


## Article

# User-Centered Development of an Online Dashboard Tool for Economic Sustainability for Small and Medium Enterprises

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**Abstract:** This study aimed to improve an existing static benchmarking tool for the economic sustainability of small and medium enterprises (SMEs) in the wine sector to develop and elevate it into a dynamic online dashboard decision support system (DSS) for economic sustainability. Development was conducted in line with a user-centered-development process in four main steps. In the first step, producers' expectations for an optimal tool were elicited using a qualitative approach of 24 in-depth interviews with long-term users of the existing PDF reports. Among the 10 requirements, producers requested an overall summary assessment of the most important KPIs of their business (including the provision of ideal values), intuitive visual presentations, long-term time developments, flexible reference groups, and short comments. Based on the wine producers' systemized responses, the first version of the online benchmarking tool was designed and implemented in cooperation with experienced online designers and programmers. In the third step, a usability test was conducted to elicit options for further improvements that were implemented before the fourth step, the release of the final version to the industry. The systematic development process outlined and established here and the released DSS tool that is publicly available with open access provide valuable insights for institutions planning similar future dashboards for other sectors, particularly for SMEs. This constitutes an important step toward the development of more holistic support tools for sustainability performance measurement across all pillars of sustainability moving forward. To the best of the authors' knowledge, the DSS developed represents the first online dashboard tool for economic sustainability for SMEs globally and in the wine sector.



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**Keywords:** economic sustainability; usability; benchmarking; key performance indicators; SME

## 1. Introduction and Purpose

Sustainability is an increasingly important topic for a variety of industries, including the wine industry [1,2]. The major effects of climate change are being observed by the wine industry, making it the fourth most important challenge recognized by wine businesses [3,4]. As a result, composing systems to make sustainability more tangible has become a driver in the recent development of new sustainability performance measurement tools [5,6].

In previous literature, sustainability has been concluded to comprehend three pillars of social, economic, and environmental sustainability, also known as the “triple bottom line” [7]. These three categories are intertwined and must all be met for a business to truly be sustainable in the long term [8–10]. As a result, a business that considers environmental and social interests, but cannot cover its cost or adapt to its economic surroundings, will not be capable of surviving long-term. No amount of excellent social and environmental performance will prolong the life of a company if it is economically unsustainable [11,12].

Internationally, multiple wine industry institutions have developed certification programs of sustainability for wineries [13–16]. While some (e.g., Nachhaltig Austria) offer an online tool for evaluating sustainability performance factors, the main focus predominantly remains on the ecological and social pillars of sustainability, with a minor focus on the

economic sustainability pillar, if at all, so far. This, however, is in contrast to wine producers' priorities, as they perceive economic sustainability to be the most important factor for planning long-term survival in the future, as it is an essential requirement for generating enough investments in order to address the major impacts of climate change [4,17].

In general, economic sustainability can be defined as a future-oriented concept, which aims at long-term economic survival, adaption to change, and healthy economic growth [11].

Labuschagne et al. [18] use four criteria to define economic sustainability:

1. Financial health: This includes the internal financial stability of a company through sub-criteria such as profitability, liquidity, and solvency.
2. Economic performance: The company's value as perceived by shareholders, top management, and government with sub-criteria such as profitability and market share performance.
3. Potential financial benefits: Financial benefits other than profits such as subsidies based on environmental, social, and/or technological improvements due to business initiatives.
4. Trading opportunities: The vulnerability of the company's trade network.

Doane and Macgillivray [11] consider financial performance to be an important aspect of economic sustainability, while Labuschagne et al. [18] even emphasize financial health as the most important of the four. This is also supported by Boar et al. [19], who mainly include financial health indicators such as operational stability and increased profitability as well as risk reduction as part of their economic sustainability dimension.

As measuring sustainability performance becomes an increasingly emerging issue, more scientific knowledge is needed to make it less subjective [20,21]. Here, quantifying economic sustainability can help overcome hurdles such as greenwashing in order to become truly sustainable in the long term [17]. With the goal of assisting decision making and improving the sustainability performance of companies, the development of sustainable KPIs (Key Performance Indicators) is a valuable source of information and a step toward making the measurement of sustainability less subjective and more data driven [22,23]. A major concern in this regard is that tools and frameworks of sustainability management tools are mainly designed for large companies. This has resulted in low usage of such tools in small- to medium-sized enterprises (SMEs), since said tools do not address and cater to their specific needs [24–26]. This also results in a major barrier for SMEs implementing and using sustainability management tools being the lack of financial and human resources and not being able to perceive the potential benefits associated with the implementation of such a tool [26,27].

In this context, SMEs depend on the support of public institutions to help reduce said barriers of implementation and create digital tools for SMEs to tailor to their needs, enabling them to align their business practices long term with sustainable goals. As a result, this paper attempts to transform an exclusive current benchmarking system of the German wine industry, the Geisenheim business analysis, into a more effective web-based decision support system (DSS) dashboard tool for economic sustainability support for SMEs. The aim of this new dashboard tool is to allow German wine estates to more precisely and purposefully evaluate their current status of economic sustainability, as well as adapt more consciously to future challenges in order to remain stable and prevail in the long term.

The development encompassed a user-centered development process, comprised of four main stages. First, qualitative interviews were conducted to gain insights into the requirements needed for the second stage. After the results of the qualitative interviews were evaluated, stage 2 established the first design of the DSS for further testing. In stage three, final usability and feedback tests aided in fine-tuning potential issues, which were subsequently addressed and adjusted before the final release of the DSS to the users of the wine sector.

To the best of the authors' knowledge, there is currently no other online dashboard tool available for in-depth economic sustainability for SMEs or businesses in the wine

sector. This study provides an important step toward the development of future tools for sustainability performance measurement.

## 2. Literature Review

### 2.1. Performance Measurement and Economic Sustainability in the Wine Sector

In multiple sections of the wine sector, there have been attempts at developing frameworks to better measure performance management generally. Garcia et al. [28] suggested a framework for improving logistics and supply chain performance in the wine industry, by using logistically relevant KPIs to utilize and benchmark. This approach suggested promising insights and feedback for improvement when applied to a case study of six wineries in the Mendoza region in Argentina [28].

When focusing on the wine industry, tools to support wineries in becoming more economically sustainable are becoming increasingly sought after. The economic sustainability of most wineries was found to be insufficient in many countries, unable to sufficiently reimburse their family labor [12,29]. This was also confirmed in a recent study by Loose et al. [12]. While assessing the economic sustainability of German wine businesses, 30% of the businesses analyzed were found to have a profitability of below zero and were unable to sufficiently reimburse their family workforce [12]. This coincides with the barrier Ingrassia et al. [27] identified for SMEs in the Italian wine industry joining sustainability programs: Will my business be able to economically survive the cost changes that accompany a certification?

Interestingly, Broccardo and Zicari [30] found that Italian family-owned wineries involved in sustainability operations showed more favorable economic indicators than businesses not involved in sustainability programs. Contrarily, Muñoz et al. [31] contended that the economic impact on wineries undertaking corporate social responsibility measures remains unclear, as their results showed no significant relationship between the profitability and the socially responsible behavior of wineries. Moreover, environmentally responsible wineries in Spain were revealed to be less profitable compared to their less environmentally responsible counterparts [31].

In an attempt to develop a three-dimensional integrated management system for the Chilean wine industry to increase its competitiveness and achieve sustainability in the sector, Valenzuela and Maturana [32] also propose integrating the economic outlook. Here, taking into account an improved cost structure, increased value to the consumer as well as sustainable business value were considered essential for the economic pillar [32].

The literature underlines the importance of SME company management being on board with sustainable goals and that management tools (e.g., web platforms) to assess sustainability performance are essential [26,33]. To the best of the authors' knowledge, there is currently no online dashboard tool available that assesses and focuses on economic sustainability for SME businesses in general and for businesses in the wine sector in particular.

### 2.2. Management Information Systems, Decision Support Systems, and Digital Dashboards in Performance

Management information systems (MISs) and decision support systems (DSSs) provide this opportunity. MISs provide information related to internal operations and external intelligence, with the goal of supporting the planning, control, and operation functions of an organization [34]. Hereby, software is used to create data-based content in the form of periodic reports, displaying various aspects of a firm's operations [35]. DSSs complement and expand upon MISs by analyzing collected data based on specific demands and problems, to aid managers at any organizational level of a business in making decisions [36,37]. As opposed to the static reports of MISs, DSSs are more interactive and flexible and offer supportive information on the data presented. DSSs can result in a significantly greater decision-making performance, although a learning period is required for users to become familiar with the interface [38]. The information of DSSs is conventionally conveyed in the

form of dashboards. As a result, while designing the dashboard interface of such a DSS, the ability of the human operator to use the final tool must be taken into account during the development process [39].

Such dashboards are becoming more important for performance management in general. In principle, a dashboard is expected to collect, summarize, and present information from multiple sources such as legacy, Enterprise Resource Planning (ERP), and Business Intelligence (BI) software so that the user can see the status of various performance indicators at once [40].

Dashboards are useful if they support their users in fulfilling their goals. They require concise, clear, and intuitive display mechanisms, and the information must be tailored specifically to the requirements of a given person or group in order to serve its purpose [41]. A well-managed dashboard can provide the tools managers need to manage performance and allocate resources optimally [42]. To ensure the widespread acceptance and application of such tools, key criteria such as simplicity/user-friendliness, practicality/cost-effectiveness, and adaptability/flexibility, as well as locally focused and group/network-oriented tools, are essential [26].

