Usage of Country Evaluations for Sustainable Supplier Selection

Theresa Hilger, Katharina Hennig, Rene Kessler, and Marx Gómez Jorge

Abstract The economic success of companies depends to a large extent on an intact and reliable supply chain. At the same time, logistics has an enormous impact on the global economy and ecology in today's world. In order to address this problem, this article is dedicated to optimize the evaluation and selection of suppliers. It provides an approach for selecting suppliers based on the status of sustainability and the legal basis (related to sustainability) in the country of origin. Therefore a strategy has been developed to calculate a risk score for each country individually. It focuses on eight Sustainable Development Goals that are most relevant in the context of supply chains. A readiness check was developed to check if a company complies with the legal basis of the selected country.

Keywords Country ranking · Readiness check · Sustainable supply chain management · Supply chain risks · Supply chain laws

1 Introduction

At the latest, through the start of the Fridays4Future protests, the topic of *sustainability* has generated a great deal of attention in politics and society. Starting with the first school strike in Sweden in August 2018, a European movement has emerged that has quickly spread to other European cities (in March 2019, thirteen major European cities are already involved) [1, 2]. The goal was to create general awareness about

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climate change, express the views of the people involved, and put pressure on politicians to act more sustainably. As the initiative started as a school strike, mainly young people were initially involved, but this has changed with the increasing attention and spread so that other age groups joined the protests [2].

Due to society's increasing environmental awareness, companies face new challenges and are forced to act more sustainably. Companies are driven by the various stakeholders [3]: EU regulations, standards and laws create political pressure on companies. For example, specific guidelines must be adhered to when procuring products. This directly forces companies to comply with them to continue operating in the market. In addition, it can be seen that the political pressure and obligations are increasing enormously and are becoming more and more. At the same time, however, customers, employees, NGOs and even investors are directly demanding the responsibility of companies, in particular also due to technological progress. On the other hand, companies are also often eager to act as sustainably as possible out of their interest. Companies want to remain competitive, but on the other hand, the issue of reputation also plays a significant role. Thus, social legitimacy and ecological responsibility are explosive topics in external presentation that can significantly impact the company and its image, and thus also the company's success [3, 4].

In addition to the company's internal sustainable alignment of procedures and processes, the supply chain and procurement are becoming the focus of attention. Sustainable procurement is now regarded as a success factor for companies and enjoys special status [3, 4]. In concrete terms, this means for companies that supplier selection should be based less on intuitive decision-making behavior and much more on ecological criteria (e.g., CO_2 emissions) and social criteria (e.g., occupational accidents, wages or forced labor) in addition to the already established economic criteria (e.g., price, ability to deliver or adherence to delivery dates) in supplier evaluation [4, 5]. For example, in a survey conducted as part of the Sustainable Procurement Barometer, 93% of all companies surveyed already regard sustainable procurement as one of the top 4 priorities [6]. An empirical study of DAX and MDAX companies came to the same conclusion. It was found that the topic of sustainability was of high importance to the companies surveyed. At the same time, however, it also became clear that ecological rather than social requirements would apply so far, often represented by Code of Conducts or standards or norms. Overall, the empirical study showed that very large companies, in particular, focus on sustainable supply chains and regard their supply chain complexity as high to very high [7].

On the one hand, sustainable procurement is thus recognized by companies and society as an essential issue. On the other hand, companies are driven by increasing globalization to divide the supply chain globally to save costs and meet competitive demands [6, 7]. However, by designing the supply chain as a global network of different organizations, additional risks become apparent, as additional socio-economic factors and contexts of suppliers and their countries of origin have to be considered when suppliers are distributed globally [7]. Companies are thus exposed to additional risks due to outsourcing (for example, for manufacturing companies, supply and demand risks) [6]. However, in addition to companies' legal and regulatory obligations, sustainable action can also be pushed for reputational reasons, leading many

companies to act responsibly beyond the legal framework [3, 5]. Particularly in the case of large companies, it has been shown that non-sustainable actions can lead to significant reputational damage [5]. One example is the Apple scandal involving the supplier Foxconn, which had products manufactured under undignified conditions and can subsequently be held jointly responsible for several employee suicides [8]. To prevent such or similar problems, research calls for fact-based supplier evaluation and selection [5].

