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A measurement framework for assessing the digital transformation of cultural institutions: the Italian case

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Abstract

Purpose – Public and private sector organisations are widely endorsing digital transformation processes, but little is known about the level of digitalisation of an organisation as a whole. The purpose of this paper is to develop a framework to assess an organisation's level of digital transformation as a whole, taking the field of museums as an exemplary case of application.

Design/methodology/approach – The framework draws upon a scoping literature review of studies examining dimensions, metrics and methods for the assessment of the digital transformation of organisations. The framework has been validated by applying it to a sample of 400 Italian museums and further interviews with museum directors.

Findings – The authors propose an assessment framework composed of five main dimensions: people, technology, process, customer and strategy and investment. These dimensions are further deployed in sub-dimensions measured through a set of questions. The weighted average of results per dimension and sub-dimension supported the development of a composite index of organisational digital readiness.

Originality/value – The developed framework contributes to the current debate on the measurement of an organisation's level of digital transformation as a whole, and it can offer practitioners a managerial tool to assess the organisation's digital readiness.

Keywords Performance measurement, Museum, Digital assessment, Digital readiness index, Digital readiness metric

Paper type Research paper

1. Introduction

The wide diffusion of digital technologies poses several challenges and opportunities for both private and public companies (European Commission, 2018; Katz, 2013; Roland Berger, 2016; Sabbagh *et al.*, 2012) with several studies focusing on the implementation of technologies and their impact on organisational processes or strategy. Notwithstanding the increasing interest in digital technology implementations and effects (Vial, 2019), there is far less knowledge on how to measure an organisation's level of digitalisation. This is an important area of investigation as the assessment of an organisation's level of digitalisation

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can support internal decision-making and improve a company's results. In this respect, Verhoef *et al.* (2021, p. 7) have recently pointed out that "To realise the full potential of digital transformation, digital firms need to measure the performance improvements on key performance indicators to facilitate learning and fine-tune the business model".

Current literature on the assessment of digital transformation has devoted a lot of attention to the measurement of the digital readiness of a certain country (Cisco, 2020; European Commission, 2019, 2018; McKinsey Global Institute, 2015; Portulans Institute, 2019; Sabbagh *et al.*, 2012; World Bank Group, 2016a, 2016b), hence taking the country as a unit of analysis for the measurement activity. When turning to the meso-level of the organisation, some studies emphasise the managerial implications connected with the introduction of digital technologies in organisations (Garzoni *et al.*, 2020; Lombardi and Secundo, 2020). Some other studies are focused on providing measurement frameworks of a specific dimension of the digital transformation or of a specific organisational function, with several contributions proposing measures to account for the digitalisation of the manufacturing process (Canetta *et al.*, 2018; Pirola *et al.*, 2019). These studies are valuable in supporting the understanding of the implication of digital technologies, but they neglect the assessment of the overall level of the digital transformation at organisational level.

This study approaches this issue of accounting for digital transformation, with the purpose of developing a measurement framework to assess the digital readiness of an organisation as a whole.

The field of museums is taken as a field of application because it is exemplary of the challenges that institutions are facing to assess whether and how they are endorsing digital innovation to frame new strategies for long-term sustainability (OECD, 2020). Indeed, digitalisation has posed several opportunities to museums, supporting the preservation and accessibility of culture as well as enhancing the impact that culture can have on society (Bertacchini and Morando, 2013; Borowiecki and Navarrete, 2017; Gombault *et al.*, 2016).

From a methodological perspective, this study followed a two-phase approach that comprises a theoretical development of the framework and its empirical application to Italian museums. The initial phase consisted of framework development, which relied on a scoping literature review (Arksey and O'Malley, 2005) carried out on extant studies examining dimensions, metrics and methods for the assessment of the digital transformation of organisations. The second phase of the framework's empirical application was carried out on a sample of 400 Italian museums, collecting data through a questionnaire applying the proposed framework using Excel and Power Bi and discussing results with museum directors. Through this empirical analysis, we were able to refine our preliminary framework and identify the expected implications connected with the implementation of the proposed framework.

Results showed the developed measurement framework, which consisted of five main dimensions (people, technology, process, customer and strategy and investment); each of them composed of sub-dimensions, quantified through a set of key questions posed to the organisation. These dimensions are then included in a composite indicator, here called *digital readiness index (DRI)*, to assess the overall digital readiness of an organisation. When applying the DRI to Italian museums, the empirical evidence highlights the lack of digital skills among museum professionals, a lack of attention for process digitisation and a lack of long-term vision. We then interviewed two museum directors, who appreciated a benchmarking analysis, helpful for evaluating their digital readiness.

While the empirical results are valid for the specific setting of the Italian museums, the theoretically developed framework provides a further step towards enhancing our

understanding of the connection between digital transformation and performance measurement, with a specific contribution on how digital transformation can be quantified for an organisation as a whole. In particular, the framework offers both the synthetic metric for digital readiness as well as its components organised into five dimensions, which facilitate the identification of good practices and areas of improvement within organisations. This framework contributes to the existent literature on how to account for the digital transformation, by considering the organisation-wide dimensions that enter the digital transformation process, overcoming a functional assessment approach. The structure of this paper is as follows. The existing digital transformation frameworks are first illustrated in Section 2. This is followed by a description of the research methodology in Section 3 and by the presentation of the measurement framework, with its application to the context of Italian museums in Section 4. Finally, results are discussed in Section 5, and discussions about the main contributions of the study are presented in the Section 6.

2. Digital transformation frameworks

This section introduces the background concept of our study, namely, performance measures for digital transformation. In revising this literature, we started from the definition of the digital transformation and then discussed the available frameworks for its assessment. As far as the conceptualisation is concerned, it is important to distinguish between digital innovation and digital transformation. Digital innovation can be defined as "The use of digital technology during the process of innovating" (Nambisan *et al.*, 2017, p. 223), while digital transformation is the "Combined effects of several digital innovations bringing about novel actors (and actor constellations), structures, practices, values and beliefs that change, threaten, replace or complement existing rules of the game within organisations, ecosystems, industries or fields" (Hinings *et al.*, 2018, p. 53). Moreover, digital transformation strategies focus on products, processes and organisational aspects within a business (Matt *et al.*, 2015). The focus of our study is on digital transformation because we are focusing on the overall approach adopted by an organisation to shift and move towards a revised set of practices, routines and procedures. Within the conceptualisation of digital transformation, our study poses particular emphasis on the assessment of such transformation. Considering that digital transformation brings organisational, structural and technological changes to an organisation (Garzoni *et al.*, 2020; Osmundsen *et al.*, 2018; Verhoef *et al.*, 2021), its measurement becomes of primary importance to understand the current practices and to guide future actions and objectives.

Current literature on the measurement of digital transformation can be divided into two main streams.

A first literature stream takes the organisation as a unit of analysis and discusses the measurement implications connected with the introduction of digital technologies (Lombardi *et al.*, 2020; Rialti *et al.*, 2020). For example, Garzoni *et al.* (2020) conducted research involving SMEs in the Apulia region and introduced a qualitative model that maps the willingness of SMEs to adopt digital technologies in business models and strategic and organisational settings. This model is based on four different and growing levels, namely, *digital awareness, digital enquirement, digital collaboration and digital transformation*, which characterize the impact of digital technologies on business models and strategic and organisational settings.

