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Redefining the Use of Sustainable Development Goals at the Organisation and Project Levels—A Survey of Engineers

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Abstract: The United Nations' (UN) Sustainable Development Goals (SDGs) aim to deliver an improved future for people, planet and profit. However, they have not gained the required traction at the business and project levels. This article explores how engineers rate and use the SDGs at the organisational and project levels. It adopts the Realist Evaluation's Context–Mechanism–Outcomes model to critically evaluate practitioners' views on using SDGs to measure business and project success. The study addresses the thematic areas of sustainability and business models through the theoretical lens of Creating Shared Value and the Triple Bottom Line. A survey of 325 engineers indicated four primary shortfalls for measuring SDGs on infrastructure projects, namely (1) leadership, (2) tools and methods, (3) engineers' business skills in measuring SDG impact and (4) how project success is too narrowly defined as outputs (such as time, cost and scope) and not outcomes (longer-term local impacts and stakeholder value). The research study is of value to researchers developing business models that address the SDGs and also practitioners in the construction industry who seek to link their investment decisions to the broader outcomes of people, planet and profit through the UN SDGs.

Keywords: sustainability; governance; UNSDG; project success; business-society; business models; Sustainable Development Goals (SDGs); sustainable development; infrastructure projects

1. Introduction

In 2015, the international community responded to the sustainable development challenge with the Sustainable Development Goals (SDGs) for 2030 in their report 'Transforming Our World: The 2030 Agenda For Sustainable Development' (United Nations 2015). The SDGs are the United Nations' blueprint and have been signed by 193 nations. They address the global challenges, such as poverty, inequality, climate change, environmental degradation, prosperity, and peace and justice. At the global level, the SDGs are interconnected, and the overarching ambition is to 'leave no one behind' in the achievement of the 2030 targets. However, the global nature of the SDGs means that they have a performance framework that is well developed at regional and national levels, but this has been difficult to cascade to the sub-national level, including at both the organisational and project levels (Patel et al. 2017; Galli et al. 2018). The problem manifests because most infrastructure investments are made at a local level, and therefore, without having an approach that makes adequate provision for the longer-term impacts across SDGs, there is a likelihood that practitioners will make less-informed decisions (Adshead et al. 2019; Thacker et al. 2019). Conversely, by using an SDG lens to view infrastructure investments, strategic infrastructure interventions can lead to significant SDG progress.

This implies that improved decisions at local level are possible through translating global impact down to the project level. The contribution of this article is to harness the results of a large-scale survey on how engineers employ the SDG performance framework at the project level to examine the 'contextual' strengths and weaknesses of utilizing the SDG measuring 'mechanism'. This provides deep insights for academics and practitioners to improve their understanding of how the SDGs can provide increased impact at the local level. It informs further research into local measurement of SDGs with, for example, the opportunity to assess theory-led investigations that establish a link from the local to global levels. Practitioners can also learn from these developments, seeking new ways to link rhetoric to action (Scheyvens et al. 2016) so that businesses can fully leverage their innovation, responsiveness, and resources to drive SDG success.

Alarmingly, after only five years, the global commitment to deliver meaningful SDG action is falling behind on ambitions at both the local and global levels (Office of National Statistics ONS). This is relevant for project managers because much of tomorrow's resilience and development will be delivered by the project management community, across all sectors, but especially infrastructure. More specifically, the IPCC's 2018 Report identifies that 'directing finance towards investment in infrastructure for mitigation and adaptation' is key to meeting SDG targets. The estimated $97.5 trillion USD (Global Infrastructure Hub 2019) of investment in infrastructure projects that is required globally by 2040, is considered by McKinsey Global Management Consultancy (Bielenberg et al. 2016) to represent a unique opportunity to stimulate economic prosperity, reduce poverty and raise standards in health, education and gender equality. At the same time, the challenge of measuring project outcomes against SDG goals, targets and indicators within existing project business models is not a new phenomenon, since the difficulty of measuring sustainability outcomes is a well-researched area (Proctor et al. 2011; Boswell et al. 2015). The use of SDGs to measure success at project level is important for two reasons: firstly, they can help monitor progress at an international level (Constanza et al. 2016); secondly, they can help with selecting infrastructure projects which aim to address SDGs in the design stage/front-end of projects (Adshead et al. 2019). In turn, investment decisions can be targeted towards the distribution of funding to infrastructure projects that can achieve broader and longer-lasting impact (Thacker et al. 2019). Up until this point, scientists, policymakers and practitioners seem to have captured the greatest challenges that the world is facing. The COVID-19 pandemic has amplified more than ever before the need to find new ways to increase the pace and scale of positive change for governance thinking and models which address the UN SDG priorities and the need for new ways to measure and support the delivery of the UN SDGs 2030 targets (Adshead et al. 2019).

Given the problem discussed above and noting the potential benefits and rising need and tension to link SDGs to local delivery on infrastructure projects, the research question is: *How do engineers in the construction sector rate and use global UN SDG goals for infrastructure projects at local level?*

The following section provides the literature review, which includes a brief overview of the concept of SDGs, the relevance to projects as well as a review of how these issues are impacted by the theories of Creating Shared Value and the Theory of Change. This is followed by the methods section and subsequently the findings and discussion sections. The final section concludes the paper with proposals for how this research can inform the development of a new model for measurement of SDGs and recommends areas for further studies based on the proposed research framework.

2. Literature Review

In order to address the research question, an extensive literature search of academic publications and professional, policy and industry reports helped identify five key themes that impact the context of the use of SDGs on infrastructure projects. The five themes are shown in Figure 1 and discussed in the sub-sections of the literature review.

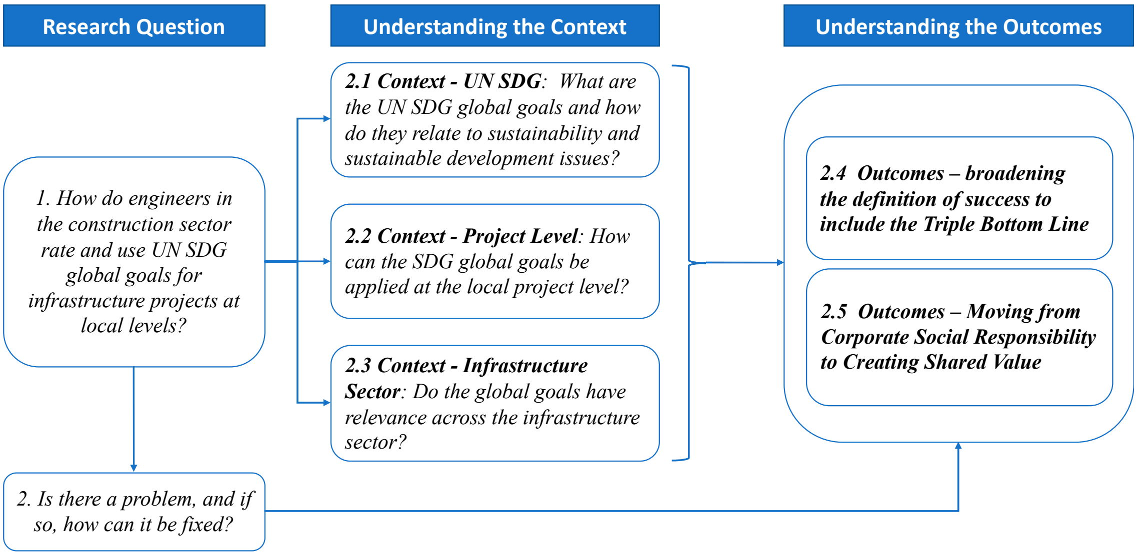


Figure 1. The logic chain illustrating the relationship between the research question and the contextual and outcome thematics.

2.1. Context—United Nations Sustainable Development Goals

The failure of not meeting the 2030 targets of the United Nations Sustainable Development Goals (hereafter, UN SDGs) is amongst the most significant global Grand Challenges threatening our survival today (IPCC 2018), and there is the potential for the project management community to play a key part (Morris 2017) in making a positive impact on the 2030 targets. Before examining how projects can help measure SDG success, it is important to understand how sustainable development has evolved into a 'three-legged stool' that seeks to balance economic, social and environmental priorities; what many refer to as 'People, Planet and Profit' (Elkington 1994, 2018; Sosik and Jung 2018).

The definition of sustainable development has emerged from Brundtland's formative report (Brundtland 1987): 'development that meets the needs of the present without compromising the ability of future generations to meet their own needs'. Since then, sustainable development has become an increasingly central theme for nation-states and their citizens (Sachs 2012; Sachs et al. 2016). Today, the Planetary Boundaries (Rockström et al. 2009; Steffen et al. 2015) provide a global litmus test for how we are doing. The concept of nine planetary boundaries, within which humanity can maintain a positive development profile for future generations, was developed in 2009 by environmental scientists from the Stockholm Resilience Centre, led by Johan Rockström and Will Steffen. In 2011, their work (Rockström et al. 2009) informed the then UN Secretary-General Ban Ki-moon's urgent appeal for global society to 'help us defend the science that shows we are destabilising our climate and stretching planetary boundaries to a perilous degree'. The most significant global response to the Planetary Boundary challenge was in 2015, when all governments ratified the UN's seventeen Sustainable Development Goals (United Nations 2015), shown in Figure 2, to be achieved by 2030 (initially with 169 targets agreed in 2015 and then 244 indicators agreed in 2017). This represents a major step-change in the implementation of the global sustainability agenda (Sosik and Jung 2018).

Figure 2. The Global Goals for Sustainable Development (United Nations 2015—permission to use from Sustainable Development Goal (SDG) logo Guidelines).

Although the SDGs build on the earlier Millennium Development Goals (MDGs) by focusing on similar issues, the SDGs differ from the MDGs because they are for all countries in the world to implement—developed and developing alike). Moreover, unlike the MDGs, the SDGs are focused on monitoring, evaluation and accountability—across society, not just at the national level, which is why it is critical that the link is made from the 'bottom-to-top', meaning from the delivery at the local project level through to the impacts at the national and global levels. However, there appears to be a gap. The golden thread from the national to the project level seems to be missing. This is key because SDGs have been conceptualised at the global level but actually materialise and are operationalised at the project level (Thacker et al. 2019). This is especially true for infrastructure projects (Adshead et al. 2019) that reflect large-scale governmental investments, which are delivered by multiple stakeholders working across boundaries and where the linking of global-to-local impacts at the project level is potentially transformative for business policy and everyday citizens, as discussed in the next section.

2.2. Context—Global SDGs at the Project Level

Recent evidence from the UK's Infrastructure and Projects Authority (UK's Infrastructure and Projects Authority 2020) suggests that projects are the major vehicle through which national-level strategic change is delivered. In 2018–2019, the IPA had oversight of 133 projects in the national portfolio, representing a whole life cost of GBP £442 billion and an annual project spend of GBP £27 billion (UK's Infrastructure and Projects Authority 2020). This is estimated at nearly 20% of the UK's national expenditure (Morris 2017), which is just the 'tip of the iceberg', as it does not account for all change projects, programmes or portfolios. Based on the clear imperative to ensure maximum value is achieved from the infrastructure investments, this sub-section explores whether measurement of SDG impacts at the project level is currently ineffective despite the endorsement of the SDGs by all the world's governments. It identifies a two-fold dilemma in terms of using global targets at business and project levels.

Firstly, a fundamental misunderstanding of the interdependent relationship between business and society (Elkington 1994, 2018). The failure to appreciate this dissonance frequently leads to sustainability being overlooked, both as a strategic opportunity for creating and maintaining competitive advantage by firms and as a source of significant business risk (Porter and Kramer 2011). Porter and Kramer argue that if businesses, and the projects that drive the changes needed, are to deliver on the SDGs by 2030, a new approach is required—they term this Creating Shared Value, discussed further in later sections.

Secondly, the SDG framework itself has its own limitations. As described earlier, the 17 SDGs are defined by 169 targets. This has been further defined by another layer of granularity, by the UN Statistical Commission's Interagency and Expert Group on SDG Indicators (IAEG-SDGs), which includes 244 individual indicators to monitor the 169 targets of the 17 SDGs. This increases the complexity of definition, which is both good and bad. Indeed, there are many (Riley 2001; Morse 2013; Hak et al. 2016) that actually criticise the SDGs for being too broad and deep—ultimately being impenetrable except for the deep specialist. Conversely, the advocates, such as Lim et al. (2016), with studies in the health-related SDGs, suggest that the 17 SDGs provide powerful 'icons' that galvanise efforts to measure critical indices. They also provide the communications medium for ensuring simplification, thereby enabling the simplest messages to be kept to 17 powerful, interlinked themes. There are further studies (Lim et al. 2016; Sachs 2012; Holden et al. 2017) that contend which targets and indicators are needed to add credible evidence-based measurement to ensure meaningful tracking of progress against a pre-determined baseline. For example, climate change (IPCC 2018) uses the pre-industrial age temperature levels and related gas emission pathways as a proxy for the objective to reduce global warming below the 1.5 °C levels by 2030. Yet some authors (Morse 2013; Hak et al. 2016) challenge the assertion that the targets and indicators are fit for purpose by suggesting that they are inconsistent and difficult to quantify, implement, monitor and report, as well as it being difficult to learn lessons. They also challenge the governance of the SDG oversight mechanism because the goals are non-binding, with each nation creating their own made-to-measure national plans that aim to be specific to their needs to have ubiquitous relevance.

