KPMG

Technical review of the Higg MSI and Higg PM tools

Expert review report
September 2023

PREFACE

The mission of the Sustainable Apparel Coalition (SAC) is to drive collective action toward creating an equitable and restorative consumer goods industry. The SAC aims to achieve this goal by aligning its global community around shared objectives, collaboratively developing and executing solutions, and leading impactful initiatives with strategic partners. One of the key initiatives is the development of the Higg Index, a comprehensive suite of tools designed for the standardized measurement of sustainability across the value chain.

The primary aim of the Higg Index is to empower brands, retailers, and manufacturers with verified data to assess, enhance, and transparently share their environmental and social[1] performance. The SAC is committed to continuously improving these tools, thereby enabling the industry to drive significant social and environmental change. To ensure this continuous development, periodic reviews of the tools are conducted, considering the evolving context in which they are utilized.

Although the Higg Index has undergone several updates throughout the years, such as incorporating more materials into the Higg Materials Sustainability Index (Higg MSI), updating the Higg Facility Environmental Module (Higg FEM), and launching a new version of the Higg Brand & Retail Module (Higg BRM), the last comprehensive and independent review took place in 2017, and was focused on the Higg MSI only. In order to move forward and inform the next phase of the Higg Index's evolution, the SAC sought expert guidance.

The SAC commissioned KPMG to facilitate the technical review of the entire suite of tools as an independent third party. A panel of ten experts has first evaluated the Higg Product Module (Higg PM) and Higg MSI tools, using relevant information and documentation made available by the SAC, Worldly platform, and consulting ISO 14040 & 14044 standards.

During the review, the experts assessed the tools' fitness for their intended purpose, use cases, alignment with Life Cycle Assessment (LCA) standards, and best practices. Their constructive feedback provided valuable insights for enhancing the understanding of environmental impacts resulting from different production choices.

The findings from the expert review were meticulously collected, discussed, and refined through various interactions, including questionnaires, one-on-one sessions, expert discussions, and tool Q&A sessions. KPMG Advisory N.V. has consolidated the final findings into this report to support the SAC in further evolving the tools.

It is important to note that this report is intended for the SAC’s information and use, guiding the future development of the Higg MSI and Higg PM tools. The review process, however, does not constitute an audit or assurance engagement (ref. chapter 9). Neither should it be interpreted as meeting the requirements for a critical review statement as defined in ISO 14040.

KPMG Advisory N.V.

Jerwin Tholen, Partner

[1]Social is out of scope for the Higg MSI and Higg PM tools.

SAC FOREWORD

We are grateful to KPMG for their work in developing this report, which captures the invaluable insights and recommendations derived from the expert review of the Higg MSI and Higg PM tools. At the Sustainable Apparel Coalition, we are committed to driving positive environmental and social change within the textile, apparel & footwear industry. The Higg Index suite of tools plays a pivotal role in achieving this mission, empowering brands, retailers, and manufacturers to measure, improve, and share their environmental and social[2] performance.

The expert review, starting with the Higg PM and MSI review, marks a significant milestone in our journey towards continuous improvement and sustainability excellence. We extend our heartfelt gratitude to the independent[3] panel of experts, whose expertise, diversity of perspectives, and dedication have enriched this report. Their contributions have been synthesized by KPMG into a series of actionable recommendations that will help us to shape the evolution of the Higg MSI and Higg PM tools.

Throughout the review process, our collective commitment to transparency and accountability has been unwavering. We have embraced the challenges and recognized the industry-wide complexities that necessitate a collaborative and sector-wide approach. By acknowledging these challenges, we can collectively strive towards transformative change that extends beyond the boundaries of our organization and requires the active involvement of the entire apparel industry.

This report is a testament to the willingness of the organization and its members to adapt, improve, and embrace the latest advancements in Life Cycle Assessment (LCA) standards and best practices. It is also a reminder that progress is a journey of continuous learning, and we must remain open to diverse viewpoints and the potential for scientific advancement in various fields.

We invite all stakeholders in the textile, apparel & footwear industry to engage with this report, recognizing that while individual recommendations may not always be aligned, they are stepping stones towards increased collaboration for a shared path forward. The need for increased collaboration, along with communication, and the development of a shared vision are essential as we work together to implement these recommendations and drive positive change on a global scale.

As we embark on this exciting next phase of the Higg Index's evolution, we renew our commitment to transparency, collaboration, and innovation. By working together, we believe we can foster a sustainable, equitable, and restorative consumer goods industry, leaving a lasting positive impact on our planet and future generations.

Thank you for your support, and we look forward to your partnership on this transformative journey.

Sincerely,

Jeremy Lardeau,
VP, Higg Index
Sustainable Apparel Coalition

[2]Social is out of scope for the Higg MSI and PM tools.
[3]Nine experts are independent from the SAC and one expert is an affiliate member (Jesse Daystar, Vice president, Chief Sustainability Officer of Cotton Incorporated – Cotton Incorporated is an affiliate member of the SAC).

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1. Executive summary

Context

The Sustainable Apparel Coalition (SAC) is dedicated to tackling pressing environmental and social challenges within the textile, apparel & footwear industry. This is accomplished through the implementation of the Higg Index suite of tools and various collective action programs. The Higg Index is a suite of tools for the standardized measurement of value chain sustainability. It leverages self-assessments and a verification program in order to measure and improve the performance of brands, retailers, and manufacturers. While the tools have made significant progress in methodology and scale in recent years, it has been five years since the last comprehensive external and independent review of the Higg MSI tool.

To ensure the continuous improvement of these tools and their ability to drive positive environmental impacts, the SAC has taken a proactive step by commissioning KPMG, an unbiased and objective independent third party, to facilitate a technical review of the Higg MSI and Higg PM tools with experts. The focus of this review is on the Higg MSI and Higg PM. By involving KPMG as a globally recognized, independent organization, the SAC aims to maintain transparency and credibility in the assessment process.

The ultimate goal is to identify areas to enhance and develop the tools, helping the industry to effectively address urgent sustainability challenges. By staying committed to the evolution and refinement of the Higg Index, the SAC strives to make a significant and lasting positive impact on the industry as a whole.

The tools

The Higg Material Sustainability Index (MSI) and Product Module (PM) are tools based on Life Cycle Assessment (LCA) methodology.

The Higg MSI is a cradle-to-gate material assessment tool that calculates the environmental impacts of materials used in the textile, apparel & footwear industry. These include items such as ready-to-be-assembled textiles, trims, and packaging featured in products. The tool aims to enable design and development teams to identify hotspots and make more sustainable choices during the materials selection process. The Higg MSI uses peer-reviewed data submitted from the industry and Life Cycle Assessment databases to calculate environmental impacts. The tool measures this environmental impact in five areas: global warming, nutrient pollution in water (eutrophication), water scarcity, abiotic resource depletion of fossil fuels, and chemistry. Higg MSI results are provided individually for each impact category and are displayed in two formats: Life Cycle Impact Assessment (LCIA) units and Higg MSI score. The LCIA units represent the environmental impact for the specific impact category (e.g. kg CO_2e with regards to global warming potential). The Higg MSI score, in turn, is based on a linear normalization set upon the weighted volume of the materials most used in the industry.

The Higg PM, in turn, assesses the cradle-to-grave environmental impacts of products made by the textile, apparel & footwear industry. This assessment includes the impacts of the specific materials used in a product, the impacts from finished goods' manufacturing processes, as well as the impacts of logistics (transportation and distribution), use phase, and end of life. The Higg PM integrates Higg MSI outputs to provide a full cradle-to-grave assessment. The Higg PM shares the same five impact categories as the Higg MSI. Higg PM results are provided individually for each impact category and are displayed in terms of LCIA units. The Higg PM aims to help companies understand the environmental performance of their products portfolio and enable progress on circularity goals.

Objective of the review

The primary objective of the review is to ensure the continuous improvement of the tools by thoroughly assessing their suitability for specific intended use cases: “internal use” and “Business-To-Business (B2B) use”.

1. Internal use: The tools aim to provide users with credible and standardized environmental assessment data to inform their product design and development decisions, as well as material innovation and material development decisions. This data facilitates process benchmarking, better decision-making, and ultimately, drives individual and collective environmental performance improvement within the industry.
2. B2B use: The tools intend to enhance value chain transparency by supporting the sharing of trusted data between different partners in the value chain. This fosters collaboration, reduces duplication, and enables the alignment of methodologies and assumptions across the industry, so users can effectively focus on making use of the data to support informed decision-making for improved environmental performance within the industry.

For these use cases, the review focuses on evaluating whether the tools are fit for purpose in these scenarios, on the quality of the results they produce, and on their alignment with current Life Cycle Assessment (LCA) standards and best practices.

Throughout the review process, these specific use cases are carefully considered to ensure that the tools effectively address the needs and requirements of both internal users and stakeholders engaging in B2B interactions.

The Business-To-Consumer (B2C) use case was out of scope for this review. The B2C use case would encompass the use of the Higg MSI or the Higg PM data in consumer facing communications, product labelling or marketing claims. The reason for not addressing this use case is the on-going regulatory developments related to consumer claims (including in particular the European Commission's Product Environmental Footprint initiative, Green Claims Directive and Empowering Consumers Directive). Therefore, the B2C debates and technical ramifications go beyond the scope of this review.

Review methodology

The review was conducted by ten experts, facilitated by KPMG. The selection of experts was based on criteria such as expertise, background, geographical location, and gender. Nine experts are independent

from the SAC and one expert is an affiliate member[4]. This approach ensured a wide range of perspectives and insights.

The review process was subdivided into the four main LCA phases that are part of the ISO 14040 & 14044 Life Cycle Assessment (LCA) framework, which offers quantitative methods and guidelines for assessing the environmental aspects of products or services throughout their life-cycle stages. To conduct the review[5], the experts were granted access to various essential resources, including the Higg MSI and Higg PM methodology documents, Worldly platform, SAC training materials, and the "How to Higg" websites. Additionally, they had the opportunity to engage in Q&A sessions with the tools' director, further enhancing their understanding.

The review spanned approximately 12 weeks and involved several crucial stages. Initially, the experts reviewed relevant documentation and information related to the Higg MSI and Higg PM tools. They then provided feedback, which was thoughtfully collected and consolidated. Subsequently, expert discussions and iterative processes were carried out to mainly develop comprehensive recommendations for tool improvement and evolution.

The outcomes of the review are presented in three sections within the report: general observations, expert feedback and expert recommendations per phase of the ISO 14040 & 14044 framework. This clear organization ensures that the report effectively conveys both the overall observations and the detailed proposals for the improvement of both tools.

The review conducted by the experts and captured in this report serves as a valuable resource, guiding the SAC in the continuous improvement and development of the Higg Index tools, reinforcing their commitment to fostering a more sustainable consumer goods industry.

General observations

It is important to properly contextualize the outcomes of this expert panel review within the larger textile, apparel & footwear industry context to ensure a fair interpretation.

The SAC has developed the tools and promotes the use thereof at scale in a context in which many challenges need to be addressed simultaneously in order to drive sustainability. Currently, approximately 21,000 organizations are using one or more of the Higg Index tools. The industry challenges that the users of the tools face include, among other things, supply chain complexity, product quality and durability issues, low margins, the lack of good data, and the need for further academic research in areas such as the impact of materials and products on biodiversity and the emissions of microplastics. Within this context, the Higg MSI and Higg PM tools aim to drive increased environmental understanding and positive change within the textile, apparel & footwear industry on a product and material level.

KPMG facilitated the expert panel review of the Higg MSI and Higg PM tools by collecting experts' input through various questionnaires, one-on-one sessions, and expert panel discussions. In addition, experts were given the opportunity to further deepen and nuance their understanding and assessment of the tools through Q&A sessions with the tools' director. Both agreement and lack of (unanimous) alignment across experts was observed throughout the review and is reflected in the feedback, listed recommendations, strengths of the tools, use cases, and alignment with ISO 14040 & 14044 standards. During the review process, we observed that the selected experts have divergent views on how to practically apply LCA methodology in the above-mentioned business context and that for few topics they could neither provide

[4] Jesse Daystar, Vice president, Chief Sustainability Officer of Cotton Incorporated, Associate Adjunct Professor, Duke University – Cotton Incorporated is an affiliate member of the SAC.
[5] The experts reviewed the Higg MSI and Higg PM tools in operation in March 2023. Therefore, further developments within the tools, even the ones intended to meet the recommendations presented here, shall not be considered as reviewed by this expert panel.

practical recommendations for improvement in the current tools nor identify available industry tools that have already incorporated a better solution.

A lack of unanimous alignment among the experts was clearly observed with regard to data availability and quality. Although experts agree that using more granular data will provide improved insights, they offer different opinions and recommendations on the balance between using available, imperfect data and assumptions for practical insights with the need for more granular data levels (e.g. product, material, geography-specific) to approach real scenarios, which are not yet widely available.

In addition, many conversations were held about the need for appropriate levels of LCA knowledge when navigating the tools, to ensure correct use and interpretation of results.

Moreover, next to the integration of the Higg MSI and the Higg PM (i.e. not use the Higg MSI as a stand-alone tool), the need to expand the amount of specific important impact categories within the tools was recommended by the experts. They do recognize that some other impact areas (e.g. biodiversity, microplastics, etc.) can be included over time, as substantial research and scientific progress and consensus is still required. Further, they also acknowledged that LCAs have limitations when it comes to accounting for all impacts of materials and products and to addressing all required changes within the textile, apparel & footwear industry.

Collaboration across and beyond the industry, fostered by partnerships across all links in the value chain, is therefore crucial for the further advancement of the industry towards the required changes and for ensuring the evolution of tools such as the Higg MSI and Higg PM.

Expert feedback

A. What are the tools doing well?

While the expert review focused on the further evolution of the tools, the experts were also asked what the tools are currently doing well. Through questionnaires, the experts identified several strengths of both tools. Subsequently, the experts also reviewed and discussed the strengths that were identified by other experts in panel discussions.

The experts acknowledged that the Higg MSI and Higg PM demonstrate a number of strengths across all four ISO LCA phases for quantifying and assessing the environmental aspects of materials and products. However, it is important to point out that the experts did not reach consensus on all highlighted strengths of the Higg MSI and Higg PM tools. Therefore, to gain a comprehensive and nuanced understanding, readers are strongly advised to refer to the exhaustive list of identified strengths and suggested recommendations in chapters 4 and 5 respectively.

Some of the identified strengths of the Higg MSI tool include (non-exhaustive):

- Goal & scope definition - The description of the tool's goal in the methodology guide is an adequate first step. Brands, designers, and manufacturers are provided with a tool to measure and quantify the environmental impacts of their materials for informed design decision-making.
- Inventory analysis - The tool demonstrates an impressive amount of data, comprehensive coverage, and options to input better data if necessary or available, while a broad range of materials and inventory factors can be considered.
- Impact assessment - The tool enables the comparison of the impact of different production steps for the same materials, uses scientifically sound standards, and applies a (broadly) science-driven approach. In addition, the tool covers key impact categories for assessing the industry's impacts.

