Received: 29 December 2017 | Revised: 18 April 2018 | Accepted: 30 June 2018

DOI: 10.1002/bsd2.33

SPECIAL ISSUE ARTICLE

WILEY Business Strategy and Development

Harnessing the Sustainable Development Goals for businesses: A progressive framework for action

Aaron Redman[1,2]

[1] Center for Global Sustainability and Cultural Transformation, Leuphana University of Lüneburg, Lüneburg, Germany

[2] School of Sustainability, Arizona State University, Tempe, AZ, USA

Correspondence
Aaron Redman, Leuphana University, Universitätsallee 1, 21335 Lüneburg, Germany.
Email: redman@leuphana.de; aaron.redman@asu.edu

Abstract

Businesses, as with other sectors in society, are not yet taking sufficient action towards achieving sustainability. The United Nations recently agreed upon a set of Sustainable Development Goals (SDGs), which if properly harnessed, provide a framework (so far lacking) for businesses to meaningfully drive transformations to sustainability. This paper proposes to operationalize the SDGs for businesses through a progressive framework for action with three discrete levels: communication, tactical, and strategic. Within the tactical and strategic levels, several innovative approaches are discussed and illustrated. The challenges of design and measurement as well as opportunities for accountability and the social side of Sustainability, together call for transdisciplinary, collective action. This paper demonstrates feasible pathways and approaches for businesses to take corporate social responsibility to the next level and utilize the SDG framework informed by sustainability science to support transformations towards the achievement of sustainability.

KEYWORDS

corporate social responsibility, sustainability science, sustainable business, sustainable development, Sustainable Development Goals

1 | INTRODUCTION

Sustainability is unlikely to be achieved without businesses playing a critical role. The business community also increasingly sees a need to integrate sustainability for their own long-term futures (Bansal & Roth, 2000; Schrettle, Hinz, Scherrer-Rathje, & Friedli, 2014). In order to show both how a business can contribute to sustainability and objectively assess its progress towards that end, a sustainability framework is critical. Businesses have experimented with approaches such as footprinting (Cucek, Klemes, & Kravanja, 2012), life-cycle analysis (Heijungs, Huppes, & Guinée, 2010), and net positive (Hershauer, O'Neill, Lidberg, Vallury, & Lubenow, 2015). Yet, even if these different approaches are combined, the results are at best incomplete if not incompatible. The need for a rigorous and comprehensive approach to business sustainability has contributed to the immediate interest by the private sector in the United Nation's (UN) newly launched Sustainable Development Goals (SDGs; Preston & Scott, 2015), but as of yet, it is still unclear how and if the SDGs can effectively be applied to businesses. This paper proposes a progressive framework for action with three discrete levels for harnessing the SDGs for business sustainability and describes the critical opportunities and challenges moving forward.

Initial interest of businesses in sustainability during the 1990s focused on improving their own internal resource efficiency (Young & Tilley, 2006). During the 2000s, businesses around the globe started regularly issuing sustainability reports which slowly moved beyond impacts on efficiency to setting and assessing progress towards individually set goals. Unfortunately, these reports typically had major shortcomings (Hubbard, 2009). In particular, the reporting had a positive bias, was mostly anecdotal, was generally unaudited by third parties, and overall lacked in rigor. In the 2010s, businesses responded to these critiques by increasingly adopting third party certifications and other more thorough analyses of their impacts on sustainability. At the same time, research into corporate sustainability has grown tremendously (Kourula, Pisani, & Kolk, 2017). Out of blends of practice and research, more comprehensive and coherent models for business

sustainability have recently been proposed, such as blended value, strongly sustainable (Upward & Jones, 2015), and flourishing (Hoveskog, Halila, Mattsson, Upward, & Karlsson, 2017) to name a few. These are too new to have been deployed widely and proven their mettle as of yet. Therefore, there remains a need for a coherent and universal framework that businesses can harness towards achieving sustainability—the UN's SDGs could be just that.

Building on the Millennium Development Goals (MDGs), the nations of the world came together in September 2015 to agree on an ambitious global program for human development. The resulting agreement, Agenda 2030, consists of 17 SDGs. The SDGs seek to end poverty, protect the planet, and ensure prosperity for all. The UN invited the business community to participate in the multiyear stakeholder process of developing the SDGs and continues to be seen as an important partner in their implementation. Individual businesses and private sector organizations have shown genuine interest in using the SDGs in some form (Jones, Hillier, & Comfort, 2016).

The structure of the SDGs has three levels (see Figure 1). On the first level, the SDGs encompass 17 categories that have been deemed essential for global sustainability, for example, "Quality Education for all." These goals are broad, all-embracing, and inspiring. Each of the SDGs has a set of targets that are intended to address that goal's most pressing areas of concern. Although the 169 targets identify the problems of interest, 230 indicators will be used to actually measure progress. But as Allen et al. (2017) point out, the SDG indicators need an additional robust framework if they are going to be used as a management tool. This is even more so if they are to be applied to businesses.

2 | METHODS

This paper investigates whether the SDGs can be effectively used to integrate sustainability into businesses so that businesses have a real impact on progress towards our shared global goals. Given the newness of the SDGs and the transdisciplinary nature of the questions the project sought to answer, the academic literature was relatively scarce and insufficient. The search therefore expanded to include blog posts from reputable websites (Center for Global Development: https://www.cgdev.org/tags/sustainable-development-goals), reports from nonprofits (J. Sachs et al., 2016), consultancies (Global Reporting Initiative, United Nations Global Compact, & WBCSD, 2016), and international agencies (World Bank, 2016a), as well as working papers and other draft documents put out by those in charge of the different aspects of the SDGs themselves (Inter-Agency and Expert Group & on the Sustainable Development Goal Indicators, 2016).

All of the SDGs, their 169 targets and the 230 proposed indictors were reviewed at a broad level but only one could be selected for an in-depth analysis in stage two of the project. To make the research sufficiently novel and useful, obvious business goals such as goal nine "Industry, Innovation, and Infrastructure" were avoided along with the energy and material focused ones where business sustainability has already shown real successes. "Quality Education" (SDG 4) was ultimately selected from the remaining options because it is being described as a fundamental, crosscutting SDG for human development, while being very relevant for businesses (impacts them greatly and is impacted by many different business sectors) and also being a sector of strategic interest to businesses as well. In stage three, a pilot study was carried out conducting a detailed mapping of one SDG (4—Quality Education) to one business sector (the information and communications technologies [ICTs] sector). The specific results of that mapping are reported elsewhere.[1]

This paper reports on the generalizable results of this study; extracting lessons from literature, experts, and the innovative mapping process. What this yielded was a progressive framework for action with three discrete levels for harnessing the SDGs for business sustainability. This progressive framework provides a structured pathway through which a business could advance from knowing nothing about the SDGs to utilizing them to have a transformative impact on achieving sustainability. It was developed on the basis of applied experience, input from academics, and corporate sustainability officers, as well as theories and approaches drawn from sustainability science. In situating this framework as well as the more in-depth mapping study into the

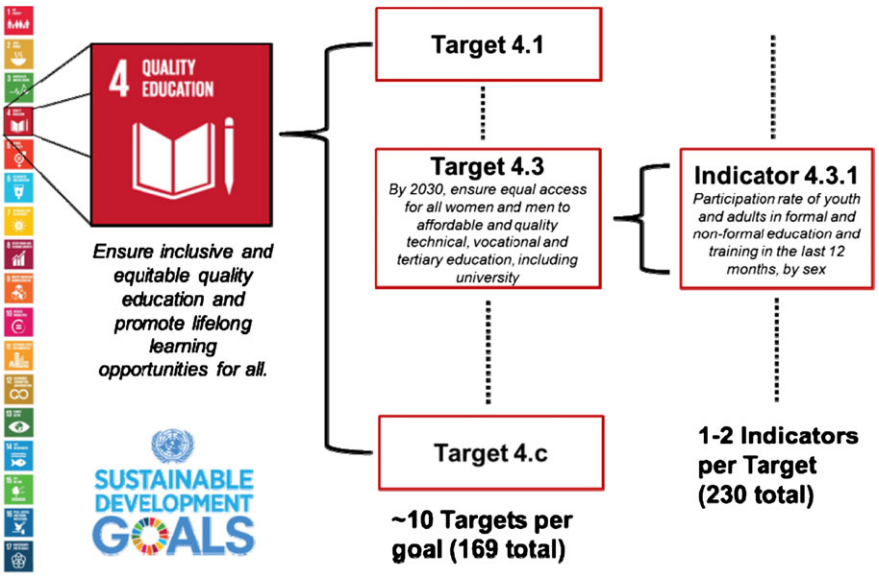

FIGURE 1 Structure of the Sustainable Development Goals (author's creation with images from www.undp.org)

real-world business context, a set of challenges and opportunities for the integration of business and the SDGs emerged, which are reported in Section 4.