Some argue (Swain 2018) that the real challenge resides with the tactical and operational issues that project managers have to contend with. These include: (a) What are the interdependent relationship between SDGs to prevent them from being assessed in silos? (b) How can the targets and indicators that were designed for national and global level reporting be cascaded down to project level? These are both addressed in subsequent sections.

2.3. Context—Global SDGs in the Construction Sector

The Global Commission on the Economy and Climate defined Infrastructure (New Climate Economy 2016, p. 4) as 'structures and facilities that underpin power and other energy systems (including upstream infrastructure, such as the fuel production sector), transport, telecommunications, water, and waste management'. This definition takes a systems perspective and includes energy, transport, buildings, water supply and sanitation, IT and communications" but does not explicitly include natural infrastructure such as forests, deserts, wetlands and other ecosystems (Bhattacharya et al. 2015; New Climate Economy 2016). In the infrastructure sector, recent analysis by the UK Infrastructure Transitions Research Consortium's (ITRC is a partnership involving seven universities and over 50 groups from infrastructure practice and policy) has provided some confidence that the higher-level targets do have influence at the project level. The analysis (Hall et al. 2016; Thacker and Hall 2018) indicates that 81% of the SDG targets are influenced by infrastructure investment projects. However, despite the positive conclusion from the analysis (Thacker et al. 2019), there is conflicting evidence that the sub-target indicators can be applied coherently at the project level. The 244 SDG Indicators were developed with nations under the leadership of the Interagency and Expert Group on SDG's (IAEG-SDG) to provide greater granularity and relevance for measurement—but there are many challenges to their use by both developing and developed nations, because whilst detail is good for clarity, it adds complexity. For example, the UK's Organisation for National Statistics (ONS), which is responsible for reporting the UK's progress against global SDG indicator measurement, shows that in October 2018, they only had data for 64% of the IAEG-SDG's indicators, with 9% of statistics 'in progress' and 27% with no data available. The challenge of the indicators' utility for measuring success becomes worse below the national level, where this research team has identified that only 12% (29) of the 244 indicators could be used meaningfully at the project level. As Merry (2019) and others (Price Waterhouse Coopers 2018; Hall et al. 2016; Thacker and Hall 2018; Thacker et al. 2019) have suggested, we need to find answers about how the infrastructure sector responds. In order to do this, we need to explore the definition of infrastructure investment success—is it for the business, the community or wider stakeholders?

2.4. Outcomes—Broadening the Definition of Success to Include the Triple Bottom Line

At the project level, the Association of Project Management's Body of Knowledge (Association for Project Management 2019) defines sustainability as 'an environmental, social and economically integrated approach to development that meets present needs without compromising the environment for future generations'. The APM's definition has been based on the modern concept of sustainable development as derived from the Brundtland Report (Brundtland 1987), which suggests that efforts to create improvements in the short-term should be without a negative impact in the longer-term. It also recognises that project strategies need to consider success against the triple bottom line (or otherwise noted as TBL or 3BL) of social, environmental (or ecological) and financial aspects.

However, the over-emphasis on the last of the TBL criteria, namely finance, brings us to the root of the problem of measuring projects' SDG impact. This is because the crux of the sustainability reporting problem lies with the dominance of accounting tools, which has been the pre-eminent business method of reporting for over 500 years since Luca Paccioli first published his papers on double-entry bookkeeping (Yamey 1949). This has largely remained unchanged. In other words, there has been a proliferation of mechanisms and economic models to track different elements of the TBL, including'ESG (environmental, social and governance) (Elkington 1994, 2018) that includes the three core areas used in the business investments measurement of ethical and sustainability impacts of a company; Social Return on Investment (SROI) (Emerson et al. 2000; Millar and Hall 2013), Net Positive (Forum for the Future 2018; Rainey et al. 2015), Double and Quadruple Bottom Lines (Sawaf and Gabrielle 2014), a myriad of capital (human, social, manufactured, financial, natural) analysis models, Environmental Full Cost Accounting (Schaltegger and Burritt 2000), Boston Consulting Group's Total Societal Impact framework, Integrated Reporting (Eccles and Krzus 2010), Blended and Shared Value (Bonini and Emerson 2005) and Impact Investment (Bugg-Levine and Emerson 2011). Recently this has been extended to new frameworks that focus on specific issues such as Sharing and Circular Economies (Preston 2012), Carbon Productivity (Malhi et al. 2009; Suess 1980) and Biomimicry (Elkington 2018). The contention of this research study is that the proliferation of financially driven sustainability measurement theories, tools and concepts causes confusion and often leads to sub-optimal governance because of the short-term focus on profit instead of wider TBL outcomes.

Current analysis suggests that the TBL framework is in need of 'rethinking' (Elkington 2018). Indeed, Elkington's contention is that his definition has not been implemented according to its true meaning, and he insists that businesses should now monitor and report economic (not just financial), social, and environmental value added—or they will become negatively impacted. Many contend (Hubbard 2009; Elkington 1994, 2018; Joyce and Paquin 2016) that private sector success is still overly influenced by financial perspectives. This is often restrictively linked to share price value and viewed as an inherent weakness of the system that drives short-termism in governance and decision-making (Elkington 2018). As a result, and relevant to the assessment of how project managers can measure projects' SDG impacts, there has been a growing demand for knowledge on how sustainability reporting can be broadened.

As a result of the increased knowledge and tempo of the uptake of sustainability language, it has become more mainstream with many academics (Tilt 2009) and practitioners (Perrini and Tencati 2006) seeking to further develop the current accounting-centric method towards a broader, or holistic, approach, such as the Balanced Scorecard (Kaplan and Norton 1996). However, the proliferation of sustainability accounting terminology (sustainability accounting is often referred as social accounting, corporate social reporting corporate social responsibility reporting, social and environmental accounting, and non-financial reporting) also negatively impacts the ability to have a single consistent view, and this contributes to the project world being mired in confusion.

2.5. Outcomes—Moving from Corporate Social Responsibility to Creating Shared Value

The debate on businesses' responsibility to 'give back' to society and the environment have evolved from earlier notions associated with corporate social responsibility (CSR) agenda, and these in turn have been influenced by the notion of creating shared value (CSV), which seeks to change the way in which business creates value for its stakeholders (Porter and Kramer 2011), i.e., through placing socially aware priorities, such as the SDGs, at the heart of core business' thinking and strategies. In Porter's paper (Porter and Kramer 2011), he states that 'the concept of shared value can be defined as policies and operating practices that enhance the competitiveness of a company while simultaneously advancing the economic and social conditions in the communities in which it operates.' CSR is clearly a key part of this idea of 'give back to society' and is of importance to investors (Hayward et al. 2013). Hayward goes further by suggesting that the major problem is with businesses, especially the ones that have remained caught in outdated approaches to value creation, that they view too narrowly. In effect, they are seeking shareholder-driven short-term profits before longer-term broader outcome success. Most of the current sustainability efforts have focused on the identification of harms to society in general and the creation of corporate responses to meet those harms as described in general. As a result, many sustainability efforts have been largely divorced from the specific business model of each organisation. In reality, sustainability activities have often functioned as 'surplus', 'add-on', 'nice-to-have' actions for the purpose of deflecting stakeholder criticism, conducted regardless of their actual relevance and impact on the business' strategy, capabilities, suppliers or customers. The net effect is to leave core business activities and risks unchanged. Moreover, sustainability cannot be delivered through CSR because it is both inefficient and ineffective (Porter and Kramer 2011). Porter argues that CSR is inefficient because it can create irrelevant 'add-on' activities that add to the costs of doing business without either adding to the real value created for any of the business' stakeholders or removing real business risks. Additionally, CSR is ineffective because it continues to pit society and business as opposing forces rather than recognising the opportunities dormant in their interdependence (Porter and Kramer 2011). However, counter to Porter's view of CSV–CSR differentiation, there is an alternative perspective that CSR has rapidly evolved in recent years and closed the CSV-CSR gap. In a recent paper (Albuquerque et al. 2019), they explore how CSR affects systemic risk and impacts the value proposition (Bénabou and Tirole 2010). This provides useful indicators that suggest that CSR is closing a gap with CSV, especially in its social value insights. More importantly for this paper, it illustrates that both CSR and CSV have an important role in linking organisational and project success to SDG impacts.

The CSV business model, first developed by leading business strategist Michael Porter of Harvard Business School (Porter and Kramer 2011), enables the potential to provide a link from local projects' objectives to global SDGs by rethinking projects' definition of success by demonstrating impact across the TBL (Elkington 1994), as discussed in the previous section. It can do this because it: (a) recognises the interdependence between society and business; (b) moves society and business away from zero-sum competition to positive-sum competition; (c) enables new ways for the business to create competitive advantage that are more resilient against sustainability risks and mimicry by other firms; and (d) combines traditional CSR and business operations into new, integrated and company-specific, strategies for creating shared value. Since business and society are interdependent, the best outcomes for each will be obtained when businesses develop strategies that integrate social needs with real commercial opportunities and vice versa.

Having identified that the theories of CSV and TBL could enable a broader understanding of how to measure business success at the sub-national level, this research project was established to test its practical implications. It achieved this by developing a methodology that could engage engineers in the construction sector, to gauge their perceived value of measuring SDG impacts at project level, and what contextual issues affected the success of this approach. The questions were framed using the Realist Evaluation approach, Context–Mechanism–Outcomes, which is discussed in the next section. The intent was to identify ways to improve the outcomes of using SDG measurement (the mechanism) by better understanding the contextual issues that affect likely success.

3. Methodology

Given the issues identified in the literature review, the methodology needed to be suitable to address the earlier stated research question: *How do engineers in the construction sector rate and use global UN SDG goals for businesses and projects at local level?* An online survey is used as the first part of a mixed methods approach that provides a triangulation (Creswell and Creswell 2017) of data (i.e., through literature review, survey and interviews) to inform the development of the prototype SDG Measurement Model as shown in Figure 3. In this way, in what Creswell and Creswell (2017) describes as a Sequential Explanatory Design, the literature review informs the survey questions and analysis, that sequentially informs the structure and questions of the interview stage. Creswell and Creswell (2017) suggests that this sequential approach has the benefit of being the most straightforward in its design because there are discrete stages that are easy to describe and to report. The main difficulty is the length of time in the data collection phase. For this study, the time required for each step of the research design was allocated in full. The interviews are not included in this article but are central to the follow-on research.

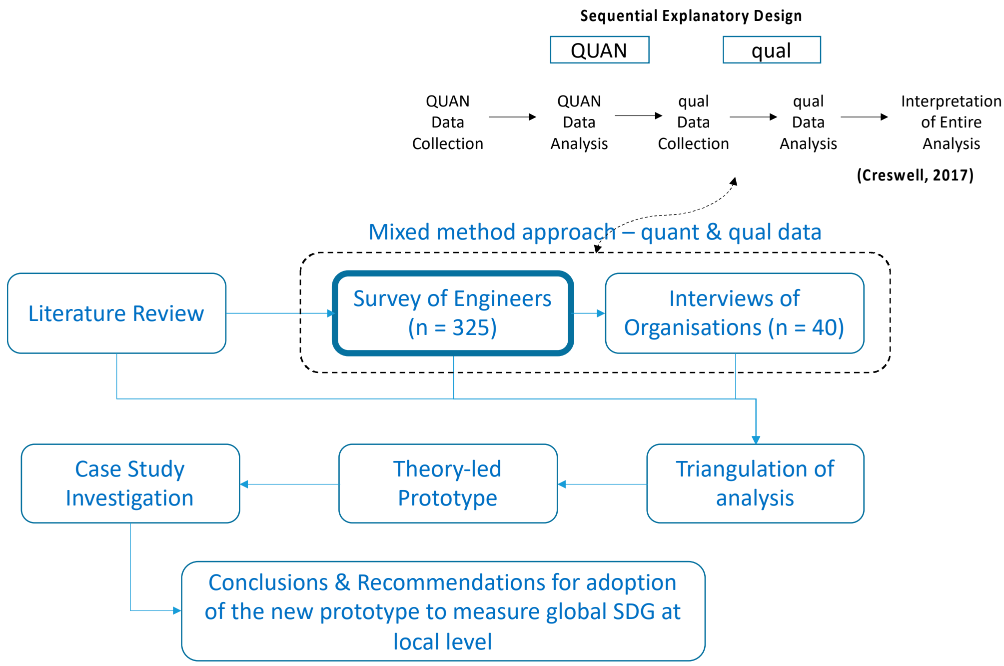


Figure 3. The research approach of mixed-method Sequential Explanatory Design, adapted from Creswell and Creswell (2017).

3.1. Using the Realist Evaluation Methodology to Structure the Survey

The research study adopts the Critical Realism perspective of philosophers such as Bhaskar (2013) to inform the choice of the Realist Evaluation approach, primarily because of its practical utility and its widespread use in social science research into the impacts of programmes (Linsley et al. 2015). It also provides a way to develop theory-led investigations, which is what this research seeks to do on SDG measurement. The adoption of the Realist Evaluation's Context–Mechanism–Outcome (C–M–O) configuration (Pawson and Tilley 1997) is widely used across clinical research (Pawson et al. 2005) and increasingly also across the social sciences (Linsley et al. 2015). Pawson and Tilley specifically recommend the C–M–O strategy so that 'programme theories can be tested for the purposes of refining them' (2005, p. 2). In this regard, the investigation is not about what works but asks instead, 'what works for whom in what circumstances and in what respects, how?' (2005, p. 2). Therefore, this approach gives a multi-layered methodological framework for analysing engineers' perception of the context of SDG measurement as well as its potential outcome on redefining investment decisions to achieve broader SDG impacts. For the purposes of this paper, the definitions of C–M–O are:

- **Context**: The conditions in a context of action encompass 'material resources and social structures, including the conventions, rules and systems of meaning in terms of which reasons are formulated' (Sayer 1992, p. 112; in Easton 2010).
- **Mechanism**: The underlying entities, processes, or structures which operate in particular contexts to generate outcomes of interest (Astbury and Leeuw 2010, p. 386).
- **Outcome**: The practical effects produced by causal mechanisms being triggered in a given context (Tilley 2016, p. 145).