- Interpretation - The tool is user-friendly, offering the possibility to deep-dive into the data with a clear view of the various impacts for designers. Outcomes are clearly presented and educational material and documentation for users is readily available.

Some of the identified strengths of the Higg PM tool include (non-exhaustive):

- Goal & scope definition - The tool covers most of the life cycle phases of the apparel and footwear products, represents a good industry initiative to assess (a selection of) the environmental impacts of textile products, and enables detailed insights by means of a cradle-to-grave study.
- Inventory analysis - The tool has a large inventory database, in which data are easy to find and verify, whilst recognizing that data is constantly evolving and therefore must be regularly updated.
- Impact assessment - The tool uses scientifically sound standards, commonly accepted LCIA methodologies, and includes some of the most important impact categories (beyond global warming potential) for the assessment of apparel and footwear products: the categories are well selected for describing impact of apparel and footwear.
- Interpretation - The tool seeks to capture the whole set of materials and technologies involved in this highly complex sector. It provides a well-presented impact assessment per lifecycle stage, leading to powerful insights. It also aims to make impact metrics more accessible.

B. Are the tools fit for internal and B2B use?

As part of the review, the experts assessed whether the Higg MSI and Higg PM tools are fit for internal and B2B use through questionnaires, one-on-one expert sessions, and expert panel discussions. Key observations include that the experts did not reach a (unanimous) consensus on whether the tools are fit for internal and B2B use.

Internal use

- Higg MSI: A minority of experts recognize the potential of the Higg MSI in guiding design decisions. However, the majority of experts recommend its use in tandem with the Higg PM instead of as a stand-alone tool. This will offer users a holistic view and includes a satisfactory functional unit definition and comprehensive cradle-to-grave perspective.
- Higg PM: About half of the experts believe the Higg PM tool is suitable for internal use as long as its users have the right understanding of topics such as LCA methodology, data assumptions, analysis, and tool limitations. One expert suggested enhancing the tool's data granularity to more accurately reflect real-life scenarios. By incorporating the experts' recommendations, the tool can be even better tailored for internal use.

B2B use

- Higg MSI: Echoing the internal use case, a minority of experts recognize the potential of the Higg MSI in guiding design decisions. However, the majority of experts recommend its use in tandem with the Higg PM instead of as a stand-alone tool, citing the Higg PM’s satisfactory functional unit definition and comprehensive cradle-to-grave perspective, which offers users a holistic view.
- Higg PM: Nearly half of the experts consider the Higg PM tool suitable for B2B scenarios, while others believe that integrating the recommendations from this review would enhance its B2B application. Two experts emphasize the need for third-party verification; they also recommend enhancing the tool’s data quality and granularity for it to be effective for B2B use.

C. Do the tools align with ISO standards?

For this review, the experts had to review and complete extensive questionnaires to assess the tools' alignment with ISO 14040 & 14044 standards. The findings from these questionnaires were then broadly discussed within expert panel sessions and further developed in recommendations for the further development of the tools.

Following the outcomes from the questionnaires and expert panel discussions, the majority of experts acknowledged that the tools are in alignment with ISO standards on following topics (please refer to chapter 4.3):

Higg MSI:

- Inventory analysis – Scope of exclusions and materials and processes coverage
- Impact assessment – Not subtracting biogenic carbon from Global Warming Potential (GWP) and presenting as an independent inventory metric

Higg PM:

- Goal & scope definition – Functional unit definition
- Inventory analysis – Product care lifecycle scenarios, data assumptions (incl. option to override if primary data is available), scope of exclusions, and materials and processes coverage
- Impact assessment – Not subtracting biogenic carbon from Global Warming Potential (GWP) and presenting as an independent inventory metric

The experts have shared various recommendations concerning areas in which the Higg MSI and Higg PM should be enhanced to improve their alignment with the ISO standards. The recommendations addressing the improvement areas are extensively discussed in chapter 5 to properly reflect their importance in the expert discussions. Topics to be enhanced include, but are not limited to, providing a process flow diagram that represents system boundaries within the tools' platform, providing warnings when comparisons should not be performed, expanding impact categories, and including third-party reviews for external use of results.

It is important to note that no unanimous consensus was observed amongst the experts on whether and where the tools fully align with the ISO 14040 & 14044 standards.

Expert recommendations per ISO 14040 & 14044 phase

This report offers valuable recommendations about enhancing the Higg MSI and Higg PM tools. These result from numerous questionnaires, Q&A sessions with tools' director, one-on-one discussions with experts, and expert panel discussions over the course of approximately three months. In addition, multiple feedback sessions and opportunities for engagement occurred during the process.

The recommendations are classified based on the phases of ISO 14040 & 14044 (goal and scope definition, inventory analysis, impact assessment, and interpretation). The recommendations are also categorized according to their overall acceptance and prioritization by the experts. Additionally, the report provides insights into certain recommendations that transcend the ISO 14040 & 14044 framework.

It is important to highlight that some recommendations are future-looking, as there is a lack of available methodologies to incorporate them effectively in LCA studies today, such as the inclusion of the environmental impact of microplastics. The report suggests monitoring scientific progress in these areas

and incorporating these recommendations once widely accepted scientific methodologies become available.

It is also essential to note that the experts' findings were diverse, leading to varying levels of support for different recommendations. Thus, not all recommendations were fully endorsed by the entire panel of experts.

In this executive summary, a brief overview is given of the recommendations that are supported by the majority of experts and that were assigned a high priority level. To gain a fuller understanding, readers are strongly advised to refer to the exhaustive list of recommendations and detailed descriptions provided in chapter 5.

Goal & scope definition

The review generated a total of 11 recommendations, three of which go beyond the ISO 14040 & 14044 frameworks. The panel strongly recommends incorporating the Higg MSI with the Higg PM, rather than utilizing the Higg MSI as a stand-alone tool. They believe integration will amplify the strengths and capabilities of both tools and minimize confusion on outputs or an incomplete view of the potential impacts of a material.

Other notable recommendations focus on improving methodological definitions, ensuring greater transparency in allocation procedures, and providing clear user interpretations.

Among the recommendations, five received support from the majority of experts and were given high priority:

1. Implementing warnings when navigating the Higg MSI and Higg PM tools on the platform to prevent inappropriate comparisons.
2. Optimizing the Higg MSI by integrating it with the Higg PM (i.e. Higg MSI not as a stand-alone tool), thereby enhancing its functionality and potential.
3. Enhancing transparency in allocation procedures and providing an uncertainty analysis for the impacts of chosen procedures in the tools' platform and uncertainty analysis of the underlying data. Enhancing transparency is required, as some experts were unable to properly access and understand the applied allocation procedures.
4. Providing a more comprehensive and well-defined goal for the Higg PM within the documentation.
5. Incorporating a process flow diagram within the tools on the platform that represents the system boundaries of the study, aligning with ISO standards' suggestions.

Inventory analysis

A total of nine recommendations were provided during the review process, with three of them extending beyond the ISO 14040 & 14044 frameworks. The primary focus of the recommendations is to enhance the data quality of the tools, particularly by addressing geographical coverage issues related to energy grid (e.g. choice of type and process of energy), water consumption, and product care assumptions. Additionally, the need for a well-communicated future looking data quality strategy was emphasized to ensure reliable and accurate information. One expert recommended that the SAC increases the transparency of this strategy and the improvement journey ahead.

The following priority recommendations received significant support from the experts:

1. Provide sensitivity analysis to support the justification of using assumptions and global averages in the tools' analyses. Experts consider this to be the SAC's responsibility and recommended including it in the tools' methodology documentation.

2. Use energy grid (e.g. choice of type and process of energy) and water consumption data at factory level in both the Higg MSI and Higg PM assessments, leveraging for example factory specific data from the Higg FEM, to enhance geographical and technological coverage. One expert highlights the importance of improving the data granularity within the Higg FEM.
3. Develop a future looking strategy to improve data quality, ensuring that the information used in the tools is robust and trustworthy.
4. Clearly indicate the dataset's geography in its name, in addition to the metadata, for better transparency and understanding.

Impact assessment

A total of five recommendations were presented, out of which two require further scientific development before implementation. The consensus among the majority of the panel is to fully align the tools with PEF (Product Environmental Footprint) impact categories and to discontinue the use of normalization. Current normalization is set upon the weighted average of most used materials, based on 2016 volumes, within the industry. According to the experts, this methodology uses outdated data and does not take into account the shifts occurring in material usage. While it is crucial to address topics such as microplastics and biodiversity, in LCA analysis over time, experts recognize that greater scientific progress and consensus is needed before their inclusion.

Another recommendation supported by the majority of experts and considered high priority, is to discontinue the current chemistry assessment in both the Higg MSI and Higg PM tools and to immediately fully implement the USEtox methodology instead.

Interpretation

Three key recommendations were put forward, with one of them exceeding the guidance provided by the ISO 14040 & 14044 frameworks. The majority of the panel emphasized the importance of aligning with PEF guidelines, on the condition that PEF will improve data quality. The experts stressed the SAC's increased responsibility for the accuracy and reliability of the results as a means of limiting the potential misuse of data in assessments intended for decision-making. The SAC can facilitate this by offering education, training and guidance on proper usage, and by installing effective control mechanisms (e.g. not allowing inadequate comparisons). Furthermore, the experts also recommend that the SAC requires third-party reviews when disclosing LCA results to external parties. A next step would be to determine which party holds the responsibility for such third-party verifications (SAC, users, etc.).

Conclusion

The expert review has provided valuable insights into the Higg MSI and Higg PM tools; the experts' observations have led to diverse perspectives and nuanced viewpoints on potential actions. This diversity demonstrates the depth of thought and the thoroughness applied during the review process. Experts were not unanimously agreeing on the identified strengths, their suggested recommendations, the tools' alignment with use cases, or the LCA standards. The outcomes of this review serve as a comprehensive and useful list for the SAC's consideration in the further development of the Higg MSI and Higg PM tools.

The experts acknowledged that the Higg MSI and Higg PM tools demonstrate a number of strengths across all four ISO LCA phases to quantify and assess the environmental aspects of materials and products. Some include the recognition that the tools are a good industry initiative to assess environmental impacts of textile, apparel & footwear products and materials. Further, the tools have an impressive amount of data and use

scientifically sound standards. However, the strengths were not unanimously supported by all experts and many aspects where the Higg MSI and Higg PM are not compliant with the ISO 14040 & 14044 standards were captured in the review and translated into recommendations on how to improve the tools (ref. chapter 5).

The main point brought forward by the experts is that it is important that the SAC harnesses the full potential of the Higg MSI by integrating it with the Higg PM and focusing on enhancing data quality. Combined with targeted training and additional resources, this will pave the way for enriching the databases and bolstering the expertise of both the SAC and the tool users.

For the further enhancement of the tools, the experts have also made several more practical recommendations. Examples include the implementation of warnings for users navigating the Higg MSI and Higg PM tools on the platform against inappropriate comparisons, and improved documentation for goal & scope definition of the LCA study.

The extensive list of identified recommendations suggests the SAC take action to improve the tools, while also recognizing the industry-wide challenges for collective acknowledgment and a sector-wide approach. These challenges, such as the complexity of the textile, apparel & footwear industry, data quality and availability issues, and the ongoing scientific progress in areas like microplastics and biodiversity, are significant. The intricacies and limitations of LCAs also add to the complexity of the landscape.

The experts highlight that by adopting the recommendations detailed in this report, the Higg PM's alignment with both internal and B2B use cases will be significantly enriched. The integration of the Higg MSI with the Higg PM can leverage its potential for both internal and B2B scenarios.

All in all, overcoming these hurdles and unlocking the tools' full potential will require industry-wide and cross-sector collaboration. By embracing the recommendations and fostering collaboration and transparency across the entire industry, the SAC can build on the momentum toward a more sustainable and responsible textile, apparel & footwear industry. The dedication to improvement and the openness to collective action sets a promising path for the continuous evolution of these tools, as they aim to contribute to lower environmental impacts and promote sustainable practices in the industry.

SAC's view on next steps

This comprehensive external review reinforces the ongoing evolution of the Higg MSI and Higg PM tools by the Sustainable Apparel Coalition. The review process has generated numerous recommendations, each classified into one of four categories: Operational Adjustment, Methodological Clarification, Methodological Development, and Data Development (ref. chapter 8 Appendix). These categories serve as a roadmap for updates and indicate the required stakeholder engagement for effective implementation. Whether it's working with technology partner Worldly for Operational Adjustments or engaging with academic researchers for Data Developments, SAC is committed to a collaborative approach for refining these tools based on the recommendations provided.

It's noteworthy that many of the recommendations were already on SAC's tool development roadmap, reinforcing the alignment between external feedback and member expert feedback and internal strategies. Further, to maintain transparency and track progress, all review findings and their implementation status will be publicly available on the How to Higg website. This external review builds upon prior internal and external engagement, underlining SAC's commitment to constant improvement and transparency in the pursuit of a more equitable and restorative industry.

SAC will be using the findings and recommendations from this report as input to the Higg MSI and Higg PM development roadmap and strategy. The recommendations have been reviewed in detail and a path forward for each proposed (see table 8), which will be discussed with Product Life Cycle Tools Strategic Council of the SAC, per SAC's established governance structure. The outcome will be a development plan

with series of improvements that will be communicated at SAC's 2023 Annual meeting in Boston on September 25th. We expect the majority of the recommendations to be addressed within approximately one year, with some easier to implement and therefore available earlier (such as methodological clarifications), and others actually dependent on further scientific research availability (such as the microplastics impact assessment).

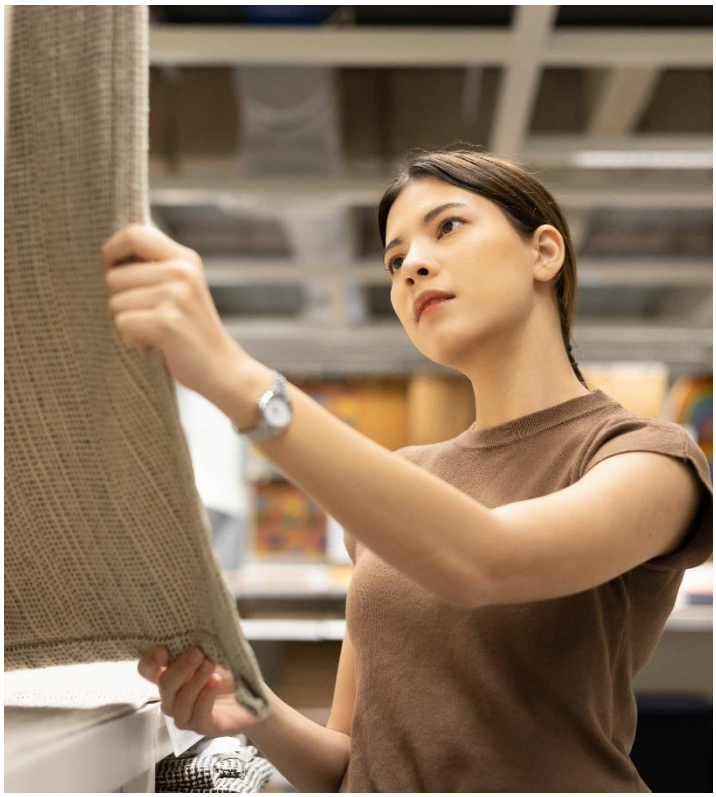
2. About this expert review

The Sustainable Apparel Coalition (SAC) is an alliance for sustainable production within the textile, apparel & footwear industry. Today, the Coalition has more than 280 members, including brands, retailers, manufacturers, academic institutions, and non-profit organizations across the global home textile, apparel & footwear supply chains, and it is central to the SAC's mission to transform businesses for exponential impact.