3 | A PROGRESSIVE FRAMEWORK FOR ACTION TOWARDS THE SDGs BY BUSINESSES

The framework is built off of the general strategic sustainability approach (Robèrt et al., 2002) and additional work categorizing business models for sustainability impact by George Basile (2013). The first level is easy, if low impact. Positive feedback from easily achievable actions has been shown to induce businesses to take on more ambitious goals (Papagiannakis, Voudouris, & Lioukas, 2014), which will be needed for the tactical and strategic levels which follow. There are as of yet only a few examples of businesses exploring tactical level approaches and even less examples formalized on the strategic level, so the discussion of these is more hypothetical and speculative.

3.1 | Communication

The communication level does not begin with messaging but with reorganizing current sustainability related metrics and activities that the business is already reporting on and fitting them into specific goals and targets of Agenda 2030. Given the newness of the SDGs, most businesses are still reshuffling their sustainability efforts to align with the SDGs (Jones et al., 2016). This is not fundamentally about marketing themselves to external stakeholders as in line with the SDGs, but more importantly about communicating the SDGs internally within the business. This type of reorganization around the SDGs is something that any business already conducting sustainability reporting can easily take on and complete in a few months.

In general, the most common response by businesses to calls for increased sustainability has been to report on the entity's performance in reducing its own footprint (Hubbard, 2009), aligning this reporting with the SDGs is the core of the communication level. The footprint of an enterprise is generally defined as the negative impact that the activities of said enterprise have on global sustainability (Cucek et al., 2012; Global Footprint Network, 2013). The sustainability aspirations of Dell, launched in 2014 as the *2020 Legacy of Good Plan* (Dell, 2014), are an example of these phenomena. This plan proposes to reduce the enterprise's direct impact on greenhouse gas emissions, water use, waste generation, and the use of dangerous materials among other things. The principal focus of efforts such as this are on the supply chain and direct operations (stores, trucks, etc., owned by the enterprise).

A further example of operating at the communication level can be found in the Global eSustainbility Initiative (GeSI) and Accenture Strategy joint report: #SystemTransformation. The authors focus on describing how potential profit-making activities could be categorized so as to fit into the SDGs and targets (GeSI & Accenture Strategy, 2016). The potential connection of these solutions to specific targets is explored briefly, but no effort is made to illustrate even a hypothetical pathway for how the solutions would lead to meaningful change against the SDG targets, let alone providing evidence of such pathways; the indicators themselves are ignored completely. A general approach to tackling the communication level is found in the SDG Compass, which provides an online guide (as well as consulting service) to facilitate the matching of currently existing measures with SDG targets. For example, the SDG Compass suggests that the Global Reporting Initiative indicator "Average hours of training per year per employee by gender, and by employee category" be used by businesses to measure their contribution to SDG Target 4.3. Under this approach, a software company providing training for its (college educated) employees to learn a new programming language could credit this effort as their contribution towards "progress" on the SDGs. From these examples it is obvious that a lot is happening at the communication level but unless businesses progress to higher levels the impact on sustainability will be minimal.

3.2 | Tactical

The tactical level involves a business utilizing its already existing products, services, and/or established operating locations to have a more positive impact on the SDGs than it is currently having. This means identifying which products and services have a real impact and which operating locations are most in need of the solutions they offer. There are three stages within this level. First is to continue existing efforts to minimize or eliminate the business's footprint having realigned internal sustainability assessments with the SDGs (as per 3.1). Second is to identify which SDGs align directly with products or services that the business already operates in and work to expand those activities as much as possible. And the third stage is to research the in-direct impacts of the business's activities, trace the causal, chain and change/improve/expand those activities to maximize impact on the SDGs.

The ICT sector provides an interesting example of how to approach stage two of the tactical level, in part due to a widely recognized potential for positive impact on sustainability. "Let us harness the power of ICTs to create a new era of Sustainable Development," proclaimed then UN Secretary-General Ban Ki-moon in a 2015 speech (UN, 2015). ICT is in a "unique position to make a difference (Pargman & Raghavan, 2014)" for sustainability. The report *ICT & SDGs* focused on the role of ICT as an enabler and accelerator of the transformations necessary to achieve the SDGs (J. Sachs et al.,2016). In 2016, the World Bank dedicated their annual World Development Report to the vital role ICT plays in accelerating economic and human development (World Bank, 2016b). Looking at the SDGs, the #SystemTransformation report identified specific "digital solutions (that) can contribute directly to the achievement of each and every one of the 17 SDGs and to over half of the 169 targets within them (GeSI & Accenture Strategy, 2016)." The extent of possibilities that ICT presents for solving our most urgent problems is indeed impressive.

Despite this recognition generally, there is little specific reference to ICT in the SDGs themselves. There is no single "ICT" goal only certain targets and indicators within various goals, which are specifically about ICT. In some cases, ICT is part of the target whereas in others,

it is only mentioned in the indicator of a target. Overall, ICT is only mentioned in 6% of all the indicators and their descriptions. Explicit mention of ICT in the SDGs includes the following:

- Indicator 4.4.1 ICT Skills: *Proportion of youth and adults with information and communications technology (ICT) skills, by type of skill*
- Indicator 4.a.1 Computers & Internet in Schools: Indicator 4.a.1: *Proportion of schools with access to: … (c) computers for pedagogical purposes; …*
- Indicator 5.b.1 Ownership of Mobile Phones: *Proportion of individuals who own a mobile telephone, by sex*
- Indicator 17.6.1 Technology agreements: *Number of science and/or technology cooperation agreements and programs between countries, by type of cooperation*
- Indicator 17.6.2 Broadband internet: *Fixed Internet broadband subscriptions per 100 inhabitants, by speed*
- Target 17.7 Environmentally Sound Tech: *Promote the development, transfer, dissemination and diffusion of environmentally sound technologies to developing countries on favorable terms, including on concessional and preferential terms, as mutually agreed.*

At the tactical level, an ICT business reviews these explicit ICT targets and indicators and may find one that aligns well with one or more of their activities. If, for example, a business provides broadband internet service, than working to expand one's networks and offer affordable subscriptions in some of the many countries with poor coverage, would mean that the business would have a large and measurable impact on SDG indicator 17.6.2.

The potential for big impact and the complexity and difficulty increase significantly in stage three, as a business looks to take a tactical approach to its indirect impacts. If businesses ignore the vast majority of the SDGs that are not directly related to their activities or their locations of production, the contribution of the corporate sector towards achieving Agenda 2030 will be underwhelming. What is critically needed is investigations into the in-direct impacts of business's activities, tracing the causal chain and evidence-based proposals for changing/improving/expanding those activities to maximize impact on the SDGs. Businesses must be aware though that, few if any causal pathways in development, particularly bridging from the micro (project) to macro (national) scale are widely agreed upon and even fewer are universal. The more distant on the pathway the proposed solution is from the problem the more caution should be taken in assuming an impact. A structured approach to tackling indirect impacts on the SDGs is therefore a critical element of the tactical level, such as that taken by the initial project which informed this research, to attempt to map ICT solutions to SDG-4.[1]

A simple example illustrates the research necessary to apply the tactical level to business activities by developing a quantifiable causal chain that would enable the assigning of credit for nation-wide improvements in certain SDG targets. The example in Figure 2 below involves supporting the addition of computer labs in schools that do not currently have them. Some of the evidence that helps to create this causal chain includes an impact analysis, which found significant impact on math scores and a bigger impact in primary and more marginalized schools (Banerjee, Cole, Duflo, & Linden, 2007; Steiner, Baird, Hamilton, & Pane, 2016). Other studies have found very mixed results in terms of student improvement after introducing computer learning, enrollment, and other metrics (Linden, 2008), though a lab looks to be a better choice than handing out laptops (Ravizza, Uitvlugt, & Fenn, 2016). A University of Milan study showed that the biggest benefits to student performance from having computers in schools comes through the teachers' use of them to support their teaching (Argentin, Comi, Gui, Origo, & Pagani, 2015).