In order to control the supply chain, which is becoming increasingly complex due to out- and single-sourcing, the progressing globalization and the volatility of the markets, the discipline of supply chain management has established itself [9]. The aim is to integrate and control flows of goods, financial resources, legal matters and information [9]. Driven by new legislation, NGOs, and the increasing focus of the public, customers, and competitors on sustainability, Sustainable Supply Chain Management (SSCM) has developed based on SCM. The central aspect of SSCM is the integration of sustainability aspects into supplier management. In addition to economic factors, ecological and social aspects are also included in the selection, evaluation and development of suppliers to reduce overall social and ecological risks in the supply chain [7]. In order to integrate sustainability risks into supply chain risk management, adequate strategies are required to include ecological and social aspects in supplier evaluations and classic economic aspects, such as liability issues [3, 7, 10]. In practice, this often involves strategic behavioral guidelines or codes of conduct binding for all partners [3, 7]. At the same time, supplier evaluation can be used to uncover potentially vulnerable components of the supply chain [6]. In addition to compliance with the Code of Conduct, the supplier selection process must always consider which due diligence obligations and laws result from the cooperation with the partner. To this end, it is necessary to check which obligations apply to the respective company, depending on characteristics such as the size of the company or its turnover. This leads to the point that evaluation and selection are the most critical step for realizing sustainable procurement [4]. In order to evaluate the sustainability of a supplier concerning ecological and social aspects, extensive data must be collected and evaluated, which can lead to a high manual effort. At the same time, in the case of globally distributed suppliers, it is necessary to check the conditions in the respective country of origin. In addition to the sustainability aspects already mentioned, regulatory aspects such as legal requirements also play a fundamental role here. Established procedures for evaluating procurement risks (e.g., according to Kraljic [11]) must therefore be expanded to include a sustainability dimension.

This article is dedicated to optimizing these potential supplier evaluations and selection problems. In essence, this will answer the following research question:

– How can indicators be used to assess the sustainability of a country and the legal requirements to be met to support supplier selection?

This paper provides an approach for selecting suppliers based on the status of sustainability and the legal basis (related to sustainability) in the country of origin. It is structured as follows. First, the introduction explains the underlying problem in more detail. In the second section, relevant indicators for country evaluation are
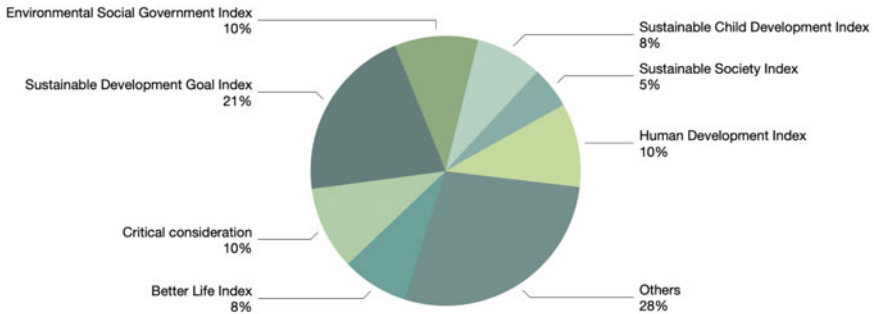
Fig. 1 Thematic classification of the publications

identified and interpreted. This consideration is extended to the legal basis in the third chapter to merge both views in the fourth chapter. The results are recapitulated in the final chapter, and an outlook is given.