The SAC is dedicated to tackling pressing environmental and social challenges within the textile, apparel & footwear industry. Over the course of more than ten years, the SAC has worked together with SAC members, consultants, stakeholders, and industry experts to develop the Higg Index tools, which consist of five tools for the standardized measurement of value chain sustainability, and are continuously evolving based on the latest scientific research and data. The tools leverage verified data in order to measure and improve the performance of brands, retailers, and manufacturers. While the tools have made significant progress in methodology and scale in recent years, it has been five years since the last comprehensive review of the Higg Index.

To ensure the continuous improvement of these tools and their ability to drive positive environmental impacts, the SAC has taken a proactive step by commissioning KPMG, an unbiased and objective independent third-party, to facilitate a technical review of the Higg MSI and PM tools with experts. The focus of this review is on the Higg MSI and Higg PM. By involving KPMG as a globally recognized, independent organization, the SAC aims to maintain transparency and credibility in the assessment process. The ultimate goal of this expert review is to identify areas to enhance and develop the tools, helping the industry to effectively address urgent sustainability challenges. By staying committed to the evolution and refinement of the Higg Index, the SAC strives to make a significant and lasting positive impact on the industry and the environment as a whole.

The Higg MSI and PM, in particular, are life cycle assessment (LCA) tools that give insights into the environmental impacts of producing materials and products across five impact categories. The purpose of the MSI and PM tools is to help sustainability analysts and material and product developers to understand the environmental impacts of different production choices when designing a product (while recognizing that LCAs alone are not sufficient to do a comprehensive environmental assessment).



- The Higg MSI is a cradle-to-gate material assessment tool that calculates environmental impacts of materials used in the textile, apparel & footwear industry, such as ready-to-be-assembled textiles, trims, and packaging featured in products. The tool aims to enable design and development teams to identify hotspots and make more sustainable choices during the materials

selection process. The Higg MSI uses peer-reviewed data submitted from the industry and life cycle assessment databases to calculate environmental impacts. The tool measures environmental impact in five areas: global warming, nutrient pollution in water (eutrophication), water scarcity, abiotic resource depletion of fossil fuels, and chemistry. The Higg MSI results are provided individually for each impact category and are displayed in two formats: Life Cycle Impact Analysis (LCIA) units and Higg MSI score. The LCIA units represent the environmental impact for the specific impact category (e.g. kg CO2e with regards to global warming potential). The Higg MSI score, in turn, is based on a linear normalization set upon the weighted average impact of the most used materials within the industry. More information about the Higg MSI can be found on the 'How to Higg' portal[6].

- The Higg PM, in turn, assesses the cradle-to-grave environmental impacts of products made by the textile, apparel & footwear industry. This assessment includes the impacts of the specific materials used in a product, the impacts from finished goods' manufacturing processes, as well as the impacts of logistics (transportation and distribution), use phase, and end of life. The Higg PM integrates Higg MSI outputs to provide a full cradle-to-grave assessment. The Higg PM shares the same five impact categories as the Higg MSI. Higg PM results are provided individually for each impact category and are displayed in terms of LCIA units. The Higg PM aims to help companies understand the environmental performance of their products' portfolio and enable progress on circularity goals. More information about the Higg PM can be found on the 'How to Higg' portal[7].

Objective of the review

The primary objective of the review is to ensure the continuous improvement of the tools by thoroughly assessing their suitability for two specific use cases: internal and B2B use.

1. Internal use: The tools aim to provide users with credible and standardized environmental assessment data to inform their product design and development decisions, as well as material innovation and material development decisions. This data facilitates process benchmarking, better decision-making, and ultimately, drives individual and collective environmental performance improvement within the industry.
2. B2B use: The tools intend to enhance value chain transparency by supporting the sharing of trusted data between different partners in the value chain. This fosters collaboration, reduces duplication, and enables the alignment of methodologies and assumptions across the industry, so users can effectively focus on making use of the data to support informed decision-making for improved environmental performance within the industry.

For these use cases, the review focuses on evaluating whether the tools are fit for purpose in these scenarios, the quality of the data they produce, and their alignment with current Life Cycle Assessment (LCA) standards and best practices.

Throughout the review process, these specific use cases are carefully considered to ensure that the tools effectively address the needs and requirements of both internal users and stakeholders engaging in B2B interactions.

[6] https://howtohigg.org/higg-msi/
[7] https://howtohigg.org/higg-product-module/

Expert selection

The review was conducted by ten experts, facilitated by KPMG. The selection of experts was based on criteria such as expertise, background, geographical presence, and gender. Nine experts are independent from the SAC and one expert is an affiliate member*. This approach ensured a wide range of perspectives and insights.

Overview of selected experts and current roles description

Beckie Ellis
Senior Material Impact Manager, PANGAIA

Donna Chan
Head of Regenerative Impact, The New Zealand Merino Company Limited

Irmeline de Sadeleer
Researcher, Norwegian Institute for Sustainability Research

***Jesse Daystar, PhD**
Vice president, Chief Sustainability Officer Cotton Incorporated, Associate Adjunct Professor, Duke University – *Cotton Incorporated is an affiliate member of the SAC*

Natascha van der Velden, PhD
Independent researcher and consultant in sustainable fashion, PhD Industrial Design Engineering 'Making Fashion Sustainable', Delft University of Technology

Paulien Harmsen
Senior Scientist Biorefinery & Textiles, Wageningen Food & Biobased Research

Priyangi Jayasinghe
Director of Research Sustainable Development, Munasinghe Institute for Development

Quentin Badonnel
Data Manager & Environmental Evaluation Leader, Sustainable development at Decathlon - *Participated as an independent expert*

Reinout Heijungs, PhD
Associate Professor of Operations Analytics, Vrije Universiteit Amsterdam

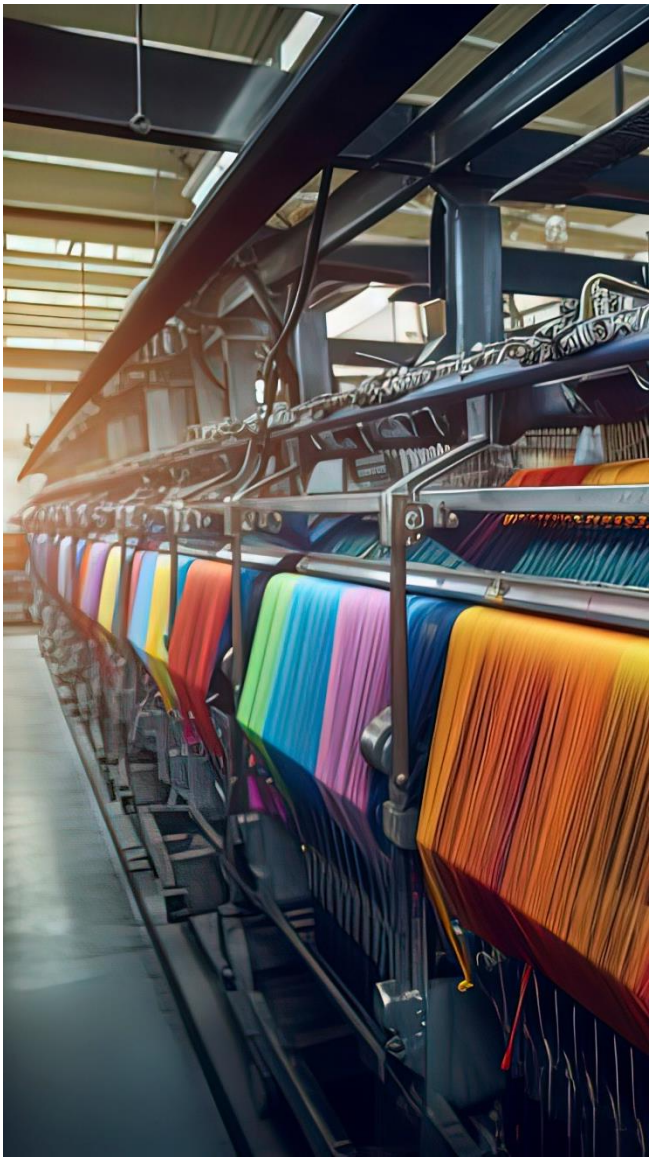
Una Jones
CEO, Sustainable Fibre Alliance

Methodology of the review

The review process was subdivided into the four main LCA phases that are part of the ISO 14040 & 14044 Life Cycle Assessment (LCA) framework, which offers quantitative methods and guidelines for assessing the environmental aspects of products or services throughout their life-cycle stages.

To conduct the review, the experts were granted access to various essential resources, including the Higg MSI and Higg PM methodology documents, Worldly platform, SAC training materials, and the 'How to Higg' websites. Additionally, they had the opportunity to engage in Q&A sessions with the tools' director, further enhancing their understanding.
The review was performed during approximately 12 weeks and consisted of the following 4 phases:

1. Expert review of relevant documentation and information on the Higg PM and Higg MSI tools, complemented by Q&A sessions with the tools' director (SAC).
2. Initial expert findings collection and consolidation through analysis of the expert's questionnaire answers, complemented by one-on-one expert sessions for further understanding and for the exploration of relevant topics not covered by the questionnaire. Based on the findings and these one-on-one sessions, an initial list of recommendations was drafted by the KPMG team.
3. Recommendation refinement through expert discussions, Q&A and feedback sessions – Expert discussion sessions were held to evaluate different recommendations made in phase 2. Further, the priority level and extent of agreement on recommendations were collected through additional questionnaires and feedback moments. Additional Q&A sessions with the SAC team were held for further clarification and understanding of the tools. Next, additional expert discussion sessions were held to reach final recommendations for the tools amongst the experts. During this phase, the tools' use cases and strengths ("what the tools do well') were also assessed.
4. The final review report on the Higg MSI and PM tools was developed and shared by KPMG with the experts, allowing for a final round of feedback.



The outcomes of the review are presented in three sections within the report: general observations, expert feedback, and expert recommendations per phase of the ISO 14040 & 14044 framework. This clear organization ensures that the report effectively conveys both the overall observations and the detailed proposals for advancing the tools' effectiveness.

Moreover, the experts' insights and recommendations were consistently clustered across the report according to the extent of agreement amongst the 10 interviewed experts:

70 to 100%
expert support
Majority of experts

40 to 69%
expert support
Approximately half of experts

10%* to 39%
expert support
Minority of experts

*Minimum one expert (i.e. 10%) agreeing with the recommendation.

3. General observations

For a fair interpretation, it is important to view the outcomes of this expert panel review in the broader context of the textile, apparel & footwear industry.
The SAC has developed, and promotes large-scale use of, these tools in a context in which many challenges need to be addressed simultaneously to drive sustainability. Currently, approximately 21,000 organizations are using the Higg suite of tools.

The industry challenges that users of the tools face include supply chain complexity, product quality issues, low margins, the lack of good data, and the need for further academic research in areas such as the impact of materials and products on biodiversity, and the environmental impacts of microplastics. Within this context, the Higg MSI and PM tools aim to drive increased environmental understanding and positive change within the textile, apparel & footwear industry on a product and material level.

KPMG facilitated the expert panel review of the Higg MSI and PM tools by collecting experts' input through various questionnaires, one-on-one sessions, and expert panel discussions. In addition, experts were given the opportunity to further deepen and nuance their understanding and assessment of the tools through Q&A sessions with the tools' director. Lack of alignment across experts was observed throughout the review and is reflected in the feedback, listed recommendations, strengths of the tools, use cases and alignment with ISO 14040 & 14044 standards. It became clear to us that the selected experts have divergent views on how to practically apply LCA methodology in the above-mentioned business context and could not provide solutions for all identified areas for improvement in the current tools or identify available industry tools that have already incorporated the suggested improvements.

A lack of unanimous alignment across experts was clearly observed in regard to data availability and quality. Although experts generally agree that using more granular data will provide improved insights, they diverge in opinions and recommendations on the balance between using available, imperfect data and assumptions for practical insights with the need for more granular data levels (e.g. product, material, geography-specific) to approach real scenarios, which are not yet widely available.

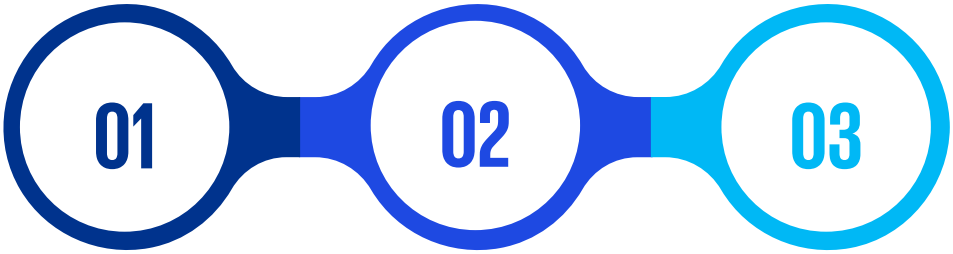
In addition, many conversations were held about the need for appropriate levels of (LCA) knowledge when navigating the tools, to ensure correct use and interpretation of results. The users require an appropriate level of LCA knowledge as a condition to enable the Higg PM use cases.

Moreover, the need to expand impact areas within the tools was recommended by the experts. They do recognize that some of the impacts areas (e.g. biodiversity, microplastics, etc.) can be included over time as substantial research and scientific progress and consensus is still required. Further, they also acknowledged that LCAs have limitations to account for all impacts of materials and products and to address all required changes within the textile, apparel & footwear industry.

Collaboration across and beyond the industry, fostered by partnerships at all stages of the value chain, is therefore crucial to further advance the industry towards the required changes and to ensure the evolvement of tools such as the Higg MSI and Higg PM.

