



Evaluating Exhibit Performance at Tower Bridge in London

An Interactive Qualifying Project submitted to the faculty of Worcester
Polytechnic Institute

Submitted To:

**The Tower Bridge
Exhibition**

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Abstract

We worked with the Tower Bridge Exhibition to determine visitor comprehension and satisfaction on recent redesigns of their exhibits. Using a combination of surveys and observation, we found that visitor demographics have not changed and that visitors described the exhibit content as too easy, and engaged with exhibit contents and hosts less than expected, yet still found the Tower Bridge Exhibition enjoyable. Our recommendations included increasing the visibility and augmenting the information of existing exhibits, and increasing host interaction with visitors.

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Executive Summary

The Tower Bridge Exhibition is an attraction run by the City of London within Tower Bridge over the Thames River. In 2015, the new exhibition development manager, Dirk Bennett, established a plan to renovate the Tower Bridge Exhibition into a more polished attraction. Through this renovation, exhibition managers hope to showcase a comprehensive, chronological history of Tower Bridge by developing exhibits that are both coherent and engaging for the exhibition's audience. More specifically, the exhibits throughout the museum must sufficiently convey key information about important moments in the Bridge's history at an appropriate level of detail. However, in order to understand how the exhibition meets these objectives, it is crucial for managers to learn who their audience is and how satisfied they are with the current exhibits. An investigation into these factors was already conducted for the Engine Rooms exhibit in 2017, but the rest of the exhibition lacked this analysis. Therefore, the goal of this project was to assist the Tower Bridge Exhibition managers in determining the effectiveness of the new exhibits in the North and South Towers, and to reevaluate the Engine Rooms. To achieve this goal, we established four objectives as logical stages of this project:

1. To measure visitor engagement within the Tower Bridge exhibits;
2. To determine the demographic profile of exhibit attendees;
3. To rate visitor satisfaction with the Tower Bridge exhibits; and
4. To assess visitor comprehension of content in the Tower Bridge exhibits.

Visitor engagement is a crucial factor in assessing which exhibits are effective. How long a visitor spends at a particular display provides insights into how an exhibit is functioning. We utilized direct observation of visitors to discover dwell times and levels of engagement at locations within the two Towers and the Engine Room Exhibits. We constructed an engagement scale from 1-3, where 1 indicated a visitor missed or ignored an exhibit feature; 2 indicated that a visitor noticed an exhibit feature but was not interested enough to stop and engage fully; and 3 indicated full engagement with an exhibit feature. We used this same scale again to rate the degree of interaction with Welcome Hosts stationed throughout the exhibition.

With over 2000 observations, we determined that visitor **engagement throughout the entire exhibition was below expectations**, especially in the North and South Towers. People frequently missed key portions of a specific exhibit, or were not interested in an exhibit element enough to stop and investigate further. This was further demonstrated by **dwell times in exhibits that were consistently under one minute** for the Tower exhibits. In the Engine Rooms, dwell times were better than in the Towers, with visitors staying for a median closer to two minutes. Regardless, both times are shorter than the runtime of many of the videos and animations found inside many of these exhibits, revealing that the majority of people do not stay to watch these in their entirety. This issue became compounded by the fact that Welcome Hosts, whose role is to narrate exhibition films and to provide extra information about some of the exhibits, did not interact with visitors nearly 80% of the time, further lowering the overall engagement with

exhibition content. We learned that this engagement issue could be resolved simply by increasing host interaction with visitors since, when **host interaction** occurred, it **drastically increased overall engagement** (Table 1).

Exhibit Item	Average Raw Score on 1-3 scale	Average Score with Host Interaction on 1-3 scale	% Change
North 4 Film	2.31	2.78	+20%
Architects	1.41	1.91	+35%
South 4 Film	2.31	2.29	-1%
Rafters	1.66	2.75	+66%

Table 1. Engagement Improvements from Welcome Host Interaction

To determine the visitor demographic profile, we administered a voluntary survey at the end of the exhibition to 120 visitors. This survey revealed information regarding nationality, interest in key topics covered at the Bridge, English proficiency, and group size. The nationality and language proficiency gave insight into who visits Tower Bridge and what language accessibility features the exhibition may need. Additionally, it provides long term insight into marketing for the Bridge in regions with few visitors. The demographic profile of visitors was very similar to previous studies of this topic conducted in 2015 and 2017. We learned that nearly half of the visitors come from Continental Europe, about 25% come from the United Kingdom, and an additional 20% come from North America (Figure 1).

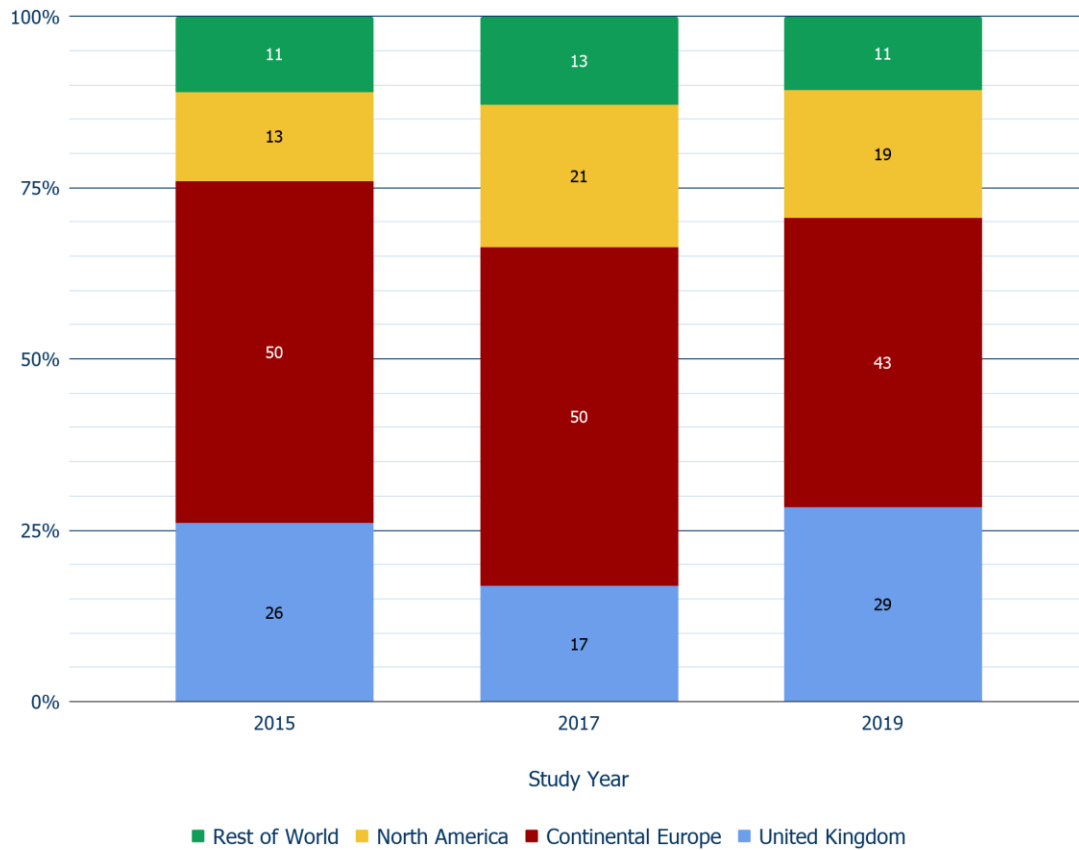


Figure 1. Demographic Profile of Visitors in 2015, 2017, and 2019

Additionally, most groups visiting the Tower Bridge Exhibition tend to be families, with only 13% of visitors belonging to other types of groups and 17% of visitors coming alone. We also determined that most people visiting had interests in history and engineering, both key themes throughout Tower Bridge.

Visitor satisfaction was also determined through the voluntary survey. The survey requested feedback on the visitors enjoyment of the Tower Bridge exhibits and of the exhibition as a whole. The survey results revealed that **Tower Bridge is highly popular among its visitors**. When asked how they would rate their overall enjoyment of Tower Bridge, every visitor responded positively, with no survey responder providing a negative opinion of the exhibition as a whole. We also learned that most visitors listed walkway exhibits such as the views of London and the glass floors found within as their favorites, along with the steam engines found in the Engine Rooms and the worker statues above the South 4 exhibit. The least popular exhibits include the “Day in the Life of Tower Bridge” video and the Engine Room Animations.

