FROM WASTE TO WEALTH

REDEFINING PROSPERITY IN FASHION. HARNESSING COLLECTIVE INTELLIGENCE FOR ENVIRONMENTAL AND SOCIAL IMPACT

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Abstract

The fashion industry is under increasing pressure to reconcile economic growth with environmental responsibility. This paper examines the 2024 Tanween Sustainable Fashion Challenge, organized by Ithra and supported by Vanina as the knowledge partner, as a case study for advancing regenerative practices in the sector. The challenge invited designers to transform undervalued local materials into luxury fashion items, using a framework rooted in the quintuple helix model to facilitate collaboration among industry, academia, government, society, and environmental stakeholders. The six-day design challenge employed agile methodologies, integrating charrette and sprint formats to enable rapid prototyping and interdisciplinary teamwork. Participants developed innovative material processes, linking ecological responsibility with cultural heritage. In the post-challenge phase, an extended network of expertise and collective intelligence was mobilized to support the winning proposal, ensuring its progression from concept to prototype through advanced material development. This paper explores the challenge's structure, its hybrid models for fostering innovation, and its integration of cultural dimensions. By embedding global expertise into local contexts, the initiative demonstrates how collective intelligence, cross-sectoral partnerships, and a glocal approach can redefine prosperity. It positions fashion not only as a tool for ecological stewardship and sustainable development but also as a medium for cultural engagement and systemic transformation in the pursuit of regenerative practices.

Keywords: *Sustainable Fashion, Upcycling, Regenerative Design, Collective Intelligence, Glocal Frameworks*

INTRODUCTION

The global fashion industry is grappling with escalating environmental and social challenges, including waste generation, unsustainable resource use, and significant carbon emissions (Niinimäki et al., 2020; Ellen MacArthur Foundation, 2017).

While fashion encompasses the broader cultural, social, and economic systems related to dress and identity, luxury represents a distinct segment within this system, traditionally associated with exclusivity and resource-intensive practices. In response to growing sustainability pressures, the notion of luxury is increasingly being reinterpreted to emphasize ecological responsibility and sustainable production practices (Adıgüzel & Donato, 2021).

Addressing these challenges requires approaches that move beyond isolated efforts and foster systemic change. Cross-sector partnerships and collective intelligence are increasingly recognized as critical to advancing sustainable innovation (Carayannis et al., 2012; Fletcher & Tham, 2019).

This paper examines the 2024 Tanween Sustainable Fashion Challenge as a case study to explore the intersection of design, sustainability, and cultural heritage. By focusing on the transformation of undervalued local materials into luxury handbags, the challenge highlights how regenerative practices can contribute to redefining prosperity in the fashion sector. The study provides insights into the processes, partnerships, and methodolo-

gies that support sustainable innovation, bridging ecological responsibility with cultural engagement.

CONTEXT AND BACKGROUND OF THE CASE STUDY

The 2024 Tanween Sustainable Fashion Challenge, organized by Ithra (The King Abdulaziz Center for World Culture), is part of the Tanween initiative—a series of yearly activities and conferences addressing global and local issues through design innovation (Ithra, 2023). Rooted in the goals of Saudi Vision 2030, the initiative aims to foster economic diversification, cultural enrichment, and sustainable development.

In 2024, the Sustainable Fashion Challenge was particularly framed around the design of handbags, guiding participants to explore waste-to-luxury practices within a focused product typology. This direction reflected strategic considerations, allowing for the demonstration of material innovation, craftsmanship, and narrative integration within the constraints of a six-day intensive format.

Supported by Vanina, a Beirut-based fashion brand with expertise in upcycling undervalued and discarded materials to raise environmental awareness and engage with cultural contexts (Hayek, 2022), the challenge exemplified a collaborative, transdisciplinary approach to sustainable innovation. Vanina's knowledge served as a foundation for participants to transform agricultural byproducts, industrial remnants, and natural resources into luxury accessory prototypes. This local-global collaboration was later extended through a network of experts, including Ibdå as the production partner, to transition the winning proposal from concept to implementation.

This case study serves as a framework for understanding how design challenges can enable ecological and cultural sustainability in fashion, offering a scalable model for fostering systemic change through collective action.

RESEARCH PURPOSE AND METHODOLOGY

This study aims to explore how the fashion industry can achieve impact-driven value through sustainable, collaborative practices, thereby redefining notions of prosperity in ways that benefit both society and the environment.

The study has several key objectives:

- To examine the role of collective intelligence in sustainable fashion and investigate how cross-sector collaborations, facilitated through the quintuple helix model, support innovation.
- To evaluate the efficacy of dual-partnership models (knowledge and production partners) in turning conceptual ideas into functional, high-quality prototypes within sustainable fashion.
- To assess the influence of risk-taking and experimentation themes, such as "Fail Forward," on redefining prosperity by valuing process over immediate commercial outcomes.
- To analyze how waste-to-luxury practices within design challenges generate both environmental and social impact, transforming undervalued materials into new forms of value.
- To investigate the integration of cultural and regional identity in sustainable fashion, focusing on how local heritage can add cultural significance to sustainable design.
- To assess the long-term impact and legacy of such regenerative practices in fashion, considering continued research, media interest, and the potential for replicating this model to foster industry-wide change.

The research employs qualitative methods, including participant observation, in-depth interviews, and the analysis of design documentation and final prototypes, providing insights into design processes, partnership dynamics, and cultural influences on outcomes.

Author's Disclosure:

The author is a co-founder of Vanina (knowledge partner), a founding partner of Ibdå (production partner), and a faculty member at DIDI, co-curating the challenges. While this provides insider knowledge, potential biases are mitigated through structured methodologies and reference to independent sources.

The partnerships between Ithra, Vanina, and Ibdå were initiated through mutual professional networks, rooted in aligned values around sustainability and innovation. Each partner benefitted from expanded knowledge exchange, exposure to new audiences, and opportunities to advance material experimentation, while costs primarily involved dedicating human and logistical resources toward project realization.

