# Modelling Kiesler's 'Endless Theatre': Approaches to paradata for heritage visualization

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**Abstract**

This article is an outcome of my investigations into the use of computer-based 3D visualization as a research methodology. Frederick Kiesler's unrealised 'Endless Theatre' (1916-26) project is employed as a case study for articulating 'paradata' in heritage visualization. This builds upon the principles of knowledge transparency outlined within the London Charter (2008). My overall objective for this article is to argue paradata as a critical framework for reading and designing heritage visualization. This is particularly focused on the procedural insights from a modeller's perspective and practical techniques for 'thick depiction', including a proposal for 'paradata maps'. To evidence these positions, the article details two contextual findings on the Endless Theatre project – concerning the principles of 'continuous movement' and 'audience seating' – that emerged through the visualization process itself. The article concludes with an appraisal of paradata as a critical framework and computer-based 3D visualization as a historiographic method that, it argues, has offered new insights into Kiesler's unrealised theatre project.

Investigations of architect and scenographer Frederick Kiesler's (1890-1965) plans for the *Endless Theatre* (1926) represent a challenge to conventional approaches to heritage visualization. Unlike other studies of historical theatre architecture that employ computer-based 3D visualization (Thomas 1999; Beacham and Denard 2003; Hildy 2008; Kuksa 2009), Kiesler's vision for an 'endless showplace' (Kiesler in Creighton 1961: 110) went unrealised and remained at an initial planning stage. The architectural drawings, manifestos, and interview

material left over from the project are complex, potentially contradictory, and raise as many questions on the pragmatics of such a building as they answer. Nevertheless, Kiesler's ambition and design for a 'theatre of continuous movement' have been cited as an influential provocation in the development of Twentieth Century performance practice (see Schechner 1968) and it remains a touchstone for speculating future concepts of performance architecture (Aronson 1981; 2018). The process of modelling a 3D representation of Kiesler's architectural provocation has innate value in-and-of-itself in terms of understanding the dramaturgical, choreographic, and scenographic possibilities of the designer's vision for a theatre of the future. Yet, any process of visualization for this unrealised project would need to extend beyond a reading of the available architectural plans and embrace historiographic approaches to speculation, hypothesis, and argument that the processes of visualising disparate knowledge sets invite.

This article is an outcome of my investigations into the use of computer-based 3D visualization as a research methodology. This is part of a larger project (see https://www.utopiantheatres.co.uk/) on the role of these processes within 'heritage visualization', which is defined by Anna Bentkowska-Kafel and Hugh Denard as 'a process of representing knowledge about space, time, behaviour, sound and light, and other elements that constitute cultural environments' (Bentkowska-Kafel and Denard 2016: 1). While based on an unrealized project, my study of Kiesler's proposal for a new kind of cultural environment is directed towards the concerns and particular frames of reference employed by heritage visualization studies. Bentkowska-Kafel and Denard summarize these concerns as follows:

> • With no fundamental *technological* difference between visualizing structures that still need to be built and structures that have existed, what are the *methodological* differences?
> • How can the process of interpretation of material evidence be conveyed, particularly in areas where data are questionable, incomplete or conflicting?
> • How can computer models and other visualization outputs be made open to

> further investigation, particularly as and when new evidence and enhanced tools become available?
> • What are the limits of visual representation; what tools are available, or need to be developed, to convey information about levels of empirical certainty in hypothetical reconstructions?
> • What is the value, in different contexts, of simplified and inexpensive visualization versus expensive and photo-realistic modelling of heritage?
>
> (Bentkowska-Kafel and Denard 2016: 2)

These questions frame my own investigations into Kiesler's project. Critically, the unrealized status of the plans dictates that my approach to paradata is explicitly concerned with evidencing possibilities and levels of interpretation. This remains cogent with absences of information or conflicting data found within, particularly ancient, archaeological processes more generally. In particular, I review my process of visualizing the *Endless Theatre* as a reply to the principles of the London Charter. Originally developed by theatre historians Denard and Richard Beacham in 2006 (then of the Kings Visualization Lab), the London Charter is the latest in a line of archaeological charters that aims to regulate and guide the processes of interpretation, translation and access to sources in heritage reconstruction. The charter proposes that, along with metadata (data about data), heritage visualization can also capture 'paradata' (process data). This is critically distinct from 'parametricism' (Schumacher 2008) or 'parametrics' (Jabi 2013), which are concerned with computational methods in the architectural design process. As articulated in principle 4.7 of the charter, paradata is an acknowledgement of the tacit knowledge that can condition any creative and/or interpretative decision. Fellow member of the Kings Visualization Lab, Drew Baker, originally coined 'paradata' in relation to heritage visualization as a 'data stream [...] which contains the decisions, selection processes and reasoning behind the interaction and combination of different data artefacts' (Baker 2007: 5). As a terminology, paradata is also used within the context of the social sciences. Normally concerning surveys, it accounts for the research conditions not discernible through an examination of the raw data alone. For instance, this might include notes on the demeanour of the interviewee, duration of the interview, or time of day (Safir, Black and Steinbach 2001: 5).

Nevertheless, Baker's notion of paradata extends beyond the remit of procedural notation. It positions the process as a distinct outcome of the project as it details, or evokes a sense of, the methods employed in 'completing' the incomplete or resolving the conflicted.

Procedural information, and the framing of the outcomes as provisional to this process, is vital in repositioning computer-based 3D visualization beyond a tool for articulating new knowledge and towards as a research methodology in its own right. Or as Baker puts it; 'The journey now becomes as important as the destination itself' (Baker 2007: 7). David J. Staley articulated a similar concern in relationship to another well-established humanities-based method for citing situational knowledge, proposing that:

> Something like Clifford Geertz's "thick description" could be translated into "thick depiction," where the historian visualizes an abstract, multidimensional network incorporating (...) social, cultural, economic, and political system(s).'
>
> (Staley 2003: 54)

The provocation of 'thick depiction' points towards a technical epistemology for displaying and framing levels of interpretation and uncertainty for heritage visualization. Similar approaches to thick depiction can be observed in projects such as *Skenographia Project* (KVL 2003), *Rome Reborn 2.0* (Frischer, et al. 2006.), and *Cerveteri Stone* (Bordoni and Rubino 2007). Influenced by Geertz's humanities-based methodology along with these previous examples from heritage visualization, one aim for this article is to offer an example of thick depiction as an approach to paradata navigation. This includes criteria and practical approaches to organising procedural information through a 'paradata map'.

Baker (2007) and Juan Barceló (2000) refer to the process of modelling detailed in this article as 'interpolation'. This is similar to the architectural design process of 'versioning', which is described by the studio Sharples Holden Pasquarelli as 'the shifting of design away from a system of horizontal integration (designers as simply the generators of representational form)

towards a system of vertical integration (designers driving how space is conceived and constructed and what its effects are culturally)' (Sharples Holden Pasquarelli 2002: 1). Akin to parametics and the rapid assessment of multiple forms or shared parameters (such as height, depth, etc.) through digital models, versioning is also argued as a site of critical understanding and knowledge generation. Crucially, Sharples Holden Pasquarelli propose that versioning can 'alter the distinction between the 'aesthetic object' and the 'theoretical text' and collapse this distinction where the object and the text are one in the same with the technique of manufacturing' (Sharples Holden Pasquarelli 2002: 3). An aim of this article is to outline how the process of interpolation, like versioning, in heritage visualization is as much a methodology for knowledge generation and articulation, as it is assessing spatial and dimensional integrity.