3.3 | Strategic

Although the tactical level focuses on reorienting existing activities, the strategic level is about planning the future in order to have maximum impact on the SDGs. This may include which markets to enter with which products, which contain which features based, at least partly, on the scale of improvement to the indicators of progress towards the SDGs. But more fundamentally, the SDGs must be used as criteria for the design and selection of innovations and new enterprise activities on an equal or greater footing to "return on investment" and other currently deployed metrics, if major sustainability transformations are to happen. Nor can one shy away from the "hard" SDG targets or from the data or infrastructure poor regions of the world. These are the areas where transformative change is most needed. The other key issue is to look at all 17 SDGs systematically and adopt some variation of the no trade-off rules as elaborated by Gibson (2006). These include maximizing net gains, avoidance of

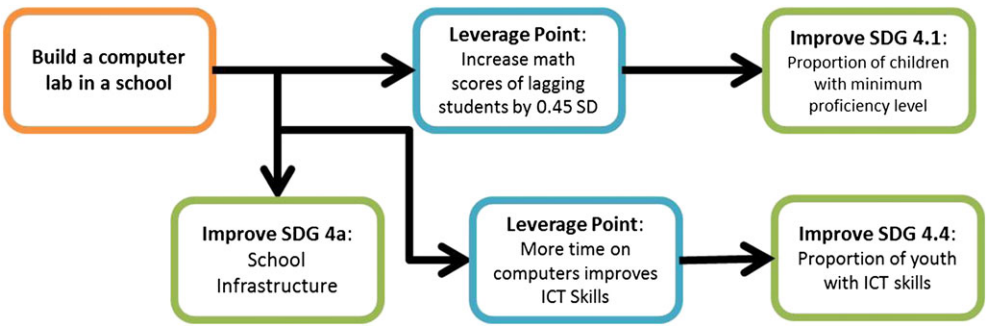

FIGURE 2 Example causal chain between building a computer lab and impact on the Sustainable Development Goals (SDGs). (Author's creation; leverage point sources: [Argentin et al., 2015; Banerjee et al., 2007]). ICT: information communications technology

significant adverse effects, protection of the future, explicit justification, and a transparent process.

If an enterprise is looking to expand into new locations or new activities, how can it make a decision which maximizes its impact on Agenda 2030? There are 17 goals, 169 targets, 193 countries, hundreds of indicators, and thousands of possible enterprise solutions. An approach to filtering and ranking possibilities is therefore necessary which turns on specifying two key variables in relation to potential solutions, which SDG targets and which countries. The specifics of the strategic level would vary greatly between enterprises, but it can be generalized into three basic steps.

1 Evaluate the targets and indicators.
2 Identify high opportunity countries.
3 Finally, having selected targets and countries, the leverage points and other research can be used to design the business activities for maximum impact on the measured SDG indicator.

3.3.1 | Evaluate SDG targets and indicators

In order to make a decision about which SDG targets a business should focus on, it can evaluate the SDG targets based on three criteria:

- *The Indicator & the Data*: This is an assessment of how well we can measure progress against this target with the proposed indicator and the available data sources.
- *Relevancy of Business Activities*: Based on the leverage points for this target, how much potential is there for the business activities to make a difference to this target? Compare the role of laptops for kindergarteners versus college students for example.
- *Magnitude of Business Activities' Impact*: Is there a transformative potential for the types of activities the business could be involved with, even if that solution does not exist yet? For example a computer program which successfully made every student a math prodigy would be transformational in terms of target 4.1.

To demonstrate the utility of this approach, an analysis of SDG 4 for the ICT sector was carried out, and the results of this are summarized with a traffic light diagram in Table 1: bad (red), okay (yellow), and good (green). The basis for these structured qualitative judgments is elaborated more fully in Appendix B. Although these judgments are evidence-based, it is important to note that they are only intended to provide a rough guide to decision-making.

3.3.2 | Identify high opportunity countries

One of the main disconnects between the SDGs and corporate sustainability reporting is the unit of interest. Businesses measure their impacts (and those of their suppliers) from around the globe, aggregating results and impacts irrespective of location. The SDGs on the other hand are concerned with how well individual countries are doing. So when it comes to measuring progress on the SDGs, it matters very much where the activities or impacts of interest are taking place. Reporting an enterprise's sustainability activities by country is an essential step for alignment with the SDGs. A reorientation towards countries presents much greater opportunities than just improved reporting. With a basic tool, one can quickly identify those countries with the best opportunity for the largest and most immediate impact on the SDGs.

This tool, the Business Opportunity Index (BOI), helps to identify the best countries for deploying their business's solutions. Beginning with a small set of priority SDG targets/indicators, one looks for a business relevant statistic or index of statistics can be seen as criteria, which best support the specific activities of the business. For example, deploying an online higher education degree program in a country where few people are online and lots of people are already getting immersive degrees anyway (such as Ukraine). The BOI is calculated as follows:

BOI = Relevant business statistic or index/current state of the SDG indicator of interest.

There would be a lot of other factors that determine the "best" country for a specific business and its proposed initiatives (supportive government, shared language, local partner, etc.), but the BOI narrows down the list to a manageable level. For an example of this type of analysis, see Appendix C.

4 | DISCUSSION: EMERGENT CHALLENGES AND OPPORTUNITIES

There is no shortage of critiques and enthusiasm in the literature over the SDGs and businesses' potential role in them; many of which have

TABLE 1 Evaluating the Targets and Indicators for SDG 4 (bad [red], okay [yellow], and good [green]; author's creation)

Target	Short name	The indicator & the data	Relevancy of ICT activities	Magnitude of ICT impact
4.1	Proficiency of primary and secondary students			
4.2	Early childhood/preprimary enrollment			
4.3	Postsecondary Education			
4.4	ICT skills			
4.5	Equal access for all			
4.6	Literacy			
4.7	Sustainable Development Knowledge			
4.a	School infrastructure			
4.b	Scholarships			
4.c	Qualified teachers			

already been highlighted in this article. This discussion in the literature is mostly happening at a hypothetical level and within narrow scopes of interest. By actually attempting to map specific SDGs to specific business activities and in building a concrete framework, a clear set of challenges and opportunities could be distilled and are articulated herein.

4.1 | Challenge: Design

The most obvious challenge businesses face in applying the SDGs is that they were not designed to be used by the private sector. Although the goals are seen as something that all of society can commit to, progress on achieving the targets and measuring the indicators is something that is intended to done by governments at the national level. This creates a nontrivial challenge of reinterpreting the SDGs for business. This is a key reason why a framework such as that proposed here will be necessary if the SDGs are going to be harnessed by businesses. Without it, the only option is to stay at a very high, mostly goal level (e.g., "we are promoting education") or to create individual and arbitrary metrics particular to your own enterprise but within the broad goal areas.

One general critique of the SDGs is that they mix together inputs, outputs, outcomes, and impacts (Kellogg, 2004) without clear distinction. Agenda 2030 claims to be striving for outcomes and impacts but, although many targets are ambitiously worded (i.e., outcome-oriented), the indicators proposed to measure these targets tend to be more conservatively oriented towards inputs and outputs. The inclusion of inputs and outputs as targets is defended on the grounds that these targets are necessary intermediaries for achieving other more ambitious outcome- and impact-oriented targets. The input-based targets will be the easiest for a business to effect but contribute the least to transformational sustainability. As Hubbard (2009) notes, businesses already have a tendency to focus on the inputs of their sustainability efforts. This has been facilitated by the fact that businesses' environmental legal and compliance requirements typically rely on measuring, reporting, and reducing at the input level (e.g., how much of x pollutant is leaving your factory). This way of thinking has carried over to the social side as Corporate Social Responsibility reports almost exclusively report on social inputs such as how many millions of volunteer hours were donated.

