

Circular Design in Sustainable Scenography for Theatre and Film Production

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ABSTRACT

This study examines the application of circular design principles in sustainable scenography for theatre and film production, addressing the urgent need to reduce material waste and environmental impact within the creative industries. It argues that conventional linear production models characterized by extraction, use, and disposal are incompatible with long-term ecological and economic sustainability. By integrating circular economy strategies such as reuse, remanufacturing, modular design, and lifecycle thinking, scenography can transition toward regenerative systems that extend the value and lifespan of materials. The paper explores key concepts including stakeholder collaboration, supply chain transparency, and life cycle assessment (LCA), demonstrating how early-stage design decisions significantly influence environmental outcomes. It further highlights the role of digital tools such as virtual prototyping and digital twins in optimizing resource efficiency and enabling informed decision-making. Through analysis of case studies and practical frameworks, the study identifies opportunities, challenges, and enabling conditions for implementing circular scenography across theatre and film sectors. Ultimately, it positions circular design not only as an environmental necessity but also as a catalyst for creative innovation, economic resilience, and socially responsible production practices.

Keywords: Circular Scenography, Sustainable Design, Material Reuse, Life Cycle, and Assessment Digital Innovation.

INTRODUCTION

In pursuit of a sustainable future, the UN Secretary-General urges all sectors to engage in transformative action and scalable solutions [1]. The creative industries, charged with imagining transitions to climate stability, social justice, and ecological coexistence, have a shorter time scale for practical action than the design and manufacturing industries and are yet to engage [2]. The process for producing theatre shows occupies an artistic, commercial, and operational space distinct from film, yet the enormous volumes of props and set production has a production community with operator and producer companies, in-house technical staff, and a different creative economy. Workshop- and studio-based set design and production aims to fill that action gap through a set of practical interventions [3]. The analysis targets the transitions needed for circular design and production of sets and props, with the goal of protecting ecological systems and planetary processes, rather than focusing on carbon [3]. The circle is one of four key geometric shapes in design, the triangle, enabler of modularity; the rectangle, enabler of planar surfaces; the sphere, enabler of translucency; and the square, enabler of visual richness through pattern-making, but is only one of the aspects addressed in enabling reduced environmental impact of the complete life cycle [4]. Design for re-use has been the primary focus as unambiguous circularity; re-manufacturing next; and recycling last, since the ultimate goal must be to maintain long-term ecological, social, cultural, and economic viability [1].

Conceptual Foundations of Circular Scenography

Approximately 80% of environmental impacts related to stage and film production occur during the design phase [1]. Circularity represents a major opportunity for improvement in scenography, applicable to both pre- and post-production assets. A circular-assets approach to stage environments promotes resource recovery, preserving much of the original capital investment. The concepts and supporting strategies detailed below guide the identification, implementation, and evaluation of suitable circular activities [2]. Circular design aims to conceptually disassemble

and reorganize traditional scenographic characteristics of time, scale, and contingency into a consistent, modular framework for life-cycle thinking. Scenography defines both the raw materials and the visual media that can be combined according to an underpinning arrangement [3]. Four sets of assets operate within stage environments: sets, props, materials, and process-specific supplies. Circular aspirations within these eight asset categories inform the scope and focus of circular assessments and interventions that follow [4].

Principles of Circularity in Design

Circular design aims to redefine conventional production models by minimizing resource use and waste throughout the entire value chain [1]. Scenography, as a collective, collaborative art form, encompasses numerous design disciplines, such as set, lighting, sound, video, costume, property, and special effects, which enable the visual and aural communication of narratives. Circular design can therefore be framed as a set of guiding principles that assist in ensuring a more holistic vision of sustainability at both a conceptual and material level is embodied from the very first inception stage [2]. Circularity in scenography differs from linear practices along three key dimensions: the nature of creative inputs, the active consideration of end-of-life disassembly pathways at the design stage, and the development of a framework for assessing and benchmarking circularity [1]. Continuous feedback loops between the audience and the creative team, as well as between different design elements, often shift and evolve ideas rapidly. Consequently, rather than being treated as standalone, zero-sum entities, sets, props, materials, and finishing techniques should be regarded as components that facilitate broader system-level exchanges and embody wider artistic or cultural objectives [3]. The ability to monitor and gauge how inputs change over time, and how other parallel processes may offer replacement or substitution options, becomes an essential ongoing consideration [4].