My overall objective for this article is to argue paradata as a critical framework for reading and designing heritage visualization. This is particularly focused on disrupting the seductive qualities of 3D rendering techniques. I argue that paradata challenges heritage visualization to represent the provisional and tacit knowledges latent within the selective and interpretative processes of the geometric form. This builds upon archaeologists Paul Miller and Julian Richards argument that 'computer models carry more authority than paper images […] people expect computers to be right, and the past is therefore presented as a known – and knowable – reality' (Miller and Richards 1995: 20). The expectation of computer imagery, especially concerning visions of the past, as a technical exercise that imposes a quality of persuasive authority when combined with the often visually seductive qualities of visualization rendering processes. Essentially, it looks 'right' so it must be. Diane Favro, however, proposes that:

> If scholars in the arts, architecture, humanities and social sciences become accustomed to the visualization of ideas, they will more readily consider less abstracted surrogates such as Virtual Reality models as knowledge representations. Once that shift occurs, scholars and other observers hopefully will supplant the axiom "to see is to believe" with "to see is to question".
>
> (Favro 2006: 328)

Favro's ethos of ‘to see is to question’ drives my argument for paradata as a critical framework. Combining approaches to visual epistemology with archaeological historiography, this article adopts the provocation of thick depiction as a starting point for investigating the practical approaches to paradata notation for heritage visualization.

To meet the above aims and objective, this article is organised into three sections. First, I detail the critical and creative contexts for Kiesler’s vision is detailed. Second, I map the critical role of a ‘modeller’s perspective’ in heritage visualization and offer criteria for ‘thick depiction’. Third, I select two lines of thought that have framed Kiesler’s vision and outline how these featured within the visualization process. Overall, I propose that paradata offers a critical framework that elevates the critical and interpretative role of modellers, in the manner suggested by Martyn Jessop as the ‘difference is perhaps of being regarded either as ‘technicians’ or ‘scholars’’ (Jessop 2008: 282). Consequently, my objective for this article is to argue how the conditions of computer-based 3D modelling shape and drive the historiographic process of heritage visualization.

**Kiesler’s approach to performance architecture**

Kiesler responded to the advent of cinematography in a manner typical of the post-industrial theatrical avant-garde. ‘The stage must not become a replica of film’, he declared, ‘it must go deeper into its own laws’ (Kiesler 1926b: 70). Born in Czernowitz, then part of the Austro-Hungarian Empire, Kiesler moved to Vienna in 1917 to study architecture under the architect Otto Wagner (1841-1918). It was in Austria that he established himself as a promising figure within the progressive art scene that developed following the end of the First World War. Kiesler’s rise to prominence was initially for his use of projection in a stage design for *R.U.R.* (1923). Later, as a member of the infamous De Stijl group, he would gain international

notoriety for his project *City In Space* (1925). As typified by fellow De Stijl member Piet Mondrian (1872-1944), Kiesler's scenographic installation realized the 2D rules of lines and primary colours that remained the focus of the De Stijl movement in the late 1910s and early 1920s. By the mid-1920s, Kiesler was a recognised international figure within the historical European avant-garde.

Central to Kiesler's artistic vision was the argument that humans share an implicit connection with all that surrounds, encloses and channels them. 'Correalism', Kiesler's term of this tacit interdependency, accounted for 'the dynamics of continual interaction between man [sic] and his natural and technological environments' (Kiesler 1939: 61). Under this remit, Kiesler's approach to theatrical architecture was as an extension of the action itself: an active component in the reception, construction and development of performance. Kiesler rejected wholeheartedly the conventions of the contemporary dramatic theatre, as evident in his manifesto 'The Theatre is Dead' (1926a). Comparable to the revelation of Mondrian's Neo-Plastic paintings, Kiesler sought an architectural format that blurred the conventional physical and psychological barriers that occurred in the hierarchal relationships of, what he termed, 'dead theatre'.

> Until the theater is forced out of the momentary "peep show box" through the overwhelming and justified success of the "talkies," it will not realize the necessity of the new type of theater which I call the "Endless". There the impulse and power of nature, actors and public are coordinated in a new kind of spatial conception unprecedented in the theatrical arts, as television was in the mechanical arts.
>
> (Kiesler 1930a: 113)

The design for the *Endless Theatre* was first formulated in 1916, but would not be formally presented to the public until 1926. Kiesler was non-specific in his description of how the architectural structures of the *Endless Theatre* would have functioned in performance. The most published textual description of the project is from an interview with Kiesler in 1961:

> The completed plans of The Endless were meant for a capacity of ten thousand people, all in one double-shell building of "cast glass." This double shell would contain the heating and the cooling, and consisted of an interplay of ramp, platform, and elevator – an endless showplace throughout the whole space. […] The Endless was a continuous intertwining of vast ramps which lead into others at several levels until spectators and actors practically reach the ceiling. The various levels connect through three elevators which are exposed; the elevators are nothing but platforms that take off from one level to another. The players and audience can intertwine anywhere in space. There, I feel, is a first attempt at an architectural expression of spatial integration. It fully used the construction principle of continuous tension – there was not a single column in the whole structure.
>
> (Kiesler in Creighton 1961: 110-111)

This 'endless showplace' was arguably his idealized theatrical vision. His later performance architecture designs – such as the *Brooklyn Community Theatre* (1930), *Woodstock Theatre* (1931), and *Universal Theatre* (1960-1961) – were labelled by Arnold Aronson as 'Cosmetic Futurism' or essentially a 'dressing up the superficial aspects while keeping the basic elements comfortable, familiar, and unchanged' (Aronson 1981: 491). The *Endless Theatre*, however, was a direct challenge to what was comfortable and familiar in theatre architecture and is representative of a 'theatre of the future' in Aronson's model.

Under Aronson's definition, a theatre of the future was an unprecedented architectural form that would operate under new, yet undeveloped, models of performance reception. The social and artistic principles enacted by the *Endless Theatre* situate it, undoubtedly, within this latter category. For its proposed lattice of ramps, continuous lifts, and spiral platforms would have offered stage practitioners a site capable of supporting experiments for the development of, what Kiesler termed, the 'open play'.