Unfortunately, so far, DSS dashboard tools for economic sustainability mainly remain conceptual [11,43–46]. Especially for the wine sector, previous DSS concepts have mainly focused on production and logistical efficiency, without taking economic sustainability into account [47,48]. The development of such systems is especially crucial for SMEs, as a major issue for businesses of this category is that they usually lack the resources to otherwise engage with sustainability practices [25]. Research by universities and business schools can be helpful in promoting research into economic sustainability dashboard tools in this regard.

### 2.3. The Visualization Development Process of Dashboards

When designing any kind of support tool, choosing the right data and the right visualization techniques is essential in making a dashboard as useful as possible [42]. To choose the right data, it is important to evaluate which data to collect, together with the reason why they must be collected. When choosing the right visualization techniques, one must focus on minimizing the time needed to understand what has to be communicated, rendering the dashboard as intuitive as possible [49].

A frequently cited and utilized technique for data visualization is the Visual Information Seeking Mantra (VISM), originally proposed by Shneiderman in 1996 [50]. It breaks down visual design guidelines into three major principles:

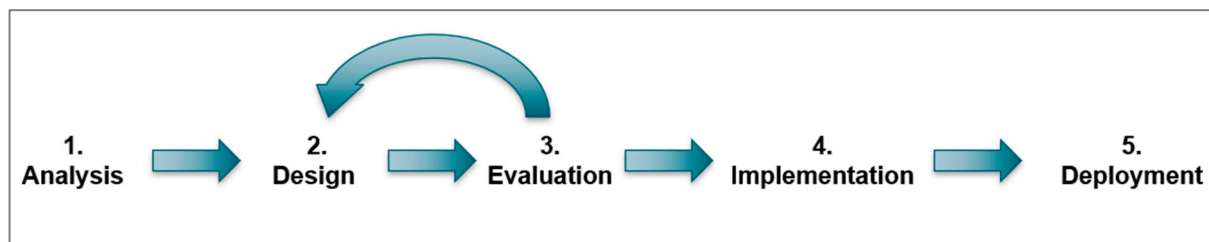
1. Overview first: Permit the user to gain an overview of the data first.
2. Zoom and filter: Allow the user to zoom in and focus on points of interest while filtering uninteresting items, allowing users to control the contents of what is displayed.
3. Details-on-demand: Provide the user with details when needed, through, e.g., optional pop-up windows with further information.

While supporting the helpfulness of VISM, nonetheless, Craft and Cairns [51] argue that it is essential to further validate the actual usability of systems resulting from this visualization methodology. Building on this suggestion, Stauffer et al. [52] expanded upon the original VISM, implementing a more user-centered development process, VISM 2.0, the general principle of which is displayed in Figure 1.

In the process outlined by VISM 2.0, Stage 1 (Analysis) prioritizes identifying and understanding the users' goals and tasks. Additionally, the tools currently in use to reach said goals are established, as well as which problems they experience and which changes they would like to see in their current tasks and tools [52,53].

Stage 2 (Design) uses the results from stage 1 to create alternative solutions with new design concepts in areas such as navigational design, storyboards, or creating functional online prototypes for further evaluation [53]. Stage 3 (Evaluation) involves periodically soliciting user feedback on the evolving design in order to iterate the design based on the

analysis of methods such as usability testing. Finally, the last two stages implement and deploy the design solutions established and defined in the prior stages 1–3 [52].



**Figure 1.** User-entered development process of a VISM 2.0 (own illustration based on Stauffer et al. [52]).

#### 2.4. A Current Benchmarking System—Geisenheim Business Analysis

The Geisenheim University business analysis has provided German wine businesses with feedback on general business data as well as key attributes in assessing business performance in the form of PDF reports and therefore has functioned as an MIS. It comprehends the analysis of six key dimensions (input factors, productivity and efficiency, profit, return on capital invested, liquidity, and stability) [12]. It is thereby closely aligned with the criteria of long-term financial health (stability, profitability, liquidity, solvency), which are suggested by Boar et al. [19] and Labuschagne et al. [18] to be the most important criteria to operationalize economic sustainability.

By evaluating the business data of hundreds of German wineries, PDF-based reports with graphs encompassing a variety of KPIs were processed in the Geisenheim business analysis through a centralized databank and subsequently distributed back to the wineries. Appendix B provides some examples of the PDF output (Figures A1–A4). The specificity of the KPIs is not relevant to this paper, so they will not be explained in depth at this point. For a more detailed definition of the KPIs, see Wetzler et al. [54] and Loose et al. [12]. The PDF-based reports, while providing general feedback and a good first overview of KPIs for a business, remained static and inflexible in suiting more specific individual winery needs and providing wineries with more varied information. As a result of winery demands for more flexibility and support for long-term economic sustainability, the goal is to improve upon and further develop these PDF reports into an online dashboard support tool.

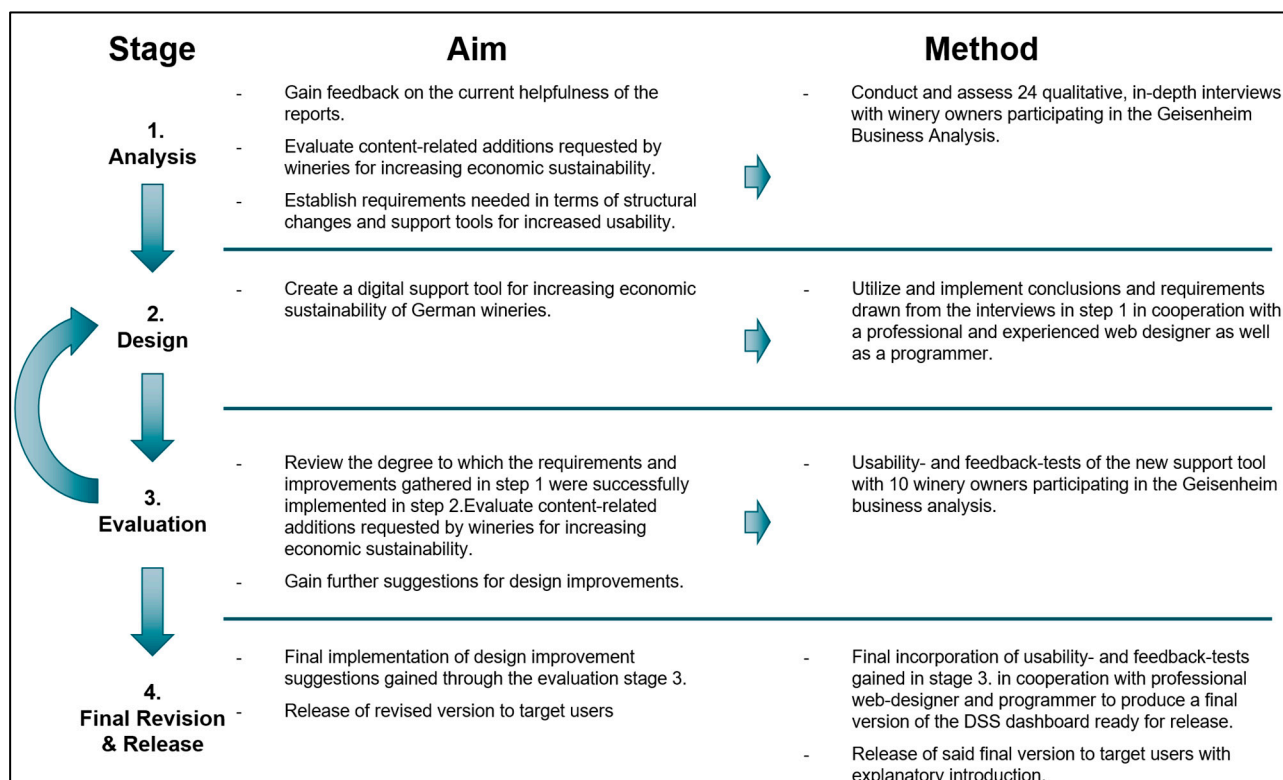
### 3. Data and Methodology

The methodology adopted here follows the first four steps of the user-centered development process of VISM 2.0 (Stauffer et al., 2016 [52]) and is outlined in Figure 2.

The first stage (Analysis) aimed to gain feedback on the helpfulness of the current static PDF reports as well as to establish content-related additions and requirements needed by the wineries to help them increase economic sustainability, as well as the usability of a new support tool. The aim of the second stage (Design) was the drafting of the first version of said new online dashboard tool based on the requirements and additions determined in stage 1. The third stage (Evaluation) aimed to review the degree to which the improvements gathered in stage 1 were successfully implemented in stage two as well as to identify further suggestions for design improvements and additions.

Before the release and final implementation of the online dashboard tool, stages two and three can be repeated indefinitely until the goals and requirements are met to an extent previously defined as sufficient. Due to cost and time limitations, this study conducted a first comprehensive cycle of the process, offering a sufficient but nonetheless improvable version of the final online dashboard tool. In the fourth stage, final revisions were implemented, and the tool was released to the industry in early 2023.