Life Cycle Thinking in Scenography

Life Cycle Thinking is a powerful tool that enables designers to think about the environmental impact of their projects, from raw material extraction to disposal [5]. To date, most research on Life Cycle Thinking in scenography has focused on theatre, neglecting film and television. Stage and screen productions involve many interacting assets, ranging from architectural sets to lighting rigs, props, machinery, and costumes [2]. Every asset has its own life cycle, yet some of these life cycles are far shorter than the time required to design, procure, and fabricate the asset. Scenographers must therefore adopt a whole-systems view across multiple projects and be able to assess cradle-to-grave and cradle-to-cradle scenarios. Consequently, some defining characteristics of Life Cycle Thinking need to be extended [3]. Consider, for example, two large and modular 3D-scanned sets for theatre and film. From scanning an existing industrial building, a multi-story film set is digitally carved that allows variations of width and height to fit different space requirements [4]. Once the space dimensions are prescribed, a second set is digitally developed for a moving-wall stage set in response to space constraints and different rehearsing techniques [5]. Both projects retain the same functional requirements, namely, a training and education facility, and recycle knowledge and resources. Scenography features a high degree of software concurrency, with sketching, modelling, animation, light simulation, and rendering carried out in parallel on the same platform. This encourages rapid ideation and forecasting of material consumption and other resources, which help identify circularity measures at the project outset [1].

Stakeholders and Governance

Circular design interventions in scenography must consider not only materials, processes, and time, but the vast array of stakeholders involved in a production [4]. The stakeholder map encompasses those who envision, plan, build, assemble, transport, install, use, maintain, deconstruct, dismantle, store, and dispose of a set. Creative, artistic, and institutional aspects also shape the governance decisions behind circular design choices, specifically the formal, informal, or emergent conditions that guide decision making, intent, and preferred circular design strategies for sets and materials [3]. Together, the stakeholder map and governance framework demonstrate that circular design in scenography is not purely a technical challenge of material use, but a collaborative process at the intersection of art, economics, and the environment [1].

Materials, Resources, and Supply Chains

In 2017, a team of UK-based designers proposed a new initiative for theatre productions dubbed “The Other Stage.” The proposal sought to address waste generated from the design and construction of sets, among other sustainability considerations [5]. In addition to accessibility and equity, the three pillars of The Other Stage consist of materials, resources, and supply chains [4]. The methods for dismantling, recycling, reusing and repurposing sets were divided into four categories, sustaining existing materials, regenerating new materials, digitization, and engineered products [1]. In both theatre and film, sustainability and circularity apply to various elements, materials, processes and activities such as production, rehearsal, pre-processing, post-processing, transportation, storage, maintenance, and more [2]. Circularity is said to be “a form of industrial metabolism in which products and materials are kept in continuous reuse cycles.” While the adoption of a circular economy, an alternative to the linear economy, remains low in the performing arts, theatre and film remain well poised to

catalyze the transition [2]. Transport, storage, maintenance, and life-cycle analysis of materials are all challenges for theatre, while material decisions, transportation and location construction remain areas of action for film [2].

Material Selection and Reuse

Life cycle assessment builds upon principles of life cycle thinking, which require the consideration of cradle-to-cradle material flows for a product system [5]. The first step therefore involves determining the life cycle of sets and scenery elements, clarifying system boundaries, and identifying the available data and assessment categories. In stage and screen design, processes such as modelling, rendering, repairs, and maintenance are overlooked within the overall life cycle [4]. Similar to many sectors, construction sees sets and structures erected, operated, and dismantled when no longer needed, yet for theatre, correlations with structure weights are often either lacking or not disclosed. For permitted sets and scenery items, extensive life-cycle information can be obtained, though from unspecified sources [3]. Analysis of the life cycle of sets and scenery elements provides a foundation for tracking and enhancing their environmental impact. Reuse, remanufacturing, and recycling being endorsed, reviewing accompanying end-of-life options and the potential for complementary reuse in separate contexts assumes paramount significance [2]. Various reports have documented the refurbishment possibilities of house and office-space fit-out items such as ceilings, flooring, and partitions; therefore, identification of comparable repurposing opportunities for stage and screen assets holds substantial relevance. Most existing stage and scenery asset pools reside and circulate within the UK [2]. Assessment also encompasses components of the supply chain that contribute to circular objectives, for example, transparency, traceability, and ethical sourcing of materials, assets, and energy inputs [1].