> … the theatre of illusion and illustration is ended. The time is ripe for the open play. … The new spirit bursts the stage, resolving it into space to meet the demands of action. It invents the space-stage, which is not merely a *priori* space, but also appears as *space*.
>
> (Kiesler 1926b: 67; italics in original)

With clear similarities with Italian Futurist Enrico Prampolini's (1894-1956) proposal for the *Magnetic Theatre* (1925), Kiesler foresaw the prophesied modernist ambition of the 'new

drama' as a site of scenographic motion or 'continuous movement' as he termed it. Prampolini described this operation within his manifestos for a Futurist scenography:

> *Space is the metaphysical halo of environment* or setting.
> *Environment is the spiritual projection of human action*.
> *What, then, can exalt and project the content of theatrical action* better than Space – Space moving rhythmically within the scenic setting.
>
> (Prampolini 1926: 105 – 106; italics in original)

Kiesler expanded upon this spatial conception of theatrical action to include the actor as verifying space by motion and plasticity by posture (see Kiesler 1934: 728). He had experimented with, what Prampolini labelled, 'kinetic scenography' in his design for Eugene O'Neill's *Emperor Jones* (1924) in Berlin. Through this commission, Kiesler was able to examine the practicalities of a theatre of continuous movement. Influenced by the Russian Constructivist Lyubov Popova's acting apparatus for *The Magnanimous Cuckold* (1922), Kiesler designed a series of complex set changes that he called 'mechanical space scenery'. These constructions would interchange throughout the performance, slowly merging upon a funnel stage to form, if only momentarily, one of five settings. Consequently, the notion of continuous movement in the *Endless Theatre* was arguably envisaged as a combination of human and nonhuman bodies moving, possibly at a slow pace, between various set forms and formations.

While movement was critical for Kiesler's vision, a predominant theme in almost all of his artistic practice was the notion of 'endlessness':

> All ends meet in the "Endless" as they meet in life. Life's rhythms are cyclical.
> All ends meet during twenty-four hours, during a week, a lifetime. They touch one another with the kiss of Time.
>
> (Kiesler 1966: 567)

In terms of the theatre, Kiesler's pursuit of an endless structure was for its unifying and performative qualities. The aim was to blur the conventional areas for performer and spectator within the *Endless Theatre*. Each of these communities – of actors and dancers, audience and

participants – would be invited to blur into one another to become a singular platform for the presentation and reception of action. In line with the biological forms that Kiesler cited in defence of the concept of Correalism, he described the theatre as 'endless like the human body […] there is no beginning and no end to it' (Kiesler 1966: 567). Yet no other form captured Kiesler's imagination in the same manner as that of the spiral. Kiesler's fascination echoes the investigations of mathematician Jacob Bernoulli (1654 – 1705). Bernoulli's research inspired Kiesler to utilize the 'spirals irresistible hypnotism' (Kiesler 1946: 98) in the realization of a Correalist total performance environment through architecture. Kiesler argued that the architectural experience of traversing a spiral promoted social regeneration (through spatial integration of groups) and personal rejuvenation (through continual ascension and re-orientation). Later in his life, Kiesler observed the same plastic qualities for 'architectural rebirth' in the central gallery space of Frank Lloyd Wright's *Guggenheim Museum* (1959). Instead of negotiating a series of floor, the gallery visitors journey through space without clear ascension markers such as steps or levels. This indirect ascension was a quality that Kiesler stated as central to the spectators' experience and navigation of the *Endless Theatre*. Accordingly, Wright's spiral structure offers a glimpse as to how Kiesler may have envisaged spectators gathering along the ramps and surfaces of the *Endless Theatre*. Although the proposed capacity for the theatre is a matter of debate, with contradictory sources citing it as either 10,000 (Creighton 1961: 110) or 100,000 (Lönberg-Holm 1930: 495). Either figure would have far exceeded that of its contemporaries, such as Walter Gropius' *Total Theatre* (1926) or Vsevolod Meyerhold's new theatre (1938) each of which were around 2,000. However, the direct impact of this figure is a question for another article.

Presented in the Middle Hall of the Vienna Konzerthaus, *Space Stage* (1924) (German, *Raumbühne*) was Kiesler initial experiment into the spiral as a platform for performance.

Although the *Endless Theatre* was not formally presented until two years later, historian Roger L. Held claimed that Kiesler designed the *Space Stage* as a smaller version of the stage found at the core of the *Endless Theatre* (see Held 1981: 24). Kiesler would return to the spiral throughout his life as he believed it offered the architect and theatre practitioner a psychological release from the physical restraints of the ground. He claimed that to journey along the spiral's endless surface would enable a 'continuous rebirth on new planes without losing contact with former ones' (Kiesler 1946: 98). Yet, the spiral's suitability as a site for the new drama relied upon 'innate motive forces' (Kiesler 1946: 98), as Kiesler termed it, implicit in the structural tension of the spiral's endless surfaces. Under the remit of Correalism, all elements condition one another. Consequently, Kiesler's reference to the spiral's innate motive forces explains how the principles of continuous tension could support the spiral structure independent of additional columns or supports. In Kiesler's vision for a Correalist theatre, the spiral becomes the ideal platform for the presentation and development of action, as its structural forces reflect the dependent relationships between the body, architecture, and action.

Kiesler would develop a series of further architectural designs for the theatre in his later life, with the *Universal Theatre* (1961) being the most internationally recognised. A unifying feature of these unrealized designs was the use of two auditoriums facing a singular stage, or what Kiesler called a 'doppelauditorium' (Kiesler 1946). While offered as a solution to architectural flexibility to enable multiple stage formats (arena, traverse, end-on, etc.), Kiesler does not outline any evidence that this arrangement formed part of the *Endless Theatre*. Nevertheless, the pragmatics of Kiesler's vision for dramatic reform is ambiguous with particular regards to how the *Endless Theatre* would generate a new performance style. 'The elements of the new dramatic style are still to be worked out', Kiesler proclaimed in 1926, 'They are not yet classified' (Kiesler 1926b: 61). This ambiguous stance towards the qualities

of the new drama is evident in the Utopian optimism of Kiesler's Modernist contemporaries such as Oskar Schlemmer (1888-1943), Edward Gordon Craig (1872-1966) and Adolphe Appia (1862-1928).

Based on this contextual literature review, I was able to draw three basic assumptions on the type of performance the *Endless Theatre* was intended to support:

- The performers would be versed in circus-based skills. The only critical success to be staged upon the *Space Stage* was a performance by a British dance troupe that used the construction as a form of 'oversized gymnastic scaffold' (Lesák 1989: 39). A comment furthered by Adolf Loos describing it as 'circus-esque' (Loos 1926: 96).
- The action was intended to occur throughout the dimensional axes of the theatre space: from above, below and around the spectator.
- Surreal projected images to reflect the emotional quality of the drama would have, in all probability, been projected upon the surface the opaque shell (see Schechner 1968: 52).
- Movements of performers and audiences would be complemented and sustained by architectural motion.

This last condition relates to Kiesler's typically Modernist fascination with mechanical motion and the articulation of space. He organized the optic process of recognizing space into four categories; by observation of the ground plan, by rotation of the object, by a reading of shadows, and by motion of the object (see Kiesler 1934: 727). In terms of diagrammatic sources, there were three key architectural / design plans (all three plans are held by the Museum of Modern Art, New York, and can be viewed via their archive):

- **Section Plan** – 1924 architectural drawing on diazotype. Dimensions 118.7 x 256.5cm. Catalogue Number: 364.1966. Details a section for the theatre, with the right-side

depicting features absent from the left-side of the plan. Includes Space-Stage, two lifts, mid-level ‘stadium seating’ and bridge, possible suspension cables, central column elevated above Stage-Space, and Spiral-Junction elevation (on right-side only).