2 Identification and Interpretation of Relevant Indicators

In order to build a scientific foundation and thus expand knowledge, develop possible theories and delineate topics, it is essential to review existing scientific work [12]. In this regard, a systematic literature review must be carried out based on Fettke's five-phase model. The first phase defines the initial problem based on which the review will be conducted [13]. In the context of the research question, the focus is on the problem of sustainability evaluation of countries in order to consider current approaches and possible evaluation schemes. It should be noted that during the literature review, only the current state of research is considered, and consequently, the focus is not on uncovering existing research gaps.

The search terms *country classification* and *sustainability*, as well as various synonyms such as *country ranking*, have been used as the basis for the literature selection process. However, in order not to be limited by predefined application areas already within the search, *supplier selection* was excluded from the search term. Consequently, the search term '(*country classification* OR *country ranking* OR '*rating of countries*') AND *sustainability*' was formed in english and german. The databases *Google Scholar* and *Scopus* were used as data sources to identify relevant literature yielding 1159 results. The collected results were then reduced through an extensive screening process and the removal of foreign language and duplicates so that a final 39 publications were included in the evaluation. These mainly focus on different indices and indexes, such as the *Sustainable Development Goal Index* or the *Human Development Index*, but also on their critical examination. Indices represent individual variables that can reflect qualitative or quantitative values or measures, while indexes are usually represented as a collection of related indices. A more precise distinction of thematic focuses is made in Fig. 1.

Sustainable Development Goal Index The Sustainable Development Goals no longer consider only developing countries like the Millennium Development Goals (MDGs) did, but rather all countries. This allows for a country-specific evaluation based on the individual goals and sub-goals, revealing potential deficits in action. This evaluation is mapped with the Sustainable Development Goals Index, which is reported annually. To calculate the index, the degree of fulfillment of a goal is determined and weighted and summed up, resulting in a score between 0 and 100 [14].

Human Development Index The United Nations first initiated the Human Development Index (HDI) in 1990 to measure human development [15]. The index is composed of various indicators from the areas of quality of life, education and per capita income [16] The calculated index lies in an interval of [0,1], whereby this is divided into four categories (very high, high, medium and low) in order to obtain a targeted classification of the quality of the index [15].

Sustainable Child Development Index The relationship between present and future generations can be inferred from the definition of sustainability provided by the Brundtland Commission, which states that meeting the needs of the present generation must not affect the needs of future generations [17]. The SDGs also show a connection between sustainable development and future generations. More than three-quarters of the SDGs directly or indirectly address children and their development [18]. The Sustainable Child Development Index (SCDI) is designed to map the sustainable development of children in order to measure intergenerational equity, as children are an essential factor in this, and their needs are different from those of an adult [17]. By combining different values from the economic, ecological and social fields, a sum is formed that reflects the current individual situation of a country concerning the sustainable development of children. In doing so, not only the current development is presented, but attention is also drawn to possible barriers that hinder the development of a child [18].

Sustainable Society Index The Sustainable Society Index (SDI) was developed by the Dutch Sustainable Society Foundation in cooperation with the European Union to measure societal progress with the help of 21 indicators [19]. The respective indicators are assigned to the three dimensions of *human wellbeing*, *environmental wellbeing* and *economic wellbeing*, which are further subdivided into subcategories and are based on the triple-bottom-line approach. In total, the SDI assesses and ranks 154 countries [20].

Better Life Index Another index that measures human wellbeing alongside the SCI is the Better Life Index. This was developed over a decade by the *Organisation for Economic Co-operation and Development* (OECD) and presented in 2011 in the *Better Life Initiative* [21]. The SCI consists of a total of eleven indicators, each of which is subdivided into further sub-indicators and whose intention is to review all OECD member countries and, since 2012, Russia and Brazil [22].

Critical consideration Indicators offer the possibility of mapping complex issues through a numerical value in an understandable way, thus enabling different countries to be compared or evaluated. The number of performance databases designed to quantify global risks in order to act as decision support for governments has increased in recent decades due to the heightened public awareness caused by global crises [23].

