The sustainability opportunity study (SOS) – diagnosing by operationalising and sensemaking of sustainability using Total Quality Management

Received 30 January 2022
Revised 29 May 2022
6 August 2022
Accepted 29 August 2022

Raine Isaksson
Division of Quality Science, Department of Civil and Industrial Engineering, Uppsala University, Visby, Sweden and
Division of Quality Technology and Logistics, Department of Social Sciences, Technology and Arts, Lulea University of Technology, Luleå, Sweden
Swaminathan Ramanathan
Division of Quality Science, Department of Civil and Industrial Engineering, Uppsala University, Visby, Sweden, and
Max Rosvall
Quality management, Uppsala Universitet Teknisk-naturvetenskapliga fakulteten, Uppsala, Sweden

Abstract

Purpose – A key issue to manage sustainability is to be able to operationalise it. Relevant indicators require an appropriate definition of sustainability and sustainable development for the studied organisation. A common problem is inadequate understanding of what sustainability is from an organisational perspective. The purpose of this paper is to propose how to understand, define and measure diagnosing of sustainability from an outside-in perspective.

Design/methodology/approach – The building, health care, education and tourism value chains are studied. Based on interpreted stakeholder sustainability needs the stages of understanding, defining and measuring of diagnosing are reviewed, and interpretations proposed. This is with focus on identifying the vital few sustainability impacts in the studied value chains.

Findings – The resulting definitions and proposed performance indicators for the chosen areas indicate that the approach works resulting in proposed definitions and indicators for sustainability and sustainable development based on stakeholders need focus. Having clear definitions and performance indicators will support working effectively with sustainable development.

Research limitations/implications – The resulting definitions and proposed performance indicators for the chosen areas indicate that the approach works. Further, proposed definitions and indicators for sustainability and sustainable development based on stakeholder needs focus is useful. Having clear definitions and performance indicators will help an organisation engage with sustainability and be sustainable within an organisational context.

Practical implications – The proposed approach enables using quality management for sustainable development.

Social implications – Social sustainability is viewed from a poverty and affordability perspective.

Originality/value – Results indicate that there is a value in using an outside-in approach with focus on stakeholder needs in connection with a process-based approach. The approach is in contrast with the

The TQM Journal
Vol. 35 No. 5, 2023
pp. 1329-1347
Emerald Publishing Limited
1754-2731
DOI 10.1108/TQM-01-2022-0038

customary way of defining sustainability which mostly is based on an inside-out approach identifying several indicators and then adding these to a measure of sustainability.

Keywords Opportunity study, Sustainability, Sustainable development, Improvement potential, Performance, Diagnosing

Paper type Research paper

1. Understanding quality and sustainability

Basing decisions on facts and working with processes are core principles in Total Quality Management (TQM) (Bergman and Klefsjö, 2010). The perfect process could be seen as doing the right thing in the right way over time. This reflects Joseph Juran's definition of the cost of poor quality as follows: "The difference between those costs that would disappear if everything was done perfectly in a process, the first time and every time, versus the actual costs" (Juran, 2022). The product is perfect when it satisfies all customer needs, and the process is perfect when it follows procedures and routines with zero errors and minimised use of resources over time. Traditional TQM has focus on customers. TQM for sustainable development could be defined as having focus on stakeholder needs, where stakeholders are defined as all those in the studied system that can be affected or that can affect the system. The challenge in this case would be agreeing on which the right things and the right ways for sustainability are in the process studied. Here, focus is on understanding, defining and measuring the right thing.

Sustainability, like quality, is a positively charged word. It is often overused. This highlights the risk that many activities aimed at increased sustainability might neither be the right thing nor the right way – or in other words, neither effective nor efficient. In short, sustainability and sustainable development needs understanding within a chosen context. Many of the proposed sustainability actions focus on the footprint ignoring the value produced.

Sustainability is complex. The 17 UN Sustainable Development Goals that cover environmental, social and business issues point to that complexity. The directives are that these goals should be seen as a whole – as a system. However, the theoretical foundations could be put into question. These goals are a mixture of cause and effect. E.g. the Sustainable Development Goal (SDG) 1 No Poverty could be seen as a clear goal to reduce impacts – an effect – whereas the SDG 9 Industry Innovation and Infrastructure points at ways towards economic sustainability and sustainable infrastructure – a cause or way towards positive sustainability effects. Poor innovation and infrastructure could be causes for impacts on atmosphere and on poverty. The 17 SDGs have a total of 169 targets which could lead to activity focus when organisations try to see how their processes relate to the goals and targets. Additionally, there is the risk of greenwashing where companies want to highlight areas with good environmental and social performance. Both the difficulty of understanding what sustainability in a system is and greenwashing, highlight the importance of correctly understanding sustainability within a chosen context to work with the right thing. Starting with the SDG goals and targets and identifying good sustainability activities to do, could be viewed as the inside-out approach. Instead, the outside-in approach would be focussing on the vital few stakeholder sustainability impacts. In combination with a Pareto approach this could be used to identify what at least should be included in understanding and defining sustainability. The scope of the system could be based on a process that describes the value chain. Here, the organisation must be clear on which part of the process they include in their scope. The broadly used Global Reporting Initiative (GRI) standards and especially the GRI 101 standard suggests using the entire value chain from beginning to end (GRI 101, 2016) or in other words from the cradle to grave. Cöster *et al.* (2020) propose a maturity grid for sustainability reporting where the right thing is defined as reporting main impacts in the

entire value chain. In studies of sustainability reports issued by leading Swedish companies only about 20% report carbon emissions in the entire value chain (Isaksson and Cöster, 2018). Since climate is something that all companies need to address this could be seen as an example of lack of understanding what sustainability is for the company. Here, the principal problem could be in understanding the scope. If scope is not correct, then important stakeholders and stakeholder needs might be missed.

Isaksson and Rosvall (2020) study in "Understanding Building Sustainability – The Case of Sweden" how leading Swedish companies have understood and defined the building value chain from the cradle to grave. The results indicate that there is no common understanding of neither what the scope should be, nor which the main sustainability impacts are. The study included several large Swedish companies that are part of the building value chain. The indication based on the study of 23 companies is that understanding generally could be a challenge. The building value chain has important impacts on climate and on poverty. Affordable shelter is a basic need. In research work related to sustainable destination development the issue of what sustainable tourism is has been discussed with researchers engaged in a PhD school for sustainability studies focussing on sustainable destination development. The group of some 30 PhD students and researchers did not have any agreed definition on sustainable tourism, and there was also a reluctance to discuss this. Focus was instead on how to work with sustainable tourism and not on how to understand and define it. This is understandable since doing something can seem more important than doing the right thing in the right way. Additional research done by the authors within education and health care has demonstrated the lack of clear definitions for quality and sustainability even if these are judged to be important by people working in the system. Focussing only on what people within the system say and do might lead to erroneous conclusions. An alternative is to use an outside-in approach in setting the scope by defining the value chain and then identifying the vital few sustainability impacts in the studied process.