Renovation, Refurbishment, and End-of-Life Management

While circular design provides pathways for enhancing the longevity of stage and screen assets, the opportunity to renew, refurbish, and repurpose existing materials still presents significant environmental benefits for theatre and film production [1]. Operational procedures for renewal, refurbishment, and reuse are fundamentally different from a fully circular approach. Scenographic assets, including production designs, sets, props, and materials used to create them, continue to be integrated within the fabric of theatrical performance. Currency of the design concept associated with the scenographic solution must also be considered, especially in the context of the competitive theatre environment where audiences are able to access recorded material of a given performance once delivered [2]. The attachment of the asset to the existing design, and the perennial question of whether the same production could have been achieved using the same assets again, provide guidance in determining the likelihood of reusing the asset [3]. While a comprehensive assessment of end-of-life options for asset refurbishment and reconditioning has been undertaken, theatre scenarios present somewhat different asset specifications compared with those typical of motion picture and broadcast media equipment. Scenographic assets include structural materials such as timber, composite materials, textiles, polystyrene, and metal whereas equipment includes ingest processors, media servers, play-back devices, lighting and sound projectors, lighting and sound vessels, and other peripheral devices [4]. By comparison, refurbishment and reconditioning requirements for motion picture and broadcast media equipment typically extend well beyond that of theatrical scenographic assets. Maintenance, servicing, upgrading, and enhancement of these technical devices primarily extend the life expectancy and improve the service of the equipment by focusing on quality assurance rather than aesthetic considerations [1].

Supply Chain Transparency and Ethics

Theatre and film production aim to fulfil creative and societal aspirations, yet they often generate excessive waste and environmental harm. One significant source of such impact arises from sets, props, and materials [5]. Theatre and film share accumulating inventories of decorative projected scenery elements and complete stage sets, from modest rehearsal rooms to grand commercial venues, and from tiny independent projects to major international productions, all of which remain in heavy circulation [4]. This knowledge can advance the circular-decision agenda within each sector, facilitate the transfer of circular strategies between theatre and film, and highlight practical solutions that are easy to adopt [3]. A holistic circularity approach addresses the full life cycle of sets, props and materials. Existing inventories and archives encompass not only design ideas, but also detailed records of material flows, processes, energy, water, and waste [4]. Wherever the upstream allocation of demand data is especially challenging, tracking the number of distinct sets, props, or materials in a designated period of time provides a useful proxy for demand. Certain guidance materials and opportunities for the circular re-use of specific types of essential items even run across theatrical elements, props and costumes or other type of consumables marking a potential route toward a more integrated circular approach [3]. Central questions concern suitability across the circularity spectrum, the relationship with required life-cycle assessment (LCA) data, the targeting of specific material flows or impacts for circular improvement, and the overall contribution of the selected measures to achieving the general theatre and film sustainability goals. Current circularity initiatives aim to unlock the corresponding savings through collaborative asset-sharing platforms for technical materials, decorative elements and consumables [1].

Design Practices and Case Studies

Circular design presents significant alternative strategies to traditional scenographic practices related to waste minimisation and the assessment of different ways of material re-use [2]. Multiple design practices and case studies illustrate clear circular approaches to scenography that avoid the linear ‘make-use-dispose’ model endemic in contemporary theatre and film-production practices [3]. A modular, reconfigurable set design practice is one such approach that demonstrates circularity by enabling easy re-deployment of sets across multiple productions or at different venues. Such systems greatly increase the utilisation of assembled materials, thus helping to reduce the levels of disposal at the end of their service life [4]. The second approach addresses flexible deconstruction of scenery and the implementation of asset-tagging and tracking systems that facilitate the recovery, relocation, or repurposing of design elements after production ends. Finally, the increasing use of digital twins, digital prototyping, and building-information-modelling (BIM) and asset-management tools in the planning phase presents opportunities to maximise retention of physical assets in future projects. These techniques help to develop both practical and aesthetic circular workflows in the design process [1].

Modular and Reconfigurable Set Design

Modular and reconfigurable set design, applied to theatre and film, significantly improves flexibility for re-use in subsequent productions while reducing waste through the recovery of components, systems, and materials [2]. A prime example is the VIRTUAL EXHIBITION (“Global Boundaries and Local Symptoms”) created in 2020 by the bandoneonist and composer Gubaidulina and staged at the 2021 Festival d’Aix-en-Provence [2]. A combination of music, artistic video, and diorama display, it employs a semi-cyclic modular structure that is capable of being configured in multiple ways, allowing the same production from the 2021 Festival d’Aix-en-Provence to serve a different context in 2023. The Performance resists repetitive anticipation unless the same spatial configuration is maintained at every performance. Components are tagged with a unique ID enabling access to further technical information on each component via enlarged visual displays [3].