However, it should be noted that various academic works criticize indicators as an object of evaluation. The criticism is justified by the fact that development systems lack data systems that measure the indicators that are relevant for the achievement of the SDGs [24]. Another criticism is the mixing of inputs and outputs, resulting in distorted results [25].

To get more into detail before developing the actual concept, existing systems were examined closely in addition to the existing scientific literature. Therefore commonalities and essential functions shall be identified as a priority, which will define some of the key requirements for the system. To be more precise, the solutions *Sustainable Development Report*, *SDG Interactive Data Dashboard*, *Corruption Perceptions Index* and *Human Development Data Center* are analysed. It can be stated that three out of all four systems use an interactive world map, allowing the user to get a preview of the data before making an actual selection. Furthermore, it turns out that coloring the world map based on a rank-based color scale can give extra information regarding achieved goals and make indicators more present.

The use of a tabular presentation, as done, for example, by the *Human Development Data Center* is considered critical since information gets messier with the increasing complexity of the data and comparisons with other countries get more complicated. In addition, the analysis reveals that all systems use scores to compare countries and make rank-based listings and graphs to visualize development trends understandably. Based on these results, a software concept is developed. In contrast to existing solutions, it differentiates itself primarily by selecting suppliers from authorized company employees. The strict contextual focus enables weighting factors and indicators to be more relevant than others. Furthermore, it is possible to omit indicators that are less relevant for the selection of new locations and simplify and optimize the calculation according to the underlying use case. Thus, for example, contrary to general information about the sustainable development of the countries in reference to the 17 SDGs, a decision's economic efficiency has always to be weighted more strongly for companies. The weighting results in a more precise score for the desired context and allows providing recommendations for actions. With the help of this recommendation, it should be easier for the user to interpret the available data as well as evaluations. Another unique feature is the inclusion of existing locations, such as checking active suppliers concerning their location. This enables the user to manage or evaluate already existing supplier locations. Finally, the concept offers an adaptive risk score depending on the industry by including the respective preference of a company in the weighting of the SDGs.

2.1 Evaluation of a Country's Risk

Based on the previous results and considering the key aspects—risk identification, risk analysis and risk control—of risk management, a concept for ranking countries in a sustainable supply chain can be developed. It becomes apparent that the identification and evaluation of risks, in particular, is correlated to the company's field of

activity. Consequently, sector-specific risks can be overlooked during identification, resulting in an incomplete or misplaced evaluation of risks. Nevertheless, a general risk evaluation can be useful decision support. In order to carry out such a rating in the context of sustainability, the SDGs can be considered a helpful foundation. However, not all of them are equally relevant for rating risks within the supply chain. The selection of the respective SDGs that are of relevance for risk identification within the supply chain and its factorization, based thereby on Fröhlich and Steinbiß, which in turn were reinforced by statements of Nieuwenhuis. Based on these statements, SDGs 4, 7, 8, 9, 11, 12, 13, and 15 can be identified as relevant goals for risk evaluation [27, 28]. Here, Goal 12 is considered the most important, with a weighting of 3, followed by Goal 9, which received a weighting of 1.5. Goals 4, 8, and 15 all received a weighting of 1.4, with the remaining goals 7, 11 and 13 receiving a weighting of 1.0. In order to be able to make a meaningful risk score in the further course, the weighted targets must be weighted according to their relevance using a min-max normal distribution on the interval [1, 2].

$$G_{SDG} = (x - \min(x)) \cdot \frac{2 - 1}{\max(x) - \min(x)} + 1 \tag{1}$$

In contrast to the interval [0.1], it can consequently be ensured that the less relevant SDGs are also included in the calculation with a weighting of 1.0. Applied to the previous weighting, the following results are obtained, which are shown in Table 1. The weightings (G_{SDG}) forms the basis for the subsequent factorization of the respective risk score[1] (R_{SDG}) of an SDG.

