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On the inclusion of sustainability and digitalisation in quality management – an overview from past to present

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The aim of this study is to explore whether trends in sustainability and digitalisation from the 1980s until today have left any significant practical or epistemological footprints on the quality management paradigm. The study design consists of a mixed-methods approach that applies a data-mining methodology and content analysis to the digital archives of eight scientific journals: six within the quality management (QM) domain and two with a focus on operations management (OM). The data set contains an unbroken time series of over 12,000 research paper abstracts, the first of them published in 1980, giving the study a coverage of almost 40 years. The findings show that sustainability came onto the scholarly scene in 1996 and has since become an increasingly popular research area. In regard to digitalisation, the story is quite different, as the concept is currently absent from the scholarly QM and OM literatures. However, a search for information technology (IT) and information systems (IS) revealed that these topics have been gaining attention since the 1980s. However, it was found that QM research only addresses one part of digitalisation, omitting several interesting dimensions. One example is that the QM and OM literatures address IS mainly in relation to standardised guidelines and business processes within organisations. At the same time, we found a handful of studies combining QM and topics related to modern digitisation, like social media.

Keywords: quality management; total quality management; sustainability; digitalisation; artificial intelligence; sustainable business excellence; sustainable development

Introduction

The 2020 Excellence Summit invites practitioners, managers and researchers to reflect on the future of quality and the quality of our future. In this venture, sustainability and digitalisation are singled out as areas of special interest to quality professionals, as both offer possibilities while also posing system-wide challenges to all parts of society. The conference organisers are not alone in their interest in these topics (Lock & Seele, 2017; Seele & Lock, 2017). Mårtensson et al. (2019) found that there are numerous connections between research on sustainability and the core values of Quality Management (QM). Similarly, Sony et al. (2020) established that QM is one of the areas that will be significantly affected by digitalisation. Consequently, it is reasonable to assume that organisations aspiring for excellence and sustainable quality development boast well-developed strategies...
regarding both sustainability and digitalisation. In the same vein, it would be reasonable to assume that academia has by now developed some level of verified scientific insight and solutions to aid the development of long-term strategies for quality in light of sustainability and digitalisation. However, what do we actually know about the current knowledge base and organisational maturity regarding sustainability and digitalisation? Klefsjö et al. (2008) pose the question of whether actors within the QM arena even agree on what we are talking about in regard to such well-used terms as customers and stakeholders and if that matters. Likewise, it is worth raising the question of whether everyone agrees on what is meant by sustainability and digitalisation and if there are any consequences for the quality field if they do not. Consequently, the purpose of this study is to look into 40 years of QM research to explore how sustainability and digitalisation have informed the quality paradigm and reflect upon the possible effects of these evolutionary patterns.

Sustainability and QM

Svensson (2006) noted a mounting interest in sustainability within the quality field during recent decades. One of the driving organisations is the United Nations (UN), and one of the UN’s many steps in its striving to promote sustainability was the formulation of the global sustainability goals declared in the General Assembly in 2015 and dubbed the 2030 Agenda (Colglazier, 2015). In 2012, the UN suggested that individuals, companies, and organisations are important to achieving global sustainable development (UN, 2012). Much has been done since then, but it is also known that there is a need for more action to make actors in the world truly sustainable (Laszlo et al., 2005).

One well-known definition of sustainable development, presented by the Brundtland Committee in the report titled ‘Our Common Future’ (WCED, 1987), posits that such development meets the needs of the present without compromising the ability of future generations to meet their own needs, but the concept of sustainability is still often perceived as vague (Kolari, 2008). One belief among many organisations is that sustainability solely addresses the environment (Canning, 2010). This knowledge gap can cause problems, since the three key spheres within sustainability, i.e. ecology, economy and society, are interconnected and need to be seen as a system (Winter, 2008).