**Figure 2.** Methodological approach of the user-centered development process (own representation).

### 3.1. Stage 1, Analysis: Qualitative Interviews

Twenty-four qualitative in-depth interviews were conducted with winery owners across a span of four months from March to July 2020. Wineries were picked at random from multiple German wine-growing regions, with the only prerequisite being participation in the Hochschule Geisenheim University business analysis (see Section 2.4) for three years or more. An interview questionnaire including 11 open and supported questions was developed (see Appendix A), covering the subjects of:

1. The current impression and helpfulness of the PDF reports.
2. Desired content-related additions or requests for more in-depth information.
3. Structural changes and additional support tools for increased usability and intuitiveness.

Four interviews were conducted in person until it was no longer possible due to COVID-19 lockdown regulations, resulting in the remaining twenty interviews being conducted by phone or video call. After their transcription, the interviews were evaluated, followed by the implementation of key takeaways in the development process of the new web tool for evaluating economic sustainability.

### 3.2. Stage 2, First Design Stage of the Online Dashboard

The results and conclusions gathered by the qualitative interviews were reviewed and implemented in cooperation with a professional web designer and programmer. By combining said results and conclusions of the interviews with the experience in web design principles of the web designer, the new support tool was developed over the span of 8 months and prepared for the usability and feedback tests.

### 3.3. Stage 3, Evaluation: Usability and Feedback Tests for the Online Dashboard

The usability tests for the first version of the online dashboard tool were scheduled and conducted from April 2022 to May 2022. Of the 10 usability tests, 4 were conducted in person, while the remaining 6 were conducted online using the video call and screen sharing software on Microsoft Teams. All participants as well as their screens were recorded

throughout the test for subsequent analysis. The author directed the tests according to the principles of Krug [55]. Participants were monitored using the first version of the online dashboard tool while being asked to think aloud to provide subsequent feedback and insights on possible usability issues. A detailed protocol on the proceedings of the test can be found in Appendix C. Hereafter, the tests were evaluated in relation to the fulfillment of the requirements by the tool established in stage 1. To ensure a sufficient sample size, the tests were conducted until a problem discovery goal of 95%, or higher, was reached, using a combined Good–Turing discounting and normalization procedure method as suggested by Nielsen et al. [56] and Cazañas et al. [57]. This resulted in a total of  $n = 10$  participants needed and usability tests conducted. The results of stage 3 were re-integrated into the design, extending and improving upon its usefulness and usability.

### 3.4. Stage 4, Release: Deployment of Final Improvements and Release to the Industry

Final improvement suggestions gathered during the usability tests were implemented by programmers, resulting in a revised version of the DSS dashboard tool by the end of 2022. A ten-page introduction, including screenshots and explanatory material for the new tool and its advantages, was sent out to more than 450 German wineries. In early 2023, all participating wine businesses were given access to their individual online DSS dashboard, followed by an official launch for the broader German wine sector at an industry seminar event in March 2023.

## 4. Results

### 4.1. Analysis: User Demands for a Management Information System

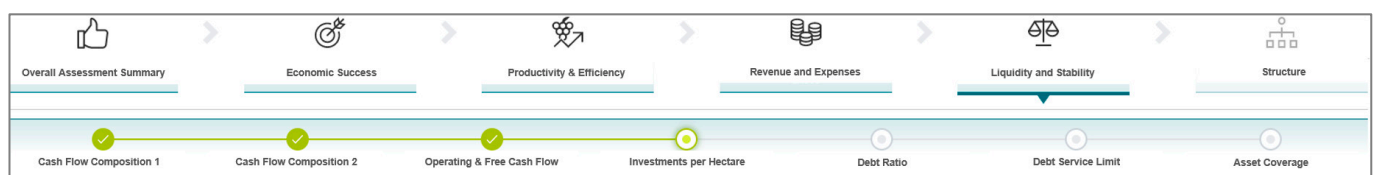
The following section presents the results of the 24 qualitative interviews divided into three parts. It addresses the feedback the respondents gave on three core issues for the development of the new online dashboard tool: (1) their overall impression and perceived helpfulness, (2) requested content-related additions, and (3) structural changes and support tools respondents requested. The main takeaways of the interviews across all three sub-sections have been systematically sorted and are listed and summarized in Table 1.

**Table 1.** Overview of producer requirements and implementation of the online dashboard.

Nr.	Requirement	Implementation	Example for Implementation
1	Make the structure of the report easier to understand	Flexible and guided navigation through a bar with visual icons per chapter.	Figure 3
2	Identify most important KPIs and their status	Summary of the most relevant KPIs based on their impact on the operational result incl. family wages and their current status.	Figure 4
3	Display ideal values of KPIs	A traffic light system that intuitively assesses good, average, and critical values, based on cut-off values.	Figure 4, Figure 5, Figure 6
4	Provide additional reference groups for benchmarking	The option of choosing and switching between different reference groups for relevant KPIs.	Figure 6
5	Extend time span	Users can switch between a time span of 5 and 10 years of reference data.	Figure 6
6	Visualize long-term trends	Linear trend line included over 5 and 10 years.	Figure 6
7	Comment on graphs	Automated comments stating current situation, average development over 5 years, and relative difference to average businesses.	Figure 6

Table 1. Cont.

Nr.	Requirement	Implementation	Example for Implementation
8	Improve annotations and ease of understanding	Integrated help texts displayed by hovering over designated help icons distributed around and within the graphs.	Figure 7
9	Include benchmark on investments and degree of obsolescence	New KPI for degree of investments included in the user story. Degree of obsolescence is currently still a work in progress; expected completion: 2023.	Figure 3
10	Provide more details on cost structures	Detailed visual analysis of expenses. Currently no more details possible due to data structure.	Currently unavailable



**Figure 3.** Example of a navigation bar with fitting icons for each chapter of the user story and the opportunity to switch between benchmarks, visualizing the structure of the report (translated from the German original).

#### 4.1.1. Overall Impression and Helpfulness of the Current PDF Reports for Wineries

All 24 of the 24 respondents were satisfied with the different graphs and visualizations used to display the performance indicators with one exemplary participant describing the analysis as “clear, concise, and good, especially the comparison with average values as well as averages of the best 25% of the reference group”.

This positive feedback persisted when respondents were asked about the use of specific KPIs. Generally, the comparison and benchmarking of KPIs with relevant reference groups (see requirement 4 of Table 1) was considered more important than focusing on a specific KPI. Nonetheless, the most important KPIs named by participants were cost per liter, profit per liter, and labor intensity (working hours required per hectare of vineyard area). “Principally, the cost-side is always relevant. In terms of turnover [per liter/pricing] I have the feeling we have it under control or, that we can flexibly increase it. But in the end, controlling costs is important for everything else”. Cost per liter as well as labor intensity were seen as highly relevant KPIs to monitor, adding to requirement 2 (Table 1) of identifying the most important KPIs and their status.

The total operational result after the deduction of an imputed family wage was only considered to be important by two winery owners: “As a family worker, you often don’t take into account every hour of work you put in [...]” and “[...] in our industry, this is a problem”. KPIs of capital information, such as return on equity, equity development, or debt ratio, also received little attention and were only mentioned by single, isolated respondents.

While the majority, 14 out of 24, of respondents claimed to have no issues understanding the structure and all KPIs, several were named as redundant or confusing due to, e.g., legibility issues through vertical chart labeling: “[...] What I currently take issue with, is the visual presentation of liquidity. [...] The chart labelling of the cash-flow and financing-cash-flow graphs [see Appendix B, Figure A1] are unfortunate, you always have to turn it to understand, what is trying to be conveyed?” A similar impression toward liquidity was shared by three other respondents, culminating in the requirement of making individual graphs more comprehensible through improved annotations (requirement 8, Table 1), as well as making the general structure of the report easier to navigate and understand (requirement 1, Table 1).



#### 4.1.2. Desired Content-Related Additions or Requests for More In-Depth Information

While the previous section of the interviews sought to gain a better overview of the current state and possible strengths of the PDF reports, the following section aims to establish areas of the analysis where content-related additions or more in-depth information on existing content was desired by the winery owners.

Decisional support for investments in general and, more specifically, construction investments was the most sought-after additional information by participants. Many mentioned currently relying on their “gut feeling” when it comes to investments or being forced to invest by sudden circumstances: *“When something breaks, I have no choice but to reinvest, I can’t preconceive if it is currently a good idea from an economic point of view or not”*. Coincidentally, a KPI providing information on the degree of obsolescence was often sought after by respondents seeking more in-depth information on investments: *“Others are in a better position and haven’t had to invest from scratch with everything being obsolete when taking over a business. [...] In our position we constantly doubt and question ourselves: ‘How do others do it? Why aren’t we able to?’”* As a result, requirement 9 of providing a benchmark on investments and the degree of obsolescence was concluded (Table 1).

Another subject requested by multiple respondents was a more in-depth look into the structure of the profit and loss statement and cost structures with the main questions being *“Were do I generate the highest profits?”* and *“Where are my highest expenses?”*. Dividing up costs and calculating expenses for individual products proved to be important needs that respondents would like to have more comprehensively explored in the future (requirement 10, Table 1).

#### 4.1.3. Structural Changes and Additional Support Tools for Increased Usability and Intuitiveness

Unprompted, isolated suggestions for improvement included the preference for an online tool as opposed to the PDF reports as well as the expansion of the current graphs to show data from up to ten preceding years as opposed to the previous five (requirement 5, Table 1). Coincidentally, this could help better visualize long-term trends and developments, a requirement also stated in connection to expanding the current graphs (requirement 6, Table 1).

