www.globalreporting.org/standards/

HIPSO

- Harmonized Indicators for Private Sector Operations – 38 reporting indicators across 15 different sectors and industries (including cross-cutting) with definitions agreed on by 25 international development finance institutions
  https://indicators.ifipartnership.org/indicators/

International Finance Corporation (IFC)

- Investing for Impact: Operating Principles for Impact Management
  https://www.ifc.org/wps/wcm/connect/Topics_Ext_Content/IFC_External_Corporate_Site/Impact-investing/Principles/
- Guide to Investing for Impact: Operating Principles for Impact Management
  https://www.ifc.org/wps/wcm/connect/Topics_Ext_Content/IFC_External_Corporate_Site/Impact-investing/Principles/

IMP (Impact Management Project)

- Resources and tools for impact management
  https://impactmanagementproject.com/resources-2/

IPA (Innovations for Poverty Action)

- Goldilocks Toolkit
  https://www.poverty-action.org/right-fit-evidence/toolkit

Sustainability Accounting Standards Board (SASB)

- SASB Standards – SASB's set of industry standards, which identify the minimal set of financially material sustainability topics and their associated metrics for a typical company in an industry
  https://www.sasb.org/standards-overview/

Appendix C: Acknowledgements

CDC Group would like to thank interviewees from the following organisations, who have contributed expertise and guidance to the development of this handbook:

- **Camilo Mondragon Velez**, Principal Research Economist, IFC
- **Evan Thomas, Director**, Mortenson Center in Global Engineering, University of Colorado at Boulder
- **James Copestake**, Professor of International Development, Department of Social and Policy Sciences, University of Bath
- **Jasper Gosselt**, Research Director, Dalberg Research
- **Joe Shamash**, Investment Director, Big Society Capital
- **Julie Zollmann**, Independent researcher and consultant
- **Matt Ripley**, Head of Insights and Evaluation at The Good Economy
- **Mike McCreless**, Head of Investor Adoption, Impact Management Project
- **Talip Kilic**, Senior Economist, Data Production and Methods Unit, Development Data Group, World Bank
- **Thelma Brenes Muñoz**, Evaluation Officer, Strategy & Corporate Affairs, FMO
- **Tom Adams**, CEO, 60 Decibels
- **Tom Farole**, Lead Economist, Social Protection and Jobs Global Practice, World Bank

References

Acumen (2015): The Lean Data Field Guide. Tips For Collecting Customer Data to Build More Impactful Businesses. November 2015. https://acumen.org/wp-content/uploads/2015/11/Lean-Data-Field-Guide.pdf

Adams, T., Gawande, R. and Overdyke, S. (2015): Innovations in Impact Measurement. Acumen. https://ssir.org/pdf/Innovations_in_Impact_Measurement_Report_Nov_2015.pdf

Adams, T., Speyer, A. and Gawande, R. (2016): Lean Data Update 2016. Lessons from another year using technology to understand customers and grow our social impact. Acumen. https://acumen.org/wp-content/uploads/2016/07/Lean-Data-Update-Report_2016.pdf

Adams, T., Ripley, M. and Speyer A. (2017): At the Heart of Impact Measurement, Listening to Customers. *Stanford Social Innovation Review*, August 2017. https://ssir.org/articles/entry/at_the_heart_of_impact_measurement_listening_to_customers

Anderson, J. and Wajiha, A. (2015): Early Insights from Financial Diaries of Smallholder Households. CGAP focus note, no. 102. World Bank, Washington, DC. © World Bank. https://openknowledge.worldbank.org/handle/10986/23498 License: CC BY 3.0 IGO.

Arc Finance (2016): REEMP Energy Diaries Fact Sheet. http://arcfinance.org/wp-content/uploads/2016/05/Arc-Finance-REMMP-Energy-Diaries-Fact-Sheet.pdf

Attridge, S., Calleja, R., Gouett, M. and Lemma, A. (2019): The Impact of Development Finance Institutions. Rapid Evidence Assessment. London: Department for International Development. https://assets.publishing.service.gov.uk/media/5d1232bee5274a066ad2cf79/DFI_Impacts_REA_Report__June_2019.pdf

Bankable Frontier Associates (2013): Rwanda Financial Diaries: Understanding the Financial Lives and Product Needs of Rwanda's Underserved Consumers. https://financialdiaries.com/wp-content/uploads/2016/02/BFA-Rwanda-Financial-Diaries.pdf