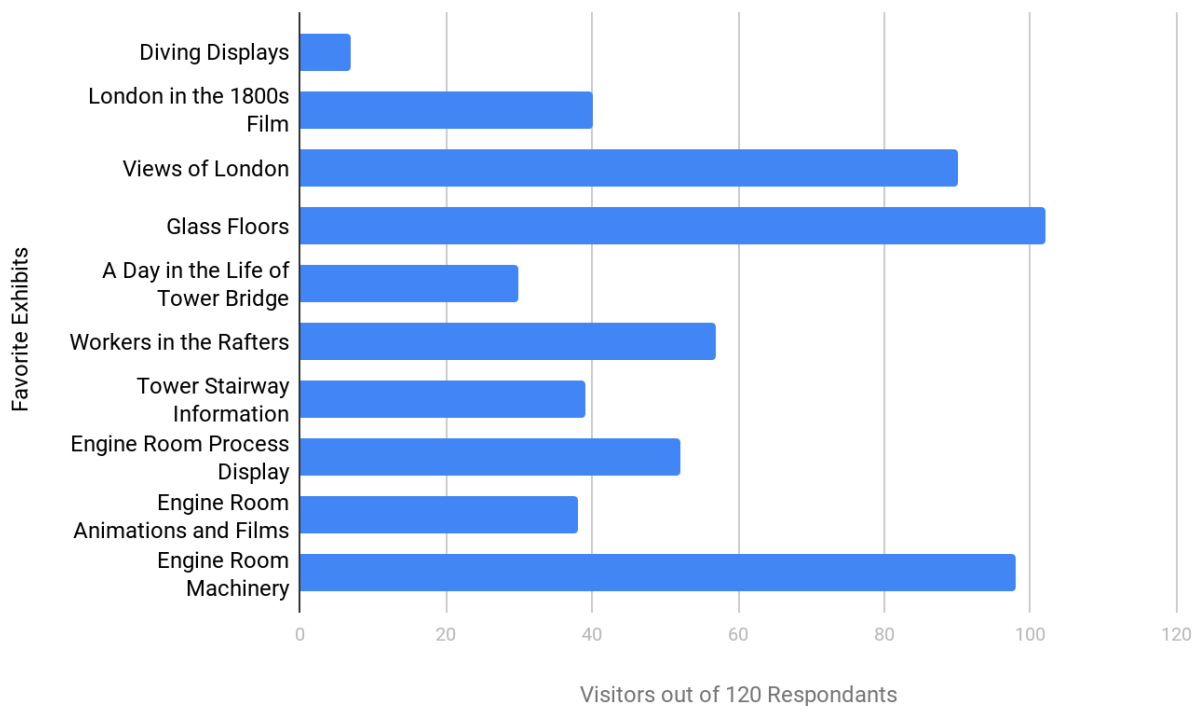


Figure 2. Visitors' Favorite Exhibits at Tower Bridge

Finally, visitor comprehension was obtained through specific questions within the survey. These questions intended to address the overall difficulty of Tower Bridge as well as whether visitors learned about the key themes of Tower Bridge: how the Bridge used to work, how the Bridge works today, and the people that worked at the Bridge. These were meant to address how well the Bridge is able to express its information, and whether the redesigned exhibits uphold the mission presented in the interpretation plan. When we analyzed our survey results on visitor comprehension, we learned that visitors find **Tower Bridge's information too easy** for their preference. Additionally, we learned that one of the three key topics covered in the revamped exhibition, **how the Bridge operates in the modern day**, was not covered sufficiently for many visitors to understand (Figure 3). These both reveal that some work may have to be done, both in the form of providing more technical content about the Bridge, and more specifically discussion regarding both the transition from steam to electrical power, as well as how the Bridge operates during modern day bridge lifts.

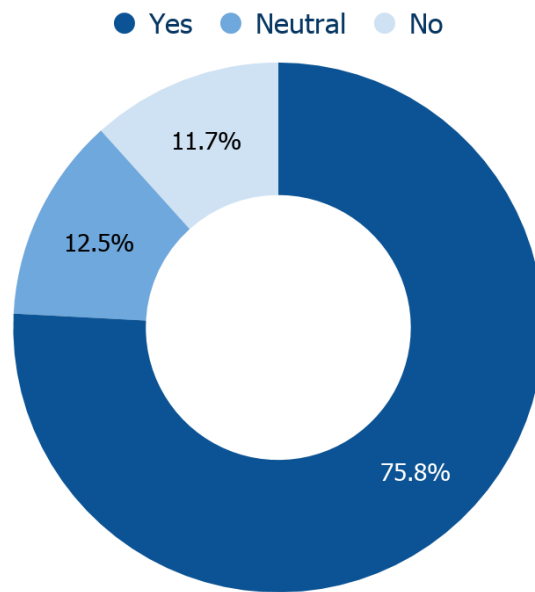


Figure 3. Visitor Comprehension of Modern Operation

We developed several recommendations for improving engagement, accessibility, and visitor satisfaction. Our first set of recommendations consists of small and **easily fixable issues**. First, we recommend **opening up North Tower’s exhibit on the Second Floor** in the off-peak season of the attraction, since they currently are often closed to the public. We found that this exhibit was very popular, and closing it off detracted from the overall experience. In main exhibits, we found that banners of historical workers and architects such as the ones pictured in Figure 4 were often skipped due to awkward positioning and lack of supplementary information. These exhibits, then can benefit from the **implementation of signage** that better explains the significance of the banners.



Figure 4. Worker Banners without Descriptive Content

Next, we found that the button that operated an animatronic display showing the Bridge lift process was easily missed due to its placement. We recommend that Tower Bridge managers either insert signage that points out the button more conspicuously, or move the button to a more visible location on the display. Finally, we noticed that people frequently mistook monitors found throughout the Engine Rooms as touchscreens. However, Tower Bridge managers are hesitant to implement touchscreen devices. To alleviate confusion and improve the lifespan of the electronics, we recommend implementing signage that indicate that these devices were not touchscreens.

More specific recommendations deal with Welcome Host interaction, Exhibit Design, and Video Styling. First, we recommend that to deal with low interaction between hosts and visitors, that the managers at Tower Bridge should **encourage more narration and interaction on the part of the hosts**. Additionally, we noticed during our surveying that many people had questions in the Engine Rooms exhibit, a region of the museum notably without any host presence. As such, we also suggest **adding a welcome host to the Engine Rooms** that can answer questions about many of the more technical elements of Tower Bridge. In order to overcome low engagement scores, especially with hard to see exhibits, we recommend implementing signage to both provide more information about the content and also direct attention to otherwise missed exhibit elements. In one highly popular exhibit among those who saw it, which contained statues of workers above the heads of visitors in the South Tower, the majority of visitors still missed the exhibit during their visit. We recommend **inserting an additional statue at ground level**, where it is more visible, either pointing at or shouting to the other statues in the rafters of the Tower (Figure 5).



Figure 5. Site for an Additional Worker in the Rafter

To deal with the lack of interest in some of the videos and animations, we propose a few changes here too. First, we recommend **replacing a video** that takes visitors through the average day at Tower Bridge. This video is unpopular, drawing disdain from both visitors and staff due to its lack of relevance toward the content in Tower Bridge. Next, to overcome language barriers, we recommend that Tower Bridge managers **implement an audio tour** into their exhibition, as it would allow more people to understand the Bridge's fascinating history.

Our final recommendation could likely solve several problems at once. Many visitors find that they learned very little about modern bridge lifts, many wished they could have seen more content, and some visitors even expressed an interest in visiting the Control Rooms, a section of Tower Bridge not open to the public. Our recommendation to solve all these problems is to **fill some of the empty space in the South Tower exhibits with content about how the Bridge operates today**. This could include providing either pictures of the Control Rooms or even provide some of the machinery such as levers, cranks, and dials, that could be found in the Control Rooms during its early operation. This would allow people to see more content, more specifically about how the Bridge operates.

1. Introduction

The Tower Bridge Exhibition in London is a world-famous attraction that needs to cater to and serve its visitors. In recent years, Tower Bridge management has worked to modernize each of its exhibits to better reflect approaches to the interpretation plan, which focuses on visitor engagement (Bennett D., personal communication, 30 January 2019). The exhibit renovations were designed to enhance the museum's narrative flow, resulting in visitors leaving the exhibition with a more complete and consistent understanding of Tower Bridge. As such, their newest exhibits require the same degree of evaluation as that performed by every museum to discover what their audience deems relevant, informative, and engaging in presenting the narrative of Tower Bridge.

In general, museums have several underlying roles, and must be designed to properly perform these roles (AAM, 2008). Most importantly, the museums must be engaging to the audience that visits them for insight on the topic presented. The museums must also clearly and factually present information relevant to the theme of the museum. Properly functioning exhibits should be able to meet all of these parameters, and doing so makes them invaluable to a society. Thus, understanding exhibit effectiveness is one of Tower Bridge managers' central goals, and strides have already been taken to understand their audience's opinions of the museum. In a 2017 study, students from the University College London (UCL) conducted an analysis of visitor satisfaction in the Engine Rooms Exhibit. This study provided a comprehensive investigation into visitor experiences within this exhibit, which provided Tower Bridge staff with information on one portion of the overall exhibition. However, as with all studies, the methodology could be improved on and elaborated, in order to create a more highly repeatable method of exhibit review.

While an evaluation of visitor experiences at Tower Bridge has already been conducted on the revamped Engine Rooms Exhibit, the North and South Tower exhibits required a comprehensive review following their renovation. The new exhibition format intends to reveal a chronological and technological history of Tower Bridge. Due to the exhibits' thematic and chronological structure, attraction managers want there to be a smooth flow through the exhibits that provides a comprehensive tour of the Bridge's history by theme. As such, it is important to discover whether the museum conveys this intended narrative. Furthermore, with a new evaluation methodology having been developed and Tower Bridge management curious as to the comparative performance of the Towers to the Engine Rooms, it was also important to re-evaluate the Engine Rooms exhibit, to see if this narrative continues throughout the exhibition experience.

The goal of this project was to determine the effectiveness of the Tower Bridge Exhibition's North and South Tower exhibits, and to evaluate whether the Engine Rooms effectiveness has changed since the prior study. This goal was achieved by measuring visitor engagement in the exhibits of interest, determining the demographic profile of exhibit attendees, rating visitor satisfaction with their visit to Tower Bridge exhibits, and assessing visitor comprehension of the content presented throughout the exhibition. To achieve these objectives,

we utilized visitor surveys regarding demographics and satisfaction, direct visitor observation, and a thorough review of the prior work done by the University College London, which assisted us in developing improved methods of evaluation. This study was conducted to provide Tower Bridge with a thorough analysis into the success of their interpretation plan with regard to the remodeled Tower Bridge exhibits, the chronological flow through these exhibits, and how the Engine Room impacts the visitor experience. With this information, Tower Bridge staff can make necessary adjustments to make the exhibit more informative and enjoyable for its visitors.

2. Background

Each year, over 800,000 people from all over the world visit London's Tower Bridge Exhibition (VisitEngland, 2018). These people take the time from their visit to London to tour this iconic functional bridge and its exhibition to see both a classic monument of London's history and to understand more about how it worked. Exhibition managers work hard to determine what media can best present key information to interested visitors, especially as technology evolves rapidly. To embrace contemporary innovations across all aspects of society, Tower Bridge recently modernized its exhibition, while trying to maintain its original goals. In this chapter, we will describe how Tower Bridge upholds the mission of a museum while trying to modernize its exhibits while yet still keeping its original vision in mind.

2.1 History of Tower Bridge

Tower Bridge was conceived with two goals in mind (Hobhouse, 1994). The first was to decrease traffic at existing bridges over the River Thames, a growing concern for the rapidly industrializing London. The second goal was to maintain access to the Pool of London, as it contained an important region of the London Ports. City officials first addressed the need for a new bridge going into the City of London in 1876, organizing a committee to address new concepts for bridges or subways into the city, either over or under the Thames (Tower Bridge, 2018). Once a design was decided on, two towers with massive bascules on either bank of the river, construction began in 1886. For the next eight years, the Bridge was constructed, with the grand opening celebrated in 1894 (PBS, 2001). The Bridge was initially received poorly by some, being called "the most monstrous and preposterous architectural sham that we have ever known" (Statham, 1894, p. 403). Over time, however, it grew in popularity, quickly becoming an attractive tourist destination.