- **Endless Plan** – 1924 architectural print mounded on board. Dimension 210.8 x 213.4cm. Catalogue Number: 362.1966. Offers a ground plan of the lower half of the Section Plan (mid-level and lower). Does not cite the Spiral-Junction or any lifts. Includes ‘iris’ and ‘apex’ structure around a central Stage-Stage, ramps over four levels, mid-level ‘stadium seating’ and bridge, possible steps or seating either side of ‘iris’, and concentric circles under main structures (possibly an auditorium?).
- **Spiral-Junction** – 1924 architectural print mounted on board. Dimensions: 196.9 x 213.4cm. Catalogue Number: 363.1966. Includes ground plan of the Spiral-Junction aligned with the upper right-side of the Section Plan, possible suspension cables, and three possible lift ‘holes’ and platforms along a central upper bridge.

Consequently, the contextual factors identified through this literature review provide a framework for assessing the rigour of any visualization of Kiesler’s unrealized theatre. This is especially vital if the visualization itself is to be consider an argument for what the *Endless Theatre* offers performance historians, architects and designers today.

**Thick depiction and procedural insights**

Digital images have, alongside image making more generally, been conventionally framed in academic contexts as an output or result of a research process. However, Johanna Drucker proposes that the use of digital technologies extends beyond the production of illustrative and organizational techniques to engender a critical methodology:

> Can we demonstrate that humanities computing isn't "just" or "merely" a technical innovation, but a critical watershed as important as deconstruction, cultural studies,

> feminist thinking? To do so, we have to show that digital approaches don't simply provide objects of study in new formats, but shift the critical ground on which we conceptualize our activity.
>
> (Drucker 2004: 2)

The potential for heritage visualization to produce new insights was outlined by Paul Reilly. Reilly led one of the first archaeological projects to employ computer-based 3D visualization and focused on the software's 'exacting demands' (Reilly 1989: 571). Reilly extends this discussion to consider the procedural insights gained from the process of modelling:

> This fluid interaction between the researcher and the data means that data exploration can proceed iteratively with very fast cycle times between the original hypothesis, data examination, modified theory, new hypothesis, and so on.
>
> (Reilly 1989: 571)

Nonetheless, this line of enquiry has not been developed much beyond these initial remarks. One reason may be due to the lack of scholarship written by 'modellers'. While the work of digital technologists such as Baker and Martin Blazeby provide important and valuable insights, for the most part, the generative and exploratory processes of computer-based 3D visualization in the humanities remain undefined or possibly even ignored as a point of knowledge production. It is important to note that in architecture and other fields, where researchers perform the technical practices themselves, ideas such as versioning and parametricism are recognised methodological approaches. These practiced-based research methods are epistemologically aligned with the argument shared here, if situated in a different disciplinary context.

Based on my perspective as a modeller, I propose that the manner with which computer-based 3D visualization allows for the convergence between empirical and interpretative datasets positions visualization-based research as a discrete 'type' of knowledge. The London Charter's definition of 'dependency relationships' suggests a similar process: 'A dependent relationship between the properties of elements within digital models, such that a change in one property

will necessitate a change in the dependent properties' (The London Charter 2009: 13). Positioned as a technical rather than an interpretative operation, the London Charter's acknowledgement of dependency relationships implies, I argue, an underlying condition of computer-based 3D visualization. Influenced by Michael Polanyi's (1958) notion of 'tacit knowledge', I propose that new approaches to the interpretation of the source material, including an architect's intentions, may become apparent through the intangible perspective of a modeller. A similar concern has also been identified by Cat Fergusson Baugh (2018) in relationship to the 'haptics' of model making. The reliability of the visualized outcome is dependent upon communicating the interpretation of dimensional (plans etc.), contextual (lit review), and the procedural insights that occurring during modelling. Especially when all three processes are undertaken by the same individual, the visualization is arguably a site of knowledge generation in the identifying, examining, and proposing of new hypotheses.

Staley's proposal for thick depiction presents a number of practical challenges for displaying heritage visualization. The first of these is organizational. To aid the navigation of the paradata for the *Endless Theatre* project, the various hypotheses were assessed through their correspondence to three methodological criteria: *dimensional*, *contextual* and *procedural*. The first of these criteria, *dimensional*, relates to the straightforward interpretation of dimensional data sourced through the literature review: this includes architectural plans and dimensional (textual) descriptions. Whereas this first criteria represents a 'classical' objective exercise or 'anastylosis', the second *contextual* criteria go beyond this remit to acknowledge the intellectual capital required to 'complete' the incomplete. Contextual paradata details the primary and secondary sources that influenced the visualization process including within the proposal of new hypotheses without clear dimensional evidence. The third criteria of *procedural* extends the remit of paradata to recording hypotheses that emerge from the

interpolation or versioning within the 3D virtual environment itself. Consequently, procedural criteria account for the influence of 'digital synthesis', as outlined by Willard McCarty (2008) and Drucker (2004), and the role of the real-time 3D environment, rapid experimentation and tacit understanding that frames the process of computer-based 3D visualization.

**Paradata map**

To realise an approach to thick depiction for heritage visualization, I developed a documentation strategy to cite, assess and contextualise the decision-making processes in relation to my three criteria. This was in reply to recommendations by Bernard Frischer, Nick Ryan, and Franco Niccolucci who proposed that a 'common library of textures' as going some way toward a methodology for the denotation of uncertainty (Frischer et al. 2002: 10). For instance, to articulate different levels of uncertainty Frischer's team modified the 'brightness' of an applied texture, in increments of 20%, to correspond to the level of uncertainty assigned by the research team. Full intensity indicated archaeological certitude while diminished clarity implies uncertainty (Frischer and Stinson 2003: 29). Similarly, my proposed 'paradata map' offers a method for navigating the latent decisions within heritage visualization. This map operates as a lens for readers to delve into the visualization process, as well as a filter for how they wish to view the material. In practice, the map acts as a fulcrum for hyperlinked contextual accounts for each of the architectural elements and allows a reader to examine alternative versions and draw their own informed conclusions. For my study, I developed a website to host the project information (see https://www.utopiantheatres.co.uk/). The navigation screen introduces the case study and supports access to the project sections: 'Contextual Statement',

‘Procedural Scenarios’, ‘Geometry Files’ and an overview of the available ‘Source Material’. The paradata map is accessed via procedural scenarios.