Similarly, recent research in an accounting context has showed the potentiality of digital technologies for corporate reporting fostering company transparency (Lombardi and Secundo, 2020), hence with an emphasis on external accountability. This literature is rich in discussing how organisations can manage digital transformation and the potentialities of

digital technologies for improving current processes and strategies. Yet, less emphasis is placed on the assessment of the digital transformation at organisational level.

A second literature stream focuses on the current available frameworks to assess digital transformation, which are discussed here distinguishing between frameworks proposed by academia and those proposed by practitioners. The academic literature shows a deep interest in the qualitative assessment of the digital transformation in sales and marketing activities (Rehm and Coppeneur-Guelz, 2021; Wengler *et al.*, 2021), finance and accounting units (Diller *et al.*, 2020) and logistics (Junge, 2019; Nekrasov and Sinitsyna, 2020). Concerning digital transformation in human resource management, Cetindamar Kozanoglu and Abedin (2020) developed a framework aimed at understanding the digital literacy measurement in an organisation, and in the literature review section they stated that, "None of the academic papers resulting from our literature review provided a particular instrument to assess digital literacy at organisational level". (Cetindamar Kozanoglu and Abedin, 2020, p. 12).

These studies are valuable for identifying the dimensions of digital transformation and for proposing qualitative analysis. Yet, they do not explore measures and metrics for the quantification of the proposed dimensions. To the best of our knowledge, only very few contributions offer performance measures for the quantification of digital transformation. For example, some authors (Canetta *et al.*, 2018; Pirola *et al.*, 2019) developed indicators that aim to assess the technology readiness in the manufacturing sector, with a specific focus on Industry 4.0 and to base the framework on an accurate literature review of previous studies. Some other studies (Sabbagh *et al.*, 2012) take a broader perspective instead, overcoming the organisational unit of analysis by proposing indexes and measures that aim to understand how digitisation affects economics, governance and society.

Performance measures for the assessment of digital transformation are often discussed in practitioners' studies, proposing both cross-country frameworks and company-wide frameworks. Cross-country frameworks are intended to assess the level of digital transformation of a certain country to support policy decisions (Cisco, 2020; Portulans Institute, 2019; World Bank Group, 2016a, 2016b). For instance, the European Commission advanced the DESI index, with the aim of assessing national digital performance among European countries and identifying areas for improvement. Company-wide frameworks are intended to assess how a company is positioned with respect to the digital transformation journey. For instance, Deloitte (2018) advanced the Digital Maturity model, identifying five main dimensions of interest: customer, strategy, technology, operations, organisation and culture. Instead, Roland Berger (2016) built an indicator for two major aims: assessing the digital maturity of a company and estimating business performance enhancements achieved through digitisation, basing the framework on systematic qualitative and quantitative surveys, Chief Innovation Officer interviews and case studies on a sample of more than 500 Polish companies.

This study approaches the issue of accounting for digital transformation by developing a measurement framework to assess the digital readiness of an organisation as a whole. In developing the framework, we consider the field of museums that is introduced in the next section as a specific reference.

3. Digital transformation in the museum context

Digital transformation in museums has received much attention in the last decade. Indeed, multiple studies have proved that digital innovation in museums is crucial for supporting the intergeneration and intrageneration preservation of culture, enhancing their reputation

and ultimately raising revenues (Bertacchini and Morando, 2013; Borowiecki and Navarrete, 2017; Chiaravalloti, 2014; De Bernardi *et al.*, 2018; Gombault *et al.*, 2016; Pierroux *et al.*, 2011).

The available literature on digital transformation in museums has tackled all the activities of the museum value chain, from the digitalisation of the heritage assets to the digitalisation of the experience offered to visitors up to administrative activities. With reference to the digitalisation of the experience, some studies have investigated the adoption of innovative digital tools such as augmented reality, interactive panels and mobile technologies with the intention of understanding the effects of these technologies on increasing participation and entertainment of the visit (Chung *et al.*, 2015; Coman *et al.*, 2019) . As far as the digitalisation of the collection is concerned, some studies explore the implications of preservation connected with the digitalisation of artifacts, namely, "The conversion into digital format of the cultural artifacts preserved in museums" (Lazzeretti and Sartori, 2016, p. 946) and saw an application to "Europeana" and "Google Arts". Finally, some other studies focus on the digitisation of the back-office practices of museums such as ticketing services, understanding the benefits of improving internal efficiency and the quality of the service offered to visitors (Coman *et al.*, 2019).

This available literature on digital technologies in museums underlined the positive effects of digital transformation in museums and offers some case studies and success stories connected with the adoption of digital tools. Yet, there is less evidence on how to assess the level of digital transformation of these particular types of organisations.

In developing a framework to assess an organization's level of digital transformation as a whole, our study takes the field of museums as an exemplary field of application for three main reasons. Firstly, digital technologies can amplify the contribution of the museum to cultural, social and economic development by offering new cultural experiences or more active cultural participation, contributing to individual and societal well-being, as well as the to the attractiveness of a given territorial area. Secondly, digital technology has been widely recognised as a crucial tool for the long-term sustainability of museums (De Bernardi *et al.*, 2018; Gombault *et al.*, 2016; Pierroux *et al.*, 2011) and the assessment of the digital transformation can help museum managers in focusing their efforts and internal resources. The third reason is the widespread adoption of technologies in all the activities of the museum value chain that makes the development of a framework that wants to have the overall organisation as a unit of analysis comprehensive.

Given this background, this study addresses the following research questions:

RQ1. What are the key dimensions of the digital transformation at organisational level?

RQ2. How can each dimension be assessed?

4. Methodology

This paper relies on a qualitative–quantitative methodology composed of two main steps. The first step is based on a qualitative methodology and consists of a scoping literature review aimed at theoretically developing the framework. The second step is based on a quantitative methodology, which consists of applying the framework to the empirical setting of Italian museums.

The empirical application of the model focuses on Italian museums because of its unique cultural heritage, which makes Italy the second country in the world in terms of UNESCO certified sites, counting on almost five thousand institutions such as museums, archaeological sites and monuments (ISTAT, 2019).

4.1 Scoping literature review

The first step was a scoping literature review with the aim of analysing current literature on the measurement of digital transformation and digital assessment frameworks. The choice of a scoping literature review is consistent with the need to examine a wide range of literature with no clear boundaries as the literature on digital transformation is widespread in different disciplines (Arksey and O'Malley, 2005). In applying the literature review, we followed the steps suggested by Arksey and O'Malley (2005) as follows:

- identifying the research question;
- identifying relevant studies suitable for answering the research question;
- studying the selection;
- charting the data according to key topics in an excel file; and
- collecting, summarising and reporting.

