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Circularity in Typography and Visual Systems: A Case Study Approach on Sustainable Digital Fonts

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Abstract: The environmental implications of digital design have become increasingly significant as reliance on energy-intensive infrastructures continues to grow. This study examines the concept of circularity in typography and visual systems, focusing on sustainable digital fonts as a critical yet underexplored area of eco-design. Drawing on circular economy theory, digital materiality, and systems thinking, the research adopts a qualitative case study approach based on secondary data, including academic literature, industry reports, and documented design practices. The findings reveal that sustainable digital fonts are characterised by efficiency, adaptability, modularity, and lifecycle awareness. Innovations such as variable font technology and system-based typographic design demonstrate the potential to reduce data transfer, optimise performance, and extend the usability of digital assets. However, challenges persist, including limited awareness among designers, aesthetic-performance trade-offs, and the absence of standardised guidelines. The study contributes to the emerging discourse on sustainable digital design by positioning typography as a strategic site for environmental intervention and advocating for the integration of circular principles into design practice, education, and policy.

Keywords: circular design, sustainable typography, digital fonts, visual systems, circular economy, digital sustainability, eco-design.

1. Introduction

The proliferation of digital technologies has profoundly reshaped contemporary design practices, positioning typography at the core of digital communication systems. From mobile applications and websites to immersive digital interfaces, typography functions not only as a medium of textual representation but also as a structural and aesthetic component of visual systems. However, the increasing reliance on digital infrastructures has raised critical concerns regarding environmental sustainability. Despite the widespread perception of digital media as immaterial, its production, storage, and dissemination depend on energy-intensive infrastructures such as data centres, network systems, and user devices, all of which contribute significantly to global carbon emissions (Aslan et al., 2018; Hilty & Aebischer, 2015).

Recent studies have demonstrated that digital activities, including web browsing and content streaming, are associated with measurable environmental costs. Typography, as an integral part of digital content, plays a role in shaping these costs through factors such as font file size, rendering complexity, and server requests. For instance, large font families with multiple weights and styles require greater bandwidth and computational power, thereby increasing energy consumption (Preist et al., 2016). Consequently, typography is no longer a purely aesthetic or communicative concern but also an environmental one.

Within this evolving context, the concept of sustainability has emerged as a critical framework for rethinking design practices. Sustainability in design traditionally emphasises minimising environmental impact, conserving resources, and promoting long-term ecological balance (Geissdoerfer et al., 2017). While much of the sustainability discourse has focused on physical products and industrial systems, there is a growing recognition of the need to address sustainability in digital environments. This shift has given rise to the field of digital sustainability, which examines the environmental implications of digital technologies and seeks to develop strategies for reducing their ecological footprint (Hilty & Aebischer, 2015).

One promising approach to achieving sustainability in design is the adoption of circular economy principles. The circular economy challenges the traditional linear model of production and consumption—often described as “take, make, dispose”—by advocating for regenerative systems that emphasise reuse, repair, and resource efficiency (Ellen MacArthur Foundation, 2013). In the context of digital design, circularity involves designing systems that minimise resource use, extend the lifecycle of digital assets, and reduce waste in data processing and storage.

Applying circular principles to typography requires a rethinking of how fonts are designed, distributed, and utilised. Sustainable digital fonts are those that are optimised for efficiency, adaptability, and longevity. For example, variable font technology enables multiple typographic

variations within a single file, reducing redundancy and improving performance (Mills, 2021). Similarly, system-based typographic approaches-where fonts are integrated into broader visual systems-can enhance consistency and reduce the need for additional resources.

Typography, however, is not an isolated design element. It operates within complex visual systems that include layout structures, colour schemes, and interactive components. These systems are interconnected and influence the overall efficiency and sustainability of digital design. Therefore, examining typography through a systems-thinking perspective is essential for understanding its role in sustainable design practices (Meadows, 2008).