According to Vandenbrande (2019), many organisations have the desire to be more sustainable, but according to the organisations themselves, they lack the structures needed to proceed. Jonker (2000) suggested that the classical QM values need to develop to offer organisations the support they need to inform the thoughts, considerations, and actions of people both within and around the organisation to allow them to take responsibility in terms of social and environmental accountability. From this perspective, it can be seen as good news that Mårtensson et al. (2019) found that earlier studies indicate several interlinkages between sustainability and values within QM (e.g. Azevedo et al., 2012; Laszlo et al., 2005; Lindsey, 2011; Piercy & Rich, 2015; Rusinko, 2005; Tice et al., 2005). According to Bergman and Klefsjö (2010), values within QM are satisfied through the usage of methods and tools. Hence, QM in this study is seen as the collective term for the development of programmes and practices that are included in the quality movement. Examples of QM programmes and practices include total quality management (TQM), Six Sigma, ISO standards and the Lean methodology (Bergman & Klefsjö, 2010). A focus on the quality and development of quality systems in organisations has been shown to positively impact outcomes related to sustainability (Lindsey, 2011). Several of the QM initiatives are built on values (Lagrosen, 2006), and values are a fundamental part of culture (Campbell, 2004). Values relate to outcomes since they energise employees by appealing to their
higher ideals and undefined principles, and they shape and coordinate behaviours and decisions (Chatman & Eunyoung Cha, 2003; Grönfeldt & Strother, 2006). Of great importance when attempting to change a prevailing culture is a long-range time horizon, as cultural changes take time to settle (Senge, 2006). Another cultural success factor when implementing a QM initiative like Lean, is that it must benefit the customer (Emiliani, 2010).

**Digitalisation and QM**

Digitalisation has undoubtedly become a trending topic in recent years, but as Brunetti et al. (2020) rightfully wonder: why? After all, digital technology and research on it have been around for over 50 years. The answer is found in the fact that digitalisation affects every human activity (Brunetti et al., 2020), changing the way we communicate, consume, and create (Aral et al., 2013). Information, knowledge and processing capacity are now permanent and ubiquitous, and the growing connections between people, objects, devices and systems are modifying the conditions under which individuals, businesses and societies live and operate (Brunetti et al., 2020). Thus, no business industry or organisation is immune to the effects of digitalisation (Brunetti et al., 2020). Neither is the QM field, which will also be significantly affected by ongoing digitalisation (Sony et al., 2020).

According to Brunetti et al. (2020), the main research streams of the digitalisation literature are focused on the following topics: (1) digitalisation as a bundle of changes, (2) key technologies of digitalisation, (3) challenges of digitalisation and (4) enabling factors. These research streams are addressed to different extents in the QM literature. For example, digital technology has been identified as presenting both enormous opportunities and enormous threats to, for example, the corporate world (Kobus et al., 2018), causing increased competition, cost pressure, and reorganisations (Behmer et al., 2016). Whereas digital technology is seen to provide opportunities for new and alternative business models and agile, fast-moving companies (start-ups), for established business models and large, slow-moving companies (traditional players), digital technology can be seen as a threat (Kobus et al., 2018). This is because start-ups and young companies can design many of their digital solutions in a straightforward greenfield setting using agile processes and flexible and minimal management structures (Kobus et al., 2018). The IT organisations of traditional players, on the other hand, often face a complex application landscape that combines multiple legacy applications, inflexible processes, and rigid managerial decision-making structures that make digitisation more difficult to introduce (Kobus et al., 2018).

Digitalisation also triggers new market and sourcing strategies, as well as shortened life-cycles of product and manufacturing technologies, adding additional factors that result in a significant increase in and QM flexibility requirements (Behmer et al., 2016). The digitalisation of organisations creates unique opportunities for managing the quality of products and services delivered by the organisation (ibid). On the other hand, Sony et al. (2020) acknowledged that it is a challenge to validate how far traditional quality management practices and methods have absorbed changes in product development stages, cycle time compression and employee effort to match demand and customer expectations.

At the same time, today’s high complexity leads to an increase in the response time needed to adjust accordingly. The gaps between strategies and set-ups as well as between the available and required response time to adjust the quality management organisation (QMO) pose, in practice, an apparently severe challenge (Behmer et al., 2016). It is an essential task of QM to ensure the fulfilment of customer requirements in the face of shortened product life cycles, increased product complexity, market dynamics and changes brought about by digitisation (Behmer et al., 2016). Nevertheless, recent incidents
of large-scale quality-related problems show that outdated QMO structures are unsuitable for keeping up with the requirements of a changed environment, putting competitive factor quality at risk (Behmer et al., 2016). This results in a gap, making the planning and implementation of appropriate QMOs an ongoing challenge (Behmer et al., 2016).

Finally, scholars such as Cavallone and Palumbo (2020) identified how digital technologies such as artificial intelligence along with technology-enhanced approaches such as industry 4.0 merge technological improvements and patient centredness in an attempt to achieve two diverging strategic goals of healthcare organisations: (1) the enhancement of the quality of health services and (2) the containment of health-related costs. However, Cavallone and Palumbo (2020) also identified a dark side of the current trends, as there seems to be a limited ability to merge industry 4.0 and patient centeredness.