Isaksson (2015) proposes an opportunity dtudy as a way of creating a sense of urgency for change. The opportunity study consists of the steps of diagnosing, analysing and solving (DAS). Diagnosing consists of finding the gap – the improvement potential – between current performance and a target. The improvement potential should, if possible, be quantifiable and based upon agreed performance indicators and targets. Analysing can be done quantitatively or qualitatively resulting in agreed causes that explain the improvement potential. Solving is about product, process and service innovation that realises the improvement potential. There is an opportunity if there is sufficient potential, and causes can be explained and solved.

The opportunity study step of diagnosing the improvement potential requires that there is an agreed and correct understanding of the process performance. Diagnosing cannot be done if there are no relevant performance indicators for quality and sustainability. If indicators are missing, then work needs to start with defining sustainability and proposing relevant indicators. Isaksson and Rosvall (2021) propose developing the opportunity study steps of DAS by combining them with the three first stages of the common-sense logic from understanding to leading that has the stages of understanding, defining, measuring, communicating and leading (Isaksson and Hallencreutz, 2008). Isaksson and Rosvall (2021) study the processes of cement and concrete manufacturing for establishing definitions and indicators for cement and concrete sustainability. Based on the previous work in some limited applications the research in this study will review, what could be called a sustainability opportunity study (SOS), in several value chains. The focus is on understanding, defining and measuring diagnosing based on the work done in the study by Isaksson and Rosvall (2021), see Table 1.

This paper argues that doing the right thing is essential for sustainable development in organisations. This implies that the organisational sense of urgency perceived is focused on the vital few sustainability impacts in the organisational value chain. A shared fact-based

Understanding	Defining	Measuring
Setting scope for the value chain and parts of it by using the process based system model (PBSM) Identifying main sustainability stakeholders and main impacts on them by referring to the UN SDGs, the planetary boundaries framework and the system principles from the framework for strategic sustainable development (FSSD) (Broman and Robèrt, 2017)	Based on the Pareto principle define the vital few stakeholders and impacts on them in terms of stakeholder needs that can measured	Measure sustainability as a state and sustainable development as change Identify value and harm indicators – the KPIs (y-values) that can be used to describe current sustainability and the sustainability performance over time
Defining the qualitative improvement potential as the difference between possible and/or required performance and current performance	Focus on people and planet needs and convert this to a proposed definition that can be operationalised	Value and harm are expressed in terms of impacts on people, the planet and profit KPIs should be expressed in absolute and relative terms Assess the quantitative improvement potential for chosen y-values in terms of level and the rate of change

Table 1.
A proposed logic to relate understanding, defining and measuring to diagnosing in an opportunity study adapted from Isaksson and Rosvall (2021)

understanding of sustainability enables formulating a definition of sustainability which then enables identifying relevant performance indicators. Good sustainability performance indicators will then support leading sustainable development effectively and efficiently using principles, practices and tools from TQM. The purpose of this study is to discuss understanding, defining and measuring sustainability and sustainable development in chosen value chains – doing the diagnosing of an SOS. The key research question is if the outside-in perspective using a process approach in combination with focus on vital sustainability impacts could support sensemaking and operationalising of sustainability.

2. Theory background

The essential principle of TQM is focus on customers. Bergman and Klefsjö (2010) in their book define it as "From Customer Needs to Customer Satisfaction". This book has been widely used in quality management education in Swedish universities for the last 30 years. The TQM principles presented in the updated book (Bergman and Klefsjö, 2020) are essentially the same as those in Figure 1, which presents what could be seen as the current

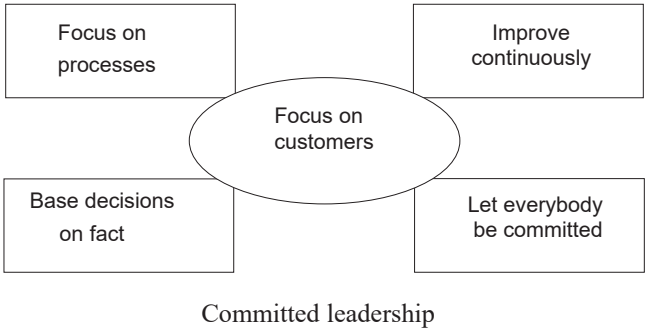


Figure 1.
The corner stone model, Bergman and Klefsjö (2010, p. 38)

understanding of TQM. Bergman and Klefsjö (2010, p. 38) define TQM using the "Corner stone model" based on six principles with focus on customers in the center supported by focus on processes, improve continuously, base decisions of facts and let everybody be committed. All this is supported by a committed leadership.

The principles presented in Figure 1 are common in most definitions. The ISO 9000 Quality Management System has seven leadership principles which essentially include all six presented in Figure 1 and then adds the principle of: "System approach to management". The model in Figure 1 is used by authors in work where TQM is transformed into sustainable development.

All value is created in processes. This means that for making sense out of any organisation as a system we can use the process approach. From an understanding and sensemaking perspective it should be an advantage to present a studied system as a process. This is what the process based system model (PBSM) does (Isaksson, 2006, 2019). The model is based on common process notation using management, main and support processes and resources, see Figure 2.

The PBSM in Figure 2 is based on the following process definition: "A process is a network of activities that using resources, repeatedly converts an input to an output for stakeholders" (Isaksson, 2006). This is a typical process definition, but by specifically highlighting resources it introduces an element that is a prerequisite for a system model. Also, it is not limited to customers, but mentions stakeholders where these include both people (humanity) and the planet (nature). The PBSM is a snapshot of any system. This snapshot can be used to make sense of current quality and sustainability performance. The change process is described as a support process.

The logic is that clearly presenting an opportunity to management will create interest and a sense of urgency with an agreed and fact-based direction. The opportunity study is seen as one way of creating a sense of urgency. When relevant sustainability performance indicators are missing these need to be created doing an SOS.