Despite the growing interest in sustainable design, the application of circularity to typography remains underexplored. Most existing research focuses on web performance optimisation or eco-friendly interface design, with limited attention to typographic systems. This gap highlights the need for a comprehensive investigation into how circular principles can be integrated into typography and visual systems.

This study addresses this gap by exploring the concept of circularity in typography through a case study approach focused on sustainable digital fonts. The research aims to examine how circular design principles can be applied to typographic practices, identify the characteristics of sustainable fonts, and analyse the challenges and opportunities associated with their implementation.

The research is guided by the following questions:

- How can circular design principles be integrated into typography and visual systems?
- What defines a sustainable digital font in terms of design, performance, and lifecycle?
- What challenges and opportunities exist in adopting circular typography practices?

By addressing these questions, this study contributes to the broader discourse on sustainable digital design and highlights the role of typography as a critical yet often overlooked component of environmental sustainability. It also seeks to bridge the gap between theoretical frameworks of circular economy and practical applications in digital design, offering insights for designers, researchers, and industry practitioners.

Ultimately, the integration of circularity into typography represents a paradigm shift in design thinking-one that moves beyond aesthetics and functionality to encompass environmental responsibility. As digital technologies continue to evolve, the need for sustainable design practices will become increasingly urgent, making it essential to reconsider even the most fundamental elements of design, including typography.

2. Literature Review

The concept of the circular economy has gained significant attention as a sustainable alternative to the traditional linear model of production and consumption. Rooted in ecological economics and industrial ecology,

the circular economy aims to create regenerative systems that minimise waste and maximise resource efficiency (Geissdoerfer et al., 2017). The Ellen MacArthur Foundation (2013) defines the circular economy as an industrial system that is restorative and regenerative by design, emphasising closed-loop processes and the continuous use of resources.

In design disciplines, circularity has been operationalised through strategies such as designing for durability, modularity, repairability, and recyclability (Bocken et al., 2016). These strategies encourage designers to consider the entire lifecycle of products, from material extraction to end-of-life management. While these principles have been widely applied in industrial design and architecture, their application in digital design remains relatively nascent.

Digital artefacts, including fonts, differ from physical products in that they are not subject to material degradation. However, they still consume resources in the form of energy and computational power. Therefore, applying circular principles to digital design requires a shift in focus from material flows to data flows and energy consumption. This shift aligns with emerging research in digital sustainability, which emphasises the environmental impact of information and communication technologies (ICTs) (Hilty & Aebischer, 2015).

2.1 Digital Sustainability and Environmental Impact of ICT

Digital sustainability is an interdisciplinary field that examines the environmental, social, and economic implications of digital

technologies. While digitalisation has the potential to reduce material consumption, for example, by replacing physical products with digital alternatives, it also introduces new environmental challenges. Data centres, network infrastructures, and user devices collectively contribute to significant energy consumption and greenhouse gas emissions (Aslan et al., 2018).

Research by Priest et al. (2016) highlights that design decisions at the software and interface levels can have a measurable impact on the environmental footprint of digital systems. For instance, optimising data transfer and reducing unnecessary computational processes can significantly lower energy consumption. Typography, as a component of digital interfaces, plays a role in these processes through its influence on file size, rendering complexity, and network requests.

Moreover, the increasing demand for high-resolution displays and rich media content has led to the proliferation of large font files and complex typographic systems. These developments, while enhancing user experience, also contribute to higher energy consumption. As a result, there is a growing need to balance aesthetic and functional considerations with environmental sustainability.

2.2 Typography as a Visual System

Typography has traditionally been understood as the art and technique of arranging type to make written language legible, readable, and visually appealing (Bringinghurst, 2012). However, contemporary design practices conceptualise typography as

part of a broader visual system that includes layout structures, grids, colour schemes, and interactive elements.