AN IMPACT-DRIVEN PARTNERSHIP FRAMEWORK

To address complex environmental and social challenges, the 2024 Tanween Challenges adopted

a collaborative approach rooted in interdisciplinarity and cross-sectoral engagement. The following sections delve into key dimensions of this initiative, examining its cross-disciplinary and cross-sectoral frameworks, the role of collective intelligence, and the scalable systems that enabled its outcomes.

A CROSS-DISCIPLINARY APPROACH: SYNCHRONIZED COMPLEMENTARY IMPACT-DRIVEN EFFORTS

The Tanween Challenges, part of Ithra's initiatives, were established in 2019 to address global issues through design innovation, aligning with Saudi Vision 2030's goals of economic diversification, cultural enrichment, and sustainable development (Ithra, 2023). Rooted in creativity and collaboration, these challenges embody Ithra's mission to bridge cultural heritage with future-oriented design practices. Over the years, the program has expanded into diverse fields such as sustainable fashion, architecture, and data visualization, demonstrating how interdisciplinary design can address complex environmental and social challenges.

In its fifth year, the Tanween Challenges 2024 embraced a theme-based approach, aligning all four challenges with the conference theme, Fail Forward. This framework encouraged risk-taking and framed failure as a critical step in innovation. Rooted in a manifesto advocating for a shift from human-centered to life-centered design, the challenges prioritized solutions that benefit all forms of life (Hayek & Daneluzzo, 2024). The program facilitated interdisciplinary collaboration across Sustainable Fashion, Architecture, Urban Design/Public Furniture, and Data Visualization by integrating synchronized schedules, shared workspaces, and joint jury sessions, creating opportunities for creative cross-pollination and collective innovation.

A CROSS-SECTOR APPROACH: ADOPTING THE QUINTUPLE HELIX INNOVATION MODEL

The 2024 challenges adopted the quintuple helix model (Carayannis et al., 2012), integrating five core sectors—industry, academia, government, society, and the environment—thereby fostering a comprehensive approach that leverages collective intelligence and a wide range of expertise. Each sector contributes unique resources, knowledge, and perspectives, enhancing the overall impact of the participants' work:

- **Industry**: Represented by Vanina, an internationally-distributed fashion brand from Beirut, the fashion industry offered expertise in sustainable design practices. As the knowledge partner, Vanina provided specialized guidance on transforming undervalued materials into high-quality fashion items.
- **Academia**: Two faculty members from the Dubai Institute of Design and Innovation (DIDI) served as curators for the four 2024 Tanween Challenges, incorporating an academic perspective and research-based methodologies into the structure.
- **Government**: The King Abdulaziz Center for World Culture (Ithra), a division of Saudi Aramco—majority-owned by the Saudi Arabian government—organized the challenges as part of its cultural mandate. Ithra's initiatives align with Saudi Vision 2030, supporting economic diversification, cultural enrichment, and sustainable development.
- **Society**: Challenge participants were drawn from the local community, representing a diverse array of disciplines, backgrounds, and regions throughout Saudi Arabia. This diversity ensured that the projects reflected a range of perspectives and regional identities (Tab. 01).
- **Environment**: Environmental responsibility was a core focus of the Tanween Challenges, which invited participants to utilize locally sourced organic and waste-based materials, such as agricultural by-products and industrial remnants, to embed ecological considerations into their designs (Tab. 02).

By employing the quintuple helix model, the Tanween Sustainable Fashion Challenge, along with the other Tanween initiatives, established a collaborative ecosystem connecting these sectors, enabling a holistic approach to innovation and fostering interdisciplinary engagement.

A GLOCAL APPROACH: KNOWLEDGE EXCHANGE, CAPACITY BUILDING, AND COLLECTIVE LEGACY

Dual Partnership Model: Knowledge Partner and Production Partner

A key feature of the Tanween Challenges is the dual-partnership model, pairing knowledge partners with production partners to bridge ideation and implementation (Ithra, 2023).

- *Knowledge Partners*: Selected internationally for their specialization in specific design approaches, they provide specialized insights and guide

Overview of Participant Disciplines, Skills, and Regional Representation

Participant	Discipline	Education	Skills/Expertise	City	Province/Region
Participant 1	Interior Design	Bachelor's in Interior Design	Conceptual design, rendering, project management	Riyadh	Riyadh Province
Participant 2	Graphic Design	Bachelor's in Graphic Design	Branding, visual identity, digital illustration	Al Khobar	Eastern Province
Participant 3	Architecture	Bachelor's in Architecture	Sustainable design, urban planning	Dammam	Eastern Province
Participant 4	Product Design	Bachelor's in Product Design	Furniture design, prototyping, 3D modeling	Jeddah	Makkah Province
Participant 5	Engineering (Undetermined)	Bachelor's in Engineering	Technical innovation, CAD modeling	Riyadh	Riyadh Province
Participant 6	Fashion Design	Bachelor's in Fashion Design	Sustainable fashion, pattern making	Abha	Asir Province
Participant 7	Architecture	Bachelor's in Architecture	Digital fabrication, parametric design	Makkah	Makkah Province
Participant 8	Fashion Design	Bachelor's in Fashion Design	Digital drawing, trend analysis, circular economy	Riyadh	Riyadh Province
Participant 9	Fashion and Textile Design	Bachelor's in Fashion and Textile Design	3D design, sewing, innovative textile solutions	Jazan	Jazan Province

Note: This table represents a subset of the 18 participants involved in the challenge. The full cohort encompassed diverse disciplines - including engineering, art, product design, and architecture - and spanned various cities and provinces across Saudi Arabia, reflecting a commitment to regional and interdisciplinary inclusivity.

Tab. 01

participants, sharing knowledge accumulated through years of work across different localities. In the case of the Sustainable Fashion Challenge, the input of Vanina as a knowledge partner, sharing its proprietary waste-to-luxury methods (Hayek, 2022), provided participants with foundational knowledge in impact-driven fashion, demonstrating the transformation of local, discarded materials into marketable luxury products.

- *Production Partners*: Selected locally or regionally, they offer resources and manufacturing capabilities, enabling participants to translate concepts into prototypes by providing access to advanced production and manufacturing capabilities. Typically, production partners are secured ahead of the challenge to ensure alignment with the conceptual and technical requirements of the projects. However, in this particular case—given the experimental and open-ended nature of the challenge—it was decided not to secure a production partner in advance. This approach allowed for greater flexibility in exploring innovative directions during the challenge.