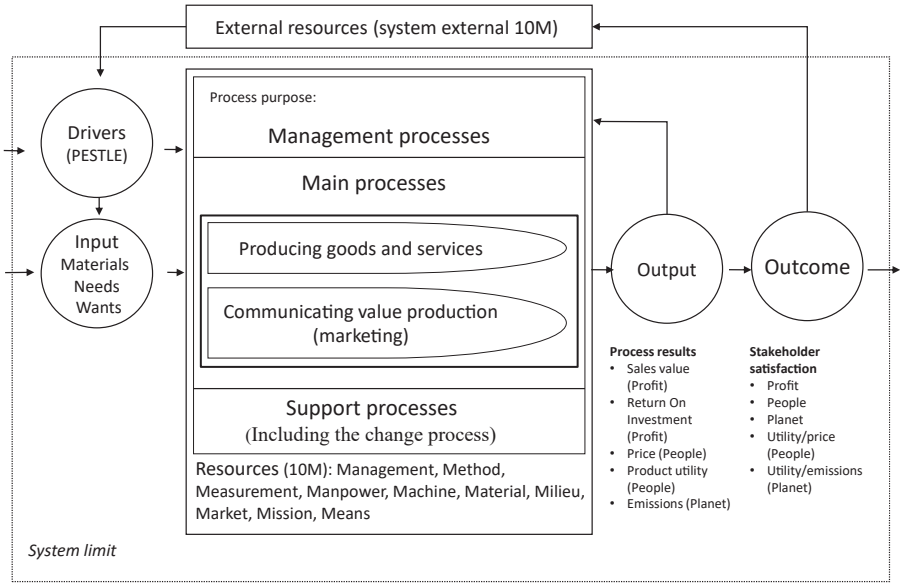


Figure 2.
The PBSM, Isaksson (2019)

Understanding of diagnosing is based on setting the scope using process models for the value chain, which is defined as going from the cradle to grave, see Table 1. This is something which is supported by the widely used Global Reporting Initiative (GRI) standards (GRI 101, 2016). Diagnosing of defining is based on identifying the vital few sustainability impacts from outside-in. Finally diagnosing of measuring sustainability is based on viewing sustainability as a level and sustainable development as a change process (Isaksson, 2013). Performance indicators are related to the system described using the PBSM.

3. Method

The paper is mainly conceptual where the model for the SOS is developed in what could be seen as innovation action research (Kaplan, 1998). Kaplan introduces a cyclical approach with five steps within a new practice for handling a management or organisational phenomena. The five steps include (1) development of the base case, (2) document innovative practice, (3) teach and speak about the innovation, (4) write articles and books and finally (5) implement the concept in new organisations, where the final step provides further insights to start over with (1) (Kaplan, 1998). In this paper the opportunity study (Isaksson, 2015) and the SOS (Isaksson and Rosvall, 2021) are used as the base case (1) and tested in new contexts with results leading both to improvements of the model and to results that are intended to improve the studied process. Results are published and presented for criticism and then further improved.

Focus, in this paper, is on studying understanding–defining–measuring of diagnosing in more detail by broadening the scope presented in Isaksson and Rosvall (2021) from cement and concrete to the entire building value chain and reviewing three other global value chains. The understanding-defining-measuring of diagnosing in Table 1 is used as a starting point for education, health care, tourism and building. The value chain of building has been chosen based on earlier work done with opportunity studies (Isaksson, 2015, 2016). Additionally, the building value chain plays an important role in the context of sustainability. For climate change a common way of viewing the main processes from a consumption perspective is to divide them into providing food, providing shelter, transporting and shopping goods and services. The building value chain is responsible for some 30–50% of global energy consumption (Berardi, 2017), (Dixit, 2019). Depending on the type of energy used this could be translated to some 20–40% of global carbon emissions. Housing relates to SDG 13 Climate Action, SDG 11 Sustainable Cities and Communities and SDG 12 Responsible Consumption and Production. In addition, it could be argued that affordable housing relates to SDG 1 No Poverty. Education is important for supporting employability but also for providing the competence needed to work with sustainable development. The SDG 4 is Quality Education. There is also a certain convenience in choosing education since work in the researcher group has been carried out with how quality and sustainability are defined in primary education. Health care is increasingly important, especially in countries with aging populations. The SDG 3 is Good Health and Wellbeing. Also, here some separate research has been carried out with regional health care systems in Sweden, a country with an aging population, which has provided primary insights into how the healthcare system works. Focus in the previous work was on quality and how quality was understood and perceived. Results from this work indicated there was no commonly agreed understanding of how to define quality and that sustainability had barely been discussed. These observations were based on several workshops with the quality unit of a Swedish regional healthcare department. Results confirmed the working hypothesis of it being difficult to create a common understanding for quality and sustainability. Health care was then chosen as one of the cases to be studied. The tourism value chain is complicated with both important value generation and

important footprints. Globally tourism provides some 10% of the global national product and is responsible for some 8% of global carbon emissions. Finally, also tourism has been the subject of parallel research involving the authors. This has provided additional insights into how tourism sustainability is viewed and to how different these views can be.

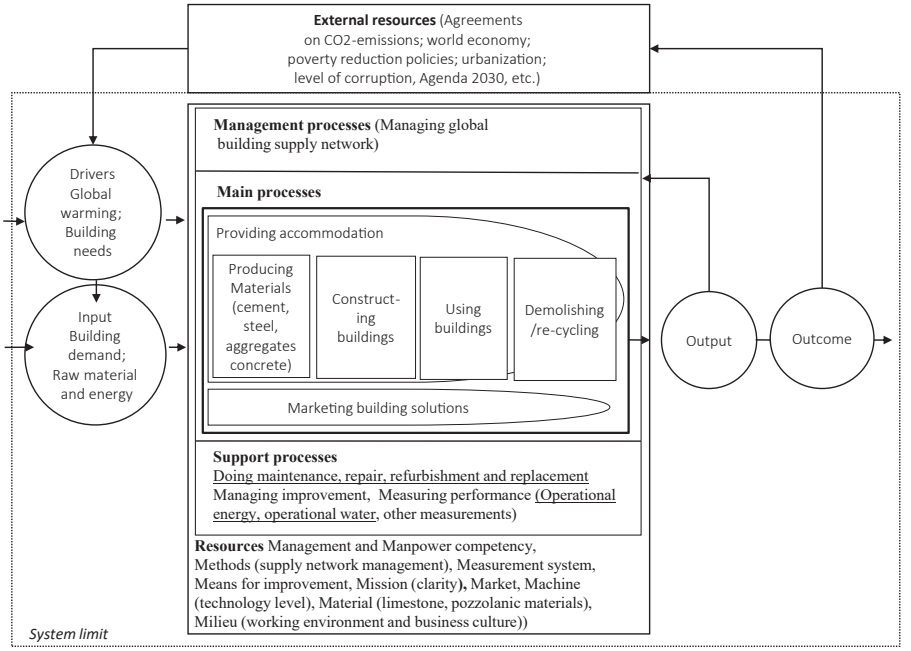
The choice of the four value chains is to a large extent based on convenience. However, there should be no bias towards the purpose of the research, which is highlighting problems with understanding what sustainability is. All chosen value chains have both local and global importance. Further, areas need to be researched, but extending the scope from the previously studied building value chain and further deepening the review of building should provide an improved understanding of how the outside-in approach for understanding, defining, and measuring sustainability could work. Deduction using Table 1, based on experiences from diagnosing understanding, defining and measuring cement and concrete sustainability, is used to study the entire building value chain and the value chains of providing education, providing health care and providing tourism. This work is based on the study by Isaksson *et al.* (2021) which is an earlier version of this work.