Figure 3 illustrates how the targets of just one SDG are a mix-mash of inputs, outputs, and outcomes. These targets are themselves interconnected by pathways that according to a basic theory of change for education should significantly contribute to the impact sought by SDG 4—Quality Education. But the SDGs are not being presented in this fashion. Instead, a hierarchy of lists of goals-targets-indicators is used, as illustrated in Figure 1, with all targets being treated as equal for achieving their respective goals. Unfortunately, this encourages businesses (and governments) to pursue the input-type targets, which are the easiest to measure and achieve but also the least meaningful in terms of transformational sustainability outcomes.

4.2 | Challenge: Measurement

A critical yet easily overlooked measurement challenge for applying the SDGs to business is that the SDGs are being measured in terms of national progress. Large businesses today are transnational whereas smaller ones may be subnational. In order to have meaning in terms of a business's contribution to the achievement of the SDGs, the businesses' impact will need to be quantified for each national unit it touches. The disconnect between official SDG measurements and business relevant metrics stems directly out of the design intentions discussed in 4.1.

In setting the indicators, the UN explicitly decided not to consider data availability. The result is that in their current state the indicators range widely from easily measurable right now, to others that will require significant data collection infrastructure so that they can be measured in a meaningful way before 2030. Experts have called on the UN to invest energy in the development of the indicator framework and its specifics (Hák, Janoušková, & Moldan, 2016), but progress is slow, and whether the end result will be sufficient is still

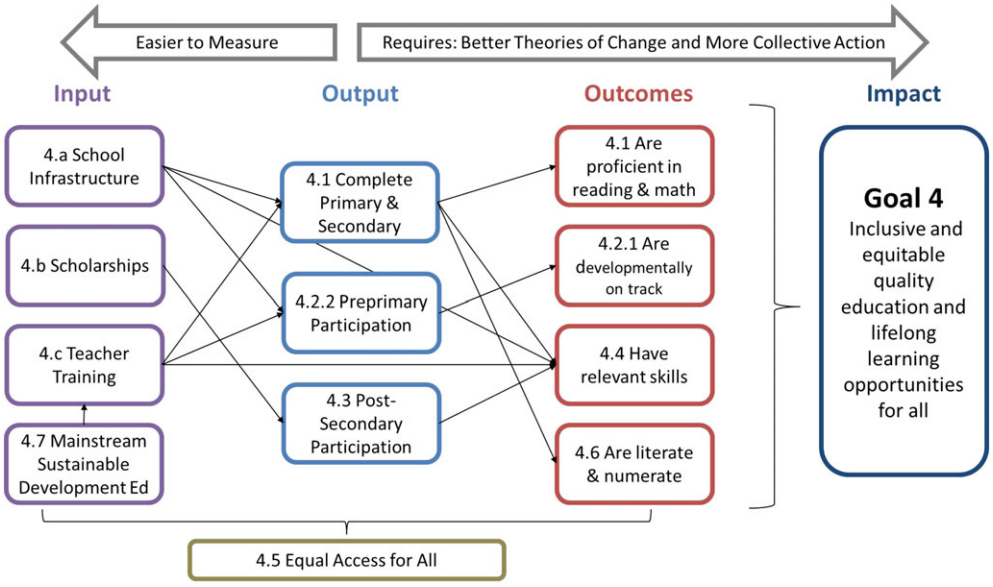

FIGURE 3 Categorization of SDG 4 targets with pathways shown (author's creation)

unknown. Several studies have attempted to measure the status of the SDGs by picking what they determined were representative measurements. Some of these assessed the goals with a handful of data points (GeSI & Accenture Strategy, 2016; J. D. Sachs, Schmidt-Traub, & Durand-Delacre, 2016) whereas another study looked specifically and systematically at two targets per SDG (Kroll, 2015). No one is yet capable of actually measuring the current status of the full Agenda 2030 (i.e., all 17 SDGs). Even the official, public facing sites tracking the SDGs such as by the World Bank (http://datatopics.worldbank.org/sdgs/) admit that "they are not always [using] the official indicators for SDG monitoring."

Research for this project revealed that there is large variability between the targets and their indicators in terms of the current capability for them to be measured (see Appendix A for specifics for SDG-4). One of the indicators with the best available data 4.3.1 (% enrollment in tertiary education) still does not match exactly what the SDG indicator actually describes and has lots of missing data in the countries for whom advancement is most critical. For sustainability in businesses, transparent data and statistics are essential (Winner, Dickey, & Showalter, 2015). The indicators are the only data-based part of the SDGs that would enable a mapping from business activities to social impact and thus empower the tactical and strategic approaches. Therefore, any meaningful application of the SDGs to businesses must focus on the indicators, not just the targets and goals. This is on top of the more general problem with indicators that they only capture what can be easily measured, not what is most critical for sustainability. For many businesses, previous holistic proposals for assessing their sustainability have faltered in large part due to a lack of measurability, and this tension will persist with the SDGs.

4.3 | Opportunity: Social sustainability

Even as environmental concerns among the business community broadened into sustainability, the reporting and metrics lagged behind. Hubbard found that "although there seems to be widespread acceptance in the business world that firms have social responsibilities, a commonly accepted standard of measuring social performance is a long way off (Hubbard, 2009, p. 185)." The focus continues to be on environmental issues (see De Marchi, Di Maria, & Micelli, 2013, for example), at the expense of "social" sustainability issues (e.g., social, cultural, and other more normative dimensions). While looking at research on corporate sustainability, Kourula and colleagues found a "relatively minimal focus on human wellbeing for all and on empowerment of the marginalized (Kourula et al., 2017, p. 16)." Bottom of the pyramid thinking (Prahalad, 2006) has promise for bringing the social side into corporate sustainability efforts, but even over a decade and a half after its introduction, there is still a lack of objective assessment approaches (Kolk, Rivera-Santos, & Rufin, 2013), and the integration of bottom of the pyramid with sustainability more broadly is just beginning (Bendul, Rosca, & Pivovarova, 2016). Missimer, Robert, and Broman (2017) have recently proposed science-based social sustainability principals for enterprises, a key step forward.

Agenda 2030 is an opportunity to bridge the gap in "social" sustainability, in concert with the efforts of Missimer et al. and others. Many of the SDGs and their targets cannot be cleaning categorized as just "social," and the potential interactions between them are just beginning to be systematically studied (Le Blanc, 2015; Nilsson, Griggs, Visbeck, & Ringler, 2016; Stafford-Smith et al., 2017). Yet, unlike most current business metrics, the social side is dominant within Agenda 2030; being primary for at least half of the SDGs—No Poverty, Quality Education and Peace, Justice, and Strong Institutions to name a few. For the business community, the SDGs present an independent and global consensus about what the most important "social" sustainability indicators are.

4.4 | Opportunity: Real accountability

The SDGs have been designed to support accountability, with specific indicators to measure progress. Unfortunately, this is intended to be for government accountability not business, but with work it may be possible to use the SDGs to create accountability for the "social" sustainability of businesses in a way that has already been done for some of the "environmental" aspects of sustainability, such as greenhouse gas emissions. This would be done by creating an evidence-based map linking the most impactful activities of a business to the specific SDG indicators in specific countries so as to enable calculation of the contribution of the business to progress on the SDGs. There are plenty of exogenous challenges for any business attempting SDG accountability including a lack of evidence to quantify the responsibility for social change (i.e., improvement in SDG indicators), a lack of data on the indicators selected by the UN, and issues with the targets and indicators themselves. The critical opportunity of the SDGs is that their application should push businesses to move away from reporting on inputs towards "social" sustainability and quantifiable and verifiable outcomes and impacts of their most important activities.

Real accountability is an opportunity not because it will be easy to pull off, but because it is so important to businesses leading sustainability transformations. Indeed, Bowen et al. (2017) note that "ensuring accountability" as one of the three key governance challenges with the SDGs. The challenge of creating frameworks that would support accountability of businesses will be require interpretation and work, which this paper initiates. Unfortunately, as Agarwal, Gneiting, and Mhlanga (2017) point out, the interest in the SDGs by businesses has "yet to be matched with commitment on their accountability (p. 16)." Accountability of businesses to achieving the full scope of Agenda 2030 is unlikely to be driven by governments, thus, this is an opportunity that businesses and their stakeholders must seize.