After the winning proposal was selected, the complexity of translating the concept into a viable prototype highlighted the need for specialized expertise. As a result, the Ibdå collective was brought in as a production partner to handle the critical research and development (R&D) needed. Their involvement provided the technical support required to overcome challenges and ensured the successful realization of the participants' ideas.

This adaptive strategy illustrates how the dual-partnership model can be modified to address the unique demands of experimental challenges, balancing the need for conceptual exploration with the practical requirements of implementation. Applied across the Tanween Challenges, this model integrates international expertise with local resources, fostering an environment conducive to innovation while simultaneously strengthening local capacity.

Hybrid jury model: global online and in-person local experts

The Tanween Challenges employed a hybrid jury model, combining in-person local experts with online global participants. This panel included specialists in sustainable fashion, material innovation, and cultural heritage from academia, industry, and cultural institutions, offering a comprehensive assessment of the projects. The jury evaluated not only the design and aesthetic qualities of each project but also their alignment with sustainable practices and cultural relevance. Their feedback provided valuable insights, guiding participants to understand the broader impact of their work while ensuring objective and well-rounded evaluations.

A GROUP-FORMING APPROACH: FLUID TEAMS AND SCALABLE SUPPORT STRUCTURES

Fluid team building systems

- *Theme-based teaming*: Participants were organized into interdisciplinary teams representing diverse regions and backgrounds, which enriched the design process by incorporating varied perspectives and cultural insights. Team formation took place on day 2, following the presentation of the initial sprint's outcomes—moodboards and research findings. This fluid, impact-driven team-forming approach prioritized the alignment of project directions over affinities, fostering teams that could adapt and evolve as the project progressed.
- Evolution of *team compositions*: team compositions continued to evolve even after the challenge concluded. For instance, the Naseem team, which initially comprised four members, transitioned to three by the end of the challenge, with two participants subsequently expressing interest in co-founding a startup or brand based on their project. The third team member opted to continue as an advisor, indicating a fluid, adaptable approach to team roles that extended beyond the immediate challenge.
- *Project-based stakeholder outreach*: Through strategic outreach, the challenge facilitated connections between participants and potential future partners relevant to each project's focus. For example, Muatah (Fig. 04) was connected with a local date production company to explore the use of date by-products. This approach established a pathway for each project to develop meaningful industry relationships that could support continued growth and real-world applications beyond the challenge.

Materials used in Tanween Sustainable Fashion Challenge proposals

Material	Type	Waste Status	Notes	Proposal
Camel Fur	Biological	Waste (usually burnt)	Triggered by a participant's memory of camel hair burning on her father's farm, highlighting its underutilized potential.	Lohab
Sand	Mineral	Waste (extracted during camel hair cleaning)	Collected as a byproduct of cleaning camel fur; repurposed for integration into material composites.	Lohab
Fish Scales	Biological	Waste (byproduct from fishing industry)	Merged with salt to create a biomaterial designed for complete dissolution in seawater.	MRG
Sea Salt	Mineral	Waste (from desalination process)	Challenging due to its hydrophilic nature, requiring innovative material-binding techniques.	MRG
Palm Fiber	Biological	Waste (byproduct of date palm agriculture)	In Saudi Arabia, date palm fibers, known locally as "الليف", are often considered agricultural waste. The country, being one of the largest producers of dates, generates substantial amounts of this byproduct annually. Traditionally, these fibers have been discarded or burned, leading to environmental concerns. However, recent studies highlight the potential of date palm fibers for various applications, including bioethanol production and sustainable material development. (Al-Rajhi & Abdelghany, 2023)	Muatah
Date Kernels	Biological	Waste (byproduct of date processing)	Represents cultural significance and abundance in Saudi agriculture.	Muatah

Tab. 02

Material	Type	Waste Status	Notes	Proposal
Leftover Fabrics	Biological/ Mineral	Waste (collected from tailors and designers)	Incorporated for texture and layered aesthetics.	Safouna
Pomegranate Skins	Biological	Waste (food industry byproduct)	Processed for bio-leather production, adding vibrant natural colors and aromatic properties	Naseem
Tangerine Peels	Biological	Waste (food industry byproduct)	Combined with other citrus for aromatic and durable material creation.	Naseem
Lime Peels	Biological	Waste (food industry byproduct)	Adds unique texture and citrus-based fragrances. Seasonal. Linked to traditional customs.	Naseem
Mango Pulp	Biological	Waste (non-commercialized produce)	Sourced for its aromatic properties, color, flexibility and durability in bio-material production.	Naseem
Lavender Buds	Biological	Commercialized	Used for aromatic properties, reflecting local ecological richness.	Naseem
Green Pumpkin Pulp	Biological	Waste (non-commercialized produce)	Represents seasonal abundance and versatility in material creation.	Naseem

Tab. 02

Scalable custom support systems

- *Mentorship*: During the 6 days of the challenge, the knowledge partner, represented by its co-founder, provided mentorship to the teams. This was supported by the challenge leader from the Ithra Idea Lab team, with the support of a senior mentor – also from that team. After the challenge, weekly meetings, both in-person and online, with the knowledge partner and the challenge leader, provided ongoing guidance and mentorship.
- *Support of Ithra's Idea Lab*: Ithra's Idea Lab offered resources, coordination, and expert input to facilitate the challenge as well as post-challenge development. For example, the Idea Lab offered access to the participants to a biomaterials workshop.
- *Support of External Experts*: As highlighted in the previous section, the winning team, MRG, required additional expertise for material development in the post-challenge phase, as the concept was promising but difficult to implement, according to the jury and Ithra Idea Lab team. To address this, Ithra invited Ibdå to join as an R&D-focused production partner, to help translate the concept into a working prototype. Ibdå further contributed by assigning specialists, showcasing the role of collective intelligence in advancing the challenge's goals.