Materials and methods
The study design consists of a mixed-methods approach that applies data mining methodology and qualitative analysis. The methodological approach was guided by the business reflexive text-mining process introduced by Carnerud (2019), illustrated in Figure 1.

Business reflexivity concerns the subject under investigation, i.e. exploration of sustainability and digitalisation within the QM paradigm. Worth noting in this context is that the use of British English is applied in the manuscript; i.e. the spellings ‘digitalisation’ and ‘digitisation’ are used throughout the text. However, in the phases elaborated below, the American English spellings were naturally also included, i.e. ‘digitalization’ and ‘digitization’. In any case, digitalisation and digitalisation as well as digitisation and digitisation are identical.

The data collection, understanding and preparation phases refer to the collection, cleaning, and structuring of data for the purpose at hand. In this study, the following points guided the search for scientific journals from which data could be collected:

Figure 1. Business reflexive text-mining process (Carnerud, 2019).
QM, TQM or OM had to be in the title.
The purpose of the journal should be to publish theoretical and practical research on QM or OM research.
The journals had to be peer-reviewed.
Journals with high Source Normalized Impact per Paper (SNIP), Impact per Publication (IPP) and SCImago Journal Rank (SJR) were prioritised.
The database structure had to allow large-scale data collection.
The journals should, if possible, be distributed by different publishing houses.

Following these guiding points, the collected data consisted of journal abstracts from the complete digital archives of eight scientific journals: six within the QM domain and two with a focus on operations management (OM). The OM journals were used to conduct comparisons of the two research areas. The eight scientific journals were Asian Journal of Quality (AJQ), Total Quality Management & Business Excellence (TQMBE), International Journal of Quality & Reliability Management (IJQRM), International Journal of Quality Sciences (IJQS), International Journal of Operations & Production Management (IJOPM), Journal of Operations Management (JOM), The TQM Journal (TQMJ) and Quality and Reliability Engineering International (QREI). In all, the data set contained 11,631 research paper abstracts, the first published in 1980, in an unbroken time series, giving the study coverage of almost 40 years. The data set was then reviewed for the terms digitalisation, digitalisation and sustainability. As there were no entries for either digitalisation or digitalisation, the data set was searched for digitisation and digitisation. Since these results were also scarce, the data set was searched for information systems (IS), information technology (IT), artificial intelligence, information and communication technology (ICT), Internet of Things (IoT), cloud computing, machine learning and social media as proxies for digitalisation, digitalisation, digitalisation and digitisation. Additionally, due to their potential relationship with sustainability, it was worthwhile to search the data set for sustainable development as well as sustainable quality of life, sustainable high performance, sustainable solutions, sustainable excellence, sustainable business excellence (SBE), sustainable success, sustainable growth, sustainable TQM, sustainable profitability, sustainable quality development and green quality. The results from the data searches are presented below in Table 1. Furthermore, a cross-examination of the abstracts was conducted to determine the overlap of abstracts, that is, the extent to which the same abstract appeared in several categories (Machi & McEvoy, 2012).

Modelling, interpretation and evaluation consisted of a longitudinal time-series analysis with sliding average and qualitative analysis of the identified abstracts. The qualitative analysis was inspired by grounded theory (Corbin & Strauss, 1990; Glaser & Strauss, 1967) as well as thematic analysis (Braun & Clarke, 2006, 2012). In particular, the more inductive parts of the above approaches – the parts that are the very foundation of grounded theory but also viable parts of both hermeneutic and thematic analysis – were adopted. The query was structured in the following main steps:

(1) Becoming familiar with the material
(2) Identifying the ways in which QM and OM has approached sustainability and digitalisation and coding these approaches through keywords
(3) Creating more comprehensive themes out of the keywords

The first step in the analysis process is, according to Braun and Clarke (2006, 2012), to become familiar with the data set. In this analysis, the familiarisation process was partly
performed by completing the quantitative analysis described above and partly by briefly looking through the abstracts to get a first feel of how the domain has approached the areas of sustainability and digitalisation on a more general level.

The next step was to identify the ways in which QM and OM has approached sustainability and digitalisation. Following the procedure of both grounded theory and thematic analysis, we read through and coded the abstracts one by one (Braun & Clarke, 2006, 2012; Corbin & Strauss, 1990). For each abstract, the way that QM and OM approached sustainability or digitalisation was identified and given a code or codes depending on the approach identified. The process was guided by a set of keywords found in the literature.
Results and analysis

Table 1 displays the results from the data search. From Table 1, it is evident that there are no entries in the data for digitalisation or digitalisation. Furthermore, Table 1 shows that there are two entries for digitisation and one for digitisation, which make the observations non-informative for analytical purposes with the current research design. The table thus displays the results for artificial intelligence, information and communication technology (ICT), Internet of Things (IoT), cloud computing, machine learning, and social media as well as sustainable quality of life, sustainable high performance, sustainable solutions, sustainable excellence, sustainable...
business excellence (SBE), sustainable success, sustainable growth, sustainable TQM, sustainable profitability, sustainable quality development and green quality.