4.5 | A collective action challenge and opportunity

The reality is that the efforts of a single business entity going at it alone will be mostly futile. For businesses to have meaningful and positive impact on the SDGs, collective action is required. Both the negative and the positive direct impacts of a business ultimately only affects a small portion of the causal chain that leads to actual change to any particular SDG target. A business claiming credit (or taking the blame) for the entire change that occurred in a SDG target (as measured by its indicator) would therefore be absurd. At the same time, businesses play a fundamental role in any causal chain that leads to positive change in the SDGs, thus, their sincere involvement is crucial

if Agenda 2030 is to be accomplished. Confronting the coordination and political problems of collective action is seen as one of the core challenges for the SDGs overall (Bowen et al., 2017).

Rather than be discouraged by this requirement for collective action in order to be able to confront the SDGs, it should be seen as a wonderful opportunity. With the SDGs as a unifying force, business, nonprofits, governments, and communities can work together in order to understand the SDG targets and their causal chains, to develop joint theories of change, and to test and apply interventions which improve on the SDG targets (Agarwal et al., 2017; Stafford-Smith et al., 2017). The common cause around a SDG target is a starting point for dialogues with governments of a country a business has never worked in, nonprofits that were once seen as enemies, and communities that have never been engaged with. This bringing together of diverse stakeholders around common causes is where the truly transformational power of the SDGs resides, not in any particular measurement or other specific characteristic of them.

5 | CONCLUSIONS

This paper described three levels of action towards achieving the SDGs that businesses could take. In addition through this research, a set of opportunities and challenges emerged for businesses looking to harness the SDGs. It is clear that the SDGs do have an enormous potential for businesses to assess their current contribution to sustainability (communication), immediately improve their impact (tactical), and plan for even bigger impacts down the road (strategic). The tactical and strategic approaches described in this paper offer the initial steps on a pathway for this sought after integration.

There are of course, significant challenges, in particular with regard to data and measurement. A more important challenge though will be ensuring that the SDGs are not just used to reshuffle the status quo as a marketing ploy, but actually leveraged as an opportunity to create change. Harnessing the SDGs is an opportunity for dramatically increasing the ambitions of business efforts towards sustainability transformations (Agarwal et al., 2017). There is a clear need for sectoral groups (e.g., ICT industry) to come together and develop concrete approaches specific to their idiosyncratic needs. This process of standard setting would make the process of assessing credit and blame much more robust and impactful.

But the responsibility for harnessing the SDGs does not solely lie with the business community. A lot more information needs to be collected around the specific SDG targets and their indicators. Sustainability science has a lot to offer both in terms of its transdisciplinary approach to research (Orecchini, Valitutti, & Vitali, 2012; Schaltegger, Beckmann, & Hansen, 2013) and to practices of implementation such as in education for sustainable development (Garcia, da Silva, Carvalho, & de Andrade, 2017; Redman, Wiek, Redman, 2018). Public–private, sector specific, partnerships need to be forged which can codevelop detailed approaches such as have been done with certifying forest and fishing products and many other "environmental" sustainability issues. On an individual business level, there are promising approaches to engaging stakeholders such as linking cocreation and relationship management to foster sustainability innovation (Arnold, 2017). Much of what is needed is an operationalization of existing research into ways that can be interpreted by businesses looking to calculate their impact along the various links between their activities and a particular SDG. Research of this type will need to be specific and applied and will be critical to validate whether general insights are possible.

These types of collaborative efforts will create the space where businesses can become honestly accountable for the impacts they are having on the achievement of Agenda 2030 in general and specific SDG targets in particular. Facilitating easy wins on the SDGs, whereas insufficient overall is key to long-term success. As Papagiannakis et al. (2014) showed, positive feedback on sustainability initiatives leads to businesses taking on more ambitious goals the next time around. More importantly though, the SDGs can and should be framed as opportunities for business (Hajer et al., 2015). Their very structure itself creates an opportunity for businesses to do long-term, strategic planning which seeks to maximize the impact of the business on specific SDG targets in specific places. For all the potential pitfalls, the SDGs if properly harnessed, offer the best available path forward of business to make a real and meaningful contribution to achieving sustainability.

ACKNOWLEDGMENTS

This research was made possible thanks to a grant from Dell Giving for a project titled, "Feasibility Assessment of Mapping ICT Solutions to Impacts on Sustainable Development Goals." Dena Baldwin, Dawn Olsen, and Salomi Pradhan helped with collecting literature and compiling data and their sources. Rajesh Buch, Dan O'Neill, George Basile, and Bruno Sarda provided invaluable guidance, feedback, and inspiration from beginning to end. In particular, I would like to thank John Pflueger (Principal Environmental Strategist, Dell), who continued to work with me well beyond the scope of the original research project and provided invaluable feedback all along which was fundamental to the creation of this manuscript.

ENDNOTE

[1] *The Feasibility of Mapping ICT Initiatives to the UN Sustainable Development Goals* https://sustainability.asu.edu/sustainabilitysolutions/programs/solutionsservices/mapping-ict-to-sdg/

REFERENCES

Agarwal, N., Gneiting, U., & Mhlanga, R. (2017). Raising the bar: Rethinking the role of business in the Sustainable Development Goals. *Oxfam Discussion Papers*, (February), 1–32. Retrieved from www.oxfam.org

Allen, C., Nejdawi, R., El-Baba, J., Hamati, K., Metternicht, G., & Wiedmann, T. (2017). Indicator-based assessments of progress towards the sustainable development goals (SDGs): A case study from the Arab region. *Sustainability Science*, *12*(6), 975–989. https://doi.org/10.1007/s11625-017-0437-1

Argentin, G., Comi, S., Gui, M., Origo, F., & Pagani, L. (2015). Is it the way they use it ? Teacher, ICT and student achievement. *Jel*. (June). https://doi.org/10.1016/j.econedurev.2016.11.007

Arnold, M. (2017). Fostering sustainability by linking co-creation and relationship management concepts. *Journal of Cleaner Production*, *140*, 179–188. https://doi.org/10.1016/j.jclepro.2015.03.059

Banerjee, A. V., Cole, S., Duflo, E., & Linden, L. (2007). Remedying education: Evidence from two randomized experiments in India. *The Quarterly Journal of Economics*, *122*(3), 1235–1264. https://doi.org/10.1162/qjec.122.3.1235

Bansal, P., & Roth, K. (2000). Why companies go green: A model of ecological responsiveness. *The Academy of Management Journal*, *43*(4), 717–736.

Basile, G. (2013). *Sustainability success today & tomorrow for sustainability graduates*. https://doi.org/10.1016/S1743-9191(13)60008-4

Bendul, J., Rosca, E., & Pivovarova, D. (2016). Sustainable supply chain models for base of the pyramid. *Journal of Cleaner Production*, *162*, 1–14. https://doi.org/10.1016/j.jclepro.2016.11.001

Le Blanc, D. (2015). Towards integration at last? The sustainable development goals as a network of targets. *Sustainable Development*, *187*(April), 176–187. https://doi.org/10.1002/sd.1582

Bowen, K. J., Cradock-Henry, N. A., Koch, F., Patterson, J., Häyhä, T., Vogt, J., & Barbi, F. (2017). Implementing the "sustainable development goals": Towards addressing three key governance challenges—Collective action, trade-offs, and accountability. *Current Opinion in Environmental Sustainability*, *26–27*(June 2016), 90–96. https://doi.org/10.1016/j.cosust.2017.05.002

Cucek, L., Klemes, J. J., & Kravanja, Z. (2012). A review of footprint analysis tools for monitoring impacts on sustainability. *Journal of Cleaner Production*, *34*, 9–20. https://doi.org/10.1016/j.jclepro.2012.02.036

De Marchi, V., Di Maria, E., & Micelli, S. (2013). Environmental strategies, upgrading and competitive advantage in global value chains. *Business Strategy and the Environment*, *22*(1), 62–72. https://doi.org/10.1002/bse.1738

Dell. (2014). *Dell 2020 legacy of good plan*. Retrieved from http://i.dell.com/sites/doccontent/corporate/corp-comm/en/Documents/2020-plan.pdf

Garcia, J., da Silva, S. A., Carvalho, A. S., & de Andrade, J. B. S. O. (2017). Education for sustainable development and its role in the promotion of the Sustainable Development Goals. In *Curricula for Sustainability in Higher Education* (pp. 1–18). Springer. https://doi.org/10.1080/20469047.2017.1341730

GeSI, & Accenture Strategy. (2016). *# SystemTransformation: How digital solutions will drive progress towards the sustainable development goals*.