We deployed the relevant studies' research by using Scopus as a peer-reviewed database. Besides this, relevant organisations and conference papers were investigated. Moreover, we checked the reference list of the papers read to identify further sources. Regarding the study selection, this process was followed:

- The first selection criterion was represented by the in-depth reading of the title and abstract of the studies retrieved, choosing only those that were better at responding to the research questions.
- The second criterion consisted of an in-depth reading of the papers, excluding those that were out of scope.

Moreover, Scopus restrictions were made to diminish the number of irrelevant papers retrieved, therefore focusing on the "Business, Management and Accounting" field as this was aligned with the overall goal of the study.

The next step was to define the keywords that would help us to delineate the problem in a more schematic way. We applied the keywords "Digital Transformation", "Digital Readiness" and "Digital Performance" together with "index", "measure" and "evaluation" (Table 1). However, only a few articles retrieved corresponded to the research. This result led us to expand the research outside the boundaries of Scopus using the Google search engine, and after an accurate reading of the 8 papers selected, only a few of them proposed an accounting framework that could have been useful for the objectives of this paper.

Table 1.
Keyword selection

Keyword1	Keyword2	N. Retrieved papers	N selected papers
Digital transformation	Index	35	1
Digital transformation	Measure	38	2
Digital transformation	Evaluation	54	2
Digital readiness	Index	2	0
Digital readiness	Measure	1	1
Digital readiness	Evaluation	1	1
Digital performance	Index	0	0
Digital performance	Measure	1	0
Digital performance	Evaluation	1	1
TOTAL		133	8

Therefore, we expanded our research to white papers produced by both consulting companies and EU Institutions, reaching a sample of 19 papers. Finally, we selected only those studies where operational measures were proposed, narrowing the research to only measures potentially relevant to our topic and obtaining a sample of 11. Figure 1 showed the PRISMA flow diagram for the literature review process (Moher *et al.*, 2009). We then conducted an in-depth analysis of this literature, creating our framework and selecting the dimensions that were most frequently repeated among the literature. Based on the literature review, we developed the theoretical framework and identified dimensions of sub-dimensions of the digital readiness framework.

4.2 Empirical application to Italian museums

The second step of the research is based on a quantitative methodology, which consisted of applying the framework to the empirical setting of Italian museums. The selection of Italian museums as an exemplary industry for applying the framework is driven by the strong pressure for digital transformation that has been directed at museums in Italy in recent years, where a plan for digital transformation has been promoted by the Ministry for Arts

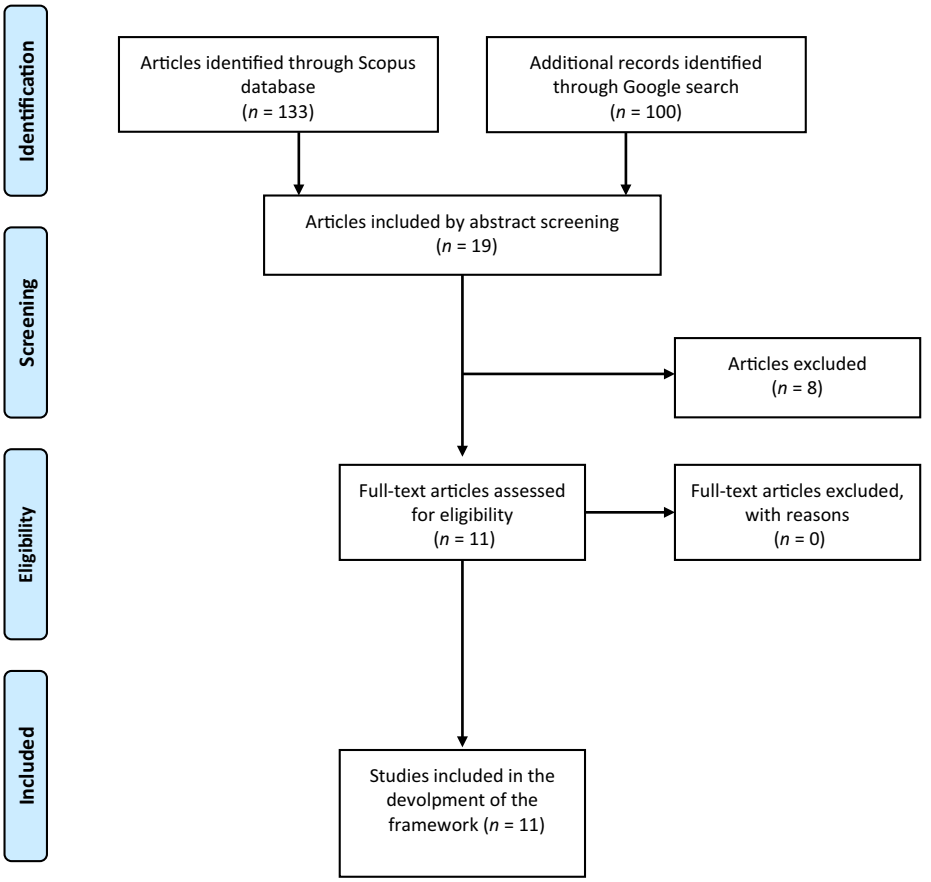

Figure 1.
Studies included in the development of the framework

Culture and Tourism. Moreover, museums are often considered as a more traditional industry, where digital innovations occur after they have been implemented in other technological-based industries. However, especially in recent years, there has also been strong pressure on the field of museums to "go digital" as a way to ensure long-term sustainability.

The empirical application required the operationalisation of the dimensions and sub-dimensions of the framework into a set of metrics specific for the field of museums (see Annex 1 for details). This activity was then followed by a data collection and data analysis phase from the questionnaire. The initial dataset for the application of the framework was based on the questionnaire developed during previous research and administered to 400 Italian museums. This sample of museums was heterogeneous in terms of the typology of institutions as well as geographical distribution and type of ownership. Most of the institutions were museums, galleries and collections (83% of respondents), followed by monuments and monument complexes (10% of respondents) and, finally, parks and archaeological parks (7% of respondents), well divided between North and South: 46% of the sample belonged to the North, 32% to the South and Islands and 22% to the Centre of Italy. Regarding the ownership, institutions in the sample mainly belong to the Italian Ministry of Heritage and Municipalities (50%), private foundations (12%), religious institutions (4%), private company museums (2.5%) or other public or private entities (27.5%). The collected data were stored in an excel file and measures developed within the theoretical framework (Phase 1 of the analysis) applied to this data set, using Excel and Power Bi. This supported the application of the measures to the organisational level of museums and the results obtained from the empirical application of the framework were discussed with two museum directors that were interested in understanding the digital readiness of their cultural institutions and were willing to provide us with feedback. The two museums participating in the research are described in Table 2.

This discussion was valuable for understanding the applicability of the proposed framework and to have an initial understanding connected with the consequences of adopting performance measures for the digital transformation of the entire organisation. These interviews were useful to understand who can use the proposed framework and how.

5. Results

This section presents the results of the analysis, distinguishing between the framework development, the empirical application and a discussion of the framework.