4. Results

4.1 Diagnosing the building value chain

The work is done by following Table 1 starting with understanding and then followed by defining and measuring.

4.1.1 Understanding the building value chain. 4.1.1.1 Setting the scope for value chain and parts of it by using the PBSM. The main purpose of the PBSM is to create a common picture of the process studied. In Figure 3 the global building value chain from the



Source(s): Adapted from EN 15978 (2011), (Isaksson and Rosvall, 2021)

Figure 3.
The PBSM applied for the building value chain adapted from EN 15978 (2011) (Isaksson and Rosvall, 2021)

cradle to grave is presented as an adaptation based on the European standard 15978 (2011).

4.1.1.2 Identifying main sustainability stakeholders and main sustainability impacts. A brief materiality analysis shows that greenhouse gases are significant for the building value chain, where carbon emissions are coming from cement production and from heating and cooling buildings. To exemplify the calculations, we have used 30% as the figure for the building value chain part of global carbon emissions. Isaksson (2021) suggests starting with the main global problems which have been proposed as climate change, loss of biodiversity and (extreme) poverty. These constitute a first check for sustainability impacts. Loss of biodiversity could be a problem with housing. However, compared with the effects on climate, housing effects on loss of biodiversity are much smaller. Here, we have focussed on the important process of providing residential buildings as an example. This enables us to clearly combine value produced with harm caused, as in the more generic version of eco-efficiency called value/harm that compares user value with global harm (Isaksson *et al.*, 2015). Providing shelter is a human need, which means it should be affordable. The two main sustainability stakeholders and impacts to be included in building sustainability are therefore the atmosphere with a need to eliminate carbon emissions and people with focus on poor people to get availability of affordable housing.

4.1.1.3 Qualitative improvement potential for carbon emissions and for housing affordability. The target for carbon emissions in housing is in many countries set to a net zero carbon footprint latest 2050. As an example, in Sweden all operations should be carbon neutral until 2045. This means carbon neutral building materials and carbon neutral heating and cooling. Our starting assumption is that about 30% of global carbon emissions or about 12% of CO_2 per year are generated in the building process. Out of this about half is from residential buildings. About 20% of this is due to cement production or about 1.2 Gtons of CO_2 per year from cement used in residential buildings. Based on total yearly global emissions of 40 Gtons/year; this is about 3%. Carbon emissions from cement production are reported as being about 5–9% of global emissions. The approximate assessment done here would end up in cement being responsible for 6% of global CO_2 emissions; based on that residential buildings constitute 50%. For assessing the magnitude assumption of 30% of emissions from the building value chain is good enough. About 80% of the total emissions in the building value chain can be attributed to heating and cooling of buildings. The improvement potential for reducing carbon emissions is important both for building and for the use of buildings. Here, the opportunity is both for the planet but possibly also for profit, where new technology could help in providing solutions that create new business.

Targets for affordability could be set based on a ratio between housing costs compared to average earnings. In many countries there is a substantial need for affordable and proper buildings, especially in developing countries with large slum areas. Globally, the improvement potential is presumably very high for people.

4.1.2 Defining building value chain sustainability and sustainable development. 4.1.2.1 Defining vital few stakeholders and main impacts. Loss of biodiversity – one of the main global vital sustainability impacts – is not included. There probably are several more, but the here the focus is on the vital few. To clarify this, we add "at least". Sustainable housing will at least be affordable and carbon neutral. This obviously is a simplification, but one that puts focus on the main impacts and the importance of considering the entire value chain. This is in accordance with the recommendations found in the GRI Standard 101 (GRI 101, 2016). Traditional ways of describing housing sustainability include listing many parameters that need to be considered such as ventilation, location, use of materials, etc. On a more detailed level many of these categorisations and certifications are contributing to improvement. These are requirements which could be seen to relate to production quality approach of doing things right. However, if the vital few issues of effects on climate and on affordability in the value

chain are not included, then proposed housing sustainability definitions are incomplete. Preliminary results indicate that both builders and researchers globally have not clearly understood what building sustainability is since definitions often seem to be missing or then they are not addressing the full value chain and the main impacts in it.

The requirements for a good definition are that it should capture the main value and harm for key stakeholders. For carbon emissions it is rather simple to measure performance both as absolute and relative values. Absolute values are emissions of CO_2 from the building value chain. The value – the housing functionality – can be expressed in units of area of acceptable housing and in the commonly used m^2 of living area. The absolute value can be expressed as the number of apartments or building area produced in m^2. Relative indicators based on the value per harm concept could be such as m^2 per price or more commonly as price per m^2. Also, kWh of energy consumption per m^2 housing can be used. The functional value is compared to emissions and price.

4.1.3 Measuring sustainability and sustainable development in the building value chain. 4.1.3.1 Measuring housing sustainability and sustainable development. Sustainability is defined as a state which in this case means that 100% of a population can afford housing that is carbon neutral. This splits into the two parts of affordability and climate neutrality. The target for climate sustainability could be expressed as 0 kg net CO_2/m^2 housing and year. The current performance for climate and affordability is probably only partially recorded but could be done to present the current level and to quantify the improvement potential.

Setting a target for affordability needs to be done. A rule of thumb often used when buying an apartment or house is that it should not cost more than three years' income. This approximate rule can be used to estimate the level of housing affordability in different contexts. Even in a rich country like Sweden, with a high standard of living, housing is not affordable. Defining the targets in different contexts is a topic for further research. However, it is possible to set targets for housing, which then can be converted to targets for building costs, building material emissions and for housing energy consumption.