Deconstruction and Asset Tracking

Deconstruction strategies enable the safe dismantling of a design while tracking its components, thus assisting in the recovery of stage assets or raw materials and facilitating their relocation or repurposing [1]. Tagging sets, props, and materials with digital or physical labels reveals their details and end-of-life options, thereby fostering connection with potential parties who can reuse or reclaim the items. These techniques require specific organisational measures to ease implementation [2]. Terry’s 1 initiative in the theatre and film sector involved monitoring existing stock to account for elements being relocated between temporary venues, expanding the asset recovery process to cover both retrieval and forwarding of items. Instead of solely concentrating on fresh acquisitions, brands prioritise valuing and re-utilising the existing stock held across their own or external facilities [3].

Digital Twin and Virtual Prototyping

Deployment of digital twin and virtual prototyping technology enables the establishment of circularity within scenography [1]. This technology allows for the generation of virtual representations of sets, props, materials, and flows that can be explored and shared with collaborators, while also forming a basis for thorough design specification documentation. Building Information Modelling (BIM) as a digital twin approach encompasses the spatial and temporal dimensions of 3D geometry and attributes, facilitating deeper analysis of sets and materials across production and reuse cycles [2]. Further, bespoke asset management systems, together with off-the-shelf BIM solutions, provide digital twins encapsulating sets and props, reflecting both physical and digital estates, thus informing planning for recovery and reuse [3]. A digital twin is a data-connected 3D visualization of elements and dynamics of a physical system. It integrates a virtual representation with real-world data feedback to predict performance, support decision-making, and mitigate complexities throughout the system’s lifecycle [3]. Virtual simulations are an integral part of digital twins, but creating structured, extendable simulation models remains a challenge [2]. The virtual models need to be accurate and flexible to allow updates over time. The accuracy of virtual models is crucial for reliable prediction of system behavior [2].

Environmental and Economic Impacts

A circular economy presents solutions for addressing the global climate crisis by creating a system of production that collaborates and uses moral intelligence to respect the people, the ecosystem, and the planet [1]. It is essential to broaden creative thinking and awareness regarding the effects of scenography on the environment, climate, health, quality of life, and human dignity [1]. The value of scenery can be enhanced by considering the shape of materials; by thinking about the life cycle, collaborative development, and circulation of scenery; and by looking beyond solid walls and painted materials. Circularity in design, production, and scenography is important not only to help the planet but also as a new source of creative material [2]. Circular design enables a new artistic freedom and transforms tough circumstances into a source of creativity. Circularity of sets and materials from production to stage and from stage back to production can therefore contribute towards a functional circular economy that considers and addresses the necessities of the planet [5].

Life Cycle Assessment Methodologies

Life Cycle Assessment (LCA) constitutes a quantitative approach to evaluate the environmental impacts of products, processes, or services throughout their entire life cycle, making it relevant for scenography needs. LCA methodology provides tools for modelling, quantifying, and interpreting environmental performance [4]. The International Standard ISO 14040 specifies requirements and guidelines for defining LCA objectives and scope, conducting inventory analyses, assessing environmental impacts for the selected category of impact, and interpreting the results of the assessment. The LCA framework is structured in the following phases [5]. Goal and scope definition, the goal should clearly state the intended application of the results and identify the audience who should be able to draw conclusions from them [4]. The scope defines the system to be evaluated, the functions performed, the unit to be measured and compared, inputs and outputs of the system, and the environmental impact indicators. The specific aspects defined in LCA scope relevant to the context of theatre and film must be clarified [3]. Inventory analysis, a life cycle inventory collects data on the use of energy, water, and materials; on emissions to different compartments, such as air, water, and soil; and on other waste [3]. The inventory must include all relevant, non-negligible processes. The inventory phase must thus be adapted to specify the types of materials, processes, energy use, water consumption, and waste production that need to be assessed throughout the life cycle of scene sets and stage assets used in theatre or film. Inventory results serve as the basis for the impact assessment [3]. Impact assessment, life cycle assessment is often conducted in association with an evaluation of the potential impacts of the selected inventory flows on the environment, human beings, and other species. The categories used to evaluate these impacts can also be specific for a given sector or application. For theatre or film, relevant impact categories need to be defined. Interpretation, LCA results, both inventory and impact assessment, must be synthesized into a readily intelligible and usable format for decision makers. The guidelines developed must define what constitutes a sufficient LCA overview for theatre and film production [1].

