Organisational sustainability using quality management

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Published in:
Proceedings of the 25th Excellence in Services International Conference

Published: 25/08/2022

Document Version
Peer reviewed version

Organisational sustainability using Quality Management: a conceptual framework for practitioners

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Abstract

The purpose of this paper is to review in which ways Quality Management adapted methods and philosophies drive sustainability in companies and to present a conceptual framework to guide application during the decision-making process.

A systematic literature review is applied to analyse and summarize the current state of research. A three-phase approach of 1) searching for articles with a set of keywords, 2) excluding unsuitable articles based on the abstracts and 3) including important papers by applying the snowball technique, led to the final number of 94 included papers. This basis was used to evaluate the most promising approaches to enable more sustainability and resulted in the conceptual framework presented here.

The literature review showed that VSM and Kaizen are the two most researched methods and TQM and LM the most researched philosophies in combination with sustainability or the economic/social pillar. The developed conceptual framework proves that different methods for different stages of the organizational sustainability journey are available.

It was also found that Quality Management practices and tools must be developed and adapted to support sustainability considerations. As this framework is only conceptual, future research needs to validate and improve possible shortcomings.

Nevertheless, this paper shows that QM can drive sustainability and is a valuable starting point as QM structures like cross-departmental responsibility and organizational culture drive the sustainability movement.

Keywords
sustainability; quality management; lean; tools

1. Introduction

In the 1970s, researchers began to question the infinite economic growth striven for by the capitalist system in western countries as it was perceived as fundamentally incompatible with social and ecological sustainability (Purvis et al., 2018). Although capitalism remained the ruling market system, sustainability research is expanding. The continuing exploitation of resources and the emerging shortage of raw materials make customers more interested in information and accountability in terms of organizational global impact. Simultaneously, governments are beginning to enact new environmental regulations (Fish, 2016). This constitutes a growing need to address sustainability on an organizational level by finding solutions for an equilibrium between economic endeavours and associated ecological and social effects (Asif et al., 2008).

For many years, profit-generating businesses considered environmental protection or sustainable development as irrelevant to their success (Siva et al., 2016). Environmental issues were addressed if they implied direct improvements in efficiency and cut costs for organizations (Ramanathan, 2021). However, new societal pressure demands higher sustainability of companies by reducing their environmental footprint and negative social impacts (Sanchez-Ruiz et al., 2020). This expected transformation relies on sustainability considerations being a natural part of everyday business activities. Quality Management (QM) is seen as an eligible infrastructure for starting the integration of sustainability (Martin et al., 2020) because it amongst others builds on communication, awareness, and the alignment of goals (Kuei and Lu, 2013). Current predictions say that the emerging pressure for sustainable business will turn into a sustainability race, where successful organizations will likely turn out to be market leaders (Deleryd and Fundin, 2020).

The term ‘sustainability’ relates to the considerate utilization of all resources and the decrease of social and environmental effects of businesses while continuously securing economic success (Asif et al., 2008).

To make sustainability more tangible, the framework of the three pillars (economic, environmental, and social) was introduced, also known as the Triple Bottom Line (TBL) (Gladwin, Kennelly and Krause, 1995). Although today it is not clear where this concept originated from before being universally used (Marshall and Toffel, 2005; Purvis, Mao and Robinson, 2018), today the framework of the three pillars has been validated as a practical and effective way strengthen to the practical application of sustainability science.

Previous literature focused on designing and testing new frameworks or adapting existing QM tools that link the fields of environmental and societal sustainability to specific aspects of QM. Also, literature reviews have been analysing for example the impact of Lean Management (LM) on organizational sustainability or have been comparing study results that applied the same methods to become more sustainable. On this basis, wide-ranging information about the connection between QM and sustainability is available already, but until now the unstructured results are difficult for companies to apply. Practitioners lack the time to read through all accessible theoretical papers and choose a suitable tool. This paper seeks to fill this gap and help organizations to start implementing more sustainability-driven QM practices immediately. Hence, the purpose of this paper is to review, summarize, and structure approaches using QM in support of achieving higher organizational sustainability.