Sustainable development is defined as change that takes us from the current level of sustainability to the defined level of sustainability in time. The change must be rapid enough to avoid irreparable damage to system resources. E.g. the Swedish goal of carbon neutrality in 2045 enables to define the rate of change needed for both building construction and building design (change towards passive houses).

Performance is expressed in both absolute and relative terms, see Table 2. Targets and indicators should also be expressed in absolute and relative terms. Sustainability is here used to describe the level of performance and sustainable development as the rate of change which should be compared to a target rate of change that assures a conversion to a state of

Indicators	Sustainability Absolute	Relative	Sustainable development Absolute	Relative
Target affordability	A USD for affordable building	100% of population	B USD investment for affordable building per year	% population increase with affordable housing
Target climate neutrality	0 kg CO_2 net emissions in value chain	0 kg net CO_2/m^2 building and year	C ton CO_2 reduction per year from buildings	D% reduction of kg CO_2/m^2 per year
Performance over time for different indicators			y = f(time)	
Performance variation – standard deviation of process over year (s)			s_y	

Table 2. Proposed targets and indicators for sustainability and sustainable development

sustainability within the time available. In Table 2 some of the proposed absolute values might be hard to record and might not be very relevant. Presenting the total cost of affordable building in a chosen value chain would be a challenge. The target for sustainable development, marked absolute, is relative in the sense that it must be compared for a period. The A to D in Table 2 indicate specific targets that need to be calculated for the context chosen. The performance should be monitored over time to enable an assessment of the rate of change and a comparison with change rate targets set as sustainable development.

4.1.4 Summarising measuring diagnosing for the building value chain. The work done presents ways to establish an indicative quantitative improvement potential in a chosen building value chain. The opportunity is defined as the difference between possible and/or required performance and current performance. The work was done using only parts of the directives described in Table 1. We used the PBSM, but it could have been enough for the part of diagnosing to identify the context by describing the value chain and the part of value chain studied. The PBSM analysis is useful for understanding the system and its elements and should therefore mainly be used in the part of analysing. The main stakeholder needs were identified based on a reasoning that identified climate and affordability as the main stakeholder impacts on the planet and people. Profit is always included as a border condition. A company needs to make profit while catering to people and Planet needs, but profit maximisation is not part of the sustainability definition (Isaksson *et al.*, 2015). The work did not include a review starting from all the 17 SDGs or the nine planetary boundaries. Instead, the logic followed the one proposed in the study by Isaksson (2021) of a first focus on climate, biodiversity and poverty. Based on the logic of the Pareto principles this seems to be a feasible start. The system principles were not explicitly discussed. However, zero net emissions and affordability as targets should follow the first and fourth system principle (Robért, 2000). The first principle or system condition says: "Not increasing concentrations of substances extracted from the Earth's crust". The fourth principle says: resources are used fairly and efficiently to meet basic human needs worldwide.

The work here was based on substantial earlier work with the building value chain. This has simplified the work of proposing targets and indicators for building sustainability. With these indicators and targets it was possible to describe how a quantitative improvement potential for the global residential building value chain could be identified (see Table 2). The indication is that Table 1 could be simplified.

4.2 Diagnosing the processes of education, health care and tourism

The three areas of education, health care and tourism have been subject to some recent studies with focus on understanding what quality and sustainability could be in these processes. Cases studied have been related to work done with a Swedish region. The three processes presented in Table 3 are presented as generic processes for providing services. Instead of using the PBSM a simple value chain has been defined by identifying purpose, input and output.

4.2.1 Understanding education, health care and tourism. 4.2.1.1 Setting scope. The first thing to do is to agree on the purpose of the chosen processes. This information can then be translated to the process that delivers the value that leads to the purpose. Interfaces of this process have been chosen based on interpretations of the cradle-to-grave concept.

Main stakeholders and stakeholder needs are identified based on the Pareto principle. There are some differences with the processes. Education and health care are human rights whereas tourism could be seen as an extra, a luxury service. This has some effect on the identification of main stakeholders, especially for tourism processes. In the context of viewing sustainability as a ratio of value per harm this needs to be elaborated to a ratio between the sum of stakeholder value and the sum of stakeholder harm. The results in Table 4 are implicitly based not only on a brief review of the SDGs but also on reasoning based on

Processes providing	Purpose	Input	Output	Comments
Education	Ensuring that every person reaches a defined minimum level of education and additionally that every person can fully exploit their learning capability over their entire lifetime	Persons entering pre-school	Persons that are finished with education	Sustainable education caters for learning needs over the entire life span
Health care	Providing needed health care during all stages of life	A child that has been conceived	A deceased person	Sustainable health care provides for the needs of everybody from conception to end of life
Tourism services	Providing experiences and earning money for the organisers while taking care of tourism resources	A tourist starting planning of trips	A tourist that has come back home	Important that out and inbound travel are included

Table 3.
Purpose and interfaces with processes for education, health care and tourism

Stakeholders	Pupils, students, adults, employees and parents	The next process in educational value chain including employers	Public education	Private education
People needs	Achieving personal goals Well-being Affordable education Employability and a certain level of general education ("Bildung")	Expected entry competence	Educational level Budget in balance Generating taxpayers	Revenue Good reputation
People harm	Working hours and efforts Cost of services	Minimising time with insufficient competency	Operational costs	Operational costs
Planet needs – value adding	Sustainability awareness and competence	Sustainability competence	Leaders of sustainable development	Leaders of sustainable development
Planet needs – minimising harm	Carbon and environmental footprint reduction and safeguarding biodiversity, work with UN development goals			

Table 4.
Proposed stakeholders and stakeholder needs in education with focus on sustainable development

commonly agreed human needs. People and the planet are dealt with as the main stakeholders. Needs (value) and harm for the main stakeholders have been identified.

With a defined value chain, we can tentatively identify the main stakeholders and their needs. In Table 4 we have proposed the main stakeholders in a global context for the value chain of education. The review of the educational value chain in Table 4 is repeated for proving health care in Table 5 and for providing tourism services in Table 6.

