SATWIKA
Kajian Ilmu Budaya dan Perubahan Sosial

Editorial office: Institute of Culture, University of Muhammadiyah Malang, Indonesia, Jalan Raya Tlogomas 246 Malang Jawa Timur 65144 Indonesia.
Phone: +6285755347700, (0341) 460318
Email: jurnalsatwika@umm.ac.id
Website: https://ejournal.umm.ac.id/index.php/JICC

Designing modular camera bags for outdoor photographers: A human-centered response to visual culture and environmental challenges in Indonesia

Dewi Pitaloka Sari[a1*], Hanif Azhar[b2], Bintang Nugraha[c2]
[abc]Telkom University, Bandung, Indonesia
[1]*saridewipitaloka@gmail.com*; [2]*hanifazhar@telkomuniversity.ac.id*; [3]*bintangnugraha@telkomuniversity.ac.id*

Article History
Accepted: May 21. 2025
Revised: June 26, 2025
Available Online: October 31, 2025

***Corresponding**
saridewipitaloka@gmail.com

10.22219/satwika.vV7i2.40843

jurnalsatwika@umm.ac.id

How to Cite: Sari, D. P., Azhar, H., & Nugraha, B. (2025). Designing modular camera bags for outdoor photographers: A human-centered response to visual culture and environmental challenges in Indonesia. *Satwika: Kajian Ilmu Budaya dan Perubahan Sosial*, 9 (2), 367-378. https://doi.org/10.22210/satwika.v9i2.40843

ABSTRACT

Outdoor photography represents an evolving visual culture practice within Indonesia's digital society, where mobility, self-expression, and environmental adaptability are increasingly crucial. However, existing photography gear often fails to address the contextual challenges faced by outdoor photographers, particularly in relation to unpredictable tropical weather and the demands of a mobile digital lifestyle. This study responds to this gap by designing a modular camera bag using a Human-Centered Design (HCD) approach. Employing a qualitative case study method with participatory elements, the research integrates interviews, field observations, and questionnaires involving urban outdoor photographers. The design process follows the IDEO Human-Centered Design (HCD) framework, consisting of the stages of Inspiration, Ideation, and Implementation, and is supported by a thematic analysis of field data to derive actionable design insights. The resulting design emphasizes spatial flexibility, weather-resistant materials, and a modular system that promotes sustainability and personalization. Beyond addressing functional requirements, the bag embodies visual identity and reflects how everyday object design can negotiate cultural expressions, environmental adaptation, and digital mobility within Indonesia's socio-visual landscape.

Keywords: *outdoor photography, human-centered design, modular design, visual culture, visual identity*

ABSTRAK

Fotografi outdoor merupakan praktik yang berkembang dalam masyarakat digital Indonesia, yang ditandai oleh interaksi antara mobilitas, ekspresi diri, dan adaptasi lingkungan. Meskipun mengalami pertumbuhan, perlengkapan fotografi yang ada seringkali mengabaikan tantangan kontekstual yang dihadapi oleh fotografer outdoor, termasuk cuaca tropis yang tidak menentu dan tuntutan gaya hidup digital yang mobile. Penelitian ini mengatasi kesenjangan tersebut dengan merancang tas kamera modular menggunakan pendekatan Human-Centered Design (HCD), dengan metode kualitatif berupa wawancara, observasi lapangan, dan kuesioner yang melibatkan fotografer outdoor urban. Proses desain mengikuti kerangka kerja HCD IDEO, yang terdiri dari tahap inspirasi, ideasi, dan implementasi, serta didukung oleh analisis tematik data lapangan untuk menghasilkan wawasan desain yang aplikatif. Desain akhir menitikberatkan pada fleksibilitas ruang, material tahan cuaca, dan modularitas untuk mendukung keberlanjutan dan personalisasi pengguna. Selain memenuhi aspek fungsional, tas ini berfungsi sebagai artefak budaya yang mewujudkan identitas visual serta merundingkan hubungan antara mobilitas digital, kondisi lingkungan, dan ekspresi budaya. Penelitian ini memberikan kontribusi dalam memperluas kerangka desain produk yang responsif secara budaya dengan mengintegrasikan

dimensi sosial-budaya dan lingkungan, serta menjadi model inovasi berkelanjutan dalam konteks lanskap sosio-visual Indonesia.

***Kata kunci**: fotografi outdoor, desain modular, human-centered design, identitas budaya, identitas visual*

INTRODUCTION

Outdoor photography has experienced significant growth within visual culture and lifestyle, especially in the digital age (Siri et al., 2022). This activity requires technical skills and serves as a medium through which individuals document, share, and express their identities in both digital and physical spaces (Dijck, 2008). Mirzoeff (2015) explains that visual culture is a contested space where meanings are continuously produced and negotiated. The emergence of social media platforms such as Instagram and TikTok has further transformed photography into a participatory cultural practice that shapes personal and collective visual narratives (Rose, 2016). Jenkins et al (2013) argue that digital media enable the widespread dissemination of cultural content, fostering new forms of engagement and identity construction. In Indonesia, this phenomenon is reflected in the rapid growth of photography communities and the prolific creation of visual content that embodies urban lifestyles and social identities (Zhuang, 2020). According to Poetri & Melania (2024), current visual culture functions as a dynamic system of symbols and meanings that continually evolves with technological and social transformations, reflecting the hybrid characteristics of modern Indonesian visual expression.

The demand for digital photography equipment continues to increase globally, reflecting growing engagement with visual culture (Cruz, 2020). According to Statista (2024), the digital camera market is projected to grow at a Compound Annual Growth Rate (CAGR) of 2.67% between 2025 and 2029, with the market volume expected to reach approximately US$0.7 billion by 2029. This trend underscores the increasing demand for photography accessories tailored to outdoor activities, emphasizing the critical need for camera bag designs that effectively balance functional performance with contextual and environmental considerations (Norman, 2013; Sheller & Urry, 2006). Asriwandari et al (2023) assert that Indonesia's natural and cultural landscapes offer opportunities and challenges for creative practices, requiring design strategies that harmonize with ecological realities while ensuring user comfort and mobility in outdoor settings.