5.1 Results: framework development

The proposed framework for the assessment of the organisational level of digital transformation consisted of five dimensions: people, technology, process, customer and strategy and investments. Each of these dimensions have been derived from the scoping literature review and they are further structured in sub-dimensions, each of them quantified through a Likert scale that is industry specific (Table 4). A final composite indicator is proposed as a weighted average of the different dimensions. More precisely, dimensions and

Table 2.
Details of the consulted museums

	Location	Annual visitors	Annual revenues (€)
Museum A	Turin	100.001–500.000	1.000.000–2.000.000
Museum B	Modena, Ferrara and Sassuolo	100.001–500.000	100.001–500.000

sub-dimensions are applicable to any organisation, while specific metrics for the assessment are computed through a questionnaire and they are specific to a certain field (Table 3).

The first dimension of the framework is *people*. The choice of this dimension is motivated by the available studies on digital innovation that identify people and staff as a main driver of digital transformation (Pirola *et al.*, 2019; Prifti *et al.*, 2017). Moreover, the integration between people and technology is recognised as essential for the development of organisations and their impact on society (Portulans Institute, 2019).More precisely, *people* refers to the presence of the appropriate digital skills and capabilities of the staff. This dimension is often called "*Human Capital*" in the digital readiness frameworks that focus on

Dimension	Definition	Sub-dimension	Definition
People	*People* refers to the presence of the appropriate digital skills and capabilities of the staff	Digital skills	Digital skills identify the way digital capabilities are managed internally and the existence of digital roles, whose competences depend on the sector of interest
Technology	*Technology* refers to the usage of digital technologies, data analysis practices and the presence of a Wi-Fi connection available to the visitor	Technology adoption	Technology adoption refers to the acquisition of a certain technology within the organisation
		Data analytics	Data analytics considers the systematic usage of online data to support decision-making processes
		Technological infrastructure	Technological infrastructure is considered with reference to the presence of a Wi-Fi connection
Process	*Process* refers to the extent to which internal processes are digitised	Front-office	Front office refers to the interaction with customers, with particular reference to the presence of an e-billing process
		Back-office	The sub-dimension *back office* considers the extent to which internal processes are digitalised
Customer	*Customer* refers to the ability of the company to engage with the customer through the usage of digital channels of interaction before and after the purchase happens	Customer awareness	Customer awareness refers to the presence and usage of social media channels and localisation websites such as Google Maps and TripAdvisor
Strategy and Investment	*Strategy and Investment* intends to measure the ability of the organisation to pursue a long-term digital strategy while investing its resources in digital transformation projects	Digital Strategy	Digital strategy measures the existence of a strategy and its integration with the overall strategy of an organisation
		Investment	The sub-dimension of Investment refers to the investment committed by the firm to digital technologies

Table 3.
The digital readiness framework

Dimension	Sub-dimension(wj)	Metric (wk)	Question(Qk)	
Strategy and Investment	Strategy (0.5)	Strategy(1)	1. Is there a strategic plan for digital innovation?	Yes, in a dedicated document(1) Yes, in another document(0.8) No(0)
	Investment (0.5)	Digital investment (0.5)	1. In which digital activities did you invest in the last 2 years More than one answer can be selected	Cataloguing and digitization of collection (1) Conservation of collection(1) Services of visit support (1) Communication and customer care(1) Ticket, booking and access control(1) Security and surveillance(1) Education activities (1) Others(1)
		Digital investment penetration	2. Which is the percentage of investment you committed to digital innovation ?	1–5%(0) 6–10%(0.2) 11–25% (0.4) 26–50% (0.6) 51–75% (0.8) more than 75%(1)

Table 4.
Example of the calculation of the dimension "strategy and investment"

country policies (Cisco, 2020; European Commission, 2019). At the functional level, Canetta *et al.* (2018) and Pirola *et al.* (2019) refer to the employee's skills and competences dedicated to Industry 4.0 practices. Based on these available studies, *People* is composed of one main sub-dimension: *digital skills*, which is subdivided into specialised personnel and access to digital skills. The former identifies the way digital capabilities are managed internally, considering the existence of a specialised organisational unit focused on digital transformation and digital innovation. The latter aims to identify the existence of digital roles, whose competences depend on the sector of interest.

In the empirical setting of museums, digital transformation has shaped the necessity for the definition of new roles in museums (MuSa, 2019), such as the digital collection curator and the digital strategy manager, which have been considered in the operational metrics.

The second dimension of the framework is *technology,* which literature considers to be one of the main drivers of digital transformation to be analysed and managed in digital innovation projects (Pirola *et al.*, 2019). Here, *technology* refers to the usage of digital technologies (such as "Internet of Things", cloud, artificial intelligence or blockchain) in the organisation. Technology encompasses three sub-dimensions: technology adoption, data analytics and technological infrastructure. The sub-dimension of *technology adoption* refers to the acquisition of a certain technology within the organisation. This is one of the most considered aspects in the literature (Canetta *et al.*, 2018; Pirola *et al.*, 2019). Cisco (2020, p. 3) considers technology adoption as "*the level of technology availability, utilisation, and adoption reflects a country's current level of digital readiness*". The type of technologies to be included in the analysis vary from one industry to another. In the specific field of museums,

the technology considered for the operationalisation of the metrics are those that enhance the visit, such as interactive displays, augmented reality and virtual reality (Chung *et al.*, 2015; Hughes and Moscardo, 2017), as well as technologies that enhance the digitalisation of the collection (Lazzeretti *et al.*, 2015).

The sub-dimension of *data analytics* considers the systematic usage of online data to support decision-making processes (Roland Berger, 2016; Romanelli, 2018). Also in this respect, available literature has widely emphasised opportunities and obstacles connected with the adoption of analytics to support decision-making, acknowledging the central role of data in digital transformation processes. Concerning museums, the usage of big data might strengthen the interaction and communication among museum professionals and users, creating new sharable knowledge fostering the digital transformation process (Romanelli, 2018).

The sub-dimension *digital infrastructure* represents a fundamental enabling factor for the digital transformation (European Commission, 2018) which has been widely addressed at country level. While at country level the digital infrastructure encompasses the existence of broadband connection and the internet bandwidth, at organisational level (and museum level too), this is considered with reference to the presence of a Wi-Fi connection available to the visitors.

The third dimension of the framework concerns *process*, with reference to the extent to which internal processes are digitised. Indeed, the digitalisation of internal processes is considered one of the main drivers for improving company efficiency. For instance, Canetta *et al.* (2018) included questions regarding the integration of cross-company processes, data collection and IT security in the Process dimension. Process is analysed here with reference to two main sub-dimensions: back office and front office processes.

The sub-dimension *back office* considers the extent to which internal processes, from human resources to administrative activities or customer management, are digitalised. Operationally, this dimension is quantified considering the presence of information systems that support the core internal operations which, in the empirical setting of the museum, comprise accounting and administration (including human resource administration), customer relationship activities and conservation of the collection.

The sub-dimension *front office* refers to the interaction with customers, with particular reference to the presence of an e-billing process, which is essential for the correct management of invoices and for the respect of legal requirements. Regarding museums, digital ticketing contributes to making the purchase leaner, also facilitating museums to gather more detailed customer information (Coman *et al.*, 2019). Additionally, if the museum provides an online ticketing service, it might also engage in some marketing activities such as add-ons and up-selling (Northrup-Simpson *et al.*, 2020).