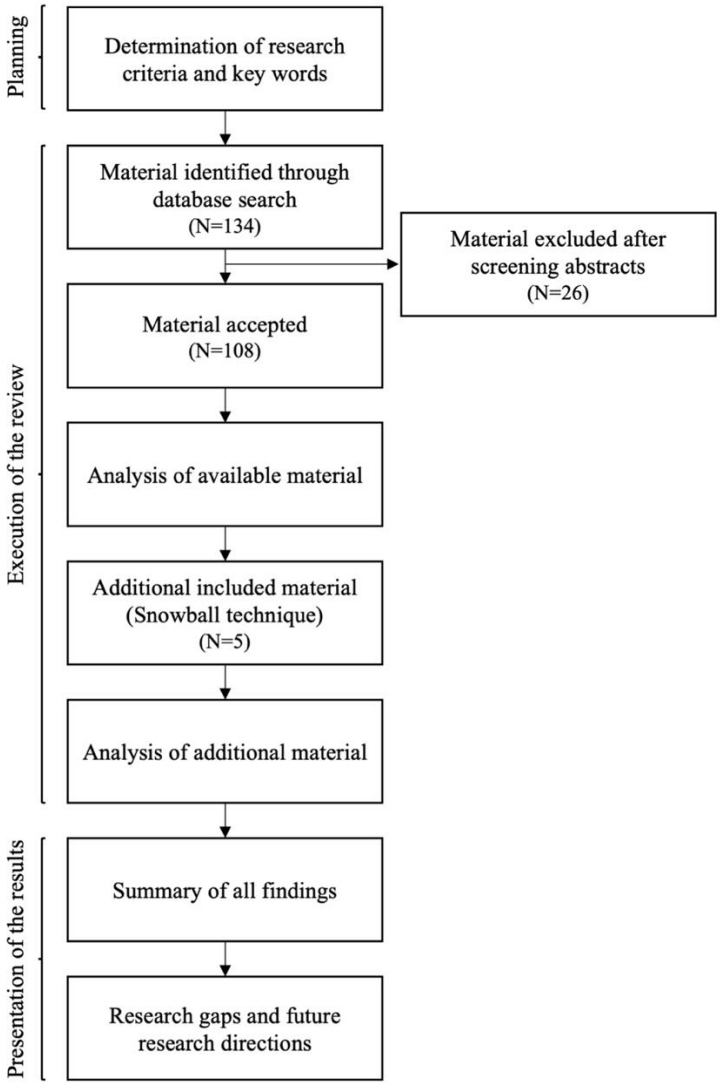
2. Methodology

In general, systematic reviews are applied to increase the transparency of available information (Laureani and Antony, 2017) and thereby learn from the past (Webster and Watson, 2002). Hence, the method is suitable to guide future research in this field. This systematic

review provides an indication of the size of the available literature on QM tools and practices for more sustainability in organizations. It also identifies existing research gaps.

Tranfield et al. (2003) suggest a three-step review procedure, which was applied for this paper. Figure 1 shows all consecutive steps undertaken, divided into three phases: (1) planning, (2) conducting the review and (3) reporting the results.

Figure 1: Process diagram of research strategy



Source: Author's own diagram

First, existing research papers that connect the QM philosophy or tools to sustainability or environmentally or socially responsible practices were searched.

Criteria that were significant for including a document:

- Document type: Peer-reviewed research paper, conference paper or book chapter
- Publication language: English
- Period: all years available until March 31, 2022
- Topic: Quality Management and Sustainability

Papers were excluded if they were based on a different understanding of sustainability that was not based on the Triple Bottom Line (TBL). Furthermore, only QM methods backed by

profound research about the relationship with sustainability were included in the paper. Complete books were excluded as reading them would have exceeded the time capacity for this article.

To have a broad basis of material, different electronic databases (University library search, EBSCO, SCOPUS and Google Scholar) were used for the search and duplicate results were included only once. Table 1shows all used keywords and the number of articles found for each step of the search process. The keys were searched for in the title, the abstract and/or the keywords of the articles. Altogether a total of 134 articles were selected in the first round.

The selection of the relevant QM philosophies and tools was guided by two considerations. First, important influences on the current QM practices should be covered because the findings potentially impact many businesses, e.g. TQM, EFQM and the ISO standards. Second, methods that emerged during the initial search for the connection between QM and sustainability were researched separately as well, as it was to be expected that a certain research basis was available for these topics.

To keep the number of articles at a reasonable amount for the scope of this research, the screening process by reading the abstracts was conducted strictly: if an article did not show a meaningful connection to the research topic in the abstract, it was excluded. This left 108 articles overall. As this procedure involves a high risk of missing important papers, the snowball technique was applied. This method allows including additional documents that were important resources for articles included in the first step (Wohlin, 2014). The new articles were also reviewed and accepted if the criteria were met. The overview shows that the keywords were well chosen, as only individual papers were added in retrospect due to the snowball technique. Ultimately, 113 articles were read and analysed.

The result of this structured review furthermore is the basis for the conceptual framework that aims to help practitioners to choose suitable tools for their individual applications. In this process, the developed approaches are judged in terms of their benefits for sustainability. Some methods focus more on one pillar, but generally, it is the goal to include the requirements of all three dimensions equally. Furthermore, the difficulty of each approach and the area of application are considered. The objective is to find concepts for companies at different stages of their sustainability journey. Therefore, it is essential to offer choices for beginners as well as organizations with advanced sustainability standards. The result is summarized in an easy-to-understand matrix to save time for applicants.