Beegle, K., De Weerdt, J., Friedman, J. and Gibson, J. (2010): Methods of household consumption measurement through surveys: experimental results from Tanzania. Policy Research working paper; no. WPS 5501; Paper is funded by the Knowledge for Change Program (KCP). Washington, DC: World Bank. http://documents.worldbank.org/curated/en/265491468312013923/Methods-of-household-consumption-measurement-through-surveys-experimental-results-from-Tanzania

Burke, M. and Lobell, D. (2017): Satellite-based assessment of yield variation and its determinants in smallholder African systems. *Proceedings of the National Academy of Sciences* P114 (9): 2189-2194. www.pnas.org/content/114/9/2189

Castelan, C. R., Weber, I., Jacques, D., and Monroe, T. (2019): Making a better poverty map. World Bank Blogs, 9 July 2019. https://blogs.worldbank.org/opendata/making-better-poverty-map

CGAP (2018): CGAP and Pula Partner to Bring Satellite-Based Insurance to Farmers. www.cgap.org/news/cgap-and-pula-partner-bring-satellite-based-insurance-farmers

Chang, E. (2018): Lessons Learned Using Mobile Tools to Compile Financial Diary Data. Next Billion. https://nextbillion.net/lessons-learned-using-mobile-tools-to-compile-financial-diary-data

Cheelo, C., McKee, D., Sanni, M. and Cheelo, M. (2018): Affordability of Protein-Rich Foods: Evidence from Zambia. Southern African Institute for Policy and Research. https://assets.cdcgroup.com/wp-content/uploads/2018/12/14110951/Affordability-of-Protein-Rich-Foods-Evidence-from-Zambia.pdf

Clarke, C. (2016): Learning from Financial Diaries. http://itad.com/learning-financial-diaries

Collins, D., Morduch, J., Rutherford, S. and Ruthven, O. (2009): Portfolios of the Poor. New Jersey: Princeton University Press. 1-28.

Copestake, J., Mosink, M. and Remnant, F. (ed.) (2019): Attributing Development Impact: The Qualitative Impact Protocol case book. Rugby, UK, Practical Action Publishing. http://dx.doi.org/10.3362/9781780447469

Crozier, S. and Cassell, C. (2015): Methodological considerations in the use of audio diaries in work psychology: Adding to the qualitative handbook. *Journal of Occupational and Organizational Psychology*. https://onlinelibrary.wiley.com/doi/full/10.1111/joop.12132

Dabalen, A., Etang, A., Hoogeveen, J., Mushi, E., Schipper, Y. and von Engelhardt, J. (2016): Mobile Phone Panel Surveys in Developing Countries: A Practical Guide for Microdata Collection. Directions in Development - Poverty. Washington, DC: World Bank. https://openknowledge.worldbank.org/handle/10986/24595

DCED (2018): Reader on Results Measurement. www.enterprise-development.org/wp-content/uploads/DCED_Reader_RM.pdf

Dichter, S et al., (2016). The Power of Lean Data. *Stanford Social Innovation Review*, 2016. https://ssir.org/articles/entry/the_power_of_lean_data

EDFI and FMO (2019): Decent Work and Development Finance. March 2019. www.edfi.eu/wp/wp-content/uploads/2019/04/Report-Decent-Work-and-Development-Finance-March-2019-2.pdf

FMO (2019): FMO Impact Model: Methodology. www.fmo.nl/l/library/download/urn:uuid:d85800f8-607a-4118-bb7a-059392b8c869/fmo+impact+model+%26+methodology.pdf

FSD Kenya (2014): Kenya Financial Diaries – Shilingi Kwa Shilingi – The Financial Lives of the Poor. FSD Kenya, August 2014. https://fsdkenya.org/publication/kenya-financial-diaries-shilingi-kwa-shilingi-the-financial-lives-of-the-poor

FSD Kenya (2015): Major growth highlights from the 2015 FinAccess geospatial mapping survey. Nairobi, Kenya: FSD Kenya. https://fsdkenya.org/publication/major-growth-highlights-from-the-2015-finaccess-geospatial-mapping-survey

Gertler, P. J., Martinez, S., Premand, P., Rawlings, L. B. and Vermeersch, C. M. J. (2016): Impact Evaluation in Practice, Second Edition. Washington, DC: Inter-American Development Bank and World Bank. © World Bank. https://openknowledge.worldbank.org/handle/10986/25030 License: CC BY 3.0 IGO.