Calculation of the risk value To determine the share of a relevant SDG in the risk score, the evaluation of the degree of fulfillment and the development trend of each subordinate indicator is considered. First, a relative, approximate estimate of the probability of occurrence of potential risks is made based on four evaluation levels. The design of the assessment levels was oriented to the Sustainable Development Report and its four assessment levels. The assessment levels of goals achieved, challenges, significant challenges and massive challenges were derived. In order to be able to make a statement about the general probability of risks occurring, the rest of the presentation is based on the assumption that full achievement of an indicator's targets is equivalent to a low probability of occurrence. Thus, a probability of occurrence of between five and ten percent was defined for the evaluation level Targets achieved. In order to determine the probabilities of the remaining three evaluation levels based on this, the previous probability range is doubled in each case with descending evaluation.

Table 2 shows the probabilities of occurrence determined in relation to their evaluation level. Since a fixed value should be assigned to each evaluation level to calculate the risk value further, the maximum value of the probability of occurrence ($W_{indicator}$) is selected in each case. In this way, it can be ensured that the score covers a large

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[1] The risk value refers to the score determined for an individual sustainability target and thus forms a proportion of the risk score.

Table 1 Relevant SDGs according to Fröhlich and Steinbiß with normally distributed weighting [27]

Sustainable development goals (SDG)		Weighting
Nr.	Name	(G_{SDG})
12	Responsible consumption and production	2.0
9	Industry, innovation and infrastructure	1.25
4	Quality education	1.20
8	Decent work and economic growth	1.20
15	Life on land	1.20
7	Affordable and clean energy	1.0
11	Sustainable cities and communities	1.0
13	Climate action	1.0

Table 2 Risk probability of an indicator after rating

Rating	Probabilities of occurrence (%)	
	Range	Fixed value (W)
Goal achieved	5–10	10
Challenges	10–20	20
Significant challenges	20–40	40
Massive challenges	40–80	80

Table 3 Factorization according to development trend of the indicator

Development trend	Factor (F)
Goals achieved/on schedule	0,8
Slightly increasing	0,95
Stagnant	1,0
Sinking	1,2

part of the risks and that no overly optimistic risk evaluation is made. Nevertheless, to introduce variance into the probability distribution, the determined probability of occurrence is multiplied by the factorized development trend ($F_{\text{indicator}}$). This is decisive for the risk development should a company decide on a new supplier location.

With the help of the factors presented in Table 3, the risk value of a sustainability target can then be determined. This is formed by the sum of the multiplied probability of occurrence with the factor of the development trend of each subordinate indicator (see Eq. 2).

$$R_{\text{SDG}} = \sum \frac{W_{\text{Indicator}}}{100} \cdot F_{\text{Indicator}} \qquad (2)$$

Calculation of the risk score To determine the country's risk score (R) in the final step, the individual risk scores ($R_S DG$) are multiplied by the normalized weighting ($G_S DG$) determined at the beginning, summed, and then divided by the total number (n) of relevant SDGs (see Eq. 3).

$$R = \frac{\sum R_{\text{SDG}} \cdot G_{\text{SDG}}}{n}, \quad n = \text{Number of relevant SDGs} \qquad (3)$$

Interpretation of the risk score In order to better interpret the calculated risk score, it is classified into four categories. The categories provide an overview of how acute general risks within a country should be assessed and include low, average, elevated or critical levels. To determine the respective value intervals that decide on the classification, Eqs. 4 and 5 are determined for each probability of occurrence (W_x).

$$\text{Min}(x) = \frac{\sum \left(\sum_{i=1}^{I} W_x \cdot \min(F) \right) \cdot G_{\text{SDG}}}{n} \qquad (4)$$

$$\text{Max}(x) = \frac{\sum \left(\sum_{i=1}^{I} W_x \cdot \max(F) \right) \cdot G_{\text{SDG}}}{n} \qquad (5)$$

whereby: I = Number of indicators per SDG

The difference between the end of the interval and the start of the interval of the next category resulting from this calculation is canceled by adding both values and then dividing by two. Thus, both limits shift in the direction of the mean value of the sum. Finally, the value ranges are normalized to the interval [0,100] to facilitate interpretation for the user (see Eq. 6).

$$R_{\text{norm}} = (x - \text{Min}(0, 1)) \cdot \frac{100}{\text{Max}(0, 8) - \text{Min}(0, 1)} \qquad (6)$$

The results, including recommendations for action, become clear in Table 4.

