# A Benchmark for Monitoring the Development of Data Analytic Capability of Hospitality Firms

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## Abstract
*The development of digitalization capabilities and data analytic capabilities is a complex multi-year endeavor. Existing multi-item research scales increase survey length, driving up costs while increasing participant break-off and/or non-response bias. There is thus a need for more parsimonious data collection instruments to examine the development of digitalization capabilities over time and across organizations. Concurrently, there is a need for a benchmarking tool that hospitality firms can use to monitor their progress towards digitalization. To address these gaps in theory and practice, the present study uses prior research to develop and validate such a digitalization benchmark for hospitality firms. Two questionnaires were developed and administered using the platform Qualtrics. In each questionnaire, the benchmark items were matched with validated scales from the literature. The results show that the newly developed single-item measures correlate well with previously validated multi-item measurement scales, offering researchers and practitioners a new benchmarking tool that is more parsimonious.*

**Keywords** *Data Analytic Capability, Smart Hospitality, Benchmark, Digitalization*

**Type of Paper** *Empirical*

**Track** *Operational Innovations*

**Focus of the Paper** *Theoretical/Academic*

**Type of Submission** *Paper*

## Introduction
Hospitality firms are embracing digitalization to improve their organizational performance (Melián-González and Bulchand-Gidumal, 2016). Digitalization, broadly defined here as society's transition from analog to digital and the corresponding changes in customer and organizational behavior (Vial, 2019), is creating new opportunities for hospitality firms to discover and service new markets (Ma *et al.*, 2018), personalize guest experiences (Neuhofer *et al.*, 2015), and improve process efficiency (Kokkinou and Cranage, 2013). Digitalization has also been linked to organizational resilience (Kokkinou *et al.*, 2025) and improved organizational learning processes (Okumus, 2013). In the context of hospitality, digitalization manifests itself in diverse ways, including as Industry 4.0, big data analytics, data analytic capability (DAC), and smart tourism and hospitality (Hsu and Tseng, 2022; Kokkinou *et al.*, 2025; Suder *et al.*, 2024). While these concepts overlap somewhat, they are captured by several definitions. Smart hospitality is "*the integrative use of smart technologies such as the internet of things, artificial intelligence (AI) and mobile communication to collect enormous amounts of data, generate insights, and provide instantaneous support to all stakeholders of a destination*" (Law *et al.*, 2022, p. 624). DAC is the broader organizational level capability to deploy data, technology and people to quickly access and analyze information to support complex decision-making" (Yu *et al.*, 2021).

The digitalization of the hospitality industry is ongoing (Suder *et al.*, 2024). It was temporarily accelerated by the disruptions caused by the COVID-19 pandemic (Usher *et al.*, 2019). During this time of crisis, hospitality operators benefited from the goodwill of their digital suppliers and used the opportunity to improve their digitalization capabilities (Kokkinou, Mitas, *et al.*, 2023). For example, restaurants that prior to the COVID-19 lockdowns only served in-person guests were stimulated to adopt delivery platforms to diversify their distribution channels. Nevertheless, despite the documented benefits of digitalization, hospitality firms seem to be engaging in digitalization at widely varying paces (Chen *et al.*, 2025), with some hospitality firms embracing smart hospitality (Stylos *et al.*, 2021) while others still being unclear as to what the concept represents (Leung, 2019). These previous studies have mostly employed a qualitative approach, limiting the generalizability of the findings.

There is a need for a more quantitative approach (e.g. survey-based and/or longitudinal) to examine the development of DAC over time and across different types of organizations. However, existing multi-item scales developed to measure DAC (Srinivasan and Swink, 2018) and its antecedents, such as alignment with strategy, leadership, and employee knowledge and skills, tend to be lengthy and cumbersome for hospitality professionals to engage with. Conversely, using single-item measures would allow researchers to either keep survey length short when participant break-off and non-response bias are a concern, or to include a broader set of factors in their study (Matthews *et al.*, 2022). Furthermore, from a practical perspective, there is a need for a benchmarking tool that hospitality professionals can use to monitor their organization's progress towards digitalization. To address these gaps in theory and practice, the present study uses prior empirical research to develop and validate such a digitalization benchmark for hospitality firms. In the next section, we review prior literature on digitalization in the hospitality industry, and specifically on the concept of DAC and its enablers and inhibitors. We subsequently describe the methods used to collect data to develop and validate a single-item benchmarking tool intended for hospitality (and other) organizations to measure their progress towards developing their DAC. This is followed by the discussion, limitations, and recommendations for further research.