The paradata map is based upon groupings of information, namely *scenario* and *category*. Scenario relates to a collection of arguments that align, inform or confirm one another. Typically, these relate to the different phases of research from initial interpretation to the preferred version. A blue border denotes my ‘Preferred Scenario’, or at least the scenario in my opinion represents the best interpretation of the available information. The second level of grouping is 'category'. To aid a reader’s assessment of each of the architectural units, I devised a coloured coding system (figures 2-5). Each unit was coded based on five categories of interpretation (detailed criteria listed on website): Probable (white), Alternative scenarios (green), Secondary sources (light blue), Reasoned conjecture (red), Omitted material (multiple). These categories exceeded any one scenario and are designed to offer insight into the type of information latent within a visualization. Influenced by Frischer and Stinson’s (2003) approach to using four models of visualization (Original Model, State Model, Restoration Model, and Reconstruction Model), I organized the project into three scenarios: *initial*, *preferred*, and *further*.

- **Initial scenario**: Unique Features: Ramps connected to Level 2 and Level 3 are assumed to be static structures; The 'iris' is interpreted as a raised platform connected to the 'apex' and 'stairs' as a singular architectural unit; Elevators clash with the bridge.

- **Preferred scenario**: Unique Features: Fixed Elevator Shafts; Hypothesised lower auditorium; Alternative Iris Configuration; Apex interpreted as a fixed platform

- **Further scenario**: Unique Features: No Elevator Shafts; Hypothesised Doppelauditorium arrangement (based on the 'stairs' and 'apex' from the preferred scenario); Further proposals for architectural motion.

Critically, the paradata map allows readers to drill down into the process. Each coded section hyperlinks to a ‘paradata account’. These accounts are organised in line with the different scenarios and offer contextual information for the decisions made. The overall purpose of the paradata map is to enable readers to engage with the range of interpretative decisions undertaken and to make their own judgements, with citation to the relevant source material (images, previous projects, textual accounts, etc.), on the historiographic arguments latent within the visualization.


Figure 1: Preferred Scenario without any paradata map

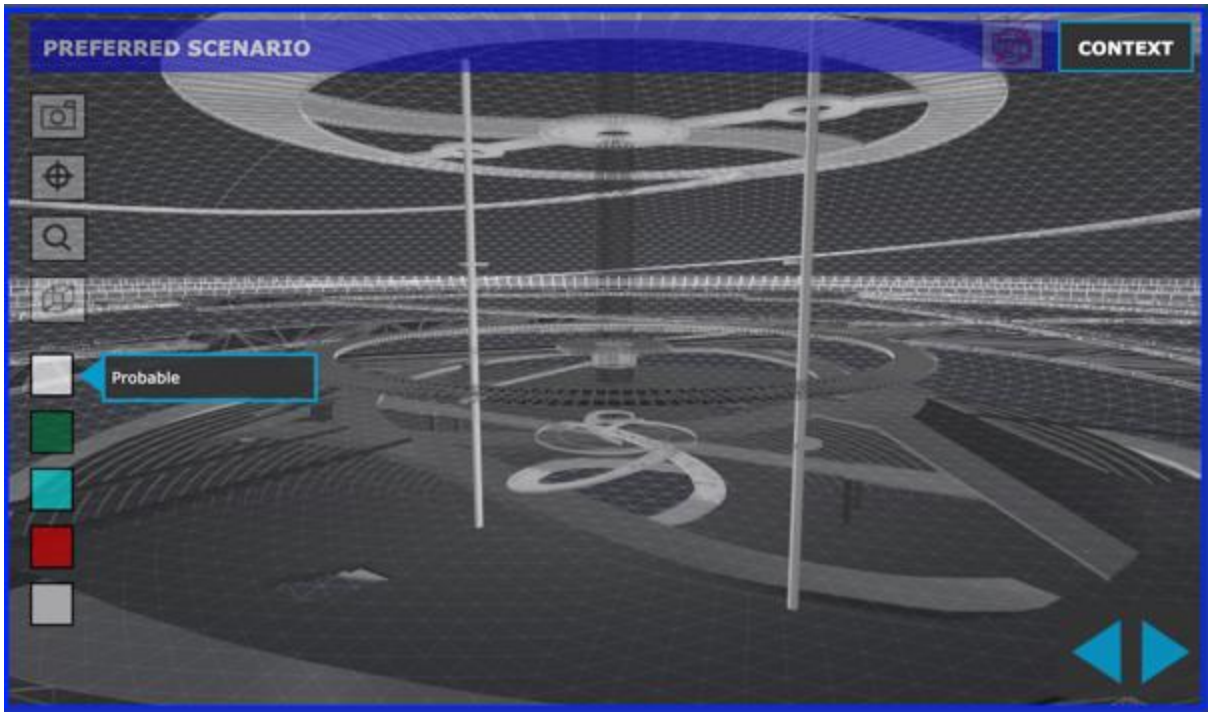


Figure 2: Preferred Scenario and overlaid Paradata map with category of ‘Probable’ highlighted.

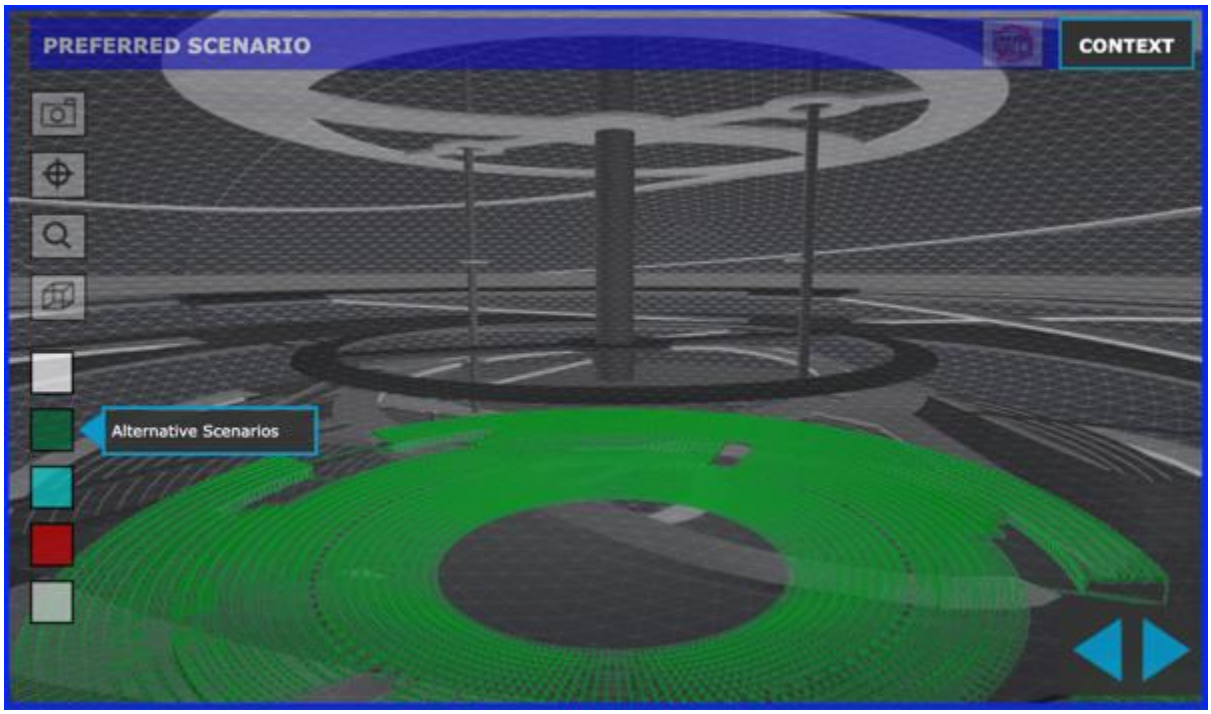


Figure 3: Preferred Scenario and overlaid Paradata map with category of ‘Alternative Scenarios’ highlighted.