The bridge bascules operated using steam-powered hydraulics, and could be raised to nearly ninety degrees over the course of a minute (PBS, 2001). Since shipping was still a major function of the Thames River, the Bridge was opened and closed many times every day. Although steam power allowed for a slightly more rapid bridge opening, the Bridge was eventually modernized with electrical hydraulics in 1976. Though, due to the decrease in river traffic by this point, London saw minimal increase in road traffic, as bridge openings were far more scarce. (D. Bennett, Personal Communication, 18 March, 2019).

The other major change applied to Tower Bridge (2018) concerned the walkways spanning between the two towers, which were originally intended to give pedestrians an opportunity to cross the Bridge even when it was open for ships. They were closed in 1910, only sixteen years after they opened to the public, as they quickly became the site of illegal activity and experienced little foot traffic due to the rapid speed of the Bridge lifts. They remained closed until 1982, when they were opened again as part of the efforts to shift the Bridge to a functional exhibition.

An important period for Tower Bridge was that of World War II, especially during the Battle of Britain in 1940 (IWM, 2018). For three months straight, the Germans bombed key

industrial and strategic sites in Britain, including factories, airfields, bridges, and important buildings. As such, it was increasingly likely that Tower Bridge would be a victim of the constant air raids, potentially crippling transport through central London. To mitigate this, backup engines were constructed in rural Norfolk, ready to be transported in case the Bridge was damaged (Francis, 2014). Luckily, Tower Bridge was never hit by German bombs, and once the air raids relented, was unthreatened for the remainder of the war.

More recently, the Bridge underwent superficial repairs once in 2008 and again in 2012 (BBC, 2008). These did nothing to alter the structure or appearance of the now iconic bridge, save for the color on the suspension cables being changed back to the original scheme. Regardless, the overall appearance of the Bridge has been preserved excellently, pristinely maintaining the original architectural vision.

2.2 Tower Bridge Exhibition

The Tower Bridge Exhibition opened in 1982 and consists of exhibits in the two towers, overhead walkways, and Engine Rooms. The Tower Bridge Exhibition is a collection of exhibits inside Tower Bridge whose purpose is to provide visitors with background into the history, significance, technical operations, and workers of the Bridge. The Exhibition also runs a gift shop and functions as an event space, while the Bridge itself remains a functional bascule bridge for both road and river traffic. It is currently open daily 9:30-17:30 (2019).

Since Tower Bridge was repurposed as an exhibition and not originally designed to house exhibits, exhibits are scattered throughout the existing structures (Figure 6). Worth noting in regard to Figure 6 is that the lower floor containing exhibits in North Tower (N2) is not emphasized. This is due to the fact that this map is commonly displayed in the lifts at the exhibition, and this floor is only accessible by stairs.

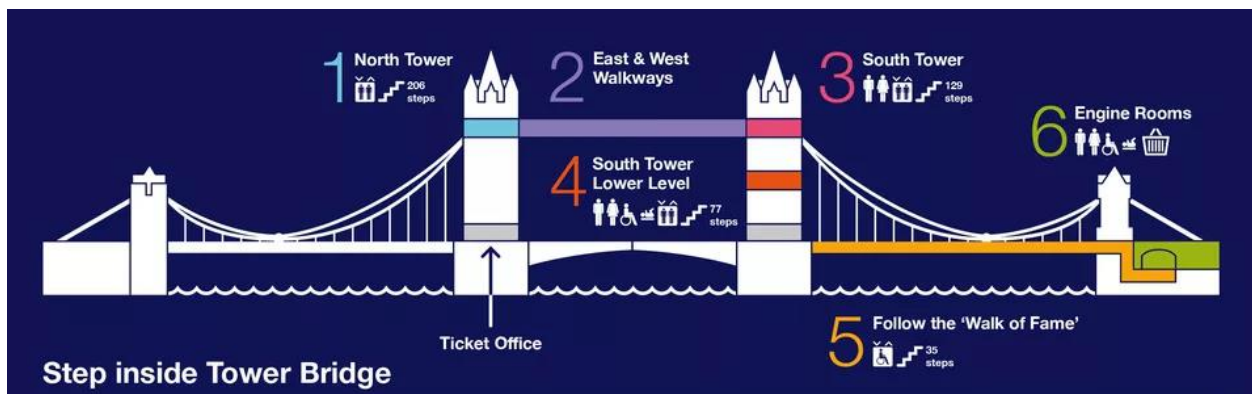


Figure 6. Tower Bridge Exhibition Map (de la Paz, 2018)

Visitors typically enter the exhibition through either a lift or a staircase at the bottom of the North Tower (Number 1 in Figure 6). If they go up the stairs they will have a chance to visit the second floor of the North Tower as pictured in Figure 7, which contains an exhibit that is skipped by the lift.



Figure 7. North Tower Level 2

The groups that go up the lift and up the stairs meet in the fourth floor of the North Tower seen in Figure 8. The groups have the opportunity to view exhibits at the top of the North Tower here, and exhibition staff often present additional history to them.



Figure 8. North Tower Level 4

After experiencing the North Tower, visitors are then directed into the East Walkway (Number 2 in Figure 6), which provides views of Canary Wharf, as well as East London (Figure 9).



Figure 9. East & West Walkway

At the end of the walkway, they go through the fourth floor of the South Tower (Figure 10) and then through to the West Walkway. From there, they can view Central London and also look down below them through glass floors.



Figure 10. South Tower Level 4

At the end of the walkway, they turn around, and head back to the South Tower (Number 3, Figure 6), where they then head down the stairs to the second floor (Figure 11). Visitors then descend the South Tower using a lift that takes them to an exit leading back out to the public pedestrian bridge (Number 4, Figure 6).



Figure 11. South Tower Level 2

After exiting the Bridge towers, visitors are expected to walk along the bridge on the ‘Walk of Fame’ (Number 5, Figure 6), a trail of plaques commemorating key figures in the Bridge’s history, to the Engine Rooms and gift shop, which are located in a separate building (Number 6, Figure 6). Occasionally, visitors will begin their visit in the Engine Rooms and gift shop; however, this path is taken by a small, fluctuating percentage of the overall visitors, largely depending on educational and tour group scheduling (Tower Bridge Exhibition, 2019-b). There is one linear progression through the Engine Rooms, with visitors starting with the boiler room before progressing to the steam engines, hydraulic pumps, and c-yard, then ending their visit at the bascule drive engine room.

2.2.1 Tower Bridge Interpretation Plan

In 2015, the Interpretation Planning Group, led by Dirk Bennett, generated the Tower Bridge Interpretation Plan (Tower Bridge, 2015). The plan analyzed the exhibits of Tower Bridge, and generated solutions to unify them into a complete narrative with a greater focus on the visitor experience.

According to the Tower Bridge Interpretation Plan, the exhibition aims to instill six core ideas to the visitors, which all fall under a common theme that “Ingenious, efficient, beautiful, and enduring, Tower Bridge is the perfect expression of the spirit of the city of London” (Tower Bridge, 2015, pg. 38). The first of these ideas is that Tower Bridge is a living showpiece of Victorian art and Architecture. Second, its construction was a major achievement in the 1800s. Third, Tower Bridge effectively manages traffic both on and across the Thames River. Fourth, the

steam engines used in Tower Bridge are responsible for its core function of managing traffic. Fifth, Tower Bridge is important to the history of London and the United Kingdom. Finally, Tower Bridge is more than a bridge or monument; it has also been a workplace for over a hundred years for the designers, builders, maintenance workers, and exhibition staff.

The exhibits were all redesigned to focus on one or more of these core ideas (Tower Bridge, 2015). Since the exhibits are visited in a specified order, the theme is built up along the duration of the visit, also allowing for a smooth flow in between exhibits and different topics. The Interpretation Planning Group was also careful to design the exhibits to have not just the proper content, but also a cohesive tone and format. For example, the team considered how much technology they should use to display information, and how one medium would provide a different experience over another. Information is presented in “International English,” which avoids utilizing localisms, and instead only contains phrases that are more universally understood. Finally, the interpretation plan aimed to design exhibits that minimize congestion within the exhibition, allowing for a more enjoyable experience moving through the attraction.

So far, the Tower Bridge Exhibition renovated its Engine Rooms in 2017, with the North and South Towers following in 2018 (D. Bennett, personal communication, January 30 2019.) The walkways are planned to be renovated by the end of 2019. Even though each new exhibit was designed for the visitors with a common theme, they have not been evaluated to determine how well they have accomplished the goals set out in the plan. The plan outlines a few general options for evaluating the new exhibits, and there are plans to conduct evaluations on a regular basis, even though some renovations are not yet complete.

2.2.2 Engine Rooms Redesign and Evaluation

The engine room was the first exhibit to be renovated, in 2017, as a consequence of the Tower Bridge Interpretation Plan (D. Bennett, personal communication, 11 February 2019). Students of the University College London conducted a preliminary evaluation of the renovated exhibit by collecting data over three weeks in 2017. Based on quantitative data plotted from the report, the research concluded that the changes to the engine room increased the clarity and enjoyment of the Engine Rooms Exhibit, and 84% of visitors liked how the Engine Rooms, pictured in Figure 11, were presented more or to the same extent as the rest of the Tower Bridge Exhibition (Oldham, S., & Thomson, F, 2017).