Based on these definitions, the survey captures engineers' perceptions of SDG goals for the measurement of project success, using a questionnaire based on a C–M–O structure, as shown in Figure 4. Taking Bhaskar's view (Bhaskar 2013), critical realism assumes that certain events exist, and then people apply different perspectives and meaning to their interpretation of the truth. The survey aimed to capture the first-level 'empirical' observed and experienced views of engineers' use of SDG measurement by seeking to quantify their perspectives on three areas: (a) the value and importance they placed in defining SDG *outcomes* as a measure of project success, (b) their insights into the use of the *mechanism* (the 'trigger' being the tools, process, structures and strategy for measurement of a prioritised list of SDG goals and targets at the project level) and (c) the *context* of issues that affect the likely success of achieving the outcomes from the use of the mechanism.

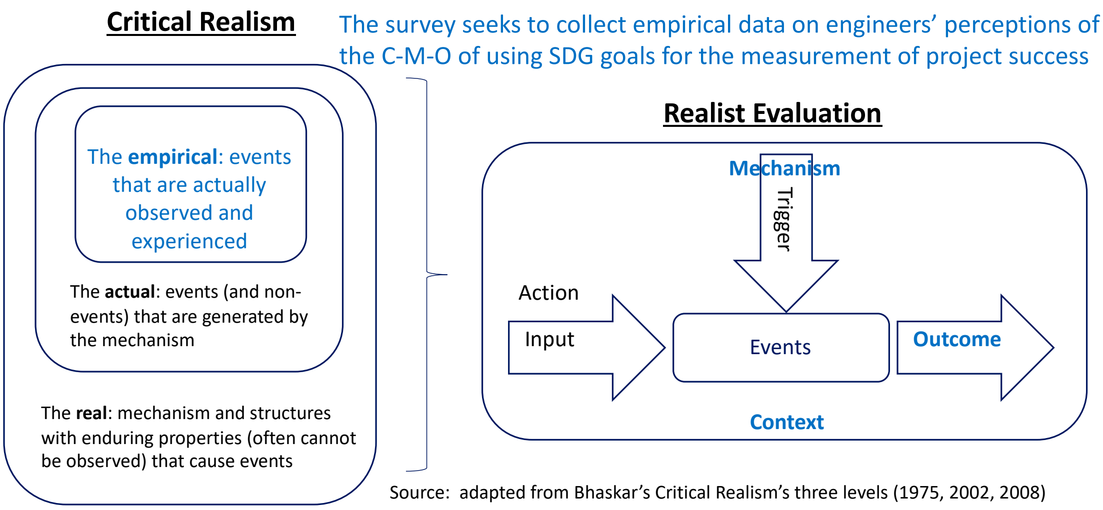


Figure 4. The Realist Evaluation (Context–Mechanism–Outcome (C–M–O)) model mapped to the Critical Realism theory of real-actual-empirical adapted from Zachariadis et al. (2013).

As shown in Figure 3, the development of a prototype SDG measurement model based on the TBL-CSV theories was to be based on the triangulation of learning from the literature review, the survey of 325 engineers and the subsequent interviews of 40 senior executives. Only the survey stage is shared in this paper. The survey procedure, discussed below, is structured using the C–M–O approach, and this enables discreet parts of the causal chain to be examined—the context, the SDG measurement approach (the mechanism), and its outcomes (the wider definition of success). In the engineering research field, the C–M–O configuration is not as widely used as it is in the clinical field; however, illustrative examples on the use of this approach are provided in Table 1.

Table 1. Examples of the use of Critical Realism and Realist Evaluation C–M–O configuration that informs similar use on evaluation of phenomena on engineering projects.

#	C–M–O Configuration Reference	How Might the Insights Inform Engineering Project SDG Measurement Analysis?
1	**Terminology.** Pawson and Tilley's Realistic Evaluation (Pawson and Tilley 1997) is widely held as the originators of the Realist Evaluation CMO configuration.	Through understanding the origins of the C–M–O approach and its terminology, research into engineering projects can build on established protocols and use their approach to widen our understanding of its employability outside the clinical and educational sectors, where they are most frequently used.
2	**Projects application.** Pawson and Tilley's Realistic Evaluation (Pawson and Tilley 1997)	Pawson and Tilley suggest that the value of the C–M–O strategy is that it enables the researcher to better analyse the nature of programmes and projects and, more importantly, how they work. Thus, the core element of the realist approach is to provide a new perspective on how intervention using a mechanism brings about outcomes that represent change. Engineering-based research can thus adopt Pawson and Tilley's approach to better understand and explore the mechanism of change in order to evaluate a project or programme.
3	**Engineering application.** Tilley (2016) developed the C–M–O model to assess how it can be used by engineers to improve their decision making for policy and project decisions.	As a proponent of realism, Tilley argues for a pragmatic approach in engineering to be adopted for its evaluations. The research adapts the C–M–O model to the EMMIEI approach that includes Effects, Mechanism, Moderator (or context), Implementation and Economic Impact. Importantly, the differences between engineering physical worlds and the social world are recognised, but it is suggested that both benefit from a pragmatic research strategy. This is helpful for the measurement of SDGs because it gives confidence of relevance to the engineering domain of using the C–M–O configuration.
4	**Engineering application.** Horrocks and Budd (2015) used the C–M–O structure to evaluate a European e-services systems engineering project to establish the outcomes and understand the why, for whom, and how?	The project evaluation of 'e-government for You' used the theory-driven evaluation approach based on the C–M–O model to enhance the focus and granularity for their study. This supports the usage of the C–M–O model for SDG measurement because it allows for the mixed-method approach and structures the analysis framework in a readily understood causal chain.
5	**Construction project application.** Peters et al. (2013) examined Critical Realism evaluation models to study business networks. They used a UK construction project to explore the managerial phenomenon, specifically the practice of novation in temporary organisational networks.	The origins of the C–M–O model are from the Critical Realism traditions, and therefore, the Peters et al. (2013) article provides a useful insight into the approach that a strongly theoretical lens can use when applied to the ground level of a local construction project. This helps shape the SDG approach by giving confidence that the 'realistic learning' from the Peters study can be replicated for SDGs.

Table 1. *Cont.*

#	C–M–O Configuration Reference	How Might the Insights Inform Engineering Project SDG Measurement Analysis?
6	**Construction project application.** Poirier et al. (2016) evaluated the use of a Critical Realism lens to assess the delivery of building projects in the architecture, engineering and construction (AEC) sector. They evaluated how collaboration can improve performance and value across five core entities, namely process, structures, agents, artefacts and context.	There are strong parallels of the study into the AEC's value derived from collaboration in project delivery. The relevance to the C–M–O approach is that they both derive from the critical realism tradition and seek to understand causal patterns and assess what are the outcomes of employing a specific mechanism within a given context. In particular, the study highlights how the learnings can be structured in a way that is most readily understood by practitioners in an area of great complexity.
7	**Multi-sector application.** Although Bergeron and Gaboury (2020) come from a clinical care perspective, their recent study highlights some of the challenges of using the C–M–O framework that has relevance to all disciplines and sectors that use its causal framework. Further challenges were also identified in the article described below, by Crosthwaite.	There are a number of methodological challenges that are identified and should be noted by engineering researchers using this approach. Solutions to the analytic difficulties are shared that can help the identification of patterns and assist the researcher to maintain transparency in the analytical process, thus strengthening the ability to make generalisations.
8	**Education application.** Crosthwaite et al. (2012) used the C–M–O approach to understand the educational impacts of the 'Engineers without Borders' in Australia and New Zealand.	While not focused on an engineering project, this article highlights the use of the model in the education sector to evaluate the causal impact based on the identification of specific issues within the C–M–O framework. In regard to the SDG approach, there is value in combining the qualitative and quantitative approaches to improve the understand the observed outcomes.
9	**Health system application.** Greenhalgh et al. (2009) used the C–M–O method to evaluate a health system. This wide-ranging analysis of a systems transformation environment sought to understand the reasons for how and why the outcomes were achieved.	The broad nature of evaluating organisational systemic transformation has similarities of complexity with research into the measurement of SDG impacts at project and organisational level. The simpler C–M–O approach offers a means to help explain causal effects more simply, and this has benefits for both research and practitioners.
10	**Projects application.** Berge (2017) used a realist evaluation approach on a Norwegian telecare project. While the study has a clinical orientation, its project approach is instructive.	Realist evaluation is used to scrutinize what it is about the telecare system that works for whom, why, how, and in which circumstances. The study provides a more nuanced approach.

3.2. The Survey

The survey approach to data gathering was selected because it is recognised (Lenth 2001) as one of the most important methods in applied social science. This approach, shown in Table 2, enabled a rapid and cost-effective way to assess a statistically significant group of engineering project managers' perceptions of the relative importance and current capability for measuring SDG impacts on their projects. The participants were all members of the UK's leading civil engineering professional society, the Institution of Civil Engineers (ICE) who sanctioned the survey and provided access to their members' contact details. A benefit of using this style of survey approach is that it delivered both qualitative research outputs, by using open-ended questions that captured text-based commentary and quantitative research outputs, by using a Likert scoring mechanism aligned to the questions. The eight-step model used to structure the survey is described below in Table 2.

The questions (shown in Figure 5 and Appendix A) were structured to measure attitudes in relation to the research question. The questions focused on three areas: the perceived value and importance of measuring SDGs on their projects (i.e., the outcomes); their current approach and capability (i.e., the mechanism), such as skills, tools, processes, structures and methods (Astbury and Leeuw 2010, p. 386); and their identification of the challenges and opportunities (i.e., the context) of measuring projects' SDG impact. SurveyMonkey © was chosen as the web-enabled survey tool because it was highly customisable and provided a comprehensive set of back-end capabilities, such as data analysis and visual representation tools, that helped present the data in a concise and informative manner.

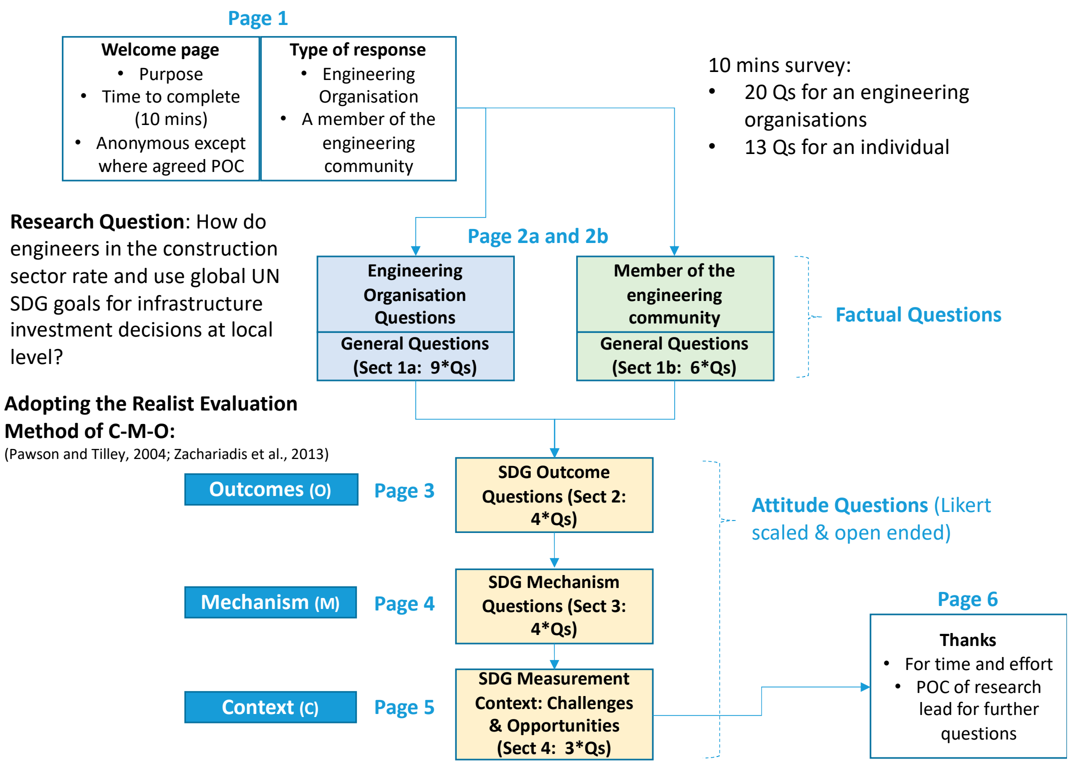


Figure 5. Survey Questions Sequence; adopting Realist Evaluation methodology of Context-Mechanism -Outcomes (Pawson et al. 2005; Zachariadis et al. 2013). (See Appendix A for the full table of questions).

Table 2. Analysis method adopted (adapted from: Creswell and Creswell 2017; Nardi 2015).