Table 1. Overview search topics with corresponding keywords and the number of articles found

Topic	Used keyword combinations for Literature Search	Number of Articles found	Articles after abstract examination	Snowball Method	Articles included
QM	Quality Management + Sustainability Sustainable Quality Management Green Quality Management Quality Management + Triple Bottom Line Quality Management + CSR Fifth Generation + Quality Management Quality Management + Society Quality Management + Future	28	22	0	22
VSM	Value Stream Mapping + Sustainability Environmental Value Stream Mapping	15	11	0	11

	Green Value Stream Mapping				
LM	Lean + Sustainability Green Lean	22	21	4	25
TQM	TQM + Sustainability Total Quality Management + Sustainability TQM + Sustainable	16	13	0	13
QFD	QFD + Sustainability Quality Function Deployment + Sustainability Green QFD	9	8	0	8
Kaizen	Kaizen + Sustainability	8	8	1	9
LSS	LSS + Sustainability	11	9	0	9
FMEA	FMEA + Sustainability	4	4	0	4
EFQM-Model	EFQM + Sustainability	9	5	0	5
ISO 9000 / ISO 14000 / ISO 26000	ISO 9000 + ISO 14 000 Quality Management + ISO 14000 Quality Management + ISO 26000	12	7	0	7

Source: Author's own

3. Literature review

This section gives an overview of the currently available articles that cover the sustainability-enhancing application of essential QM tools and methods.

An early more sustainable adaption of Quality Function Deployment (QFD) is based on Cristofari et al.'s (1996) Green Quality Function Deployment method. Zhang (1999) integrated Life Cycle Assessment (LCA)[1] and Life Cycle Costing (LCC)[2] into QFD matrices and called their improved version GQFD-II. The three different matrices (a regular House of Quality, a Green House and Cost House) help to enhance the design deployment as well as the planning of processes, production, maintenance, and retirement.

QFD is also applied in combination with other methods to strengthen a balanced approach to the three pillars. Dai and Blackhurst (2012) proposed the use of the Analytic Hierarchy Process (AHP)[3] merged with QFD to support the prioritization of many choices in the context of sustainable supplier assessments. As the number of parameters will presumably increase further in the future this tool can help to overcome decision difficulties (Dai and Blackhurst; 2012).

More criteria also increase trade-off situations. In this context, a case study by Yazdani et al. (2016) investigated how Step-wise Weight Assessment Ratio Analysis (SWARA)[4] in combination with QFD enhances the selection of green suppliers. They use SWARA to rank all criteria and with this information basis guide the supplier choice.

[1] LCA is a method to evaluate the environmental impacts of an industrial activity from the stage of raw material gathering to the final disposal. The procedure is specified in ISO 14040 and ISO 14044 (França et al., 2021).
[2] LCC is one tool for a LCA and helps to determine the costs of a specific product or service life cycle. ISO 15686-5 is the most commonly used guideline as there is no general standard for the application (França et al., 2021).
[3] AHP supports decision making among multiple alternatives by comparing pairwise and totalling the relative importance of different choices (Sipahi and Timor, 2010).
[4] SWARA is an alternative to AHP and based on expert opinions. Their individual rankings for the set of criteria is summarized in one hierarchy based on the average rank (Yazdani, Hashemkhani Zolfani and Zavadskas, 2016).

In another approach, Zaitsev and Dror (2020) utilized the QFD methodology to enhance the CSR model. They showed how to integrate priorities in a set of CSR parameters to achieve high benefits in all business development stages.

Furthermore, various authors published frameworks and case studies with approaches to introduce FMEA in a sustainable context. For example, Kokangül et al. showed that their Environmental Failure Mode and Effect Analysis (E-FMEA) method helped identify, evaluate, and prioritize environmental risks leveraging the environmental impact categories of ISO 14000. The name E-FMEA is misleading as the included criteria also consider social aspects like the impact area and physical effort. Moreover, Mangla et al. (2018) studied the benefits of applying fuzzy[5] Environmental FMEA to strengthen fact-based choice-making in Green Supply Chain (GSC) decisions compared to the normal FMEA. Using a similar strategy, the findings of Foroozesh et al. (2017) support the evidence.

Faulkner and Badurdeen (2014) were the first to design a methodology called Sustainable Value Stream Mapping (Sus-VSM) which helps to evaluate the manufacturing performance regarding all three pillars of sustainability more evenly. This framework was used and validated by Brown, Amundson and Badurdeen (2014), and later also further enhanced with additional aspects. In 2020, Jamil et al. for example extended the Sus-VSM framework and fit it into the DMAIC-Cycle[6] to strengthen the systematic nature of the approach, the repeatability, and the continuity of the improvement cycle.