Each team was thus a microcosm of collective intelligence, integrating participants with diverse areas of expertise and regional backgrounds, which is shown to facilitate cross-pollination of ideas and enhance innovation potential (Levine & Moreland, 2004; Woolley et al., 2010). This diversity underscores the value of a collaborative, interdisciplinary approach, aligning with findings that suggest innovation often emerges from blending different perspectives in team environments (Johnson, 2010).

Framed under the challenge's overarching 'Dare to Fail' title, aligned with the 'Fail Forward' theme of the conference, the experience reflected the inherent uncertainties of experimental design, with participants navigating evolving team dynamics, material development challenges, and the complexities of translating concepts into viable prototypes.

A CROWD-SOURCED APPROACH: AUGMENTED COLLECTIVE INTELLIGENCE MODELS

Artificial intelligence (AI) tools supported the creative processes of the challenge teams. Vizcom, an AI-based tool, was used to transform early sketches into digital renderings (Vizcom Technologies, Inc., 2024), incorporating visual elements derived from preliminary material experiments. This collaboration between the teams and AI facilitated a blend of human creativity with machine-generated refinement, drawing on a collective intelligence embedded in Vizcom's datasets of prior works. While AI-generated imagery typically raises ethical concerns regarding ownership, accountability, and social impact (Franzke et al., 2023), these issues were mitigated here. The AI outputs were created using original sketches and reference images from the teams' physical experiments, thus preserving the uniqueness of their contributions while enhancing them through AI assistance (figure 1b). This approach aligns with the concept of Augmented Collective Intelligence, where AI acts as an enabler of human creativity (Woolley et al., 2010).

In addition, in the post-challenge development phase, the teams tapped into collective intelligence through online platforms like Materiom, which provides open access to recipes and research on sustainable materials (Materiom, 2024). By using Materiom, participants gained access to a global network of sustainable material innovations, allowing for environmentally responsible design exploration based on established research. This combination of AI support and open-access platforms expanded the teams' capabilities in sustainable material development and design.

AN AGILE DESIGN INNOVATION FRAMEWORK

CHALLENGE TIMEFRAME AND STRUCTURE

The six-day Tanween Challenge followed a structured, high-intensity format inspired by the charrette model, which combines rapid prototyping and interdisciplinary collaboration to tackle complex problems (Lennertz & Lutzenhiser, 2006). Each day of the challenge was organized as a single-day sprint, borrowing from the Agile methodology (Schwaber & Sutherland, 2017) and adapted for swift progress through iterative cycles.

Each day functioned as a focused sprint with an action-oriented verb guiding its theme (Tab. 03), incorporating a mix of lectures, tutorials, working sessions, discussions, and presentations. This combination of activities provided participants with theoretical insights, practical guidance, and collaborative feedback, facilitating rapid development and iterative refinement of their concepts within the structured yet fast-paced environment of the Tanween Challenge.

The six-day structure was fast-paced yet systematic, enabling participants to progress swiftly from conceptualization to prototyping. Day 1 (Re-value) focused on research and the identification of undervalued materials, exploring their transformative potential. Day 2 (Conceive) introduced moodboards and initial material testing, emphasizing the integration of local crafts and modern technologies. By Day 3 (Materialize), teams were actively creating digital models and physical prototypes, supported by tools such as 3D printers and laser cutters. Day 4 (Refine) emphasized detailed renderings, technical drawings, and sourcing strategies. Day 5 (Strategize) introduced branding, cost positioning, and market communication, culminating in Day 6 (Present), where teams pitched their concepts to a jury, showcasing their journey from initial research to early-stage prototypes.

This approach ensured that participants could explore innovative solutions while managing the constraints of time and resources. The iterative, sprint-inspired framework supported the dynamic and collaborative nature of the Tanween Sustainable Fashion Challenge, demonstrating how rapid iteration can drive impactful outcomes within interdisciplinary contexts.

This six-day journey was preceded by a carefully planned pre-challenge phase, which laid the groundwork and established the themes, and followed by a post-challenge phase, culminating at the conference. The paragraphs that follow analyze the pre-challenge and post-challenge phases, extracting key insights on preparation, execution, and strategies for sustaining influence beyond the initial event.

PRE-CHALLENGE RESEARCH, PREPARATION, AND DECISION MAKING

The pre-challenge phase involved participant selection, team formation, and briefings to establish a shared vision and methodology. This stage began with drafting the design brief and assessing the feasibility of achieving the ambitious goal: transforming waste materials into a luxury handbag concept within six days. Aligning with the 2024 Tanween Conference theme, Fail Forward, which emphasized risk-taking in the design process, the Ithra team embraced this high-risk challenge. They believed that the true impact extended beyond creating marketable products, focusing instead on raising awareness and fostering local knowledge about regenerative possibilities within the fashion industry.

After finalizing the brief, the team sourced local organic and discarded materials as primary resources, supplemented by sustainable materials like vegan leathers and regenerative textiles. Accessories such as metal handles, chains, and ropes were also procured to support prototyping. The workspace, equipped with tools like 3D printers, laser cutters, and sewing machines, was carefully organized to facilitate rapid hands-on development, drawing on lessons from previous challenges.

POST-CHALLENGE PROJECT DEVELOPMENTS AHEAD OF THE TANWEEN CONFERENCE SHOWCASE

Initially, only the winning project was intended for the Tanween public conference showcase. However, given the successful outcomes of all proposals (Fig. 01, Fig. 02, Fig. 03, Fig. 04 illustrate some of the outcomes), Ithra, together with the knowledge partner, chose to mentor all interested teams, offering them the chance to further develop their concepts for exhibition at the conference. After the challenge, the challenge leader and the knowledge partner, now acting as mentors, convened with all participants to set a structured plan of action. Through this ongoing mentorship and planning process, three concepts—MRG, Naseem, and Muata'—were ultimately selected for exhibition. The paragraphs below detail the development of the Naseem and MRG projects and extract findings from all teams in the post-challenge phase, highlighting key challenges for long-term continuation and solutions set forth.