4. Expert feedback

The goal of the Higg MSI and Higg PM review was to offer recommendations that can be integrated in the Higg Index continuous improvement roadmap, and to suggest clear actions in support of SAC's commitment to a more sustainable textile, apparel & footwear industry. In addition to collecting comprehensive recommendations (ref. chapter 5) and to provide a full overview of the Higg MSI and Higg PM, experts were asked to provide feedback with regards to questions such as:



What are the Higg MSI and Higg PM doing well?

Are the tools fit for internal and B2B use?

Do the Higg MSI and Higg PM align with ISO standards?

4.1 What are the Higg MSI and Higg PM doing well?

While the expert review focused on the further evolution of the tools, the experts were also asked what the tools are currently doing well. Through questionnaires, each expert individually identified a number of strengths of both tools per ISO 14040 & 14044 phase (goal and scope definition, inventory analysis, impact assessment and interpretation). Subsequently, the experts also reviewed and discussed the strengths that were identified by other experts in panel discussions.

The experts acknowledged that the Higg MSI and Higg PM demonstrate strengths across all four ISO LCA phases to quantify and assess the environmental aspects of materials and products. It is important to point out that the experts did not reach a consensus on all highlighted strengths of the Higg MSI and Higg PM tools. As a result, some identified strengths required further nuancing with references to the recommendations of chapter 5 whenever applicable. For full transparency, these nuances are captured next to their respective strengths in the "comments" column of the table 1. The comments are clustered according to the extent of agreement (majority, approximately half, and minority) as defined in "methodology of the review" in chapter 2.

It is recommended that the tools' strengths are reviewed together with the specific expert recommendations in chapter 5. Although the tools currently demonstrate strengths across all four ISO phases, the experts emphasize identified recommendations for the further development of the tools.

Table 1: Overview of identified strengths of the Higg MSI tool per ISO LCA phase

ISO LCA Phase	Strengths of the Higg MSI tool	Comments
Goal & Scope definition	Description of goal in the methodology guide is an adequate initial step	A majority of experts stated that the description can be further improved as suggested in recommendation R.GS.4
	Intention to provide brands, designers, and manufacturers with a tool to measure and quantify the environmental impacts of their materials	A minority of experts do not agree with the statement and believe the data quality and granularity should first be improved
	Wide range of data to evaluate apparel and footwear production steps (except geographical differentiation)	• A minority of experts partly agree with the quoted strength and suggest communicating an overview of unavailable data within the tool to facilitate selection of the right proxies • Approximately half of the experts do not agree with statement and believe the data quality should be improved in terms of geographical coverage and technology coverage
	Accessible material impact modeling, allowing certain roles within businesses to make more informed decisions on product design	• A majority of experts recommend that Higg MSI should be integrated into the Higg PM (recommendation R.GS.3) • A minority of experts stated in particular that Higg MSI could lead to wrong decisions due to the lack of a good functional unit definition
	Flowcharts provided for various materials in the methodology	• The flowcharts currently presented on the Higg MSI methodology are addressing processes to transform a raw material to a textile material (cradle-to-gate) • Recommendation R.GS.8 requests a more detailed flowchart scoping all the processes, cradle-to-grave, to produce an apparel and footwear product including their inputs, outputs, etc. (applicable for Higg PM)
Inventory Analysis	Relevant data gathering for bill of materials	A minority of experts partly suggest the requirement to provide location of production steps to improve the tool
	Impressive amount of data gathered	A majority of experts recommend data to be improved as suggested in recommendation R.IV.4

ISO LCA Phase	Strengths of the Higg MSI tool	Comments
	Comprehensive coverage and options for better data input if necessary/available	A minority of experts do not agree with "comprehensive coverage" as suggested by the strength. Experts mentioned better geographical and processes technology coverage as examples on how data coverage can be improved
	Gatekeeper and Data Manager in place to ensure data quality	Approximately half of the experts highlighted that more resources (Gatekeepers and Data Managers) should be allocated to ensure data quality for improved decision-making over a wide range of different material sources
	Broad range of materials and inventory factors taken into account	A minority of experts find the inventory factors weak when compared to the real world
	Emphasis on the upstream perspective of the materials	-
	User interface to implement the production process of a material is well designed	-
	Example materials and video training and tutorials to help users use the platform	Recommendation R.IP.3 describes how trainings and guidance can be further improved to ensure the tools' results are interpreted fairly and credibly
Impact assessment	Individual impact of each selected dataset is useful to compare impact of different production steps for the same material	A minority of experts do not agree with the statement and suggest that data quality and granularity should first be improved and that boundaries of comparable production steps should be proven to match
	Useful rating tool examining multiple indicators to provide an environmental index	A majority of the experts do not agree with the statement as the normalization is suggested to be discontinued according to recommendation R.IM.5
	Use of scientifically-sound standards, using a (broadly) science-driven approach	A majority of experts have highlighted concerns with regards to using the tool for comparisons and the normalization methodology
	Accessibility of large datasets to a wider audience	A minority of experts question the tools accessibility as they are not available for free and shared concerns regarding the data quality

ISO LCA Phase	Strengths of the Higg MSI tool	Comments
	Inclusion of some of the most important impact categories for the description of the industry's impacts, thus well selected to describe apparel and footwear stakes	Majority of the experts believe the impact categories should be expanded as recommended by recommendation R.IM.1
Interpretation	User-friendliness of the tool, and the possibility to deep-dive into the data with a clear view on the various impacts which enables designers to anticipate the environmental impact of a material or a production process change	-
	Clear presentation of tool outcomes with overview of some environmental impacts, which is helpful when analyzing the materials that are in use	-
	Readily-available educational material and documentation for users, aiming to make impact metrics more accessible	Recommendation R.IP.3 describes how trainings and guidance can be further improved to ensure the tools' results are interpreted fairly and credibly
	Quick benchmark for understanding impacts of materials	-

Table 2: Overview of identified strengths of the Higg PM tool per ISO LCA phase

ISO LCA Phase	Strengths of the Higg MSI tool	Comments
Goal & Scope definition	Description of goal in the methodology guide is an adequate initial step	A majority of experts highlighted that the goal description can be further improved as suggested in recommendation R.GS.5
	Coverage of main life cycle phases of the apparel and footwear products	Recommendation R.GS.11 suggests to integrate an additional lifecycle step within the tool
	Good industry initiative for assessment of (a selection of) the environmental impacts of textile products	A minority of experts do not agree with the statement and suggest that data quality and granularity should first be improved
	Accessibility for modeling apparel and footwear product impacts	-
	Detailed insights by deploying a cradle-to-grave study	A minority of experts do not agree with the statement and suggest that data quality and granularity should first be improved
	Comprehensive definition of the functional unit which includes the lifetime and quality of the product being assessed	A minority of experts share the opinion that the functional unit should be more detailed
Inventory Analysis	Data on most of the important stages of the life cycle, emphasizing upstream and downstream perspective of products and allowing to input better data if necessary/available	A minority of experts do not agree with the statement and suggest that data quality and granularity should first be improved
	Large inventory database which can be easily found and verified	• A minority of experts do not agree with the statement and suggest that data quality and granularity should first be improved. In addition, it was questioned how easily third-party data can be verified • A minority of experts do not agree with the statement as datasets used in the bill of materials (from Higg MSI) lack transparency
	Recognized continuous evolution of data with ambition to update system accordingly	A majority of experts recommend the SAC to better communicate its strategy to improve data quality as recommended in R.IV.4
	Guided explanations for evaluations when entering activity data, has good library management for previous evaluations	Recommendation R.IP.3 describes how trainings and guidance can be improved to ensure the tools' results are interpreted fairly and credibly
	Distinct product care scenarios depending on the product and fabric (except footwear)	Recommendation R.IV.5 describes the need to regionalize product care scenarios for further improvement

ISO LCA Phase	Strengths of the Higg MSI tool	Comments
	Inclusion of trims and additional components used for producing a garment	-
Impact assessment	Use of scientifically-sound standards, commonly accepted LCIA methodologies, and includes some of the most important impact categories (beyond global warming potential) to assess apparel and footwear products, thus well selected to describe apparel and footwear stakes	• Recommendation R.IM.1 suggests to expand the number of impact categories to capture a more comprehensive set of environmental impact areas • Recommendation R.IV.5 describes the need to regionalize product care scenarios for further improvement
	Accessibility of LCA approach to a wider audience	-
Interpretation	Attempt to capture the whole set of materials and production technologies comprising a highly complex sector	A minority of experts pointed out that not all production technologies are covered yet
	User-friendliness of the tool, and the possibility to deep-dive into the data and have a view per impact category across lifecycle stages is useful, as well as the 'plus' button which enables a deeper look at each stages' impacts	-
	Unparalleled product insights, which could be one of the few options for brands to use to comply with upcoming PEF	A minority of experts noted that recommendations should be implemented in order to comply with PEF
	Overview of well-presented impact assessment results per lifecycle stage, leading to powerful insights on environmental impacts of apparel and footwear products	A minority of experts do not agree with the statement and suggest that data quality and granularity should first be improved
	Option of a 'per use' or an absolute impact perspective (depending on the purpose)	-
	Helpful final review and confirm view for last check on set-up of evaluation	-
	Readily-available educational material and documentation for users, aiming to make impact metrics more accessible	Recommendation R.IP.3 describes how trainings and guidance can be improved to ensure the tools' results are interpreted fairly and credibly

4.2 Are the tools fit for internal and B2B use?

Experts assessed whether the Higg MSI and Higg PM tools are fit for internal and B2B use through questionnaires, one-on-one expert sessions, and expert panel discussions.

The internal and B2B use cases are defined by the SAC as:

- Internal use: The tools aim to provide users with credible and standardized environmental assessment data to inform their product design and development decisions, as well as material innovation and material development decisions. This data facilitates process benchmarking, better decision-making, and ultimately, drives individual and collective environmental performance improvement within the industry.
- B2B use: The tools intend to enhance value chain transparency by supporting the sharing of trusted data between different partners in the value chain. This fosters collaboration, reduces duplication, and enables the alignment of methodologies and assumptions across the industry, so users can effectively focus on making use of the data to support informed decision-making for improved environmental performance within the industry.

It is important to highlight that the B2C use case, which aims to provide performance insights for consumers, has been excluded for this review given this is not an actual use case of the Higg MSI and Higg PM tools. Regulators are required to give more guidance on how LCA-based tools may or may not be appropriately used for B2C use cases.

Overall, the experts did not reach (unanimous) consensus on whether the tools are fit for internal and B2B use. Insights regarding both use cases were clustered according to the extent of agreement (majority, approximately half, and minority) as defined in “methodology of the review” of chapter 2.

Internal use case

Higg MSI

The majority of experts recognize the synergistic value of integrating the Higg MSI within the Higg PM framework, as the Higg PM adopts a comprehensive approach, encompassing a cradle-to-grave perspective, which enriches the insights provided to users. According to the majority of the experts, the use of the Higg MSI as a stand-alone tool could be prone to misinterpretation given the lack of proper functional unit definition and uncertainties related to study boundaries and allocation procedures. A minority of experts recognize the potential of the Higg MSI in guiding design decisions within the same material category. Designers and brands can use the tool to measure and quantify the environmental impacts of their materials processes.

Higg PM

Approximately half of the experts believe the Higg PM tool is suitable for internal use when users have the right understanding of topics such as LCA methodology, data assumptions, and tool limitations. The current users of the Higg PM are largely product designers and likely do not have proper education and qualifications to meet the above criteria. Experts who do not consider the tool as fit for internal use yet believe there is potential to enhance the tool's suitability by focusing on data quality enhancements. Individual experts emphasized incorporating specific geographical energy and water considerations as a must-have for the tool to be fit for internal use, and that a large part of the data used is not as granular as it should be. One expert also mentioned that system boundary differences can be a barrier to better internal environmental decision-making. An additional comment was that the Higg PM data should better reflect the reality of actual facilities. For example, technical details such as energy sources, factory details, and agricultural details are important to be reflected within the data and on a granular level. The experts who

shared the above-mentioned concerns and improvement points believe the Higg PM tool would be more fit once the recommendations of this expert panel are addressed.

Business-To-Business (B2B) use case

Higg MSI

Echoing the internal use case, the majority of experts recognize the synergistic value of integrating the Higg MSI within the Higg PM framework, as the Higg PM adopts a comprehensive approach, encompassing a cradle-to-grave perspective, which enriches the insights provided to users. As a result, potential uncertainties associated with study boundaries and allocation procedures are reduced. A minority of experts recognize the potential of the Higg MSI in guiding design decisions.

Higg PM

Approximately half of the experts agreed that the Higg PM tool is fit for B2B use, provided that the user is informed and educated about appropriate use of results, and there is maximum transparency on the origin, volume, and background of data (incl. methodology) used within the tool. In contemplation of informed and better educated users, it is suggested to SAC to provide trainings and better guidance on what tool can be used and not used for. According to one expert, the prerequisite for the tool to be fit for B2B use is that value chain partners need to be willing to share background data and results.

It was pointed out that the Higg PM tool can be used to find hot spots within the same material source and across different lifecycle stages of a textile product. Strategies can be developed from current results to define where specific data should be gathered. In addition, the B2B use case can support the improvement of general data quality within the sector.

Experts who do not agree that the Higg PM is fit for internal use referred to recommendations in chapter 5 as enablers for the Higg PM B2B use case. Experts pointed to the need of third-party verification (ref. chapter 5, recommendation R.IP.2) and improved data type II transparency to better fit the B2B use case. If transparency on this is not improved, it is suggested to remove data type II submission options. Related to the latter, one expert noted that not allowing data type II submission will hinder the B2B use case.

4.3 Do the tools align with ISO standards?

Experts reviewed and completed extensive questionnaires to assess the tools' alignment with ISO 14040 and 14044 standards. The findings from these questionnaires were then broadly discussed within expert panel sessions and one-on-one sessions. Following the outcomes from the questionnaires and expert panel discussions, the experts are divided on whether the tools are currently fully in line with the ISO 14040 and 14044 standards. Experts identified both areas of alignment and areas where there was no alignment with ISO 14040 & 14044 standards.

The majority of experts acknowledged that the tools are in alignment with ISO standards on following topics:

Higg MSI

Inventory analysis

- The Higg MSI scope of exclusions is in line with the ISO standards, although topics such as end-of-use (e.g. differentiating landfill and incineration according to the material being processed) should provide a sensitivity analysis to support the exclusion decision (refer to recommendation R.IV.1 in chapter 5).
- Higg MSI covers the most frequently used materials and processes used in the textile, apparel & footwear industry.

Impact assessment

- Displaying biogenic carbon as an independent inventory metric instead of subtracting biogenic carbon from the Higg MSI Global Warming Potential assessment.

Higg PM

Goal & scope definition

- The Higg PM functional unit covers all aspects of products' performance characteristics as stated by the ISO standards. Additionally, a per use functional unit encourages design decisions that would improve lifetime extensions and therefore potentially reduce impacts in the long term. However, recommendation R.GS.6 requests a clear "per use" description.