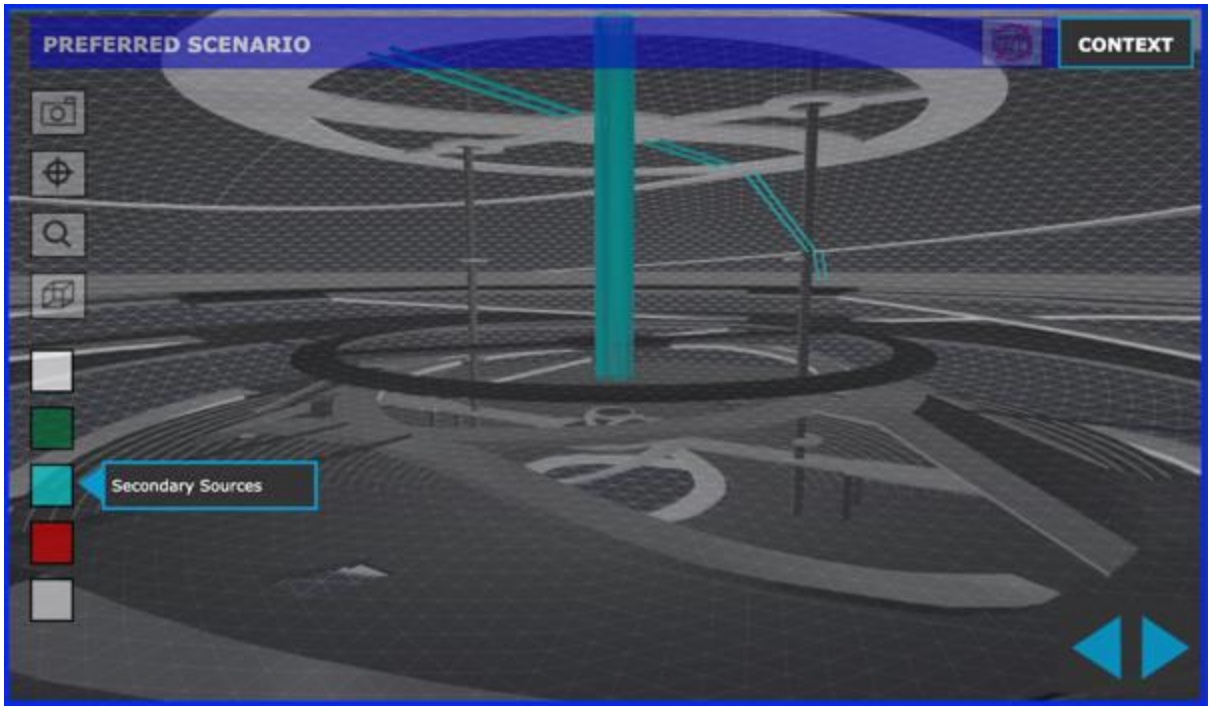


Figure 4: Initial Scenario and overlaid Paradata map with category of ‘Secondary Sources’ highlighted.

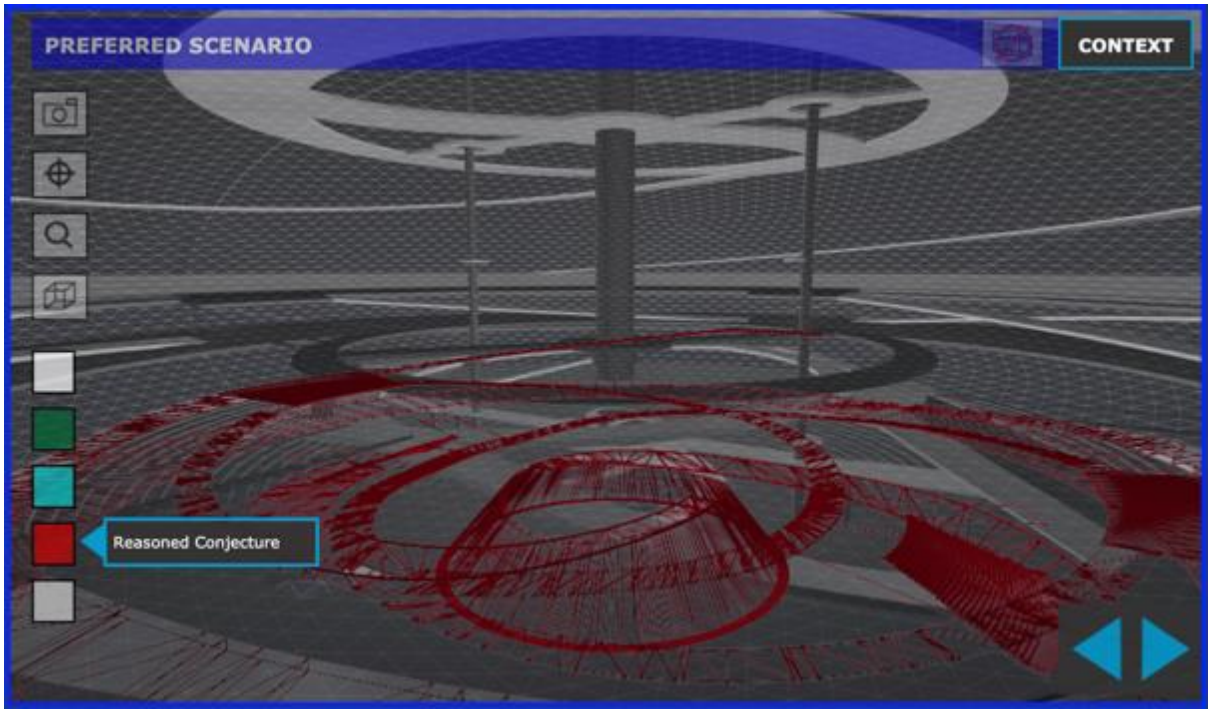


Figure 5: Preferred Scenario and overlaid Paradata map with category of ‘Reasoned Conjecture’ highlighted.