The Case of Naseem: From Prototype to Venture

Naseem's development was characterized by a passion-driven, self-led approach. The team underwent voluntary reshuffling to ensure alignment and commitment among its members,

Daily agenda of the Tanween 2024 Sustainable Fashion Challenge (synthesized version)

Day	Action-Driven Theme	Activities	Focus
Day 1	Re-value	Research boards	Devalued Materials, Crafts & Visual Heritage
Day 2	Conceive	Concept & material samples	Moodboard, Material Tests, Concept & Visual Narrative
Day 3	Materialize	Prototypes & models	Digital Models, Physical Prototypes, Sketches and Files
Day 4	Refine	Renders & details	Detailed Renderings, Technical Drawings, Manufacturing Manuals
Day 5	Strategize	Collection & brand	Collection Architecture, Brand Identity, Costs & Positioning
Day 6	Present	Showcase & pitch	Rehearsal, Jury Presentation

Tab. 03

ultimately enabling the project to move forward with a dedicated focus.

The Case of MRG: From Concept to Prototype

The MRG project involved a challenging task that required advanced expertise in biomaterials. Ibda, as the production partner, facilitated over 90 trials and material experiments in a specialized lab to develop the custom material needed for the concept's realization.

Challenges for Long-Term Continuation

Several obstacles emerged during the post-challenge phase. A lack of specialized expertise hindered progress in material development, as some projects required advanced R&D capabilities in biomaterials and sustainable practices. Additionally, logistical challenges arose from the geographical dispersion of team members and their professional commitments, which limited their availability for collaboration.

Solutions Set Forth

To overcome these challenges, collaborations with R&D experts and specialized labs played a pivotal role in addressing technical complexities and advancing prototypes. Furthermore, team restructuring was facilitated voluntarily, allowing projects to continue with aligned and dedicated members, ensuring the continuity and development of the concepts.

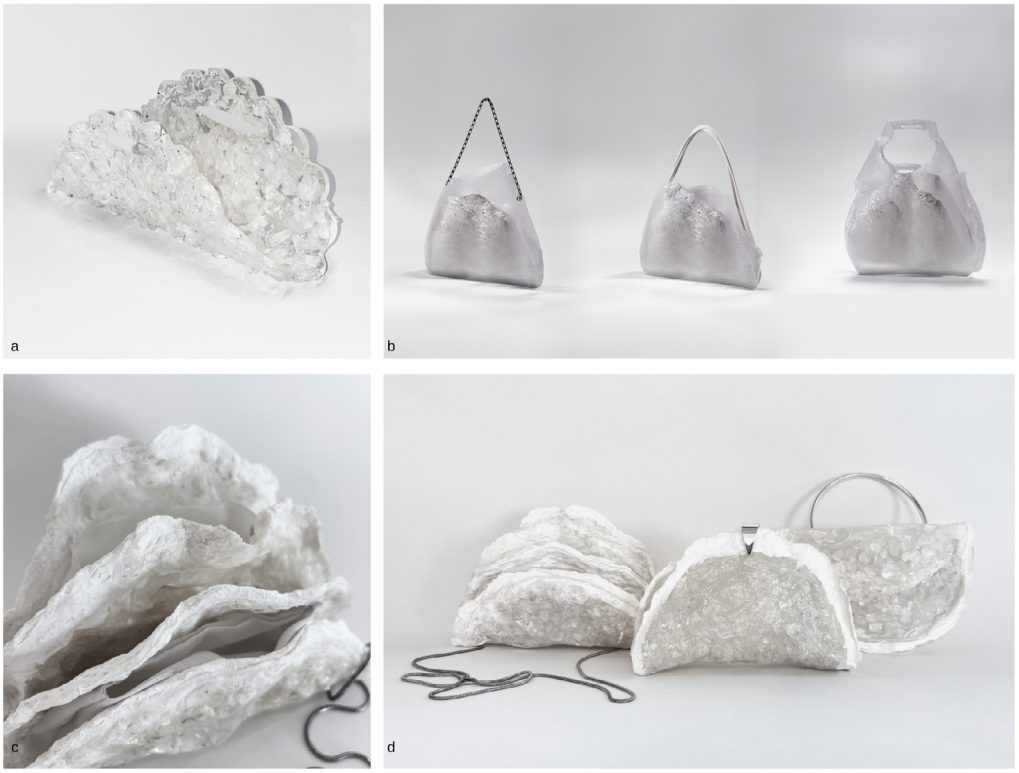
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Fig. 01