However, outdoor photography in tropical environments such as Indonesia presents unique challenges. High humidity, unpredictable rainfall, and diverse locations—from forests to coastal areas —demand equipment that supports high mobility, rapid accessibility, and robust protection against environmental factors. Pangestu (2021) emphasizes that extreme weather conditions can jeopardize photographic equipment and complicate fieldwork. Therefore, camera bags as essential accessories must balance functionality with adaptability to these conditions (Yang et al., 2023). Ridwan & Meitasari (2023) indicate that Indonesia's tourism and cultural heritage sites integrate environmental and social aspects, necessitating design solutions that are attuned to spatial and climatic variability while facilitating users' cultural engagement with their environment.

Previous studies, such as those presented in the journals Konsep Tas Modular Fotografi dan Videografi by Mahendra & Anam (2020) and Perancangan Tas Perlengkapan Kamera untuk Video Blogger by Madani et al (2023), have primarily focused on the functionality and flexibility of bags for general photographers or videographers. However, these studies have not explicitly addressed the needs and contextual use of camera bags for outdoor photographers in tropical environments such as Indonesia, which face unique climatic challenges and a distinct visual culture. Nayottama & Syarief (2023) emphasize that design visualization must embody consumers' beliefs and perceptions, underscoring cultural sensitivity as a crucial element of design development in the Indonesian setting.

Other studies have examined camera bag design from various perspectives. Kurniawan & Kusuma (2011) and Pepiana (2022) emphasized capacity and ergonomic aspects, focusing on storage optimization and ease of access. Azhar et al (2024) and Garip et al (2019) highlighted modularity as a key design strategy to enhance product flexibility, adaptability, and sustainability. Nevertheless, these studies have mainly overlooked integrating tropical environmental challenges with the cultural and social dimensions of outdoor photographers' visual lifestyles in Indonesia.

Moreover, the application of Human-Centered Design (HCD) principles within this socio-cultural context remains limited, hindering the development of camera bags that are both functionally effective and culturally meaningful.

This gap is important because camera bags serve as practical tools and cultural artifacts that mediate identity and social status within photographic communities (Schmitt, 2022). Mirzoeff (2015) and Pink (2013) emphasize that material culture plays a vital role in the performativity of identity, particularly in digital and urban spaces where visual expression is dominant. Atsabit & Irfansyaha (2023) illustrate how visual composition and mise-en-scène affect audience perception and emotional involvement—insights that can guide understanding how product aesthetics shape meaning-making and self-representation in photography communities. This perspective suggests that design elements such as color, form, and modularity do not merely serve technical purposes but also convey aesthetic codes and social meanings within communities (Yu, 2023).

Furthermore, digital platforms have reshaped how photographers engage with their audiences and construct their identities (McDonald et al., 2021). Visual culture scholars argue that platforms like Instagram and TikTok act as digital public spaces where aesthetics and identity are continuously performed and negotiated (Couldry & Hepp, 2017; Senft, 2013). This dynamic underscores the need for camera bag designs that resonate with the visual lifestyles shaped by these socio-digital interactions.

Given these considerations, this research aims to investigate how modular camera bag designs can accommodate the functional needs of outdoor photographers operating in Indonesia's tropical environment while simultaneously reflecting their visual lifestyle and identity within the socio-digital landscape. By employing a Human-Centered Design approach, this study seeks to develop camera bag solutions that address both environmental challenges and cultural demands. The research focuses on how flexible compartments and weather-resistant features can enhance usability and protection while considering how design elements can express community aesthetics and social symbolism.

By bridging technical, ecological, and cultural considerations, this study contributes to design research in the Global South by offering insights into how product design can respond to complex, context-specific needs to support both practical functionality and identity expression (Saad et al., 2023). Ultimately, this research expands the discourse on design studies by integrating visual culture theory with human-centered product development, thereby advancing knowledge of sustainable, culturally resonant design practices for outdoor photography accessories in tropical settings.

METHOD

This study employs a qualitative case study approach with a participatory design lens to explore the needs and preferences of outdoor photographers regarding camera bag design in Indonesia's tropical environment. Qualitative research is appropriate for understanding social phenomena from the perspectives of the individuals involved (Creswell & Creswell, 2018). The participatory design approach aligns with contemporary co-creation practices, emphasizing user involvement throughout the design process (Sanders & Stappers, 2008).

Data was collected through non-participant observation, in-depth interviews, and structured questionnaires. Non-participant observations were carried out over two months, with daily sessions lasting approximately 15 to 30 minutes, within a community of photographers in Jalan Braga, Bandung. The observations aimed to capture real-life behaviors and challenges photographers face during outdoor shoots, particularly regarding the use of camera bags. Approximately five photographers were observed during this period.

In-depth interviews were conducted with three professional outdoor photographers selected based on their active engagement in field photography. Interviews were face-to-face and online across Jakarta and Bandung, each lasting about 10 minutes. The interview topics included field challenges, camera bag preferences and issues, equipment carried, and desired bag features.

Additionally, a structured questionnaire comprising 11 closed-ended questions, using a 5-point Likert scale, was distributed online and via photography communities to 25 outdoor photographers across Indonesia. The questionnaire aimed to quantify the difficulties and needs associated with camera bag use. Results indicated that approximately 84% of respondents identified extreme weather conditions as the primary challenge when using camera bags, while ergonomic issues such as shoulder and back discomfort were also prominent concerns.