GIIN (2016): The Business Value of Impact Measurement. https://thegiin.org/research/publication/business-value-im

GIIN (2019): Annual Impact Investor Survey 2019. The ninth edition. https://thegiin.org/research/publication/impinv-survey-2019

Glennerster, R. and Takavarasha, K. (2013): Running Randomized Evaluations. Princeton University Press.

GOGLA (2018): Standardized Impact Metrics for the Off-Grid Solar Energy Sector. www.gogla.org/sites/default/files/resource_docs/gogla_impact_metrics.pdf

Goldblatt, R., Moroe, T., Antos, S. E. and Hernandez, M. (2019): Innovations in satellite measurements for development. World Bank Blogs, January 8, 2019. https://blogs.worldbank.org/opendata/innovations-satellite-measurements-development

Grant Thornton (2014): Investing in the Internet of Things: Spotlight on technology in the dairy industry. www.grantthornton.ie/globalassets/1.-member-firms/ireland/insights/publications/grant-thornton-investing-in-the-internet-of-things-spotlight-on-dairy.pdf

GSMA (2019a): The Mobile Economy. Sub-Saharan Africa 2019. www.gsma.com/r/mobileeconomy/sub-saharan-africa

GSMA (2019b): The Mobile Gender Gap Report 2019. www.gsma.com/mobilefordevelopment/wp-content/uploads/2019/02/GSMA-The-Mobile-Gender-Gap-Report-2019.pdf

Iarossi, G. (2006): The Power of Survey Design: A User's Guide for Managing Surveys, Interpreting Results, and Influencing Respondents. Washington, DC: World Bank. © World Bank. https://openknowledge.worldbank.org/handle/10986/6975

IFC (2018a): Economy-wide Private Impact Quantification Model - EPIQ Ethiopia Pilot. Estimating and Analyzing Expected Impacts of Private Investments in Ethiopia. www.jobsanddevelopment.org/wp-content/uploads/2018/10/EPIQ-Ethiopia.pdf

IFC (2018b): Guide to Investing for Impact: Operating Principles for Impact Management. October 2018. www.ifc.org/wps/wcm/connect/Topics_Ext_Content/IFC_External_Corporate_Site/Impact-investing/Principles/

IFC (2019): Operating Principles for Impact Management. February 2019. www.ifc.org/wps/wcm/connect/Topics_Ext_Content/IFC_External_Corporate_Site/Impact-Investing

ILO and IFC (2016): The Business Case for Quality Jobs Evidence from Better Work. Policy brief. www.enterprise-development.org/wp-content/uploads/Quality-jobs-policy-brief-1.pdf

The Impact Programme (2018): Deep Dive: Sunculture Highlights. www.theimpactprogramme.org.uk/wp-content/uploads/2018/08/Deep_Dive_Insights_Sunculture_PRINT-proof4.pdf

IPA (2016a): Using Administrative Data for Monitoring and Evaluation. Goldilocks Deep Dive. www.poverty-action.org/publication/goldilocks-deep-dive-using-administrative-data-monitoring-and-evaluation

IPA (2016b): Sensing Impacts: Remote Monitoring Using Sensors. Goldilocks Deep Dive. www.poverty-action.org/publication/sensing-impacts-remote-monitoring-using-sensors

IPA (2016c): Micro-Satellite Data: Measuring Impact from Space. Goldilocks Deep Dive. www.poverty-action.org/publication/micro-satellite-data-measuring-impact-space

IPA (2016d): Goldilocks Case Study: One Acre Fund: Measuring Yields From Space. www.poverty-action.org/publication/goldilocks-case-study-one-acre-fund-measuring-yields-from-space

ITU and Cisco (2016): Harnessing the Internet of Things for Global Development. Geneva, 2016. www.itu.int/en/action/broadband/Documents/Harnessing-IoT-Global-Development.pdf

Jean, N., Burke, M., Xie, M., Davis, W. M., Lobell, D. B., and Ermon, S. (2016): Combining Satellite Imagery and Machine Learning to Predict Poverty. *Science*, 19 August 2016, Vol. 353, Issue 6301. https://doi.org/10.1126/science.aaf7894

Khandker, S. R., Koolwal, G. B. and Samad, H. A. (2010): Handbook on Impact Evaluation: Quantitative Methods and Practices. World Bank. © World Bank. https://openknowledge.worldbank.org/handle/10986/2693 License: CC BY 3.0 IGO.