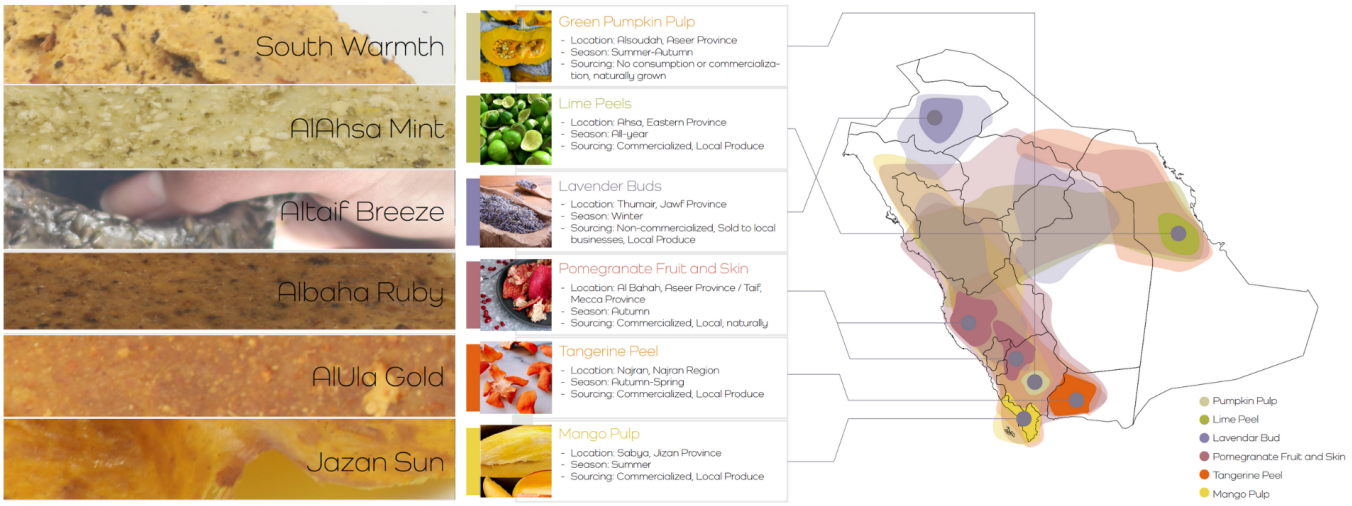

South Warmth
AlAhsa Mint
Altaif Breeze
Albaha Ruby
AlUla Gold
Jazan Sun
Green Pumpkin Pulp
- Location: Alsoudah, Aseer Province
- Season: Summer-Autumn
- Sourcing: No consumption or commercialization, naturally grown
Lime Peels
- Location: Ahsa, Eastern Province
- Season: All-year
- Sourcing: Commercialized, Local Produce
Lavender Buds
- Location: Thumair, Jawf Province
- Season: Winter
- Sourcing: Non-commercialized, Sold to local businesses, Local Produce
Pomegranate Fruit and Skin
- Location: Al Bahah, Aseer Province / Taif, Mecca Province
- Season: Autumn
- Sourcing: Commercialized, Local, naturally
Tangerine Peel
- Location: Najran, Najran Region
- Season: Autumn-Spring
- Sourcing: Commercialized, Local Produce
Mango Pulp
- Location: Sabya, Jizan Province
- Season: Summer
- Sourcing: Commercialized, Local Produce
Pumpkin Pulp
Lime Peel
Lavendar Bud
Pomegranate Fruit and Skin
Tangerine Peel
Mango Pulp

Fig. 02

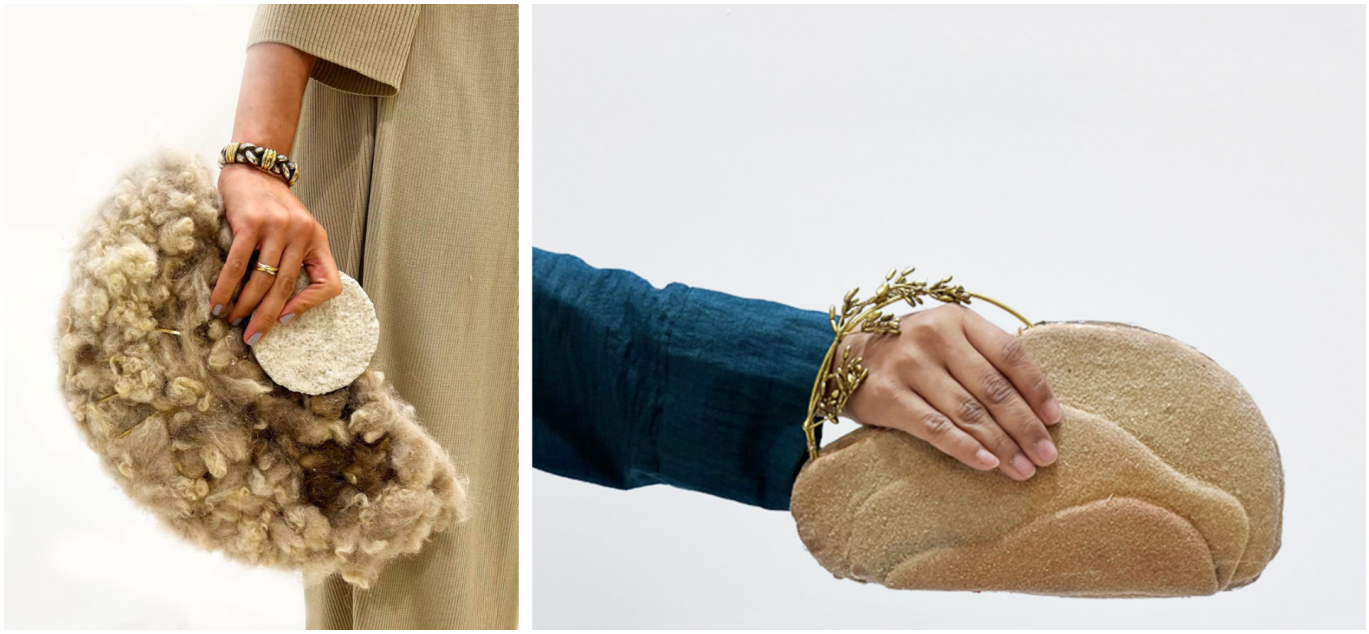
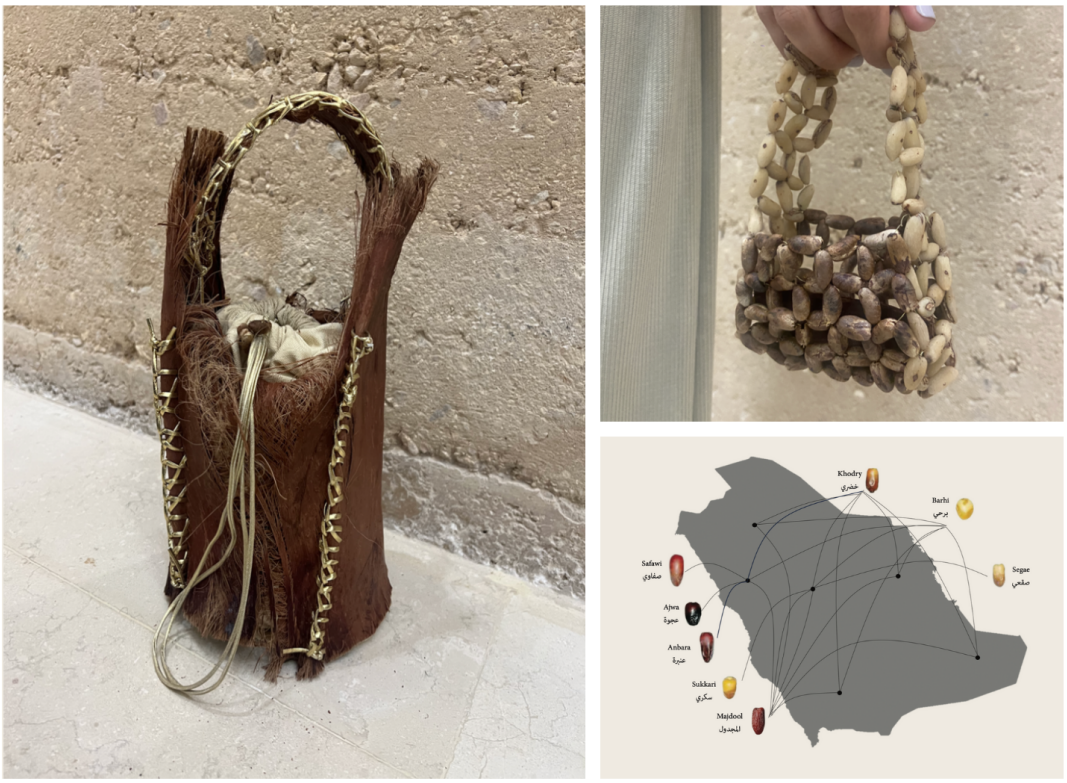