## Review of the Literature

Digitization, digitalization and digital transformation are often used interchangeably, however can be distilled into distinct processes with corresponding definitions: (1) digitization as the process of converting analog into digital data, (2) digitalization as the improvement of business processes through the application of data and digitalization tools, and (3) digital transformation as the development of new business model to take advantage of new opportunities stemming from digital technologies (Chen *et al.*, 2025; Machado *et al.*, 2019). Organizations can invest in the assets and processes that enable them to combine data, data analytics, and other digital tools to improve their DAC (Garmaki *et al.*, 2016; Gupta and George, 2016; Mikalef *et al.*, 2018; Yu *et al.*, 2021)

To develop their DAC, hospitality organizations need to invest in people, process, and technology related assets and processes (Gupta and George, 2016). These can be further subdivided in six categories, namely management, employee knowledge and skills, data analytics, data, IT infrastructure, structure and processes (Kokkinou, Kollenburg, *et al.*, 2024; Mikalef *et al.*, 2017, 2018). Furthermore, alignment between digitalization projects and strategy is essential (Kokkinou, Kollenburg, *et al.*, 2023).

An important enabler of the development of DAC is the attitude towards digitalization of senior leadership (Behl *et al.*, 2019), accompanied by the required resources. By adopting a long-term orientation towards investment and resources, senior leadership manifests their commitment and support (Tabesh *et al.*, 2019). They also need to lead by example, developing their managerial analytics acumen (Tabesh *et al.*, 2019; Vidgen *et al.*, 2017) and disseminating data-driven insights.

Within the organization, both employees with technical skills and domain knowledge are needed. Technical skills are needed in order to collect, analyze, and interpret data to generate new insights (Behl *et al.*, 2019; Ghasemaghaei *et al.*, 2018). Nevertheless, these insights will be meaningless unless they address a relevant problem for the organization in an actionable way. This is why domain knowledge is necessary. Both technical skills and domain knowledge can be hired externally through consultancy or onboarding, or developed internally through training (Kokkinou, 2023).

At the onset of a digitalization journey, organizations typically start with descriptive analytics, often in the form of dashboards, before moving on to predictive and prescriptive analytics. In the hospitality context dashboards are commonly used. The most common application of predictive analytics is forecasting

(Kokkinou, Forthcoming). For this, data is a necessary but not sufficient condition (Amankwah-Amoah and Adomako, 2019). Data needs to not only be available, but also fit for purpose and meet quality requirements (Mikalef *et al.*, 2020). Quality requirements are completeness, timeliness and reliability (Mikalef *et al.*, 2017, 2018). This often requires investments in suitable data governance (Mikalef and Krogstie, 2018) and an appropriate IT infrastructure. The IT infrastructure is the technical infrastructure that organizations have at their disposal to collect, analyze, store, and share data. These seven categories of assets and processes act as enablers of DAC and digitalization in hospitality firms (Kokkinou, Forthcoming). Organizations need to invest therein to make progress in their digitalization journey.

## Methodology

A mixed methods approach was employed to develop and validate the DAC benchmark. First, during prior studies (Kokkinou, Kollenburg, *et al.*, 2023; Kokkinou, Mandemakers, *et al.*, 2024), a review of the literature on enablers and inhibitors of DAC was used to develop a semi-structured interview guide that guided interviews with hospitality managers (Kokkinou, Forthcoming). This led to the identification of the seven aspects of digitalization that organizations developing their DAC needed to address, as discussed in the previous section. Further interviews with hospitality operators and hospitality SME owners led to the refinement of how these factors contribute to the development of DAC in hospitality organizations. The findings of these studies were used to formulate eight questions that provide a comprehensive yet easy-to-use and quick-to-fill self-assessment tool, as shown in Table 1. Existing scales from the literature were used to validate each benchmark question.