IDEO's Human-Centered Design (HCD) framework guided the design process, encompassing three stages: Inspiration, Ideation, and Implementation. The HCD model emphasizes empathy, collaboration, and creativity throughout the design process, facilitating the development of innovative, user-centered solutions (Yunidar et al., 2024). During the Inspiration phase, data

from observations and interviews were collected to gain contextual insights into user needs and challenges. The Ideation phase involved developing mood boards, mind maps, and five modular design concepts, which 15 photographers subsequently validated through qualitative assessment sheets. The Implementation phase consisted of producing 3D mock-ups tested by three field photographers under tropical weather conditions, with iterative refinements based on user feedback.

To provide further clarity and context-specific detail, Table 1 outlines the design stages and objectives based on the HCD framework:

Table 1. *Design Process Stages and Objectives*

Stage	Activity	Objective
Inspiration	Analyzing	Understand user needs through various analyses (e.g., SWOT, user, activity, and product comparison).
Ideation	Mood Board	Set the visual and aesthetic direction.
	Mind Mapping	Organize ideas and features into a structured design reference (TOR).
	Alternative Sketches	Generate multiple design ideas.
	Final Sketch	Choose the most suitable design based on goals and user needs.
	3D Modeling (Final Design)	Visualize the selected design in 3D form.
	Technical Drawing	Detail design dimensions for prototyping.
Implementation	3D Validation	Test the 3D prototype in real conditions and gather user and expert feedback.

Data analysis was performed manually using open coding to identify key themes and patterns across observations, interviews, and questionnaire responses. Interview transcripts and field notes were thematically coded based on recurring user patterns and contextual behaviors. To strengthen the validity of interpretations, peer debriefing and participant feedback were integrated during the ideation and validation stages. Data triangulation was also employed by cross-verifying results from the three data sources (Patton, 2002). Consistent themes emerged regarding the need for flexible storage space, weather protection, and ergonomic comfort. These triangulated findings informed the development of a modular camera bag design tailored to the specific needs of outdoor photographers in Indonesia's tropical environment.

RESULTS

This section presents the main findings of the study, based on triangulated data from in-depth interviews, non-participant observations, and structured questionnaires with outdoor photographers in Indonesia. The objective is to identify user needs, contextual challenges, and design implications through thematic analysis, open coding, and direct participant quotations.

Inspiration

This chapter presents the main findings from the research and development process of a modular camera bag design for outdoor photographers. The findings are derived from triangulated data—including interviews, observations, and surveys—and are enriched with direct participant quotations. The discussion begins by exploring user needs and field experiences, which form the foundation for developing relevant, contextually appropriate design concepts.

Understanding Users

Interviews with three professional photographers—specializing in landscape, journalistic, and event photography—revealed various challenges in outdoor shooting (Figure 1). One landscape photographer noted that "the challenge is to produce good results regardless of the weather" (Interview, R1). An event photographer highlighted ergonomic issues, stating that "a sling bag hurts one shoulder, but with a backpack, it is hard to grab the camera quickly" (Interview, R2). On the other hand, a photojournalist expressed concerns about durability and material reliability, explaining that "my bag's material is not weather-resistant and makes me nervous when it rains or during crowded shoots" (Interview, R3).

Beyond these individual preferences, participants consistently mentioned the need to carry supplementary items such as raincoats, water bottles, and laptops. This emphasizes the need for a camera bag that offers modular organization and flexible storage, adapting to different assignments and travel conditions.

These interview findings were reinforced through non-participant observations of street photographers in Bandung. Researchers documented that photographers spent an average of 3 minutes setting up their gear, with time decreasing significantly when clients waited. Many struggled to access equipment quickly, particularly when bags lacked external or side compartments. These behavioral patterns confirm the critical importance of fast-access design features and ergonomic usability—especially in fast-paced or unpredictable field conditions.

Figure 1. *The photographer is preparing the camera equipment from the bag before shooting*

Moreover, a structured questionnaire completed by 25 outdoor photographers provided quantitative confirmation of these challenges. The user insights are summarized in Table 2 below.

Table 2. *Summary of Questionnaire Findings from 25 Outdoor Photographers*

Aspect	User Insight	Precentage
Weather Challenges	Weather, especially rain, is the biggest obstacle in outdoor photography.	84%
Equipment Accessibility	Quick access to camera gear is considered essential.	72%
Space Management	Difficulty organizing items inside the camera bag.	36%
Ergonomic Comfort	Users experience discomfort (shoulder/back pain) after prolonged usage.	32%
Bag Type Preference	Prefer backpack-type bags over sling bags.	68% backpack / 32% sling
Additional Storage Needs	Use of extra bags for personal items during shoots	72% use additional bags
Color Preference	Prefer neutral-colored bags (black/gray) for practical and aesthetic reasons	84% prefer neutral colors

Thematic Analysis

The thematic analysis was conducted by coding qualitative data from interviews, observations, and survey responses. This process identified three dominant themes that consistently appeared across data sources and reflected core user needs. These themes were then translated into actionable design implications to guide the development of a modular camera bag tailored for outdoor photographers.

The three primary themes—weather protection, ergonomic comfort, and accessibility—capture users' fundamental challenges and expectations. Weather protection relates to users' need for security in unpredictable environments. Ergonomic comfort reflects concerns about physical strain during prolonged use. Accessibility emphasizes the importance of intuitive and rapid access to equipment, particularly in time-sensitive situations.

The synthesis of these themes into design priorities aligns with the existing literature in product design, particularly studies that emphasize the importance of balancing protection, usability, and user comfort in outdoor gear. A summary of these themes and their associated design directions is presented in Table 3.