Goyal et al. (2018) did not develop a new framework but proved with a case study that Kaizen itself is an effective tool for waste reduction. Sanchez-Ruiz et al.'s (2020) insights from their literature review about Kaizen and Green Practices confirm these results.

A promising model in terms of Kaizen, was designed by Raffaeli et al. (2021) and is divided into 11 steps with applicable methods for each stage. Even though the number of stages might seem overwhelming in the beginning, the map is a good guideline to start the project of organizational sustainability in a structured way.

VSM and Kaizen are methods included in the LM philosophy, but there is also extensive research about Lean and environmental impact. While there is evidence that certain aspects of Lean (e.g. pull approach, cellular manufacturing system, pre-production planning) reduce the environmental impact (Fliedner, 2008; Costa and Ferraz, 2017; Henao, Sarache and Gómez, 2019), Just-In-Time increases transportation emissions due to smaller badges and more frequent deliveries (Sartal, Martinez-Senra and Cruz-Machado, 2018; Green et al., 2019). Also, there is a lack of research on the integration of social sustainability in LM (Siegel et al., 2019).

The investigation of Green Lean Six Sigma (Kumar et al., 2016; Gholami et al., 2021; Ahmad and Kan, 2022) reflects a trend toward merging different philosophies to mitigate individual shortcomings. It is unclear to what extend these combinations help or whether new tools need to be created.

There are also results available on the connection between the QM philosophy, Total Quality Management (TQM), and sustainability. It can be stated that TQM raises the sustainability of an organization due to various shared success factors like top management commitment, appropriate communication and training, change management and deployment of tools like zero defects, waste reduction, employee involvement, and LCA (Benavides-Velasco, et al., 2014; Aquilani et al., 2016). Depending on external customer requirements (Green et al., 2019), the environmental and social pillars will be driven more or less strongly. In addition, a positive relationship between TQM and CSR as one aspect of sustainability has been proven (McAdam and Leonard, 2003; Kazmierczak, 2015).

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[5] In this context 'fuzzy' relates to the concept of fuzzy logic. Fuzzy models deal with vagueness and imprecise information and use mathematics to convert this data into a numerical value (Sabahi and Akbarzadeh-T, 2016). Detailed information about the algorithm of fuzzy decision making can be found in Zimmermann (2001).

[6] As PDCA, the five steps of DMAIC help to establish a CI cycle. The abbreviation is short for: Define, measure, analyse, improve and control (Jamil et al., 2020).

Another potential influence on more sustainable QM is the European Foundation for Quality Management (EFQM)-Model. The available research evaluates the old EFQM-Model which was replaced by the new version in 2021 (European Foundation of Quality Management, 2021). Until today, the literature mainly discusses the connection to CSR (Calvo-Mora et al., 2017; Martín-Gaitero and Escrig-Tena, 2018) or the social pillar of sustainability (Asif et al., 2011), even though it is mentioned that also the environmental aspects are included. Nevertheless, the balance of the three dimensions is dependent on the management focus of each company.

Apart from that, the ISO standard series for Quality Management (ISO 9000) shaped many businesses since its first release. Overall, there is some evidence that the integration of ISO 9000 and ISO 14000 (Standard series for Environmental Management) is possible and beneficial (Tarí and Molina-Azorín, 2010; Aba and Badar, 2013). Although the research does not examine the recent versions of both standards, the ISO 14000 standard was developed to be compatible with ISO 9000 (Miles and Russell, 1997). Therefore, one can assume that the documented benefits are still applicable. Regarding the newer ISO 26000 (Standard for Corporate Social Responsibility), no articles specifically discussing the integration of all three management systems could be found. This indicates a clear research gap.

Concluding this short literature review, it is reflected on QM and sustainability from a macro perspective.

Vandenbrande (2020) introduced a matrix with three stages of sustainability (awareness, adoption and achievement) that helps to perform a self-assessment about where the company at present stands and thereafter allows it to launch a formal sustainability program.

Looking at a different aspect of becoming sustainable, Lagrosen and Lagrosen (2019) investigated the US-American manufacturing company Sky Factory, which became one of the first zero-net companies in the United States in 2012. Their outlined conceptual model describes the required organizational culture for sustainable quality management.

Goyal, Agrawal and Saha (2019) suggest a new way of dealing with defects by proposing to concentrate on the impact of defects. This implies that each defect is weighted in terms of severity.

Focussing on CSR, Tarí (2011) states that managing quality successfully is inevitably interconnected with an explicit focus on moral values. In this context, ‘doing the right things right’ is not only a common principle of QM but also of CSR (Tarí, 2011; Neri et al., 2019). From this point of view, CSR can be considered a subset of QM programs aimed at achieving higher customer satisfaction to enhance organizational performance (Parast and Adams, 2012). In the long-run QM and CSR promise businesses substantial and sustainable success (Larrán Jorge et al., 2016). This view is generally shared, nevertheless more guidelines for the implementation are required in the future.