Table 1 shows that there are 166 entries for sustainability, representing 1% of the total set of abstracts. The table further shows that sustainability has 95 entries in the QM data set, which represent 1% of that data set. There are 71 entries from the OM data set, which represent 2% of the overall OM data set. Sustainable development has in total 38 entries, which represent less than 1% of the total data set. The 29 entries in the QM data set also represent less than 1%, as do the 9 entries in the OM data set. IS has a total of 113 entries, which represent 1% of the total data set. Whereas the 51 entries in the QM data set account for...
less than 1% of that data, the 62 entries in the OM data set account for 2% of that data. Similarly, IT has a total of 139 entries, which corresponds to 1% of the total data set. The 67 entries in the QM data set represent less than 1% of the data, and the 72 entries in the OM data set correspond to 2% of the data.

Regarding the overlap of abstracts, the results show that sustainability and sustainable development appear together in 14 abstracts, 10 within the QM journals and 4 within the OM journals. Sustainability and IS appear together once in one QM journal abstract, as did sustainability and IT. There are no overlaps between sustainable development and IT or IS. For their part, IT and IS appear together in 7 abstracts, three QM journal abstracts and four OM journal abstracts.

**Sustainability**

Figure 2 and Appendix 1 show that sustainability came onto the scholarly scene in 1996 and has since become an increasingly popular research theme within QM and OM, with peaks in 2018 (QM journals) and 2019 (OM journals).

In the manual processing of the identified research paper abstracts, two main themes of sustainability were identified in the QM journals. The first theme covers QM programmes and practices such as TQM and how these initiatives can be sustainable over time (Matta, 1996). Some of the concepts that appear in these abstracts are business excellence models (BEMs) and the Malcolm Baldrige National Quality Award.

We present in this paper a number of propositions regarding the implementation of total quality management (TQM). … Each of these issues is critical to the implementation or sustainability of TQM in organizations. (Matta, 1996)

The second theme concerns sustainability and how it is related to sustainable development as an overall concept or as a part of one of the three key spheres: environment, society or economy. When we plot the two themes in a timeline, the second appears later in the literature, with the first identified abstract being published in 2002 (Zairi, 2002).

Sustainable development is based on a perceived need to address environmental deterioration and to maintain the vital functions of natural systems for the well-being of present and future generations. (Zairi, 2002)
The second theme detected in the QM journals is that there is no visible result that differentiates the three key spheres of sustainable development (environment, society and economy), except that the environmental sphere is analysed separately for the first time in 2002 (Zairi, 2002) and the social sphere in 2005 (Dervitsiotis, 2005). The economic sphere as a single object is more difficult to identify. Economic aspects are instead integrated into other concepts, such as efficiency (Wilkinson, 2005) and profitability (Aras & Crowther, 2010).

We argue that the way to manage a business for excellence and sustainable competitive advantage is to focus on the four key areas of profitability, sustainability, reputation and governance. (Aras & Crowther, 2010)

The second theme is also diversified in other ways, here called sub-themes, still in relation to all or some of the three key spheres of sustainable development (environment, society and economy). One sub-theme found in the data were analytical tools such as quality function deployment (QFD), failure mode and effects analysis (FMEA) and 5S, used to study different phenomena related to quality and sustainability. Another sub-theme was the application and evaluation of frameworks and models that aim to achieve sustainability in a chosen quality practice or programme; one example is the service excellence and innovation (SEIB) model (Edvardsson & Enquist, 2011). A third sub-theme that embodied sustainability covered topics such as ISO 26000, corporate social responsibility (CSR) and corporate sustainability performance (CSP).

There was considerable thematic overlap between the OM journals and QM journals, but some differences could also be noted. The first common theme to arise is related to sustainable development, which appeared when the IJOPM published a special environment issue in 2001. In these observations, sustainable development is understood both as an overall concept built on multiple underlying aspects as well as a topic encompassing single areas of research (e.g. ethics, transparency and waste reduction) (de Burgos Jiménez & Céspedes Lorente, 2001; Hill, 2001; Wilkinson et al., 2001). Some of the identified terms that are visible in the OM journals are socially responsible sourcing (SRS) (Zorzini et al., 2015) and the triple bottom line (Wilhelma et al., 2016). The environmental sphere dominates up until approximately 2010, when a change occurs, and the social sphere is singled out as an entity of its own, having earlier been a sub-domain within sustainable development (Jeffers, 2010). The term economical aspect is not identified, but terms such as performance and outcome are recurring and can be assumed to be related.