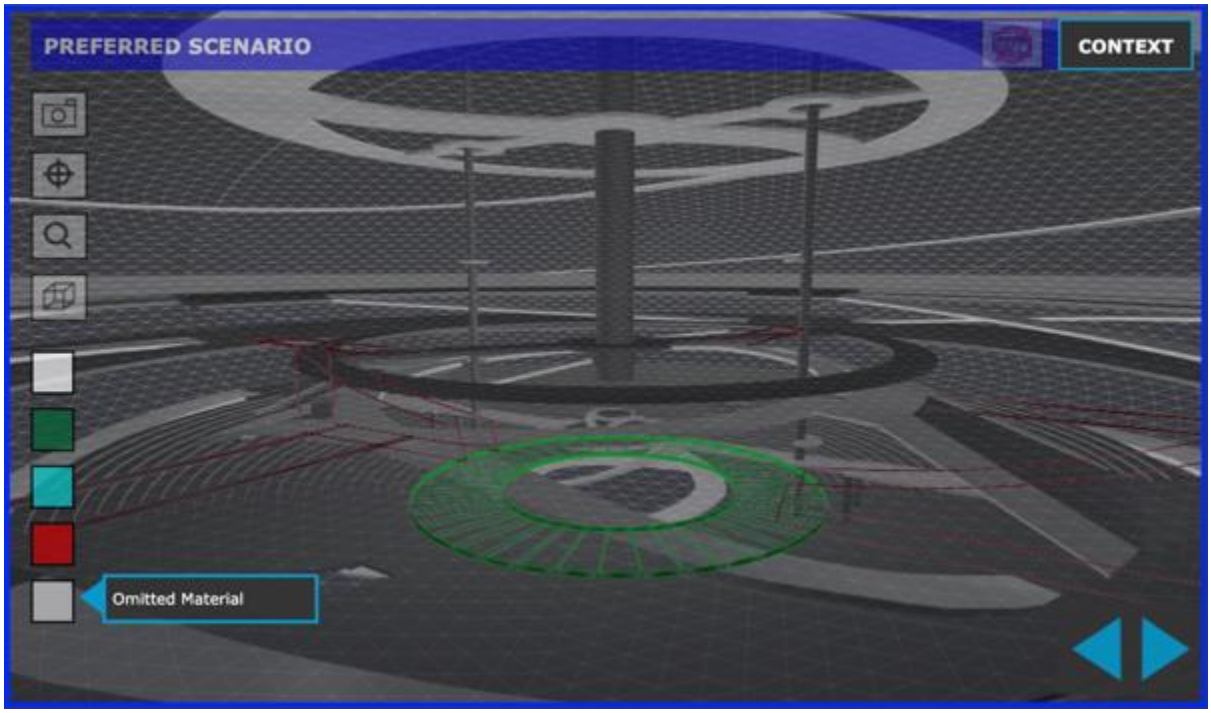


Figure 6: Preferred Scenario and overlaid Paradata map with category of 'Omitted material' highlighted.

**Findings: Kiesler's 'elastic' architecture?**

While the critical insights into Kiesler's proposed new drama are multiple, I have selected two important contextual features for the *Endless Theatre* and how these impacted the visualization process. First and foremost, Kiesler's articulation of an 'endless showplace' and 'architectural expression' were often coupled with the idea of an 'elastic' architecture. A descriptive label from 1930 offered by Kiesler as context for the published versions of the plans offers the most straightforward summary, stating that the 'structure is an elastic building system of cables and platforms developed from bridge building. The drama can expand and develop freely in space mounted on the spiral' (Kiesler cited in Lönberg-Holm 1930: 495). The seemingly flexible qualities of this cabling system were echoed in secondary readings of the plan. Schechner described how the 'white intersecting rings are wide roads that go up and down, disappear and appear again at different levels, and sometimes continue into ramps reaching the highest ring'

(Schechner 1968: 52). Aronson builds upon this description, adding the ‘ramps and platforms could be arranged to allow endless variations in design’ and it was ‘the first, to this day, most complete concept for the total use of space by both spectator and performer’ (Aronson 1981: 499). Schechner and Aronson’s readings on flexible structures are seemingly confirmed within Kiesler’s 1932 account on the future of scenographic experimentation:

> The changing demands of stage production and the need for proper correlation between actors and audience made necessary a flexible ephemeral construction and a building technique best achieved through tensional structures, light-weight easily fabricated tubular supports of metal, and web coverings of weatherproofed fabrics.
>
> (Kiesler 1932: 8)

As part of his later writings on endlessness, Kiesler cites a variety of project's that display his intended qualities for the *Endless Theatre*. For instance, Kiesler cites the *Zeiss Planetarium* (1926) as an example of a 'continuous tension' structure (Kiesler 1930), where the weight of the structure is distributed throughout the architectural framework. As already noted, Kiesler also identified Wright's *Guggenheim Museum*, along with Berthold Lubetkin's *Penguin House* (1932) at London Zoo, as an example of an endless structure. Notably, Wright and Lubetkin’s designs are concrete spirals, and the Zeiss Planetarium is a dome with no suspended ramps. None of these cited influences involved light weight fabricated supports or web coverings. The interpretation of these structures is assumed to have no direct reference and instead infers a form of architectural innovation that Kiesler foresaw as a requirement of realizing the *Endless Theatre*.

The Endless Plan offers the only diagrammatic evidence for architectural motion. Namely, Kiesler proposed three elevators or moving platforms to enable the performers to move freely between levels, which are referenced in most descriptive accounts. While functional, they would have been performative in a manner akin to Kiesler proposals for continuous movement and sceno-dynamic action. The quality of this motion is assumed to be similar to a Paternoster

lift; ‘The movements begin abruptly’, Kiesler describes, ‘accelerated and retarded, they continue without interruption until the play is ended’ (Kiesler 1926b: 70). This description would form the basis for interpolating the role of movement within the *Endless Theatre*. Critical to this process was the apparent absence of a third lift on the plans, which had been cited in numerous descriptions (both primary and secondary).

My initial assumption was that a central column would house the third lift. However, upon visualization the spatial viability of this interpretation was contested in the absence of a suitably defined platform on the plans. There was also a query regarding its potential relationship with the central Space-Stage, positioned directly below the central column. If the top level of the Space-Stage or another platform were to move vertically, it would certainly offer the functionality of a central Paternoster lift. Based on this assessment, I assumed this platform to be a central element in Kiesler’s vision for sceno-dynamic action. The rotation and elevation speed of this platform could be potentially manipulated and provide a key tool in the development of ‘rhythmic space’ due to its dominant position and size. A different perspective on architectural motion, however, was evident in Gropius’ description for how his *Total Theatre* would have functioned in performance:

> Thus the playhouse itself, made to dissolve into the shifting, illusionary space of the imagination, would become the scene of action itself. Such a theater would stimulate the conception and fantasy of playwright and stage director alike; for if it is true that the mind can transform the body, it is equally true that the structure can transform the mind.
>
> (Gropius 1961: 14)

Gropius’ account of a shifting and illusionary space was in part due to his own project’s proposed usage of 360-degree projection on the walls of the auditorium. Yet, Kiesler had foreseen the importance of projection and Schechner suggested that the ovoid walls of the *Endless Theatre* could have been used as a projection surface. Unlike Gropius who envisaged documentary footage being projected onto the walls of his *Total Theatre*, Kiesler more likely

foresaw projection as an extension of the lighting system. While Schechner's description in 1968 is the only textual reference, the lighting concept for Kiesler's realized cinema *Film Arts Guild Cinema* (1929), New York, offers a useful comparison (McGuire 2007). However, the lighting scheme for the *Endless Theatre* extends beyond the remit of this investigation.