4.2.1.2 Improvement potential. In a global context education, health care and tourism are not sustainable. For education and health care the value delivered is insufficient. SDG 3 – Good Health and Wellbeing and SDG 4 Quality Education signal important targets for these two areas that still are to be achieved. Tourism is in some of the SDGs mentioned to achieving other goals and generally as a way towards SDG 1 No Poverty. Tourism can contribute to SDG 8 Decent Work and Economic Growth. On the other hand, it is a problem due to climate effects from flying. The improvement potential for tourism as for the education and health

Stakeholders	Patients	Employees	Public health care	Private health care
People needs	Good health Good availability and affordability of health care	Reasonable working hours and salary Well-being	Budget in balance	Revenue Good reputation
People harm	Waiting time Lack of access Price of services Lack of necessary treatment	Working hours and efforts	Operational costs Population health status	Operational costs
Planet needs – minimising harm	Medical waste	Medical waste	Energy and material consumption	Energy and material consumption

Table 5.
Proposed stakeholders and stakeholder needs in health care

Stakeholders	Tourists	Employees	Local people and nations	Entrepreneurs
People needs	Experiences Affordability Contributions to preservation (good conscience)	Reasonable working hours and salary Well-being	Contribution to GNP	Revenue
People harm	Health risks Quality problems	Working hours and efforts	Disturbance and effects from tourism Damage to culture artefacts and heritage	Operational costs
Planet value	Individual contributions	Possibility to work with conservation and restoration of nature	Income Contribution to preserving nature	Company contribution Branding
Planet needs – minimising harm	Carbon emissions Energy consumption Waste Loss of biodiversity Water consumption	Ecological footprint	Effects on cultural and natural heritage	Carbon emissions Energy and material consumption

Table 6.
Proposed stakeholders and stakeholder needs in providing tourism

care is in producing more stakeholder value while reducing the footprints. For education and health care the user needs are in focus whereas for tourism the user or the tourist is one of several important stakeholders. For all three value chains there is a substantial improvement potential.

4.2.2 Defining sustainability and sustainable development in education, health care and tourism. 4.2.2.1 Defining vital few stakeholders and main impacts in education, health and tourism. The proposed definitions are tentative and based on reasoning starting from identified global people and planet needs.

The SDG 4 states "Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all." With some rewording this is a good enough definition for the value created. It identifies people of all ages as learners. The definition also indicates that education should be equitable which can be interpreted as affordable. This means that

educational costs constitute an important harm. We suggest educational sustainability as "Inclusive quality education and lifelong learning opportunities for all."

The SDG 3 states the following: "Ensure healthy lives and promote well-being for all at all ages". The value is defined whereas harm is not directly mentioned. However, with reference to all it means that healthcare costs are an important harm. To emphasise affordability, we propose sustainable health care as the following: "Healthy lives and equitable well-being for all at all ages". Both for education and health care we can use the definition from the UN SDGs as a base. For tourism the issue is a little bit different, and there we would focus more on the economic effects of tourism.

The SDG 8 states the following: "Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all". The target 8.9 focusses on tourism: "By 2030, devise and implement policies to promote sustainable tourism that creates jobs and promotes local culture and products". The license to operate for tourism in a resource scarce world lies in the effects it can have in creating employment, reducing poverty and supporting cultural and natural resource conservation. This could be seen as an example of how there is a shift from customer focus to stakeholder needs focus (Isaksson, 2021). Sustainable tourism needs to focus on several stakeholders. To attract the money, there needs to be focus on customers, but to make tourism sustainable this is not enough. In addition, tourism needs to contribute to satisfying other stakeholder needs while minimising footprints. The two planetary boundaries that are most critical are climate and biodiversity. Tourism affects mostly climate since a large part of tourism includes flying. Tourism could also affect biodiversity both positively and negatively. Travel to national parks in poor countries can help providing the necessary economy for maintaining natural resources. The third impact mentioned in the study by Isaksson (2021) that always should be checked is the effect on poverty. The text in SDG 8.9 does not specify what sustainable tourism is but identifies creation of jobs and promoting local culture and products. Possibly the word sustainable is supposed to include effects on climate and biodiversity. Our proposed definition of sustainable tourism is tourism that reduces poverty, respects cultural heritage and maintains or increases biodiversity with a zero, net carbon footprint.

4.2.3 Measuring sustainability and sustainable development education, health care and tourism. In Table 7 we have proposed sustainability indicators for education, health care and tourism based on the proposed definitions.

The purpose of the process is related to the mission and business idea of the company or organisation. Within the studied processes, particularly within tourism, there could be company missions which are not compatible with sustainable development. As an example, it would be very questionable if space tourism is sustainable. Possibly space tourism could be sustainable if it pays for all externalities such as carbon emissions. Extending the scope, it would be very hard to see how the business ideas of, e.g. coal mining and oil drilling could be sustainable. This indicates that within understanding there probably should be a review of the business idea sustainability in the longer run.

4.2.4 Summarising UDM of diagnosing for education, health care and tourism. The review of Table 1 for the value chains of education, health care and tourism has been partial. Instead of the PBSM, only input and output of the value chain has been indicated. At this overall level deciding upon interfaces seems to be enough for proposing definitions and measurements for sustainability.

Sustainable development has been defined as the rate of change for the chosen indicators, which is quick enough to reach a defined state of sustainability within the time available. This requires an agreement of when a level of sustainability should be achieved. These levels have only been mentioned qualitatively.

The indicators and metrics proposed in Table 7 need to be tested in specific contexts, and they probably need to be modified. Still, at an overall level, the logic of focussing on main

Value chain - providing	Sustainability indicators	Sustainability metrics	Comments
Education – value	Qualification for higher learning	% of population	The perfect learning teaches the right thing in the right way
	Employability and salary	% employed after six months with job that corresponds to qualifications	The right thing should include relevant sustainability competence
	Sustainability competence	Contribution to sustainable development	
Education – harm	Time used	Years	Harms could possibly in specific cases be turned into monetary units
	Money spent	US$	
	Carbon footprint	Tons of CO_2	
Education value/harm	Employability and salary/time and cost		Employability and salary could be turned into indices as could time and cost
			The ratio could be turned into sustainability metrics
Health care – value	Life expectancy	Years	
	Good health	Perceived health status and years	
Health care – harm	Cost; availability	US$	
		% of yearly income	
		Waiting time in days	
Health care value/harm	Life expectancy/Cost	Years/per capita cost	
Tourism – value	Revenue	US$ total and to poverty alleviation; % of revenue that goes to poverty alleviation	
	Money stream that goes to poverty alleviation	Value of support for nature and culture	
	Support for maintain nature and culture		
Tourism – harm	Carbon footprint	Ton of CO_2	
Tourism value/harm	Revenue per carbon footprint	US$/ton of CO_2	

Table 7. Proposed sustainability indicators

stakeholders and their main needs seems to result in workable definitions of sustainable development. This enables us to identify indicators for sustainability and sustainable development. Using the proposed metrics enables diagnosing the improvement potential in chosen processes for education, health care and tourism. With agreed metrics it becomes possible to define an improvement potential which is a prerequisite for an opportunity study.