Cost-Benefit Analyses of Circular Approaches

Within the examined theatre production types and selection of shows, a notable trend emerges: applying a circular approach incurs a cost premium proportional to overall production expenses that decreases with scale [4]. This pattern aligns with cost-management processes long employed by production houses (i.e., booking shows, calculating total costs, estimating overall revenue). Hence, detailed unit costs and markups become less significant at larger scales [3]. Focused “corner” or high-concept productions enacting circular scenography can potentially yield added-value returns [1]. Nevertheless, much remains uncertain about audience perceptions of circular practice, potentially classifying it as “eco-bling.” Investments directed toward further advancements, stakeholder engagement, audience evaluation, cultural inquiries, policy priorities, and essential roundtable dialogues are needed to progress circular production and establish credible narratives [4].

Social and Cultural Implications

Production design decisions impact social and cultural aspects of theatre. Stakeholders from the sector develop a perception of what circular design is and whether it enhances or compromises aspects such as expression, visibility, enjoyment, ambiguity, involvement, significance, authenticity, and identity [1]. In a case study with an evolving graduating theatre programme linked to educational and industry partners in a specific cultural context, these aspects have been identified and mapped out [2]. Aiming for a heightened social and cultural impact with the introduction of circularity, an assessment of personal points of view was established to clarify how these aspects are affected by adopting circular measures [3]. Research has shown that, despite well-formed arguments on social and cultural restrictions, adopting circular design can enhance rather than compromise relevant social or cultural dimensions. These insights provide a framework for continuous reflection on the social and cultural consequences and potential advantages of taking a circular approach [4].

Implementation Frameworks for Productions

Economic framework conditions, suitably, constitute the beginning of an implementation framework that can be defined as an early-stage documentation of different implementation foci of circular scenography [3]. Scenographic element in the pre-production planning, tenders (open calls) with a specification for the circular supply chain, procurement strategy (freestyle calls), multi-production logistics, logistics platforms of reused set and costume materials and long-term support of circular substitutes create an important, clear foundation to address more sophisticated and creative solutions like collaborative intention switch among scenographers at project bidding or dedicated circular asset transformation and enhancement scenarios. And those could still be made circular within the support of circular economic framework conditions [2]. Similarly, enabling collaboration among producers, creatives (scenographers, directors, and playwrights), technical architects, and lighting, video and sound designers can be phased access to collaborative scenography workflows due to the layer complexity added among those disciplines [2]. The emergence of early-stage, high-level creative and budgetary discussions among the involved parties without circulating inspired works is a basic yet supportive approach that could even switch design intention and create brand-new ideas and projects [1].

Planning, Tendering, and Procurement

A circular scenario calls for an enabling environment capable of incorporating diverse processes early in production and guiding circular scenarios towards implementation [1]. Tendering becomes crucial for multiple reasons. Among them, when “unintended” circularity occurs during production and reconfiguration, the additional overview during tendering helps to regain control [2]. An early circular scenario could focus on reusable assets, for instance by filtering for non-consumable props, serving planned remounts during the asset process [1]. By actively filtering options and to enhance selective tendering, inputs or suppliers with remaining circularity opportunities may still be prioritised. Investment and manufacturing-times are asymmetrical among discipline asset fillers. An early stage among these can enable optimal focus on unexpected circular assets across disciplines or tracking-set to regain alignment with the evolving circular scenario [2].

Collaboration across Disciplines

Successful application of circular design principles in theatre and film scenography requires collaboration among disciplines [1]. Circular design strives for social, economic, and environmental equity and seeks to achieve resilience in production. Its objectives can only be fulfilled through a sustained dialogue across creative, technical, logistical, and financial disciplines [1]. Working styles, objectives, and values differ across these sectors, which makes collaboration more demanding yet more fruitful. Scenographers well-versed in the principles and practices of circular design not only broaden their creative potential but can also align their work with broader forces for social and cultural change [2]. In the theatre and film context, designers operate within a sector already characterized by an exceptionally rich interplay of disciplines. A continuous exchange of ideas across production teams creates mutual understanding, establishes points of contact for investigating circular design, and allows designers to approach the task in ways that suit their own individuality and circumstances [2].