Gibson, R. B. (2006). Sustainability assessment: Basic components of a practical approach. *Impact Assessment and Project Appraisal*, *24*(3), 170–182. Retrieved from http://www.ontarioenergyboard.ca/documents/cases/EB-2006-0207/commemts/pembina_attachment_051006.pdf. https://doi.org/10.3152/147154606781765147

Global Footprint Network. (2013). World footprint. Retrieved February 8, 2013, from http://www.footprintnetwork.org/en/index.php/GFN/page/world_footprint/

Global Reporting Initiative, United Nations Global Compact, & WBCSD. (2016). *SDG compass: The guide for business action on the SDGs*. Retrieved from http://sdgcompass.org/wp-content/uploads/2016/05/019104_SDG_Compass_Guide_2015_v29.pdf%5Cn17goals.org

Hajer, M., Nilsson, M., Raworth, K., Bakker, P., Berkhout, F., de Boer, Y., … Kok, M. (2015). Beyond cockpit-ism: Four insights to enhance the transformative potential of the sustainable development goals. *Sustainability (Switzerland)*, *7*(2), 1651–1660. https://doi.org/10.3390/su7021651

Hák, T., Janoušková, S., & Moldan, B. (2016). Sustainable Development Goals: A need for relevant indicators. *Ecological Indicators*, *60*, 565–573. https://doi.org/10.1016/j.ecolind.2015.08.003

Heijungs, R., Huppes, G., & Guinée, J. B. (2010). Life cycle assessment and sustainability analysis of products, materials and technologies. Toward a scientific framework for sustainability life cycle analysis. *Polymer Degradation and Stability*, *95*(3), 422–428. https://doi.org/10.1016/j.polymdegradstab.2009.11.010

Hershauer, J., O'Neill, D., Lidberg, S., Vallury, S., & Lubenow, C. (2015). *The net positive valuation of information and communication technology in online education*.

Hoveskog, M., Halila, F., Mattsson, M., Upward, A., & Karlsson, N. (2017). Education for sustainable development: Business modelling for flourishing. *Journal of Cleaner Production*. https://doi.org/10.1016/j.jclepro.2017.04.112

Hubbard, G. (2009). Measuring organizational performance: Beyond the triple bottom line. *Business Strategy and the Environment*, *18*(December 2006), 177–191. https://doi.org/10.1002/Bse.564

Inter-Agency and Expert Group, & on the Sustainable Development Goal Indicators. (2016). *Provisional proposed tiers for global SDG indicators*.

Jones, P., Hillier, D., & Comfort, D. (2016). The sustainable development goals and business. *International Journal of Sales, Retailing and Marketing*, *5*(2), 38–48.

W.K. Kellogg. (2004). *Using logic models to bring together planning, Evaluation and Action*. https://doi.org/10.1002/cbdv.200490016

Kolk, J., Rivera-Santos, M., & Rufin, C. (2013). Reviewing a decade of research on the "base/bottom of the pyramid" (BOP) concept. *Business & Society*, *20*(10), 1–40. https://doi.org/10.1177/0007650312474928

Kourula, A., Pisani, N., & Kolk, A. (2017). Corporate sustainability and inclusive development: Highlights from international business and management research. *Current Opinion in Environmental Sustainability*, February, 1–10. https://doi.org/10.1016/j.cosust.2017.01.003

Kroll, C. (2015). *Sustainable Development Goals: Are the rich countries ready?* Retrieved from https://www.bertelsmann-stiftung.de/fileadmin/files/BSt/Publikationen/GrauePublikationen/Studie_NW_Sustainable-Development-Goals_Are-the-rich-countries-ready_2015.pdf. https://doi.org/10.1016/j.sjpain.2015.03.001

Linden, L. L. (2008). *Complement or substitute?: The effect of technology on student achievement in India*. InfoDev. https://doi.org/10.1371/journal.pone.0003995

Missimer, M., Robert, K. H., & Broman, G. G. G. (2017). A strategic approach to social sustainability—Part 1: A principle-based definition. *Journal of Cleaner Production*, *140*, 32–41. https://doi.org/10.1016/j.jclepro.2016.04.059

Nilsson, M., Griggs, D., Visbeck, M., & Ringler, C. (2016). *A draft framework for understanding SDG interactions, (June)*.

Orecchini, F., Valitutti, V., & Vitali, G. (2012). Industry and academia for a transition towards sustainability: Advancing sustainability science through university-business collaborations. *Sustainability Science*, *7*(SUPPL. 1), 57–73. https://doi.org/10.1007/s11625-011-0151-3

Papagiannakis, G., Voudouris, I., & Lioukas, S. (2014). The road to sustainability: Exploring the process of corporate environmental strategy over time. *Business Strategy and the Environment*, *23*(4), 254–271. https://doi.org/10.1002/bse.1781

Pargman, D., & Raghavan, B. (2014). Rethinking sustainability in computing: From buzzword to non-negotiable limits. In *NordiCHI'14 Proceedings of the 8th Nordic Conference on Human-Computer Interaction: Fun, Fast, Foundational* (pp. 638–647). Helsinki. https://doi.org/10.1145/2639189.2639228

Prahalad, C. K. (2006). The fortune at the bottom of the pyramid. In *Wharton school pub*. Retrieved from https://books.google.de/books?id=R5ePu1awfloC. https://doi.org/10.1038/sj.gene.6364317

Preston, M., & Scott, L. (2015). *Engaging with the sustainable development goals*.

Ravizza, S. M., Uitvlugt, M. G., & Fenn, K. M. (2016). Logged in and zoned out. *Psychological Science*, *28*(0), 1–10. https://doi.org/10.1177/0956797616677314

Redman, E., Wiek, A., & Redman, A. (2018). Continuing Professional Development in Sustainability Education for K-12 Teachers: Principles, Programme, Applications, Outlook. *Journal of Education for Sustainable Development*, *12*(1), 59–80. https://doi.org/10.1177/2455133318777182

Robèrt, K.-H., Schmidt-Bleek, B., Aloisi de Larderel, J., Basile, G., Jansen, J. L., Kuehr, R., … Wackernagel, M. (2002). Strategic sustainable development—Selection, design and synergies of applied tools. *Journal of Cleaner Production*, *10*(3), 197–214. https://doi.org/10.1016/S0959-6526(01)00061-0

Sachs, J., Modi, V., Figueroa, H., Fantacchiotti, M., Sanyal, K., & Khatun, F. (2016). *ICT & SDGs: How information and communications technology can accelerate action on the sustainable development goals*.

Sachs, J. D., Schmidt-Traub, G., & Durand-Delacre, D. (2016). *Preliminary sustainable development goal (SDG) index and dashboard*. Retrieved from http://unsdsn.org/resources/publications/sdg-index/

Schaltegger, S., Beckmann, M., & Hansen, E. G. (2013). Transdisciplinarity in corporate sustainability: Mapping the field. *Business Strategy and the Environment*, *22*(4), 219–229. https://doi.org/10.1002/bse.1772

Schrettle, S., Hinz, A., Scherrer-Rathje, M., & Friedli, T. (2014). Turning sustainability into action: Explaining firms' sustainability efforts and their impact on firm performance. *International Journal of Production Economics*, *147*(PART A), 73–84. https://doi.org/10.1016/j.ijpe.2013.02.030

Stafford-Smith, M., Griggs, D., Gaffney, O., Ullah, F., Reyers, B., Kanie, N., … O'Connell, D. (2017). Integration: The key to implementing the sustainable development goals. *Sustainability Science*, *12*(6), 911–919. https://doi.org/10.1007/s11625-016-0383-3

Steiner, E. D., Baird, M. D., Hamilton, L. S., & Pane, J. D. (2016). *Informing progress—Personalized learning teacher and student survey results*.