There is also a need for a strategy paradigm that embraces the wider concerns of social and environmental sustainability as pressing issues of the twenty-first century. (Jeffers, 2010)

In contrast, entries that cover organisational capacity to be sustainable over time are less visible in the OM journals. When this topic appears, it does so in the context of specific improvement initiatives such as Kaizen events and process improvement.

Finally, it should be mentioned that a large proportion of the studies in the OM journals are related to supply chains. Additionally, integrated systems such as ISO and the Lean methodology appear, but they could not be categorised within a specific theme or described as exhibiting some kind of pattern.

Sustainable development

In Figure 3 and Appendix 2, it is evident that sustainable development came onto the scholarly scene at the start of the new millennium. As seen from Figure 3 and Appendix 3, the
entries have been volatile over the years, albeit with a slow but steady increase in both QM and OM journals.

In the QM journals, the environmental aspect of sustainable development seems to be a common theme (see e.g. Edgeman & Hensler, 2001; Liu et al., 2015; Madu, 1996; Turk, 2009).

Around 2007, publications linked to ISO began to appear (Rocha et al., 2007), and in 2010, integrated management systems entered the scene (see e.g. Ho, 2010; Zeng et al., 2011). Additionally, softer aspects, including values such as organisational culture and value creation, became visible at that time (Conti, 2010).

There is a trend for enterprises to implement an integrated management system for overcoming the problems resulting from multiple management systems. Using structural equation modelling, this paper examines empirically the benefits obtained from implementing an integrated management system for enterprises. (Zeng et al., 2011)

Regardless of which sphere within sustainable development is studied, the papers in this study to a large extent present created and tested models, frameworks and/or different systems focused on becoming more sustainable (Hwang et al., 2010; Peršič et al., 2018; Rocha et al., 2007).

In regard to the OM journals, there are very few observations on sustainable development in the sample, so it is hard to say anything about trends or themes. However, what can be seen is that the outcome is similar to what is observed in the QM journals. A small difference is that the term life cycle occurs a few times (Matos & Hall, 2007; Schuman & Brent, 2005). Until 2010, the focus seemed to be on the environmental sphere (de Burgos Jiménez & Céspedes Lorente, 2001; Linton et al., 2007), and the social sphere eventually also emerged as a topic to be studied separately from the perspective of sustainability (Koh et al., 2016).

Consideration is given to the convergence of supply chains and sustainability. In doing so, the focus on environmental management and operations is moved from local optimization of environmental factors to consideration of the entire supply chain during the production, consumption, customer service and post-disposal disposition of products. (Linton et al., 2007)

**Information technology (IT)**

Figure 4 and Appendix 3 reveal that appearances of the IT concept steadily increased interest from 1989 until 2007, after which a slow decrease can be identified. The interest in IT as a concept differs somewhat between QM and OM, with a slightly higher number of publications in OM journals, visible in Figure 4 and Appendix 3, which also illustrate occasional spikes in publications, for example, in 2006 and 2013.

Even though the number of publications addressing IT differs in QM and OM, the main approaches are the same. In both QM and OM, the dominant ways of approaching IT are either as a context for research or as a technology that is a crucial part of modern organisations, among many other fields. In regard to IT as a context for research, studies have been conducted on organisations such as IT companies (Singh & Soltani, 2010), IT institutes (Khoong & Ku, 1994), IT industries (Huang et al., 2018), IT projects (de Carvalho, 2013), IT departments (Hunt et al., 2005), offices of information technology (Lawson & Manortey, 2010), IT service organisations (Gijo et al., 2019), IT centres (Badri et al., 2005), and IT sectors (Vijaya & Mahalingam, 2018). As can be concluded from the above, QM research has been conducted in a wide variety of IT organisations and continuously over the years.
In regard to IT as technology, IT is viewed as a resource, something that is changing and continuously improving and that might affect research results, serve as a critical factor for applications, or provide support for other activities. IT is, simply put, a technology to be used in different ways by organisations, thereby affecting them. The following quotes illustrate this approach:

As organizations face diverse changes, staff members require increasing amounts of information to manage task uncertainty and complexity. Information technology continues to improve. (Harvey et al., 1997)

In addition to the above two approaches that the QM and OM literatures have in common, each strand has developed unique approaches. In QM, there are abstracts that focus on the relation between QM or TQM and IT. One illustrative quote of this trend is the following:

Although aligning information technology (IT) with quality management (QM) is a popular concept, it has not yet been properly, theoretically and empirically grounded. Therefore, the purpose of this paper is to identify critical factors for the effective implementation (CFEI) of the IT-enabled ISO-9000 quality management system (QMS). (Kharub, 2019)

In the QM abstracts, IT has also been approached by applying theories, models and methods from the QM field to the production of IT.