Leo, B., Morello, R., Mellon J., Peixoto, T. and Davenport, S. (2015): Do Mobile Phone Surveys Work in Poor Countries? Center for Global Development. Working Paper 390, April 2015. www.cgdev.org/publication/do-mobile-phone-surveys-work-poor-countries-working-paper-398

L-IFT (2018): Methodologies. http://l-ift.com/methodologies

Lobell, D. B., Azzari, G., Marshall, B., Gourlay, S., Jin, Z., Kilic, T. and Murray, S. (2018): Eyes in the Sky, Boots on the Ground: Assessing Satellite- and Ground-Based Approaches to Crop Yield Measurement and Analysis in Uganda. Policy Research Working Paper; No. 8374. World Bank, Washington, DC. © World Bank. https://openknowledge.worldbank.org/handle/10986/29554 License: CC BY 3.0 IGO.

MacGillivray, A., Kim, R., van Moorsel, T. and Kehoe, A. (2017): Measuring Total Employment Effects: a lean data methodology for a portfolio of investments in developing countries. February 2017. https://assets.cdcgroup.com/wp-content/uploads/2018/06/25150849/Methodology-for-measuring-total-employment-effects.pdf

McKinsey Global Institute (2015): The Internet of Things: Mapping the Value Beyond the Hype. June 2015. www.mckinsey.com/business-functions/digital-mckinsey/our-insights/the-internet-of-things-the-value-of-digitizing-the-physical-world

OECD (2005): Glossary of statistical terms: Statistical microdata. https://stats.oecd.org/glossary/detail.asp?ID=1574

Oshri, B., Hu, A., Adelson, P., Chen, X., Dupas, P., Weinstein, J., Burke, M., Lobell, D. and Ermon, S. (2018): Infrastructure Quality Assessment in Africa using Satellite Imagery and Deep Learning. Proceedings of the 24th ACM SIGKDD Conference, 2018. https://dl.acm.org/citation.cfm?id=3219819.3219924

Perez, A., Yeh, C., Azzari, G., Burke, M., Lobell, D. and Ermon, S. (2017): Poverty Prediction with Public Landsat 7 Satellite Imagery and Machine Learning. 31st Conference on Neural Information Processing Systems (NIPS 2017). https://arxiv.org/pdf/1711.03654.pdf

Rawlings, L. (2013): Who's Afraid of Administrative Data? Why administrative data can be faster, cheaper and sometimes better. World Bank Blogs. http://blogs.worldbank.org/impactevaluations/whos-afraid-administrative-data-why-administrative-data-can-be-faster-cheaper-and-sometimes-better

Robson, C. and McCartan, K. (2016): Real World Research. Fourth Edition. John Wiley & Sons Ltd.

Shivalingegowda, K., Ravishankar, G. S. and Prasanna, R. (2018): Enhancement of Milk Quality by Deployment of Stellapps Cold Chain Monitoring System in Mysore Milk Union (MYMUL) - Case Study. September 25, 2018. www.stellapps.com/index.php/case-studies

Thomas, E. (2013): (Im)Proving Global Impact: How the Integration of remotely reporting sensors in water projects may demonstrate and enhance positive change. UNESCO Global Water Forum, December 1, 2013. www.globalwaterforum.org/2013/12/01/improving-global-impact-how-the-integration-of-remotely-reporting-sensors-in-water-projects-may-demonstrate-and-enhance-positive-change

Thomas, E. and Mattson, K. (2013): Using Innovative Technologies to Measure Behavior Change in Public Health Programs, Mercy Corps, July 9, 2013. www.mercycorps.org/sites/default/files/Instrumented%20Monitoring%20Indonesia.pdf

UN and World Bank (2018): Integrated Geospatial Information Framework. A strategic guide to develop and strengthen national geospatial information management. http://ggim.un.org/meetings/GGIM-committee/8th-Session/documents/Part%201-IGIF-Overarching-Strategic-Framework-24July2018.pdf

Wiseman, V., Conteh L. and Matovu, F. (2005): Using diaries to collect data in resource-poor settings: questions on design and implementation. Oxford University Press in association with the London School of Hygiene & Tropical Medicine.

For further information:

- **CDC Group plc:**

  123 Victoria Street
  London SW1E 6DE
  United Kingdom

  T: +44 (0)20 7963 4700

  E: enquiries@cdcgroup.com

  cdcgroup.com

CDC
Investment works