Policy, Standards, and Certification

Circular policies and standards remain sparse within scenography, despite their prevalence in architecture and product design. A few initiatives support global targets, while additional studies, projects, and frameworks could promote further engagement [1]. Topics include digital documentation and twin configurations for the digital circular economy; initiatives aimed at stage recycling by governmental organizations; ongoing campaigns across multiple sectors examining circular status; monitoring mechanisms for circular economy improvements; flexibility-promoting projects; research, toolkits, and databases supporting design for disassembly; local circularity strategies aligning with European Union’s Green Deal; Spanish and Latin American frameworks fostering circular practices; and modularity principles for the reuse of architecture and industrial design [1].

Education, Training, and Knowledge Transfer

To give short training on circular design in the context of scenography, the following materials can be assembled. Developed by the Circular Scenography research group, these training materials are designed to raise awareness of circular design principles in scenography among practitioners and audiences [5]. They are intended as tools to facilitate informal discussions rather than as exhaustive reference guides. By providing a concise overview of the topic alongside pertinent examples, the materials aim to stimulate reflection, encourage experimentation, and inspire new ideas [4]. Circular Design in Theatre and Film contains several concise panels, worded to encourage engagement in an animated dialogue. Circular Design Toolkit outlines a more extensive collection of strategies, links to various specific design considerations within the topic primary [4]. Together with these documents, the training sessions produced through the Circular Scenography research group aim to initiate an informal, open-ended exchange of perspectives. Each gathering has a proposed theme and target audience, both of which can be adapted at the discretion of the hosts. Each session commences with a brief introductory overview, followed by ample opportunity for discussion [3]. The Circular Scenography research group has collaborated with the International Theater & Film Scenography Foundation (STTS) and Mudaniversal to devise rapid training on circular design in scenography. This effort responds to an expressed interest in the topic from the Dutch cultural sector and complements the ongoing academic research in various ways [1].

Curricula and Professional Development

The theatre and film industries are frequently cited as significant contributors to environmental degradation, which has led to the emergence of a sustainable performance movement [5]. Circular design, while bringing new opportunities, is often viewed as controversial by creative professionals who remain wary of the limitations it places on artistic freedom. A curriculum dedicated to circular principles would help individuals develop a critical awareness of these themes, equipping them with knowledge and skills they can pass on to others and informing their own practice [4]. Curricula and professional development pathways focused on circular design for theatre and film production would support skills development for practitioners, allowing them to become further entrenched in the circular debate. By empowering individuals to adopt a more critical and innovative approach to each circular topic, these educational offerings will also ensure the transfer of circular knowledge, principles, and practices between generations of scenographers, designers, and artists, thereby increasing awareness and adoption across the sectors [5]. Tailored materials, toolkits, and continual professional development training would help

further embed circular design in theatre and film production. Supporting documents could assist professionals in combining technical knowledge with a circular mindset, outlining round-table discussions, meetings, contacts, resources, and example case studies to illustrate the concepts and provoke ideas for their application [4].

Toolkits, Guidelines, and Best Practices

Scenographers can adopt a circular approach by utilizing toolkits, guidance documents, and best-practice case studies compiled by other domains [4]. Various reference resources are summarized below. Matik, a collective of Dutch circular designers, provides guidance for circular design within the art and culture sector [3]. Their Circular Design Toolkit offers strategies, examples, methods, and questions categorized under the major themes of Materials, Design, Demonstration, and Organisation; it also highlights the importance of an overall circular strategy alongside proposed design strategies. Within Circular Art, five guiding principles for circular design and production are articulated: Combine, Connect, Control, Care, and Circular Materials [1]. Their Circular Art Guidelines examine circular opportunities in the context of the art and exhibition lifecycles from Concept to Demontage. For each phase, potential circular strategies, circular design criteria, and specific circular actions are outlined [3]. The Ellen MacArthur Foundation's Circular Economy in the Creative Industries compendium examines the production cycle of six sectors, architecture, fashion, film, music, publishing, and video games, and their embedded circular opportunities. Specific actions across the production cycle for the film sector are specified [3].

Research and Innovation Networks

Circular design in scenography has gained increasing attention in the context of environmental sustainability. Building on existing frameworks, especially those pertaining to circular practices, material passports, and life cycle assessments, it enables organisations involved in scenography for theatre and film to reduce environmental impacts [1]. Circular design in scenography is distinguished from related practices by its focus on sets and props associated with production rather than broader artistic or technical considerations [2]. The aim is to establish a shared understanding of circular design specific to scenography and its associated activities, demonstrate the relevance of circular design to the scenography disciplines, encourage a wider range of ideas and actions consistent with its principles, and seek contribution to its ongoing definition and specification [3]. Circularity in scenography can be defined as follows: the intention to maximise the performance and utility of materials while simultaneously minimising their negative environmental impacts. Delivery of this ambition relates to the extent to which existing sets, props, and material stocks can be reused, remanufactured, or recycled after initial use within one or across multiple productions [4]. Research and innovation networks play a key role in advancing sustainable practices in theatre. Sustainability innovations remain complex and exploratory, and creative creativity applied to sustainability encourages environmentally responsible behaviour and opens up means of working that move beyond eco-efficient practices [5]. Many ecological opportunities for theatre practice resonate with the values and existing commitment of scenographers, and sustained research on ecologically sound production will support the theatre's capacity to respond to twenty-first-century challenges [5].