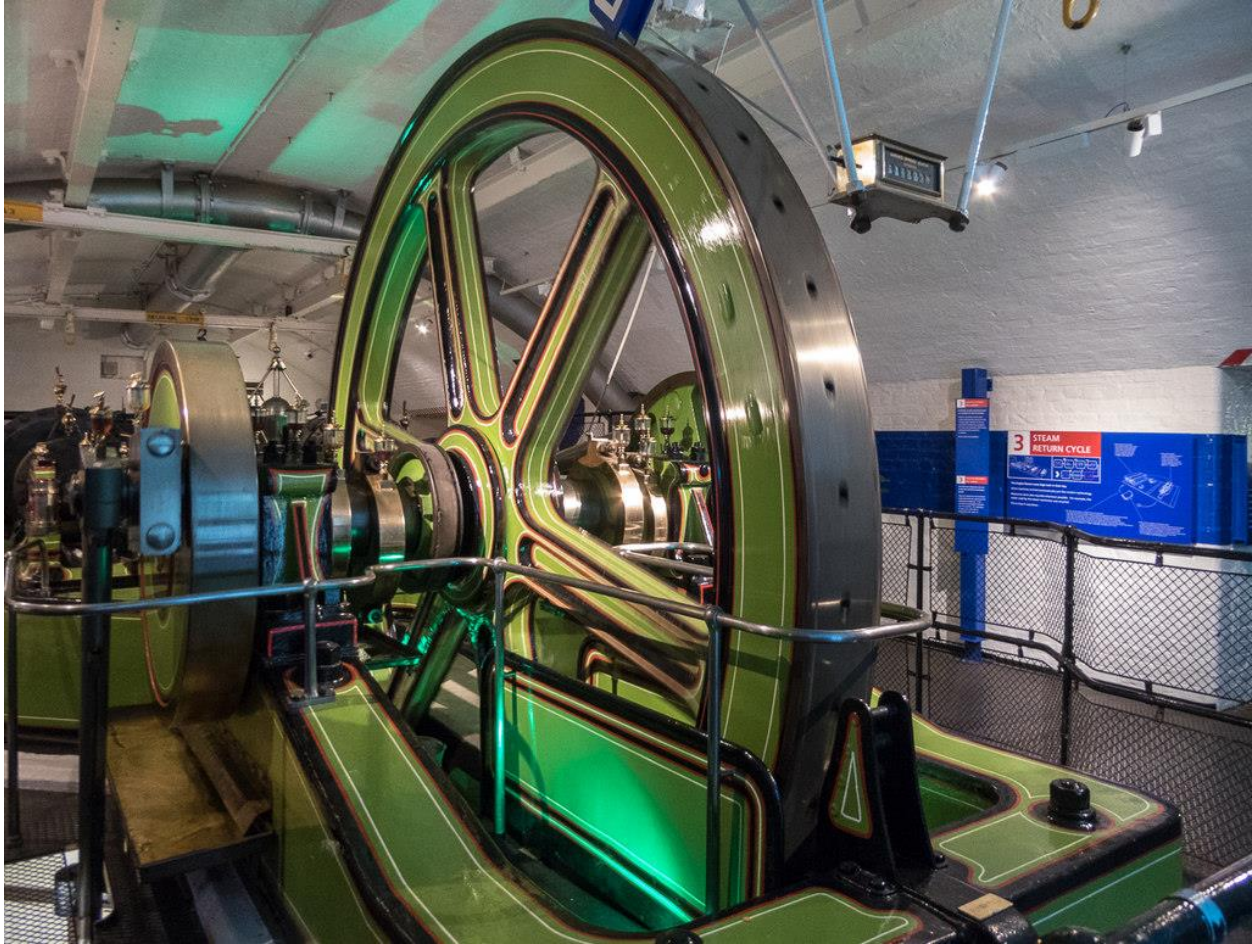


Figure 12. Tower Bridge Engine Rooms Exhibit (Matthews, 2016)

Overall, the study draws some basic conclusions, but the methods used to collect the information are not described with enough detail in their report to allow for replication elsewhere. The evaluation report performed in 2017 measured three main categories:

- Dwell time
- Engagement
- Behavior and Interaction

The first category was **dwell time**, which is the most straightforward of the categories. The researchers recorded how long, in minutes, each observed visitor spent in a specific area of the Engine Rooms. They were able to report average times for each of the areas, but did not go as far as to report other statistical measurements or analyze any other patterns on a case-by-case basis.

The second category that was analyzed was **engagement**. From the report, it is apparent that the researchers converted their measurements into a numerical “engagement score.” To complicate matters, Figure 11 in the report is unclear to us, because the text below the figure claims that the chart shows an average of engagement scores which range from 1 to 5. However, the

vertical axis on the chart ranges from 0 to 300. Without further specification about how this was done, it would be difficult to design a methodology to be compatible with this previous effort to measure engagement.

The third category that the researchers explored was other participant **behavior and interaction**. The number of occurrences of interaction is reported for the various displays, as well as general qualitative observation describing the types of interaction. There is relatively little information about situational variables that might have played a role in the behavior of visitors from the report alone, other than the fact that the Engine Rooms interpretation was recently relaunched.

2.3 Visitor Engagement at Tower Bridge

By engaging museum visitors, as opposed to passively offering information, museums have an opportunity to make learning more entertaining and relatable for visitors. In turn, by tying interesting experiences to their exhibit, the museum can increase the chances of visitors retaining information learned while visiting, while also developing a reputation as a fun place to visit (Tran, 2007). Being known as more than just a center for information on the subject matter can help museums draw in visitors who consider themselves more interested in entertainment, rather than education. Methods of engaging a museum audience can be divided into three main categories: physical engagement, emotional engagement, and cognitive engagement (Shaby, 2006). All three of these methods are utilized by Tower Bridge.

Physical engagement can be achieved through hands-on exhibits, giving visitors tactile information on potentially novel materials or mechanisms as opposed to visual information only. At Tower Bridge, physical engagement is employed in instances such as the Engine Room worker logbook. This book is an enlarged recreation of the journals and notes of Tower Bridge workers, including personal entries alongside official records. The book is laid out for visitors to flip through, a more physically engaging option than having each page displayed in a frame, for instance.

Emotional engagement can be achieved by encouraging an emotional response to information gained, whether it is sadness regarding a tragedy or excitement regarding an important breakthrough. With emotions being strongly tied to memory retention and recall, this can be an important method of engaging audiences to ensure that the information is not forgotten. At Tower Bridge, emotional engagement is utilized to get visitors to identify with and care for the workers behind the construction and maintenance of the Bridge. For instance, in the South Tower, images are shown of workers in dangerous positions without any safety gear, along with scale models of workers in the rafters in similarly unsafe situations. These displays result in visitors feeling concern for the workers over their risky work, along with more astonishment in regards to how much work went into the construction of Tower Bridge.

Cognitive engagement can be employed by providing visitors with a problem to solve or a casual test of knowledge, such as a simulation or puzzle. By allowing visitors to interact with the material, it is more likely that the visitors will be engaged by museum exhibits, rather than simply

observing. At Tower Bridge, one such exhibit element is included towards the end of the Engine Rooms. On touchscreens, a game is available for visitors to play in which they must manage the resources of the Bridge, along with ensuring that no boats hit the Bridge while traffic does not pile up on the streets. Visitors can utilize the knowledge they have gained throughout their visit in this simulation to be “Bridgmaster” for two minutes, keeping the Bridge maintained and traffic under control.

2.4 Visitor Timing and Tracking

Many museums wish to gain feedback in order to improve their exhibits and the overall experience for their visitors. In order to obtain unbiased data in regards to visitor activity in an exhibit, direct observation is often employed, with minimal to no contact between observers and museum patrons. Initially, using a video might seem like the perfect solution to gather accurate data about visitor behavior and movement. It is true that many museums have used this technology for visitor observation (Serrell, 2010). At the same time, there are many logistical hurdles that need to be dealt with in order to make video useful for visitor tracking. First, many exhibits can not be viewed from a single camera angle. The problem is exacerbated when a study needs to be done on an entire museum. Piecing together video from multiple cameras to track a single visitor’s movements across an entire museum is a difficult and time consuming task. Because of this limitation, most studies involving video only take a single exhibit into consideration. Since the convenience of video is immediately diminished when taking into account larger spaces, many museums still rely on traditional pencil-and-paper methods to perform visitor tracking (Yalowitz et al., 2009).

While the task of observing visitors and their behaviors throughout a museum may seem like a rote task, certain variables that an evaluator can record take a fair degree of interpretation. Being an evaluator for timing and tracking studies is involved, and the quality of the collected data depends on the skill of the evaluator (Serrell, 2010).

Beverly Serrell (2010) is an expert on museums and has written much about concepts and strategies for visitor tracking. One of her contributions to this field has been identifying four categories for variables for timing and tracking studies. The first category is stopping behaviors, which is simply the total time in an area as well as the total number of stops. In *Paying Attention: Visitors and Museum Exhibits*, Serrell defines a stop as “a visitor’s stopping with both feet planted on the floor and head or eyes pointed in the direction of the element for 2 to 3 seconds or more” (as cited in Yalowitz et al., 2009). The second category is other behaviors, which encompass behaviors that go beyond the previous category. This includes information such as the specific path the visitor takes through an exhibit, or how they interacted with the elements of an exhibit. The third category is “observable demographic variables,” such as age, number of children in the party, and gender. The fourth and final category, situational variables” is for data that may have affected behavior. This category includes a myriad of factors, such as special events that were going on that day and how crowded the exhibit was at the time (Yalowitz et al., 2009).

After years of presenting exhibits in the same manner, the Tower Bridge Exhibition began renovations in 2015. The renovations were carried out with the goal of creating a more comprehensive story that visitors can experience as they progress through the different sections of Tower Bridge on display (D. Bennett, personal communication, January 30 2019). In the past, an evaluation was conducted on the Engine Rooms exhibit, but since this renovation, the areas on display in both the North and South Towers have undergone updates. Tower Bridge staff would like to determine if the updated exhibits aid or inhibit the flow of history that they are trying to present.

In the next chapter, we will describe the methods we used to collect information that helped us determine the effectiveness of the revised exhibits of the Tower Bridge Exhibition.

3. Methodology

The goal of this project was to assist the Tower Bridge Exhibition managers in determining the effectiveness of the new exhibits in the North and South Towers and Engine Rooms. Our research objectives were:

1. To measure visitor engagement within the Tower Bridge exhibits;
2. To determine the demographic profile of exhibit attendees;
3. To rate visitor satisfaction with the Tower Bridge exhibits; and
4. To assess visitor comprehension of content in the Tower Bridge exhibits.

To effectively assess the performance of the exhibit, we utilized multiple surveys and observational methods. In the following sections, we explain why these methods were used, and how they helped us achieve our objectives.