Inventory analysis

- Most of the Higg PM data assumptions, with the option to override if primary data is available, are in line with the ISO standards. For assumptions on energy mix, water scarcity, and product care scenarios refer to recommendation R.IV.2 in chapter 5.
- Using standardized care scenarios based on consumers' behavior to address Higg PM product care lifecycle is supported by the ISO standards.
- The Higg PM scope of exclusions is in line with the ISO standards. Although topics such as end-of-use (e.g. differentiating landfill and incineration according to the material being processed), product care for footwear, and customer travel should provide a sensitivity analysis to support the exclusion decision (refer to recommendation R.IV.1 in chapter 5).
- Higg PM covers the most frequently used materials and processes used in the textile, apparel & footwear industry sector.

Impact assessment

- Displaying biogenic carbon as an independent inventory metric instead of subtracting biogenic carbon from the Higg PM Global Warming Potential assessment.

It should be noted that the Higg MSI goal & scope definition and interpretation phases as well as the Higg PM interpretation phase presented topics considered in line with the ISO 14040 and 14044 standards. However, these topics did not receive the majority support from the experts and therefore are not listed above.

The topics where the majority of experts acknowledge no alignments with the ISO 14040 and 14044 standards are extensively discussed in chapter 5 to properly reflect their importance. Readers are strongly advised to consult these in chapter 5.

5. Expert recommendations per ISO 14040 & 14044 phase

This report offers valuable recommendations to enhance the Higg MSI and Higg PM tools. These are the result of numerous questionnaires, Q&A sessions with tools' director, one-on-one discussions with experts, and expert panel discussions over the course of approximately three months. In addition, multiple feedback sessions and opportunities for engagement occurred during the process of writing numerous iterations of the review report.

The recommendations are classified based on the phases of ISO 14040 & 14044 (goal and scope definition, inventory analysis, impact assessment, and interpretation) and categorized according to the overall experts' extent of agreement on recommendations and priority level based on the following two dimensions:

Extent of agreement on recommendations

Expert recommendations are clustered based on the extent of agreement for these amongst the 10 interviewed experts (consistent with definition at "methodology of the review" in chapter 2)

70 to 100% expert support	40 to 69% expert support	10%* to 39% expert support
Majority of experts	**Approximately half of experts**	**Minority of experts**

*Minimum one expert (i.e. 10%) agreeing with the recommendation.

Priority level of recommendations

Recommendations are clustered based on average priority level assigned by the experts on a scale of 0 (none) to 5 (highest) in following categories:

High priority	Medium priority	Lower priority
Average priority greater or equal to 4 ($x \geq 4$)	Average priority less than 4 but greater or equal to 2 ($2 \leq x < 4$)	Average priority less than 2 ($x < 2$)

The report also provides insights into certain recommendations that transcend the ISO 14040 & 14044 framework (highlighted as "beyond ISO guidance"). In addition, the report identified some recommendations which are deemed strictly relevant for future consideration (highlighted as "for future consideration"), as there is currently a lack of available methodologies to incorporate them effectively into LCA studies. The report suggests monitoring scientific progress in these areas and incorporating relevant recommendations once widely accepted methodologies become available.

It is essential to note that the experts' findings were diverse, leading to varying levels of support for different recommendations. Thus, not all recommendations were fully endorsed by the entire panel of experts.

Despite the major recommendation to integrate the Higg MSI into the Higg PM (R.GS.3), this review report still provides recommendations on how the Higg MSI should be improved. This in order to enable further improvements to the Higg MSI.

5.1 Goals & scope definition

The review generated a total of 11 recommendations, of which three go beyond the ISO 14040 & 14044 frameworks. Although experts did not unanimously support each listed recommendation and assigned varying priority levels, 10 recommendations did receive majority support from the experts. One key recommendation from the expert panel is to integrate the Higg MSI into the Higg PM.

Table 3: Overview of recommendations addressing the ISO phase Goal & Scope definition

Recomm-endation number	Recommendation summary	SAC reference	ISO standard	Beyond ISO guidance	For future considera-tion	Extent of agreement	Priority Level
R.GS.1	The Higg MSI and Higg PM should implement warnings where comparisons should not be performed	-	-	Yes	-	Majority	High
R.GS.2	Allocation procedures should be more transparent and uncertainty analysis should be provided regarding impacts of chosen procedures	Allocation procedures are provided at the Higg platform	ISO 14044 / section 4.3.4	-	-	Majority	High
R.GS.3	Higg MSI should be integrated into the Higg PM	Higg MSI methodology / page 4	ISO 14044 / section 4.2	-	-	Majority	High
R.GS.4	Higg MSI goal should be better described	Higg MSI methodology / page 4	ISO 14044 / section 4.2	-	-	Majority	Medium
R.GS.5	Higg PM goal should be better described	Higg PM methodology / pages 5-7	ISO 14044 / section 4.2	-	-	Majority	High
R.GS.6	Higg PM should better describe the expected level of quality (“how well”) and the lifetime of the product (“how long”) in its functional unit definition, as well as provide a per use definition	Higg PM methodology / page 9	ISO 14044 / section 4.2.3.2	-	-	Approx. half	Medium
R.GS.7	The term “overhead” within the scope of exclusions should be better explained	Higg PM methodology / page 11	ISO 14044 / section 4.2.3.3.1	-	-	Majority	Medium

Recomm-endation number	Recommendation summary	SAC reference	ISO standard	Beyond ISO guidance	For future considera-tion	Extent of agreement	Priority Level
R.GS.8	The tools should provide a process flow diagram representing the system boundaries of your study as suggested by the ISO standards	-	ISO 14044 / section 4.2.3.3.1	-	-	Majority	High
R.GS.9	Materials taxonomy should be more consistent	Higg MSI methodology / page 5	-	Yes	-	Majority	Medium
R.GS.10	The leather alternative production phase should include more steps	Higg MSI methodology / page 6	ISO 14044 / section 4.2.3.3.1	-	-	Majority	Medium
R.GS.11	A new lifecycle step should be included in Higg PM to differentiate reuse and recycle from end-of-use	-	-	Yes	-	Majority	Medium

Recommendation supported by the majority of experts

High priority

R.GS.1 The Higg MSI and Higg PM should implement warnings where comparisons should not be performed. According to the experts, the tools could facilitate comparisons between (different) materials and/or products when it should not be allowed. Comparisons should only be made where functional unit, boundaries, assumptions, allocation and factory specific details are consistent. It is important to note that these concerns are mainly with regards to comparing (different) materials using the Higg MSI. Comparisons for Higg PM products should only be allowed if they have the same function and when LCAs are comparable.

- One expert added that comparisons should not be performed at all unless the exact same data set parameters are used for the range of products being compared

Examples of what should not be allowed in the tools include but are not limited to:

(a) Presenting different materials sources and their impact assessments side-by-side as currently possible for example materials (especially for different material types or compositions, e.g. comparing cotton to polyester). One expert added that all possible boundaries (incl. technical details) should be considered to inform, through warnings, whether comparisons between virgin and recycled materials are allowed.

(b) Selecting different material compositions (cotton and polyester) and using the “compare” feature within the Higg MSI tool

R.GS.2 Allocation procedures should be more transparent and uncertainty analysis should be provided regarding impacts of chosen procedures. Comparing materials with different allocation methods can introduce uncertainty in the assessment and impair meaningful conclusions. It is recommended for the SAC to provide more clarity on assumptions made and how they affect final results to avoid end users’ potential misinterpretation.

- One expert suggested that, due to uncertainties, the results should be provided as a range rather than a single, absolute value result

R.GS.3 The Higg MSI should be integrated into the Higg PM. Experts suggest that by utilizing the functional unit from Higg PM, the tool's insights can be enhanced and optimized. The experts argue that the Higg MSI, used as a stand-alone tool and incorrectly, could be prone to misinterpretation as the tool does not integrate a proper functional unit definition, as “per kg” is currently used but has clear limitations. For example, a certain material “A” could have a lower environmental impact per kg than another material “B”. However, material “A” could require more weight than material “B” to deploy the same function, potentially leading to higher impacts if material “A” is selected instead of material “B”. This example illustrates how the Higg MSI could be prone to misinterpretation due to its functional unit. In addition, the experts highlighted uncertainties due to the Higg MSI boundaries and allocation procedures to further support the recommendation. Experts shared their concerns in using the Higg MSI for both internal and B2B use cases. The Higg PM tool is considered to be much more holistic as it defines a cradle-to-grave approach with a satisfactory functional unit definition.

- However, a minor part of the experts did believe that the Higg MSI can be a relevant stand-alone tool and can provide important insights and results. These experts recommended that the Higg MSI should provide a clear and strong framework guiding what the tool can be and cannot be used for.
- Another expert highlighted that using the Higg MSI only as part of the Higg PM does not make the tools better as Higg MSI’s data quality issues will be carried over to the Higg PM.

R.GS.5 The Higg PM goal should be better described. The SAC should differentiate the Higg PM goals from the goals of an LCA study performed with the tool. The Higg PM is not a LCA study itself but a tool that is based on LCA methodology and thus supports LCA studies. Additionally, it should be stated that the tool’s results are not representative of real scenarios due to the use of assumptions and averages within LCA methodology.

R.GS.8 The Higg MSI and Higg PM should provide a process flow diagram representing the system boundaries of the study being performed as suggested by the ISO standards. Currently, the Higg MSI provides a high-level flow diagram regarding materials’ processes in a cradle-to-gate perspective within the tool’s documentation. The experts recommend having a more detailed version displaying aspects such as waste treatment of upstream processes and product care assumptions (e.g. ironing). In addition, the process flow diagram should be expanded to Higg PM boundaries and, therefore, represent a cradle-to-grave perspective. The diagram will improve transparency over system boundaries and will help end users make better decisions. The information to be included in the flow chart should balance the level of detail with user-friendliness and be directed at the intended audience (designers). It can be made up of high-level information and/or aggregation of the main processes, with an expert suggesting to have the option to drill down for more levels of detail. Another expert suggested that dedicated experts per material type or process could decide what should be included in the flow charts.

Medium priority

R.GS.4 The Higg MSI goal should be better described. The Higg MSI should differentiate the Higg MSI goals from the goals of LCA studies performed with the tool. The goal should clearly state if the tool is intended for comparative assertions or intended to be disclosed to the public as recommended by ISO 14040 & 14044 standards. The goal should define material as “materials used in textile” and state that the tool's results are not representative of real scenarios due to the use of assumptions and averages within LCA methodology.

R.GS.7 The term "overhead" within the scope of exclusions should be better explained in the Higg MSI and Higg PM documentation. It is not clear what “overhead” means throughout the tools’ methodology. The ISO standards state that any decisions to omit life cycle stages, processes, inputs or outputs should be clearly

stated. In some sectors, overhead includes commercial activities which can derive substantial environmental impacts (e.g. automotive industry sponsoring the Formula One competition).

R.GS.9 Materials taxonomy should be more consistent. The material's taxonomy in the Higg MSI is perceived to present inconsistencies such as:

(a) Some materials have their unique taxonomy (e.g. alternative leather) versus larger grouping under textiles.

(b) Some categories are based on their resource (e.g. leather, metals, wood-based materials), while others are based on their application (e.g. textiles, coating, insulation, foam).

The suggestion is to opt for material categories based on the resource type such as natural (e.g. plants, animals, fungi, microorganisms), fossil, etc.

In this way, system boundaries can be more easily defined, and the system can be adapted for (future) bio-based alternatives.

- It is important to note that a minority of experts did not identify inconsistencies with the current taxonomy and would not support the recommendation as it does not improve usability or the outcomes of the study.

R.GS.10 The leather alternative production phase should include more steps. The leather alternative is represented in the Higg MSI methodology with only one production phase, i.e. raw material source. More production phases should be displayed to provide a better assessment of such materials such as raw material processing and finished material processing. However, the experts also acknowledge that it can be challenging as leather alternatives are very broad and thus difficult to cluster in similar steps.

R.GS.11 A new lifecycle step should be included in Higg PM to differentiate reuse from end-of-use. Recycling and reuse should not be in the same lifecycle stage as they have substantial differences. With recycling, a textile, apparel, or footwear product reaches the end-of-use; for reuse, the product retains its function and main characteristics. Therefore, a new lifecycle step should be added before the end-of-use. This should be included to reflect reuse, repair, etc., as these processes will become more important in the near future and will enhance the tools' analyses.

- A minority of experts do not agree with the recommendation as they argue that reuse and recycling is already considered in the tool despite of the lifecycle name used.

Recommendation supported by approximately half of experts

Medium priority

R.GS.6 The Higg PM should better describe the expected level of quality ("how well") and the lifetime of the product ("how long") in its functional unit definition, as well as, provide a per use definition. According to experts, the Higg PM definition of "How long" and "How well" does not reflect the consumer behaviour within the sector. Usually, products achieve their end of life well before reaching the Higg PM described expected level of quality ("Wear in good condition with appropriate use for the given product"). However, it is acknowledged that the tool properly implements consumer behaviours characteristics in its calculation. Therefore, this recommendation addresses how the functional unit is describe in the Higg PM methodology and does not address how the tool implements a product end of life, the latter is considered adequate by the experts.

Additionally, the Higg PM should better define what "per use" means. Per use could be interpreted as the number of times the garment is washed, or the number of days the garment was used, etc. Experts recommended to define per use as of a time period unit (e.g. hours)

- One expert shared an additional concern with regards to implementing consumer behavior in the tool. In the expert opinion, the scenarios captured from consumers' questionnaire should be validated with real life data to balance intention and reality. The expert referred to the rebound effect[8] to illustrate potential disconnections between intention and reality

5.2 Inventory analysis

A total of nine recommendations were provided during the review process, with three of them extending beyond the ISO 14040 & 14044 frameworks. It is important to note that experts did not unanimously support the listed recommendations for this ISO phase and assigned varying priority levels to each one. Seven out of the nine identified recommendations were agreed upon by the majority of experts. The primary focus of the recommendations is to enhance the data quality of the tools, particularly by addressing geographical coverage issues related to the energy grid, water consumption, and product care assumptions. Additionally, the need for a data quality strategy was emphasized to ensure reliable and accurate information. One expert recommended that the SAC become more transparent in its strategy and the improvement journey ahead.

