



RESEARCH ARTICLE

Overcoming Cost, Time, and Engagement Barriers through Projection Mapping: A Study of Egyptian Independent Theatre

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ARTICLE INFO	ABSTRACT
Received: Sep 17, 2025	Independent theatre in Egypt faces challenges of high costs, limited space, and outdated scenic methods. Traditional set construction requires extensive labor and materials, restricting creativity and delaying scene changes. This study explores projection mapping as a digital scenography alternative that addresses these limitations while enhancing visual storytelling. Guided by Gillette's Scenic Design Theory, a mixed-methods approach was applied: surveys with 600 stakeholders and interviews with theatre professionals. Statistical analysis confirmed reliable responses (Cronbach's Alpha > 0.76), and thematic coding highlighted benefits such as cost reduction, rapid transitions, and improved audience engagement. Results demonstrate that projection mapping offers not only a practical substitute for traditional scenography but also a transformative medium, supporting immersive environments and aesthetic cohesion. Audiences valued the enhanced visual impact, while practitioners emphasized flexibility and efficiency. The study advances digital scenography scholarship and proposes projection mapping as a sustainable innovation for resource-constrained theatre contexts in Egypt.
Accepted: Nov 4, 2025	
Keywords	
Projection Mapping Egyptian Independent Theatre Egyptian Theatre Scenic Design Audience Engagement Theatrical Background Gillette Scenic Design Theory	
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INTRODUCTION

Independent theatre in Egypt is currently navigating a complex set of challenges, shaped by limited financial resources, spatial constraints, and outdated scenic design practices. These limitations have restricted the artistic potential and operational efficiency of productions, often forcing creative teams to compromise on visual storytelling, scene transitions, and audience engagement. Traditional scenic design methods—reliant on physical materials, manual labour, and extensive setup time—have become increasingly unsustainable within the economic and infrastructural limitations facing most independent theatre companies.

In response to this ongoing crisis, there is a growing need for adaptive scenography solutions that are both cost-effective and creatively liberating. This study investigates the application of projection mapping as a digital scenography technique capable of transforming the landscape of Egyptian independent theatre. Projection mapping, a process that digitally projects images and animations onto stage surfaces, provides the opportunity to replace physical sets with immersive, dynamic visuals. It offers theatrical practitioners a practical tool to reduce costs, streamline production workflows, and elevate audience experience through compelling visual environments.

Anchored in Gillette's Scenic Design Theory—which emphasizes the principles of unity, mood, period accuracy, and functionality—this study evaluates whether projection mapping can fulfill these core design values while overcoming logistical and budgetary barriers. By using this theoretical lens, the research positions projection mapping not just as a technical upgrade but as a conceptual advancement in scenography design.

This study contributes to both academic theory and applied practice by proposing projection mapping as a scalable, context-appropriate solution for scenography challenges in Egypt's

independent theatre. The study not only reaffirms the relevance of digital scenography in constrained environments but also offers a roadmap for integrating emerging technologies into traditional artistic frameworks—paving the way for a more sustainable and visually dynamic theatrical future.

LITERATURE REVIEW

The evolving demands of visually compelling storytelling in contemporary theatre—marked by financial limitations and shrinking performance spaces—have heightened global interest in innovative scenography solutions (McKinney & Palmer, 2010; Howard, 2019). Egyptian independent theatre, in particular, offers a critical site of inquiry due to its restricted access to advanced technologies and dependence on labour-intensive, traditional scenic practices (Youssef, 2022; El-Banna, 2021). These limitations underscore the urgency for approaches that balance artistic integrity with pragmatic production strategies.

Within this discourse, McKinney and Palmer (2010) provide a valuable framework using Gillette's Scenic Design Theory for evaluating scenography practice through its emphasis on unity, mood, period accuracy, functionality, and aesthetic coherence. While Gillette's principles were originally conceived in relation to physical set construction, scholars have noted their continued relevance in the age of digital scenography, where projection mapping, virtual environments, and multimedia offer both creative dynamism and cost efficiency (Machon, 2013; Aronson, 2018). Thus, examining how Egyptian independent theatre negotiates these theoretical principles under technological and economic constraints reveals both the resilience of traditional scenography logics and the transformative potential of digital tools. This transformative potential is most clearly demonstrated through projection mapping, which has become a defining tool in contemporary scenography practice.