For the purpose of this study, two questionnaires were developed and administered using the platform Qualtrics. In each questionnaire, the benchmark items were matched with validated scales from the literature. Each questionnaire consisted of an introduction to the study and informed consent, demographic information and eligibility checks, the benchmark items, the validated scales, and additional demographics and attention checks. The first questionnaire tested the benchmark items alignment with strategy, management, data analytics and data quality, while the second questionnaire (re)tested the benchmark items alignment with strategy, management, employee knowledge and skills, data analytics, IT infrastructure, and process and structure. While the sampling and analysis procedures were identical for both questionnaires, for the purpose of brevity, we describe here only the sample and results of the second questionnaire.

Participants were recruited from the platform prolific which provides access to crowd-workers. While this type of sampling has been criticized for generating samples that tend to be younger, more tech savvy, and lacking real-world experience (Mahmud *et al.*, 2022), strict eligibility conditions and checks were implemented to address these issues. Participants were eligible for the study if they were currently, or had recently been employed by a hotel, or owned a hotel. In addition to the eligibility check in section 1 of the study, a second eligibility check was introduced in section 2, by asking participants to describe their activities with an open question. While the initial sample comprised 240 responses, after reviewing the answers to this questions, attention checks and other control measure, 201 remained for further analysis. Of the remaining participants, 38.9% identified as male. The average age was 36.125 years (sd=11.843) and the average tenure at the company was 4.896 yeads (sd=3.851). 53.7% of participants reported working at a smaller hotel (defined here as fewer than 100 rooms). 67.2% reported working for non-affiliated hotels.

The study underwent a preliminary research ethics self-assessment following the requirements of the Breda University of Applied Sciences Research Ethics Review Board. Given the data collection procedures detailed in this section, the study was found to be exempt from a full review.

**Table 1: Benchmark Items and Corresponding Scales**

| | Benchmark Question | Scale from Literature** |
|---|---|---|
| Strategy* | ***Which of the following best describes how digitalization is part of your strategy?*** We currently have no digitalization objectives. (1) We have departmental digitalization objectives but they are not linked to our business strategy. (2) We have company-wide digitalization objectives but they are not linked to our business strategy. (3) | Digital Strategy (Li *et al.*, 2022; Podsakoff *et al.*, 1990) |

| | | |
|---|---|---|
| | We have departmental and/or company-wide objectives linked to our business strategy. (4)<br>We have a digital strategy that is somewhat connected to our business strategy. (5)<br>In our company, digitalization and business strategy are integrated. (6) | |
| Management* | ***Which of the following best describes the role of management vis a vis digitalization in your organization?***<br>Leaders and senior managers are not sufficiently aware of digitalization. (1)<br>Management / leaders are aware of digitalization, but not sufficiently to be able to envision how it could contribute to the organization. (2)<br>Leaders and senior managers have allocated resources to digitalization, but with no concrete objectives. (3)<br>Leaders and senior managers have formulated objectives for digitalization, but have not allocated resources. (4)<br>Leaders and senior managers have formulated objectives for digitalization (projects) and allocated resources. (5) | Digital Transformational leadership (Chen and Chang, 2013)<br><br>Chen and Chang (2013), Podsakoff et al. (1990), Podsakoff et al. (1996) |
| Employees* | ***Which of the following best describes the digitalization related skills of employees at your company?***<br>Digitalization related skills are not considered important in our organization. (1)<br>Some of our employees have digital skills and expertise related to their work activities. (2)<br>Most employees have digital skills and expertise and routinely use digital products and services for their work activities. (3)<br>All employees have digital skills and expertise and need to use digital products and services for their work activities. (4) | Employee Digital Capabilities (Shin et al., 2023) |
| Data | ***Which of the following best describes <u>data collection</u> in your organization?***<br>We collect limited data in our organization. (1)<br>We collect some data from our processes (e.g. transaction data). (2)<br>We collect some data from various sources in our organization (e.g. operations, marketing, sales). (3)<br>We collect extensive data from various sources throughout the organization. (4)<br>We have extensive data covering all aspects of our business from various sources of our organization. (5)<br>***Which of the following best describes <u>data quality</u> in your organization?***<br>We have little awareness of the quality of our data. (1)<br>We collect data but it has errors and is not complete. (2)<br>We collect data but has some errors or is not complete. (3)<br>We collect data that is error-free and mostly complete. (4) | Data Consistency (Rai *et al.*, 2006)<br><br>Data completeness (Malhotra *et al.*, 2005) |