Twenty-two of the twenty-four participants would prefer comments to be added to all graphs, with short individual feedback on the developments depicted (requirement 7, Table 1): *“It would be a great help to receive one or two sentences commenting on a graph.”*, *“No long text, just a brief assessment”*.

Additional factors to benchmark oneself against other wineries were requested, for example when providing more information on investments (requirement 4, Table 1): *“[...] If there was an opportunity to compare how much wineries of a similar category invest, that would be great, but here it would also be all the more important, to be able to divide up the reference groups for comparison by size”*. Further desired benchmarking segments included the factors by region or type of certification (e.g., organic).

Furthermore, a support tool was desired to provide a more in-depth grading of KPIs using critical values/thresholds (requirement 3, Table 1): *“A brief explanation of ideal values for example like ‘This is the ideal span for long-term success’ would be great”*. Ideally, this would also result in suggestions for which areas of the business require improvement (requirement 2, Table 1): *“[...] giving recommendations, maybe in which areas there could be a need to act [...], wouldn’t be bad at all”*.

All core requirements and desires requested by the interviewees were collected, structured, and summarized in Table 1, for further planning and developing the nature of their implementation.

#### 4.2. Design: Implementation of Requirements in Online Dashboard

The key requirements identified and steps taken for implementing them in the online dashboard tool are summarized in the second column of Table 1. In cooperation with an

experienced web designer, the forms of implementation to cater to said requirements were operationalized in Column 3. Lastly, Column 4 references exemplary figures providing an overview of the first design status of the online dashboard tool. This section elaborates on all implementations and exemplary figures of the online dashboard tool below.

#### 4.2.1. Requirement 1—Structure of the Report

The first requirement identified during the interviews was to make the structure of the PDF report easier to understand. To cater to this need, Figure 3 displays a newly developed and implemented flexible menu bar, with a sub-menu bar for every chapter of the new online dashboard tool. The aim of this addition is to allow for a clearer navigation of the dashboard, by constantly being able to verify one's position within the structure of the dashboard while scrolling through it.

Figure 3 illustrates the top menu bar with a total of six chapters across the whole report. The chapter currently selected (here, “liquidity and stability”) is highlighted with a petrol-colored downward arrow pointing at the second bar below, where the specific KPIs of the selected chapter are listed. The previously examined KPIs are differentiated by a ticked green circle, while the currently selected KPI is highlighted by a green glow. KPIs yet to be examined remain grey. The vertical movement of scrolling down and through the specific KPIs within the dashboard is translated to the horizontally moving menu bar. Users are free to jump among KPIs of a selected chapter or between chapters in general by clicking the desired name, a feature implemented to improve usability based on usability test participant feedback.

#### 4.2.2. Requirement 2 and Requirement 3—Status of Most Important KPIs and Their Ideal Values

The second requirement gathered from the interviews was making it easier to identify the most important KPIs of the report and their status. This was attempted by providing and developing an overall evaluation of the most relevant KPIs of long-term economic sustainability for the participating wineries (Figure 4). Each KPI was rated through a corresponding traffic light system. This approach functions as an aid to intuitively grasp the current state of an observed KPI at a glance. To ensure maximal inclusion of users with varying degrees of color blindness, three changing signs were included to complement the classic three colors of green, yellow, and red.

The traffic light system was developed as an overall summary of the most important KPIs at the start of the online tool (Figure 4). Additionally, the traffic lights are repeatedly shown for each KPI throughout the different sections of the tool (Figure 6).

These main KPIs were empirically selected based on their strong discrepancy between negative and positive values of the main target variable. For small- and medium-sized enterprises with a majorly involved family workforce, “operational result incl. imputed family wages per hectare” (in short: *operational result*) was chosen as the most important target variable for long-term economic success and sustainability. This is in line with the empirical research by Wetzler et al. [54] and supported by the importance of long-term stability and profitability for economic sustainability stated by Boar et al. [19].

This target KPI best represents the adjusted capability of an SME, in this case, a winery, to operate in a stable and profitable manner in the long term, while adequately compensating all staff including family employees. The target variable is listed as the first entry in the table of KPIs in Figure 5.

To assess which KPIs were most relevant for wineries' economic sustainability, data from 451 Geisenheim business analysis participants, across the span of five agricultural years from 2014/15 to 2018/19, were retrieved. In a similar approach to Bennett and Loose [58], averages across all five years were generated for each KPI. This allowed for a robust, stationary observation, independent of strong annual fluctuations or long-term structural changes.

Overall Assessment Summary ⓘ	
Operational result	⬢ ⬢ ⬢
Turnover per ha	⬢ ⬢ ⬢
Hours of labour per ha	⬢ ⬢ ⬢
Turnover per worker	⬢ ⬢ ⬢
Profit per litre	⬢ ⬢ ⬢
Operating cash flow per ha	⬢ ⬢ ⬢
⏩ continue	

**Figure 4.** Summary slide of the most important KPIs in terms of economic sustainability and their representative status based on cut-offs displayed in an intuitive traffic light system (translated from German original).

In the next step, it was evaluated whether businesses with positive and negative operational results differed in other KPIs. The KPIs with large differences between businesses with positive and negative operational result are deemed to have discriminatory power for the target variable. The cut-off values for the traffic light systems of each KPI were calculated as follows (Figure 5):

1. Green traffic light: The average KPI values of all wineries able to generate a positive operational result incl. imputed family wages per hectare.
2. Red traffic light: The average KPI values of all wineries generating a negative operational result incl. imputed family wages per hectare.
3. Yellow traffic light: The span of KPI values between the averages of wineries with a positive and a negative operational result incl. imputed family wages per hectare.

As the goal variable for economic sustainability within this framework, the operational result was deemed the most important variable for the overall assessment summary (Figure 4). Out of all KPIs listed in Figure 5, five additional most important KPIs were chosen for the overall assessment summary (Figure 4) based on their strength of discrimination between averages of wineries able to generate a positive operational result and wineries generating a negative operational result.

As the sample of the Geisenheim business analysis only offers a limited representation of the entire body of wineries in Germany, the values were subsequently aligned with experienced German wine industry consulting values published in Göbel [59], to ensure more accurate feedback for German wineries. The values were partly rounded for clarity and ease of use for the wineries. They will be adjusted in the future to keep them up to date and the feedback as relevant as possible for participants.

#### 4.2.3. Requirement 4—Switching between Different Reference Groups

Figure 6 provides an example of a line graph (translated into English) with the majority of the adjustments implemented on the online dashboard tool based on user feedback (see points 3, 4, 5, 6, and 7 in Table 1). The highly requested option of switching between different reference groups for benchmarking was implanted as an option below the line graph. Most importantly, since both the region and the size group that a winery belongs to have a significant influence on KPIs, this constitutes a major expansion upon the static PDF reports, which only provided a comparison of the corresponding producer type [58]. As a result, wineries can now switch between the most relevant groups of comparison to benchmark themselves against, for each individual KPI.




Key-performance-indicator			
Operational result incl. family wages per hectare	<0	–	0<
Return on equity	<3%	3% – 12%	12%<
Return on assets	<3%	3% – 10%	10%<
Turnover per hectare	<25,000 €	25,000€ – 34,000€	34,000 €<
Yield per hectare	<73hl	73hl – 77hl	77hl<
Turnover per Litre	<4.10 €	4.10€ – 5.00€	5.00 €<
Turnover per worker	<55,000 €	55,000€ – 92,000€	92,000 €<
Working hours per hectare	>900h	900h – 750h	750h>
Cost per Litre	>5.40 €	5.40€ – 4.70€	4.70 €>
Profit per Litre	<0 €	0€ – 0.90€	0.90 €<
Operating cash flow per hectare	<9,200 €	9,200€ – 15,300€	15,300 €<
Debt ratio	>70%	40% – 70%	40%>
Debt service limit	<0 €	0€ – 61,300€	61,300 €<
Asset coverage ratio	<120%	120% – 150%	150%<

Figure 5. Cut-off values for the traffic-light system. Values were rounded for easier legibility (own illustration).



Figure 6. Exemplary line chart for labor intensity with new requirements implemented (own illustration, translated from German to English).

Groups of comparison were divided into the following categories:

1. All participating wineries.
2. By producer type: Choice between bottled wine producers, bulk wine producers, or mixed wine producers.
3. By size group: Choice between five distinct size groups according to vineyard area, from below 5 ha to more than 30 ha in size.
4. By region: Choice between all 13 major German wine regions.
5. By organic certification: Choice between organically certified and conventional wineries.
6. Steep-slope viticulture: Choice between wineries with a large share of steep-slope vineyards and wineries with only a minor share of steep-slope vineyards.

Nonetheless, to ensure data protection and anonymity for participants, only reference groups with an  $n > 10$  are displayed and available for selection, to avoid any potential conclusions on the data of other participating wineries.

#### 4.2.4. Requirements 5 and 6—Extended Time Span and Trend Lines

Requirement 5: Additionally, as requested by winery owners, the available time span of visualized data was expanded from 5 to 10 years. While 5 years are shown as the default option, users can switch to 10 years at the bottom right, if preferred.

Requirement 6: Both the extended time span as well as including a linear trend line for both options allow for a more long-term historic assessment of the development of KPIs for users of the online dashboard tool (requirements 5 and 6, Table 1). The linear trend line was generated as a linear regression based on the data from the number of years chosen for display.