Table 3. *Summary of primary themes from qualitative data analysis*

Theme	Description	Design Implication
Weather Protection	There is a need for materials and structures that shield equipment from external hazards such as rain, dust, and impact.	Integration of waterproof fabrics, sealed seams, and reinforced compartments.
Ergonomic Comfort	Emphasis on reducing physical strain through well-distributed weight and cushioned support.	Use padded shoulder straps, adjustable load systems, and back panel ventilation.
Accessibility	Need for efficient access to camera gear during dynamic shooting scenarios.	Side and top access points, modular interior configurations, and external utility pockets.

Ideation

After thoroughly understanding user needs, the Ideation phase begins by exploring ideas and concepts for the modular camera bag to be developed. This process starts with creating a mind map, which serves as a visual aid to organize the main ideas based on the research findings from the Inspiration phase. This mind map outlines several key aspects of the design's focus: the structure and modularity of compartments, weather-resistant materials, ergonomics and load distribution, security aspects, and functionality for everyday use.

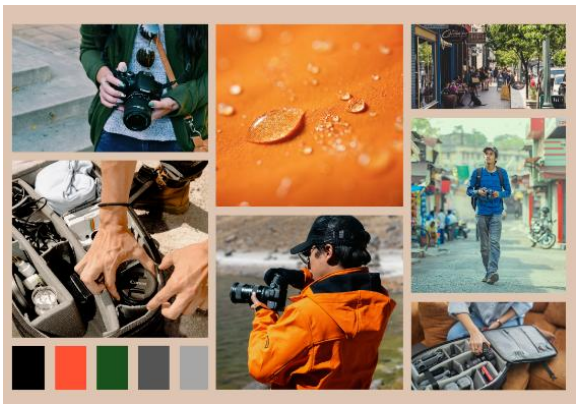

Figure 2. *Mood Board showing color palette and textures used as visual inspiration for the modular camera bag design*

Figure 3. *Mind Map organizing key design themes based on user needs analysis and data collection*

To complement the idea development process, a mood board containing visual references regarding forms, colors, textures, and relevant design inspirations was created (Figure 2). This mood board is a visual guide to maintain stylistic consistency and design ambiance, ensuring that solutions are functionally effective and visually aligned with the user's identity. Such visual tools are instrumental in communicating design intent and fostering user-centered design outcomes.

Furthermore, an alternative sketching process was undertaken to visualize various ideas (Figure 3). These sketches depict a range of potential structures, opening systems, ergonomic features, and compartment layouts. At this stage, water-resistant materials that can protect the equipment from rain and moisture, and padding on the shoulder straps and back for enhanced comfort, are also considered. A modular system with movable velcro partitions offers flexibility in organizing equipment according to the user's needs. These sketches were produced based on the results of the mind mapping phase and are intended to test various design approaches before selecting the best concept.

The following are five alternative sketches developed as design explorations, each offering different solutions to enhance the functionality, comfort, and efficiency of using modular camera bags for outdoor photographers.

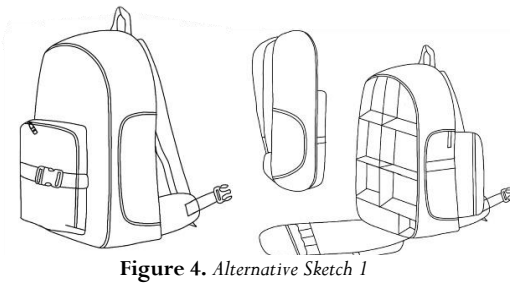

Figure 4. *Alternative Sketch 1*

Alternative Sketch 1 (Figure 4) is designed in a shape resembling a conventional bag. This design features a side-opening that provides quick access to the primary camera. On the other side, a compartment is intended to store small items, such as memory cards, spare batteries, and keys. The front of the bag features an additional modular compartment that can be detached and reattached as needed. Meanwhile, the bag's interior on the other side has storage space for a laptop, tablet, memory cards, and spare batteries, optimally supporting the user's mobility and storage needs.

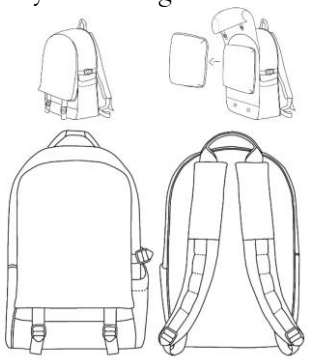

Figure 5. *Alternative Sketch 2*

Alternative Sketch 2 (Figure 5) features a cover that only covers the front of the bag. Behind this cover is a compartment for storing supporting equipment, such as lens-cleaning tools, USB cables, raincoats, and power banks. This bag also features a right-side opening to facilitate access to the interior. Meanwhile, on the left side, there is a pocket that can serve as a place for a water bottle or as a tripod support, depending on the user's needs.

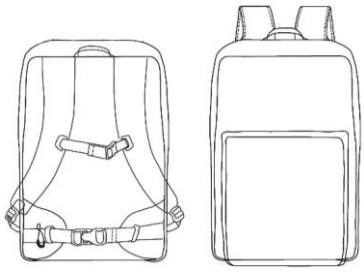

Figure 6. *Alternative Sketch 3*

Alternative Sketch 3 (Figure 6) features a functional, straightforward box shape. This bag has only two main compartments: a sufficiently large front compartment and a main compartment for core storage. This bag features additional straps at the waist and chest to enhance comfort and stability during use, making it suitable for activities that require high mobility.

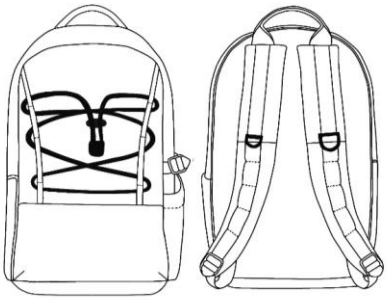

Figure 7. *Alternative Sketch 4*

Alternative Sketch 4 (Figure 7), at the front of the bag, where the elastic strap only covers a portion of the bag's surface, while the remaining part is utilized as an additional compartment for storing small items. Inside the bag, the main compartment features adjustable dividers to accommodate the user's needs. This feature provides flexibility in organizing storage space, particularly for camera equipment and other supporting accessories.