Projection mapping has emerged as a leading tool, capable of digitally transforming stage environments through the projection of animated visuals onto various surfaces. This approach eliminates the need for physical scene changes and enables real-time manipulation of scenic elements, thereby aligning well with Gillette's principles of keeping with performance unity and mood (McKinney & Butterworth, 2009; Salem, 2020). They further explain how digital imagery can be mapped onto three-dimensional surfaces, creating illusionistic environments that respond fluidly to narrative shifts.

The intersection of digital innovation and theatrical scenic design has gained increasing academic attention in recent years, especially in contexts where economic and spatial limitations hinder traditional production methods. The literature emphasizes the burdensome nature of classical scenography in independent theatre, where material costs, physical storage requirements, and labor constraints often obstruct creative freedom and efficient production (Youssef, 2022; El-Banna, 2021). This scenario is particularly evident in Egyptian independent theatre, which frequently operates under tight budgets and minimal institutional support (Ministry of Culture Egypt, 2022).

Although projection mapping is still nascent in Egyptian independent theatre, several studies reveal a growing interest among artists and designers to explore its possibilities (Atef, 2019; Zaki, 2021). Zaki (2021) underscores the urgent need for structured training programs and technical infrastructure to support digital scenography adoption. Salem (2020) identifies psychological and institutional resistance to technological change as a key barrier, often stemming from the entrenched use of analog scenography techniques.

This research positions projection mapping not only as a technological intervention but as a conceptual reconfiguration of scenography practice. By offering a cost-effective, scalable, and creatively expansive medium, projection mapping addresses the fundamental challenges of traditional design. It stands at the convergence of theory and practice, simultaneously advancing scholarly discourse and offering pragmatic solutions to the evolving demands of theatrical production in Egypt and beyond. It adds to a growing body of literature advocating for technological adaptation in arts sectors facing systemic resource challenges, while also reinforcing the need for institutional and educational support to enable this transformation (Smith, 2018).

METHODOLOGY

This study employed a mixed-methods design, integrating quantitative and qualitative approaches to evaluate the viability and impact of projection mapping in Egyptian independent theatre. The combination of surveys and interviews provided both breadth and depth in assessing cost, time, and audience engagement.

Quantitative Phase

A structured questionnaire was administered to 600 participants representing five stakeholder groups: directors (1.3%), actors (21.8%), designers (8.5%), producers (1.7%), and audience members (66.7%). Respondents evaluated challenges of traditional scenic design and the perceived benefits of projection mapping using a five-point Likert scale focused on cost, time, and engagement.

Data were analyzed using SPSS, applying descriptive statistics, correlation tests, and reliability analysis. Internal consistency was confirmed, with Cronbach's Alpha ranging from 0.76 to 0.91 across groups (see Table 2). These results ensured the robustness of the survey instruments.

Table 1. Distribution of survey participants by role

Role	Frequency	Percentage
Directors	8	1.3%
Actors	131	21.8%
Designers	51	8.5%
Producers	10	1.7%
Audience	400	66.7%

Survey Participant Distribution by Role

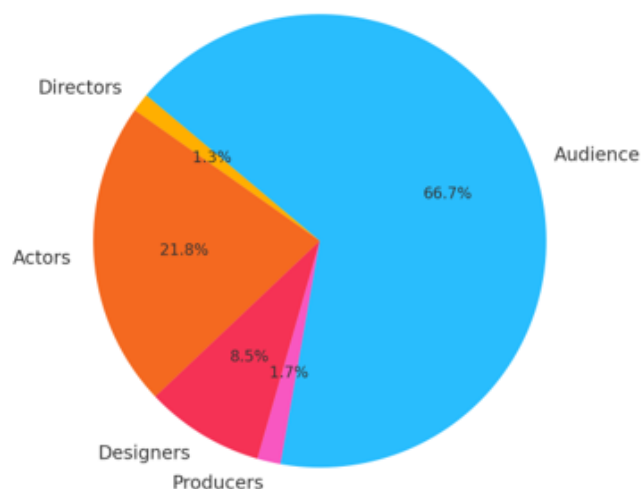


Figure 1. Survey participant distribution by role (illustrated in the document as a pie chart)