#### 4.2.5. Requirement 7—Automated Comments

The final addition depicted in Figure 6 is the automated comments (requirement 7, Table 1). As opposed to the PDF version provided in Figure A2 (Appendix B), these comments (on the right) provide a brief written addition on the short- and long-term development of said KPI. They are generated automatically and consist of three types, depending on the graph and data they are referencing (Table 2): Comparing the current value of the KPI to the previous year, comparing it to the current average of the reference group, and a comparison between the long-term trend of the KPI to the long-term trend of the reference group (Table 2).

**Table 2.** Automated supportive comment types.

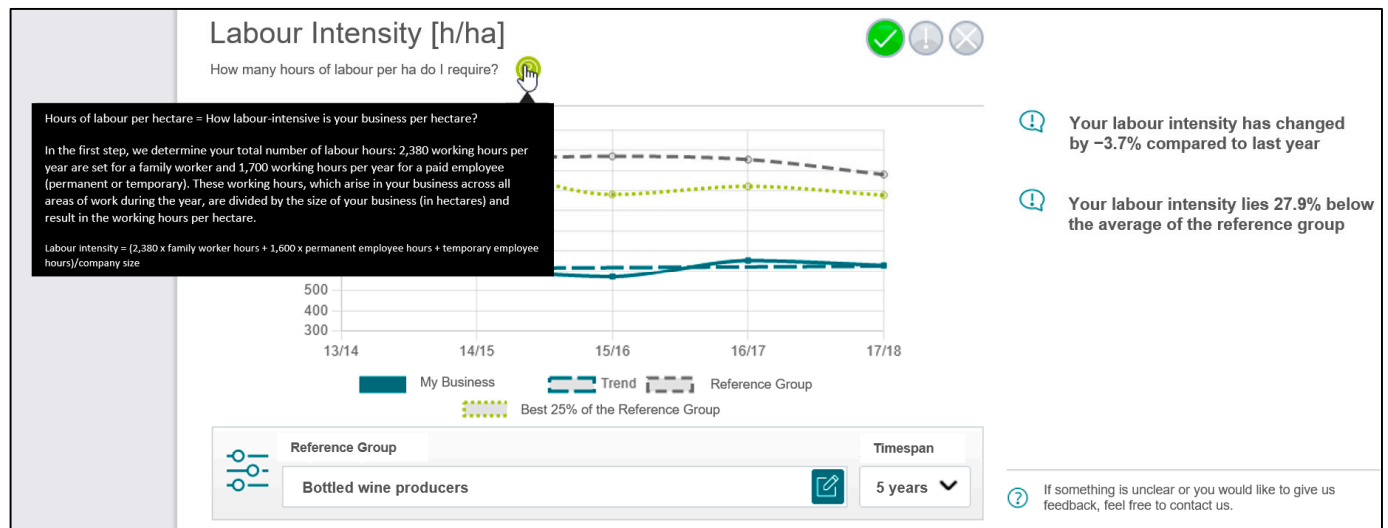
Comment Type	Content	Example
1	The short-term comparison of the current value of a KPI compared to the previous year.	“Your profit per litre has changed by x% compared to the previous year”
2	The comparison of the current value of KPI to the average current value of the chosen reference group.	“Your profit per litre lies x% below the average value of the reference group.”
3	The average development of a KPI per year across the past five or ten years, compared with the average development of a chosen reference group for benchmarking across the past five or ten years.	“In the past ten years, your profit per litre has changed by x% per year on average, while the average profit per litre of the reference group has changed by x% per year.”

Generating such automated comments reliably is a labor-intensive and rigorous process including multiple cycles of random testing to maximize potential error detection and prevent inaccurate or incorrect statements from being communicated to participants upon release. Comments are only generated if sufficient comparable data are available (and selected for comparison) and otherwise left blank. Finally, the comments aid in gaining a deeper understanding of long- and short-term developments for the KPIs, to support decision making on an organizational level for the participating wineries.



#### 4.2.6. Requirement 8—Help Text and Annotations

Figure 7 displays the final requirement implemented in the online dashboard tool. To further support a clearer comprehension of the graphs and prevent confusion or misunderstandings, integrated help texts displayed via hovering over green, designated help icons were distributed around and within the graphs. These provided insights into specific definitions of terms and calculations used to generate KPI graphs. Furthermore, users can ask for individual help or provide feedback by using an automated email button at the bottom right of each KPI graph. This email directly addresses the Geisenheim business analysis team for further evaluation.



**Figure 7.** Example of integrated help text displayed by hovering over the help icon (own illustration, translated from German to English).

#### 4.2.7. Requirement 9—Investments and Degree of Obsolescence

A new KPI displaying more information on the relative amount of annual investments per hectare as opposed to a chosen reference group was implemented. As a KPI for the degree of obsolescence requires additional data input and cleansing, it could not be provided at the point of launch of the tool. Development for this KPI is nonetheless in progress and is currently expected to be added to the dashboard by the end of 2024.

#### 4.3. Evaluation: Usability and Feedback Tests and Adjusted Implementations

After the development of the first version of the online dashboard tool, ten usability tests were conducted to gather feedback on how well the needs and requirements established by the interviews in Section 3.1 had been met. The degree of successful implementation of the said requirements of Table 1 as well as issues or suggestions for improvement gathered by the usability tests are summarized in Table 3.

**Table 3.** Results of the usability test: degree of successful implementations of the ten requirements.

Nr.	Requirement	Degree of Successful Implementation	Issues or Suggestions for Improvement	Final Implementation at Time of Launch
1	Make the structure of the report easier to understand	Partly successful	The menu bar guiding users through the report should be refined in order to increase intuitiveness for all users.	The menu bar was updated, allowing for more flexibility while browsing chapters and increasing the font size and therefore the visibility of the sub-menu bar.

Table 3. Cont.

Nr.	Requirement	Degree of Successful Implementation	Issues or Suggestions for Improvement	Final Implementation at Time of Launch
2	Identify most important KPIs and their status	Successful		
3	Display ideal values of KPIs	Partly successful	Further information on the method of calculating the exact ranges of the KPIs must be provided.	A separate frequently asked question (FAQ) site with more details on ranges and the method of calculation for the KPIs was provided and linked to the corresponding KPIs within the tool (shown in Figure 5).
4	Provide additional reference groups for benchmarking	Partly successful	Additional reference groups were implemented successfully, However, their visibility and the intuitiveness of their utilization must be increased.	Upon release, a 10-page explanatory report was sent out to wineries and published in industry journals, highlighting this additional function for better visibility.
5	Extend time span	Successful		
6	Visualize long-term trends	Successful		
7	Comment on graphs	Partly successful	Comments must be highlighted and double-checked to make sure they are correct and will not be overlooked.	Comments were double-checked on a sample basis, with an option added for users to offer feedback on suspicious comments for future corrections. Additionally, the font size was increased for better intuitive visibility for users.
8	Improve annotations and ease of understanding	Successful		
9	Include benchmark on investments and degree of obsolescence	Partly successful	A new KPI for relative degree of investments was included in the user story; however, the degree of obsolescence KPI has not been completed yet.	Degree of obsolescence is currently still a work in progress; expected completion: late 2024.
10	Provide more details on cost structures	Partly successful	While the visualization of the income and expenses statement was reworked and improved upon, the current database does not allow for more details on cost structures.	No further improvements possible for the final launch.

While general feedback was very positive, seven main usability problems were identified across the ten participants. Two issues were content related, while the remaining five referred to the intuitiveness and formatting of different sections and attributes of the support tool. Eight out of ten participants did not find the menu bar (Figure 3 and requirement 1, Table 1) intuitive enough, with two participants missing the sub-menu bar completely. This was also reflected in two participants being unable to find specific chapters within the dashboard tool while searching for them. Two main changes addressing these issues for launch were implemented: (1) The font size of the sub-menu bar was increased for more intuitive visibility of the chapters; (2) Every element/KPI of the sub-menu bar was made clickable for more flexible navigation among chapters.

The overall assessment summary (Figure 4 and requirement 2, Table 3) was received as highly intuitive by all participants. However, the traffic light system was considered slightly insufficient by two of the ten participants, due to the lack of information provided on how the different stages (green/yellow/red) were calculated and how the cut-off values were defined (requirement 3, Table 3). To account for this lack of information, an additional FAQ page with more detailed information on cut-off values and overall methodology was created and linked to the corresponding KPIs within the tool before launch (available online: <https://www.geisenheim-portal.de/faq/>, accessed on 3 November 2023).

Five out of ten participants addressed issues using the additional reference groups for benchmarking (Figure 6 and requirement 4, Table 3), either being unable to use them intuitively or even overlooking them at first. Nonetheless, the extended timespan and visualization of the long-term trend line were used and received positively by all ten participants. To combat the reference group selection being overlooked, a 10-page report was sent out to all participants and published in multiple trade magazines upon release, highlighting all additions and functions of the new tool.

In a more general sense, two participants remarked the font size overall as being too small to read properly, and therefore the supportive comments (Figure 6 and requirement 7, Table 3) were too easily overlooked. Since this issue also coincides with the problem of other attributes of the tool being overlooked, the tool's font size was increased as a final implementation before launch.