Fig. 03


Khodry
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Sukkari
سكري
Majdool
المجدول

Fig. 04

LONG-TERM MULTI-LAYERED LEGACIES

The following paragraphs investigate the impact of the challenge by analyzing its different long-term outcomes.

DISSEMINATION OF IDEAS

The challenge itself served as a critical platform to expose participants and their communities to alternative approaches to fashion prosperity. It emphasized upcycling undervalued materials by turning waste to luxury, and identifying local cultural heritage—shared through a mix of lectures, tutorials, experiments, and discussions.

The dissemination continued through press coverage, social media posts, videos, and interviews. At the Tanween Conference, prototypes of three projects (MRG, Naseem, and Muatah) were showcased, engaging an interdisciplinary audience of diverse backgrounds. Additionally, the knowledge partner delivered a talk, sharing behind-the-scenes insights into the challenge, highlighting the pre- and post-challenge processes, and emphasizing the potential of sustainable practices in redefining fashion. The Tanween Challenges Legacy section also presented outcomes from previous years, underscoring the long-term impact and commitment to project implementation beyond the prototype stage. For instance, the outcome of a previous fashion challenge—a handbag made of kombucha leather—is now available for purchase, demonstrating how concepts developed during the challenges can evolve into market-ready products. This legacy highlights the sustained efforts to advance the projects, ensuring their continued relevance and impact.

RE-VALUATION OF UNDERVALUED MATERIALS AND WASTE

Participants uncovered a variety of undervalued local materials, offering insight into Saudi's specific ecological and cultural resources. This included agricultural byproducts, industrial remnants, and natural materials that could be reimagined for fashion applications (Tab. 02). Although the transformations remained at a prototype stage, they demonstrated significant promise for material innovation and redefined the potential of fashion in a local and sustainable context, as highlighted by the jury's feedback and evaluation.

MATERIAL INNOVATION AND WASTE-TO-LUXURY PROCESSES

The Tanween Sustainable Fashion Challenge supported the creation of innovative sustainable materials that addressed key challenges in fashion production (Tab. 04).

MRG introduced a sea-sourced binder developed by the Ibdå team, functioning as a biodegradable resin-like material. This material provided an alternative to synthetic and bioresins, the latter being odor-free but non-biodegradable. By combining scientific research and artisanal testing, MRG demonstrated how materials could address environmental challenges while leveraging local ecological resources.

The MRG, Muatah, and Naseem projects emphasized the act of designing as integral to material remediation. Instead of sourcing pre-existing sustainable materials, designers engaged in a closed-loop process, from sourcing raw byproducts to cleaning, processing, and forming the bags directly through the material transformation process. For example, Muatah's work with palm fibers and date seeds required cleaning, polishing, and shaping these materials into both structural components and decorative elements, creating a seamless connection between material innovation and design.

This approach underscores the importance of integrating design with material development, fostering a holistic process that not only creates sustainable products but also enhances the environmental and cultural value of local resources.

REVISITING AND COMMUNICATING CULTURAL IDENTITY

The projects reflected a deep engagement with Saudi Arabia's cultural and ecological heritage, creating materials and designs that reconnected with local stories, practices, and landscapes. By linking materials to personal and regional narratives, these projects demonstrated how design can serve as a bridge between cultural storytelling and sustainable innovation. The key cultural inspirations, materials, and approaches are summarized in Table 05.

The integration of cultural diversity into sustainability frameworks extends beyond material innovation to carry a political dimension, reinforcing regional identities and resisting the homogenizing forces of globalization. The projects developed through this challenge demonstrate how local heritage can drive sustainable innovation, merging

Materials developed during the challenge: properties and conventional counterparts

Material	**Properties**	**Standard** (Non-Sustainable) **Alternatives**
MRG's Sea-Sourced Binder	Biodegradable, clear, resin-like adhesive made entirely from sea-based materials; binds fish scales and salt while addressing salt's hydrophilic nature.	Traditional bioresins: odor-free but not biodegradable. Synthetic resins: durable but derived from petroleum and non-biodegradable.
Naseem's Aromatic Bio-Leather	Biodegradable, leather-like material with rich sensory properties, including regional aromas and textures.	Animal leather: durable but resource-intensive and unethical to some. Synthetic leather (e.g., PU or PVC): often non-biodegradable and toxic.
Muatah's Palm Fiber Composites	Combines the flexibility of leather when wet and rigidity of wood when dry, allowing moldable applications.	Conventional leather: non-biodegradable and resource-intensive. Wood composites: require synthetic adhesives, adding environmental concerns.
Muatah's Date Seed Beads	Durable, natural, and biodegradable beads derived from agricultural byproducts (date seeds).	Acrylic, glass, or synthetic beads: visually appealing but resource-heavy, non-biodegradable, and often energy-intensive to produce.

Tab. 04

material exploration with cultural storytelling to foster more pluralistic, resilient, and regenerative models of design that reflect the richness of Saudi Arabia's natural and cultural landscapes.