The fourth dimension of *customer* refers to the ability of the company to engage with the customer through the usage of digital channels of interaction (Coman *et al.*, 2019; Deloitte, 2018) before and after the purchase takes place. Indeed, in the digital environment, the customer can be aware of a service in a digital way. For instance, customers can collect information from search engines, read other customers' reviews or be inspired by social networks (Kannan and Li, 2017). In this respect, the dimension of customer has a unique main sub-dimension that is represented by *customer awareness*, intended as the phase in which the customer discovers the offer (Stickdorn *et al.*, 2018). In the empirical setting of museums, customer awareness has been analysed with reference to the presence and usage of social media channels and localisation websites such as Google Maps and TripAdvisor. The usage of social media in museums has been widely investigated, where the main objective of social media is communicating and promoting activities (Lazzeretti *et al.*, 2015) and engaging a new audience to build awareness (Chung *et al.*, 2014). Lazzeretti *et al.* (2015)

for instance, suggest the "*one-way*" and "*two-way*" role of Twitter and Facebook in museum communication, where the visitor is engaged in commenting and participating in the cultural debate. Indeed, visitors are more and more engaging in an active role, bringing their content and insights to the museum (Coman *et al.*, 2019). On the other hand, the existence of a website is essential in any organisation, especially in museums, where the curiosity of the visitor can be triggered (Coman *et al.*, 2019; Padilla-Meléndez, 2013).

The last dimension is represented by *strategy and investments*, and it intends to measure the ability of the organisation's pursuit of a long-term digital strategy while investing its resources in digital transformation projects. The inclusion of this dimension is justified by the available studies on digital innovation that identify strategy and the amount of investments as drivers of digital transformation (Lokuge *et al.*, 2019; Nwankpa and Merhout, 2020). The sub-dimension of *digital strategy* measures the existence of a strategy and its integration with the overall strategy of an organisation. Digital strategy is defined as "A pattern of deliberate competitive actions undertaken by a firm as it competes by offering digitally enabled products or services" (Woodard *et al.*, 2013). For instance, Pirola *et al.* (2019) refer to the construct "strategy" considering investment in R&D, the definition of a strategy and a roadmap towards Industry 4.0 and management commitment. The sub-dimension of Investment refers to "A firm's strategic technology investment for exploring how cutting-edge digital technologies could potentially differentiate the firm's business, transactions and operations" (Nwankpa and Merhout, 2020, p. 1). Regarding museums, a strategic oriented point of view is essential for the correct management of such complex institutions (Carlucci, 2018). Policymakers should advance digitisation plans, providing museums with some guidelines: the Directorate-General of Italian Museums has recently launched a three-year plan (2019–2021) with the aim of supporting digitisation and innovation. Nevertheless, creating digital environments requires significant investments, which led to the introduction of this sub-dimension, quantified with reference to the percentage of budget devoted to digital innovation projects.

It is important to underline that both dimensions and sub-dimensions of the framework have been theoretically derived and they can be applied widely at organisational level. The selection of Likert-scale questions is instead industry specific. The detail of the specific questions for the assessment of each sub-dimension for the field of museums is provided in the annex.

5.2 Definition of an overall measure for digital transformation: the digital readiness index

The measurement part of the framework consisted of quantifying each dimension and sub-dimension until the development of a unique measure, here called *DRI*, to assess the organisational level of digital readiness. Once the dimension and sub-dimensions have been defined in the conceptual part of the framework, industry-specific questions are posed to the respondent (Canetta *et al.*, 2018; Pirola *et al.*, 2019). In the empirical case of museums, *ad hoc* questions have been developed based on previous research (see Annex for the details). Within this logic, the DRI is computed starting from the values associated with each question (i.e. metrics), sub-dimension and, finally, the dimensions. The overall formula for DRI is as follows:

$$DRI = \sum_{i=1}^{5} wi * \left(\sum_{j=1}^{n} wj * \left(\sum_{k=1}^{m} wk * Qk \right) \right)$$

where:

wi = *weight of dimension i;*
wj = *weight of sub-dimension j;*
wk = *weight of question k; and*
Qk = *score of question k.*

The score of question Qk can be assessed using one of these three criteria, depending on the specific literature on the industry:

- Likert-scale items: A score ranging from 0 to Nmax is assigned for each answer and is then normalised in a 0-1 scale using the maximum value as a proxy.
- Boolean items: Boolean questions are evaluated with 0 or 1.
- Multiple-choice items: These are questions in which more than one option can be selected. To assign a score, each option is considered as if it was a Boolean item. Therefore, this procedure is followed:

Qk = *score of question k*
q = *number of available options belonging to question k*
bh = *number of options selected*

$$Qk = \frac{bh}{q}$$

- Grid questions are inquiries in which respondents must answer two or more questions at the same time (Bell and Waters, 2014), often using a Likert-scale, and can be assessed using the following formula:

Noptions = *number of available options belonging to question k*
sl = *score of option l*

$$Qk = \sum_{l=1}^{Noptions} Sl * \frac{1}{Noptions}$$

After the quantification of each sub-dimension, the calculation of the DRI is based on a set of weights assigned to each dimension and sub-dimensions. This step is acknowledged as one of the most important issues when building a composite indicator (European Commission, 2008). The literature provides multiple ways to define weights, such as data envelopment analysis, benefit of the doubt approach, equal weighting and public opinion (European Commission, 2008).

In this study, we initially used an equal weighting approach. Then we assigned those factors that were deemed more influential accordingly to interactions with experts in the field, which in the empirical setting of cultural institutions was represented by museum association and policy maker (i.e. Ministry for Arts and Culture). More generally, weight assignment depends on the specific industry and should be based on expert validation. The application of weights to the value of each dimension and sub-dimension resulted in the synthetic indicator of the DRI, whose values are included in a range [0–1], where 0

represents the absence of digitalisation and 1 corresponds to the highest value of full digitalisation.

5.3 Results: application of the framework to Italian museums and critical analysis

The second area of results consisted of validating the proposed measurement framework by applying it to the empirical setting of 400 Italian museums. This application supported the calculation of the DRI at museum level and the calculation of digital readiness values per each of the five dimensions of the framework (Figure 2). At organisational level, the application of the DRI resulted in an average value of Italian museums equal to 0.35/1.

Figure 2 highlights the value scored by each dimension of the framework, enhancing the visualisation of more digitalised areas compared with others. Table 5 instead detailed the calculation of the score for the dimension "Strategy and Investment", with the details on specific questions and weights (see annex for the full operational model).