The improved annotations displayed via hovering over help icons as well as the new investment KPI were used and received positively by all participants, while a KPI on the degree of obsolescence is currently still a work in progress (expected completion: late 2024), which will therefore have to be included in a test at a later date.

Finally, it was not possible to provide more details on cost structures (requirement 10, Table 3), due to the current structure of the input data, only allowing for a visual improvement of the PDF-based version with the general benchmarking option additions mentioned prior.

In conclusion, the list of suggestions for further improvements to the dashboard was implemented to the extent provided in Table 3, in line with the structure of the user-centered design process in Figure 2. In the future, the feedback circle by users will allow for constant design adaptations to increase usability and further adjust the tool to the participants' needs. To further support new/first-time users, an instructional video will be produced, elaborating on the tool's different features in detail.

#### 4.4. Tool Launch after Final Implementations and Feedback

After taking into account all requirements of stage 1 and confirming their degree of implementation with usability tests in the first draft of the online support tool, final adjustments were conducted to ensure the best possible degree of implementation at the time of launch. Subsequently, on 18 January 2023, the tool was launched to all participating wineries, followed by an official conference held on 2 March 2023 at Geisenheim University, open to the public, where the tool and all its mechanics were introduced and explained.

Following the launch, feedback from the wineries on multiple aspects of the new tool has been overwhelmingly positive. On one hand, the additional option of analyzing long-term developments was greatly welcomed by long-term participants: *"Apart from comparisons with other wineries, the analysis of long-term developments is especially interesting! Providing long-term data from our side has really yielded positive advantages now!"* Moreover, the benefit of being able to benchmark oneself with other relevant groups of comparison was emphasized by multiple participants: *"Especially being able to choose more groups of comparison is a helpful improvement to the PDF-reports!"* Finally, the new structure was deemed to *"[...] provide a fast and intuitive overview of the most important KPIs [...]"*

## 5. Discussion

Economic sustainability is an important part of the overall sustainability of a wine business. It is a crucial dimension for a winery's long-term survival [12]. Previous studies have shown an increasing urgency of wineries needing to align themselves with more economic sustainability [12,29]. In order to provide companies with more valuable information in terms of KPIs, MSI and DSS dashboards can help wine businesses assess and improve economic sustainability [22,33,35]. While economic sustainability can also be expanded toward further economic aspects, such as transforming general business alignments and business models or directly including economic impacts of climate change, this study focused on the most important KPIs measurable through the existing framework brought forward by Labuschagne et al. [18].

Specifying a more general financial framework of economic sustainability through the inclusion of sector-specific KPIs assists in addressing the needs of the businesses within this sector more effectively.

This importance of KPIs was confirmed and strengthened through feedback from the participating wineries of the Geisenheim business analysis. Based on qualitative research, this study advanced and enhanced a currently static PDF-based MSI for wineries into a flexible online decision support dashboard tool with automated comments, using a user-centered development process established by Stauffer et al. [52].

Previous providers of sustainability assessment or certification programs within the wine industry have mainly taken into account the social and ecological pillars of sustainability, with only minor regard to measuring the economic pillar of sustainability [13–16]. Disregarding the economic pillar puts businesses at risk of not remaining able to adapt and cover costs in the future [11,12]. To align this important field more closely with the priorities for the long-term economic survival of wine producers and add to a more holistic approach to sustainability measurement, this study focused exclusively on the pillar of economic sustainability. To the authors' best knowledge, this is the only currently available online tool assessing economic sustainability to such an in-depth extent for SMEs in general and, specifically, within the wine sector. The development process and design of said tool's interface was based on the needs and abilities of participating wineries, an essential step as pointed out by Li et al. [39].

This resulted in various content- and structure-related requirements identified by the users, as put forward in Table 1.

As established in Table 3, through the usability tests, all requirements but one could be implemented successfully or partly successfully. Said usability tests provided an essential step to ensure improved usability and legibility of the released DSS dashboard. All issues gathered within these tests were taken into account and corrected before the final release of the DSS dashboard. As the process of error detection and feedback will be ongoing following the implementation and launch of the dashboard, constant adjustments are expected to keep it as useful and up to date as possible for the wineries.

In this regard, the user-centered development process was established as a viable structure for streamlining the development of an online tool for economic sustainability for SMEs (in this case, for the wine sector). By focusing on the needs of and practicability for the end user at every step of the development process, other sectors with a similar business structure to SMEs could also benefit from this framework.

## 6. Conclusions

The process showcased in this paper can be used as a blueprint to develop further online tools for economic sustainability. Future research can benefit from the process outlined, the specific requirements identified, and the operationalization of the tool presented here. Utilizing the learnings from the process demonstrated here might provide the opportunity to shorten the development process of similar tools for other industries. Also, the graphical solutions established here might serve as examples when eliciting producer expectations for other sectors and collaborating with programmers and designers to construct a new

DSS. While expanding such a tool, e.g., into other countries or other industries, an essential prerequisite is to determine the most important country/industry-specific KPIs and their corresponding cut-off values, to ensure maximum relevance and helpfulness for the SMEs using the tool.

Shifting frameworks of sustainability management tools away from the prioritization of large companies and toward the specific needs of said SMEs could lead to higher usage of the tools and, thereby, more long-term sustainability overall [24,25]. More specifically, even short-term economically sustainable businesses are expected to be more likely to survive the current economic crisis in the global wine sector [3].

All in all, the around 400 wineries of the Geisenheim business analysis are currently able to utilize the tool, with any German wine estate being able to participate for free, if interested. For further insights on how the tool functions, the tool is openly accessible to the public by visiting <https://backend.geisenheim-portal.de/login> and using the following login details to gain access to the analysis of a fictional wine estate:

User: unternehmensanalyse@hs-gm.de

Password: Musterbetrieb123

An additional benefit of the development of these tools is their aid in making sustainability performance measurement less subjective and more data driven, an issue introduced frequently by previous studies [20–23]. Tying to operationalize the topic of sustainability to hard data and facts can be expanded upon by covering all pillars of social, economic, and environmental sustainability and therefore gaining a more holistic impression of how to strategically move forward in a truly sustainable fashion. This paper offers a framework for the development of further tools for other SMEs to measure economic sustainability or to include it in existing sustainability schemes and make its measurement more data driven and less subjective.

## 7. Limitations

Like any research, this DSS tool also has limitations, which can be improved upon by future research. Here, economic sustainability is limited to financial health (as established in Section 1). Further potential aspects of economic sustainability are not operationalized here.

Additionally, we see the increasingly fast development and implementation of artificial intelligence in the IT and business intelligence sectors as having strong potential for improving the automated comments developed for this tool [60]. Although automated comments on a single KPI can help elucidate certain bearings, they are and will be limited in scope and, for the near future, cannot fully replace consultation and advice on strategies and deriving conclusions for required changes in action.

One of the main challenges for SMEs with low profitability, such as the wine sector, will be to generate and find sufficient resources to keep up with the fast development in the area of business intelligence [27]. Businesses in this sector are already strongly dependent on public support such as funding through the Regional Development Fund by the EU (EFRE), which made the development of the DSS presented here possible.

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**Data Availability Statement:** Due to privacy reasons for all participants, details on the data cannot be provided to ensure anonymity.

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## Appendix A. Interview Guide for Qualitative Interviews on the Geisenheim Business Analysis

Questions by category:

The current impression and helpfulness of the PDF reports:

1. What is your first impression of the current PDF based Geisenheim Business Report?
2. Which Key-Performance-Indicators (KPIs) of the current PDF reports are most important to your business?
3. Which KPIs do you use, to derive direct actions and decisions for your business from?

Desired content-related additions or requests for more in-depth information:

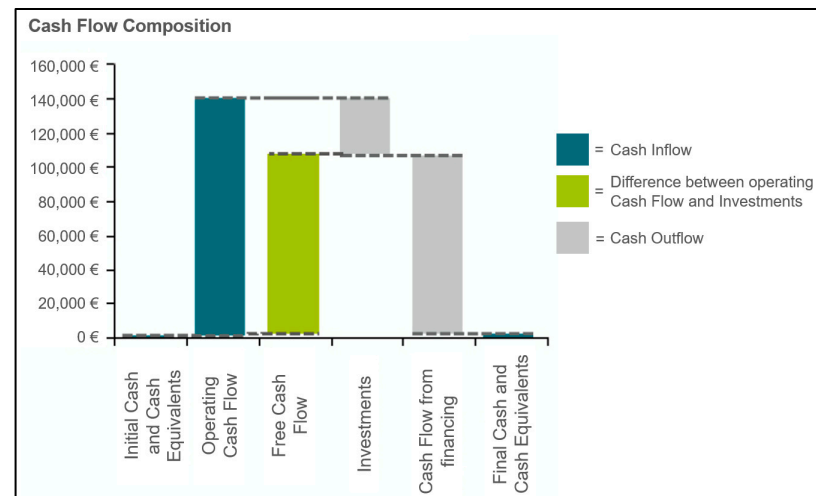
Are there concrete business decisions for your business, which you are currently seeking supportive information for?

4. What would you like more in-depth information about your business situation on?
5. Which KPIs or sections to you find lacking or missing?
6. Which part of the report seems unimportant to you?