In order to reduce the cost of software activities and improve the quality of software products, effectively managing the software development process is an important topic in the IT field. Since the early 1990s, there has been rapidly growing interest in the capability maturity model (CMM) in software organizations. (Li et al., 2002)

In OM, on the other hand, IT was identified in some of the abstracts as a factor driving change or success:

The purpose of this paper is to examine the impact of these technologies on managing next generation manufacturing, (NGM), and the benefits that can be reaped by effectively utilising these technologies (Soliman & Youssef, 2001)

Another way of approaching IT is by viewing it as a capability:

Inventories represent an important strategic resource for firms, with implications for shareholder wealth. As such, firms expend considerable effort in managing their inventories efficiently. Among other factors, information technology (IT) capability can play an important role in enabling inventory efficiency and financial performance. (OM55, 2013)

Information systems (IS)

Figure 5 and Appendix 3 show that information systems came onto the scholarly scene as early as 1984. However, the entries were sporadic until the mid-1990s, when publications became recurrent within both QM and OM. In 2013, there was a peak in publications on the topic within OM; within the QM domain, the topic peaked in 2014.

The analysis of IS in the QM literature shows that QM initiated its relation with information systems through systems such as management information systems (MIS) (e.g. Meredith, 1981), enterprise resource systems (ERP) (e.g. Allahyari & Ramazani, 2012), and material planning systems (MPS) (e.g. De Meyer & Ferdows, 1985). MIS, ERP, and MPS offer standardisation of business processes as well as development and measurement of those processes and are of interest for the QM field given their role in increasing internal quality in an organisation. IS have changed in direction throughout the years in relation to both technology, such as web and mobile applications, and focus, e.g. e-commerce and e-health. QM has not followed these trends; specifically, the analysis shows scattered results related to technology and focus. MIS, ERP, and MPS are still of interest within the QM
field, despite their current slow development and low levels of research in relation to
digitisation.

Initially, the research broadly focused on guides on how to use IS for business trans-
fomation, adding to standardisation or efficiency of business processes, such as manufac-
turing or production. One overall description is given by this study by Fuller and Fortin
(1985):

The success of the initial stage of a management information system in a described project
suggests that such a system is the logical vehicle to implement operations management con-
cepts. Management information systems should continue to incorporate proven quantitative
techniques and apply these to production management problems. (Fuller & Fortin, 1985)

The research trend slowly moved towards the evaluation of IS, still focusing on MPS and
ERP. The evaluation gives guidelines for the evaluation of various IS, as explained in Chow
and Lui (2001).

The selected respondents were asked to evaluate the adoption level of the TQM concept in gov-
erning their information systems function. Through the tests of reliability and validity, the pro-
posed instrument was verified as a good measuring tool. The findings show that dissatisfying
performers of ISF [IS function] should pay more emphasis on the practices of user focus [and]
IS top management support …. (Chow & Lui, 2001)

There are some examples of abstracts on IS related to domains other than manufacturing or
production. One such domain is e-health (Mcsweeney, 1997), and another is finance (Sen,
2001). Occasionally, the research relates to areas close to IS, such as business processes,
implementation projects, system development, or agile processes.

The analysis of the treatment of quality aspects in the OM literature reveals a divided
field, where the time line shows that OM initially focused on operational aspects governed
by management in various aspects (Vastag & Whybark, 1994). At first, the OM perspective
focused on describing various ways of using information systems for production purposes,
such as in assembly and supply chains (Engström & Medbo, 1992; Young et al., 1992). Later,
the evaluation path emerged, and various parts of it were emphasised. One was
the value of the implemented IS (Saldanha et al., 2013), another the learning effects of
IS (Yao et al., 2013), and a third the business process-related changes established by IS
(Bala, 2013).

The quality aspects cover a broad area of both specific topics and IS in general in
relation to business processes, stored information, and processes such as traceability
(Cheng & Simmons, 1994). Often business processes, stored information, and traceability
are viewed as only a step toward the goal of achieving customer satisfaction or product
quality.