Going into more detail on each dimension of analysis, the People dimension scores 0.29/1. This result is explained by a lower score on the presence of digital skills in museums, an aspect already acknowledged by both practitioners and academia (Federculture, 2019;

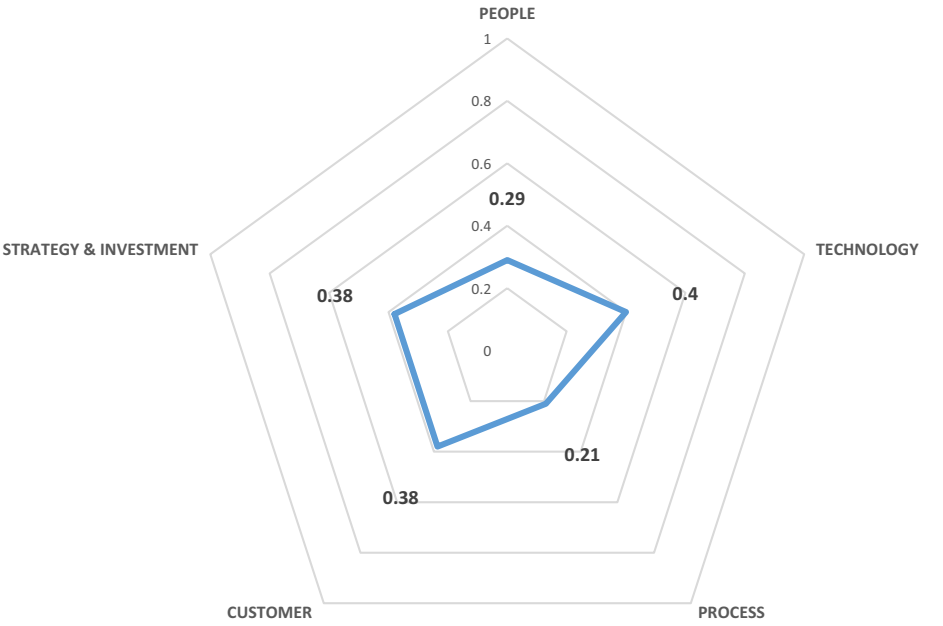

Figure 2.
Digital readiness index in Italian museums

Table 5.
The application of the digital readiness framework in museum A, museum B and Italian museums

	People	Technology	Process	Customer	Strategy and Investment
Italian avg.	0.29	0.4	0.21	0.38	0.38
Museum A	0	0.52	0.45	0.62	0.42
Museum B	0.65	0.33	0.43	0.58	0.62

MuSa, 2019). Indeed, despite museum professionals being knowledgeable about history and heritage, there is a huge lack of hard skills such as digital skills, which are not sufficiently valued. The Technology dimension scores 0.40, where data analysis is the most critical aspect. Indeed, collections and archives are still mainly managed through paper or non-integrated systems, while data about visitors are collected via digital media only in 33% of cases.

The Process dimension scores 0.21, representing the worst dimension for Italian museums. Indeed, very few museums allow online ticketing purchases, and often, the majority of cultural institutions do not use any information system. The Customer dimension scores 0.38, underlying the fact that very few museums are using data and digital marketing techniques to attract new visitors. Nevertheless, social networks are starting to be used, since 69% of museums have at least one social media account. The recent health crisis has enhanced the need to use social media as a communication tool to engage visitors, showing a relevant increase in interactions during the lockdown period (Pirelli, 2020). The Strategy and Investment dimension scores 0.38. The most remarkable fact is that 76% of Italian institutions do not present a digital plan, and museums are still investing low amounts of monetary resources in digital issues, prioritising communication.

The computation of the DRI for the sample of the 400 museums supported not only the analysis at organisational level, but also an industry-based analysis, also supporting correlation analysis between the DRI and other variables such as the annual number of visitors or type of collection.

The framework has also been discussed specifically with two museum directors, with the purpose of identifying benefits and pitfalls connected with everyday practices and the possible consequences related to the adoption of performance measures for digital transformation. More specifically, museum directors appreciated a benchmarking analysis, which consisted of comparing their score for each dimension and the overall DRI with each other and with the Italian average (Table 6 and Figure 3).

In particular, the benchmarking of measures at the level of each dimension stimulated further reflections on the actions in place and future strategy. For example, when commenting on a score equal to 0 in correspondence to the People dimension, the director of Museum A stated:

> "We acknowledge that digital skills are necessary for the correct functioning of our cultural institutions; however, we find difficulties in recruiting internal personnel because we have to face Ministers' restrictions. What we can do, is rely on external consultants that provide us with services, but we still have to face a bureaucratic process for doing so".

On the one hand, this strategy allows the museums to gain more flexibility and cut costs, but on the other hand leads to some problems that need further investigation. One issue is related to the transaction cost: when engaging in a market transaction, an economic agent faces both ex-ante and ex-post transaction costs (Grossman and Hart, 1986). Moreover, due to its bounded rationality, every time an economic agent engages in a market transaction, it results in contract incompleteness, namely the inability to account for all the relevant aspects and future contingencies, thus provoking the other party to behave opportunistically (Grossman and Hart, 1986). However, to overcome these problems, the museum might use proper monitoring tools like weekly reports, for instance. A second comment was about the risk for an organisation like a museum to be fully digital, as commented on by the Director of Museum B:

> "For us it is very difficult to be fully digital. We have thousands of small pieces that often do not belong to any collection. It requires a very deep effort to digitalise everything. Additionally,

DRI	Dimension (wi)	Italian result	Sub-dimension(wj)	Italian result	Metric (wk)
0.35	People (0.2)	0.29	Digital skills(1)	0.29	Specialised personnel (0.6) Access to digital skills (0.4)
	Technology (0.2)	0.4	Technology adoption (0.4)	0.44	Technology presence (0.5) Digitisation of the collection (0.5)
			Data analytics (0.4)	0.33	Digital archives (0.5) Data gathering and storage (0.25) Data monitoring (0.25)
			Technological infrastructure (0.2)	0.5	Wi-Fi presence (1)
	Process (0.1)	0.21	Front office(0.5)	0.12	E-billing process (0.6) Access control (0.4)
			Back office (0.5)	0.26	ERP presence (1)
	Customer (0.2)	0.38	Customer awareness (1)	0.38	Digital marketing activity (0.33) Social media presence (0.33) Presence in reputation of websites (0.33)
	Strategy and Investment (0.3)	0.38	Strategy (0.4)	0.2	Digital strategy (1)
			Investment (0.6)	0.5	Digital investment (0.5) Digital investment penetration (0.5)