Survey Design and Analysis Methods		
1	Problem specification and Research Question	As captured in the introduction paragraph of this paper; formulation of problem and objectives.
2	Population Definition	With support from the Institution of Civil Engineers (ICE); seeking a representative sample from across the engineering community.
3	Selection of Mode	Use of Survey Monkey © software tool—for design and running of survey data collection. It also provided statistical analysis, supported by SPSS.
4	Design Instrument	Identify types of questions aligned to the Realist Evaluation C–M–O approach; draft of the expected results to assess whether the design would achieve the outcomes; draft the questions on Likert scale; use closed and open questions selectively; test the approach with experts.
5	Specify and Test Procedure	Build the logic framework in the tool and run a pilot to test the success.
6	Data Collection	ICE distributes the survey to 1500 of its members; 325 complete the survey, ca. 20% response rate, providing representative sample.
7	Analysis	Analysis completed in four stages of diagnostic analysis: **Stage 1**: Download all data (quantitative and qualitative) in MS Excel™; remove erroneous and false data, e.g., delete test data from the pilot. Structure data for analysis—e.g., charts and graphs to visualize data. **Stage 2**: Use software tool on survey monkey and SPSS to analyse the data's statistical significance; identify patterns and gaps/overlaps against research question's objectives. **Stage 3**: Analyse data touch points (using C–M–O coding) and correlate findings to the original research question and the C–M–O model. Complete initial write-up for review. **Stage 4**: Share data findings with expert panel (of 12 qualified engineers) organised by the ICE; test the findings; keep integrity of the data but use expert panel to assess the implications and possible next steps. For example, the panel suggested that the low level of organisational responses could be addressed in the interview stage of the research. (Note: The three separate workshops were recorded, but they have not been included in this article.)
8	Reporting	**Step 1**: Build the data charts that illustrate the findings. **Step 2**: Write up the findings: test and adjust to ensure recommendations and conclusions are consistent with original research question; identify lessons and insights that inform the next stage of research—the 40 interviews.

The tool also provided guidance on bias-elimination and sample-selection best practice. This enabled a structured approach for presenting the questions, which were designed to capture the required data, which at its core, sought to establish whether this research area was of perceived importance to practising professionals, and if it was of high importance, was there a gap between the import of measuring SDG impact versus their capability to do so? It achieved this by using both open-ended and closed questions within a clear structure that explored firstly broader and secondly, more specific areas and concepts within the research areas. The survey was sent to participants by the UK's leading civil engineering institution, the ICE, thereby providing reassurance to the participants since they would recognise the institution's name and logo, which would be likely to increase the response rate. Data protection methods fulfilled ethical and legal data management requirements, including GDPR (general data protection regulation). For example, by sending the survey from the engineering institution to their members, the approach conformed with the members' original opt-in agreement to receive similar knowledge-sharing initiatives.

3.3. Access

The survey aimed to access between 200–300 qualified engineers. In actuality, the Institution of Civil Engineers' communications team selected a random representative distribution of its members, aiming to achieve ca. 20% of a total number of 1500 targeted participants. Since the respondents voluntarily opted in, this was considered a non-probability sample, which Tansey (2007) suggests is preferable to identify what he terms 'elite interview subjects' in order to avoid the randomness of generic sampling. The response rate of 325 completed surveys was relatively high by the ICE's previous experience of surveys, typically achieving only 5% to 30% responses, the latter higher response rates being due to well-publicised events, such as committee elections. In this case, the ICE only sent a single email without any follow-ups; therefore, the response rate was considered good. The ICE also confirmed that the sub-set of the 325 respondents from the 1500 targeted participants was representative of the wider membership population (of 6500) because it included a sample selection across all experience levels, from student to engineers with over 20 years of experience, and this added to the statistical validity of the sample.

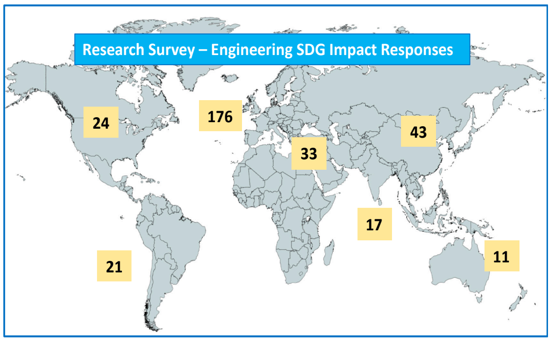
The questionnaire included a question on demographics designed to distinguish between the generations and, more specifically, capture the responses of millennials (i.e., people born between 1983 and 2000) (US Public Interest Research Group 2016; Howe and Strauss 1991) who, according to the U.S. Bureau of Labor Statistics (Labor 2017), within the next two years, will reflect 50% of the US workforce, growing to 75% by 2030. The millennials can be viewed as the generation who are rapidly becoming the organisational leaders and already acting as policy shapers (Baird 2015), which is relevant to this study as they will increasingly be owning the selection and reporting of SDG priorities on their projects.

4. Data Analysis and Results

4.1. Descriptive Statistics

Using an anonymous data collection approach, 325 survey responses were received during June 2018, 24 of which were corporate responses, with an average completion time of 7 min. There was a minimum of 159 answers for each survey response from individuals. From the 301 responses from individuals, 81% (243) were from qualified engineers, of which 45% had over 20 years of experience. When all the years of experience were added together, it provided a cumulative total of 3628 years of professional engineering expertise, not including the non-engineers, which covered professions ranging from lawyers and investment specialists to academics. This indicates that although the total number of survey respondents was limited to the 325, it did include a high level of expertise that adds to the weight and power and thus validity for the research findings (Diekhoff 1992). The descriptive statistical data are shown in the tables and charts in Figure 6.

Europe	176 responses
Africa	0 responses
Middle East	33 responses
Indian Sub-continent	17 responses
Asia	43 responses
Australasia	11 responses
North America	24 responses
Latin America	21 responses

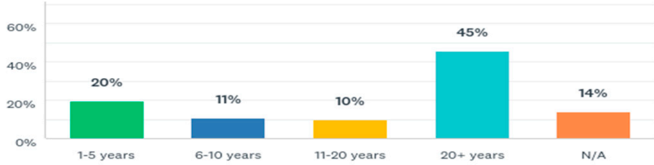


(**a**). Geographical region.

Qualified engineer	81%
Engineer working towards chartered status	4%
Student engineer	10%
Academic / educator	2%
Supply chain	0%
Related engineering business	3%

(**b**). Types of respondents.

1–5 years	20%
6–10 years	11%
11–20 years	10%
20+ years	45%
N/A	14%



(**c**). Years of experience.

Millennials	40%
Non-millennials	60%

(**d**). Percentage of Millennials reporting.

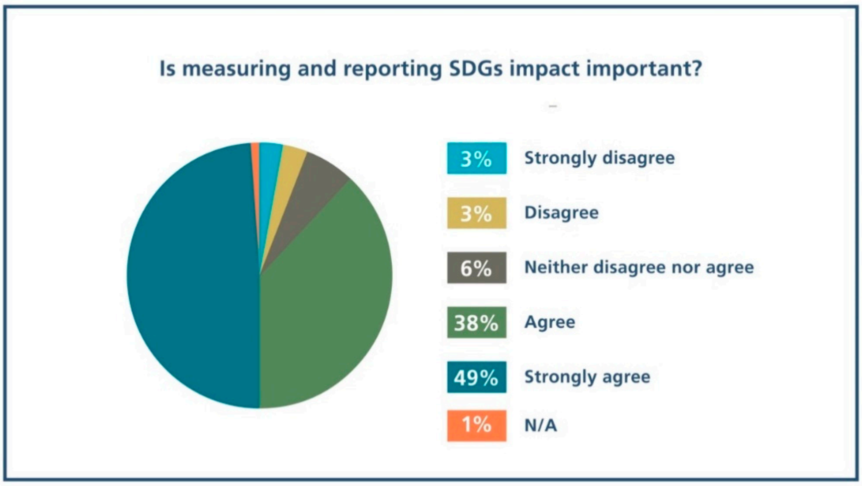
Figure 6. Statistical descriptive data from survey.

4.2. Survey Results

Responses from the survey's primary C–M–O-related questions are shown below, with summary data and supporting analysis.

4.2.1. Question 1 (Outcomes): Should Engineering Businesses Seek Ways to Measure and Report SDG Impact?

Data overview: The first set of results show that there was overwhelming agreement that it was important that engineering businesses seek ways to measure and report SDG impact. Eighty-seven per cent of respondents either agreed or agreed strongly that this was important. Millennials rated this as more important than non-millennials did (94% and 82%, respectively) (see Figure 7).



	STRONGLY DISAGREE (1)	DISAGREE (2)	NEITHER DISAGREE OR AGREE (3)	AGREE (4)	STRONGLY AGREE (5)	N/A	TOTAL	WEIGHTED AVERAGE
(no label)	3% 5	3% 5	6% 10	38% 60	49% 78	1% 1	159	4.27

BASIC STATISTICS				
Minimum	Maximum	Median	Mean	Standard Deviation
1.00	5.00	4.00	4.27	0.95

Figure 7. Response to Question 1: Should engineering businesses seek ways to measure and report SDG impact?

Relation to the research question: the data suggest that engineers rate the use of SDG for measuring impact is important, and this provides a starting point for delving deeper into the context, mechanism and outcomes issues that affect its application.

Differences analysis: there were few differences, and this strengthened the findings.

4.2.2. Question 2 (Outcomes): What Are the Top 5 SDG Goals Most Relevant to Measuring Impact of Your Infrastructure Projects and Programmes?

Data overview: The survey results showed that engineers have a strong focus on five priority SDGs (shown in Figure 8), namely SDG6 (clean water and sanitation), SDG7 (affordable and clean energy), SDG9 (industry, innovation, and infrastructure), SD11 (sustainable cities and communities) and SDG13 (climate change).

Relation to the research question: The data suggest that engineers rate the use of SDG for measuring impact is important, andcontext, mechanism and outcomes issues that affect its applicati this provides a starting point for delving deeper into the on.

Differences analysis: The results also showed that there was a marked difference in millennial responses as shown in Figure 9.

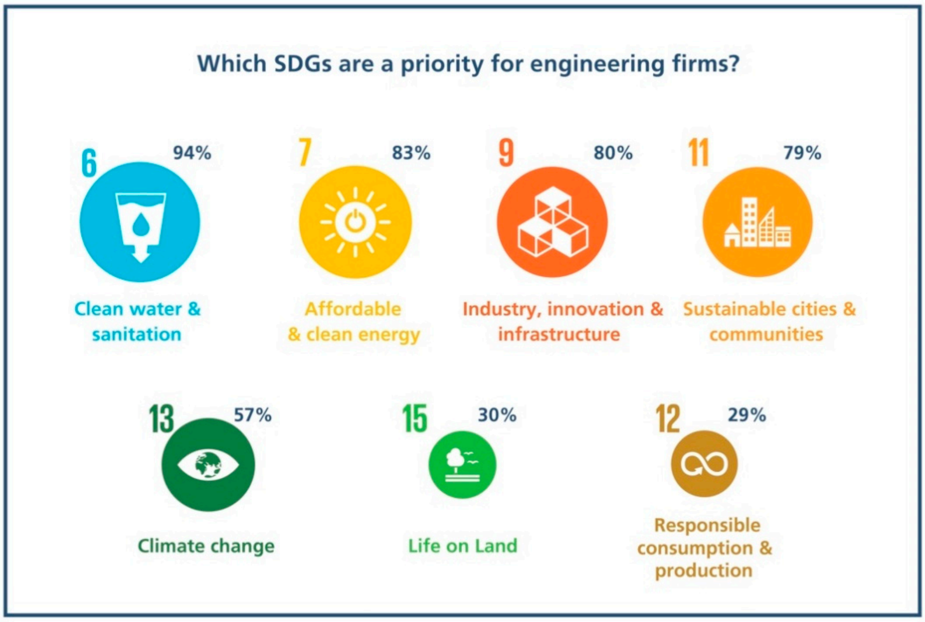


Figure 8. Responses of participants to their five top SDGs that engineering projects should measure impact against, showing the top seven list (with six and seven being significantly less popular).