5. Discussion and conclusions

5.1 Limitations of the study

The study focusses on how sustainability could be understood, defined and measured in some examples of value chains. How the proposed results relate to the current situation in the different value chains has not been studied in any detail. With the building value chain there are indications of that the proposed definition and indicators are not used. However, clarifying and establishing possible gaps between the research findings and the situation in the four studied value chains need to be done in future research.

The usability and acceptance of proposed definitions and performance indicators has not been studied except partly in the building value chain where the overall performance indicators can be used for proposing indicators for sub-processes. However, the acceptance in the business of these has not been studied.

Four value chains have been studied where it has been possible to define sustainability and propose performance indicators. These studies only provide an indication of that the approach seems feasible, but further value chains need to be studied to see if the approach can be generalised.

There are other versions of TQM and other ways of defining processes. However, the used process definition and the outside-in approach are generic ways of working with the user-based quality approach that is central in TQM (Garvin, 1984).

5.2 Conclusions

The purpose of this paper is to develop the step diagnosing in an opportunity study by discussing it in the three stages of understanding, defining and measuring, presented in Table 1. This is the first part of an SOS. The proposed answer for "How could Understanding, Defining and Measuring sustainability and sustainable development be generally clarified?" is presented in Tables 8 and 9. Table 9 consists of a summary of the findings in Tables 3–7.

Based on the results the conclusion is that extending the TQM customer focus to stakeholder needs focus seems relevant. In practical terms this means that sustainability is defined from an outside-in perspective based on main stakeholder needs in the entire value chain. This provides a good starting point for understanding what sustainability is for the organisation. Based on this understanding, sustainability and sustainable development can be defined and operationalised. Agreed and identified Key Performance Indicators (KPIs) for sustainability enable follow-up and reporting of sustainability performance. These KPIs also

	Understanding	Defining	Measuring
D	Scope, using value chain from cradle to grave by defining input, output and *business idea* of the studied business	Based on the Pareto principle define the vital few stakeholders, value needs and harms caused	Measure sustainability as a state and sustainable development as change
	Identifying main sustainability stakeholders, their value needs and the harms they are subjected to by in the value chain *with focus on climate, biodiversity and poverty* as well as any other significant harm as identified with the four sustainability principles	Focus on people and planet needs and convert this to a proposed definition that can be operationalised	Identify value and harm indicators – the KPIs (y-values) that can be used to describe current sustainability and the sustainability performance over time
	Defining the qualitative improvement potential as the difference between possible and/or required performance and current performance		Value and harm are expressed in terms of impacts on people, the planet and profit
			KPIs should be expressed in absolute and relative terms
			Assess the quantitative improvement potential for chosen y-values in terms of level and the rate of change

Table 8.
A proposed matrix based on Table 1 for understanding, defining and measuring diagnosing. The main addition compared to Table 1 have been introduced in italic

Value chain of	Understanding	Defining	Measuring (value/harm)	Summary improvement potential
Residential building	Main value is affordable shelter, and main harm is climate effect	Affordable with zero-carbon footprint	Living space per price and carbon footprint	1.2 Gton of CO_2/year Huge deficit in appropriate housing
Providing education	Main value is the right to learn and main harm the cost of learning	Inclusive quality education and lifelong learning opportunities for all	Realising educational potential and employability	The percentage and number of dropouts Percentage of those that cannot read and write
Providing health care	Main value is the right to health and main harm the cost of it	Healthy lives and equitable well-being for all at all ages	Life expectancy at birth compared to yearly costs	The number of people not attaining target life expectancy
Providing tourism	Main values are reducing poverty, preserving nature and culture, and increasing biodiversity with the main harms being the climate effect and loss of biodiversity	Tourism that reduces poverty, respects cultural heritage and maintains or increases biodiversity with a zero net carbon footprint	Tourism revenues compared to footprints Revenue going to poverty alleviation	Current carbon footprint Lost poverty alleviation opportunities

Table 9.
Visualising diagnosing for different value chains based on understanding defining and measuring of diagnosing

constitute a prerequisite for carrying out diagnosing, the first step in an opportunity study (Isaksson, 2015). Diagnosing results in an assessed quantified improvement potential requires agreed KPIs as well as an agreed target performance. Sustainability has been expressed as a level of sustainability using chosen indicators. Sustainable development has been described as a change process that takes the current level of sustainability to a level where the system is stable. Sustainability targets should be scientifically based on stakeholder needs. Sustainable development can be seen as a rate of change exceeding a minimum rate. The required rate of change needs to be set depending on the system studied. An example for this is the change needed to stop global warming. There is a common understanding that the target for greenhouse gas emissions need to be close to zero in 2050. A target of zero emissions in 2050 makes it possible for companies to set their targets for the yearly change needed, which should at least be reaching zero by 2050 for the change to be qualified as sustainable development.

The study done proposes an approach for doing an SOS which is needed when an organisation or process lacks relevant sustainability performance indicators. The SOS is intended to provide an operationalisation of sustainability in any organisation but has so far only been tested in a limited number of areas.

5.2.1 A proposed matrix for diagnosing of understanding–defining–measuring sustainability and sustainable development. In Table 8 the new proposed UDM of the diagnosing matrix is presented. The PBSM has been omitted. It is more logical to use it as part of analysing where it has a role in making sense of the system studied. The planetary boundaries and the SDGs were partly used and the system principles of the Framework for Strategic Sustainable Development (FSSD) were mentioned but not systematically used. With the purpose of further simplifying the start and a first iteration of improvement

potential it is proposed that the logic described in the study by Isaksson (2021) is used as a starting point. In this logic climate change, loss of biodiversity and extreme poverty are used for a first review of impacts in the value chain. Further, any significant stakeholder harm in addition to the three mentioned previously should be identified. These harms could be assessed using the four system principles. The point is that the work does not require a review of all nine planetary boundaries and all 17 SDGs. Still, these could be used as a support as was done with health care and tourism. Stakeholder value and stakeholder harm have been highlighted more clearly. We have also introduced the business idea or the organisational purpose as an input for understanding. For other parts the reviewed Table 1 has been confirmed as relevant. Table 8 which is an updated version of Table 1 should be viewed as the latest proposal in ongoing work.