New technological developments and environmental problems will change QM. Deleryd and Fundin (2020) claim that the fifth generation of QM (called Quality 5.0) requires a broader quality definition. This perspective includes societal satisfaction meaning that stakeholders presume organizational sustainability for their satisfaction. Customers will stay the most important stakeholders, but a broader sense of stakeholders that covers environmental and social dimensions need to be considered as well (Deleryd and Fundin, 2020).

On this account, companies must start to implement available tools and enhance them as new insights emerge. In the end, societal satisfaction as a quality goal is the most advanced approach to sustainable quality management. The presented framework in the subsequent chapter is aimed to help practitioners choose the right tool on their journey for more sustainability.

4. Framework

The framework summarizes applications of respected QM tools from the conducted literature review above and categorizes them in terms of complexity of implementation and aspect of utilization. As these methods help to achieve better sustainability, they also pave the way to implement the future QM philosophy aiming for societal satisfaction.

The framework in Figure 2 is divided into two axes. On the one hand, all methods are classified in terms of difficulty of application (easy, medium, and hard) in ascending order. On the other hand, each tool is categorized in a type of application. It is based on the assessment of the author which practices build comprehensive clusters. Users can thus find a suitable method faster and more easily.

Figure 2. Guiding framework for sustainable Quality Management

	STRUCTURE FOR APPROACHING SUSTAINABILITY	CULTURE FOR SUSTAINABILITY	ORGANIZATIONAL SUSTAINABILITY	MANUFACTURING	PRODUCT DEVELOPMENT	SUPPLY CHAIN
EASY	11-step Kaizen framework (Raffaeli, Rossi and Cappelletti, 2021)		Kaizen 5S	Sus-VSM (Faulkner and Badurdeen, 2014; Jamil et al., 2020)		
MEDIUM	SQMS framework (Pun, Chin and Lau, 1999)	House of Values (Lagrosen and Lagrosen, 2019)	LM and Sustainability (with 7S checklist) (Vinodh, Arvind and Somanaathan, 2010) E-FMEA (Kokangül, Polat and Dağsuyu, 2017) QFD for CSR (Zaitsev and Dror, 2020)	Weighted defects (Goyal, Agrawal and Saha, 2019)	GQFD-II (Zhang, 1999)	
HARD	Sus-QM self-assessment framework (Kuei and Lu, 2013)	5th generation of quality (Deleryd and Fundin, 2020 or Wen, Sun and Yan, 2020)	TQM EFQM			Fuzzy FMEA (Mangla, Luthra and Jakhar, 2018 or Foroozesh, Tavakkoli-Moghaddam and Meysam Mousavi, 2017) QFD + AHP (Dai and Blackhurst, 2012) / QFD + SWARA

						(Yazdani, Hashemkhani Zolfani and Zavadskas, 2016)

Source: Author's own diagram

The remainder of this section clarifies the benefits of the selected methods as well as suitable areas of application to facilitate the decision-making process for practitioners even further.

The first category, 'structure of approaching sustainability', includes concepts to approach the topic of sustainability in an organized way. Mentioned frameworks help users to apply methods in a reasonable way, which will increase the chances of a successful outcome.

Raffaeli et al. (2021) designed the 11-step Kaizen framework guiding through the process of increasing sustainability from problem identification up to the standardization of solutions. Especially in companies where CI with PCDA or DMAIC is not a standard yet, this framework can be helpful. But also experienced users can assess their processes with this methodology and gain new ideas for improvement potentials or useful tools. Even though the 11-step plan is easy to understand, the user requires knowledge about the various tools for each step. Nevertheless, the difficulty of the framework is considered as easy, and knowledge can be gained one step at a time.

A similar approach by Pun et al. (1999) is a self-assessment scheme for QM systems based on the integration of ISO 9000, ISO 14000 and Malcolm Baldrige National Quality Award requirements. Their comprehensive 14-step plan is interesting for companies that either aspire to be certified or are already certified and need to comply with the given specifications. As this framework is over 20 years old, it is not adapted to the current versions of the standards or the quality award. Overall, it is considered to have a medium application difficulty because details must be adapted independently.

Quality-driven Sustainability Management by Kuei and Lu (2013) is of interest to all companies that want to use stable quality structures to start building a sustainability practice. It is valuable as the paper is conceptualized for organizations of all sizes. Also, it includes pitfalls for each step of the PDCA-Cycle and an adaptable self-assessment template. As it is essential that QM structures and a QM culture are already successfully integrated within the business, the entry-level for this framework is evaluated as hard.