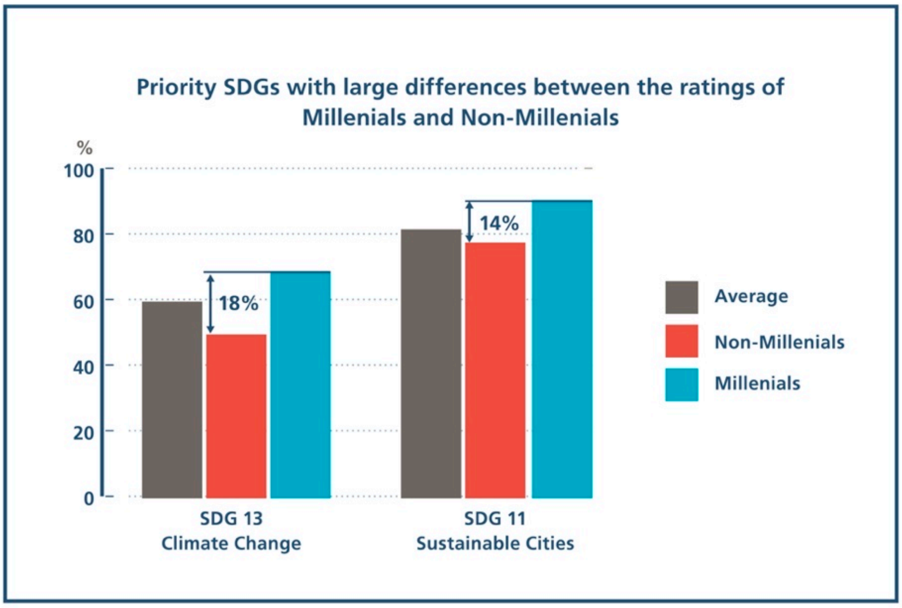
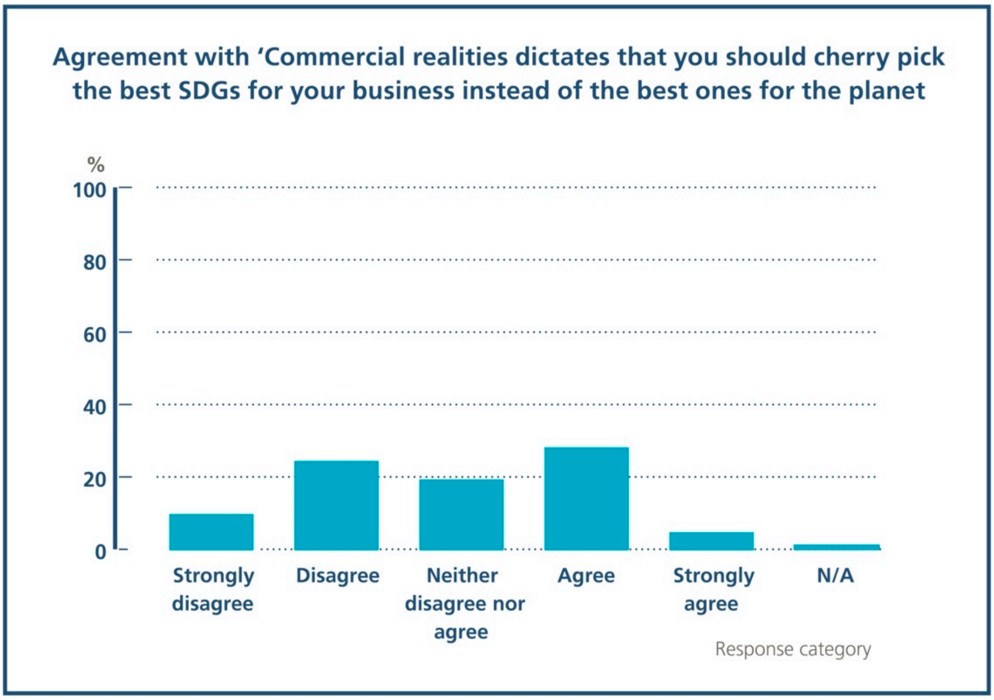


Figure 9. Preference of the SDGs 13 and 15; differentiating between millennials.

4.2.3. Question 3 (Mechanism): Do Commercial Realities Dictate the SDGs You Pick?

The next question probed the way in which commercial realities influence the selection of SDGs to measure (see Figure 10).



	STRONGLY DISAGREE (1)	DISAGREE (2)	NEITHER DISAGREE OR AGREE (3)	AGREE (4)	STRONGLY AGREE (5)	N/A	TOTAL	WEIGHTED AVERAGE
(no label)	12% 19	26% 41	21% 33	31% 50	9% 15	1% 2	160	3.01

BASIC STATISTICS				
Minimum 1.00	Maximum 5.00	Median 3.00	Mean 3.01	Standard Deviation 1.20

Figure 10. Response to Question 3: Do commercial realities dictate the SDGs you pick?

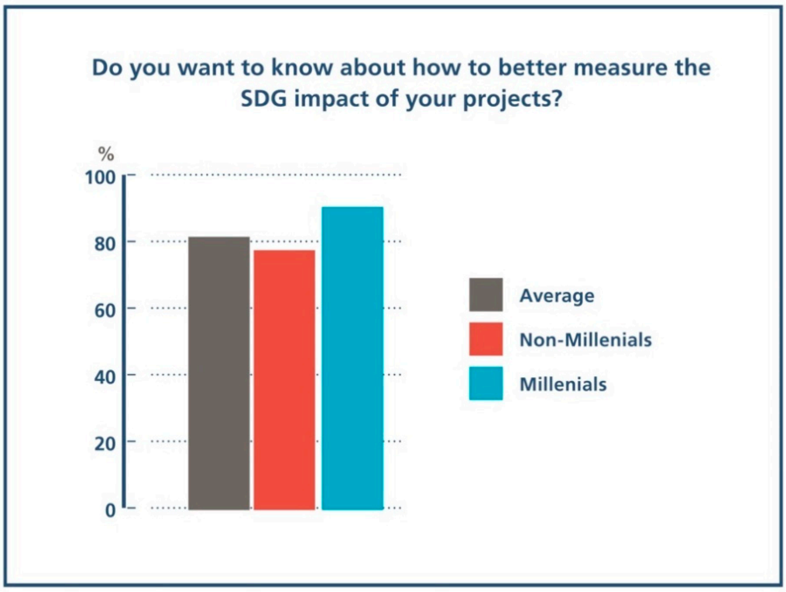
Data overview: Respondents were nearly equally split on this issue; 36% either disagreed or strongly disagreed that SDG choice was influenced by commercial realities, while 39% agreed or strongly agreed, with 21% non-committal.

Relation to the research question: The responses can be linked to the second question in Figure 1, that seeks to identify problem areas. There is evidently an issue that many engineers feel that the businesses they work for can be too commercially orientated. This is not a consistent view but potentially an area for further exploration.

Differences analysis: It is likely that the 'agree' type of responses, as well as the non-committal responses, could reflect the difficulty of interpreting the question. For example, if the respondent identified that the use of SDGs was a secondary consideration after ensuring 'business survival', they might have agreed with the proposition, whereas an alternative position might have been to suggest SDGs are good for business based on the wider 'societal shared values'.

4.2.4. Question 4 (Mechanism): Do You Want to Know more about Measuring SDG Impact on Your Projects?

Data overview: In addition, the overwhelming majority of engineers wanted to know more about how to measure SDG impact on their projects better (83% vs. 17%), especially among the millennial generation (see Figure 11).



ANSWER CHOICES	RESPONSES	
Yes (1)	83%	181
No (2)	17%	37
TOTAL		218

BASIC STATISTICS				
Minimum	Maximum	Median	Mean	Standard Deviation
1.00	2.00	1.00	1.17	0.38

Figure 11. Response to Question 4: Do you want to know more about measuring SDG impact on your projects?

Relation to the research question: this supports the rationale for deepening the research and provides a useful way to seek interviews with CEOs in the follow-on stage of this research programme.

Differences analysis: there were few differences which strengthened the findings and provided evidence for further evaluation into this area in future research.

Data overview: eighty-seven per cent of respondents either agreed or agreed strongly that this was important. Again, millennials rated this more importantly, at 94%, versus 82% for non-millennials (see Figure 11).

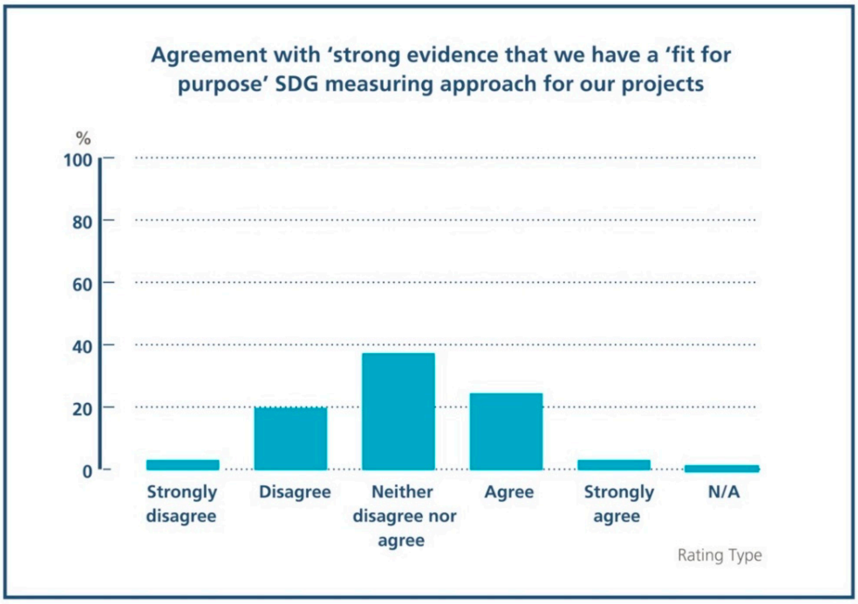
Relation to the research question: The survey respondents gave very strong support to the view that it was important that engineering businesses seek ways to measure and report SDG impact. This consolidated the views expressed in earlier questions that this was a matter of import and that they wanted to be engaged in future knowledge and learning activities. The responses would help galvanise future engagement in this research project.

Differences analysis: millennials were stronger in their responses but not at a significant level.

4.2.5. Question 5 (Mechanism): What Is the Engineers' View on Current Infrastructure Projects and Their Achievement of the SDGs?

Data overview: Only 34% of engineers believed that 'there is strong evidence that we have a "fit for purpose" SDG measuring approach to track our projects' impact on SDGs'. Thirty-seven per cent neither disagreed nor agreed, probably due to the fact that it is such a complex and difficult challenge to measure impact and to-date, the industry continues to struggle to find a practical and workable solution to this issue (Merry 2019; Fukuda-Parr and McNeill 2019).

Relation to the research question: The results reveal some areas where the current measurement of projects' SDG impact needs improvement (see Figure 12), despite the strong support for the importance of measuring and reporting SDG impact, and the clear identification of five priority SDGs for the sector.



	STRONGLY DISAGREE (1)	DISAGREE (2)	NEITHER DISAGREE OR AGREE (3)	AGREE (4)	STRONGLY AGREE (5)	N/A	TOTAL	WEIGHTED AVERAGE
(no label)	5% 8	19% 31	37% 59	27% 43	7% 12	5% 8	161	3.13

BASIC STATISTICS				
Minimum 1.00	Maximum 5.00	Median 3.00	Mean 3.13	Standard Deviation 0.99

Figure 12. Response to Question 5: Do we have a 'fit for purpose' measuring approach to track projects' SDG impact?

Differences analysis: there were significant differences but across a balanced response curve. This could be interpreted positively (only 24% did not agree) or negatively (only 34% agreed).

4.2.6. Question 6 (Context): What Are the Greatest Challenges for Measuring SDG Impact?

Data overview: The respondents to the exploratory survey said that the four greatest challenges were (see Figure 13): success definition (56%), business priorities (55%), leadership (52%) and a focus on outputs rather than outcomes (46%).

Relation to the research question: These responses address the aim to identify contextual issues (as shown in 2.2 in Figure 1). This starts to build a nodal framework for further investigation and also provides links to the 'outcomes' issues (2.4 and 2.5 of Figure 1).

Differences analysis: the four issues with the highest incidence are all within 42% to 58%. Each of the margins between the issues is 4–6%, which shows a balanced and consistent view without outliers.

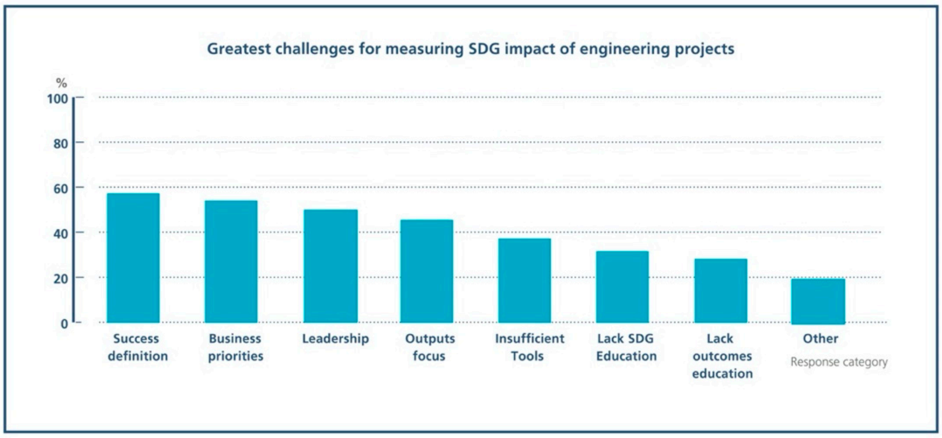


Figure 13. Responses to Question 6: What are the greatest challenges for measuring SDG impact? (See Appendix B for full data).

The four top challenges identified in the results can also be interpreted as reflecting the difficulties of integrating business needs with the SDGs in the absence of shared value business strategies, although 'success definition' could also reflect the lack of KPIs to measure SDG performance on engineering projects.

4.2.7. Question 7 (Context): How Could the Achievement of the SDGs on Future Infrastructure Projects Be Improved?

Data overview: This exploratory research shows (in Figure 14) that in terms of the greatest opportunities within engineering firms, the top four opportunities were leadership (57%), increased education and training in SDG impact skills (57%), use of a simple and widely used tool (55%) and business skills (48%).

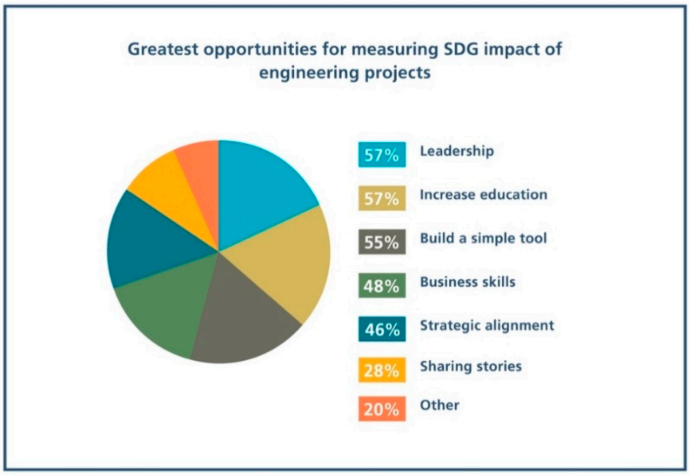


Figure 14. Responses to Question 7: What are the greatest opportunities for measuring SDG impact? (See Appendix C for full data).