UN. (2015). In Seoul, Ban spotlights role of young people and technology in future development agenda. Retrieved June 18, 2017, from http://www.un.org/apps/news/story.asp?NewsID=50911#.WUZO6Wh96Um

Upward, A., & Jones, P. (2015). An ontology for strongly sustainable business models: Defining an enterprise framework compatible with natural and social science. *Organization & Environment*, *29*, 1–27. https://doi.org/10.1177/1086026615592933

Winner, W., Dickey, D., & Showalter, S. (2015). Sustainability and metrics: Use of statistics and independent auditing. *Sustainability: The Journal of Record*, *8*(2), 54–60. https://doi.org/10.1089/SUS.2015.0019

World Bank. (2016a). *World development indicators: Featuring the sustainable development goals*. https://doi.org/10.1596/978-1-4648-0683-4

World Bank (2016b). *World development report 2016: digital dividends* (ed., Vol. 53). Washington DC: World Development Report. https://doi.org/10.1596/978-1-4648-0671-1

Young, W., & Tilley, F. (2006). Can businesses move beyond efficiency? The shift toward effectiveness and equity in the corporate sustainability debate. *Business Strategy and the Environment*, *15*(6), 402–415. https://doi.org/10.1002/bse.510

How to cite this article: Redman A. Harnessing the Sustainable Development Goals for businesses: A progressive framework for action. *Bus Strat Dev*. 2018;1:230–243. https://doi.org/10.1002/bsd2.33

APPENDIX A

SUSTAINABLE DEVELOPMENT GOAL 4: QUALITY EDUCATION

Target	Definition	Indicator	Closest existing match(s) for data
4.1	By 2030, ensure that all girls and boys complete free, equitable and quality, primary and secondary education leading to relevant and effective learning outcomes	Proportion of children and young people: (a) in grades 2/3; (b) at the end of primary; and (c) at the end of lower secondary achieving at least a minimum proficiency level in (i) reading and (ii) mathematics, by sex	Gross graduation ratio from primary education, both sexes (%) Gross graduation ratio from lower secondary education, both sexes (%) *Number of graduates regardless of age in a given level or program, expressed as a percentage of the population at the theoretical graduation age for that level or program.*
4.2	By 2030, ensure that all girls and boys have access to quality early childhood development, care and preprimary education so that they are ready for primary education	Proportion of children under 5 years of age who are developmentally on track in health, learning and psychosocial well-being, by sex	Early Childhood Development Index (ECDI) The ECDI score is calculated as the percentage of children aged 36 to 59 months who are developmentally on track in at least three of four domains of development—literacy-numeracy, physical, social–emotional, and learning. The index is best interpreted within the context of other variables related to support for early childhood development in the home and community.
		Participation rate in organized learning (1 year before the official primary entry age), by sex	School enrollment, preprimary (% gross) *Gross enrollment ratio is the ratio of total enrollment, regardless of age, to the population of the age group that officially corresponds to the level of education shown. Preprimary education refers to programs at the initial stage of organized instruction, designed primarily to introduce very young children to a school-type environment and to provide a bridge between home and school.*
4.3	By 2030, ensure equal access for all women and men to affordable and quality technical, vocational and tertiary education, including university	Participation rate of youth and adults in formal and nonformal education and training in the last 12 months, by sex	School enrollment, tertiary (% gross) *Gross enrollment ratio is the ratio of total enrollment, regardless of age, to the population of the age group that officially corresponds to the level of education shown. Tertiary education, whether or not to an advanced research qualification, normally*

(Continues)

(Continued)

Target	Definition	Indicator	Closest existing match(s) for data
			requires, as a minimum condition of admission, the successful completion of education at the secondary level.
4.4	By 2030, substantially increase the number of youth and adults who have relevant skills, including technical and vocational skills, for employment, decent jobs and entrepreneurship	Proportion of youth and adults with information and communications technology (ICT) skills, by type of skill	Eurostat: Has collected the data called for in this indicator, but this provides only a limited snapshot of the global state. This is not useful for measuring trends globally but gives an idea of what the indicator will look like.
4.5	By 2030, eliminate gender disparities in education and ensure equal access to all levels of education and vocational training for the vulnerable, including persons with disabilities, indigenous peoples and children in vulnerable situations	Parity indices (female/male, rural/urban, bottom/top wealth quintile and others such as disability status, indigenous peoples and conflict-affected, as data become available) for all education indicators on this list that can be disaggregated	The GPI is available for most of the data sources that were selected to represent the indicators and little of the other disparities of interest, so we'll focus on that Proposed existing data sources: 4.1: GPI-Graduation from Primary and Lower Secondary (UNESCO) 4.2: GPI-Enrollment Preprimary 4.3: GPI-Enrollment Tertiary 4.4: GPI (calculate)-ICT Skills Eurostat (check online) 4.6: GPI (calculate)-Literacy youth and adult 4.c: GPI (calculate)-Trained teachers at various levels
4.6	By 2030, ensure that all youth and a substantial proportion of adults, both men and women, achieve literacy and numeracy	Percentage of population in a given age group achieving at least a fixed level of proficiency in functional (a) literacy and (b) numeracy skills, by sex	Literacy rate, youth total (% of people ages 15–24) *Youth literacy rate is the percentage of people ages 15–24 who can both read and write with understanding a short simple statement about their everyday life.* Literacy rate, adult total (% of people ages 15 and above) *Adult literacy rate is the percentage of people ages 15 and above who can both read and write with understanding a short simple statement about their everyday life.* OECD Skills Outlook 2013: has the literacy and numeracy scores of the style called for in the indicator for 20 countries
4.7	By 2030, ensure that all learners acquire the knowledge and skills needed to promote sustainable development, including, among others, through education for sustainable development and sustainable lifestyles, human rights, gender equality, promotion of a culture of peace and nonviolence, global citizenship and appreciation of cultural diversity and of culture's contribution to sustainable development	Extent to which (i) global citizenship education and (ii) education for sustainable development, including gender equality and human rights, are mainstreamed at all levels in: (a) national education policies, (b) curricula, (c) teacher education and (d) student assessment	Nothing available
4.a	Build and upgrade education facilities that are child, disability and gender sensitive and provide safe, nonviolent, inclusive and effective learning environments for all	Proportion of schools with access to: (a) electricity; (b) the Internet for pedagogical purposes; (c) computers for pedagogical purposes; (d) adapted infrastructure and materials for students with disabilities; (e) basic drinking water; (f) single-sex basic sanitation facilities; (g) basic handwashing facilities (as per the WASH indicator definitions)	World Bank currently collects data on access to electricity, improved water sources, and improved sanitation facilities among households This is not available for schools, just households Data from UNESCO on Proportion of computers connected to the Internet for Primary and Secondary Limited set of countries with data Data from UNESCO on Proportion of all computers available for pedagogical use for Primary and Secondary Limited set of countries with data

(Continues)

(Continued)

Target	Definition	Indicator	Closest existing match(s) for data
4.b	By 2020, substantially expand globally the number of scholarships available to developing countries, in particular least developed countries, small island developing States and African countries, for enrolment in higher education, including vocational training and information and communications technology, technical, engineering and scientific programs, in developed countries and other developing countries	Volume of official development assistance flows for scholarships by sector and type of study	OECD reports on flows from most donor countries: "I.A.5 Scholarships and student costs in donor countries"
4.c	By 2030, substantially increase the supply of qualified teachers, including through international cooperation for teacher training in developing countries, especially least developed countries and small island developing States	Percentage of teachers in: (a) preprimary; (b) primary; (c) lower secondary; and (d) upper secondary education who have received at least the minimum organized teacher training (i.e., pedagogical training) preservice or in-service required for teaching at the relevant level in a given country	World Bank currently collects data on trained teachers in preprimary, primary, lower, and upper secondary (% of total teachers) Trained teachers in primary education are the percentage of primary school teachers who have received the minimum organized teacher training (preservice or in-service) required for teaching in a given country.