The next matrix category is 'culture for sustainability'. Just like quality, sustainability is a matter that concerns all employees (Lagrosen and Lagrosen, 2019). Therefore, it is fundamental to build a strong culture that supports sustainable practices. The framework by Lagrosen and Lagrosen (2019) presents a set of values that characterizes the culture in the award-winning sustainable Sky Factory though it doesn't include a corresponding framework. This paper can be helpful for companies that already apply tools and techniques but did not get the desired impact. Although users do not require any prior knowledge to understand the results of the study, the process of building a culture around chosen values is long and unpredictable (Furst and Cable, 2008). Therefore, it is considered to be medium in terms of implementation. This is also a major pitfall of a potential re-application of this study: the desired result is to establish easily comprehensible values in an organization and while the theory behind organizational culture is explained, it does not reflect the difficult process to alter organizational values.

With this in mind, the adaption of an entirely new view on quality in the context of Quality 5.0 is considered even more difficult, not least because it still lacks research and methods. Therefore, only organizations that already have a high degree of excellence should start to engage in this new evolution of quality. The possible benefits of being a role model for Quality 5.0 are balanced by high risks due to little theoretical foundation and should be evaluated with

caution. Nevertheless, taking the leadership role is not feasible for all businesses. ‘Organizational sustainability’ addresses all tools that are not limited to a certain department of the business like for example the production area or specific processes like product development.

The research about Kaizen as a method itself (Goyal et al., 2018; Sanchez-Ruiz et al., 2020) shows that it enhances the environmental pillar of the TBL. It is included in the framework because it helps to start building momentum for change and to gather evidence for the economic advantages of sustainability in the long run. All companies can carry out small projects without high investments and thereby slowly build a culture around CI and employee involvement, thus leading to a rating as easy in terms of application.

Like Kaizen, 5S is classified as easily applicable and equally all companies can start to introduce the 5S systematically without major investments or required pre-existing knowledge. It slightly strengthens the environmental and social performance, but more importantly, starts to build a culture around quality and sustainability. Therefore, it is a good starting point. In this context, the 7S check list of Vinodh et al. (2010) can also be beneficial as an extension of the original 5S. It ensures that important areas of sustainability are taken into account, while at the same time providing a layout for data collection that enables progress tracking. It is categorized as medium, as the six-step implementation approach of sustainability relates to Lean tools and philosophy.

Kokangül et al. (2017) use the environmental impact categories of the ISO 14000 standard in connection with an FMEA to assess the environmental risk of a company. Therefore, this approach is helpful for organizations that want to make strategic decisions about which factors threaten their business the most. If the business invests time to define social parameters as well, this tool can be enhanced to improve sustainability. Considering this additional independent research, it is classified as medium difficulty.

Zaitsev and Dror (2020) developed a QFD-based approach to CSR. Especially for companies that already use QFD in the original context of QM, this adapted version of the HoQ represents a valuable possibility to engage more with CSR without the need to implement completely new tools. This method connects CSR goals with CSR key performance indicators (KPIs) and thereby strengthens the measurability of rather intangible values. It should be noted that knowledge about MSE is required for the application which justifies the categorization as medium difficulty of implementation.

TQM, as a QM philosophy, is sorted into the category ‘hard’. Even though TQM is an established and well-researched subject, which helps practitioners to be prepared for pitfalls and to use available information to support the implementation process, the rollout of TQM in an organization is a long process and requires adequate resources. Companies that have introduced TQM can benefit from the existing structures and specifically strengthen the aspects corresponding to CSR. Especially the culture is considered helpful for driving sustainability further (Curry and Kadasah, 2002). However, no framework on how to proceed to connect TQM and CSR more closely was found in the reviewed articles.

The EFQM model was also classified as hard to implement within the ‘organizational sustainability’ category. The excellence model guides companies to achieve a high standard of quality and also incorporates all three dimensions of the TBL, although especially the social aspect would need to be strengthened in the model (Calvo-Mora, Domínguez-CC and Criado, 2017). Nevertheless, this model helps organizations to assess themselves and improve without necessarily investing the financial resources for an award application. As the demands are very high, for new users the different possibilities for improvement might be overwhelming and not give enough guidance for a suitable prioritization. Therefore, it is recommended that organizations with a certain level of quality use the EFQM-Model to find weaknesses in their sustainability performance.

The fourth category - ‘manufacturing’ - contains methods that will have the biggest impact on the production environment.

The Sus-VSM method developed by Faulkner and Badurdeen (2014) was assessed as the easiest tool to start with. It is a comprehensible advancement of the traditional VSM with variables of the environmental and social pillars. Furthermore, it was tested and complemented by various other researchers such as Jamil et al. (2020). For users that want to connect the Sus-VSM closer to a CI, Jamil et al.’s framework is the preferred choice. Faulkner and Badurdeen’s original research guides organizations to successfully apply the method. It is a convenient way to start measuring more environmental and social parameters. All existing information can be used which reduces the implementation effort further. In general, it is a good starting point if companies do not yet engage in QM, as VSM is a fundamental QM tool and helps to detect improvement methods and monitor ongoing changes.