3.1 Measuring Visitor Engagement

To analyze visitor engagement, we used direct observation to measure levels of visitor interaction with the exhibits of Tower Bridge. We also measured the total time spent by visitors in each exhibit (also known as ‘dwell time’). For each visitor studied, we recorded some additional information that could help in analysis. Some of these external variables were the visitor’s age group and whether the welcome host encouraged participation.

3.1.1 Identifying Key Exhibit Features

When determining what observations would be of value to our analysis, we quickly realized that chronicling every behavior of visitors would not necessarily be our best course of action, and would likely lead to a vast quantity of irrelevant data. For example, visitor engagement with structural elements such as windows or metal beams of the rooms would not be of interest to investigate, since these are permanent fixtures of the structure itself, and not intentional exhibit design that Tower Bridge management is interested in evaluating. Therefore, we carefully went through each exhibit and identified key features, such as props, videos, fun fact displays, text displays, and interactive games (see Figures 13 through 24, and Tables 2 through 10). Exhibits were divided into a total of 9 major sections, where observations were conducted, as described in the sections that follow.

Exhibit elements were grouped into sub-sections based on their location, format, and content. We limited each exhibit section to have at most six subsections be able to easily and accurately collect data. All of the exhibit subsections for the Towers and Engine Rooms are available in our observation matrix found in Appendices C and D.

Observation locations in the North Tower

Figure 13 pictures the entirety of the two Towers and the exhibit components.

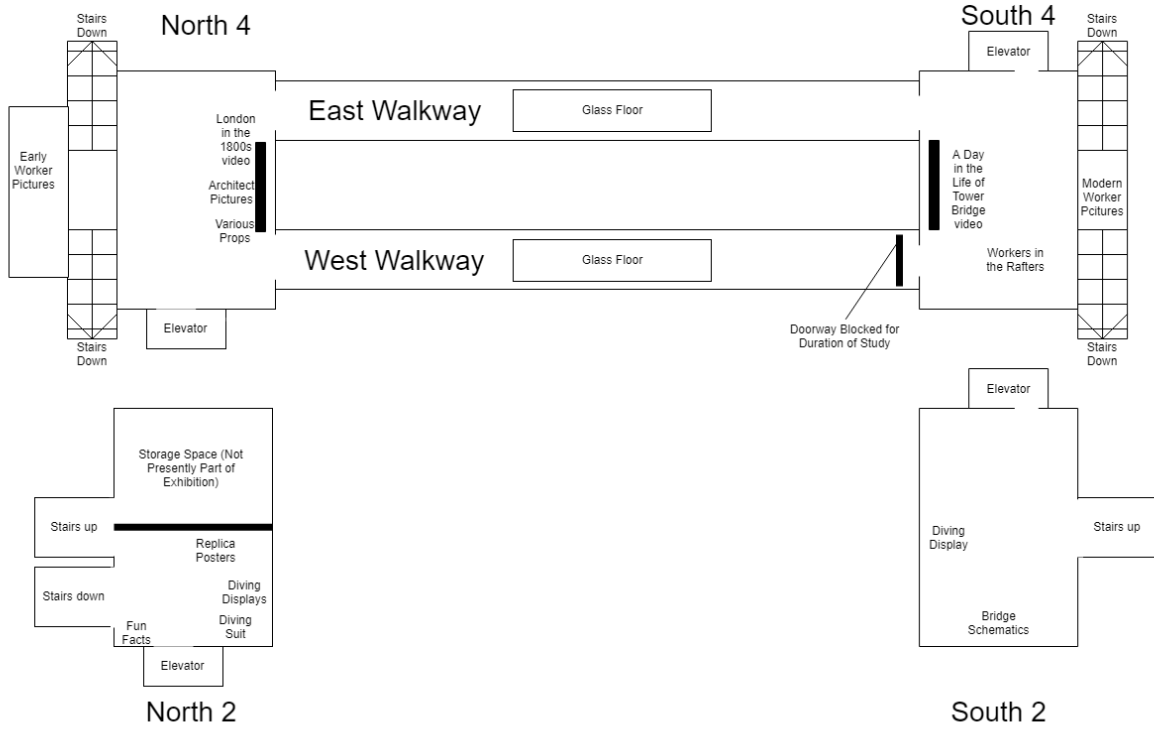


Figure 13. Towers Exhibition Map

We observed visitors interaction with 4 exhibits on the 2nd floor (N2, Figure 14).

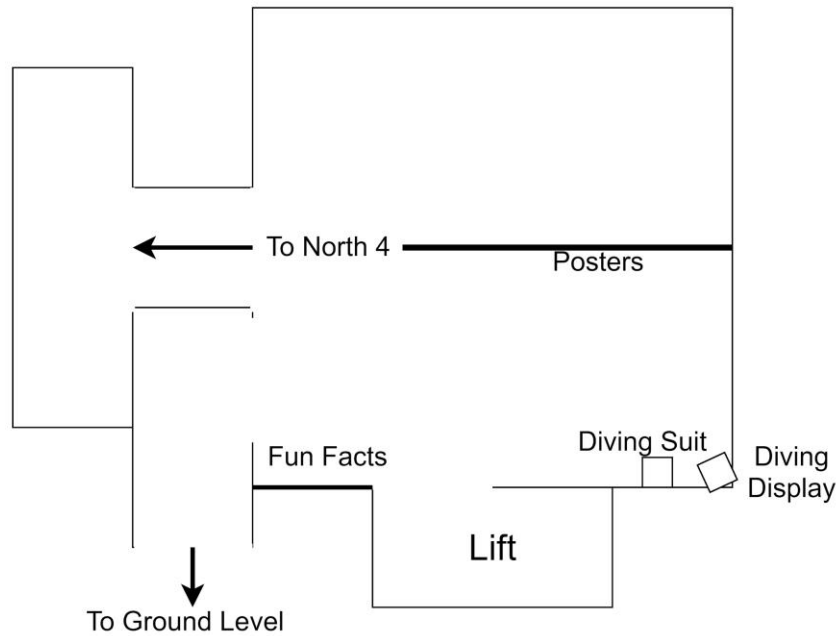


Figure 14. Floorplan of North 2

Second Floor of the North Tower (N2) Observation locations

Item	Medium	Visibility
Fun Facts	Sign	Partly Visible
Diving Suit	Physical Item	Fully Visible
Diving Display	Physical Item	Fully Visible
Posters	Sign	Mostly Visible

Table 2. Exhibit Elements in North 2

Also in the North Tower, we observed interaction with 5 exhibits on the 4th floor (N4, Figure 15).

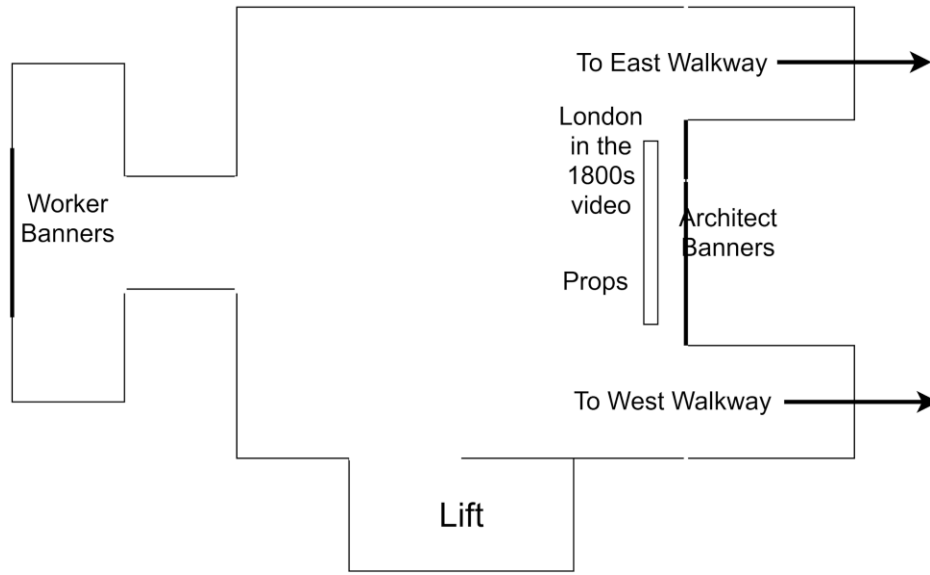


Figure 15. Floorplan of North 4

Fourth Floor of the North Tower (N4) Observation Locations

Item	Medium	Visibility
“London in the 1800s” Video	Video	Fully Visible
Architect Banners	Pictures without Text	Partly Visible
Worker Banners	Pictures without Text	Mostly Visible
Props	Physical Item	Fully Visible
Welcome Hosts	Not Applicable	Not Applicable

Table 3. Exhibit Elements in North 4

East and West Walkways

The East and West Walkways (Figure 16) connect the fourth floors of the two towers. Visitor engagement with the walkways was not our focus, so no engagement was recorded for any components of these sections of the exhibition. However, during shadowing, visitor dwell time was recorded for the walkways.

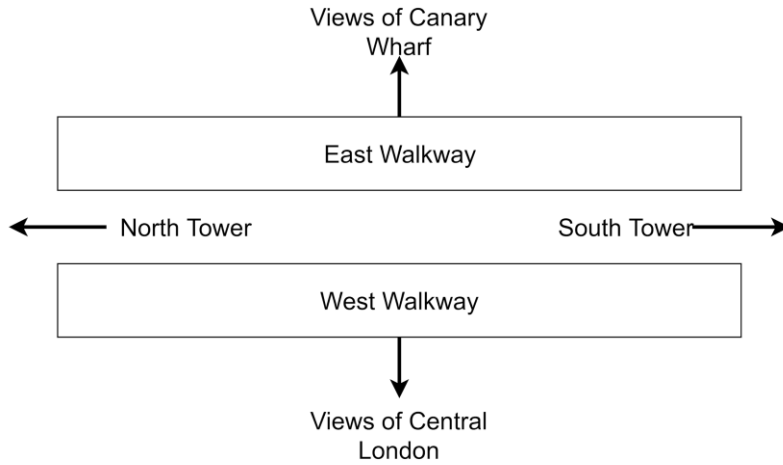


Figure 16. Floorplan of East and West Walkways

In the South Tower fourth floor (Figure 17), we observed engagement with 4 elements of the exhibition.