5.3 Testing understanding, defining, measuring and diagnosing in different applications

The four cases consisting of the value chains of building, providing education, providing health care and providing tourism have been tested using the proposed UDM-diagnosing in Table 9. This is based on Table 8 with some summary added based on findings in Tables 3–7.

The proposed structure of highlighting diagnosing by going through the stages of understanding, defining and measuring provides the prerequisites for an SOS. The initial step of diagnosing aims to redirect and guide organisations and actors engaged in the pursuit of sustainable development. The structured review provides a working solution for sustainability and sustainable development in the organisation studied. The first step of the SOS – UDM-diagnosing, can help an organisation to define its change orientation to find a direction for its work with sustainable development. By sorting out the vital few sustainability impacts as a first critical step, a common direction for sustainable development can be established. An organisation that can agree upon what the sustainability improvement potential is can then continue with UDM-analysing causes and UDM-solving problems and carry out the full SOS. This will then enable moving towards communicating and leading effective and efficient sustainable development.

5.4 Theoretical and managerial implications

The studies carried out support the working hypothesis of that there could be a generic problem in understanding what sustainability is in a chosen context. Understanding could be created by focus on vital stakeholder needs in the entire value chain. The main theoretical implication is that TQM could become sustainable development. The main change from customary TQM is going from customer focus which implies wants and needs to stakeholder needs. By needs based prioritisation resulting in agreed sustainability KPIs most principles, practices and tools from TQM could be used.

Important managerial implications are reviewing if the organisation has an agreed and relevant sustainability definition which has been translated to operational sustainability KPIs.

Further research is needed to describe the entire SOS. This should result in a complete UDM-DAS matrix that could form an essential part of managing sustainability and sustainable development.

References

Berardi, U. (2017), "A cross-country comparison of the building energy consumptions and their trends", *Resources, Conservation and Recycling Volume 123, August 2017, Pages 230-241*, Vol. 123, pp. 230-241, doi: https://doi.org/10.1016/j.resconrec.2016.03.014.

Bergman, B. and Klefsjö, B. (2010), *Quality from Customer Needs to Customer Satisfaction*, Studentlitteratur AB, Lund.

Bergman, B. and Klefsjö, B. (2020), *Kvalitet från behov till användning (In Swedish)*, Studentlitteratur AB, Lund.

Broman, Göran and Robèrt, Karl-Henrik (2017), "A framework for strategic sustainable development", *Journal of Cleaner Production*, Vol. 140 Part 1, pp. 17-31, doi: https://doi.org/10.1016/j.jclepro.2015.10.121.

Cöster, M., Dahlin, G. and Isaksson, R. (2020), "Are they reporting the right thing and are they doing it right?—A measurement maturity grid for evaluation of sustainability reports", *Sustainability*, Vol. 12 No. 24, p. 10393.

Dixit, M.K. (2019), "Life cycle recurrent embodied energy calculation of buildings: a review", *Journal of Cleaner Production*, Vol. 209, pp. 731-754.

European Standard (2011), *Sustainability of Construction Works – Assessment of Environmental Performance of buildings – Calculation Method*, CSN EN 15978.

Garvin, D.A. (1984), "What does product quality really mean", *Sloan Management Review*, Vol. 25, pp. 25-43.

GRI (101), "Global reporting initiative standards", available at: https://www.globalreporting.org/information/current-priorities/integrated-reporting/Pages/default.aspx (accessed 28 April 2018).

Isaksson, R. (2006), "Total quality management for sustainable development: process based system models", *Business Process Management Journal*, Vol. 12 No. 5, pp. 632-645.

Isaksson, R. (2013), "Defining quality and sustainability–looking for synergies", *Paper presented at the 16th QMOD– ICQSS; 4 - 6 September*, Portorož, Slovenia, pp. 833-843.

Isaksson, R. (2015), "Making sense of building material production", *The TQM Journal*, Vol. 27 No. 6, pp. 781-797.

Isaksson, R. (2016), "Process based system models for detecting opportunities and threats–the case of World Cement Production", *International Journal of Quality and Service Sciences*, Vol. 8 No. 3, pp. 246-262.

Isaksson, R. (2019), "Creating a sense of urgency for Sustainable Development–testing two system models", *Journal of Cleaner Production*, Vol. 227, pp. 1173-1184.

Isaksson, R. (2021), "Excellence for sustainability–maintaining the license to operate", *Total Quality Management & Business Excellence*, Vol. 32 Nos 5-6, pp. 489-500.

Isaksson, R. and Cöster, M. (2018), "Testing a maturity grid for assessing sustainability reports", *Paper presented at The 11th Performance Measurement Association Conference, Performance Measurement and Management in a Globally Networked World*, Warsaw, Poland, 23-26 September.

Isaksson, R. and Hallencreutz, J. (2008), "The measurement system resource as support for sustainable change", *International Journal of Knowledge, Culture and Change Management*, Vol. 8 No. 1, pp. 265-274.

Isaksson, R. and Rosvall, M. (2020), "Understanding building sustainability – the case of Sweden", *Total Quality Management and Business Excellence*, pp. 1-15, doi: 10.1080/14783363.2020.1853520.

Isaksson, R. and Rosvall, M. (2021), "Cement and Concrete - quality and Sustainability - understanding, defining and measuring opportunities", *Paper presented at the digital 23rd ISDRS conference*, July 14-16.

Isaksson, R.B., Garvare, R. and Johnson, M. (2015), "The crippled bottom line–measuring and managing sustainability", *International Journal of Productivity and Performance Management*, Vol. 64 No. 3, pp. 334-355.

Isaksson, R., Ramanathan, S. and Rosvall, M. (2021), "Sustainability opportunity study-diagnosing", *Paper presented at the Excellence in Services 24th International Conference*, Salerno, Italy, 2-3 September.

Juran (2022), "The future of quality", available at: https://www.juran.com/products-solutions/assessments/ (accessed 29 May 2022).

Kaplan, R.S. (1998), "Innovation action research: creating new management theory and practice", *Journal of Management Accounting Research*, Vol. 10, p. 89.

Robèrt, K.H. (2000), "Tools and concepts for sustainable development, how do they relate to a general framework for sustainable development, and to each other?", *Journal of Cleaner Production*, Vol. 8 No. 3, pp. 243-254.

Corresponding author
Raine Isaksson can be contacted at: raine.isaksson@angstrom.uu.se; raine.isaksson@ltu.se