Visual systems are essential for maintaining consistency and coherence across different platforms and media. They enable designers to create scalable and adaptable solutions that can be applied across various contexts. From a sustainability perspective, system-based design approaches can reduce redundancy and improve efficiency by standardising components and minimising the need for repeated design efforts (Lupton, 2010).

In digital environments, typography interacts with various technical parameters, including screen resolution, device compatibility, and user interaction. These factors influence how fonts are rendered and perceived, making typography a dynamic and context-dependent element of design. Understanding typography as a system rather than an isolated artefact is crucial for developing sustainable design strategies.

2.3 Sustainable Typography and Eco-Design Practices

Sustainable typography is an emerging area of research that focuses on reducing the environmental impact of typographic design. This involves optimising font files, minimising data transfer, and designing for efficiency and longevity. Mills (2021) argues that sustainable web design practices, including the use of efficient typography, can significantly reduce the carbon footprint of digital products.

One key strategy in sustainable typography is the use of variable fonts, which allow multiple styles and weights to be contained

within a single file. This reduces the need for multiple font files and decreases data transfer requirements. Additionally, designers can reduce the number of glyphs included in a font by limiting character sets to those necessary for specific applications.

Another approach is the use of system fonts, which are pre-installed on user devices and do not require additional downloads. This eliminates the need for external font files and reduces network requests. However, system fonts may limit design flexibility and brand differentiation.

Eco-design practices also emphasise simplicity and minimalism, which can contribute to sustainability by reducing resource consumption. Minimalist typography, characterised by clean lines and limited variation, can improve readability while minimising computational complexity.

2.4 Materiality and Immateriality in Digital Design

The notion of digital immateriality has been widely debated in design and media studies. While digital artefacts appear intangible, they are deeply embedded in material infrastructures that consume energy and resources (Pink et al., 2016). This perspective challenges the assumption that digital design is inherently sustainable.

Fonts, as digital objects, exist within this material context. They are stored on servers, transmitted over networks, and rendered on devices, all of which involve energy consumption. Recognising the materiality of digital design is essential for understanding its environmental impact and developing sustainable practices.

2.5 Systems Thinking and Lifecycle Approach

Systems thinking provides a holistic framework for understanding the interconnected nature of design elements and their environmental impacts. Meadows (2008) emphasises the importance of considering feedback loops, interdependencies, and system boundaries in addressing complex problems such as sustainability.

In typography, a lifecycle approach involves considering all stages of a font's existence, including design, production, distribution, use, and eventual replacement. This approach aligns with circular design principles and encourages designers to create fonts that are durable, adaptable, and efficient.

2.6 Research Gap

Despite the growing body of literature on sustainable design and digital sustainability, there is limited research specifically addressing typography from a circular perspective. Most studies focus on broader aspects of web design or ICT sustainability, with typography often treated as a secondary concern.

This gap highlights the need for focused research on sustainable digital fonts and their role in circular design systems. By integrating insights from circular economy theory, digital sustainability, and typographic design, this study aims to contribute to this emerging field.

3. Theoretical Framework

This study is grounded in an interdisciplinary theoretical framework that integrates circular design theory, the materiality of digital artefacts, and systems thinking. These perspectives collectively provide a conceptual foundation for understanding how sustainability can be embedded within typography and visual systems, particularly in the context of digital fonts.

3.1 Circular Design Theory

Circular design theory originates from the broader concept of the circular economy, which seeks to replace linear production-consumption models with regenerative systems that minimise waste and maximise resource efficiency (Geissdoerfer et al., 2017). In design practice, circularity emphasises strategies such as designing for longevity, adaptability, modularity, and reuse (Bocken et al., 2016).

Applying circular design principles to typography involves rethinking fonts as dynamic, reusable assets rather than static design outputs. Traditional font design often results in multiple files for different weights, styles, and formats, leading to redundancy and increased data consumption. Circular typography, by contrast, encourages the development of flexible systems-such as variable fonts-that consolidate multiple styles into a single file, thereby reducing resource use and enhancing efficiency (Mills, 2021).