Table 4: Overview of recommendations addressing the ISO phase Inventory analysis

Recomm-endation number	Recommendation summary	SAC reference	ISO standard	Beyond ISO guidance	For future considera-tion	Extent of agreement	Priority Level
R.IV.1	The Higg MSI and Higg PM should provide sensitivity analysis to support the claims for using assumptions and global averages	-	ISO 14044 / section 4.2.3.6	-	-	Majority	High
R.IV.2	Higg MSI and Higg PM analyses should use energy grid and water consumption in the factory level geography to improve the geographical coverage data quality requirement	Higg PM methodology / page 14	ISO 14044 / section 4.2.3.6	-	-	Majority	High
R.IV.3	The Higg MSI and Higg PM should apply the cut-off criteria based on a combination of mass, energy, and environmental significance	-	ISO 14044 / section 4.2.3.3.3	-	-	Majority	Medium
R.IV.4	The SAC should define a strategy to improve data quality	-	-	Yes	-	Majority	High

[8] An example of the rebound effect would be the driver who replaces a car with a fuel-efficient model, only to take advantage of its cheaper running costs to drive further and more often. Extracted from: Druckman, A., M. Chitnis, S. Sorrell and T. Jackson (2011). "Missing carbon reductions? Exploring rebound and backfire effects in UK households " Energy Policy 39: 3572–3581.

Recomm-endation number	Recommendation summary	SAC reference	ISO standard	Beyond ISO guidance	For future considera-tion	Extent of agreement	Priority Level
R.IV.5	Product care assumptions should be regionalized	Higg PM methodology / pages 20-29	ISO 14044 / section 4.2.3.6	-	-	Majority	Medium
R.IV.6	Lifetime extension (at duration of service and end-of-use pathways) should not be included in LCA assessment, but it should be an additional feature where end users can test different scenarios and analyze potential impacts	Higg PM methodology / pages 30-41	-	Yes	-	Minority	Medium
R.IV.7	The geography of the dataset should be shown in the name of the dataset, and not only as part of the metadata	-	-	Yes	-	Majority	High
R.IV.8	The Higg MSI and Higg PM should use specific factory data from the facility module (Higg FEM) to improve the geographical coverage and technology coverage data quality requirement	-	ISO 14044 / section 4.2.3.6	-	-	Majority	High
R.IV.9	MSI contributor should not consider data type II submission in order to improve data quality	Higg MSI methodology / appendix B	ISO 14044 / section 4.2.3.6	-	-	Approx. half	Medium

Recommendation supported by the majority of experts

High priority

R.IV.1 The Higg MSI and Higg PM should provide sensitivity analysis to support the claims for using assumptions and global averages. Assumptions and global averages are expected to occur within LCA analysis and it is important that users are aware of such assumptions for correct interpretation. However, the use of assumptions and global averages should only be applied when the final results are not highly influenced by them. Additionally, providing sensitivity analysis is required to align with the ISO standards. In case the sensitivity analysis indicates high relevance for specific assumptions, the Higg MSI and Higg PM should request mandatory primary data. Sensitivity analysis should be added to the tools' methodology for critical aspects where assumptions were taken or a study should be referenced to substantiate the decision. Beyond implementing sensitivity analysis within the Higg MSI and Higg PM methodology, one expert said that it is useful for the user to have sensitivity analysis in the Higg MSI and Higg PM platforms and across the different lifecycles to understand the most important levers in design decision-making.

This panel suggests sensitivity analysis to be provided on the following critical aspects:

(a) Product care for footwear

(b) Customer travel (travelled distance to/from store)

(c) Landfill and incineration impacts during end-of-use according to the product material. Differentiation is required when it is a relevant topic: for instance, if the differences in impacts of synthetic and natural fibres are very different. In order to implement such differentiations, the experts suggested that available Ecoinvent data may be a starting point and, in the future, the PEF database EF 3.1 can be leveraged. According to another expert, data in this field will evolve within the next two years to allow for such differentiations to be made.

- One expert noted that the use of global averages for benchmarking is allowed and not in contradiction with the ISO standards, provided that the background data and the context of the results are given.
- One expert highlighted the relevance of communicating where averages and assumptions are used in the platform, so the user's interpretation can be reflective of that.

R.IV.2 The Higg MSI and Higg PM analyses should use energy grid and water consumption in the factory level geography to improve the geographical coverage data quality requirement. The majority of experts agree that it should be required to use the most granular form of data for energy grid (e.g. type and process) and water consumption. One example given by the experts to support this recommendation is that a cotton t-shirt produced with the same techniques in the worst- and best-case factories would likely receive the same score in the current set up, even though the impacts could be several times higher in the worst case. In order to implement more granular data, the geography of where the process is performed should be mandatory primary data and, if specific factory data is available, it should be used as an override. In cases where aggregated data does not permit applying factory level geography assumptions, it is important to have information on the geography considered for the dataset and regionalized averages should be prioritized over global ones.

- One expert believes that it should be mandatory to use factory-specific data instead of making it an option to override when available. The use of global or regional averages is thus not sufficient.

R.IV.4 The SAC should define a strategy to improve data quality. Using global averages and assumptions can generate misunderstanding due to a lack of representativeness (i.e. geographical coverage, time period, and technology coverage) and completeness. One expert suggests the SAC should signal more clearly where the data quality and granularity can be improved. A data quality plan of action with a timeline should be publicly disclosed in order to provide transparency. In addition, the SAC should clearly formulate their position and role with regard to data, and how they partner with others to improve it.

- One expert added that the SAC should take a more active role to improve data quality.
- Experts shared concerns of the current resources attributed to MSI contributors and that it can be beneficial to dedicate additional resources, like one expert per material, to ensure data quality.
- Another expert believes the SAC can inform users more on the improvement journey, tracking which data improvements have already been accomplished to give an understanding on the impact of improvements or changes within data.
- One expert further stressed the value of data quality and that the priority to improve data quality should be greater than implementing other recommendations (such as integrating the Higg MSI into the Higg PM). In addition to a data quality plan of action, the expert suggested that the SAC should quantify the current error margins (validation of data gaps between the tool's data and the real world) and provide a technically justifiable indicator to allow improved insights. Furthermore, the expert highlighted the concern that if underlying data set quality is weak, the tools can misdirect companies' policies across all use cases and impair designers' decision-making.

R.IV.7 The geography of the dataset on the Higg MSI and Higg PM platform should be shown in the name of the dataset, and not only as part of the metadata. While choosing between different processes, you currently have to further investigate the dataset specific information to assess the geography description. Showing the geography in the name of the dataset would avoid the selection of incorrect geographical data.

R.IV.8 The Higg MSI and Higg PM should use specific factory data from the Higg facility module (Higg FEM) to improve the geographical coverage and technology coverage data quality requirement. The integration of verified FEM data into the Higg MSI and Higg PM would substantially improve the types of insights that could be derived to inform better material and product development processes.

- One expert noted that data granularity should be improved beyond energy grid and water consumption; for example, towards better technological and procedural coverage (e.g. technologies and procedures applied in manufacturing processes). The expert also shared a concern regarding the Higg FEM data as it comprises mainly carbon-related data, therefore technological and procedural differences are not considered.

Medium priority

R.IV.3 The Higg MSI and Higg PM should apply the cut-off criteria based on a combination of mass, energy, and environmental significance. Many examples regarding potential issues with the currently applied 5% weight cut-off were shared, such as:

1) Gold and silver buttons

2) Chemicals used for garment treatment

Despite a small share in weight, these components can highly influence a product's impact. Acknowledging that certain components are included by the end user and upon the end user responsibility, the recommendation can be implemented by means of:

(a) Warnings at the bill of materials screen to highlight critical components that should not be neglected (e.g. rare minerals, chemicals, etc.), clearly communicating the issues of not complying with the cut-off criteria.

(b) Requesting if detailed information is known for each component included in the bill of materials.

(c) Providing a warning within the tool for the percentage of total material for which no detailed information was known, as currently users can add example materials/trims in the bill of materials even if the processes taken to produce them are not known. This action can highly influence the final result.

In addition, one expert added that energy and non-mass related inputs are important to consider as the impacts can be significant (e.g. microplastics are small in mass but still significant in impact). This expert suggested there could be a list of aspects where cut-offs are not appropriate (e.g. for chemicals of concern such as PFAS).

R.IV.5 Product care assumptions should be regionalized. Most experts agree with implementing product care scenarios based on consumers' questionnaire responses, which is relevant to better reflect consumers behaviour in the Higg PM. However, product care and consequential impacts should be more granular as consumer behaviour, energy grids, and water scarcity factors are very distinct across the globe. Therefore, insights on where the product will be consumed should be requested from the end users. The current questionnaire used by the Higg PM should be expanded to add these regional differences.

- Two experts stated that some regional differences in use and end-of-life phases are useful for design decision making (e.g. designing clothing to be biodegradable where waste treatment infrastructure is not available, or clothing for cold washing or no ironing if not available in those markets).

- One other expert added that an alternative might be to implement a warning which indicates to the user that standardized scenarios have been used and that these may differ from the actual practices of the product consumer.
- Another expert stressed that the regionalization of product care assumptions depends on the goal and scope of the study. If the tool is used for design, then consumer behavior is beyond the scope of the study.

Recommendation supported by approximately half of experts

Medium priority

R.IV.9 Higg MSI contributors should not consider data type II submission in order to improve data quality. The Higg MSI and Higg PM currently use secondary data provided by external parties. The secondary data is submitted in two different ways:

1) Data inputs/outputs at the process level, known as data type I.

2) Characterized results life cycle impact assessment (LCIA) of the inputs at the process level, known as data type II.

According to the experts, including inputs in the form of data type II is very complex as it requires not only checking consistency with the Higg MSI methodology but also with the rest of the data . Therefore, allowing data type II submission increases uncertainties in system boundaries and allocation procedures, and reduces data quality (reproducibility and consistency requirements). Experts stated that if the tool is to be used for the long term, only data type I submissions should be allowed.

- Two experts think data type I are the most ideal to have. However, this is not possible yet for all. Therefore, they do not view data type II submissions as an issue as long as data quality can be secured, metadata is clearly documented, and system boundaries are in line with methodology.
- One expert further added that only allowing data type I submission would lead to a higher credibility of the Higg index. If users do not agree to this, they could use Environmental Product Declarations (EPD) instead. The SAC should be fully transparent with the Higg index and set the bar high.

Recommendation supported by the minority of experts

Medium priority

R.IV.6 Lifetime extension (at duration of service and end-of-use pathways) should not be included in the Higg PM LCA assessment, but it should be an additional feature where end users can test different scenarios and analyze potential impacts. Experts had concerns regarding how the interventions on duration of service would lead to a lifetime extension. According to the experts, a garment's lifetime is influenced by many factors beyond its technical characteristics (such as tearing strength, dimensional stability, etc.) and applying duration of service could double count effects already factored in consumers' questionnaires (for example, the consumer's questionnaire currently deployed by the Higg PM considers 66 lifetime uses for cotton pants and 69.5 lifetime uses for synthetic pants. This distinction on lifetime uses may represent the differences in strength between both garments. If by providing a strength certificate the lifetime uses of the synthetic pants can be extended, thus this factor is being double counted by consumer's questionnaire and lifetime extension). Similar concerns were shared regarding the end-of-use pathways (e.g. how providing an additional button will enable repairability is highly uncertain).

- Most experts agreed to the use of lifetime extension and end-of-use pathways as it can help steer the textile, apparel & footwear industry to produce higher-quality products

- Although one expert acknowledged the above-mentioned benefit of steering the industry toward higher-quality products, the expert did not agree to include lifetime extension. Rather, the expert suggests it should be an additional feature in the tool and not part of the Higg PM LCA assessment.

5.3 Impact assessment

A total of five recommendations were presented, out of which two are to be considered in the future as they require further scientific development before implementation. The prevailing consensus among the majority of the panel is to fully align the tools with PEF impact categories and to discontinue the use of normalization.

Table 5: Overview of recommendations addressing the ISO phase Impact assessment

Recomm-endation number	Recommendation summary	SAC reference	ISO standard	Beyond ISO guidance	For future considera-tion	Extent of agreement	Priority Level
R.IM.1	The tools should align with PEF impact categories	Higg MSI methodology / page 10 and appendix C	ISO 14044 / section 4.4	-	-	Majority	High
R.IM.2	Higg PM and Higg MSI could include biodiversity, once scientifically sound methodologies are available	Higg MSI methodology / page 10 and appendix C	ISO 14044 / section 4.4	-	Yes	Approx. half	Medium
R.IM.3	Microplastics and solid waste should be included, when scientifically sound methodologies are available	Higg MSI methodology / page 10 and appendix C	ISO 14044 / section 4.4	-	Yes	Approx. half	Medium
R.IM.4	Higg MSI and Higg PM should discontinue use of current chemistry assessment	Higg MSI methodology / appendix D	ISO 14044 / section 4.4	-	-	Majority	High
R.IM.5	Higg MSI should discontinue use of normalization	Higg MSI methodology / pages 12 -13	ISO 14044 / section 4.4.3.2	-	-	Majority	Medium

Recommendation supported by the majority of experts

High priority

R.IM.1 The tools should align with PEF impact categories. Although the impact categories selection is clearly described in the tools methodology documents, the majority of experts shared that the Higg MSI and Higg PM impact categories are not fully in line with the ISO standards, as the standards require “a comprehensive set of environmental issues related to the product system being studied”. According to the experts, the current impact categories only present a limited perspective of the environmental burdens associated with apparel and footwear, and do not meet the goals and scope of the tools’ study. Therefore, impact categories should be expanded from the current five impact categories to the 16 impact categories prescribed by PEF. Implementing the PEF impact categories will provide a more comprehensive set of

environmental issues related to textile, apparel & footwear products by adding topics such as acidification, human toxicity, freshwater ecotoxicity, land use, and others.

An additional discussion was held on whether biogenic carbon and water consumption should be presented as a separate inventory metric within the tools. One expert shared concerns that presenting biogenic carbon and water consumption as an inventory metric could lead to misinterpretations and biased conclusions; for example:

(1) Water consumption presented in isolation would favor fossil materials over biological materials

(2) Biogenic carbon presented in isolation would favor biological materials over fossil materials

Therefore, the expert would not support this even if it is recommended by PEF.

R.IM.4 The Higg MSI and Higg PM should discontinue the use of the current chemistry assessment. Most experts do not agree with the current chemistry assessment and suggest fully implementing USEtox instead (USEtox is also suggested by PEF), with the following main arguments:

1) The current methodology applies non-linear calculations opposite to the ISO 14040 & 14044 standards' assumption of linear relationship between emissions and damage

2) The performed calculations are against ISO 14040 & 14044 standards' recommendations of being scientifically valid, internationally accepted, and reproducible

However, USEtox can carry over certain uncertainties and there are a relevant number of scientists working to improve the methodology:

- One expert shared concerns related to USEtox and would not suggest implementing it as USEtox and other toxicity models in LCA are not yet solid enough for decision-making to be included. If USEtox were to be used, an uncertainty analysis should be used due to the model's uncertainty
- Two experts acknowledge that, while there are large differences in USEtox, a wide community is aware of these issues and working to improve them. In light of this, they still view USEtox as useful despite the presence of such uncertainties.

Medium priority

R.IM.5 Higg MSI should discontinue the use of normalization. Although the ISO standards refer to normalization as an optional stage, experts shared that the current methodology does not meet LCA best practices. Expert concerns regarding the normalization methodology are:

(1) Use of outdated data

(2) LCA results are exposed to shifts in the most frequently used materials

Additionally, the experts would refrain from implementing another normalization methodology as they include a large number of biases and recommend more training on how absolute values could be interpreted by users.