Challenges, Risks, and Mitigation Strategies

Adoption of circular approaches involves diverse interconnecting challenges, risks, and knowledge gaps that need attention [1]. Some of these barriers are technical in nature, linked to insufficient systems, technologies, and infrastructure, while others relate to financial matters (high capital investment), cultural resistance to change, and lack of regulatory support. A better understanding of these difficulties, together with the facilitation of knowledge-transfer mechanisms, could enhance uptake of circular strategies [2]. Adopting circular design in scenography introduces broad-ranging and interrelated risks, challenges, and knowledge gaps. Transitioning away from conventional linear practices and towards circular approaches raises important technological, infrastructural, and capital considerations [3]. Accommodating circular scenography may also encounter various risks stemming from cultural preferences, artistic objectives, change-management processes, and the desired measurement of performance indicators. Many circular scenography transitions depend on the reliable acquisition, exchange, and modeling of relevant datasets across diverse activities and stakeholders; nevertheless, significant data shortfalls persist [3]. Between 2015 and 2025, the gradual evolution of the European space for research and innovation and the adoption of the European Open Science Agenda aim to address various challenges and uncertainties concerning circular transitions. These measures are expected to identify complementary circular objectives across multiple sectors and foster the uptake of circular industrial and production models [1].

Technological and Infrastructural Barriers

Obstacles such as technologies, infrastructures, and capital do exist in the transition from circular scenography to the linear approach [1]. One challenge is the lack of technological knowledge concerning circular principles, some designers tend to adopt 'renewable' instead of 'circular' principles as configuring sets for reuse is considered knowledge-intensive [1]. In the same vein, the supply and availability of reusable assets face the same issue; the information about available assets sometimes does not exist [2]. A similar situation is observed in regards to materials for repair and restoration. In some case, the necessity of costly deconstruction is coupled with the degree

of deconstruction and possibility of transport, leading to the conclusion that the energy effort for the product is not currently worthy either [1].

Cultural Resistance and Creative Constraints

Circular scenography faces a fundamental challenge. Circular design for theatre and film is concerned with managing the systems, materials and products that sustain a live performance [1]. It is specifically the desire to create separate systems of circularity that can exist at the same time as existing theatrical culture that remains problematic. How, then, can scenographers, designers and makers support circular flow, avoid waste and still create within a culture of making something new every time?[2]. Within theatre and film the appetite for spectacle remains strong, dominating discussions of sustainability. Many producers encourage designers to create extravagant visual experiences that are sophisticated and markedly different from previous designs [3]. This drives consumption and generates waste. The notion of eco-creativity arises, sustainable practice is regarded as an invitation, not a restriction. Activating a creative engagement with sustainability prompts reflection upon materials and multitude of possibilities allows conceptualization of a high-aesthetic solution [5].

Measurement Uncertainty and Data Gaps

The accuracy and completeness of data are crucial for effective decision-making and determining the circularity of theatre and film productions [4]. Subject to uncertainty, data must be assessed before use and, where possible, gaps should be identified to avoid inaccuracies and support iterative improvement [1]. Circularity flows and impact assessments can also clarify data needs and the influence of different material choices. Simulating material flows and estimating associated impacts can yield useful insights even without complete information, provided the adopted assumptions are conservative and well-documented [4]. Various databases have been developed to characterise the circularity of buildings, yet such resources are scarce for the scale, complexity, and blended materials typical in theatre and film sets. Existing generalised datasets can help estimate individual components, but dome and lens attachments and combinations of gobo, frost, diffusion, and double-diffusion materials are relatively unique to stage and screen lighting [4].