Moreover, circular design promotes lifecycle thinking, where designers consider the entire lifespan of a product or system. In the context of digital fonts, this includes stages such as creation, distribution, use, maintenance, and

eventual obsolescence. Designing with lifecycle awareness enables the identification of opportunities to reduce environmental impact at each stage, aligning typographic practices with sustainability goals.

3.2 Materiality of Digital Design

A critical theoretical perspective underpinning this study is the concept of digital materiality. While digital artefacts are often perceived as intangible, they are deeply embedded in material infrastructures that require energy and physical resources (Pink et al., 2016). Fonts, as digital entities, exist within this material ecosystem, relying on servers, networks, and devices for storage, transmission, and rendering.

The materiality of digital design challenges the assumption that digitalisation inherently reduces environmental impact. Instead, it highlights the hidden ecological costs associated with data processing and transmission. For example, larger font files require more bandwidth and computational power, leading to increased energy consumption and carbon emissions (Aslan et al., 2018).

Understanding fonts as material entities within digital systems allows designers to make more informed decisions about their design and implementation. This perspective emphasises the importance of efficiency, optimisation, and resource awareness in typographic design. It also aligns with broader discussions in digital sustainability, which advocate for reducing the environmental footprint of information and communication technologies (Hilty & Aebischer, 2015).

3.3 Systems Thinking in Design

Systems thinking provides a holistic framework for analysing complex relationships within design processes and outcomes. Rather than viewing design elements in isolation, systems thinking emphasises interconnections, feedback loops, and the broader context in which design operates (Meadows, 2008).

Typography is inherently systemic, functioning as part of larger visual and communication systems. It interacts with layout structures, user interfaces, content hierarchies, and technological constraints. Therefore, changes in typographic design can have cascading effects on the overall efficiency and sustainability of digital systems.

From a systems perspective, sustainable typography requires coordination across multiple levels, including design, development, and infrastructure. For instance, optimising font files alone may not be sufficient if other components of the system, such as images or scripts, are inefficient. Consequently, a holistic approach is necessary to achieve meaningful sustainability outcomes.

Systems thinking also facilitates the integration of circular principles into design processes. By understanding the interdependencies between different components of a system, designers can identify opportunities for resource optimisation, reuse, and waste reduction. This approach is particularly relevant in digital environments, where multiple elements interact dynamically.

3.4 Integration of Theoretical Perspectives

The integration of circular design theory, digital materiality, and systems thinking provides a comprehensive framework for analysing sustainable typography. Circular design offers principles for reducing waste and enhancing resource efficiency; digital materiality highlights the environmental implications of digital artefacts; and systems thinking provides a holistic lens for understanding complex interactions within design ecosystems.

Together, these perspectives enable a nuanced understanding of how typography can contribute to sustainability. They also support the development of practical strategies for designing sustainable digital fonts, such as optimising file structures, adopting modular design approaches, and considering lifecycle impacts.

This integrated framework guides the analysis of case studies in this research, allowing for a systematic examination of how circular principles are applied in real-world typographic practices.

4. Methodology

This study adopts a qualitative research design to explore the application of circularity in typography and visual systems. Qualitative research is particularly suitable for investigating complex, context-dependent phenomena, as it allows for in-depth analysis and interpretation of meanings, practices, and experiences (Creswell & Poth, 2018).

Given the exploratory nature of this research, a case study approach is employed. Case studies enable the examination of contemporary phenomena within their real-world contexts, particularly when the boundaries between the phenomenon and context are not clearly defined (Yin, 2018). In this study, sustainable digital fonts are analysed as cases to understand how circular design principles are implemented in practice.

4.1 Data Collection: Secondary Data Sources

The research relies on secondary data, which includes existing literature, documented case studies, industry reports, and design publications. Secondary data analysis is appropriate for this study because it allows for the synthesis of a wide range of perspectives and findings without the need for primary data collection (Johnston, 2017).