Respondents evaluated aspects of traditional scenic design and the perceived benefits of projection mapping using Likert-scale items focused on cost, time, and audience engagement. The Statistical Package for the Social Sciences (SPSS) was used for analysis. Reliability was assessed via Cronbach's Alpha, with values as follows:

Table 2. Internal consistency reliability coefficients for each questionnaire group

Questionnaire Group	Number of Items	Cronbach's Alpha
Audience	20	0.883
Designers	26	0.852
Directors	26	0.905
Actors	4	0.76
Producers	19	0.903

Qualitative Phase

To complement the survey findings, semi-structured interviews were conducted with a purposive sample of directors, designers, and producers from the Egyptian theatre community. Interviews explored practical, aesthetic, and cultural dimensions of projection mapping. Thematic coding was carried out using NVivo software, which identified recurrent themes such as cost efficiency, design flexibility, time savings, and audience immersion.

Validation

Instrument validity was established through expert review by faculty members of the Set Design Department at Helwan University. Questionnaire items were refined for clarity, relevance, and cultural alignment. Feedback from practitioners further ensured that the instruments captured the specific realities of Egyptian independent theatre. This study employed a mixed-methods approach to investigate the viability and impact of using projection mapping in Egyptian independent theatre. The research was structured around both quantitative and qualitative components to gain a holistic understanding of the challenges and opportunities in scenic design.

The findings demonstrate widespread stakeholder consensus on the limitations of traditional scenography and a strong approval of projection mapping as a viable alternative. Notably, participants identified projection mapping to create visually rich environments without the burdens of material cost, storage, or construction delays. Moreover, digital scenography was credited with enhancing narrative clarity and emotional engagement for audiences. To supplement the quantitative data, semi-structured interviews were conducted with a purposive sample of directors, designers, and producers actively involved in Egyptian independent theatre. The qualitative data were coded and analyzed thematically using NVivo software, which helped identify patterns relating to implementation barriers, design flexibility, and user perceptions of projection mapping.

RESULTS

The findings provide a comprehensive evaluation of the challenges in Egyptian independent theatre and the perceived benefits of projection mapping. Results are presented across three thematic domains—cost, time, and audience engagement—in line with Gillette’s Scenic Design Theory.

Cost Challenges of Traditional Scenic Design

Survey data indicated that traditional scenic methods impose significant financial burdens. Directors ($M = 4.65$) and designers ($M = 4.60$) strongly agreed that reliance on physical sets and materials increases production expenses. Actors also emphasized that rising ticket prices, often linked to high production costs, discourage audience attendance ($M = 4.74$). These results are summarized in Table 3.

Table 3. Cronbach’s alpha reliability coefficients

Questionnaire Group	Number of Items	Cronbach’s Alpha
Audience	20	0.883
Designers	26	0.852
Directors	26	0.905
Actors	4	0.76
Producers	19	0.903

Time Inefficiencies

Both quantitative and qualitative findings highlighted time delays as a major limitation of traditional scenography. Directors ($M = 4.50$) reported that extended scene changes disrupted performance continuity, while designers noted logistical difficulties in multi-scene productions. Audience members confirmed that prolonged transitions reduced their overall engagement with the performance.

Audience Engagement Limitations

Static stage backgrounds were widely perceived as unengaging. Audience respondents ($M = 4.30$) reported that current designs often failed to connect with the narrative. Similarly, actors ($M = 4.60$) noted the frequent need to verbally supplement scenes to compensate for weak visual cues.

Projection Mapping as a Solution

Across all groups, projection mapping was endorsed as a transformative scenographic tool. Directors unanimously agreed ($M = 5.00$) that it reduces costs, eliminates manual transitions, and enhances overall production quality. Audiences ($M = 4.73$) reported higher immersion levels, while actors ($M = 4.64$) valued stronger integration between performance and environment.

Visual Summary of Stakeholder Evaluations

A visual comparison of stakeholder evaluations is presented in Figure 2, which illustrates mean scores across cost, time, and engagement. The figure reinforces the consistency of responses, showing directors, designers, and actors prioritizing cost and time, while audiences emphasized enhanced engagement.