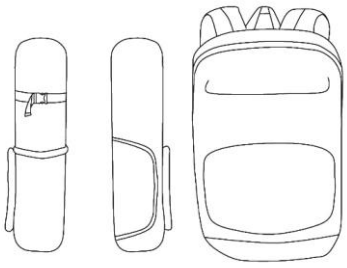

Figure 8. *Alternative Sketch 5*

Alternative Sketch 5 (Figure 8) features a long compartment at the front of the bag, designed to store personal items or equipment for photography activities. At the top front is an additional pocket with a zipper that securely stores other personal belongings while allowing easy access. Furthermore, on the side of the bag is a dedicated pocket for storing a tripod or water bottle, catering to users actively engaged in photography or videography.

A scoring and evaluation process was conducted on the five alternative sketches developed, involving outdoor photographers as potential users (Figure 9). This process aims to identify the design that best meets the user's functional needs and comfort. Alternative sketch number 2 received the highest score of 17 and was therefore chosen as the basis for further design development.

No	Sketsa Alternatif	Aspek					
		Fungsional	Estetika	Kenyamanan	Kemudahan Operasional	Keamanan	Total
1.	Alternatif 1	3	3	2	4	3	15
2.	Alternatif 2	4	4	2	3	4	17
3.	Alternatif 3	2	2	3	2	2	11
4.	Alternatif 4	3	3	2	3	3	14
5.	Alternatif 5	2	2	2	3	2	11

Figure 9. *Scoring Alternative Sketches*

One participant from Bandung noted that the side-opening feature was convenient as it saved time when reacting quickly to capture a shot. However, conflicting user needs emerged during the evaluation; while some preferred compact bags for mobility, others required larger capacity. This necessitated design compromises to balance modularity with structural stability. For example, a user from Jakarta commented that too many modular parts made the bag unstable and preferred a simpler design that offered flexibility.

Building on these insights, the final sketch represents the culmination of the design process, which has undergone iterative stages of analysis, evaluation, and development informed by user input (Figure 10). This user-centered, iterative approach aligns with established design methodologies that emphasize continuous refinement driven by stakeholder feedback. This design adopts a more geometric, box-like shape to enhance the bag's space utilization efficiency. Ergonomic adjustments to the strap have been made to improve user comfort, especially during extended carrying periods. Additionally, a dedicated compartment has been incorporated for storing memory cards and backup batteries, designed for easy access while ensuring security. Overall, this final sketch aims to meet users' functional needs while providing maximum protection for the camera equipment.

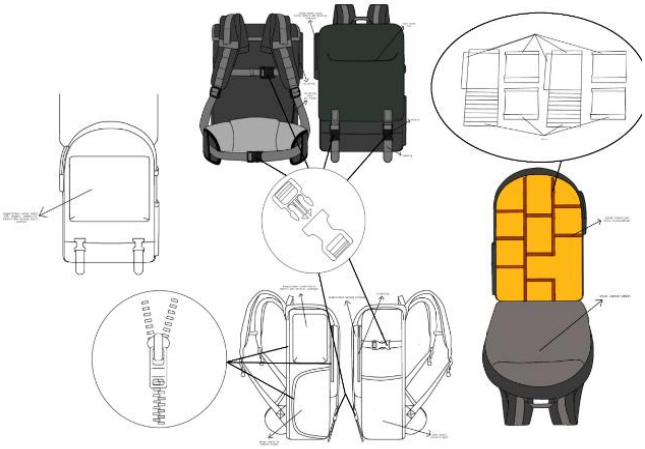

Figure 10. *Final Sketch*

The design integrates socio-cultural factors influencing outdoor photographers, particularly in their color choices (Figure 11). During the ideation stage, color selection was guided by a questionnaire distributed to respondents, which showed a majority preference for neutral tones. This became a primary consideration when choosing black and gray as the dominant exterior colors, as both convey an intense, profound impression while remaining neutral. Gray is a calm background amidst brighter or darker colors, while black is a timeless, modern, and stylish color that evokes elegance and luxury. These neutral exterior colors align well with the professional aesthetics valued within photography communities.

In addition to the neutral exterior, bright orange was applied to the interior compartments to enhance functionality. The high-visibility orange provides a clear contrast against the darker outer colors, facilitating users in quickly identifying items inside the bag, especially in low-light conditions. This choice supports usability and reflects a thoughtful design approach that balances practical needs with socio-cultural symbolism. Overall, the bag serves as both a tool and a cultural artifact that symbolizes professionalism and identity. Furthermore, the design responds to social media aesthetics, appealing to millennial users who prioritize style and practicality.

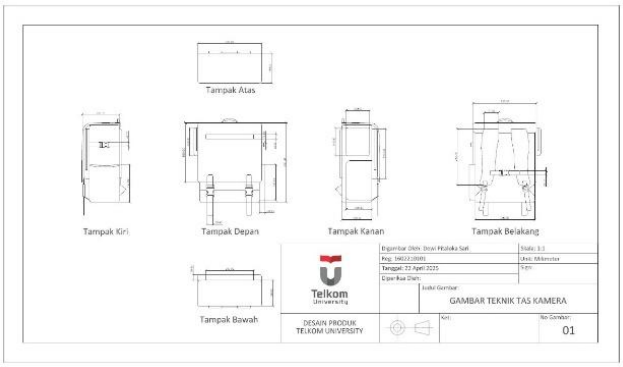

Figure 11. *Technical Drawing*

Implementation

In the implementation phase, the developed design was visualized through a detailed three-dimensional (3D) model, serving as a vital medium for further Validation and evaluation (Figures 12, 13, 14, 15). This 3D representation allowed clear communication of the design concepts, showcasing the bag's overall shape, proportions, and the strategic layout of its compartments. Validation sessions involving interviews and discussions with professional photographers, who regularly use camera bags in outdoor environments, provided valuable feedback that informed iterative improvements to the design. Engaging expert users in the evaluation process is a recognized practice in user-centered design to ensure product relevance and usability. These experts agreed that the bag's rectangular shape optimizes space utilization by minimizing unused volume, which is crucial for efficiently organizing photography equipment and accessories. Moreover, the ergonomic improvements to the shoulder and back straps were highly appreciated, as they significantly enhance comfort during prolonged use, reducing fatigue and strain.