It should be noted that the generalized risk evaluation only covers the identification and evaluation of the risk. Risk management and thus the implementation of countermeasures are strongly correlated to the size and structure of the company itself [?].

Table 4 Classification of the risk score

Category	R	R_{norm}	Recommendation for action
Low	<1,09	<6,71	**The risk is low**. It is pretty unlikely that risks with a significant impact on the company will arise with the selection of this country
Medium	1,09–2,19	6,71–22,6	**The risk is average**. The probability of a risk occurring in the selected country is medium range
High	2,19–4,38	22,6–54,4	**The risk is increased**. The selected country has an increased probability of risk occurrence. If you prefer a supplier in this country, you are advised to contact them to find out what measures they are taking to reduce possible risks and support sustainable action
Critical	>4,38	>54,4	**The risk is critical**. The selected country is located in a critical area. The occurrence of possible risks is to be regarded as highly probable. It is recommended to select another country with a lower risk to prevent negative effects on the company

3   Consideration of Existing Systems and Legal Bases

Considering that the proposed system contains two core functions that can be used independently, as already explained in the introduction, two literature research were conducted. For the second literature review, various literature databases, including *Springer Link* and *Google scholar* were searched with the keywords *readiness check* and the addition *supply chain* as well as *supply chain law* in English and german. The keywords are based on the second research question. It addresses the identification of relevant criteria in supply chain laws to identify which legislation a company has to ratify and which actions it is required to implement. The purpose is also to identify readiness checks with the same intention further. Through the literature research, a total of 217 sources were therefore retrieved. Afterward, a screening process was applied to verify the relevance of the sources and identify duplicates. The topic is a novel subject area, also considered a niche topic. The final publications were narrowed down to eleven. This is because, on a closer review of the results, it has been determined that the literature findings are indeed related to readiness checks, however, on other topics. Since the results of the literature research are limited to none, documented internet research with typical search engines has been conducted to find additional corresponding sources. As a result of both researches, it can be stated that there are no readiness checks or other verification software available to check if a company fulfills all necessary actions that are mandatory through national supply chain laws. However, based on the research, readiness checks are used for various other business purposes to improve the efficiency of company processes, including digital readiness or it-security.

3.1 Readiness-Checks to Simplify Company Processes

Through technological progress and the resulting technologies, company processes and workflows can be arranged more efficiently to generate higher sales and ensure long-term development. A readiness check is a software tool that can help make company processes more efficient. By submitting company data, the current state is analyzed [29]. To evaluate the current status, a readiness check includes general company data and questions about existing measures relating to the company's area undergoing analysis. The tool evaluates the company's maturity level concerning the specific area based on the entered data. The intention is to detect the current state and present an overview in order to be able to conclude from the evaluated results whether the company is ready in this area or a necessary action needs to be derived [30].

The identified readiness checks through this process were partially analyzed to highlight commonalities. The reason why only a partial amount could be analyzed is that the majority is not freely accessible. The scope of the analysis is the identification of the structure and questioning possibilities. Most systems have a query of general company data at the beginning, along with the industry in which the company operates, what products it manufactures or sells and the number of employees, before proceeding to topic-specific related questions. Furthermore, it can be concluded that mainly multiple-choice questions are used. That is because the context and comprehensiveness of the answer are predefined for the user, and the evaluation and analysis of the data can be performed comparatively simply. Only in some instances the option "Other" is offered. As a result, a free text field becomes disabled, and the user can make an individual entry. The purpose of analyzing existing Readiness-Checks was to identify the structure and used questioning techniques. Taking into account the results described above, the paper will describe the development of a tool with the feature to verify compliance with laws in the supply chain.