Data sources were selected based on their relevance, credibility, and contribution to the research objectives. These sources include:

- Peer-reviewed journal articles on sustainability, digital design, and typography
- Books and theoretical texts on circular economy and systems thinking
- Industry reports and white papers on digital sustainability
- Case studies of sustainable font design and web performance optimisation

The use of diverse data sources enhances the comprehensiveness and validity of the analysis.

4.2 Case Study Selection Criteria

Case studies were selected using purposive sampling, a non-probability sampling technique commonly used in qualitative research to identify information-rich cases (Patton, 2002). The selection criteria included:

- **Relevance to Sustainable Typography:** Cases must involve digital fonts or typographic systems designed with sustainability considerations.
- **Evidence of Circular Practices:** Cases should demonstrate principles such as efficiency, reuse, adaptability, or lifecycle thinking.
- **Availability of Documentation:** Sufficient data must be available for analysis, including design processes, performance metrics, and contextual information.

Examples of relevant cases include variable font implementations, minimalist web typography systems, and eco-friendly design frameworks.

4.3 Data Analysis: Thematic Analysis

The collected data were analysed using thematic analysis, a qualitative method for identifying, analysing, and interpreting patterns within data (Braun & Clarke, 2006). Thematic analysis is well-suited for this study as it allows for the systematic examination of diverse data sources.

The analysis process involved several stages:

- **Familiarisation:** Reviewing and organising the data to gain an overall understanding.
- **Coding:** Identifying relevant segments of data and assigning codes based on key concepts such as efficiency, adaptability, and lifecycle design.
- **Theme Development:** Grouping codes into broader themes that reflect circular design principles.
- **Interpretation:** Analysing the relationships between themes and linking them to the theoretical framework.

This approach enables the identification of recurring patterns and insights بشأن sustainable typography practices.

4.4 Validity and Reliability

Ensuring validity and reliability is essential in qualitative research. In this study, several strategies were employed to enhance the credibility and trustworthiness of the findings:

- **Triangulation:** Using multiple data sources to cross-verify information and reduce bias (Creswell & Poth, 2018).
- **Transparency:** Clearly documenting the research process, including data collection and analysis procedures.
- **Theoretical Alignment:** Ensuring consistency between the research questions, theoretical framework, and analytical approach.

These measures contribute to the robustness of the research and support the validity of the conclusions.

4.5 Limitations of the Methodology

While secondary data analysis offers several advantages, it also has limitations. One key limitation is the reliance on existing data, which may not fully address the specific research questions. Additionally, variations in data quality and methodology across sources can affect the consistency of the analysis (Johnston, 2017).

Another limitation is the lack of direct engagement with designers or users, which could provide valuable insights into the practical challenges and experiences associated with sustainable typography. Future research could address this limitation by incorporating primary data collection methods such as interviews or surveys.

4.6 Ethical Considerations

This study adheres to ethical research practices by using publicly available data and properly citing all sources in accordance with APA (7th ed.) guidelines. As no human participants are involved, issues of informed consent and confidentiality are not applicable. However, the study maintains academic integrity by ensuring accurate representation and interpretation of data (Mannan & Farhana, 2026).

5. Findings and Analysis

This section presents the key findings derived from the thematic analysis of secondary data and selected case studies of sustainable digital fonts and typographic systems. The

findings are organised around five major themes aligned with circular design principles: efficiency, adaptability and longevity, modularity and system integration, lifecycle thinking, and socio-technical implications. Each theme is discussed with analytical depth, linking empirical observations to the theoretical framework outlined earlier.

5.1 Efficiency in Font Design and Data Optimisation

Efficiency emerged as a foundational principle in sustainable typography. Across the analysed cases, reducing font file size and optimising data transmission were consistently identified as critical strategies for minimising environmental impact. Digital fonts contribute to the overall weight of web pages and applications, directly influencing energy consumption during data transfer and rendering (Preist et al., 2016).