Figure 12. *3D Model of the Camera Bag – Front View*

Figure 13. *3D Model of the Camera Bag – Side View*

Figure 14. *3D Model of the Camera Bag – Back View*

Figure 15. *3D Model of the Camera Bag – Side View*

The addition of dedicated compartments specifically designed for memory cards and backup batteries received positive remarks for their accessibility and security. Respondents emphasized that having these compartments positioned for easy reach, while protecting the items from accidental loss or mixing with

other gear, dramatically improves the user experience. Material selection was another key aspect validated during this phase. The chosen fabrics and components resist extreme weather conditions, impact, and humidity, ensuring delicate photographic equipment remains well protected during transport and outdoor activities. Ergonomically, the balanced weight distribution combined with padded straps reduces the user's physical stress, especially during extended carrying periods. The compartment arrangement also facilitates quick access and efficient equipment mobilization, which is essential for photographers who often need to react swiftly in dynamic shooting environments.

Despite meeting most functional and ergonomic criteria, the design's visual appeal was identified as an area for improvement. While the current aesthetic is professional and straightforward, some respondents suggested introducing subtle decorative elements such as patterns, textures, or minimalist motifs to add depth and character to the bag's appearance. Additionally, although practical, the bag's boxy, rectangular shape could be softened by incorporating slight curves or adopting a trapezoidal silhouette. These modifications would enhance the bag's modern and dynamic look and maintain, or even improve, its functional integrity and user comfort. By balancing aesthetics with practicality, the design can better meet the expectations of contemporary outdoor photographers who value style and performance.

DISCUSSION

Building on the results, this section discusses how the findings were translated into design strategies through the Human-Centered Design (HCD) approach. This approach emphasizes understanding people's needs, engaging stakeholders throughout the design process, and adopting a systemic approach to develop solutions that are usable, meaningful, and contextually appropriate (Melles et al., 2021). The iterative process involves discovering the right problem, defining user requirements, developing solutions collaboratively, and delivering tested designs that enhance user satisfaction and well-being.

The design of this modular camera bag demonstrates that a Human-Centered Design (HCD) approach can yield products that are genuinely responsive to users' diverse needs and preferences. The flexibility of the modular compartments provides significant added value for outdoor photographers who often face dynamic conditions and equipment of varying sizes. This adaptability supports user mobility and accelerates access to essential devices, such as cameras and supporting accessories, reflecting the demands of a mobile digital lifestyle.

Importantly, this study interprets the camera bag as a technical product and a cultural artifact. Drawing on perspectives from design culture and digital anthropology, the bag reflects social values, identity construction, and symbolic meaning in Indonesia's visual society. As photographers increasingly engage with digital platforms like Instagram, their gear becomes an extension of self-representation. The aesthetic yet professional appearance of the modular bag allows photographers to project competence, creativity, and mobility, integrating seamlessly into aspirational visual narratives. The bag is part of the performative toolkit that shapes one's online presence, reflecting professional capability and participation in visual subcultures.

The semiotic role of the bag also reinforces its symbolic capital in digital and urban environments. Through the lens of cultural theory, such design objects serve as markers of lifestyle and status, aligning with Bourdieu's notion of distinction and symbolic power (Bourdieu, 1984). Modularity signifies adaptability, a valued trait in contemporary creative professions, and echoes the expectations of flexibility and control in modern mobile work culture.

Using waterproof, impact-resistant materials addresses the challenges posed by Indonesia's fluctuating tropical climate and often harsh outdoor terrain. These materials enhance the bag's protective function and extend its lifespan, offering users long-term economic value. Material selection that prioritizes durability and environmental resistance is critical in product design for tropical and rugged outdoor conditions (Ashby, 2011; Zhai et al., 2021). This durability is crucial in outdoor equipment design, as emphasized in prior research (Pangestu, 2021).

From a sustainability perspective, modularity presents both opportunity and tension. On one hand, the detachable and replaceable components may reduce long-term waste by extending product lifespan and enabling repairs. On the other hand, modularity may also encourage continuous upgrading, reinforcing consumerist patterns common in photography gear culture. A critical reflection is required to determine whether the design promotes genuine sustainability or merely shifts the consumption model.

Ergonomically, the adjustable strap and padding design significantly improve comfort during prolonged use, reducing fatigue and injury risk through even weight distribution. This focus on comfort supports

photographers in maintaining creative focus during extended outdoor activities, an aspect often overlooked in similar products.

However, it is essential to recognize that photographers are not homogeneous. This study acknowledges the social complexities that influence who can access and benefit from such a design. Gender, social class, geographic location, and access to digital tools all shape photography practices. The current design primarily reflects the needs and preferences of middle-class, urban photographers, raising critical questions about its relevance and accessibility for regional photographers, women, and marginalized communities. Future design iterations should incorporate inclusive strategies to address diverse user groups, ensuring the bag's adaptability and social relevance across different contexts. Inclusive design principles emphasize creating products that accommodate diverse abilities, preferences, and cultural backgrounds, thereby enhancing usability and equity (Clarkson et al., 2013).