| | | |
|---|---|---|
| | We collect data that is error-free, complete, and value-added for our decision-making. (5) | |
| Data Analytics* | ***Which of the following best describes how your organization uses data analytics?***<br>There are limited applications of data analytics in our organization. (1)<br>Some departments or employees have access to dashboards. (2)<br>We consistently use dashboards for decision-making. (3)<br>We occasionally use data analytics tools to make predictions (e.g. forecasting) and use this information for decision-making. (4)<br>We consistently use data analytics tools to make predictions (e.g. forecasting) and use this information for decision-making. (5)<br>We use data analytics tools to assess the impact of various decisions on our business and use this information for decision-making. (6) | Data analytics<br>(Yunis *et al.*, 2018) |
| IT Infrastructure* | ***Which of the following best describes your organization's IT infrastructure in relation to data?***<br>We have little awareness of where our data is stored and how to retrieve it. (1)<br>We know where most of our data is stored and know how to retrieve it, but it is not easily accessible. (2)<br>Most of our data is easily accessible, but not connected and working together. (3)<br>All of our data and IT applications are connected and working well together. (4) | Digital IT Capabilities<br>(Proksch *et al.*, 2024) |
| Process and Structure* | ***Which of the following best describes how digital expertise is embedded in your organization?***<br>We do not have employees with digital skills and expertise in our organization. (1)<br>We have employees with digital skills and expertise in our organization but no dedicated IT department. (2)<br>Most of our digital expertise is within our IT department. (3)<br>In addition to our IT department, we have employees with digital expertise working in departments, but there is no structure for them to work together. (4)<br>We have various employees with digital expertise in various departments across the organization, working in cross-functional teams. (5)<br>We have a dedicated team of employees with digital expertise that support employees in various departments across the organization. (6) | Digital culture and digital processes<br>(Proksch *et al.*, 2024) |

** included in questionnaire 2*

*** the references shown refer to the publication(s) from which the measurement items were taken, which may not necessarily be the original source. * included in questionnaire 2*

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## Results

We describe here the analysis and results of the data collected using the second questionnaire. First, the reliability of each scale was assessed using Cronbach Alpha. As Table 2 shows, Cronbach Alpha exceeded the recommended threshold of 0.7 for each scale. Therefore, for each scale, the items were average to create a single measure per participant. For each scale, mean and standard deviation are shown in Table 2.

**Table 2: Scale Reliability**

| | Cronbach Alpha | Mean | Standard Deviation |
|---|---|---|---|
| Alignment with strategy | 0.864 | 3.809 | 0.896 |
| Leadership | 0.955 | 3.469 | 1.109 |
| Data Analytics | 0.928 | 3.755 | 0.943 |
| IT infrastructure | 0.876 | 3.680 | 0.946 |
| Process and structure | 0.854 | 3.692 | 0.758 |
| Employee skills | 0.883 | 3.603 | 0.983 |

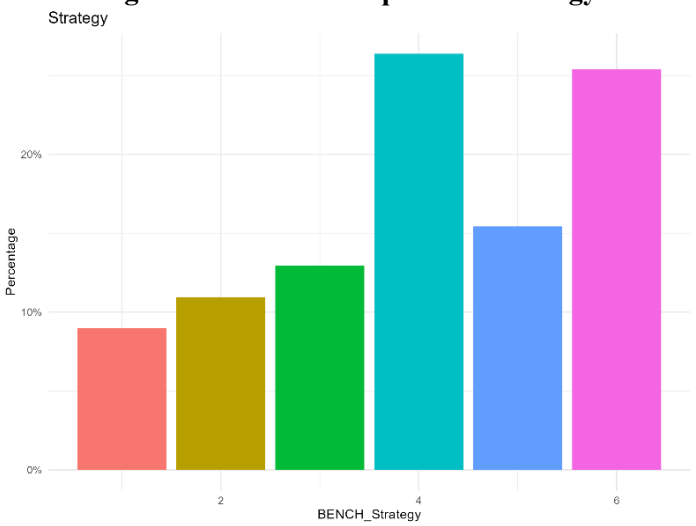
Subsequently, a correlation was calculated for each combination of benchmark question and corresponding scale, as shown in Table 3. For example, the correlation between the benchmark question Strategy had a statistically significant positive correlation with the *alignment with strategy scale* ($r(198)=.502$, $p<.001$). Similarly, the benchmark question Management had a statistically significant positive correlation with the *Digital Transformational Leadership* scale ($r(198)=.560$, $p<.001$). The full results are shown in Table 3.