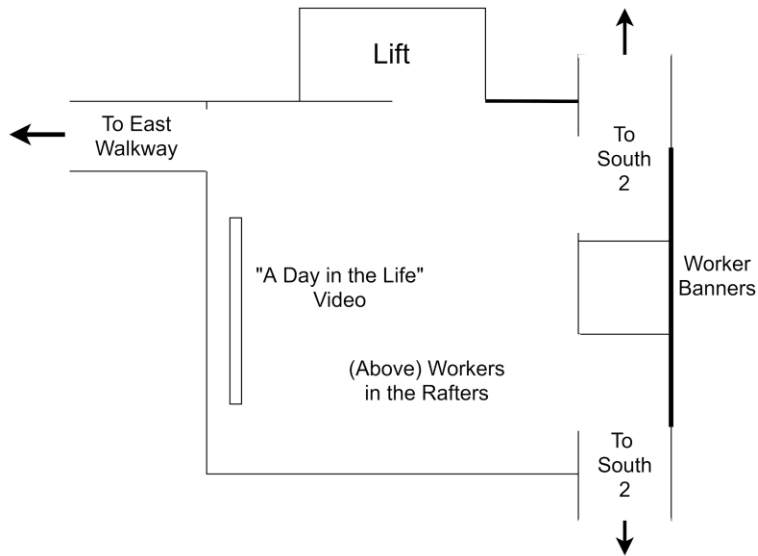


Figure 17. Floorplan of South 4

Fourth Floor of the South Tower (S4) Observation Locations

Item	Medium	Visibility
“A Day in the Life of Tower Bridge” Video	Video	Fully Visible
Workers in the Rafters	Physical Item	Partly Visible
Worker Banners	Pictures without Text	Mostly Visible
Welcome Host	Not Applicable	Not Applicable

Table 4. Exhibit Elements in South 4

To conclude the Towers, on the second floor of the South Tower (Figure 18), we observed two exhibit components.

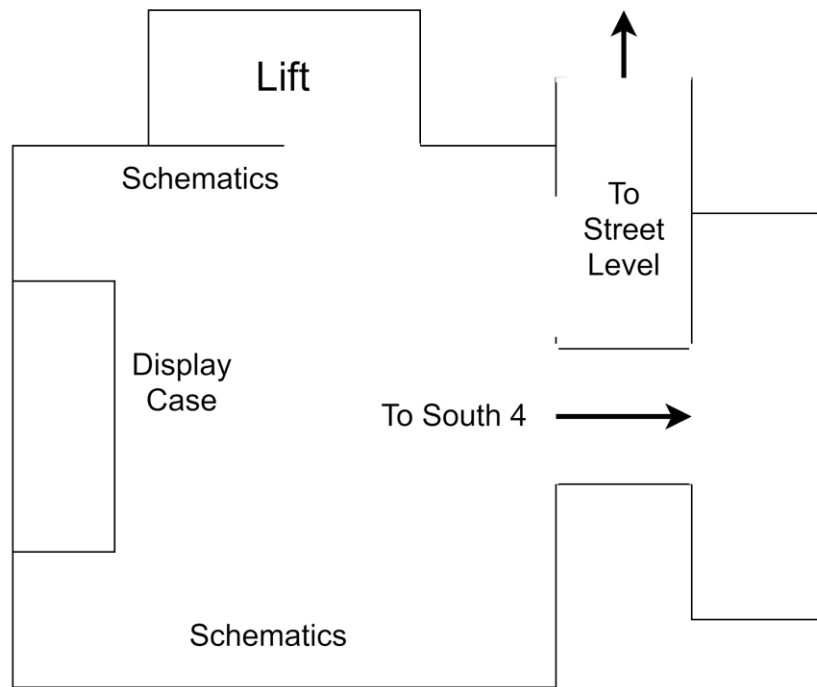


Figure 18. Floorplan of South 2

Second Floor of the South Tower (S2) Observation Locations

Item	Medium	Visibility
Display Case	Physical Item	Fully Visible
Wall and Floor Schematics	Pictures without Text	Mostly Visible

Table 5. Exhibit Elements in South 2

Observation Locations in the Engine Rooms

In Figure 19, the entire layout of the Engine Rooms can be viewed.

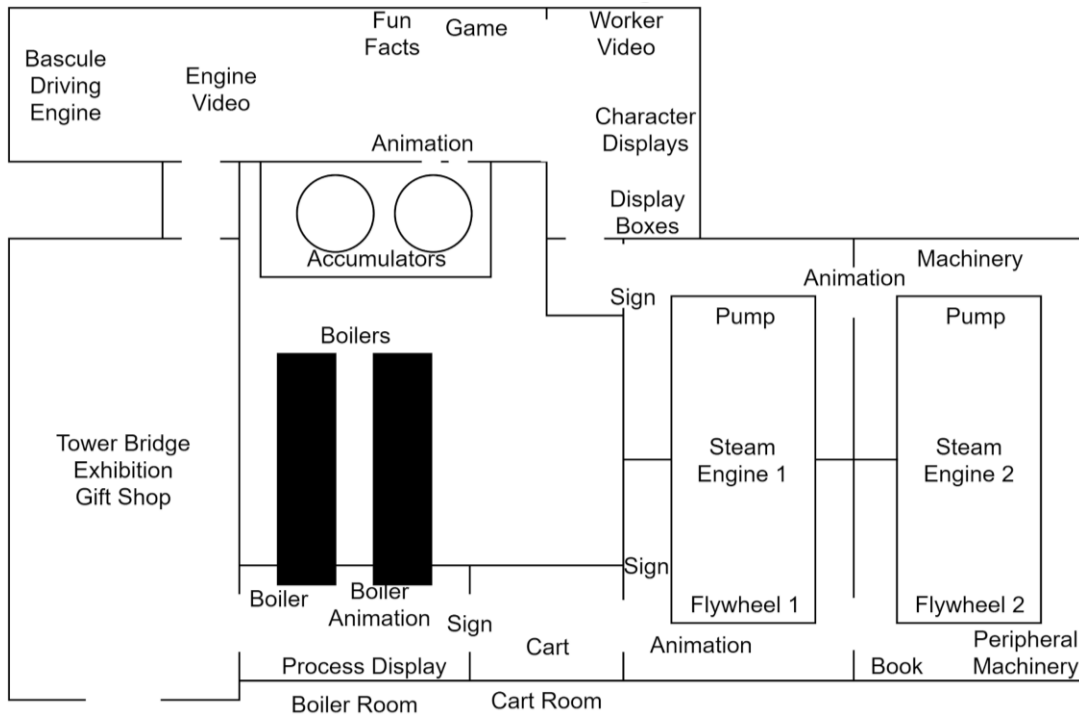


Figure 19. Engine Rooms Exhibition Map

In the Engine Rooms, the first location was the Boiler and Cart Rooms (Figure 20). Five exhibit components were observed in this location.

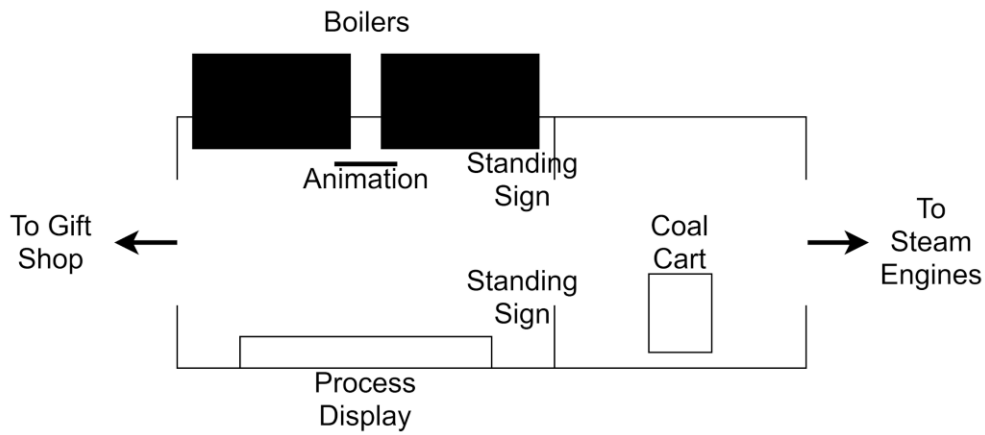


Figure 20. Floorplan of Boiler and Cart Rooms

Boiler & Cart Rooms Observation Locations

Item	Medium	Visibility
Process Display	Interactive	Fully Visible
Animation	Animation	Fully Visible
Standing Signs	Sign	Mostly Visible
Boilers	Physical Item	Fully Visible
Coal Cart	Physical Item	Mostly Visible

Table 6. Exhibit Elements in the Boiler Room

In the Steam Engine Rooms, also known as the Flywheel Rooms (Figure 21), 6 components were observed.

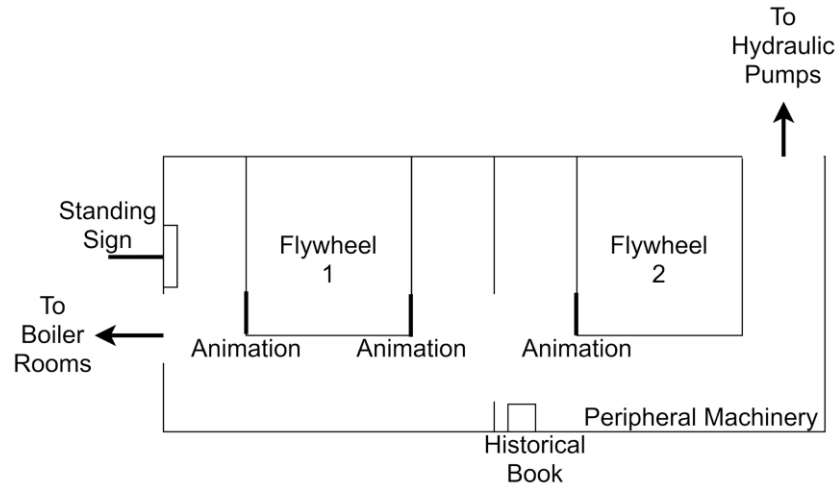


Figure 21. Floorplan of Steam Engine Rooms

Steam Engines Observation Locations

Item	Medium	Visibility
Flywheel 1	Physical Item	Fully Visible
Standing Sign	Sign	Partly Visible
Animation	Animation	Fully Visible
Flywheel 2	Physical Item	Fully Visible
Historical Book	Interactive	Partly Visible
Peripheral Machinery	Physical Item	Mostly Visible

Table 7: Exhibit Elements in the Steam Engines

At the Hydraulic Pumps (Figure 22), 4 components were of interest.