Table 6.
Main findings of the digital readiness index

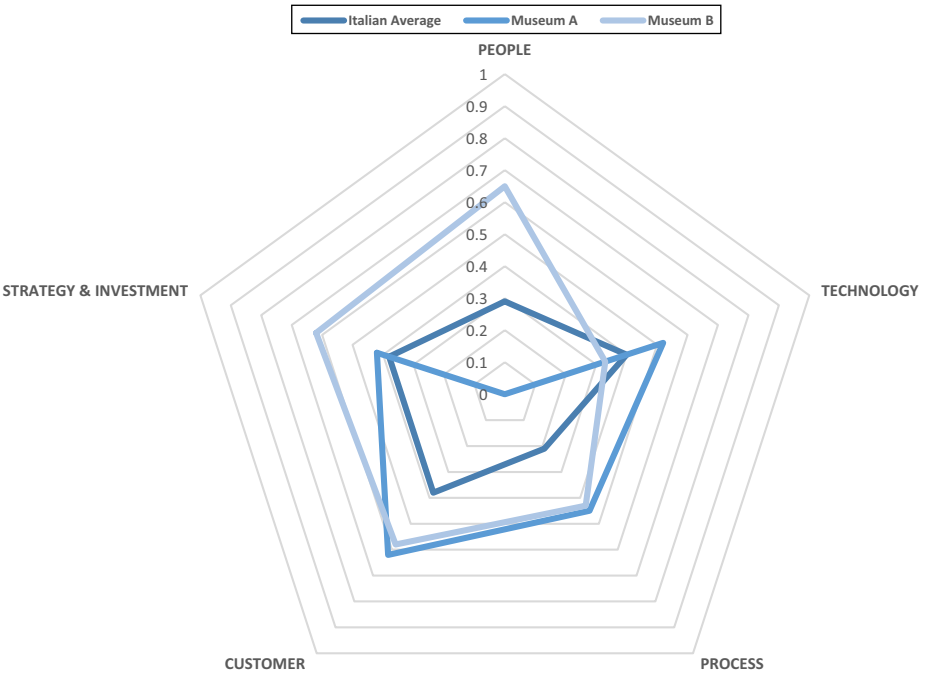

Figure 3.
Digital readiness index in Italian museums, Museum A and Museum B

> offering only digital services might lead to a potential visitor loss. For instance, senior visitors might be discouraged to buy online ticketing, not having digital devices or less ability to purchase online. Additionally, if we consider making the ticketing service fully digital, it could be that a passer-by would not enter a museum without the presence of a physical point of sale".

This comment is connected with an issue of inclusivity, with several studies underlying the risks of excluding some categories of customers because of their non-use of digital technologies (Büchi *et al.*, 2016; Colombo *et al.*, 2015). In summary, the overall framework and its empirical application at the context of Italian museums is summarised in Table 6. It shows the two-level assessment:

- An organisational level assessment, obtained through the calculation of the DRI.
- A punctual assessment of each dimension of the digital transformation, namely, people, processes, technology, customer and strategy and investment.

This double layer supports both the organisational view as well as more focused dimensions in order to grasp enablers and obstacles.

6. Discussion and conclusion

The aim of this study was to develop a measurement framework for the assessment of the digital readiness at organisational level, focusing specifically on i) the key dimensions of the digital transformation and ii) the assessment of digital transformation. We relied on a qualitative–quantitative methodology that supported the development of a digital assessment framework through a scoping literature review, then applied this to the empirical setting of Italian museums. The main result of this study is the development of a framework for the assessment of digital transformation, which consists of five dimensions (people, technology, process, customer and strategy and investment), nine sub-dimensions and a synthetic DRI, obtained from a weighted average of the operational metrics. While dimensions and sub-dimensions are applicable at organisational level, operational metrics and weights are industry specific. This framework was applied empirically to a set of Italian museums, and the results were further discussed with museum directors.

This critical discussion highlighted some reflections on the importance of assessing and quantifying the digital transformation at organisational level. The first reflection is about the need to consider transversally, rather than functionally, the implications of digital transformation. This transversal view facilitates the adoption of digital transformation projects that move beyond the functional benefits, and includes a digital capability plan that is organisation-wide. The second reflection is about the importance of benchmarking. The empirical application of the framework and its discussion with museum directors highlights the importance of benchmarking values of digital readiness per each dimension and sub-dimension between organisations in order to identify different organisational strategies and approaches to digital transformation. In terms of accounting and performance measurement implications, this is connected with the need to develop further comparative analysis of digital practices and to enhance benchmarking exercises also in terms of digital measures.

This study presents some academic, managerial, social and cultural implications. At an academic level, this study contributes to the literature on accounting and digital transformation by proposing a digital framework for the quantification of digital readiness at organisational level. This result enlarges the current qualitative approaches focused on one function (Cetindamar Kozanoglu and Abedin, 2020; Diller *et al.*, 2020; Junge, 2019; Rehm and Coppeneur-Guelz, 2021) by pushing reflections on the importance to have measures for the analysis of the digital transformation as an organisation as a whole. A second theoretical

contribution is industry specific and focus on the field of museums. The empirical application of the model in the cultural industry contributes to the debate on the digital transformation of cultural institutions, offering a framework and a set of performance measures that can be adopted to understand and evaluate the extent to which museums endorse the digital transformation (Chung *et al.*, 2015; Hughes and Moscardo, 2017).

At managerial level, this study provides managers with an operative tool to evaluate digital readiness and to conduct benchmark analysis with their peers or the national average. At a policy level, policy makers can benefit from the application of the tool within a given industry (e.g. the cultural industry in the empirical setting of this study) to have an overall quantification of the digital readiness of a certain economic sector. Therefore, they would benefit from a framework that would guide them in the promotion of digital innovation and encourage the design of *ad hoc* policy schemes, such as grants and financial support. Additionally, introducing an assessment tool to measure the digital readiness of a certain organisation presents some social implications, since it could advance the prioritisation of the introduction of digital-ready roles inside the organisation. Finally, this work can also have an impact on society, since it provides a numerical tool that can evaluate the digital readiness of a certain industry and, therefore, society can benefit from a new introduction of policy actions that can be advantageous.

As a last step, we identified the main limitations of our study. A first limitation is related to the applicability of the framework in the cultural sector only. Despite the application of a sample of 400 museums that were heterogeneous in size, location, type of collection, the empirical data are specific to the field of culture and museums. Further studies could explore and operationalise the sub-dimensions into other industries.

A second limitation is related to the timeliness of the data collection since the time requested to distribute the questionnaire, collect and analyse data was approximately one year. In a fast- changing digital arena, in the time span of data collection and analysis, the digital readiness of an organisation may vary and results obtained could be no longer representative of that reality. Further studies could consider the application of the framework into a digital-based platform to have a self-assessment tool of digital readiness.

In summary, the application of the developed framework supported the calculation of a DRI at organisational level, alongside a benchmarking of results at industry level. The discussion of the framework with museum directors also confirmed its applicability at a practitioner's level with museum mangers who can be guided in the understanding of their digital readiness and in the process of managerial decisions. To conclude, this study represents a first attempt to move forward with the discussion on digital readiness frameworks, by recognising the importance of evaluating performances in museums.