**Table 3: Correlation Results**

| Benchmark | Scale | Correlation | t-value | p-value |
|---|---|---|---|---|
| Strategy | Alignment with Strategy | 0.502 | 8.179 | p<.0001 |
| Management | Leadership | 0.560 | 9.552 | p<.0001 |
| IT infrastructure | Process and structure | 0.538 | 8.985 | p<.0001 |
| Employee knowledge and skills | Employee | 0.485 | 6.781 | p<.0001 |
| Analytics | Data Analytics | 0.635 | 11.594 | p<.0001 |

The results of the benchmark were subsequently visualized using the R package ggplot. For example, Figure 1 illustrates the results of the Link to Strategy question. As Figure 1 shows, the majority of sampled companies are in level 4, described as "*we have departmental and/or company-wide objectives linked to our business strategy*" and level 6, described as "*in our company, digitalization and business strategy are integrated*."

**Figure 1: Benchmark question: strategy**




Similarly, as Figure 2 shows, the majority of participants rate their company as a 5 on the management question, namely as "*leaders and senior managers have formulated objectives for digitalization (projects) and allocated resources.*" However, splitting this by company size as is shown in Figure 3 shows a more nuanced view, with mostly large hotels being in level 5.

**Figure 2: Benchmark question Management**

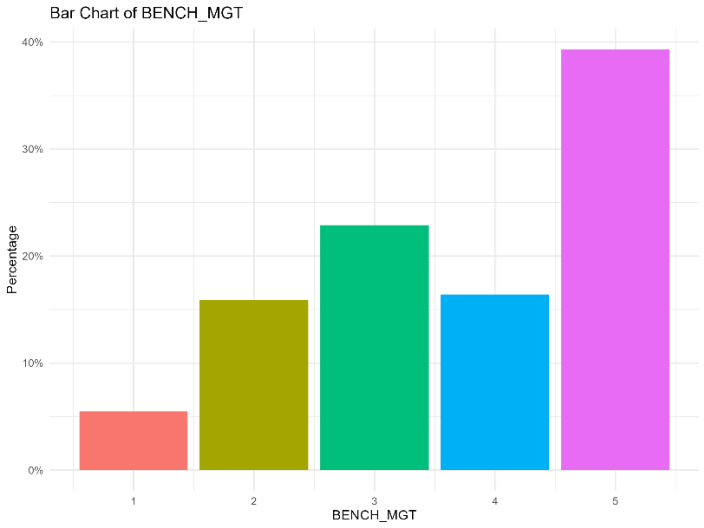
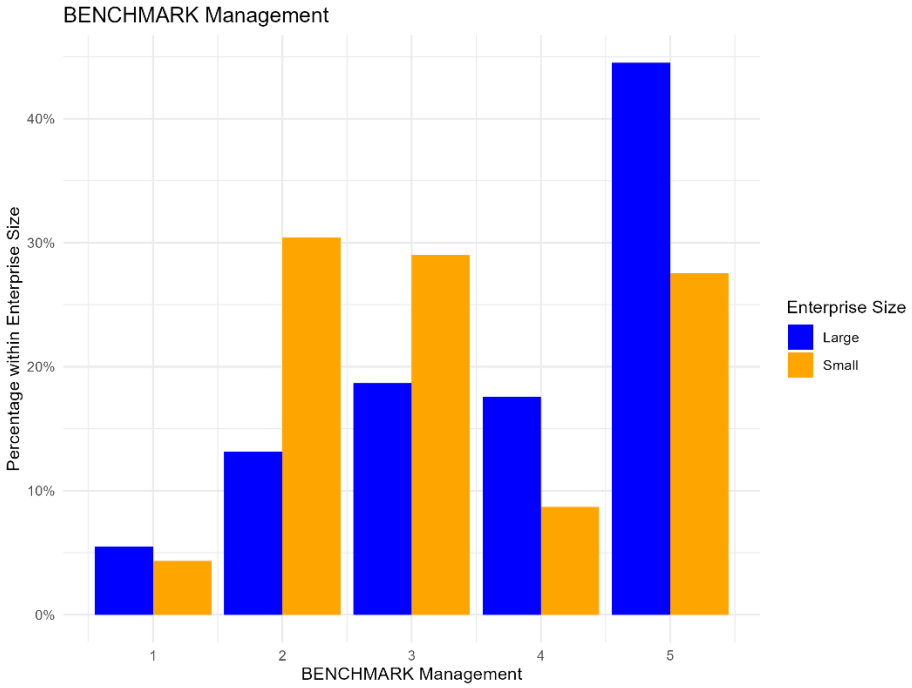