The challenges were also compared to the 'opportunities' in Figure 15 to assess the respondent's understanding of whether the same themes were noted as both a challenge and an opportunity. There were data linkages between the two results, with 'leadership' and 'business skills/success definition' appearing in both of the top four responses.

From Survey: Challenges/opportunities to measuring the projects' SDG impact:

Challenges:
1. Success definition (56%),
2. Business priorities (55%),
3. Leadership (52%)
4. Focus on outputs rather than outcomes (46%)

ANSWER CHOICES	RESPONSES	
Success definition. Inconsistent definition of what defines projects' success - eg more than time, cost, scope? (1)	57%	92
Outputs/outcomes. Too much focus on outputs and not enough on outcomes and wider benefits? (2)	46%	74
Tools. Insufficient credible quantifiable measures linking project success to SDG impact? (3)	39%	62
Education. Insufficient understanding of credible quantifiable measures for reporting SDG impact? (4)	32%	52
Education. Under-investment in skills and capabilities education to support definition of outcomes? (5)	29%	47
Leadership. Without sufficient leadership to drive focus on the SDGs. (6)	52%	83
Business Priorities. That business priorities get in the way of seeking SDG outcomes. (7)	55%	89
Other (please specify) (8)	18%	29
Total Respondents: 161		

BASIC STATISTICS				
Minimum	Maximum	Median	Mean	Standard Deviation
1.00	8.00	4.00	4.21	2.31

Opportunities
1. Leadership (57%)
2. Increase education and training in SDG impact skills (57%),
3. Build a simple tool (55%)
4. Business skills (48%).

ANSWER CHOICES	RESPONSES	
Strategic alignment. Using the GEC opportunity to build alignment on how our community demonstrates impact. (1)	46%	73
Sharing stories. Use video platforms and Apps to enable rapid sharing of SDG impact stories. (2)	36%	57
Build a simple Tool. Develop a credible quantifiable measurement linking project success to SDG impact. (3)	55%	88
Education. Increase training and education as a student and as Career Professional Development in SDG Impact skills. (4)	57%	91
Business Skills. Investment in developing business skills that reflects commercial realities and the SDG Impact? (5)	48%	77
Leadership. Leadership increases drive and support for demonstrating SDG impact. (6)	57%	90
Other (please specify) (7)	16%	26
Total Respondents: 159		

BASIC STATISTICS				
Minimum	Maximum	Median	Mean	Standard Deviation
1.00	7.00	4.00	3.83	1.80

Figure 15. Responses to Question 6 (opportunities) and 7 (challenges) for measuring SDG impact? (See Appendix B for full data).

4.3. Inferential Statistics

Chi-Square analysis provided a *p*-value between 0.001 and 0.132 (see Appendix C). Therefore, the statistical validation was not found to be consistent, and as such, the findings should be viewed as an indicator of where further research can be focused. However, the survey has been followed by 40 interviews with CEOs and Heads of Sustainability, and while analysis of this data remains underway, it provides increased confidence that there is a gap between current practices and engineers' strong desire to improve how sustainability is addressed in the context of infrastructure projects.

5. Discussion, Framework Development and Policy Implications

The survey has captured engineers' views on the measurement of SDG impact on projects. Therefore, it has provided an individualistic and rich perspective on the views of engineers on the importance of SDG measurement. The survey also specifically examined the mechanism and context of SDG measurement to identify strengths and weaknesses of employing such an approach. In doing so, the survey identified that the overwhelming majority (87%) of engineers surveyed have a strong appetite for action on the SDGs. From the engineers surveyed, millennial engineers are 15–20% more likely than non-millennials to want to work on projects that deliver according to the SDGs. However, this strong focus and desire, almost commitment, to the SDGs and their materialisation was accompanied by an equally strong frustration with the lack of solutions that are fit for purpose and currently available for use in industry.

5.1. Analysis of Results and Development of a Future Research Model

The survey highlighted four critical success factors to improve the effectiveness of SDG measurement at the sub-national levels: (1) tools and methods, (2) suitable training geared towards an understanding of the SDGs, (3) definition of business success that differentiates between outputs and outcomes, and finally, (4) the most frequently identified success factor was the leadership and governance tailored to driving change under the SDG framework. This led to eight core themes that emerged from the results, which are discussed within the three categories of Context, Mechanism and Outcomes, consistent with the C–M–O Realist Evaluation approach in Figure 4 (Zachariadis et al. 2013). The first category of *Context* had four emergent themes: (C1) leadership and governance, (C2) business skills for engineers, (C3)performance measurement tools, and (C4) millennials. The second category of *Mechanism* had three emergent themes: (M1) prioritisation of SDGs and (M2) adapting to levels of portfolio–programme–project (P3M) complexity. The third category was *Outcomes*, which had two themes: (O1) outputs versus outcomes as definition of project success and (O2) adopting a Creating Shared Value approach using the Theory of Change and the Triple Bottom Line.

5.2. Context

5.2.1. Leadership—Governance (C1)

Unsurprisingly, leadership was identified as a dominant contextual issue in the measurement of SDG impacts at organisational and project levels. Whilst the results from the engineers' survey are insightful, the data need triangulation by seeking the senior leaders' attitudes in the follow-on interview stage of this research. This will capture views of 40 CEOs and senior executives to gain an organisational perspective on the dominant contextual issues. It is expected that leadership will be a prominent theme because of its role in transformation, which lies at the core of adopting the SDG lens to measure business and project success.

As Metcalf and Benn noted (2013), leadership is a well-recognised success factor in the implementation of sustainability and CSR in businesses. The SDGs have similar complexity patterns to sustainability, with an equal need for adaptive systems that place an extraordinary demand on leaders (Metcalf and Benn 2013). These leaders need the skill sets that can balance the complexities of achieving the economic business success of profitability with the increasing demands on co-balancing with environmental and social objectives. The visionary leaders will be the ones that harness the CSV mindset and then can empower and align their organisations with the people, profit and planet thematics of TBL, thinking and acting within 'systems of systems' models that seek innovative solutions to the SDG challenges (Fullan 2005).

5.2.2. Business Skills for Engineers (C2)

Following on from the previous theme of defining success through outcomes and not just through the traditional outputs of time, cost and scope (and quality), the survey results also indicated the need to build capability and capacity amongst engineers. This complements the work by Zahra et al. (2006) into entrepreneurship and dynamic capabilities needed of engineers beyond their traditional technical expertise. Others (Armanios et al. 2017) propose that the broadening of skill sets to include business skills of innovation and definition of broader TBL success will play a more dominant part of the education and learning syllabus in future. In this regard, it was suggested by a number of respondents that embedding business skills learning within core engineering educational programmes would help provide opportunities for meaningful improvements in the measurement of SDG performance on projects.

5.2.3. Measurement Tools and Processes (Methodologies) (C3)

There are many authors that recognise the need for using benefits and impact performance measurement to ensure strategic plans are delivered effectively and efficiently (Micheli and Manzoni 2010; Prasad et al. 2003). The survey responses also showed that there is significant room for improvement on availability of 'fit for purpose' engineering tools and methodologies to measure SDGs. These results highlight the need for a new simple tool (such as a set of KPIs linked to the SDG indicators) developed with a global sustainability body, such as the Global Reporting Initiative (GRI). This might allow the engineering community to align projects' SDG reporting with the growing trend of using global standards to report sustainability, with 93% of the world's largest 250 corporations reporting on their sustainability performance in 2018 and 82% (Global Reporting Initiative 2016) of these using GRI Sustainability Reporting Guidelines to do so.

5.2.4. Millennials (C4)

In addressing the research question on engineers' use and rating of SDG measurement at local levels, a further investigation was carried out to explore potential differences between millennials and others. In a highly encouraging note, the survey results indicate that millennial engineers are 15–20% more likely than non-millennials to want to work on projects that deliver the SDGs. This is a key insight for engineering business leaders to take note of (such as CEOs and other managers) because in the UK alone, 50,000 engineers (all forms) will have to be recruited per year until 2022 to meet the projected level of demand for qualified engineers (Institution of Civil Engineers 2018). These talent management priorities will be important to business resilience in the near future. Indeed, the identified lack of alignment between millennials' perceptions of businesses' motivations balanced against their own imperatives is typically shown in their allegiance to employers (Deloitte 2018b). Simply stated, if businesses do not make a greater effort to demonstrate their ability to create shared value that achieves financial, but also environmental and social, outcomes, then it will not engender loyalty. In turn, this may result in higher staff turnover, thereby damaging its business interests as well as negatively impacting the projects' delivery of SDGs.

The survey results are further evidenced by a report from Deloitte (2018a) on findings from over 10,000 millennials. The Deloitte (2018b) survey indicated a distinct, negative shift in millennials' attitudes on CEO's and business' motivations and ethics. Today, less than half of millennials believe businesses operate ethically (48% balanced against 65% in 2017) as well as a drop in the number of them that believe that CEOs are committed to supporting society (47% balanced against 62% in 2017). This highlights that there is a significant mismatch between what millennials define as responsible organisations and the people that lead them, in terms of what responsible businesses should aspire to achieve. The message is clear that millennials want business leaders to be proactive about making a positive impact on society. Measuring projects' SDG impact is a way to do this.

5.3. Mechanism

5.3.1. Prioritisation of SDGs (M1)

The survey highlighted a clear preference for measuring just five SDG goals (there was a 50% reduction in the preferences for the next two SDG goals). This indicated a long tail of ten further goals that did not appear to resonate with participants. The literature review also noted that there is a growing body of evidence (Allen et al. 2019; Bali Swain and Yang-Wallentin 2020; Jones and Comfort 2020) that suggests that the complexity of the 17 Goals and the 169 targets needs to be simplified and a reduced selection prioritised for measurement. Combined, the findings from the survey on the top five SDGs and the complexity noted in the literature review is consistent with the advice given by the UN

Global Compact in their proposed methodology (Global Reporting Initiative 2015). This indicates an important area for further research to assess how this simplification can be achieved at organisational and project levels.

5.3.2. Organisational, Portfolio, Programme and Project (P3M) Complexity (M2)

The survey questions did not specifically address the separate levels of organisations and projects, which in the project management discipline, is referred to as portfolio–programme–project management (P3M) levels. This becomes important in the development of a prototype since the measurement of SDGs at the enterprise level (the portfolio) will likely be different from that at programme and project levels. This requires further research. The non-response error, noted in Section 3.3, highlighted that the survey of organisational level had not achieved its objectives and that this should be addressed in the next research stage of the forty interviews, which will introduce the wider issues of the P3M structure.

5.4. Outcomes

5.4.1. Defining Success—Outputs Versus Outcome (O1)

The survey showed that engineers agreed that too often, projects define success by traditional outputs using the so-called 'iron triangle' of time/cost/scope (and quality) dimensions to deliver on the SDG goals. Instead, the majority of survey respondents agreed that the engineering and project management communities need to place a greater emphasis on the achievement of long-term outcomes and a corresponding broader definition of success.

5.4.2. Creating Shared Value using Theory of Change and Triple Bottom Line (O2)

As noted above (Section 5.4.1), the survey showed that many engineers agreed that the choice of SDG goals and targets should be primarily selected on the basis of business profitability. This is counter to CSV and TBL. As a result, the longer-term value of making investment decisions based on broader TBL principles could be weakened. It is therefore proposed that the next research stage, to inform the development of the prototype, investigates how the TBL could be integrated with the measurement of SDGs.

5.5. Development of Conceptual Framework for Measuring the SDG Performance of Infrastructure Projects

The identification of the four *context* issues discussed in Section 5.2 above offers insights into the situational effects on the likely success of the *mechanism*. Stated slightly differently, for the measurement of SDG impacts to deliver the *outcomes* expected, the contextual situation needs to be appropriate. For example, without the requisite organisational leadership inter- and intra-businesses, from the government as well as executives, the measurement of SDGs will not be successful. This survey therefore informs the next stage of the Sequential Explanatory Design (Creswell and Creswell 2017), shown in Figure 16, that involves interviews of forty senior executives. It is proposed to deepen the exploration of the four *context* issues by using a nodal coding system (Creswell and Creswell 2017) for the interviews. This will strengthen the analysis and, combined with the literature review to enable the triangulation of data, will enable the development of a robust prototype to test the approach with practitioners.

Four of the mechanism and outcome C–M–O themes, noted in Sections 5.3 and 5.4, are further explored below in Table 3 to identify themes that can be included in future research. As a deduction, it is posited that the shared value approach aligns individual business priorities of specific firms with sustainable development imperatives. Consequently, adopting an enhanced SDG measurement approach is capable of releasing the energies of businesses to pursue competitive advantage and the SDGs through integrated business strategies. As a way of summarising the conceptual development of a prototype SDG measurement model, based on the survey findings presented in this study, a tabulated compendium is shown below that includes some exploratory questions, with derived assumptions and supporting literature references.

Table 3. Summary of conceptual development of a future prototype model for SDG measurement, based on the survey results in this study, including questions & sub-questions, supporting literature and corresponding concepts.