Discussion and conclusions

The results of this study show a great overlap between sustainability and sustainable devel-
opment. This outcome is not surprising, as the concepts were selected on the basis of a pre-
sumed proximity to together offer a comprehensive, thematic picture of sustainability. If we
look closer at sustainability, it is possible to distinguish a longitudinal change in how the
term was used. The first observations focused on studying whether QM initiatives such as
BEMs and the MBNQA were sustainable over time, without any consideration of
environmental or social aspects. This would strengthen the claim of Jonker (2000) that
the underlying values within QM have been questioned regarding their fuzzy relationship
with sustainable development and that the connections need to be clarified. Recent studies,
summarised by Mårtensson et al. (2019), show several connections between QM values and
sustainability. The fact that the links have become clearer may be attributed to the fact that more studies in which these two areas are intertwined appear in the selected journals.

The identified themes and sub-themes related to sustainability and SD include: (1) programmes or practices in general, (2) descriptions, evaluations and follow-ups of models and frameworks, and (3) methods and tools. This study identified no themes or patterns related to values, whether organisational or individual, even though values are seen as fundamental in an organisation, as they have a clear link to the results achieved (Chatman & Eunyoung Cha, 2003; Grönfeldt & Strother, 2006).

Implementation of QM programmes and practices often face challenges, as documented by Bashin (2012), who pointed out that most implementations and applications of the Lean methodology fail. The result here points to the fact that several studies in the sample explain different ways of developing and applying different programmes and practices as well as models and frameworks to facilitate sustainability practices. However, there seems to be a lack of proper follow-up studies that empirically evaluate the success rate of these initiatives. It might be the case that there would be more lessons to be learned concerning the implementation, application and evaluation of various initiatives related to QM, OM and sustainability if the study were expanded to include full papers. However, as this was not the case, it is worth highlighting that two important perspectives seem to be neglected in current studies. The first involves sustainability initiatives as culture-changing initiatives, which, as such, require a long-term horizon, as highlighted by Senge (2006). The second concerns the need to sustain a customer focus in sustainability work to avoid the trap that, according to Emiliani (2010), many Lean initiatives have fallen into, i.e. losing customer focus.

Both sustainability and SD are terms encompassing areas with multiple components; for instance, the three key spheres of SD are in themselves complex fields. The weakness of sustainability being seen as a vague concept (Kolari, 2008) does not make it easier for researchers or practitioners to frame the field. In this study, sustainability was identified in two different ways: first, in terms of the sustainability of different QM initiatives and their effect over time and, second, as an equivalent expression to SD. This differentiation was visible in the abstracts, since a connection to one or several of the three key spheres was identified.

Has digitalisation informed the quality paradigm in any way, and if so, what are the visible effects? The natural starting point to answer such a query is to search for entries on digitalisation. However, as shown in Table 1, this query was fruitless. Here, we ended our exploration and concluded that digitalisation has not been addressed in the scholarly QM and OM literature. The closest term to digitalisation is digitisation, but the latter term was also basically absent. In any case, the two concepts, even though similar, carry rather different connotations. According to Tilson et al. (2010), digitising is the technical process of transforming analogue signals into a digital form, while digitalisation refers to a sociotechnical process of applying digitising techniques to broader social and organisational contexts that render digital technologies infrastructural. However, with only one hit in our sample for digitisation and with the definition of Tilson, Lyytinen and Sorensen in mind, neither concept can be viewed as representative of the ways in which digitalisation has been approached in the scholarly QM and OM literatures. However, as was argued by Brunetti et al. (2020), the mega-trend in contemporary society labelled digitalisation is as such not a revolutionary idea. It has been a continuously ongoing process since at least the 1960s, albeit under different labels, such as IT or IS, to mention a few. As illustrated in this study, using keywords such as IT or IS to represent digitalisation gives quite a different picture. In this picture, digitalisation as indicated by the use of the IT and IS as concepts
has been part of the quality paradigm for four decades, entering the scene in the early 1980s and becoming a stable part of quality research in the early 1990s.

The analysis of the ways in which digitalisation has been addressed in the scholarly QM and OM literatures through the use of IT and IS as concepts indicates that the dominant approaches are shared and are somewhat shallow. IT is in some cases the research context; in other cases, IT is viewed as an important but rather anonymous piece of technology that affects the organisations studied in different ways. The analysis of IS indicated that the focus is on traditional systems such as management systems of different kinds, omitting, for example, the inclusion of web-based functionalities. There were examples of studies that included web-based IS such as e-commerce systems, but the studies were not based on the modern functionalities highlighted by movements such as Industry 4.0, e.g. the use of sensors as IS.