**Figure 3: Benchmark question Management split by hotel size**




## Discussion and Practical Implications

The purpose of this study was to develop a set of single-item measures that would provide a comprehensive representation of how organizations developed their DAC. Using a review of the literature and semi-structured interviews, a set of eight single-item measures was developed to represent seven known enablers of DAC and digitalization in hospitality organizations (Kokkinou, Forthcoming). As the results show, these eight single-item measures were found to correlate well with existing and previously validated multi-item measurement scales.

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While in the context of scientific research, the use of multi-item measurement scales is recognized as the gold standard to achieve valid and reliable results, (Matthews *et al.*, 2022), it is not without limitations. The use of multi-item measurement scales often leads to lengthy and cumbersome surveys, which can deter participation among hospitality professionals. This can jeopardize longitudinal research projects and/or force researchers to adopt a too narrow perspective to keep surveys short. Organizational phenomena such as digitalization are complex, and scope reduction can lead to a lack of ecological validity.

Developing a set of single-item benchmark measures accomplishes two objectives simultaneously. First, the parsimony made possible by the use of single-item measures enables researchers to collect larger and/or longitudinal datasets (Allen *et al.*, 2022). Researchers can use these single-item scales when survey length is a concern, either because of potential participant break-off or non-response bias (Matthews *et al.*, 2022). For longitudinal research projects, the reduction in survey administration costs resulting from a decrease in survey length can also be highly desirable. In this study, eight questions addressing alignment with strategy, senior leadership, employee knowledge and skills, data analytics, data, IT infrastructure, and structure and processes (Chen *et al.*, 2025; Gupta and George, 2016; Mikalef *et al.*, 2017) were developed and validated against existing scales. The development and validation of these single-item measures allow researchers to study the development of DAC over time and across organizations (Kokkinou, Forthcoming; Mikalef *et al.*, 2018).

Second, hospitality firms can utilize this set of benchmark items to track their progress toward digitalization. Given the complexity of implementing digitalization and developing DAC, hospitality firms can use this tool to ensure that they are giving sufficient attention to all relevant enablers and inhibitors. Managers can use this

self-assessment tool to evaluate their organization's current state of digitalization and consider future development actions.

## Limitations and Future Research

The present study describes the development and validation of a benchmark tool that allows hospitality firms to evaluate their organization's current state of digitalization and consider future development actions. While the benchmark tool is based on extensive qualitative research, both in the hospitality industry (Kokkinou, Forthcoming) and other industries (Kokkinou, Kollenburg, *et al.*, 2023, 2024; Mikalef *et al.*, 2018), relevant factors may have been overlooked, rendering it incomplete. Concurrently, the data used for this study were collected using a crowd worker platform. While strict eligibility requirements were employed to mitigate sampling bias risks, the criticism persists that participants recruited from such platforms tend to be more tech-savvy (Mahmud *et al.*, 2022). A next step in the validation of these single-item measures would be to conduct additional interviews with key informants from hospitality organizations using a different sampling technique (e.g., convenience sampling in combination with snowball sampling).

While the single-item measures are intended to be broadly applicable in the hospitality industry, the current study only collected data from participants employed by hotels, limiting the generalizability of the study. The study should be replicated using data from a broader sample of hospitality organizations, such as restaurants, bars, and pubs.

Finally, while previously validated scales were used to triangulate the individual benchmarking questions, it remains unclear what their practical relevance is. Specifically, no data was examined to test whether hospitality managers using the benchmark would be empowered to improve the DAC of their organization. Future research should therefore examine the practical relevance of the benchmarking tool and whether it indeed leads to superior development of DAC through more comprehensive research approaches, such as action research.

## Acknowledgements

We would like to acknowledge funding received from the Dutch Taskforce for Applied Research (SIA). This publication is part of the project A Collaborative Data Driven Approach to Developing Resilience for Hospitality SMEs (project number MV.KIEM.01.115) funded by the Taskforce for Applied Research (SIA) and the Dutch Research Council (NWO).

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