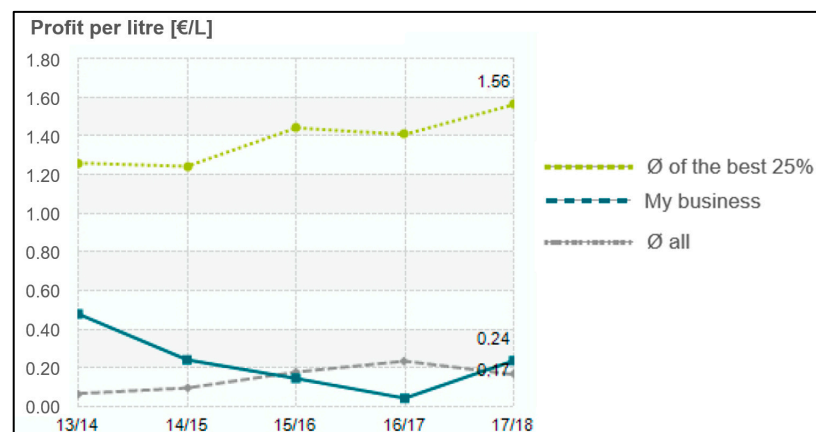
Structural changes and additional support tools for increased usability and intuitiveness:

7. Which decision-support tools would you deem helpful?
8. Would you prefer additional comments on graphs or sections of the report?
9. If you could see the three KPIs most important to you at a glance, which would you choose?
10. Which of the following questions, do you deem the most important for your businesses long-term success?
  - a. How much is my business able to generate at the end of the financial year?
  - b. How efficient is my business?
  - c. Where are my business expenses highest?
  - d. How costly is it for my business to generate turnover?
  - e. Where does my business generate the highest revenue?
  - f. How solvent is my business currently?
  - g. Does my business have too much debt capital?
  - h. Am I able to generate equity yearly?
  - i. How is my frequency of investments compared to others?

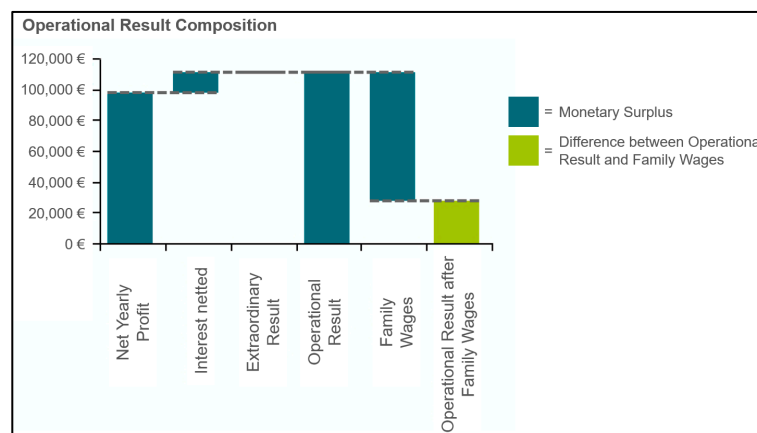
## Appendix B. Examples from Existing Benchmarking Report (Geisenheim Business Analysis)



**Figure A1.** Exemplary PDF-report bar chart for the composition of cash flow (Translated from the German original to English).



**Figure A2.** Exemplary PDF-report line chart for profit per liter (Translated from the German original to English).



**Figure A3.** Exemplary PDF-report bar chart for operational result inc. family wages (Translated from the German original to English).

REPORT  
GEISENHEIM BUSINESS ANALYSIS  
U-14-002 Year 17/18  
Comparison with all participants



**Figure A4.** Exemplary page of the PDF-based reports (Translated from the German original to English).

## Appendix C. Usability Test Protocol

### Prerequisites for the test:

- A PC and adequate screensharing/recording software.
- A tester guiding the participant through the test, while encouraging them to think out loud as much as possible throughout the entire test.
- The tester is to give no support throughout the test (only in cases of extreme frustration); if the participant asks for help, answer with "How would you go about this issue, if I were not in the room?"

### Test procedure:

1. Brief introduction for participant on:
  - The current status of the dashboard.
  - What to expect from the test.
2. Launch the online dashboard:

- Let participants describe their first impressions.
  - Ask participants to log in to their personal dashboard.
3. Have participants conduct tasks within the dashboard:
    - a. What is my current operational result incl. family wages?
    - b. Where do I generate my highest revenue?
    - c. Is it possible for me to annually generate equity?
    - d. Where do my highest expenses lie?
    - e. How high are my annual investments compared to others?
    - f. How is my business performing in terms of economic sustainability?
  4. Closing questions by the participants.
  5. Thank participants for their participation and conclude the test.
- Debriefing after the test:
- Note the most important usability issues arisen from the test.
  - Prioritize issues according to importance in improving usability.

## References

1. Klohr, B.; Fleuchaus, R.; Theuvsen, L. Sustainability: Implementation programs and communication in the leading wine producing countries. In Proceedings of the 7th International Conference of the Academy of Wine Business Research (AWBR), St. Catharines, ON, Canada, 12–15 June 2013.
2. Szolnoki, G. A cross-national comparison of sustainability in the wine industry. *J. Clean. Prod.* **2013**, *53*, 243–251. [\[CrossRef\]](#)
3. Del Rey, R.; Loose, S. State of the International Wine Markets in 2022: New market trends for wines require new strategies. *WEP* **2023**, *12*, 3–18. [\[CrossRef\]](#)
4. Loose, S.M.; Pabst, E. Current state of the German and international wine markets. *Ger. J. Agric. Econ.* **2018**, *67*, 92–101.
5. Searcy, C. Corporate Sustainability Performance Measurement Systems: A Review and Research Agenda. *J. Bus. Ethics* **2012**, *107*, 239–253. [\[CrossRef\]](#)
6. Cagno, E.; Neri, A.; Howard, M.; Brenna, G.; Trianni, A. Industrial sustainability performance measurement systems: A novel framework. *J. Clean. Prod.* **2019**, *230*, 1354–1375. [\[CrossRef\]](#)
7. Golobic, S.; Flint, D.J.; Signori, P. The Triple Bottom Line in the Global Wine Industry. In Proceedings of the 9th Academy of Wine Business Research Conference, Adelaide, Australia, 17–18 February 2016.
8. Elkington, J. *Cannibals with Forks: The Triple Bottom Line of 21st Century Business*; Reprint; Capstone: Oxford, UK, 2002; ISBN 1841120847.
9. Joyce, A.; Paquin, R.L. The triple layered business model canvas: A tool to design more sustainable business models. *J. Clean. Prod.* **2016**, *135*, 1474–1486. [\[CrossRef\]](#)
10. Ferrer, J.R.; Garía-Cortijo, M.C.; Pinilla, V.; Castillo-Valero, J.S. The business model and sustainability in the Spanish wine sector. *J. Clean. Prod.* **2022**, *330*, 129810. [\[CrossRef\]](#)
11. Doane, D.; Macgillivray, A. Economic Sustainability the Business of Staying in Business. 2001. Available online: <https://www.semanticscholar.org/paper/Economic-Sustainability-The-business-of-staying-in-Doane-Macgillivray/a3c16301f63ba432df3f131895a94e12b605bfd9> (accessed on 5 May 2020).
12. Loose, S.; Strub, L.; Kurth, A. Economic sustainability of wine estates: First insights and a roadmap for future research. In Proceedings of the 12th International Conference of the Academy of Wine Business Research, Virtual, 6–8 July 2021.
13. CSWA (California Sustainable Winegrowing Alliance). Available online: <https://www.sustainablewinegrowing.org/> (accessed on 8 December 2021).
14. SWNZ (Sustainable Winegrowing New Zealand). Available online: <https://www.nzwine.com/en/sustainability/swnz/> (accessed on 8 December 2021).
15. Nachhaltig Austria. Nachhaltig—Weingenuss mit Verantwortung. Available online: <https://www.nachhaltigaustria.at/> (accessed on 8 December 2021).
16. SWA (Sustainable Winegrowing Australia). Let's Make a World of Difference in Wine. Available online: <https://sustainablewinegrowing.com.au/> (accessed on 8 December 2021).
17. Loose, S.M. *ProWein Business Report 2021 "Sustainability"*; ProWein, Messe Duesseldorf GmbH: Duesseldorf, Germany, 2022. [\[CrossRef\]](#)
18. Labuschagne, C.; Brent, A.C.; van Erck, R.P.G. Assessing the sustainability performances of industries. *J. Clean. Prod.* **2005**, *13*, 373–385. [\[CrossRef\]](#)
19. Boar, A.; Bastida, R.; Marimon, F. A Systematic Literature Review. Relationships between the Sharing Economy, Sustainability and Sustainable Development Goals. *Sustainability* **2020**, *12*, 6744. [\[CrossRef\]](#)
20. Sartori, S.; Campos, L.M.S. *Analysis of Corporate Sustainability Assessment Tools and Operations Management*; Production and Operations Management Society: Miami, FL, USA, 2016.