To return to Kiesler's methods for the optic recognition of space, explorations into the potential candidates for architectural motion within *Endless Theatre* are critical to understanding the dramaturgical and scenographic qualities of the project. In particular, the rotation of structure detailed on the Spiral-Junction Plan had been assumed from the outset as a top candidate for motion. However, the model revealed that this movement would have been limited by the presence of the two lifts clearly cited on the plans. Without these halting the spiral's rotation, the possible impact of a 360-degree turning circle would add a significant dimension to the flexibility of structure. Yet, given that the lifts appeared to be vital to Kiesler's vision, the argument for the rotation of the spiral structure itself was discounted. This brought attention to other aspects of the project in search of architectural motion. One of the main candidates was a suspected amphitheatre-like 'seating area' detailed on the 1924 ground plan.

**Findings: Audience seating?**

In a 1924 newspaper interview, Kiesler offered an account of how audiences would be spatial organized within the theatre; 'A characteristic of the Endless Theatre … was that the audience area was to move around the stage allowing each viewer to see all sides of the stage' (Footnoted from Arbeiterzeitung (Vienna), October 4th, 1924 in Held 1982: 29). There are two possible readings of this statement. First, that the auditorium area itself was to rotate and impart the quality of motion upon the spiral structures. Second, that Kiesler imagined the spectators walking around the structure, enabling them to see from all sides. The provision for seating is

described in multiple accounts, but seemingly only once by Kiesler as ‘seats’ (cited in Lönberg-Holm 1930: 495). Creighton provides an interpretation of the Endless Plan as ‘Spectators' seats (thin circles) also included three rows of stadium seats at perimeter and continuous standing room along ramps’ (Creighton 1961: 112). However, in addition to these ‘stadium seats’ at the perimeter, the Endless Plan does indicate a series of concentric thin circles within the main cavity of the theatre. The Section Plan only cites the three rows at the perimeter. There is no evidence of a large amphitheatre-like seating arrangement in the central cavity. This is particularly significant as this feature was either located at the base of the ovoid structure (while missing from the Section) or it sat as a suspended disc halfway up the structure. The second of these interpretations divides the space in two, with half of the ovoid surface situated underneath this seating structure.

Before the visualization process, I had assumed that spectators would be free to roam the structure including the various ramps, the central Space-Stage and upper Spiral-Junction, but excluding the paternoster lifts. The absence of the ‘auditorium’ on the Section Plan indicated one of two things. First, that this auditorium arrangement had been omitted from the section to focus on the spiral structures and, in particular, how spectators would traverse from the central Space-Stage to the upper Spiral-Junction level. Second, that the auditorium seating was part of a structural ‘disc’ and through the use of mechanical pullies could change elevation, moving up and down within the central cavity. Upon modelling, this latter interpretation had a limited scope. Aside from the poles of the paternoster lifts, there were no supporting structures on any of the plans suggesting that Kiesler has intended for this function. What this process did reveal, however, was that if the seating were located in the base of the ovoid, it may have rotated on its central axis. Nevertheless, the pragmatics of a rotating seating auditorium at the base falls down when assessed against Kiesler’s first practical demand of the stage-builder; ‘Every event

on the stage must be seen with uniform clarity from all points in the audience' (Kiesler 1934: 727). If the *Endless Theatre's* auditorium, assuming it had one, were to rotate in the manner described the ramps and the Space-Stage would be viewed from the underside. If, however, this auditorium structure was able to elevate through the central cavity of the *Endless Theatre*, this would have met Kiesler's ambition for uniformity between the spectators in a formal sense. This interpretation, while imaginative, contradicted Kiesler's framing of the *Endless Theatre* as a 'Mobius strip' (one continual performance surface). The ability for spectators to roam freely along the ramps would be impeded, as the connecting bridges would need to retract or fold back intermittently to allow the auditorium to elevate.

The most likely interpretation of these 'thin circles' on the Endless Plan emerged when modelling a route for the spectators to traverse the interconnected ramps. Acting as a lower auditorium, it would have provided the entrance/exit with the concentric rings acting as steps (to ascend to the ramp levels) and seats (for those to rest and watch others traverse the structures above). The 'apex' structure detailed on the Endless Plan would then provide two sets of steps to connect this lower level with the mid-level of the Space-Stage. Following this spatial plan, spectators would be able to travel from the base of the ovoid all the way to the top of the Spiral-Junction in a manner reminiscent of Wright's *Guggenheim Museum*. It is this last option that I considered to be the most likely interpretation of Kiesler's intention for the 'auditorium', albeit with no explicit evidence beyond the visualization itself to support this reading.

The architectural idealism of Kiesler's design foresaw many of the pertinent questions that would emerge throughout the Twentieth Century. The proposed flexibility and performativity of the endless surfaces, a subject that I have only briefly touched upon here, would form a precursor to what Schechner termed 'environmental' or 'transformative space'. What is more,

Aronson goes a step further and explicitly names Kiesler as the 'father of surrounding space environments' (Aronson 2018: 75). The spiral form has since been used within performance architecture, either for its functional qualities as an access ramp, as with the *Spiralia Theatre* (1993) in Prague, or the use of the endless form of the spiral to evoke a sense of control and unity, as with Zaha Hadid's *JS Bach* (2009) for the Manchester International Festival. Whatever the case, there is still much to be revealed on the pragmatics of the *Endless Theatre*. Kiesler's utopian ideals and audacity in the rejection of the conventional logic of theatre design make it a significant experiment in the Modernist search for a new drama and theatre of the future.

**Conclusion**

In terms of methodology, my argument for paradata as a critical framework for heritage visualization focuses on the exchange, mediazation, or convergence of a modeller's critical insights. When located within a scholarly narrative, the result is neither factual nor artistic. It is indicative of the same level of conjecture associated with conventional historical methodologies. Any 'reasoned conjecture', as Favro (2006) puts it, is an amalgamation of the source material, the insights of the researcher, along with the dynamic new ways of knowing engendered by a tangible 3D impression of an otherwise disparate dataset. In recognising the existence and the contexts of paradata, the value of the visualization is analogous to that of an informed scholarly argument. Unlike creative visions of the past, framing the visualization through the concept of paradata acknowledges the exploratory facility of computer-based 3D visualization to extend beyond the available source material. Within this context, paradata as inclusive of procedural notation is indicative of a specific epistemological state of knowledge representation, as implied by Staley's proposal for 'thick depiction' (Staley 2003: 54). Consequently, the requirements of any new citation methodologies and production techniques

remain coupled to Favro's axiom 'to see is to question'. To locate computer-based 3D visualization as a rigorous undertaking requires the development of an intuitive critical lens, which resonates with its intended research audience to outline the specific line of scholarly enquiry. Nevertheless, I argue that to establish a 'one-size-fits-all' policy would be counter-intuitive and instead I commit to Favro's provocation and the need for a critical framework. The necessary remit of this new framework can be accounted for through the notion of paradata: a way of reading heritage visualization within a scholarly context.

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