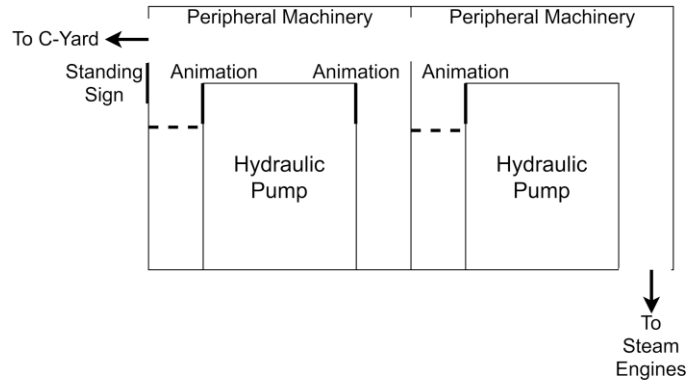


Figure 22. Floorplan of Hydraulic Pumps

Hydraulic Pumps Observation Locations

Item	Medium	Visibility
Hydraulic Pumps	Physical Item	Fully Visible
Animation	Animation	Fully Visible
Peripheral Machinery	Physical Item	Mostly Visible
Standing Sign	Sign	Fully Visible

Table 8. Exhibit Elements in Hydraulic Pumps

In the C-Yard (Figure 23), interaction with 3 elements was observed.

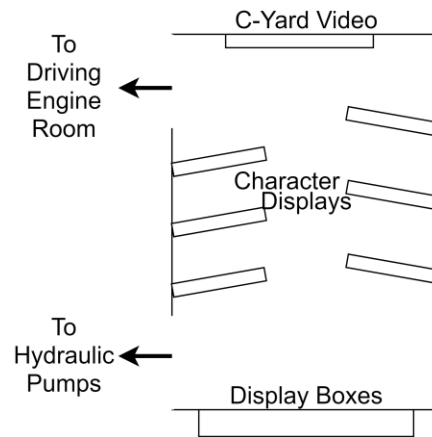


Figure 23. Floorplan of the C-Yard

C-Yard Observation Locations

Item	Medium	Visibility
Display Boxes	Physical Item	Mostly Visible
Character Displays	Sign	Fully Visible
C-Yard Video	Video	Fully Visible

Table 9. Exhibit Elements in the C-Yard

Finally, in the Driving Engine Room (Figure 24), 6 elements were of interest.

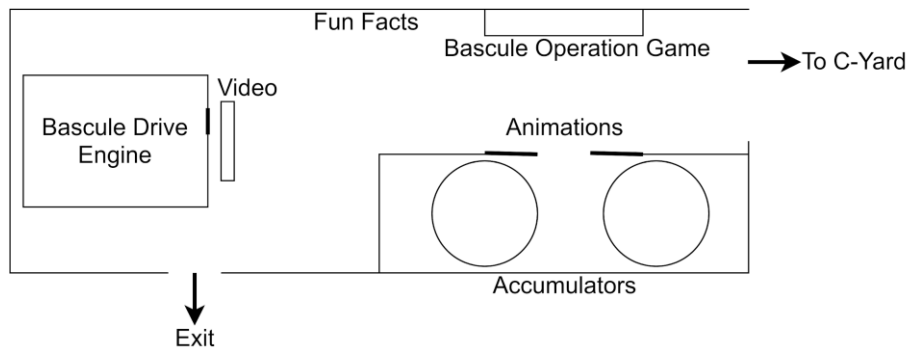


Figure 24. Floorplan of Driving Engine Room

Bascule Driving Engine Room Observation Locations

Item	Medium	Visibility
Accumulators	Physical Item	Partly Visible
Animations	Animation	Fully Visible
Bascule Operation Game	Interactive	Fully Visible
Fun Facts	Sign	Fully Visible
Drive Engine Video	Video	Fully Visible
Driving Engine	Physical Item	Fully Visible

Table 10. Exhibit Elements in the Drive Engine Room

3.1.2 Rating Visitor Engagement

After we separated the exhibits into sections and subsections, we needed to define how to measure interaction within them. We measured all interactions on a Likert scale between one and three:

1. No interaction
2. Minor interaction
3. Strong Interaction

A score of one signified **no interaction** with that subsection. A score of two represented someone having **minor interaction**, such as glancing at a photograph, prop, or film quickly. A score of three represented a **strong reaction** to the subsection; this could be stopping to view, pointing towards, taking a photograph of, or examining something. We also measured interaction with the welcome hosts and staff where applicable. We measured host interaction by no interaction, listening, and higher level interactions like asking a question or having a conversation. We list how to specifically rate interaction for each subsection on our observation matrix found in Appendices C and D.

3.1.3 Measuring Dwell Time

For each section of the exhibition, we measured how much time visitors spent at each location within the exhibit. In recording the dwell time in each section, it was important to set a clear start and stop point for the timer. Some of the sections were very simple; since the rooms only had one entrance and exit, it was very simple to start the clock when a visitor entered, and stop when a visitor exited. Such simple sections included South Tower Level Four, since visitors would enter from the walkway, progress through the room, and then exit down one of the two identical staircases. We recorded the dwell time in the same way for each visitor, regardless of how engaged with the exhibit they were, since we use other methods to track engagement. Some of the exhibit sections were more complicated. For example, The South Floor Level Two section has a lift to exit the building. Commonly, visitors stood there waiting for the lift without engaging with the exhibit at all. For this case, we stopped the timer as soon they stood by the elevator and stopped looking at any part of the exhibit. Furthermore, we made sure that they did not go back to engage with the exhibit more, and would start the clock again if that was the case. Each section of the exhibition examined and how dwell time was determined is presented in Appendix E, which provides in depth details about dwell time selections.

3.1.4 Pre-testing and Calibration of Observations

Before collecting data that would be included in our analysis, we tested our observation sheets in each observation area to ensure that the information we were trying to collect was consistent, and that the observation areas were set up effectively. For some interactions, it was too difficult to obtain consistent and accurate data, because some elements were too small, making it difficult to tell if a visitor was looking at that element or another. We also restructured our sections by combining sections together, such as the two flywheel rooms becoming the single “steam engine” observation region, which removed collecting redundant and potentially conflicting

information. This allowed us to better define our interaction qualifications, dwell time limits, and to even combine exhibits sections together.

Another tool that helped us refine our methods was **calibration** to make sure that each one of us could collect data independently and interchangeably without any major discrepancies. All team members recorded visitor interaction and dwell time for the same visitor simultaneously and compared sheet responses to ensure we all had the same observation skills, sense of interaction level qualifications, and timing for the start and stop of a visitor's dwell time.

3.1.5 Full Visit Shadowing

In order to evaluate if visitor engagement tends to decrease as their time at the exhibition increases, we utilized visitor shadowing. For this method of data collection, we selected visitors at the start of their visit, either at the N2 staircase or exiting the lift to N4. We then followed the selected visitor through the exhibition, often remaining slightly ahead of or behind them to avoid arousing suspicion or making them uncomfortable. The same observation protocol was utilized as in Appendices C and D, with time on the walkways measured but engagement not observed, due to engagement with these exhibits not being of interest before their renovation.

3.2 Determining Demographic Profile of Visitors

Demographics can give information about the general profile of people visiting museums, which provides some insight into potential cultural biases or beliefs that may impact their engagement with the exhibit. The methods included were utilized to assess the preexisting demographic profile currently utilized by Tower Bridge, and also to determine whether visitors were alone, with friends or family, or with a larger ordered group. The attraction managers requested this information with the hope that a clear demographic study could confirm previous analyses regarding whom museum exhibits should be designed for. By shifting the target audience of an exhibit to better reflect those actually attending, it will allow management to create better exhibit engagement with the audience.

3.2.1 Demographic Surveying

Visitors to Tower Bridge are the sole source of information regarding accurate demographic information of the museum audience. As such, to collect this data, we developed an exit questionnaire to be answered by visitors as they end their visit to Tower Bridge. Our questionnaire addressed many questions that can help draw out demographic information of the respondents. In particular, we determined each person's region of origin, especially if they were from the United Kingdom or international. We also asked if there were any languages that visitors wished information was presented in. This could be of interest to Tower Bridge staff as they plan content for future renovations with the goal of increasing accessibility. Finally, the size of the group attending Tower Bridge is important for management in order to understand the strain on

the physical movement through exhibits. Our demographic questionnaire can be found in Appendix C.

More specifically, the questionnaire also asked whether people were attending the museum alone, or if they were part of a larger group. These larger groups could include friend groups, families, or larger schools or other organized tour groups. Additionally, the age of visitors is pertinent for exhibit design, especially if some of the people in a group of respondents are children. If children are found to be common among visitors, it would indicate that exhibits would likely have to appeal heavily to a younger audience, since the exhibits might otherwise pose an intellectual challenge to some of the core audience. Therefore, we asked for the general age range of visitors within a group. The survey also addressed the prior knowledge of visitors. It was thought that it would be insightful to understand what people who enter the museum already know about Tower Bridge and its history, as it can set a baseline for what knowledge can be overlooked as common knowledge when presenting new information in the exhibition.

A majority of the questions were presented as multiple choice, to allow for simple, standardized data analysis which could more clearly provide conclusions. A few key exceptions were made to this standard, however, especially when it came to the country of origin, where we asked about general region in multiple choice format, followed by the visitor's specific country of origin as a fill-in-the-blank question. Our goal was to obtain as many questionnaires as possible within our allotted period, to gain insight into as large of a sample group as possible. One limitation however, is that due to the short time we had available to conduct our surveying, we could not get a truly random sample group, and were limited to those who we could get to agree to the survey as they exited. The surveys were crafted using Google Forms and administered orally to participants, with answers being entered by the researchers.