C–M–O Future Research Focus	Assumptions Derived from Stage 1 Research	Supporting Literature	Questions for Next Stage of Research
Prioritisation of SDGs (M1)	**Assumptions:** 1. Only a small proportion of the 1554 SDG indicators are currently being measured at the project level, and consequently, there is a large gap between global definitions of SDG objectives and project-level definitions of action. 2. The evidence of the difficulty to use the existing 169 targets and 232 indicators suggests that the derived model should recognise that a contextual perspective needs to be adopted to keep it simple for practitioners who are already heavily committed to other performance measurement frameworks.	(Klopp and Petretta 2017; Donohue et al. 2016; Nerini et al. 2018; Allen et al. 2016; IPCC 2018; Swain 2018; United Nations 2018; Hall et al. 2016; Martens and Carvalho 2016)	**Q1**: How can a simplified selection of goals and targets be identified at organisational and project levels?
Organisational P3M Complexity and Sustainability (M2)	**Assumptions:** 1. Measurement of SDG performance should accommodate the required different organisational levels, namely portfolio, programme and project levels. 2. That existing sustainability measurement at organisational and project levels is well established, and therefore, SDG measurement should be aligned to existing successful approaches, not created as an 'add-on' (i.e., the organisational level will likely have different SDG imperatives and reporting requirements, such as using the GRI, from the project level, which might have limited capability and capacity to track too many targets and indicators.)	(Morris 2013; Cooke-Davies 2007; Morris 2017); NAO Report Projects (National Audit Office 2005); (Silvius and Schipper 2014; Silvius et al. 2017; Martens and Carvalho 2016; Økland 2015; Silvius and Schipper 2014; Association for Project Management 2019; Sawaf and Gabrielle 2014; Schaltegger and Burritt 2000; Eccles and Krzus 2010; Bonini and Emerson 2005; Bugg-Levine and Emerson 2011; Preston 2012; Malhi et al. 2009; Suess 1980; Tilt 2009; Perrini and Tencati 2006; Kaplan and Norton 1996)	**Q2**: Can a measurement system be designed to address different P3M levels? **Q3**: Can an MREL (monitoring, reporting, evaluation and learning) learning loop be established that is suitable for each of the levels from organisational level to portfolio, programme and project levels? **Q4**: What existing sustainability measurement systems are used at project (e.g., CEEQUAL) and organisational (e.g., Global Reporting System) levels, and how might they be used to align with SDG measurement?

Table 3. *Cont.*

C–M–O Future Research Focus	Assumptions Derived from Stage 1 Research	Supporting Literature	Questions for Next Stage of Research
Defining Success—Outputs Versus Outcome (O1)	**Assumptions:** 1. Measurement of SDG performance should be viewed from a systemic perspective and thereby move beyond the traditional 'iron triangle' view of projects in the short term (i.e., according to schedule, budget, scope and quality performance) and additionally, take account of longer-term project outcomes and impacts. 2. The model should harness the core concepts of the Theory of Change and the Logic Model, with their focus on outcomes measurement, including the analysis of causal linkages, engagement of stakeholders and strategic design with the 'ends' being the starting point for a right to left causal mapping.	**Theory of Change and Logic Model**: Stein and Valters 2012; Weiss 1995; **Project Success**: Thiry 2004; Themistocleous and Themistocleous and Wearne 2000	**Q5**: Can the existing causal value chain of the benefits approach (from project inputs through activities, outputs, outcomes and impacts) be used to build a commonly understood view of what future SDG measurement success looks like?
Creating Shared Value using Triple Bottom Line (O2)	**Assumptions:** 1. Measurement of SDG performance should accommodate the perspective of Creating Shared Value (CSV) (i.e., seeking solutions that are good for business in the short and longer term through balance of profit–planet–people objectives). 2. Measurement of SDG performance should accommodate the perspective of the Triple Bottom Line (i.e., social, environmental and economic performance). This will drive a broader definition of project sustainability that includes the three pillars (i.e., social, environmental and economic performance). It provides simplicity and structure for the analysis in regard to selecting and measuring SDGs.	**Creating Shared Value**: (Porter and Kramer 2011; Elkington 1994, 2018; Organisation for Economic Co-Operation and Development OECD; United Nations 2018); **Triple Bottom Line**: (Elkington 1994, 2018; Griggs et al. 2013)	**Q6**: Can the prototype model include the TBL 'golden thread' to establish a pathway through the project SDG measurement in a way that practitioners can use effectively and efficiently? **Q7**: Is the concept of CSV recognised and valued by executives, and does it offer a route to integrated SDG measurement?

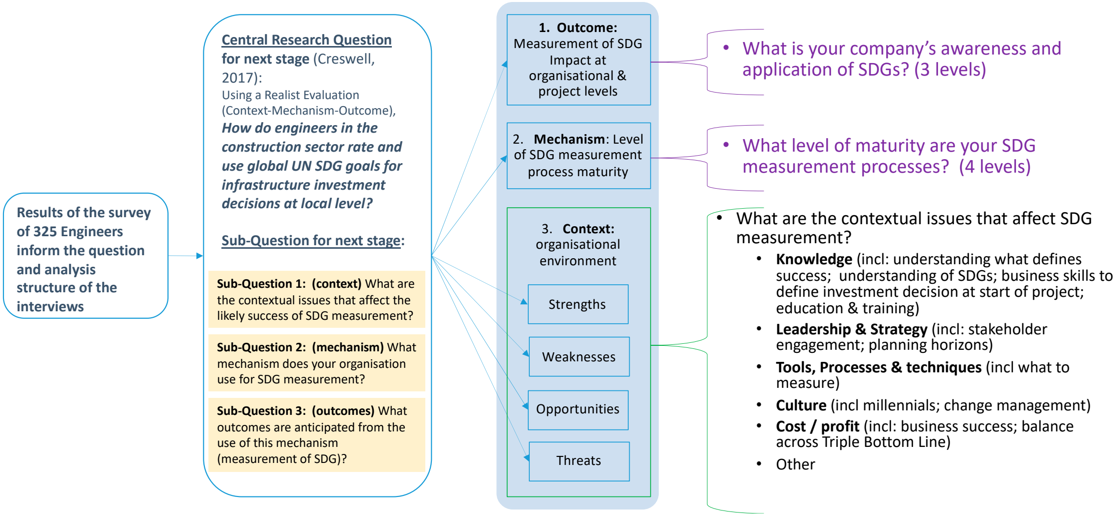


Figure 16. Proposed nodal evaluation framework for sequential explanatory design of the next stage—the semi-structured interviews of forty executives.

The eight emergent themes discussed earlier, which informed the identification of the seven questions shown above in Table 3, have been further developed into a conceptual framework for future research, shown in Figure 17 below.

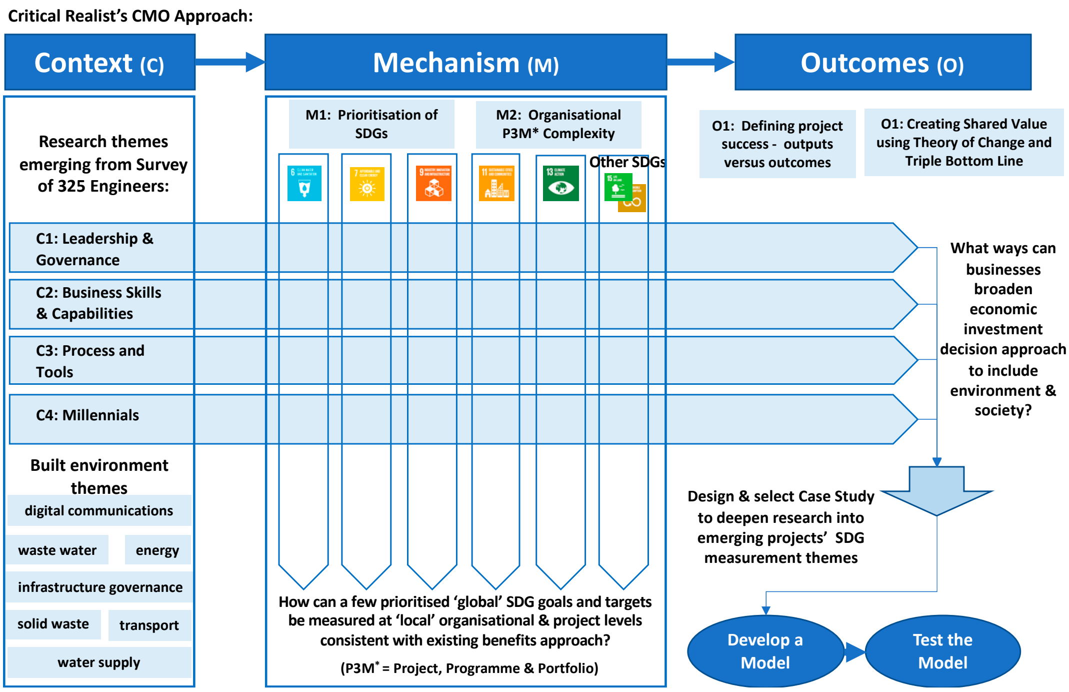


Figure 17. Conceptual framework for next phase of research using the critical realist Context–Mechanism–Outcome Approach for future qualitative investigation of forty senior executive interviews.

5.6. Policy Implications

This paper has evaluated the potential of linking the SDG global level goals to the local level delivery on infrastructure projects. The survey has provided an individualistic view on what is important but has not given an authoritative organisational view. Despite not having the organisational perspective, there are some important implications that can affect the design of policies aimed at achieving sustainable development. These need further research but are summarised at a high level in Table 4 below.

Table 4. Policy implications of research.

No.	Policy Area	Research Implications Affecting Policy Design
1	Harnessing the power of millennials to drive the SDG and climate change agenda.	• The survey highlights the appetite and demand for change in the improved and increased pace of response to the SDG agenda. This needs to be acknowledged and harnessed, using the power of the Greta Thunberg-generation to drive action.
2	Redefining success	• Governments often use financial-centric models and methods to make return-on-investment decisions when deciding on infrastructure investments. The research indicates that this needs to be broadened to include a balance with environmental and social factors. • Policy should be reviewed on what outcomes define success and which should be longer-term and incorporate SDG impacts at the local and organisational level.
3	Engineering organisational and project context—designing measuring mechanisms that work	• What tools, processes and systems are needed to support policy? For example, whilst many nations are setting Net Zero targets (e.g., UK in 2050), there are insufficient tools, systems or processes to measure this in a consistent way. • The research indicates that more education is needed in understanding projects' outcomes–benefits management and how this might affect the successful measurement of SDGs on projects.
4	MREL—Monitoring, reporting, evaluation and learning	• What are the core characteristics of monitoring, reporting, evaluation and learning (MREL) as defined by leading global organisations such as the OECD (Organisation for Economic Co-operation and Development) and the World Bank, and how might these be applied for MREL of SDGs at project level?

A potential limitation of the study may have emerged as originally the survey was intended to capture attitudes of both individual engineers as well as organisations. However, this was not successful because respondents were unable (with only five exceptions) to provide an authoritative organisational perspective. This was a form of non-response error (Singleton and Straits 2010), and the strategy to reduce this error was to firstly diagnose the problem and then find ways to mitigate the error. The reasons given when the researcher followed up with a few known participants who had waivered their anonymity and volunteered their feedback was that no official statement would be given by large organisations on a survey without having secured senior leadership sanction. These organisations were later approached at the interview stage of the research study (not included in this paper), which involved CEOs and Heads of Sustainability who had the authority to provide a corporate statement on their organisations' SDG measurement strategy. Singleton and Straits (2010) highlight the need for self-awareness of bias when using surveys and actively address these from the start. As an example, as shown in Table 2, the survey approach addressed four known biases: (1) asking the wrong question, which was addressed by testing the questions in a pilot stage and getting feedback and adapting where necessary; (2) surveying an inadequate sample, which was addressed by partnering with the ICE to benefit from a defined group of engineers (they were all active members of a global standards body), although 'opting-in' meant that the sample was potentially biased in favour of the survey due to participants being more aware of sustainable development; (3) the single nature of the survey format did not allow for a free-flowing of ideas, and the time restraint of making it quick to entice busy professionals to be part of the survey meant it lacked the depth of separate interviews. This was balanced by having a follow-on phase of 40 interviews with construction company CEOs; (4) misrepresenting the data results, which was addressed by having forums hosted at the ICE to share back the findings in discussions (as described in Stage 4 of the Analysis phase in Table 2). This feedback was used to shape the design requirements of the follow-on interviews.

6. Conclusions and Future Work

This paper started from the premise that there is a problem with linking the SDG global-level goals to the local-level delivery on infrastructure projects. This potentially manifests in poorer investment decisions on infrastructure projects because they are too often based on purely financial return on investment (RoI) instead of a broader set of criteria across the TBL of economic, environment and society. In order to explore the identified gap in the literature, the research adopted a mixed-method approach of a Sequential Explanatory Design (Creswell and Creswell 2017). This paper addresses the first stage, a survey of 325 engineers, to answer the research question of *How do engineers in the construction sector rate and use global UN SDG goals for infrastructure investment decisions at local level?* To derive the answer, it used the Realist Evaluation methodology of the Context–Mechanism–Outcomes model (Pawson and Tilley 1997) to structure and evaluate practitioners' views on using SDGs to measure local success.

The literature review analysed whether the CSR approach to governance and project decision-making is sufficient to ensure infrastructure projects' investments maximise their positive impacts on the UN SDG 2030 targets. The study suggests that the scale and urgency of the SDG challenge necessitate radical rethinking at the project delivery level, where the majority of the SDG targets are delivered. Consequently, CSR requires updating by placing socially aware priorities, such as the SDGs, at the heart of core business thinking and strategies. CSV was offered as a theoretical model to do this, but it requires practical engagement to implement CSV's ambitions. In particular, CSV is dependent on businesses ensuring that there are four key success criteria in place: the leadership, tools, business skills and a common understanding of the broader definition of success beyond the 'iron triangle' of time, cost and scope.