Recommendation supported by approximately half of experts

Medium priority

R.IM.2 Higg PM and Higg MSI could include biodiversity once scientifically sound methodologies are available. Pollution (e.g. air, water) and materials depletion, caused during the textile lifecycle, certainly contribute to biodiversity loss. Currently, there is no scientifically-based LCA method with consensus, although the field is quickly progressing. Several parties are conducting research on this, such as the European Commission's JRC and the French ADEME. Some experts argue that PEF can be used as a starting point given that PEF includes eight impact categories that affect biodiversity (e.g. aquatic freshwater

eutrophication, land use, and freshwater ecotoxicity). However, one expert does not believe biodiversity should be a separate impact category as part of the LCA.

R.IM.3 Microplastics and solid waste should be included when scientifically sound methodologies are available. Most experts recommended including microplastic and solid waste in the analysis. However, the experts acknowledge the current lack of available methodologies to properly integrate microplastic and solid waste as part of an LCA study.

- Two experts have suggested implementing warnings together with the product's outcomes to highlight the likelihood of releasing microplastic and its biodegradability
- Research is being conducted in this field and some experts suggested monitoring progress on the Plastic Leak project, Microfibre Consortium, and research on methodology by the French environmental labelling for apparel and footwear project
- One expert gave the plastic leakage assessment developed by Quantic as an example of a currently available assessment of macro plastic leakage

5.4 Interpretation

Three key recommendations were put forward by the expert panel, with one of them exceeding the guidance provided by the ISO 14040 & 14044 frameworks. The majority of the panel emphasized the importance of aligning with PEF guidelines, subject to the condition that it enhances data quality. Furthermore, the experts also recommended the SAC include third-party reviews when disclosing LCA results to external parties. The next step would be to determine which party holds the responsibility for such third-party verifications (SAC, users, etc.).

Table 6: Overview of recommendations addressing the ISO phase interpretation

Recomm-endation number	Recommendation summary	SAC reference	ISO standard	Beyond ISO guidance	For future considera-tion	Extent of agreement	Priority Level
R.IP.1	Higg MSI and Higg PM should be compliant with PEF when it is ready for use, provided PEF increases data quality	-	-	Yes	-	Majority	High
R.IP.2	When communicating results about the LCA to any external party, third-party reviews are needed to comply with ISO standards	-	ISO 14044 / section 4.2.3.7	-	-	Majority	High
R.IP.3	The SAC should take responsibility for the results instead of allocating this responsibility solely to the end users	-	ISO 14044 / section 4.5.4	-	-	Approx. half	High

Recommendation supported by majority of experts

High priority

R.IP.1 Higg MSI and Higg PM should be compliant with PEF when it is ready for use, provided that PEF increases data quality. The majority of the experts agree that compliance with PEF is crucial within the European Union, as the adoption of PEF guidelines for product reporting has the potential to enhance standardization, strengthen the reliability of environmental impact assessments, and increase data quality.

This could lay the groundwork for future communication of a product's environmental impacts to consumers in a more consistent and comprehensive manner. Compliance with PEF for users beyond the European Union was supported by approximately half of the experts as they believe that the most stringent standards should prevail.

- Some experts noted that data sets should be improved as a priority over alignment with PEF. Thus, if PEF increases data quality, alignment with it is suitable
- One expert shared the concern of recommending compliance with PEF if the guideline is not yet finalized

R.IP.2 When communicating results about the LCA to any external party, third-party reviews are needed to comply with the ISO standards. Using a tool that conforms to these standards does not guarantee a standardized LCA. It is essential to advise users that their LCAs should undergo third-party review to align with the ISO standards when communicating to external parties (i.e. any interested party other than the commissioner or the practitioner of the study). The third-party report may be based on confidential study documentation that cannot be divulged in the final report. Such a report serves as a reference document and must be accessible to any relevant third party for whom the communication is intended. The next step would be to determine which party holds the responsibility for third-party verifications (SAC, users, etc.).

Recommendation supported by approximately half of experts

High priority

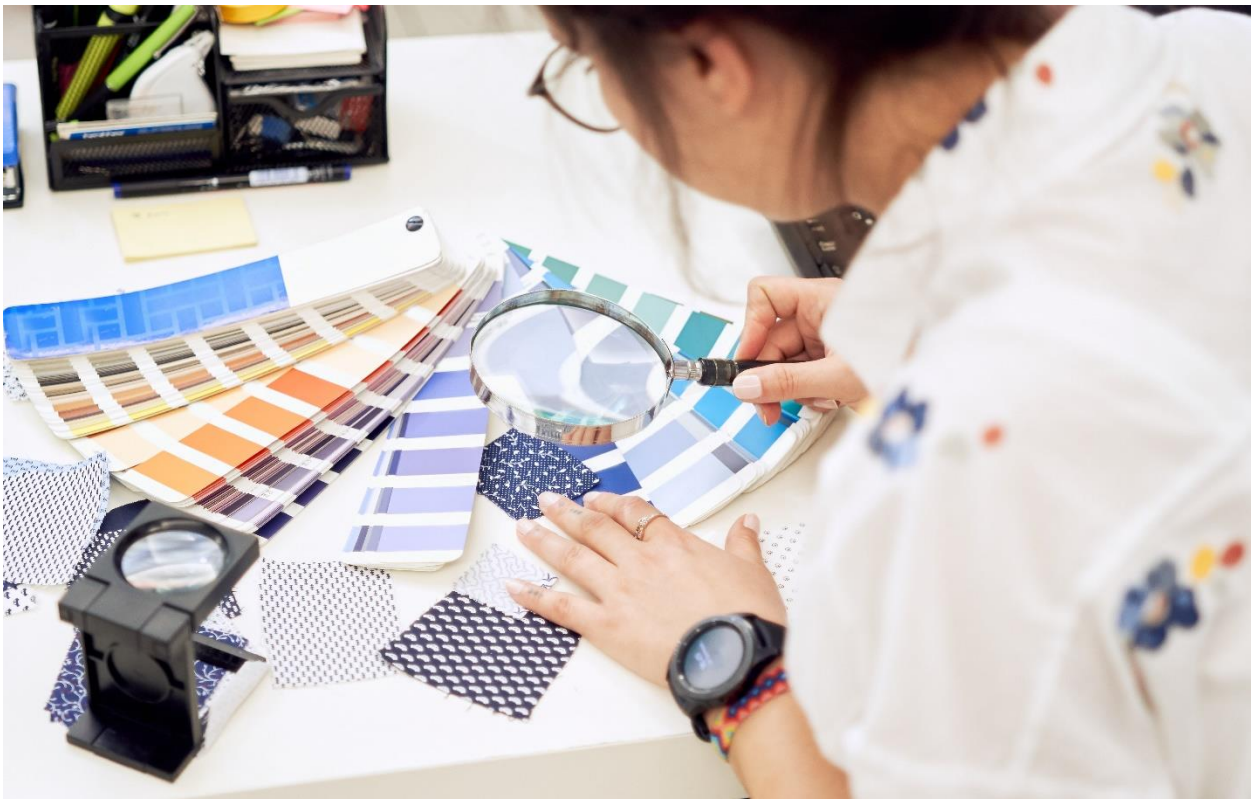
R.IP.3 The SAC should take more responsibility for the results, instead of allocating it solely to the end users. Approximately half of the experts believe the SAC, as the tool owner, has a responsibility to ensure fair interpretation, use, and credibility of the tool, given the numerous assumptions that are built into it. To address this, the SAC could increase its accountability by:

- Providing better guidance on what the tools can be used and not used for
- Providing training on such guidance (one expert suggested even to test user LCA knowledge prior to tool use)
- Ensuring data reliability
- Building in more control mechanisms to limit potential misuse of data in assessments intended for decision-making

It is important to note that the experts did not give any examples of tools who are doing this well as a reference for the SAC.

A minority of experts argued that the SAC is not responsible for what the user is doing with the tools (i.e. results). Rather, the SAC is responsible for the tool (incl. calculation methodology), the data it uses, and can provide training to guide the users toward a fair interpretation of the results.

6. Conclusion



KPMG facilitated the review of the Higg MSI and the Higg PM tools with a panel of ten experts. The versions of the Higg MSI and Higg PM tools reviewed were those in operation in March 2023. This review has provided valuable insights into the Higg MSI and the Higg PM tools, with the experts' observations leading to diverse perspectives and nuanced viewpoints on potential actions. The observed diversity of perspectives demonstrates the depth of thought and thorough examination undertaken during the review process. As a result, the identified strengths, individual recommendations, and the tools' alignment with use cases and LCA standards may not have unanimous or majority support from the experts, but they serve as a comprehensive and useful list for the SAC's consideration in the continuous evolution of the Higg MSI and Higg PM tools.

The experts acknowledged that the Higg MSI and Higg PM tools demonstrate a number of strengths across all four ISO LCA phases to quantify and assess the environmental aspects of materials and products. Some include the recognition that the tools are a good industry initiative to assess the environmental impacts of textile, apparel & footwear products and materials. Furthermore, the tools have gathered an impressive amount of data and use scientifically-sound standards.

The primary guidance from the experts is to harness the full potential of the Higg MSI by integrating it with the Higg PM and focusing on enhancing data acquisition process and data quality. This will pave the way for enriching and improving the databases and lays the foundation for the tools, bolstering the expertise of both SAC and end users through targeted training and resources.

For the further enhancement of the tools, the experts have also made several more practical recommendations, such as implementing warnings when navigating the Higg MSI and Higg PM tools on

the platform to prevent inappropriate comparisons and improved documentation for goal & scope definition of the LCA study.

The extensive list of identified recommendations suggests the SAC take action to improve the tools while also recognizing the industry-wide challenges for collective acknowledgment and a sector-wide approach. Examples of such challenges are:

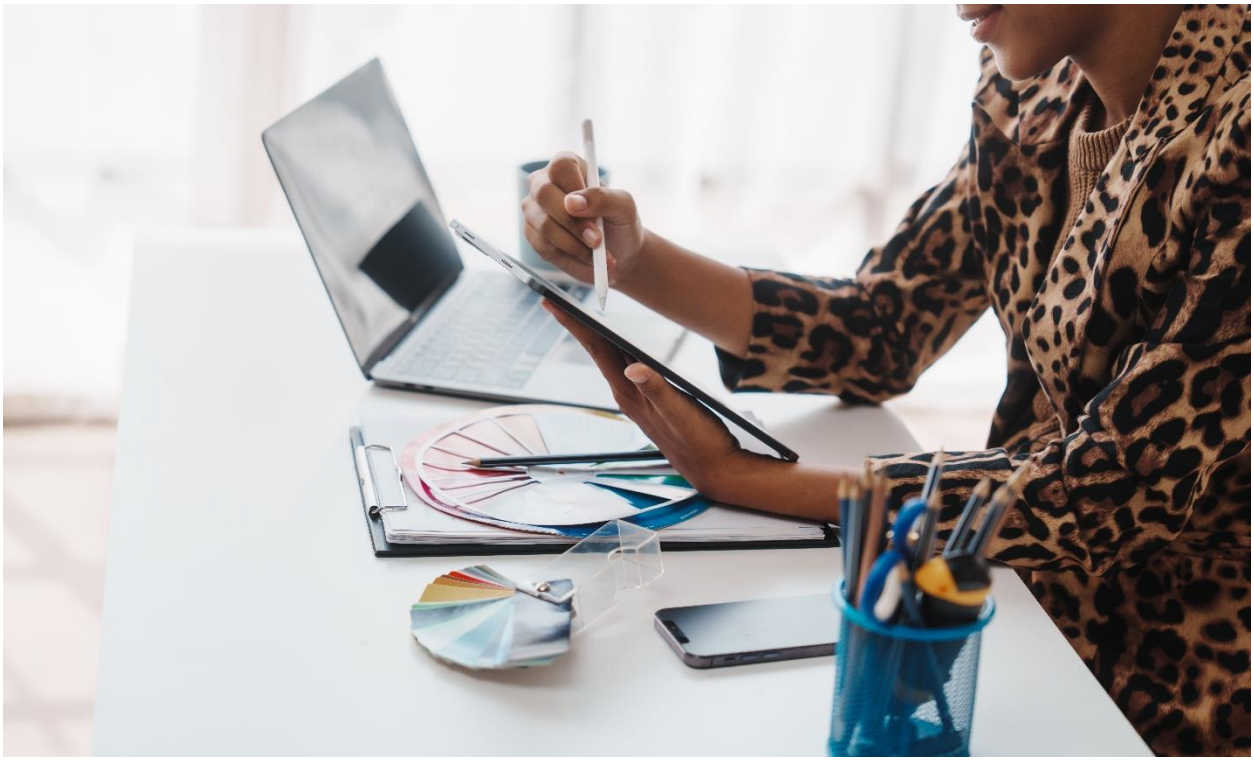
- Globalized supply chains increase the complexity of implementing good data quality leading to the discussion on the balance between availability and granularity of data. An industry-wide effort is required to increase the granularity and availability of data.
- The use of LCA studies to address the entire apparel and footwear industry is complex due to the great variety of product categories, material sources, manufacturing processes, and consumer behaviors. This complexity was observed as the majority of recommendations did not receive the full support of all experts and many nuances were discussed throughout the review.
- Scientific progress and consensus is required to improve apparel and footwear LCAs, especially within areas such as biodiversity and microplastics.
- Interpreting and using LCA results can be perceived as challenging for non-LCA specialists. Therefore, the experts have made recommendations to enable better guidance on how analyses should be conducted and how to avoid misinterpretation.
- Experts acknowledge that LCA studies, conducted through tools such as the Higg MSI and Higg PM tools, focus mainly on improving the efficiency of products or materials. Thus, LCA-based tools carry limitations to address broader sustainability topics such as the volume of products being produced or sold and fast fashion. One expert highlighted a concern in regard to the rebound effect[9], i.e. efficiency savings that do not lead to lower resource consumption levels (e.g. through increased resource demand and thus consumption levels).

The experts highlight that by adopting the recommendations detailed in this report, the Higg PM's alignment with both internal and B2B use cases will be significantly enriched. The integration of the Higg MSI with the Higg PM can leverage its potential for both internal and B2B scenarios.

All in all, overcoming these hurdles and unlocking the tools' full potential will require industry-wide and cross-sector collaboration By embracing the recommendations and collaborating as an industry, the SAC can build on the positive momentum toward a more sustainable and responsible textile, apparel & footwear industry. The dedication to improvement and the openness to collective action set a promising path for the continuous evolution of these tools, as they aim to decrease environmental impacts and promote sustainable practices in the industry.