3.2 Importance of Supply Chain Laws

The legal obligations are examined below, given the motivation and relevance for companies to act and produce more sustainably. This is followed by developing a concept to implement a prototype to create a tool to support companies in this process of identifying which legal obligations are relevant for the company and if they fulfill the requirements to achieve more transparency in supply chains. Over the last decade, the number of national legislation has increased significantly. Across Europe, countries have enacted legislation requiring companies to review their supply chains regarding human rights and environmental risks or impacts. For instance, in 2021, Norway passed a law on corporate transparency and labor with fundamental human rights and decent working conditions [31]. France passed the "Loi de vigilance", a law that obliges companies to identify risks related to human rights violations, health and safety of persons, and environmental damage in supply chains [32], and

the Netherlands is also implementing a law to prevent child labor in supply chains, to name a few [33]. However, even beyond the borders of Europe, more and more countries are addressing the problem, for example, Australia, which passed the Australian Modern Slavery Act in 2018. This is to ensure better working conditions and the protection of the environment. At the same time, it presents companies with significant challenges because large corporations, which are particularly obligated by the laws, have very complex supply chains and are globally interconnected. Due to the differences between the laws and the resulting actions for companies, it is a time-consuming and labor-intensive process to find out which of the countries of operation have a national supply chain law and what actions the company needs to implement in order to act in conformity with the regulations [34]. Despite this, companies must comply with a legal obligation. Otherwise, they may be subject to fines or legal action. Suppose human rights or environmental risks or violations have been identified, and no remedial actions are taken to ensure an end. In that case, some of the laws require that the business activities with the relevant business partner be terminated. Fundamentally, the laws already differentiate in their areas of application. One part covers only human rights or environmental risks and violations, while others include both. Furthermore, the scope of application also varies, as either direct suppliers or sub-suppliers are included in the risk analysis. However, there are some actions that almost all supply chain laws expect companies to undertake. These include conducting a risk analysis, reporting the process and results, and developing and implementing remedial actions that lead to the prevention, minimization, or termination of the identified risks. On the other hand, they are many actions that are only required from a single legal obligation, for example, only the German Supply Chain Act requires companies to designate one person as responsible for monitoring risk management [35]. Further, only the U.K. Modern Slavery Act demands a report on available training on slavery and human trafficking for employees [36].

Beyond this, companies should not only act more sustainably because of the laws that have been passed. Transparency in supply chains and fair production can generate an added value for the product and thus differentiate the company from its competitors. Furthermore, a higher commitment to sustainability can lead to the more straightforward attraction of investors or qualified employees, as they identify better with the company's guidelines [37].

Based on the results from the literature review, analysis of related systems, and the legal obligations, a concept for the implementation of the prototype was developed. For the purpose of creating a concept, the national supply chain laws were analyzed in full detail with the result that question catalogs could be formulated for each legal basis. By answering the questions, the aim is to determine whether the company is acting in accordance with the legislation or whether there is a need for action. In addition, the analysis of the laws made it possible to create an impact analysis, which determines which laws the company is required to comply with. Companies can fill this out as a preliminary step and then complete a country-specific questionnaire.
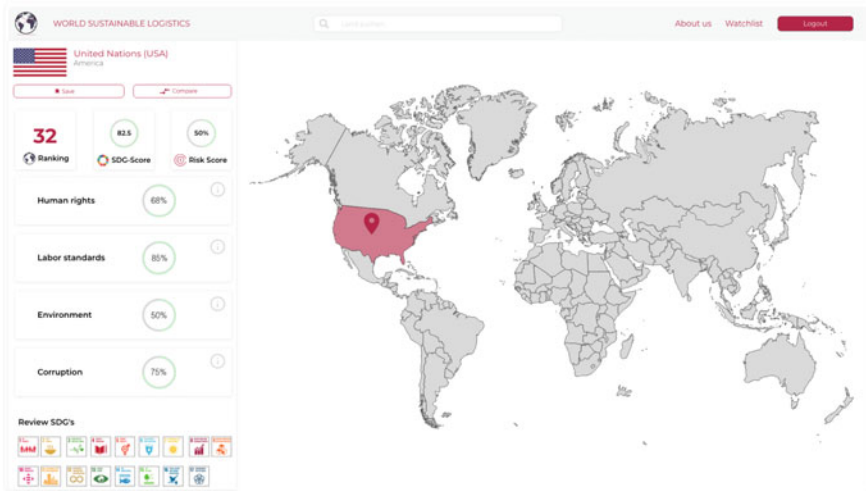
Fig. 2 User interface of the dashboard