One of the most significant developments in this regard is the adoption of variable font technology. Variable fonts enable multiple typographic variations-such as weight, width, and slant-to be contained within a single file, thereby reducing the need for multiple static font files. This consolidation leads to a substantial decrease in file size and HTTP requests, improving performance and lowering energy consumption (Mills, 2021).

From a circular design perspective, efficiency aligns with the principle of resource optimisation. By minimising redundant data and streamlining typographic assets, designers can reduce the environmental footprint of digital systems. Moreover, efficient fonts contribute to faster loading

times and improved user experience, demonstrating that sustainability and usability are not mutually exclusive but mutually reinforcing.

However, the analysis also reveals a tension between efficiency and aesthetic diversity. Many branding systems rely on extensive font families with multiple styles to achieve visual distinction. Balancing these aesthetic requirements with sustainability considerations remains a key challenge for designers.

5.2 Adaptability and Longevity of Digital Fonts

Adaptability and longevity are central to circular design, emphasising the extended use and reuse of resources. In the context of typography, these principles manifest in the design of flexible and scalable font systems that can be applied across multiple platforms and contexts without requiring frequent redesign.

The findings indicate that sustainable digital fonts are often designed with cross-platform compatibility in mind. This includes responsiveness to different screen sizes, resolutions, and operating systems. Fonts that can adapt to diverse environments reduce the need for multiple versions, thereby conserving resources.

Variable fonts again play a crucial role in enhancing adaptability. Their ability to dynamically adjust typographic parameters allows designers to create responsive typographic systems that maintain consistency across devices. This adaptability extends the functional lifespan of fonts,

aligning with circular principles of durability and reuse (Bocken et al., 2016).

Furthermore, longevity is supported by timeless design approaches that prioritise readability and clarity over trend-driven aesthetics. Minimalist and neutral typefaces tend to have longer lifespans, reducing the need for frequent updates and replacements. This approach not only conserves resources but also contributes to brand consistency and user familiarity.

Nevertheless, the emphasis on longevity may conflict with the fast-paced nature of digital design, where trends and technological advancements drive continuous change. This highlights the need for a balanced approach that accommodates both innovation and sustainability.

5.3 Modularity and Integration within Visual Systems

Another key finding is the importance of modularity and system integration in sustainable typography. Modular design involves creating components that can be reused and recombined in different contexts, reducing redundancy and enhancing efficiency.

In typography, modularity is reflected in the use of consistent design principles, standardised glyph structures, and interoperable formats. These elements enable fonts to function as part of broader visual systems, including grids, layouts, and interface components. Such integration promotes coherence and reduces the need for additional design resources (Lupton, 2010).

The analysis shows that sustainable typographic systems often adopt a systems-based approach, where typography is not treated as an isolated element but as an integral part of the overall design ecosystem. This approach aligns with systems thinking, which emphasises interconnections and holistic optimisation (Meadows, 2008).

For example, integrating typography with responsive design frameworks allows for dynamic adjustments based on user context, reducing the need for separate assets. Similarly, using shared design tokens and style guides ensures consistency and minimises duplication across projects.

From a circularity perspective, modularity supports reuse and adaptability, key principles of the circular economy. By designing typographic components that can be easily repurposed, designers can extend the lifecycle of digital assets and reduce waste.

5.4 Lifecycle Thinking and Circular Typographic Practices

Lifecycle thinking is a cornerstone of circular design, requiring consideration of all stages of a product's existence. In the case of digital fonts, this includes design, development, distribution, use, maintenance, and eventual obsolescence.

The findings indicate that most current typographic practices focus primarily on the design and development stages, with limited attention to distribution and usage impacts. However, these latter stages are critical in determining the environmental footprint of digital fonts.