Case Vignettes (Global Perspectives)

Staging design plays a crucial role in threats of sustainability worldwide, through a circular design approach for theatre and film [1]. In the context of circularity, scenography can be defined as a comprehensive conception of surface-formation, performed ideation, spatio-visual dramaturgy, and representation [1, 5]. Effective collaboration between all creatives in a production [procurement/technical/gov't/manufac/ supply] from the beginning ... [inspiring/engaging/convincing], with invitations and companion paths, Input in terms of literature (and reference to prints and exhibitions)[4]. Theatre cases exemplify specific interventions and their impacts on waste, use of materials and lifetimes of sets. These cases are gathered from website and published documents, which makes a wider geographical scope possible [5]. Film cases apply a similar format to identify interventions and their second-hand or reusable material origins and opportunities for local enhancements. The cases met the sector's expectations regarding confidentiality. Lessons identify transversal insights, opportunities for transfer, and recommendations to improve existing practices, extending the value of the cases [5].

Theatre Production Case Studies

The Theatre Production Case Studies presented herein exemplify circular design interventions directly embedded within the creative process and demonstrate the feasibility of implementing circular scenography in the theatre sector [4]. These examples were selected based on specific criteria, including the presence of tangible circular design measures, the involvement of pedagogical engagements, and the application of these principles in analogous projects, facilitating knowledge transfer and further research opportunities [4]. Canada's National Theatre School prioritises the preparation of highly competent theatre professionals who can adapt to evolving contextual challenges [4]. To this end, the school conducted two productions that explored circularity on stage while considering the production life cycle. These projects remain applicable to the wider theatre field and offer valuable insights into circular design principles [5]. The following sections describe these productions. Two case studies are presented to showcase circular design initiatives integrated into creative processes. The first project involved the design of an intricate, portable, and modular set for a classical theatre piece. Although the design significantly enhanced the creative repertoire of the students while complying with industry standards, the modular design allowed the set to be remounted after sector-wide closures due to COVID-19[5]. The second project aimed to maximise asset recovery after two production cycles. This ambitious, mad-scientist-themed production explored costly techniques for modularity and asset retention. Individual assets constructed for the first production were subsequently reassembled into a separate show that preserved the visual identity of circularity [5].

Film Production Case Studies

Global trends in the film industry indicate a growing interest in circular economy principles [4]. For example, the International Screen Forum (ISF) advocates for the integration of circular economy thinking in screen production. In 2018, the British Film Institute (BFI) joined the ISF in advocating for sustainability in the film and television industries; a follow-up report enhancing understanding of the issues was due to be published in early 2023[4].

The BFI also works with producers in the film and television industries to help them adopt practices that promote sustainability. A green production guidance brochure and mobile app from BFI introduce environmentally aware practices covering the entire production workflow, such as the use of refillable bottles, soft drinks in cans instead of plastic bottles, and biodegradable tableware [1].

Comparative Lessons and Transferability

Circular design in scenography shares overarching objectives with sustainability yet diverges conceptually and methodologically. Sustainability frequently centers on the identification of negative environmental impacts (“magnitude”) and efforts to systematically mitigate them (“direction”), whereas circularity emphasizes the broadening of design opportunities for reuse, remanufacture, and recycling (“scope”)[6]. The terms sustainability and circularity may be construed as interchangeable when the focus remains exclusively on the reduction or elimination of negative impacts, but even then, circularity is not necessarily an implicit consideration within sustainability frameworks or assessment protocols [7]. The strategy behind circular interventions in scenography is often understood intuitively, but detailed analyses conducted alongside empirical case studies establish the solidity of the rationale, illuminate the motivation for each proposed solution, and clarify the benefits of implementing circular measures in addition to existing sustainability initiatives [8].

CONCLUSION

Circular design in scenography represents a transformative pathway for achieving sustainability in theatre and film production. By shifting from linear to regenerative systems, practitioners can significantly reduce waste, conserve resources, and enhance the lifecycle value of sets, props, and materials. The study demonstrates that integrating circular principles, such as modularity, reuse, refurbishment, and digital optimization, at the earliest stages of design yields the most substantial environmental and economic benefits. However, successful implementation depends on overcoming key barriers, including technological limitations, data gaps, financial constraints, and cultural resistance within the creative sector. Strengthening collaboration among stakeholders, improving access to circular resources, and embedding circular thinking in education and policy frameworks are essential to accelerating this transition. Moreover, circular scenography offers new artistic possibilities, enabling innovative storytelling approaches and fostering a deeper connection between creative expression and environmental responsibility. As the theatre and film industries continue to evolve, adopting circular design strategies will be critical not only for sustainability but also for ensuring long-term resilience, relevance, and impact in a rapidly changing world.

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