Figure 2. Stakeholder Evaluation Scores by Theme

Reliability of Findings

The robustness of these results is supported by high internal consistency across all stakeholder instruments, with Cronbach's Alpha values ranging from 0.76 to 0.91 (see Table 2). Thematic analysis of interview data corroborated the survey findings, particularly regarding cost efficiency,

temporal fluidity, and enhanced audience experience. The results of this study present a comprehensive evaluation of the current challenges and potential advantages of implementing projection mapping in Egyptian independent theatre. Data were analyzed in three thematic domains—cost, time, and audience engagement—aligned with the core principles of Gillette’s Scenic Design Theory. These results confirm high internal reliability across stakeholder instruments, in alignment with established thresholds in social science research (Zaki, 2021; Smith, 2018).

Statistical Consistency

The internal consistency of the findings was supported by high Cronbach’s Alpha values (ranging from 0.760 to 0.905 across stakeholder groups). This confirms the reliability of the questionnaire items used in the study. Overall, the data highlight the widespread support for projection mapping as a cost-effective, time-efficient, and visually engaging solution to the challenges of traditional scenic design in Egyptian independent theatre.

DISCUSSION

The findings underscore the transformative potential of projection mapping as a scenography solution for Egyptian independent theatre. Interpreted through Gillette’s Scenic Design Theory, the results demonstrate how digital scenography can simultaneously address operational constraints and reinforce classical design principles of unity, function, and mood.

Cost Efficiency

The consensus across stakeholder groups confirms projection mapping’s capacity to reduce material and labor costs. Directors and designers emphasized its ability to replace expensive set constructions, while actors linked high production costs to reduced audience accessibility. These results align with previous research that highlights the financial advantages of digital scenography in resource-limited contexts (Smith, 2018; Zaki, 2021). By lowering expenditure, projection mapping not only improves economic feasibility but also supports broader audience inclusion.

Temporal Optimization

Time emerged as a critical factor in production quality. Traditional scene changes were seen as disruptive to narrative continuity, whereas projection mapping allowed seamless, real-time transitions. This finding validates Gillette’s emphasis on functionality and fluidity as essential to sustaining dramatic rhythm. It also echoes international studies (McKinney & Butterworth, 2009) that describe digital scenography as a means of enhancing temporal cohesion in performance.

Audience Engagement

Projection mapping significantly enhanced the immersive quality of stage environments. Audiences reported greater narrative clarity and emotional involvement, while actors noted reduced reliance on verbal explanations to establish context. These outcomes resonate with Salem (2020), who emphasized the psychological impact of visual immersion on contemporary spectators. The findings suggest that digital scenography can meet evolving audience expectations, particularly among younger demographics accustomed to multimedia-rich experiences.

Theoretical and Practical Implications

The convergence of quantitative and qualitative data reinforces projection mapping as both a technological innovation and a conceptual reconfiguration of scenography practice. By aligning with Gillette’s principles while overcoming cost and time barriers, projection mapping demonstrates how traditional theoretical frameworks remain relevant in digital contexts. Practically, the results point to a sustainable pathway for modernizing independent theatre in Egypt, provided that challenges in training, infrastructure, and institutional adoption are addressed.

The results not only validate the study’s objectives but also offer a roadmap for future practices in independent theatre. The alignment of technological innovation with classical scenography principles, as articulated by Gillette, suggests that projection mapping is not merely a modern trend but a sustainable enhancement to theatrical storytelling and production design. These findings contribute to the broader academic and artistic discourse by demonstrating how digital technologies

can bridge the gap between aesthetic ambition and operational limitation in resource-constrained theatrical contexts like Egypt.

CONCLUSION

This study demonstrates that projection mapping is not merely a technical enhancement but a strategic and sustainable solution for the future of Egyptian independent theatre. By addressing cost burdens, reducing time inefficiencies, and deepening audience engagement, projection mapping redefines scenography practice while remaining consistent with Gillette's classical principles of unity, function, and mood. The findings advocate for its integration as a practical and conceptual advancement, urging theatre practitioners, educators, and policymakers to embrace projection mapping as a viable pathway toward innovation, accessibility, and the long-term vitality of independent theatre in resource-constrained contexts. In conclusion, projection mapping should not be viewed merely as a technological novelty but as a strategic asset for the sustainability and artistic evolution of independent theatre in Egypt. The successful adoption of this approach can establish new standards in design efficiency, audience immersion, and production agility—marking a pivotal moment in the digital transformation of theatrical practices. Future research and policy efforts should focus on training, infrastructure, and hybrid models to fully harness projection mapping's potential.

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