In light of this finding, it is not that strange that digitalisation as a concept has not found its way into the QM literature, as IT as well as IS in these examples are ‘just’ pieces of technology affecting or defining an organisation. There are, however, other approaches communicated in the abstracts that penetrate digitalisation through IT somewhat more deeply and start to align with the main research streams on digitalisation identified by Brunetti et al. (2020). In the OM abstracts, IT is addressed as, for example, a factor in change, and in the QM abstracts, IT is addressed as something that can be tightly coupled with QM theory and practice. IT thus becomes something that triggers some kind of change (Brunetti et al., 2020). What has not been clearly addressed in either the QM literature or the OM literature is the more challenging part of digitalisation. Both the QM and the OM literature communicate a rather positive attitude towards IT as either something that is simply part of the changing organisational landscape or something that in a positive way causes change. However, Kobus et al. (2018) and Brunetti et al. (2020) argued that IT and digitalisation also pose challenges that need to be addressed. Another issue that needs to be addressed is that of the focus on supporting and developing standardised business processes within organisations while, with few exceptions, omitting the individual perspective. One could argue that organisations include individuals, whereas aggregation to the organisational perspective precludes detailed knowledge of individuals. With these examples, one could argue that the QM field is not addressing the full potential of digitalisation, omitting several interesting parts of the phenomenon. At the same time, we have found a handful of studies on topics combining QM and modern digitisation, such as social media and artificial intelligence (see Table 1). This indicates that the QM field has a slight awareness of ongoing digitisation trends.

**Practical applications**

The study results indicate that QM scholars seem to share a positive attitude towards sustainability as well as digitalisation. Nonetheless, sustainability and digitalisation initiatives and thought lines within the QM paradigm seem to be lagging, i.e. are not state-of-the art. On the other hand, this could perhaps be seen as a result of a sound scepticism towards the initial frenzies that often surround new concepts and technologies, such as the business process reengineering (BPR) and digitalisation euphoria that engulfed many industries and organisations at the dawn of the new millennium. Consequently, QM practitioners and scholars might be doing well in recognising the strength of such a cautious attitude towards modern phenomena such as digitalisation and sustainability. Valuable improvements can thus be made at a steady pace while great failures are avoided.
Additionally, it may do QM practitioners well to be reminded of system thinking, which includes culture and values, not only tools and methods, when implementing both sustainability and digitalisation initiatives.

**Limitations**

Needless to say, the study can be criticised for taking IT and IS as proxies for digitalisation. On the other hand, as shown in the study, these were absolutely the most prevalent terms when searching for terms associated with digitalisation and were therefore seen as legitimate objects of study. Obviously, it may well be that there are numerous studies on QM and digitalisation, etc., but that they are published in journals other than the ones included in this study. Consequently, the trends and patterns of sustainability and digitalisation depicted in this study on the basis of data from eight journals within QM and OM may not be transferable to other research fields. In sum, a study containing a different data set may yield dissimilar results.

**Future research**

To increase the knowledge base on sustainability and sustainable development, further studies can be done that provide more information about geographical locations and types of businesses and industries covered as well as how the definitions of sustainability and sustainable development appear in QM and OM research and develop over time. Also, it would be valuable to extend the dataset so that it includes journals specifically addressing environmental and sustainability research. Such increased coverage would allow for trans-disciplinary comparisons and explore the similarity, or divergence, between QM and OM research and environmental and sustainability research.

The findings also show that there are numerous other terms and concepts that seem to be related to sustainability and sustainable development, such as *sustainable quality of life*, *sustainable high performance*, *sustainable solutions*, *sustainable excellence*, *sustainable business excellence (SBE)*, *sustainable success*, *sustainable growth*, *sustainable TQM* and *sustainable profitability*. Taken separately, the number of observations is few, but collectively, they amount to quite a high number of observations, a fact that calls for an extended in-depth survey of the interrelationship of these concepts as well as their unique contribution to QM.

Finally, it could generate valuable methodological insights to develop the research design so that the abstracts are also surveyed using text mining methodology. This would not only increase the reliability of the results but could also inform scholars and practitioners of the strengths and pitfalls of both methodological approaches.

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Appendices

Appendix 1. Moving average of appearances of sustainability in the total data set

[Graph showing moving average of sustainability in the total data set]

Appendix 2. Moving average of appearances of sustainable development in the total data set

[Graph showing moving average of sustainable development in the total data set]
Appendix 3. Moving average of appearances of IT in the total data set

Appendix 4. Moving average of appearances of IS in the total data set