NEW VENTURES

The challenge nurtured entrepreneurial potential, with Naseem evolving into a startup that offers a collection of goods celebrating the colors, aromas, and textures of organic leftovers from different provinces. Supported by Ithra's Idea Lab and the knowledge partner, Naseem refined its prototypes and developed a comprehensive business plan.

NEW COLLABORATIONS

Following the review of the challenge outcomes, other institutions, such as the Saudi Fashion Commission, expressed interest in collaborating on future fashion challenges, according to interviews with the Ithra team and program leader. This engagement underscores the potential of fashion as a tool for fostering impact-driven, cross-sector collaboration, drawing together stakeholders from industry, public institutions, and academia around shared sustainability goals. The positive reception of the challenge outcomes thus acted as a catalyst for future partnerships, positioning fashion as a strategic platform for generating meaningful social and environmental impact.

CONCLUSION

The Tanween Sustainable Fashion Challenge 2024 highlights the importance of collective intelligence and cross-sector collaboration in advancing sustainable practices within the fashion industry. Through its glocal framework—bridging local material exploration with global dissemination—the challenge demonstrated how localized efforts, when combined with interdisciplinary expertise, can contribute to systemic innovation. By integrating methodologies such as charrettes and sprints, participants were able to address ecological and

Cultural connection and sustainability approach of four of the proposals

Project Name	Arabic Meaning	Materials Used	Cultural Connection	Sustainability Approach
MRG (مرج)	“To merge/coexist”	Fish scales, salt – along with custom-developed sea-sourced binder	Saudi Arabia, the largest country without rivers, relies heavily on its seas for fresh water. The project draws inspiration from Alkhobar’s deep connection to marine life and its seas. Reflects the Quranic verse: مَرَجَ الْبَحْرَيْنِ“ يَبْغِيَانِ“ (الرحمن: يَلْتَقِيَانِ * بَيْنَهُمَا بَرْزَخٌ لَا 20-19) [“He released the two seas, meeting side by side; between them is a barrier [so] neither of them transgresses.” (Surat Ar-Rahman: 19-20)]	Sea-sourced biodegradable (made with bi-products of sea-based industries: water desalination and fishing industry) material dissolving back into the sea
Muatah (معطاه)	“The giver”	Palm fibers, date seeds	Rooted in memories of family date farms	Upcycling agricultural byproducts
Lohab (لوهب)	“Gift of joy”	Camel hair, desert sand, desert plant (Hiram)	Inspired by camel farming heritage, desert ecosystem, and the ancient joy of camel births	Reviving overlooked resources like camel hair and connecting materials to natural cycles
Naseem (نسيم)	“Breeze”	Tangerine peels, pomegranate skins, lavender buds, etc.	Embodies regional diversity and personal sensory memories of Saudi’s provinces	Transforming food waste into aromatic bioleather

Tab. 05

cultural challenges in a structured, fast-paced environment, producing actionable outcomes.

The challenge's significance extends beyond the prototypes developed. It fostered knowledge-sharing and capacity-building, facilitated through the involvement of partners like Vanina and Ibdå. These collaborations emphasized the role of cross-disciplinary networks in supporting local initiatives and demonstrated how the exchange of knowledge across regions can create opportunities for sustainable innovation. Furthermore, the engagement of academia, industry, and government sectors reinforced the value of integrated approaches in addressing complex environmental and social issues.

By encouraging a shift from human-centered to life-centered approaches, the 2024 Tanween challenges underlined the need to align design practices with regenerative methods. Initiatives like Tanween illustrate how fashion can raise awareness about ecological challenges, celebrate cultural heritage, and enable sustainable development through structured, collaborative models. This approach is essential for fostering long-term systemic change in response to the pressing challenges of today.

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- **Curators**: Joanne Hayek and Mirko Daneluzzo (DIDI faculty), introduced to the Ithra team by Dr. Carlos Montana.

Sustainable Fashion Challenge Challenge:

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- **Challenge Participants**:
  - ***MRG Team***: Ebaa Altaweel, Ghayda Alnasser, Rawan Alsalem
  - ***Naseem Team***: Albatool Almuhanna, Anwar Alsafwani, Fatima Nammi, Haifa Aldaham.
  - ***Naseem Venture***: Anwar Alsafwani, Haifa Aldaham.
  - ***Muatah Team***: Nora Alghaihb, Rawan Alqahatani, Sara Alawad.
  - ***Louhab Team***: Amani Alamoudi, Mudhy Alhassoon, Rawabi Alotaibi.
  - ***Safouna Team***: Amjad Alqahtani, Amal Almazed, Moadah Alomran
- **Jury Members**: Dr. Andra Clitan (DIDI faculty), Emilie Duval (Former DIDI faculty), Razan Alissa (Lead Creative Programs Developer, Ithra), Shahd Wazani (Senior Program Developer, Ithra).

CAPTIONS

[Fig. 01] The MRG Concept and Prototypes: (a) non-biodegradable initial concept prototype using resin with salt and fish scales - courtesy of MRG team; (b) AI-generated images of the MRG concept – courtesy of MRG Team; (c) and (d) MRG prototypes presented at the conference, featuring a custom-developed sea-sourced bioresin that merges the fish scales with the salt, and can dissolve back in the sea – courtesy of the Ibda team.

[Fig. 02] Naseem: (left) developed materials: names and early trials; (right) raw materials: location in Saudi Arabia, season and sourcing mode. Courtesy of Naseem team.

[Fig. 03] Lohab: (left) winter season early prototype woven using Camel fur; (right) summer season early prototype developed with sand. Courtesy of Lohab team.

[Fig. 04] Muatah: (left) bucket bag crafted using wasted palm fibers; (right top) mini bag crafted using date seeds turned to beads; (right bottom) map of variety of date types found in Saudi Arabia according to the regions. Courtesy of the Muatah team.

[Tab. 01] Overview of Participant Disciplines, Skills, and Regional Representation.

[Tab. 02] Materials used in Tanween Sustainable Fashion Challenge proposals.

[Tab. 03] Daily agenda of the Tanween 2024 Sustainable Fashion Challenge (synthesized version).

[Tab. 04] Materials developed during the challenge: properties and conventional counterparts.

[Tab. 05] Cultural connection and sustainability approach of four of the proposals.

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