4 Combination and Operationalization of the Approaches

The following section describes the software concept that implements the two above-mentioned approaches. In this context, requirements had to be placed on the software to be developed to implement an optimized system. The requirements were divided into functional and non-functional requirements. The functional requirements represent action assumptions and how a system should interact [38]. The non-functional requirements serve again as quality characteristics, whereby this can stand partially or, in addition, entirely in relation to the functional requirements [39]. Based on the requirements, a software concept could be compiled. Its most significant component was the dashboard (see Fig. 2).

This consists of an interactive world map, which is colored based on the individual risk scores of the respective country and can therefore be used as a first simplified comparison. After the user has selected a country, a sidebar opens in the left section of the dashboard. In addition to general and geographical information on the selected country, this sidebar contains the country's achieved rank as well as the SDG and risk score. In addition, by clicking on the "Remember" and "Compare" buttons, the respective country can be added to the user-specific watch list or to the comparison view for comparison. In the lower section, on the other hand, various sustainability categories and their degree of achievement are displayed graphically. In addition to the four sustainability categories, the user is also shown the 17 SDGs. By clicking on the individual tiles that symbolize the individual goals, the sidebar changes so that the score of the goal to be achieved and a trend are now displayed. Furthermore to comparing and remembering countries, the user also receives recommendations

for action based on the calculated risk score as to whether the respective country is worth considering.

After selecting a country, companies must check if they fulfill the legal obligation regarding supply chain laws. In order to be able to do this, they can proceed to the readiness check by clicking on the relevant country on the interactive world map and accessing the country-specific questionnaire.

5 Discussion and Future Work

This paper developed a concept to simplify the selection of suppliers based on a sustainable country evaluation to serve as decision support for expansion and out-sourcing decisions. A comprehensive literature review was used to identify relevant indicators in this context. In addition, existing systems were considered to support statements and possible requirements. These results were used to develop a risk score, which is used as an additional evaluation criterion to influence the country's rating. Subsequently, existing systems and the legal basis were analyzed to develop a readiness check afterward. The results of both components can then be used by decision makers in supply chain risk management to be able to realize sustainable supplier selection.

A particular focus should be on risk evaluation in future work, as this is a fundamental component of the concept. Thus, in order to increase the informative value of this evaluation, not only the SDGs but also other indicators should be used in order to be able to track objective risks, for example, depreciation per country, legal disputes and delays. The use of the identified indicators, such as the HDI, can also be included in the risk evaluation. Another potential issue for future work is reliance on third parties for the timeliness of data. The continuous actuality of data relating to the country evaluation and the legal basis is essential to provide constructive decision support. For this purpose, changes in laws must be considered, and the questionnaire has to be updated accordingly to the laws and resulting actions for companies. In addition, it is necessary to pay attention to the development of draft laws and whether they are passed or not. In case of law is passed, it must be incorporated into the tool.

However, country evaluation should always take into account that acute sudden results cannot be directly reflected in the data sets used. Therefore, companies must independently consider these events when selecting a country.

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