One stage more difficult is the approach of Goyal et al. (2019) to prioritise defects in terms of their impact. This review suggests that companies that already work with Six Sigma use this approach to enhance the view on their issues by also weighting them with environmental and social factors. The case study presents how to proceed in a mathematical way. The required mathematical skills make this method more advanced than the previous one. Therefore, the overall difficulty of implementation is medium.

Even though only Zhang’s (1999) tool specifically targets the product development process, it was classified as a separate category in the framework, because it is a specific topic. A good planning phase saves efforts for changes in later stages of the product life cycle, for example with regards to materials or the manufacturing processes. GQFD-II is especially interesting for companies that already apply QFD and that have knowledge about LCA and LCC. In this case the fusion of these methods should mean relatively low effort. Understanding LCA and LCC in general is rather easy, but for example installing new processes for measuring the specific environmental costs for each individual product implies high effort. Furthermore, the company requires defined and consistent demands for all products considering all three dimensions of sustainability. Especially the importance factors for each category of the TBL must be as balanced as possible. Considering the required preparation before starting to apply GQFD-II, the overall difficulty is assessed as medium.

The last category of the developed framework is ‘supply chain’. As it is easier to start change in their own business, it is suggested that all organizations should start to improve their own sustainability first, before concentrating on the entire supply chain. To show a complete picture of the reviewed literature, this category was included as well. However, all presented methods have high demands in term of mathematical or programming skills which makes their implementation relatively difficult.

Mangla et al. (2018) and Foroozesh et al. (2017) follow similar approaches in which they combine FMEA with a fuzzy decision-making method. Both try to overcome the human bias and the difficult-to-deal-with amount of data. As the supplier choices are becoming more complex, it is recommended that organizations with the required capabilities introduce one of the two approaches. If a business prefers to work with an expert group for the decision-making process, the case study of Foroozesh, Tavakkoli-Moghaddam and Meysam Mousavi (2017) is suggested, otherwise Mangla, Luthra and Jakhar (2018) is recommended.

QFD in combination with AHP (Dai and Blackhurst, 2012) or SWARA (Yazdani et al., 2016) facilitates making decisions where many different customer demands are involved. For companies that want to strengthen the influence of customers, these methods are of interest. The difference between both approaches is the mathematical formula that calculates the priorities. Judging from the published papers both methods seem to be successful, but at this point it cannot be evaluated which one is better overall or in a specific context.

Tables 2 and 3 summarise important decision criteria such as the impact of the method on the three dimensions of the TBL and the effort of applying them with the corresponding evaluation of how strong the benefit for each category is.

Table 2. Overview of impact, difficulty, and effort for adapted QM methods for sustainability

Source	Method	Impact sustainability dimensions			Difficulty	Effort	Additional Knowledge
		Eco	Env	Soc			
Pun, Chin and Lau (1999)	SQMS framework	↑	↑	→	→	↓	↓
Zhang (1999)	GQFD-II	→	↑	↑↑	→	→	↑ (LCC and LCA)
Vinodh, Arvind and Somanaathan (2010)	LM for Sustainability (7S checklist)	↑	↑	→	→	→	↑ (VSM+LM)
Dai and Blackhurst (2012)	QFD + AHP	↑	↑	↑↑	↑↑	↑	↑ (Programming/Maths)
Kuei and Lu (2013)	Sus-QM self-assessment framework	↑	↑	↑	↓	↑	→ (Auditing)
Faulkner and Badurdeen (2014)	Sus-VSM	↑	↑↑	↑	↓	↓	↓
Goyal, Agrawal and Saha (2019l)	Weighted defects	↑	↑	↑	→		→ (Six Sigma)
Yazdani, Hashemkhani Zolfani and Zavadskas (2016)	QFD + SWARA	↑	↑	→	↑↑	↑	↑ (Programming/Maths)
Foroozesh, Tavakkoli-Moghaddam and Meysam Mousavi (2017)	Fuzzy FMEA	↑	↑	↑	↑↑	↑	↑ (Programming/Maths)
Kokangül, Polat and Dağsuyu (2017)	E-FMEA	↑	↑↑	(↑)	→	→	→ (Social parameter)
Mangla, Luthra and Jakhar (2018)	Fuzzy FMEA	↑	↑	↑	↑↑	↑	↑ (Programming/Maths)
Lagrosen and Lagrosen (2019)	House of Values	↑	↑	↑	↑	↑	↑ (Organizational change)
Jamil et al. (2020)	Sus-VSM + DMAIC	↑	↑↑	↑	↓	→	↓
Zaitsev and Dror (2020)	QFD for CSR	→	↑	↑↑	→	→	↑ (MSE)
Raffaeli, Rossi and Cappelletti (2021)	11-step Kaizen framework	→	→	→	↓	↓	↑ (QM Tools)