Despite limitation of the sample (all 325 ICE members 'opted-in', inferring interest), the results of the survey show that the vast majority (87%) of engineers surveyed have a strong appetite for action on the SDGs. From the engineers surveyed, millennial engineers are 15–20% more likely than non-millennials to want to work on projects that deliver the SDGs. However, this strong focus and desire, almost commitment, to the SDGs and their materialisation was accompanied by a strong frustration with the lack of solutions that are fit for purpose. This research identifies that there is a gap between their perceived importance of measuring SDG impact, contrasted with their current capabilities (such as skills, knowledge, leadership, tools and approaches) to do so.

The limitations of this exploratory research are that it has not provided definitive findings from the perspective of organisations. However, it has helped to narrow the scope of future research by establishing priorities for future research and sign-post for further analysis that deepens the research. Through use of the refined research framework developed in this paper, with key assumptions and derived research questions, there is an opportunity to deepen our understanding of this important area. This can guide the next stage of the forty interviews of engineering organisations' CEOs and Heads of Sustainability. The triangulation of data analysis from this paper with the literature review and the interviews will inform the development of the prototype model, which will subsequently be tested in case study research. In this way, future research will provide more meaningful insights into how the use of the SDGs can strengthen future infrastructure investment decisions for people, planet and profit.

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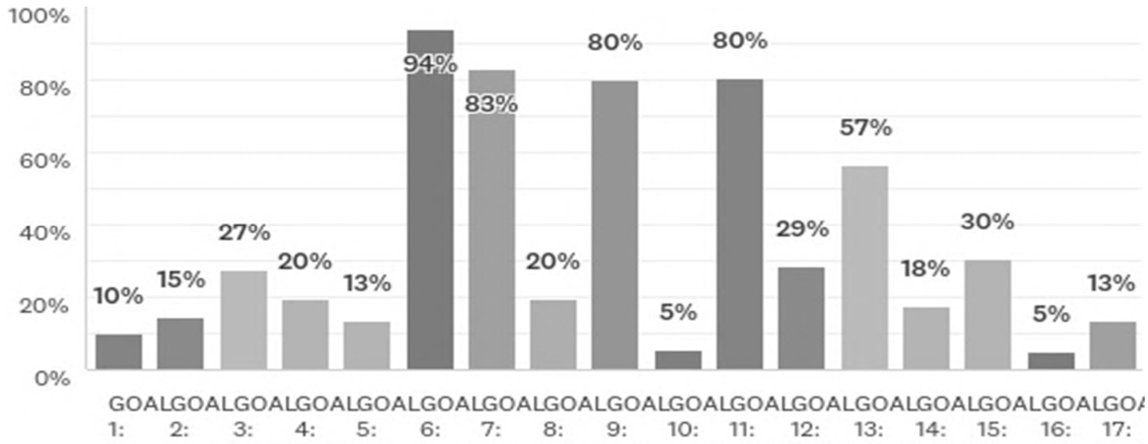
Appendix A. Survey Questions and Selection of the Type of Question and Metric to Align with Analysis Requirements for Measuring Engineers' Views on Projects' SDG Impact

Q#	Theme	Question	Measuring Value				
			Y / No	1 to 6	text	List	option
	Opening Page	With ICE and GEC logos. Thank the respondent for their time. Explain the purpose of the survey. Who is it for? How long will it take (10 mins)? What will happen with the data? Who is the POC at ICE.					
a		**Are you completing this survey as an individual or for an engineering firm?**					allow single choice for either individual or as engineering firm
1a	Engineering Organisation - General Data on your organisation						
1.1		**Q: What is the name of your organisation.**					complete text
1.2		**Q: In which country is your organisation based?**					text for country and list for continets
1.3		**Q: Name of person completing Survey for firm**					complete text
1.4		**Q: Your role/grade**					complete text
1.5		**Q: Contact details (email)**					complete text
1.6		**Q: Number of Engineers in your firm**					options include 1-49; 50-99, 100 +etc
1.7		**Q: Number of current engineering projects underway (from design through to completion)**					options include 1-20; 20-49; 50-99, 100 +etc
1.8		**Q: In which countries do you deliver projects?**					just home country; 2-5 countries; 6-20 countries; 20+ countries
1.9		**Q: Who is the company's SDG or CSR lead?**					complete text
2	Engineering Organisation - SDG Data on your organisation						
2.1		**Q. How do you plan to assess your impact on the SDGs?** 1 We have no intention to assess our impact on the SDGs 2 We plan to assess our impact on the SDGs but have not thought through how 3 We plan to assess our impact on some of the SDGs and indicators relevant to our business 4 We plan to assess our impact on all the SDGs and indicators relevant to our business 5 We plan to assess our impact on all 17 SDGs and indicators 6 Don't know					select one of the six choices
2.2		**Q. We fully understand the SDG priorities of the governments in our key markets and countries of operation.**					1=strongly agree; 2=agree; 3= neither agree or disagree; 4=disagree; 5=strongly disagree 6=n/a
2.3		**Q. Our company has fully defined the tools that will help it to assess its impact against the SDGs.**					1=strongly agree; 2=agree; 3= neither agree or disagree; 4=disagree; 5=strongly disagree 6=n/a
2.4		**Q. We can comprehensively report to governments and other key stakeholders on how our company is contributing to SDGs.**					1=strongly agree; 2=agree; 3= neither agree or disagree; 4=disagree; 5=strongly disagree 6=n/a
1b	General SDG Data - as a member of the engineering community						
1.1b		**Q: What is the name of your organisation?**					complete text
1.2b		**Q: In which country is your organisation based?**					text for country and list for continets
1.3b		**Q: Contact details (email) - optional**					complete text
1.4b		**Q: Years of experience as qualified engineer**					options incl eg 1-5; 5-10; 10-15; 15+; n/a
1.5b		**Q: Are you a millenial (born 1980-2000)?**					select Y or N; this allows to filter data to assess any difference between them and others
1.6b		**Q. As an engineer I want to know more about UN's Sustainable Development Goals,and what we are doing to measure our impact against them.**					1=strongly agree; 2=agree; 3= neither agree or disagree; 4=disagree; 5=strongly disagree 6=n/a
3	SDG-Engineering specific Questions						
3.1		**Q. From the list below, please rank the five SDGs where you believe engineers have the greatest impact and opportunity.**					list of all 17 Goals with titles
3.2		**Q. Having read the UN's Sustainable Development Goals, do you agree it is important that engineering business' sign up to these goals?**					1=strongly agree; 2=agree; 3= neither agree or disagree; 4=disagree; 5=strongly disagree 6=n/a
3.3		**Q. There is strong evidence that we have a 'fit for purpose' SDG measuring approach to track our contribution from our projects.**					1=strongly agree; 2=agree; 3= neither agree or disagree; 4=disagree; 5=strongly disagree 6=n/a
3.4		**Q. Commercial realities dictate that you should cherry pick the best SDGs for your business instead of the best ones for the planet.**					1=strongly agree; 2=agree; 3= neither agree or disagree; 4=disagree; 5=strongly disagree 6=n/a
4	GEC related Questions: Engineering Community – Sharing Best Practice	*The Global Engineering Congress is being hosted at the ICE from 22-28 Oct 18 (please see details at: Global Engineering Congress Info*					Global Engineering Congress Info
4.1		**Q. I/we are planning to actively engage with the GEC discussions and support plans to agree and implement a global engineering response roadmap to the SDGs?**					1=strongly agree; 2=agree; 3= neither agree or disagree; 4=disagree; 5=strongly disagree 6=n/a
4.2		**Q. As an engineer, I/we support the Global Engineering Congress' objective to unite the engineering community to agree and mobilise a response roadmap to the UNSDG?**					1=strongly agree; 2=agree; 3= neither agree or disagree; 4=disagree; 5=strongly disagree 6=n/a
4.3		**Q. We should look to engineering associations and standards bodies for advice, support and guidance on measuring project contribution to specific SDGs.**					1=strongly agree; 2=agree; 3= neither agree or disagree; 4=disagree; 5=strongly disagree 6=n/a

Appendix B. Data Capture from Survey: Select the Six SDGs That You Believe That Engineers Have the Greatest Impact and Opportunity



GOAL 6: Clean Water and Sanitation - Ensure availability and sustainable management of water and sanitation for all (6)	93%	158
GOAL 7: Affordable and Clean Energy - Ensure access to affordable, reliable, sustainable and modern energy for all (7)	83%	140
GOAL 8: Decent Work and Economic Growth - Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all (8)	19%	32
GOAL 9: Industry, Innovation and Infrastructure - Build resilient infrastructure, promote inclusive and sustainable industrialisation and foster innovation (9)	80%	135
GOAL 10: Reduced Inequality - Reduce inequality within and among countries (10)	5%	9
GOAL 11: Sustainable Cities and Communities - Make cities and human settlements inclusive, safe, resilient and sustainable (11)	80%	136
GOAL 12: Responsible Consumption and Production - Ensure sustainable consumption and production patterns (12)	28%	47
GOAL 13: Climate Action - Take urgent action to combat climate change and its impacts (13)	56%	95
GOAL 14: Life Below Water - Conserve and sustainably use the oceans, seas and marine resources for sustainable development (14)	17%	29
GOAL 15: Life on Land - Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss (15)	30%	51
GOAL 16: Peace and Justice Strong Institutions - Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels (16)	5%	8
GOAL 17: Partnerships to achieve the Goal - Strengthen the means of implementation and revitalise the global partnership for sustainable development (17)	15%	25
Total Respondents: 169		

BASIC STATISTICS

Minimum	Maximum	Median	Mean	Standard Deviation
1.00	17.00	9.00	8.86	3.76

Appendix C. Data Capture from the Survey's Chi-Square Tests (with Continuity Correction, Likelihood Ratio, and Linear-by-Linear Association)

Are you a millennial (born between 1980-2000)? * q0023_0001 Crosstabulation

			q0023_0001		
			Agree	Strongly Agree	Total
Are you a millennial (born between 1980-2000)?	Yes	Count	21	2	23
		Expected Count	17.7	5.3	23.0
	No	Count	22	11	33
		Expected Count	25.3	7.7	33.0
Total		Count	43	13	56
		Expected Count	43.0	13.0	56.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	4.615[a]	1	.032		
Continuity Correction[b]	3.337	1	.068		
Likelihood Ratio	5.087	1	.024		
Fisher's Exact Test				.052	.031
Linear-by-Linear Association	4.533	1	.033		
N of Valid Cases	56				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 5.34.

b. Computed only for a 2x2 table

Are you a millennial (born between 1980-2000)? * q0024_0001 Crosstabulation

			Total
Are you a millennial (born between 1980-2000)?	Yes	Count	65
		Expected Count	65.0
	No	Count	95
		Expected Count	95.0
Total		Count	160
		Expected Count	160.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	8.564[a]	5	.128
Likelihood Ratio	9.474	5	.092
Linear-by-Linear Association	4.358	1	.037
N of Valid Cases	160		

a. 2 cells (16.7%) have expected count less than 5. The minimum expected count is .81.

Are you a millennial (born between 1980-2000)? * q0024_0001 Crosstabulation

			q0024_0001		
			Agree	Strongly Agree	Total
Are you a millennial (born between 1980-2000)?	Yes	Count	24	9	65
		Expected Count	21.4	6.2	65.0
	No	Count	28	6	93
		Expected Count	30.6	8.8	93.0
Total		Count	52	15	158
		Expected Count	52.0	15.0	158.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	7.150[a]	4	.128
Likelihood Ratio	7.372	4	.117
Linear-by-Linear Association	3.358	1	.067
N of Valid Cases	158		

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 6.17.

Are you a millennial (born between 1980-2000)? * q0022_0001 Crosstabulation

			q0022_0001		
			Agree	Strongly Agree	Total
Are you a millennial (born between 1980-2000)?	Yes	Count	23	39	62
		Expected Count	27.7	34.3	62.0
	No	Count	39	38	77
		Expected Count	34.3	42.7	77.0
Total		Count	62	77	139
		Expected Count	62.0	77.0	139.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	2.553[a]	1	.110		
Continuity Correction[b]	2.034	1	.154		
Likelihood Ratio	2.567	1	.109		
Fisher's Exact Test				.125	.077
Linear-by-Linear Association	2.535	1	.111		
N of Valid Cases	139				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 27.65.

b. Computed only for a 2x2 table

Question 2: We conducted SPSS analysis to ascertain Chi-Square between the two age groups (namely millennial and non-millennial) and their responses. There were 159 answers that gave a *p*-value (Pearson Chi-Square) of 0.136. This was not fully statistically significant but indicates a viable trend that supports further analysis. However, when the optionality of questions was condensed, combining the 'agree' and 'strongly agree' categories as well as separately combining the 'disagree' and 'strongly disagree' categories, the results became more statistically significant at a *p*-value of 0.110.

Question 3: There was initially a *p*-value of 0.001, suggesting that the non-millennials did not have any markedly different opinions on the answers to this question. However, when further analysis was conducted by combining agree and strongly agree, the *p*-value was 0.032, indicating that the millennials had similar numbers agreeing, but a much higher proportion of millennials were strongly agreeing. It is difficult to interpret what this categorically means, but it may indicate that there is likely to be a stronger viewpoint from a generation that prefer to give higher ratings for an issue that has such catastrophic impacts if it is not dealt with effectively.

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