21. Hristov, I.; Chirico, A. The Role of Sustainability Key Performance Indicators (KPIs) in Implementing Sustainable Strategies. *Sustainability* **2019**, *11*, 5742. [\[CrossRef\]](#)
22. Adams, C.A.; Frost, G.R. Integrating sustainability reporting into management practices. *Account. Forum* **2008**, *32*, 288–302. [\[CrossRef\]](#)
23. Pannell, D.J.; Glenn, N.A. A framework for the economic evaluation and selection of sustainability indicators in agriculture. *Ecol. Econ.* **2000**, *33*, 135–149. [\[CrossRef\]](#)
24. Das, M.; Rangarajan, K.; Dutta, G. Corporate sustainability in small and medium-sized enterprises: A literature analysis and road ahead. *J. Indian Bus. Res. JIBR* **2019**, *12*, 271–300. [\[CrossRef\]](#)
25. Martins, A.; Branco, M.C.; Melo, P.N.; Machado, C. Sustainability in Small and Medium-Sized Enterprises: A Systematic Literature Review and Future Research Agenda. *Sustainability* **2022**, *14*, 6493. [\[CrossRef\]](#)
26. Johnson, M.P.; Schaltegger, S. Two Decades of Sustainability Management Tools for SMEs: How Far Have We Come? *J. Small Bus. Manag.* **2016**, *54*, 481–505. [\[CrossRef\]](#)
27. Ingrassia, M.; Chironi, S.; Lo Grasso, G.; Gristina, L.; Francesca, N.; Bacarella, S.; Columba, P.; Altamore, L. Is Environmental Sustainability Also “Economically Efficient”? The Case of the “SOSain” Certification for Sicilian Sparkling Wines. *Sustainability* **2022**, *14*, 7359. [\[CrossRef\]](#)
28. Garcia, F.A.; Marchetta, M.G.; Camargo, M.; Morel, L.; Forradellas, R.Q. A framework for measuring logistics performance in the wine industry. *Int. J. Prod. Econ.* **2012**, *135*, 284–298. [\[CrossRef\]](#)
29. Delord, B.; Montaigne, É.; Coelho, A. Vine planting rights, farm size and economic performance: Do economies of scale matter in the French viticulture sector? *Wine Econ. Policy* **2015**, *4*, 22–34. [\[CrossRef\]](#)
30. Broccardo, L.; Zicari, A. Sustainability as a driver for value creation: A business model analysis of small and medium enterprises in the Italian wine sector. *J. Clean. Prod.* **2020**, *259*, 120852. [\[CrossRef\]](#)
31. Muñoz, R.M.; Fernández, M.V.; Salinero, Y. Sustainability, Corporate Social Responsibility, and Performance in the Spanish Wine Sector. *Sustainability* **2021**, *13*, 7. [\[CrossRef\]](#)
32. Valenzuela, L.; Maturana, S. Designing a three-dimensional performance measurement system (SMD3D) for the wine industry: A Chilean example. *Agric. Syst.* **2016**, *142*, 112–121. [\[CrossRef\]](#)
33. Corbo, C.; Lamastra, L.; Capri, E. From Environmental to Sustainability Programs: A Review of Sustainability Initiatives in the Italian Wine Sector. *Sustainability* **2014**, *6*, 2133–2159. [\[CrossRef\]](#)
34. Watson, H.J. (Ed.) *Information Systems for Management: A Book of Readings*, 3rd ed.; McGraw-Hill Inc.: New York, NY, USA, 1987; ISBN 0256037213.
35. Asemi, A.; Safari, A.; Asemi Zavareh, A. The Role of Management Information System (MIS) and Decision Support System (DSS) for Manager’s Decision Making Process. *Int. J. Bus. Manag. IJBM* **2011**, *6*, 164–173. [\[CrossRef\]](#)
36. McLeod, R.; Schell, G.P. *Management Information Systems*, 10th ed.; Pearson/Prentice Hall: Upper Saddle River, NJ, USA, 2007; ISBN 0131889184.
37. Terribile, F.; Agrillo, A.; Bonfante, A.; Buscemi, G.; Colandrea, M.; D’Antonio, A.; de Mascellis, R.; de Michele, C.; Langella, G.; Manna, P.; et al. A Web-based spatial decision supporting system for land management and soil conservation. *Solid Earth* **2015**, *6*, 903–928. [\[CrossRef\]](#)
38. Sharda, R.; Barr, S.H.; McDonnell, J.C. Decision Support System Effectiveness: A Review and an Empirical Test. *Manag. Sci.* **1988**, *34*, 139–159. [\[CrossRef\]](#)
39. Li, T.; Feng, S.; Xia Li, L. Information visualization for intelligent decision support systems. *Knowl.-Based Syst.* **2001**, *14*, 259–262. [\[CrossRef\]](#)
40. Yigitbasioglu, O.M.; Velcu, O. A review of dashboards in performance management: Implications for design and research. *Int. J. Account. Inf. Syst.* **2012**, *13*, 41–59. [\[CrossRef\]](#)
41. Few, S. *Information Dashboard Design: The Effective Visual Communication of Data*, 1st ed.; O’Reilly: Beijing, China, 2006; ISBN 9780596100162.
42. Burstein, F.; Holsapple, C. (Eds.) *Handbook on Decision Support Systems 2: Variations*; Springer: Berlin/Heidelberg, Germany, 2008; ISBN 978-3-540-48715-9.
43. Zhai, Z.; Martínez, J.F.; Beltran, V.; Martínez, N.L. Decision support systems for agriculture 4.0: Survey and challenges. *Comput. Electron. Agric.* **2020**, *170*, 105256. [\[CrossRef\]](#)
44. Bottani, E.; Gentilotti, M.C.; Rinaldi, M. A Fuzzy Logic-Based Tool for the Assessment of Corporate Sustainability: A Case Study in the Food Machinery Industry. *Sustainability* **2017**, *9*, 583. [\[CrossRef\]](#)
45. Baffo, I.; Leonardi, M.; Bossone, B.; Camarda, M.E.; D’Alberti, V.; Travaglioni, M. A decision support system for measuring and evaluating solutions for sustainable development. *Sustain. Futures* **2023**, *5*, 100109. [\[CrossRef\]](#)
46. Rinaldi, M.; Parretti, C.; Salimbeni, L.B.; Citti, P. Conceptual Design of a Decision Support System for the Economic Sustainability of Nonprofit Organizations. *Procedia CIRP* **2015**, *34*, 119–124. [\[CrossRef\]](#)
47. Musee, N.; Lorenzen, L.; Aldrich, C. Decision support for waste minimization in wine-making processes. *Environ. Prog.* **2006**, *25*, 56–63. [\[CrossRef\]](#)
48. Latorre-Biel, J.-I.; Jiménez-Macías, E.; Blanco-Fernández, J.; Sáenz-Diez, J.C. Decision Support in the Rioja Wine Production Sector. *Int. J. Food Eng.* **2013**, *9*, 267–278. [\[CrossRef\]](#)
49. Janes, A.; Sillitti, A.; Succì, G. Effective Dashboard Design. *Cut. IT J.* **2013**, *26*, 17–24.



50. Shneiderman, B. *The Eyes Have It: A Task by Data Type Taxonomy for Information Visualizations*; IEEE Computer Society Press: Los Alamitos, CA, USA, 1996; pp. 336–343. [[CrossRef](#)]
51. Craft, B.; Cairns, P. Beyond Guidelines: What Can We Learn from the Visual Information Seeking Mantra? In Proceedings of the 9th International Conference on Information Visualisation (IV'05), London, UK, 6–8 July 2005; Banissi, E., Ed.; IEEE Computer Society: Los Alamitos, CA, USA, 2005; pp. 110–118, ISBN 0-7695-2397-8.
52. Stauffer, M.; Ryter, R.; Hil, D.; Dornberger, R. A Review and Extension of the Visual Information Seeking Mantra (VISM). In Proceedings of the IMCIC—ICSIT 2016, Orlando, FL, USA, 8–11 March 2016. Available online: <http://hdl.handle.net/11654/24213> (accessed on 3 March 2020).
53. Henry, S.L.; Thorp, J. Notes on User Centered Design Process (UCD). Available online: <https://www.w3.org/WAI/redesign/ucd> (accessed on 22 August 2022).
54. Wetzler, A.; Bennett, A.; Loose, S. The Relative Importance of Benchmarks on the Economic Success of Wine Estates. In Proceedings of the 12th Academy of Wine Business Research, Virtual, 6–8 July 2021.
55. Krug, S. *Don't Make Me Think, Revisited: A Common Sense Approach to Web Usability*, 3rd ed.; New Riders: Berkeley, CA, USA, 2014; ISBN 978-3-8266-9705-0.
56. Nielsen, J.; Lewis, J.; Turner, C. Determining Usability Test Sample Size. In *International Encyclopedia of Ergonomics and Human Factors—3 Volume Set*, 2nd ed.; CRC Press: Boca Raton, FL, USA, 2006.
57. Cazañas, A.; de San Miguel, A.; Parra, E. Estimación del tamaño de la muestra para pruebas de usabilidad. *Enfoque UTE* **2017**, *8*, 172–185. [[CrossRef](#)]
58. Bennett, A.W.; Loose, S. Benchmarking Economic Sustainability: What Factors Explain Heterogeneity between Wine Businesses? *Sustainability* **2023**, *15*, 16686. [[CrossRef](#)]
59. Göbel, R. *Betriebswirtschaft: Erfolgreiche Unternehmensführung im Weingut*; TZ-Verlag & Print GmbH: Roßdorf, Germany, 2021; ISBN 9783940456984.
60. Praful Bharadiya, J. A Comparative Study of Business Intelligence and Artificial Intelligence with Big Data Analytics. *Am. J. Artif. Intell. AJAI* **2023**, *7*, 24–30. [[CrossRef](#)]

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