Source: Author's own

Table 3. Overview of impact, difficulty, and effort for sustainability enhancing common QM methods

Method	Impact sustainability dimensions			Difficulty	Overall Effort
	Eco	Env	Soc		
5S	↑	↑	→	↓	↓
Kaizen	↑	↑	↑	↓	↓
TQM	↑	→	↑	→	↑
EFQM	↑	↑	↑	↑	↑

Source: Author's own

5. Conclusion

Sustainable organizations consider the utilization of all resources and the decrease of negative social and environmental impact while continuously guaranteeing economic success. Building on the methodology of a structured literature review, the purpose of this paper was to find and analyse research that connects QM methods, standards, and philosophies with organizational sustainability. This article, therefore, helps to close a research gap, as up to this point there is no resource available that combines and evaluates sustainable QM approaches and outlines them in a short and understandable way for QM professionals.

The conceptual framework that was developed based on the structured literature review is divided into three degrees of difficulty (easy, medium and hard) in terms of implementation as well as five different fields of application (approaching sustainability in general, culture for sustainability, organizational sustainability, manufacturing, product development and supply chain). Thus, users with specific goals should easily find a method suiting their objectives and their status of current sustainability practices. Thereby, the initial hurdle of implementing the tool is minimized.

Especially in the categories ‘structure for approaching sustainability’ and ‘organizational sustainability’ a high variability in terms of implementation difficulty was found. This ensures suitable options for beginning and advanced organizations on their journey to more sustainability. Also ‘manufacturing’ includes approaches that are beginner friendly, whereas the areas ‘culture for sustainability’ and ‘supply chain’ are better suited for advanced applicants.

Tables 2 and 3 give an essential overview of the impact of the method on the three dimensions of the TBL and the effort of applying them with the corresponding evaluation of how strong the benefit for each category is.

The course of this article confirms Fundin et al.’s (2020) opinion that the relationship between quality and sustainability still needs further research. As only some frameworks were tested in case studies or validated by other authors (e.g. Vinodh and Chintha, 2001; Faulkner and Badurdeen, 2014; Foroozesh et al. 2017; Mangla et al., 2018), future research should analyse existing methods in more detail involving cross-sector organisations. This will expose implementation issues and help to specify suitable measurements, especially for the environmental and social dimensions of the TBL. In this context, generally applicable KPIs for the other two pillars, such as rentability or cycle time for the economic dimension, should be evaluated and if necessary developed. Available lists incorporating factors like company size, industry sector and process types, could help organizations choose effective indicators to measure their processes and direct their efforts.

Overall, the social dimension is under-represented in research. Therefore, new research should fill this gap by either testing the expansions of current green practices to sustainable methods or by creating new sustainable tools.

The ISO 9001 certification series remains highly important for international organizations, and the certifications around ISO 14000 and ISO 26000 are gaining more relevance as well (Wen et al., 2020). Therefore, it should be investigated how to build a joined management

system around the requirements of the standards series and how integrated audits could be conducted (Kurdve et al., 2014). At the moment, all available research is outdated (e.g. Pun, Chin and Lau, 1999; Renzi and Cappelli, 2000; Poksinska, Jörn Dahlgaard and Eklund, 2003).

The limitations of this review include the selection process and the analysis of the papers that were conducted by only one person. The corresponding bias was mitigated by the definition of clear inclusion and exclusion criteria during the literature search as good as possible.

Nevertheless, the evaluation of all included tools and their effectiveness remains biased due to the perspective of only one researcher. More generally speaking, the defined inclusion criteria can result in further sustainable approaches to QM methods not being considered.

A future case study with different organizations using the framework to choose methods to enhance their sustainability can give more insight into the validity and possible shortcomings of this first version.

Furthermore, the framework does not differentiate between different types of companies. As the available literature for example does not consider if the organization is an SME, it wasn't incorporated into the framework either.

However, this paper represents the first framework to help practitioners in choosing the right methods for their objectives. of various QM methods and how they can be used to improve organizational sustainability. This saves quality professionals effort and gives them more time to concentrate on the implementation, thereby closing a research gap.

In conclusion, this paper shows that QM has the tools to help organizations to improve their sustainability. As the pressure of society on companies increases to consider more than just financial success, QM can be one starting point. Quality already has the advantage that it is built on a company-wide infrastructure and a set of values. This basis can be leveraged for the implementation and promotion of more sustainable practices as well. This process will not only require more research about existing QM tools, but also new approaches that help to solve emerging problems. Therefore, it is possible that this trend also shapes the future of the quality perception toward societal satisfaction.

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