For instance, hosting fonts on external servers can increase network requests and energy consumption, while self-hosting optimised fonts may reduce these impacts. Similarly, updating fonts frequently without considering backward compatibility can lead to unnecessary data transfers and increased resource use.

Lifecycle-aware design practices include:

- Minimising initial file size during design
- Optimising delivery methods during distribution
- Ensuring efficient rendering during use
- Planning for updates and maintenance

These practices align with circular principles by reducing waste and extending the usability of digital assets (Geissdoerfer et al., 2017).

Moreover, the concept of “design for disassembly,” commonly applied in product design, can be adapted to digital typography. This involves creating modular font structures that can be easily modified or updated without requiring complete replacement.

5.5 Socio-Technical and Cultural Dimensions

Beyond technical considerations, the findings highlight the socio-technical and cultural dimensions of sustainable typography. Design decisions are influenced by factors such as industry norms, client expectations, and cultural preferences.

One notable insight is the limited awareness of sustainability issues among designers and stakeholders. Many practitioners prioritise aesthetics and functionality without considering environmental impact. This lack of awareness represents a significant barrier to the adoption of circular typographic practices (Hilty & Aebischer, 2015).

Additionally, the cultural significance of typography, particularly in branding and identity, can complicate sustainability efforts. Custom fonts are often developed to achieve uniqueness, leading to increased resource consumption. Balancing cultural expression with environmental responsibility is, therefore, a complex challenge.

The findings also suggest that collaboration between designers, developers, and sustainability experts is essential for implementing effective solutions. Sustainable typography requires interdisciplinary approaches that integrate technical, aesthetic, and environmental considerations.

6. Discussion

The findings of this study provide valuable insights into the potential and challenges of integrating circularity into typography and visual systems. This section interprets these findings in relation to the theoretical framework and broader literature, offering a critical analysis of their implications for design practice, research, and policy.

6.1 Reframing Typography as a Site of Sustainability

One of the central contributions of this study is the reframing of typography as a significant site for sustainability interventions. Traditionally, sustainability discussions in design have focused on physical products and large-scale systems, often overlooking the role of digital artefacts such as fonts.

However, the findings demonstrate that typography has measurable environmental impacts through its influence on data transmission, rendering processes, and energy consumption. This aligns with the concept of digital materiality, which emphasises the physical implications of digital technologies (Pink et al., 2016).

By recognising typography as a material practice embedded in energy-intensive infrastructures, designers can begin to address its environmental impact more systematically. This reframing challenges the assumption that digital design is inherently sustainable and highlights the need for more responsible practices.

6.2 Circular Design Principles in Digital Contexts

The application of circular design principles to typography reveals both opportunities and limitations. Principles such as efficiency, adaptability, and modularity translate effectively into digital contexts, enabling the development of sustainable typographic systems.

For example, variable fonts exemplify circular design by reducing redundancy and

enhancing flexibility. Similarly, modular design approaches support reuse and scalability, aligning with circular economy principles (Bocken et al., 2016).

However, the findings also indicate that certain aspects of circularity-such as recycling and material recovery-are less directly applicable to digital artefacts. Instead, digital circularity focuses on optimising data flows and extending the lifecycle of assets.

This suggests the need for a nuanced understanding of circularity in digital design, one that accounts for the unique characteristics of digital systems while retaining the core principles of resource efficiency and waste reduction.

6.3 Tensions Between Aesthetics, Performance, and Sustainability

A recurring theme in the findings is the tension between aesthetic goals, performance requirements, and sustainability considerations. Designers often face trade-offs between visual richness and resource efficiency, particularly in branding and user experience design.

For instance, using multiple font styles can enhance visual hierarchy and brand identity, but it increases data consumption. Conversely, limiting typographic variation can improve efficiency but may constrain creative expression.

This tension highlights the need for design frameworks that integrate sustainability as a core criterion rather than an afterthought. Such frameworks could guide designers in making informed decisions that balance

aesthetic, functional, and environmental considerations.