[9] An example of the rebound effect would be the driver who replaces a car with a fuel-efficient model, only to take advantage of its cheaper running costs to drive further and more often. Extracted from: Druckman, A., M. Chitnis, S. Sorrell and T. Jackson (2011). "Missing carbon reductions? Exploring rebound and backfire effects in UK households " Energy Policy 39: 3572–3581.

7. SAC's view on next steps



The Higg MSI and Higg PM have continued to improve since their inception and the recommendations from this external review build on a foundation of previous internal (SAC member) and external engagement. As this report notes, finding consensus across different stakeholders and experts is not always straightforward and there aren't always available solutions to implement. As part of this review process, the SAC and expert panel members had the opportunity to discuss and clarify the final recommendations.

Each recommendation has been further reviewed by the SAC to decide upon next steps. Each has been categorized by the SAC into one of four categories:

- **Operational Adjustment** – A recommendation that can be adopted in the tools through a platform or guidance update, without requiring modification to the methodology documents
- **Methodological Clarification** – A recommendation that is already partially or fully implemented (i.e. no user-facing changes), but which is unclear in the current tool methodology documents
- **Methodological Development** – A recommendation that changes the current tools and requires further discussion for alignment and implementation with tool users
- **Data Development** – A recommendation representing a current gap in knowledge and cannot be directly implemented without closing information gaps and/or requiring new data

Completing these four categories will require the engagement of different stakeholders. Operational Adjustments require conversations with Worldly, SAC's technology partner in delivering the Higg Index platform. Methodological Clarifications are SAC's responsibility, but will require engagement with the MSI Gatekeeper and Higg Data Managers to ensure accuracy. Methodological Developments require further engagement as these apply across different technology, methodology, and user needs and expectations. Recommendations listed as Methodological Developments will be discussed and aligned upon by Member Expert Teams composed of all SAC member stakeholders. Data Developments require further work with

academic researchers, consultants, or industry stakeholders. These may require additional scoping work to define before they can be implemented.

Also, it is important to note that many of these recommendations were already on SAC's tool development roadmap. Please refer to Table 8 for SAC's categorization and comments on each recommendation.

Like the previous external reviews of the Higg MSI and the Higg PM, this external review will be made publicly available. A list of the recommendations from this review and their implementation status will be made available on the 'How to Higg' website for tracking progress over time.

8. Appendix

Experts' remarks

Table 7: Experts shared remarks at the end of the Higg MSI and Higg PM review

Expert name	Remarks
Natascha van der Velden	*"It was a pleasure to work on this review of the Higg MSI and Higg PM tools in operation in March 2023 that were neither in line with formal LCA calculation rules, nor scientific LCA practice, and could lead to incorrect results and conclusions and I would like to thank the SAC for this opportunity. The detailed, open, and transparent guidance of KPMG and the constructive discussions with the Director of the Higg Product Tools and the expert panel members led to a comprehensive set of recommendations for further improvement of the Higg MSI and the Higg PM.* *I hope that this review and the implementation of the recommendations will help the SAC to guide the sector towards the environmental improvements that are so much needed."*
Reinout Heijungs	*"I appreciate the efforts made to construct a comprehensive system. This necessarily requires a compromise between quality and feasibility, and I believe the developers have in general found a good balance here. However, the world of sustainability assessments is dynamic, and improvements (better data, more impact types, etc.) emerge every year. In my opinion, the MSI and PM should be clearly defined as evolving systems, and it may even be wise to introduce an updating procedure (how often, in which form, etc.)"*
Priyangi Jayasinghe	*"The Higg MSI and Higg PM:* *1. Lack data diversity and granularity - Without diverse, granular (energy, geographical, and specific details of technology) and quality data, LCA values are approximations that can mislead if not qualified properly. For example, scope 3 carbon emissions calculations using this dataset are inaccurate* *2. Cannot avoid comparisons - But, in LCAs, comparisons are only allowed if boundaries and parameters are the same* *3. Does not address the issues of re-bound effect (including fast fashion) - LCA per product efficiency gains are likely erased by increasing quantities. MSI/PM does not communicate this aspect to users* *Hence, the recommendation, R.IV.4. to improve data is critical for use of MSI/PM to advance sustainability, and must include:* *1) Quantification of the current data gap between the tool's data and the real world* *2) A technically justifiable data granularity/quality fit for intended purposes* *That proposal must be technically reviewed"*
Paulien Harmsen	*"Like other industries, the textile industry needs to become fossil-free in the future. This is a huge challenge, as the industry is still relying heavily on fossil resources for its materials. This calls for new materials and thus a new taxonomy, and new circular actions like design for circularity (mono-materials (no blends), reuse, repair, recycle, etc.). The Higg Index can be a powerful tool in this transition, once shifted from a linear system as it is now, to a more circular way of working in the future."*

Expert name	Remarks
Jesse Daystar	*"The SAC undergoing a critical review of their tools shows a commitment to providing the industry tools and data that evolve with the changing science and industry needs."*

SAC's action plan in response to the experts' recommendations

Table 8: Overview of SAC's action plan in response to the experts' recommendations

Recomm-endation number	Recommendation summary	SAC categorization	Topic History	Additional SAC comments
R.GS.1	The Higg MSI and Higg PM should implement warnings where comparisons should not be performed	Operational adjustment	-	**Included in Upcoming Update:** This is already implemented in our Communication Guidelines, but we are already looking at implementing it more visibly on the actual platform.
R.GS.2	Allocation procedures should be more transparent and uncertainty analysis should be provided regarding impacts of chosen procedures	Methodological clarification	-	**Included in Upcoming Update:** Expanding the explanation of allocation procedures is in progress already and will be included in the next iteration of the methodology document.
R.GS.3	Higg MSI should be integrated into the Higg PM	Methodological development	Topic discussed with members in past	**Included in Upcoming Update:** We are looking into the best way to implement this recommendation, this is already on our roadmap.
R.GS.4	Higg MSI goal should be better described	Methodological clarification	-	**Included in Upcoming Update:** We will factor this recommendation into future methodology document updates.
R.GS.5	Higg PM goal should be better described	Methodological clarification	-	**Included in Upcoming Update:** We will factor this recommendation into future methodology document updates.
R.GS.6	Higg PM should better describe the expected level of quality ("how well") and the lifetime of the product ("how long") in its functional unit definition, as well as, provide a per use definition	Methodological clarification	-	**Included in Upcoming Update:** We will factor this recommendation into future methodology document updates.
R.GS.7	The term "overhead" within the scope of exclusions should be better explained	Methodological clarification	-	**Included in Upcoming Update:** We will factor this recommendation into future methodology document updates.

Recomm-endation number	Recommendation summary	SAC categorization	Topic History	Additional SAC comments
R.GS.8	The tools should provide a process flow diagram representing the system boundaries of your study as suggested by the ISO standards	Methodological clarification	-	Included in upcoming Update: We will factor this recommendation into future methodology document updates.
R.GS.9	Materials taxonomy should be more consistent	Methodological development	-	**Included in Upcoming Update:** Materials taxonomy is consistent within similar material categories (ex: all textiles, all leather, all plastics, etc.); however, we will review the taxonomy to consider where this recommendation can be implemented.
R.GS.10	The leather alternative production phase should include more steps	Methodological development	-	**Included in Upcoming Update:** Materials taxonomy is consistent within similar material categories (ex: all textiles, all leather, all plastics, etc.); however, we will review the taxonomy to consider where this recommendation can be implemented.
R.GS.11	A new lifecycle step should be included in Higg PM to differentiate reuse and recycle from end-of-use	Methodological development	-	**For future consideration:** We will review life cycle stage breakdown as part of alignment with PEFCR once available.
R.IV.1	The tools should provide sensitivity analysis to support the claims for using assumptions and global averages	Methodological Development	-	**Included in Upcoming Update:** Background sensitivity analysis is limited by dataset aggregation from commercial providers. However, we already are exploring ways to better surface uncertainty analysis through an academic partnership with MIT SHINE and will further build on this recommendation.
R.IV.2	Higg MSI and Higg PM analyses should use energy grid and water consumption in the factory level geography to improve the geographical coverage data quality requirement	Data Development	On Current Tool Roadmap	**Included in Upcoming Update:** While we are currently limited by existing available datasets and data quality, this is something we are working actively on to implement in the next iteration of the tools.
R.IV.3	The tools should apply the cut-off criteria based on a combination of mass, energy, and environmental significance	Methodological Clarification	-	**Already implemented:** This is already the case; we will clarify in the methodology document.

Recomm-endation number	Recommendation summary	SAC categorization	Topic History	Additional SAC comments
R.IV.4	SAC should define a strategy to improve data quality	Methodological Development	-	**Already implemented:** We have defined priority areas and are working with industry stakeholders to enable methodological alignment and streamlining of LCA data creation. Currently, this work focuses on cotton fiber (cotton farming) and textile wet processing (e.g. dyeing and finishing) as those are hotspots within the industry.
R.IV.5	Product care assumptions should be regionalized	Methodological Development	Topic discussed with members in past	**For future consideration:** This approach was rejected by member experts during the last methodology review, as it does not lead to actionable improvements or insights for the B2B or Internal use cases.
R.IV.6	Lifetime extension (at duration of service and end-of-use pathways) should not be included in LCA assessment, but it should be an additional feature where end users can test different scenarios and analyze potential impacts	Methodological Development	Topic discussed with members in past	**For future consideration:** Last discussion with members prioritized including duration of service as a required part of results to prevent light weighting products to claim more sustainable products that have lower quality (and therefore, expected lifetimes). This is also aligned with the approach the PEFCR Is taking. We will align with the PEFCR methodology on lifetime extension once finalized.
R.IV.7	The geography of the dataset should be shown in the name of the dataset, not only as part of the metadata	Methodological Development	-	**Under consideration:** Will be reviewed by a member expert team to ensure usability and accuracy are both enhanced.
R.IV.8	The Higg MSI and Higg PM should use specific factory data from the facility module (Higg FEM) to improve the geographical coverage and technology coverage data quality requirement	Data Development	On Current Tool Roadmap	**Included in Upcoming Update:** This is work currently in progress, although we are limited by existing data and ability to accurately allocate facility data to individual process steps. The work is progressing through our Textile Wet Processing Member Expert Team and we aim to release this feature within a year.
R.IV.9	MSI contributor should not consider data type II submission in order to improve data quality	Methodological Development	Topic discussed with members in past	**Under consideration:** Type II submissions were kept after last discussion since excluding would limit the possibility of including much of the latest LCA data, leading to further proxies and worse quality overall. SAC has been pushing towards more Type I submissions and requirements will be reviewed again.
R.IM.1	The tools should align with PEF impact categories	Methodological Development	On Current Tool Roadmap	**Included in Upcoming Update:** Agreed, this is on our tool roadmap.

Recomm-endation number	Recommendation summary	SAC categorization	Topic History	Additional SAC comments
R.IM.2	Higg PM and Higg MSI could include biodiversity once scientifically sound methodologies are available	Data Development	-	**For future consideration:** Limited by availability of suitable biodiversity LCIA methodology.
R.IM.3	Microplastics and solid waste should be included when scientifically sound methodologies are available	Data Development	On Current Tool Roadmap	**For future consideration:** Limited by availability of marine litter LCIA methodology; following MarILCA development.
R.IM.4	Higg MSI and Higg PM should discontinue use of current chemistry assessment	Methodological Development	Topic discussed with members in past	**Under consideration:** Our current method is in place due to USEtox not being implemented consistently across different datasets, due to cutoff interpretations; the differences between datasets do not match expert opinions and will likely lead to unintended actions by users. We are looking into this recommendation and how we can better represent toxicity impacts, including simply aligning to USEtox.
R.IM.5	Higg MSI should discontinue use of normalization	Methodological Development	Topic discussed with members in past	**Included in Upcoming Update:** Discontinuing normalization will require changes to access model for free users due to data licensing agreements for LCIA results.
R.IP.1	Higg MSI and Higg PM should be compliant with PEF when it is ready for use, provided PEF increases data quality	Methodological Development	On Current Tool Roadmap	**Included in Upcoming Update:** Agreed, this is on our tool roadmap.
R.IP.2	When communicating results about the LCA to any external party, third-party reviews are needed to comply with ISO standards	Operational Adjustment	-	**Included in Upcoming Update:** The results from the Higg MSI and Higg PM do not constitute an LCA report and we will clarify this within our communication guidelines.
R.IP.3	The SAC should take responsibility for the results instead of allocating this responsibility solely to the end users	N/A	-	**Cannot implement:** SAC will focus on improving the tools and their interpretation, but cannot assume responsibility of other organizations' use (or misuse), this is stipulated in the Terms of Use, in the very same way as the vast majority of such tools offered by other organizations.

Glossary

Table 9: Glossary

Abbreviation	Meaning
SAC	Sustainable Apparel Coalition
ISO	International Standards Organization
Higg MSI	Higg Material Sustainability Index
Higg PM	Higg Product Module
Higg FEM	Higg Facility Environmental Module
LCA	Life Cycle Assessment
LCIA	Life Cycle Impact Assessment
B2B	Business-to-business
B2C	Business-to-consumer
IP	Intellectual property
GWP	Global Warming Potential
PEF	Product Environmental Footprint
USEtox	UNEP (United Nations Environmental Programme)-SETAC (Society of Environmental Toxicology and Chemistry) toxicity model
JRC	Joint Research Centre
ADEME	French Environment and Energy Management Agency
EPD	Environmental Product Declaration

9. Limitations & disclaimer

This report is intended solely for the information and use of the Sustainable Apparel Coalition (SAC) and is not intended to be used by anyone other than this specified party. Any other party that obtains a copy and chooses to rely on it in any capacity does so at its own risk. It is not the responsibility of KPMG to provide information to any third party that has become known or available at any time after the date of this report. KPMG accepts no responsibility or liability for the use of this report other than for the purpose for which it has been prepared and accepts no responsibility or liability to parties other than the SAC.

The terms and conditions of the agreement under which this report has been drawn are exclusively governed by Dutch law, and the court in the district within which the office is situated has exclusive jurisdiction with respect to any disputes arising under or in connection with that agreement.

Information presented and use of the report

The procedures that have been performed to establish this report did not constitute an audit or other assurance engagement. We have referred the experts to documentation and information provided by the SAC on the Higg platform as well as made reference to ISO 14040 and ISO 14044 standards for the experts to come to conclusions. Consequently, our report does not express any assurance as to the reliability of such information, provided by the SAC, Worldly platform, ISO standards and other parties, in the report.

It is important to note that the expert review was conducted on the Higg MSI and Higg PM versions in operation in March 2023. Therefore, further developments within the tools, even the ones with the intention to meet the recommendations resulting from this review report, will not be considered as reviewed by this expert panel. In addition, the recommendations presented in this report take into account scientific limitations at the moment of the review. As scientific progress in the coming years can substantially affect the recommendations, the expert panel suggests that this report should be periodically reviewed as part of a continuous improvement process.

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