APPENDIX B

EVALUATING TARGETS AND INDICATORS

Overall, there is significant variability between targets for all of the aspects studied. Indicators could be quite different or quite similar to the target while there is good data for some indicators and no data for others. A traffic light style chart was created in order to capture the overall situation for the indicators and data of SDG 4. Each of the 11 indicators were rated as bad (red), okay (yellow), and good (green) for three criteria:

- *Indicator <-> Target*: How well does the indicator capture all of what the target describes?
- *Current Data*: How well does currently available public data match the proposed indicator?
- *Future Data*: How good do prospects look for data availability for measuring this indicator in the future (by ca. 2020)?

Target	Short name	Indicator <-> target	Current data	Future data
4.1.1	Proficiency of primary and secondary students			
4.2.1	Early Childhood Development Index			
4.2.2	Preprimary enrollment			
4.3.1	Postsecondary education			
4.4.1	ICT skills			
4.5.1	Equal access for all			
4.6.1	Literacy			
4.7.1	Sustainable development knowledge			
4.a.1	School infrastructure			
4.b.1	Scholarships			
4.c.1	Qualified teachers			

Quality of Current Data for SDG 4

There is significant gap in both the quantity and quality of data and the current provisional indicators released by the UN. The Center for Global Development (CGD) has made an effort at scoping all the indicators http://www.cgdev.org/blog/sdg-indicators-serious-gaps-abound-data-availability and http://www.cgdev.org/blog/what-sdgs-can-we-track-now. The UN also assessed the indicators ranking them in three tiers. The UN itself found that of their 230+ indicators only 42% have an established methodology and regularly accessible data. The CGD analysis of the indicators found that only a portion of these supposed tier one indicators have direct, publically accessible data, leaving only 25% of SDG indicators usable today.

For this study, the independent analysis of the indicators for SDG4: Education was conducted (see previous table). The table below compares the study's rating of the current data available with the rating of the agency which proposed the indicator and then the rating of the UN Secretariat which reviews all the indicators after submission (and tend to be more pessimistic than the proposing agencies).

Target	Short name	Review of current data	UN tiers	
			Agency	Secretariat
4.1.1	Proficiency of primary and secondary students			
4.2.1	Early Childhood Development Index			
4.2.2	Preprimary enrollment			
4.3.1	Postsecondary education			
4.4.1	ICT skills			
4.5.1	Equal access for all			
4.6.1	Literacy			
4.7.1	Sustainable development knowledge			
4.a.1	School infrastructure			
4.b.1	Scholarships			
4.c.1	Qualified teachers			

In general, the study's ratings line up with what the UN has determined about the indicators with three exceptions.

1. ICT skills (4.4.1) were rated lower than the UN because the skills they propose are already quite outdated.
2. Scholarships (4.b.1) were rated lower because it only includes official development aid for scholarships and not private or other types of scholarships.
3. Qualified teachers (4.c.1) was rated because the data are based on national standards which varies enormously (or in the United States does not exist) and makes comparisons between countries useless.

A structured judgment was made for each of the criteria for each of the indicators. The following two charts provide justifications for the rankings on relevancy and magnitude columns.

Target	Short name	Relevancy of ICT	Justification
4.1.1	Proficiency of primary and secondary students		Although student performance has been a key justification for the integration of ICT into schools the world over, the evidence of it improving student performance is mixed at best, especially when compared on a cost effectiveness basis. This is not to say that ICT skills and competence are not valuable but so far improvement in other subject areas is not enough to alone justify these programs. One study did show that ICT is most effective when it supports the teacher through access to resources and in class presentations and activities (but was not when the students use the ICT themselves).
4.2.1	Early Childhood Development Index		Early childhood does not appear to be a good target for ICT solutions, in fact, it is often not recommended that young children have too much screen time. Unsurprisingly there were not many solutions in this space out there.
4.2.2	Preprimary enrollment		
4.3.1	Postsecondary education		ICT looks to be the future of postsecondary education. Fully online education is going to make up an increasing portion of students and even immersive students will be using ICT to do homework, take some classes online or for other services.
4.4.1	ICT skills		Clearly no progress can be made on this indicator without ICT.
4.5.1	Equal access for all		ICT has the potential to help integrate disadvantages populations from women to the rural poor in education, but ICT is generally more accessible to advantaged populations so without explicit efforts ICT will likely only exacerbate inequalities.
4.6.1	Literacy		Mobile phones provide a possibility for ICT improving literacy, but only if they are one part of a much bigger non-ICT related project.
4.7.1	Sustainable development knowledge		In order to mainstream sustainable development education rapidly, it will be necessary to share resources globally, which ICT could enable. ICT is likely to be as effective in this area as other subjects (see 4.1.1)
4.a.1	School infrastructure		Two parts of this indicator, computers and internet, are directly ICT, but the rest of the parts have little to do with ICT.
4.b.1	Scholarships		Online degrees would seem to present an obvious opportunity to greatly increase the impact of scholarship money, but it is not (yet) explicitly included as part of this indicator.
4.c.1	Qualified teachers		Computer-based in-service training has potential to increase qualified teachers but the record so far is not significant.

(Continued)

Target	Short name	Relevancy of ICT	Justification
4.1.1	Proficiency of primary and secondary students		Although so far ICT has not produced consistent gains among K-12 students, continued experimentation and evaluation may be pointing the way to approaches such as computer-assisted-learning that could easily be rolled out and create widespread gains across an entire education system.
4.2.1	Early Childhood Development Index		There appears to be little possibility for large scale impact with early childhood.
4.2.2	Preprimary enrollment		
4.3.1	Postsecondary education		The most significant problem postsecondary education faces is massification—the hundreds of millions of secondary graduates who want to further education but currently have no place to go. It is probably physically impossible to meet this challenge without the extensive use of ICT.
4.4.1	ICT skills		Clearly no progress can be made on this indicator without ICT.
4.5.1	Equal access for all		ICT has the potential to help integrate disadvantages populations from women to the rural poor in education, but ICT is generally more accessible to advantaged populations so without explicit efforts ICT will likely only exacerbate inequalities.
4.6.1	Literacy		So far, there is no evidence that ICT-based programs can have large impacts on reducing illiteracy.
4.7.1	Sustainable development knowledge		In order to mainstream sustainable development education rapidly, it will be necessary to share resources globally, which ICT could enable. ICT is likely to be as effective in this area as other subjects (see 4.1.1)
4.a.1	School infrastructure		Two parts of this indicator, computers and internet, are directly ICT, but the rest of the parts have little to do with ICT.
4.b.1	Scholarships		Online degrees would seem to present an obvious opportunity to greatly increase the impact of scholarship money, but it is not (yet) explicitly included as part of this indicator.
4.c.1	Qualified teachers		Currently, teacher education has a poor reputation the world over. If one could develop an effective ICT-based model for preservice or in-service training, the ability to cheaply replicate it at scale would be enormously impactful.

APPENDIX C

BUSINESS OPPORTUNITY INDEX

So after selecting a target using the traffic light analysis in Table 1, the BOI can be used to select an initial list of target countries. In this case, the BOI was calculated by dividing the percentage of internet users by the percentage enrollment in tertiary education with Table A1 detailing the results for the top 15 countries (including their Human Development Index grouping for reference). Countries with a high score are considered to be the best opportunities because in these countries there is a large number of people who can use the ICT solution relative to the number of people who need such solutions.

TABLE A1 Top 15 ICT Opportunity Index countries for Indicator 4.3.1

Countries	HDI level	Tertiary enrollment (%)	Internet access (%)
Kenya	Low human development	4.0	43.4
Seychelles	High human development	6.5	54.3
Malawi	Low human development	0.8	5.8
Tonga	High human development	6.3	40.0
Equatorial Guinea	Medium human development	3.2	18.9
Qatar	Very high human development	15.8	91.5
Trinidad and Tobago	High human development	12.0	65.1
Swaziland	Low human development	5.3	27.1
Uzbekistan	Medium human development	8.9	43.6
Luxembourg	Very high human development	19.4	94.7
Nigeria	Low human development	10.4	42.7
United Arab Emirates	Very high human development	22.0	90.4
Vanuatu	Medium human development	4.7	18.8
Uganda	Low human development	4.5	17.7
Maldives	High human development	12.7	49.3