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Appendix

Table A1.
Dimension: People (wi = 0.2)

Sub-dimension(wj)	Metric (wk)	Question(Qk)	
Digital Skills(1)	Specialized personnel(0.6)	1. In your institution, are there employees specialized in digital transformation?	No (0) Yes, some people are in charge of managing digital activities, even if there is not a specialized team(0.5) Yes, external consultants(0.5) Yes, we rely on a specialized team of X people (1)
	Access to Digital Skills (0.4)	2. In your institution, is it present any of these positions?	Digital Responsible(1) Social Media Manager(1) Digital Curator(1) Digital User Experience developer(1) Data Protection Officer (1) Others (1)

Table A2.
Dimension: Technology (wi = 0.2)

Sub-dimension(wj)	Metric (wk)	Question(Qk)		
Technology adoption(0.4)	Technology presence (0.5)	1.Which one of these technologies is present in your museum?	Audioguide (0.02) We would like to include audioguide (0.01) We had audioguide but decided to remove it (0.01) Augmented Reality (0.2) We would like to include Augmented Reality (0.1) We had Augmented Reality but decided to remove it (0.1) Virtual Reality (0.2) We would like to include Virtual Reality (0.1) We had Virtual Reality but decided to remove it (0.1) QR Code (0.08) We would like to include QR Code (0.04) We had QR Code but decided to remove it (0.04) 3 D Display or interactive panel (0.1) We would like to include 3 D Display or interactive panel (0.5) We had 3 D Display or interactive panel but decided to remove it (0.5) Interactive installation (0.1) We would like to include Interactive installation (0.5) We had Interactive installation but decided to remove it (0.5) Chatbot (0.2) We would like to Chatbot (0.1) We had Chatbot but decided to remove it (0.1) Videogames (0.1) We would like to include Videogames (0.5) We had Videogames but decided to remove it (0.5)	
	Digitization of the collection (0.5)	2. Is there a digitalized version of the museums' artifacts?	Less than 25% (0.25) 25%−50% (0.5) 51%−75%(0.75) More than 75% (1) No (0)	
Data Analytics (0.4)	Digital Archives (0.5)	3. To what extend is your collection catalogued?	Paper catalogue (0.25)	Technology not adopted (1) 1%−25% (0.8) 26%−50%(0.6) 51%−75% (0.4) 76%−99% (0.2)

(*continued*)

Table A2.

Sub-dimension(wj)	Metric (wk)		Question(Qk)	
				100% (0)
			Database catalogue (0.25)	Technology not adopted (0) 1%−25% (0.2) 26%−50%(0.4) 51%−75% (0.6) 76%−99% (0.8) 100% (1)
			The cataloguing is handled through a proprietary software (0.25)	Technology not adopted (0) 1%−25% (0.2) 26%−50%(0.4) 51%−75% (0.6) 76%−99% (0.8) 100% (1)
			The cataloguing is handled through an open source software (0.25)	Technology not adopted (0) 1%−25% (0.2) 26%−50%(0.4) 51%−75% (0.6) 76%−99% (0.8) 100% (1)
			The cataloguing is handled through an ICDD or Region proprietary Information system (0.25)	Technology not adopted (0) 1%−25% (0.2) 26%−50%(0.4) 51%−75% (0.6) 76%−99% (0.8) 100% (1)
	Data storage and gathering (0.25)	4.Do you gather data about visitors?	Yes, with paper (0.1) Yes, in an excel file (0.5) Yes, in an appropriate software (1) No (0)	
	Data monitoring (0.25)	5. Do you monitor data about your social network channels? (0.5)	Yes (1) No (0)	
		6. Do you monitor data of online reviews? (0.5)	Yes (1) No (0)	
Technological infrastructure (0.2)	Wi-Fi presence (1)	1. Does your institution have a wi-fi connection?	Yes (1) No (0)	

Table A3.
Dimension: Process (wi = 0.1)

Sub-dimension(wj)	Metric (wk)	Question(Qk)		
Front-office (0.5)	Prerequisite	Does your institution have a ticketing service?	Yes → Include front-office No → exclude front-office	
	e-Billing process (0.6)	1. Which kind of ticketing service is present in your institution? (more than one answer is possible)	paper bill and paper accounting (0) paper bill and digitalized invoice (0.2) e-ticket printable at home (0.3) e-ticket not printable (you can see from phone) (0.5)	
	Access control (0.4)	2. How do you control visitors' access? (more than one answer possible)	We do not check visitors' access (0) Paper ticket control at the entrance (0) Bar code pistol reading paper (0.19) Bar code pistol reading screen (0.19) QR code reader (0.19) Gates or automatic people counter (0.19) Paper file (0) Excel file (0.14) others. . . (0.05)	
Back-office (0.5)	ERP Presence (1)	3. Do you have an informatic system that support these activities?	Accounting (0.1)	yes, dedicated or yes, shared with other institutions(1) No, not available or we do not manage this activity
			Supplier management (0.1)	yes, dedicated or yes, shared with other institutions(1) No, not available or we do not manage this activity
			Human Resources (0.1)	yes, dedicated or yes, shared with other institutions(1) No, not available or we do not manage this activity
			Customer Information Management (CRM) (0.1)	yes, dedicated or yes, shared with other institutions(1) No, not available or we do not manage this activity
			Cataloguing, conservation and	yes, dedicated or yes, shared with other institutions(1)

(*continued*)

Sub-dimension(wj)	Metric (wk)	Question(Qk)	
		ordinary maintenance of collections (0.1)	No, not available or we do not manage this activity
		Lending and moving of artworks (0.1)	yes, dedicated or yes, shared with other institutions(1) No, not available or we do not manage this activity
		Space Management (0.1)	yes, dedicated or yes, shared with other institutions(1) No, not available or we do not manage this activity
		Public services (bookshop, restaurant) (0.1)	yes, dedicated or yes, shared with other institutions(1) No, not available or we do not manage this activity
		Teaching activities (0.1)	yes, dedicated or yes, shared with other institutions(1) No, not available or we do not manage this activity
		Ticketing(0.1)	yes, dedicated or yes, shared with other institutions(1) No, not available or we do not manage this activity

Table A3.

Sub-dimension(wj)	Metric (wk)	Question(Qk)	
Customer Awareness (1)	Digital Marketing Activity (0.33)	1.Which one of these marketing activities do you perform (internally or externally)? (More than one answer is possible)	Newsletter (0.2) online/social network advertising (0.25) Search Engine Optimization (0.3) Use of Social Media to convey internet traffic towards the website or other marketing practices (0.25) None (0)
	Social Media presence (0.33)	2. Which social accounts do you have? (More than one answer is possible)	Facebook (0.15) Twitter (0.15) Instagram (0.15) YouTube (0.15) Pinterest(0.15) TikTok (0.25) None (0)
	Presence in reputation website (0.33)	3.On which of these review websites are you subscribed? (More than one answer is possible)	TripAdvisor(0.25) Google Maps (0.25) Facebook Place (0.25) Foursquare (0.25) None (0)

Table A4.
Dimension: Customer (wi = 0.2)

Sub-dimension(wj)	Metric (wk)	Question(Qk)	
Strategy (0.5)	Strategy(1)	1. Is there a strategic plan for digital innovation?	Yes, in a dedicated document (1) Yes, in another document (0.8) No (0)
Investment (0.5)	Digital investment (0.5)	1. In which digital activities did you invest in the last 2 years? (More than one answer can be selected)	Cataloguing and digitization of collection (1) Conservation of collection (1) Services of visit support (1) Communication and customer care (1) Ticket, booking and access control (1) Security and surveillance (1) Education activities (1) None (0)
	Digital investment penetration	2.Which is the percentage of investment you committed to digital innovation ?	1–5%(0) 6–10%(0.2) 11–25% (0.4) 26–50% (0.6) 51–75% (0.8) more than 75%(1)

Table A5.
Dimension: Strategy and investment (w = 0.3)

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