It is also necessary to consider conflicting user needs. While some users prioritize compactness and portability, others require greater storage capacity and rigidity. These divergent preferences cannot be universally fulfilled in a single design. The outcome reflects a design compromise between modular flexibility and structural coherence, illustrating the iterative negotiation inherent in Human-Centered Design. Moreover, tensions emerged between aesthetics and functionality, as minimalism and stylistic appeal had to be balanced with ruggedness and technical performance.

User feedback also suggests room for aesthetic refinement. Introducing subtle textures or minimalist patterns can add character and appeal, transforming the bag into a product that balances function with substantial style. Additionally, softening rigid geometric shapes with slight curvature or alternative silhouettes could create a more dynamic, modern impression without compromising spatial efficiency.

For future development, broader field testing over extended periods is recommended to validate material durability and bag performance under extreme conditions. Expanding design options, such as lighter models, compact options, or the integration of innovative technologies like GPS tracking and device charging, could better meet outdoor photographers' diverse preferences and evolving needs.

Ultimately, this research underscores the importance of a comprehensive, human-centered design approach that integrates functional, ergonomic, and socio-cultural considerations. Functional success alone is insufficient; meaningful design must also support the symbolic, emotional, and cultural dimensions of user experience. By acknowledging the product as both a practical tool and a cultural symbol, the design supports the technical requirements and the creativity, identity, and self-expression of outdoor photographers within Indonesia's complex social landscape.

CONCLUSION

This study demonstrates that modular product design—grounded in Human-Centered Design (HCD)—can meaningfully address the intertwined demands of functionality, comfort, environmental adaptation, and cultural identity. The flexible compartments and waterproof materials effectively support outdoor photographers operating in tropical, high-mobility settings. Ergonomic considerations enhance user experience during prolonged activities, sustaining creative productivity. More significantly, the camera bag serves as a vehicle of visual identity, allowing photographers to articulate mobility, digital self-representation, and professional belonging. This reinforces the semiotic role of product design as an artifact embedded in social and digital culture.

Methodologically, this research contributes to expanding the application of HCD in the Global South by integrating environmental and cultural considerations into participatory design frameworks. It highlights how iterative co-design processes can produce locally resonant and socially inclusive solutions. The study also acknowledges limitations in inclusivity, recognizing that photographers are not a monolithic group. Gender, economic status, and technological access shape how individuals interact with design. Future iterations must involve regional, female, and marginalized voices through co-creation to ensure equitable access. Ultimately, this research affirms that product design is not merely about solving problems but about engaging people, culture, and place in shaping meaningful and expressive tools for everyday life.

AUTHOR CONTRIBUTION

DPS is fully responsible for the research's conceptualization and design, methodology development, formal data analysis, conducting field investigations and data collection, and data management and curation. In addition, DPS also writes the initial draft of the entire manuscript. HA and BN supervise lecturers who provide academic supervision during the research process. They also validate the methodology and research results to ensure their appropriateness and

quality. Furthermore, HA and BN make significant contributions during the review and editing processes to enhance the article's quality and clarity.

FUNDING STATEMENT

This research was conducted without financial support from any institution; thus, the author carried out all research activities, data collection, and article writing.

INFORMED CONSENT

The authors have obtained informed consent from all participants.

CONFLICT OF INTEREST

The author hereby declares that there are no financial or non-financial conflicts that may affect the results and interpretation of this research. All research processes and reporting are committed to objectivity and academic integrity.

REFERENCES

Ashby, M. F. (2011). *Materials selection in mechanical design* (4th ed.). Butterworth-Heinemann.

Asriwandari, H., Tantoro, S., & Nurfahima, R. (2023). Potensi alam dan budaya dalam pengembangan ekowisata Pulau Tilan Kepenghuluan Rantau Bais Kabupaten Rokan Hilir Provinsi Riau. *Satwika : Kajian Ilmu Budaya Dan Perubahan Sosial*, 7(2), 489–502. https://doi.org/10.22219/satwika.v7i2.28541

Atsabit, M. F. H., & Irfansyaha, I. (2023). Pengaruh elemen visual terhadap ketertarikan khalayak sasaran terhadap karakter fiksi menggunakan pendekatan mise-en-scene pada video game Trailer 'Final Fantasy XIV: Endwalker.' *Satwika : Kajian Ilmu Budaya Dan Perubahan Sosial*, 7(2), 460–468. https://doi.org/10.22219/satwika.v7i2.28140

Azhar, H., Putri, A. S., & Basha, A. A. P. (2024). *Metode perancangan untuk circular design*. PT. Pustaka Saga Jawadwipa.

Bourdieu, P. (1984). *Distinction: A social critique of the judgement of taste*. Harvard University Press.

Clarkson, J., Keates, S., Coleman, R., & Lebbon, C. (2013). *Inclusive design: Design for the whole population*. Springer Science & Business Media.

Couldry, N., & Hepp, A. (2017). *The Mediated Construction of reality* (1st ed.). Polity. https://lccn.loc.gov/2016011836

Creswell, J. W., & Creswell, J. D. (2018). Research design. In *Introducing English Language*. SAGE. https://doi.org/10.4324/9781315707181-60

Cruz, E. G. (2020). Digital photography studies. In *Handbuch soziale praktiken und digitale alltagswelten* (pp. 97–103). Springer Fachmedien Wiesbaden. https://doi.org/10.1007/978-3-658-08357-1_12

Dijck, J. van. (2008). Digital photography: Communication, identity, memory. *Visual Communication*, 7(1), 57–76. https://doi.org/10.1177/1470357207084865

Garip, B., Saglar, N., Politecnico, O., Torino, D., Garip, S., & Güzelci, O. (2019). Flexible and modular furniture design for changing living environments. *The XXIXTH International*.