Moreover, advancements in technology, such as variable fonts, offer promising solutions by enabling both flexibility and efficiency. These innovations demonstrate that sustainability and creativity can coexist when supported by appropriate tools and practices.

6.4 Systems Thinking and Interdisciplinary Collaboration

The importance of systems thinking is evident in the interconnected nature of typographic design and digital ecosystems. Sustainable typography cannot be achieved in isolation; it requires coordination across multiple components, including design, development, and infrastructure.

The findings underscore the need for interdisciplinary collaboration among designers, developers, and sustainability experts. Such collaboration can facilitate the integration of circular principles into all stages of the design process, from conceptualisation to implementation.

Systems thinking also highlights the role of organisational and institutional factors in shaping design practices. For example, company policies, client requirements, and industry standards can influence the adoption of sustainable typography.

Addressing these systemic factors requires collective action and shared responsibility among stakeholders. This aligns with broader sustainability frameworks that emphasise collaboration and governance.

6.5 Implications for Design Practice and Education

The study has several implications for design practice and education. First, there is a need to incorporate sustainability principles into design curricula, particularly in areas such as typography and digital media. Educating designers about the environmental impact of their work can foster more responsible practices.

Second, design tools and platforms should support sustainable practices by providing features such as font optimisation, performance analysis, and lifecycle assessment. These tools can enable designers to make informed decisions and implement circular strategies more effectively.

Third, industry guidelines and standards for sustainable typography should be developed to promote consistency and accountability. Such standards could include recommendations for font file sizes, usage practices, and performance benchmarks.

6.6 Future Research Directions

While this study provides valuable insights, it also highlights several areas for future research. Empirical studies involving primary data collection could provide a deeper understanding of user behaviour and design practices. Additionally, quantitative analyses of energy consumption associated with different typographic strategies could offer more precise measurements of environmental impact.

Further research could also explore the cultural dimensions of sustainable typography, examining how different

contexts influence design decisions and sustainability practices.

7. Conclusion

This study has explored the integration of circularity within typography and visual systems, emphasising the role of sustainable digital fonts in advancing environmentally responsible design practices. By synthesising insights from circular design theory, digital materiality, and systems thinking, the research demonstrates that typography—often perceived as a purely aesthetic or functional component—holds significant potential as a site for sustainability intervention.

The findings indicate that sustainable typography is characterised by key principles aligned with circular design, including efficiency, adaptability, modularity, and lifecycle awareness. Strategies such as the use of variable fonts, optimisation of file sizes, and integration within system-based design frameworks contribute to reducing data transfer, improving performance, and minimising environmental impact. These practices illustrate how circular principles can be effectively translated into the digital domain, despite the immaterial appearance of digital artefacts.

However, the study also highlights several challenges that hinder the widespread adoption of sustainable typographic practices. These include limited awareness among designers and stakeholders, the tension between aesthetic aspirations and performance efficiency, and the lack of standardised guidelines for eco-friendly typography. Additionally, the fast-paced

nature of digital design and technological innovation often prioritises novelty over longevity, complicating efforts to implement circular strategies.

The research underscores the importance of adopting a systems-thinking approach, recognising that typography operates within interconnected digital ecosystems. Achieving sustainability in typography requires collaboration across disciplines, including design, development, and sustainability research. Furthermore, integrating sustainability principles into design education and professional practice is essential for fostering long-term change.

In conclusion, this study contributes to the growing field of digital sustainability by highlighting the relevance of typography within circular design discourse. It calls for a paradigm shift in design thinking—one that moves beyond aesthetics and functionality to incorporate environmental responsibility as a core consideration. Future research should focus on empirical validation, quantitative assessment of environmental impacts, and the development of practical tools and guidelines to support sustainable typographic practices. As digital technologies continue to evolve, embedding circularity in even the most fundamental design elements will be crucial for building a more sustainable digital future.

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