Helander, M. (2005). *A Guide to human factors and ergonomics* (2nd ed.). CRC Press. https://doi.org/10.1201/b12385

Jenkins, H., Ford, S., & Green, J. (2013). *Spreadable media: Creating value and meaning in a networked culture*. NYU Press. http://www.jstor.org/stable/j.ctt9qfk6w

Kurniawan, A., & Kusuma, Y. (2011). *Jalan and bidik: Panduan kreatif fotografi travel*. Grasindo.

Madani, S., Herlambang, Y., & Pambudi, T. S. (2023). *Perancangan tas perlengkapan kamera untuk video blogger*. 1–20.

Mahendra, A. T., & Anam, C. (2020). *Konsep desain tas modular fotografi dan videografi*. *7(2), 59-67*. https://doi.org/10.46964/jkdpia.v7i2.53.

McDonald, P., Williams, P., & Mayes, R. (2021). How professional photographers engage with and resist digital platform work. *New Media & Society*, *23*(6), 1602–1623. https://doi.org/10.1177/1461444820917905

Melles, M., Albayrak, A., & Goossens, R. (2021). Innovating health care: Key characteristics of human-centered design. *International Journal for Quality in Health Care*, *33*(Supplement_1), 37–44. https://doi.org/10.1093/intqhc/mzaa127

Mirzoeff, N. (2015). *How to see the world*. Pelican Books.

Muhamad Ridwan, & Meitasari, I. (2023). Potensi pariwisata situs Candi Jiwa Batujaya Kabupaten Karawang. *Satwika : Kajian Ilmu Budaya Dan Perubahan Sosial*, *7*(2), 447–459. https://doi.org/10.22219/satwika.v7i2.28126

Nayottama, N. N., & Syarief, A. (2023). Visualisasi desain busana berdasarkan pandangan masyarakat terhadap karakteristik gender dysphoria. *Satwika : Kajian Ilmu Budaya Dan Perubahan Sosial*, *7*(2), 350–360. https://doi.org/10.22219/satwika.v7i2.27488

Norman, D. (2013). *The design of everyday things: Revised and expanded edition*. Basic Books.

Pangestu, D. D. (2021). Desain produk tas backpack modular "6 in 1" multifungsi untuk mempermudah kinerja fotografi outdoor. *Repository Dinamika*, *75*(17), 399–405.

Patton, M. Q. (2002). *Qualitative research and evaluation methods*. SAGE.

Pepiana, M. A. imanuel. (2022). *Pengembangan tas kamera modular guna meningkatkan efisiensi dalam penggantian peralatan cadangan bagi fotografer event*. https://katalog.ukdw.ac.id/7035/1/62180089_bab1_bab5_daftarpustaka.pdf

Pink, S. (2013). *Doing visual ethnography* (3rd ed.). SAGE Publications.

Poetri, M., & Melania, C. F. (2024). Channeling midsommar from celtic rituals to pagan culture and humanist criticism. *Satwika : Kajian Ilmu Budaya Dan Perubahan Sosial*, *8*(2), 369–378. https://doi.org/10.22219/satwika.v8i2.34900

Rose, G. (2016). *Visual methodologies* (4th ed.). SAGE Publications.

Saad, Q., Sicklinger, A., & Mehmeti, L. (2023). Design values out of the mainstream: New geographies of influence. *Diid — Disegno Industriale Industrial Design*, *10*(Digital Special Issue 1), 578–587. https://doi.org/10.30682/diiddsi23t4a

Sanders, E. B. N., & Stappers, P. J. (2008). Co-creation and the new landscapes of design. *CoDesign*, *4*(1), 5–18. https://doi.org/10.1080/15710880701875068

Schmitt, A. (2022). The I of the photographer: A historical perspective. In *The Photographer as Autobiographer* (pp. 15–64). Palgrave Macmillan. https://doi.org/10.1007/978-3-031-08855-1_2

Senft, T. M. (2013). Microcelebrity and the branded self. In J. Hartley, J. Burgess, & A. Bruns (Eds.), *A companion to new media dynamics* (A companion, pp. 346–354). Wiley. https://doi.org/10.1002/9781118321607.ch22

Sheller, M., & Urry, J. (2006). The new mobilities paradigm. *Environment and Planning A: Economy and Space*, *38*(2), 207–226. https://doi.org/10.1068/a37268

Siri, H. Bin, Khairani, M. Z., & Halim, H. (2022). Digital photography and the future of photography culture. *International Journal of Applied and Creative Arts*, *5*(1), 13–22. https://doi.org/10.33736/ijaca.4664.2022

Statista. (2024). *Digital cameras - Indonesia*. https://www.statista.com

Yang, H., Yuan, G., Pan, J., & Zhou, D. (2023). Environmental stability design of the aerial mapping camera based on multi-dimensional compound structure. *Sensors*, *23*(9), 4421. https://doi.org/10.3390/s23094421

Yu, B. (2023). Understanding new colors in urban environments: Deciphering colors as semiotic resources. *Color Research & Application*, *48*(5), 567–577. https://doi.org/10.1002/col.22871

Yunidar, D., Muttaqin, T. Z., & Barr, T. J. (2024). *Simplicity amplified*. PT. Kanisius.

Zhai, W., Bai, L., Zhou, R., Fan, X., Kang, G., Liu, Y., & Zhou, K. (2021). Recent progress on wear-resistant materials: Designs, properties, and applications. *Advanced Science*, *8*(11), 1–29. https://doi.org/10.1002/advs.202003739

Zhuang, W. (2020). Panna foto institute: Teaching photography and building communities in Indonesia. *Trans Asia Photography*, *10*(2). https://doi.org/10.1215/215820251_10-2-213