3.3 Rating Visitor Satisfaction

This section outlines the surveying method which we utilized to assess visitor satisfaction within the Tower Bridge Exhibition. Since the major renovations to the content displayed within a bulk of the exhibition, this has been of major interest to Tower Bridge staff. With more renovations underway, it is important for the staff to understand which exhibits are favored by visitors, so that they are able to consider how to renovate the walkway and any other planned sections of the Bridge in the future in ways that would most satisfy visitors.

The survey utilized was crafted with the goal of quantifying overall visitor satisfaction such that it could then be assessed, and it could be decided by museum staff if the exhibits are at a good place, or if a possible overhaul is required to increase satisfaction. Satisfaction with individual aspects of the exhibits were also of interest, as we aimed to determine if a particular aspect performs particularly well and should be made the centerpiece of the exhibit, or if any aspects do not contribute to the overall exhibit and should be put under review and considered for removal.

3.3.1 Satisfaction Survey

In order to rate visitor satisfaction with Tower Bridge, we asked the visitors to reflect on their experience directly. To obtain these opinions, we administered a satisfaction survey to visitors who had completed their visit to the exhibition at the end of the Engine Rooms. The location at which this survey was administered can be seen in Figure 25.



Figure 25. Survey Administration Point

The questionnaire addressed the major concerns of Tower Bridge staff, and ultimately was combined with the demographic survey, to assess whether some demographic groups enjoy the museum more than others.

In order to determine which aspects of the visitor experience should be inquired about, we asked Tower Bridge staff what they were interested in exploring, or had concerns about in regards to the exhibition. Suggestions that we ended up implementing included if the content was easy enough to understand, if the visit was enjoyable and entertaining, if visitors felt that they learned something from their visit, and which aspects of the exhibits are visitor favorites. These are important opinions for Tower Bridge to be aware of, as they aim to make the experience of visiting the Tower Bridge Exhibition as entertaining and educational as possible, and for visitors to leave satisfied with their visit. Therefore, visitors were asked about their thoughts on these topics.

Many of these questions utilized scales from one to five. This allowed for a “neutral” option, along with the ability to separate extreme opinions from slight judgments, but did not provide so many options that participants trivially selected one number over another. It was determined that it would also be valuable to allow visitors to leave comments on the exhibit, as it

was suspected that there may be some common thoughts that are not captured by fixed scale questions. However, such open-ended questions were kept to a minimum, given that it can be an intensive process to process such data. This survey was administered to visitors after they had finished their visit to the exhibition and were exiting the Engine Rooms, and is presented in Appendix C.

3.4 Assessing Visitor Comprehension

This section outlines the methods utilized to collect data on understandability of exhibits within the Tower Bridge Exhibition. A major factor of visitor comprehension was analyzing exhibits to see whether they presented easily understandable information that still remained informative and engaging. We wanted to see if the exhibits were able to pinpoint a level of difficulty between too difficult to understand and too easy to be engaging. To analyze this, we included questions within our exit survey that analyzed how difficult they found the material represented within the exhibition. We felt as though the questionnaire was the most reasonable method of acquiring this data from the main methods utilized, since it would have been difficult to determine cognition from observation or shadowing alone.

We designed the survey questions to allow us to provide an intellectual baseline for their answers by requesting information about their interest in both history and engineering, as well as understanding their preexisting knowledge of Tower Bridge. This was then followed up with questions asking visitors' opinions on the difficulty of the exhibit contents, making sure to target that middle ground between too easy and too hard to understand. By requesting both bodies of information, we could then analyze potential connections between previous knowledge and interests and overall difficulty of the material presented within the exhibition.

4. Results & Analysis

Overall, the methods of observation and surveying that we utilized provided us with a set of comprehensive data with which we analyzed to create constructive recommendations for Tower Bridge managers. Our observational data allowed us to determine which elements of an exhibit are most engaged with, along with where potential bottlenecks of the exhibition are located. Our survey data enabled us to understand visitor backgrounds and opinions of the exhibition. From the data we gathered, we were able to assess both what visitors objectively do, along with their thoughts and opinions about the exhibits. In the following sections, we discuss the results of our research by following the objectives of our paper.

Included in the **engagement** section is data regarding the effectiveness of media types used in the exhibition, location of specific items within the exhibit, visitors' engagement patterns with Welcome Hosts, the engagement patterns in individual exhibits, and an overall engagement analysis through the whole exhibition. The **demographics** section covers the geographic distribution of visitors, visitor group types, reasons for visiting Tower Bridge, and visitor interest in key topics presented within the exhibition. The visitor **satisfaction** section addresses which exhibits are the most popular and how visitors feel about Welcome Hosts, as well as the overall enjoyment of the exhibits. Finally, the visitor **comprehension** section addresses the question of whether the material is presented at the proper difficulty, whether the visitor is happy with the performance and role of the Welcome Hosts, and whether visitors better understand the workings of the bridge in the past and modern day, and the history of workers at Tower Bridge.

4.1 Visitor Engagement

Visitor engagement within the exhibition was revealed to be **greatly varied** between exhibits and exhibit elements. Likewise, the level of engagement achieved at the same location often varied for each visitor. Across all of our data, we found patterns revealing **lackluster engagement scores** in many regions of the exhibition.

4.1.1 Exhibit Item Location and Media Affect Engagement

In an effort to understand why some exhibit items had particularly low engagement scores in our research, we investigated engagement based on the type of media and also the visibility of the item in the exhibit. To research **the effect of media type** on engagement, we first divided exhibit elements into six types of media: physical objects, animations, signs, interactive objects, videos, and images. Physical objects, such as the Engine Room steam engines, serve as very visualized and authentic forms of information. While they do not include descriptions about their history or function, they provide a highly unique and simple element for visitors to enjoy. Animations at Tower Bridge teach concepts through pre-programmed displays intended to simplify the complicated bridge lift process to a level where it can be understood and enjoyed by

a varied audience. Signs provide a more traditional experience using images and larger bodies of text. Interactive objects, such as the bascule control game, are able to be manipulated by visitors and provide a more customized experience. Videos differ from animations at the Bridge in that they contain longer film experiences designed to provide a narrative into one of the themes of the Tower Bridge Exhibition. Finally, images provide pictures of relevant characters or figures, but intentionally lack supporting text as to add additional content for visitors to experience. In Figure 26, the average visitor engagement with each type of media in the Towers and Engine Rooms are compared.

Engine Rooms and Towers

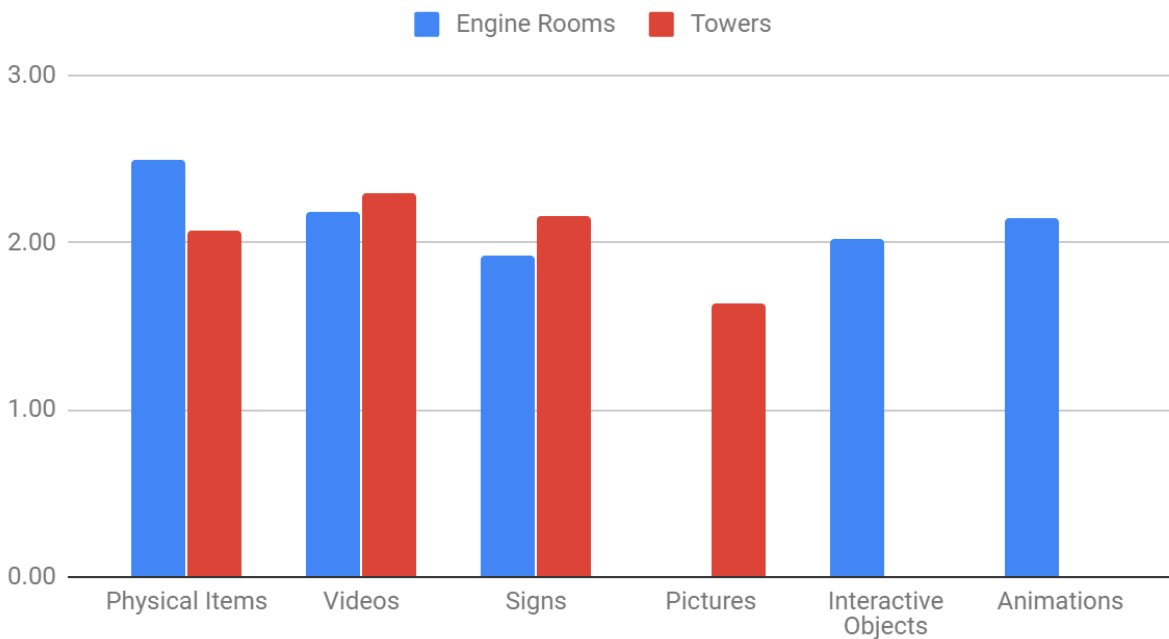


Figure 26. Engagement Scores of Media Types within Tower Bridge

It is important to note that there are no pictures without text in the Engine Rooms, just as there are no interactive objects or animations within the Engine Rooms. Figure 26 revealed that, although **pictures without text have a noticeably lower engagement**, that the exhibit media has little impact on engagement; however, pictures without text appeared to be the only case where media did impact engagement, since the data in Figure 26 also showed that the other media types all hovered around a similar engagement score of 2.00.

Exhibit location, on the other hand, was revealed to have a **much larger impact on visitor engagement**. This time, exhibit items were broken up into their visibility from the main path through the museum. The element visibility classifications can be found in Tables 2 through 10, in section 3.1.1. Exhibit features found in the column for fully visible are those that are directly in front of visitors on the main path, making them nearly impossible to miss. Similarly, exhibits found in the mostly visible column are elements that while not directly in front of visitors while on the

path through the exhibition, are still at eye level and can be seen without straying from the intended path through the museum. Finally, exhibits that are partially visible are those that are either well above eye level or require a visitor looking a direction different than the intended path.

From this analysis, we found that there was a **decrease in engagement** in both the Towers and Engine Rooms **as the visibility of exhibit decreased**. Once the averages of each of these visibilities were calculated and plotted, as seen in Figure 27, we noticed that there is a considerable drop in engagement between clearly visible exhibit elements and mostly visible elements.

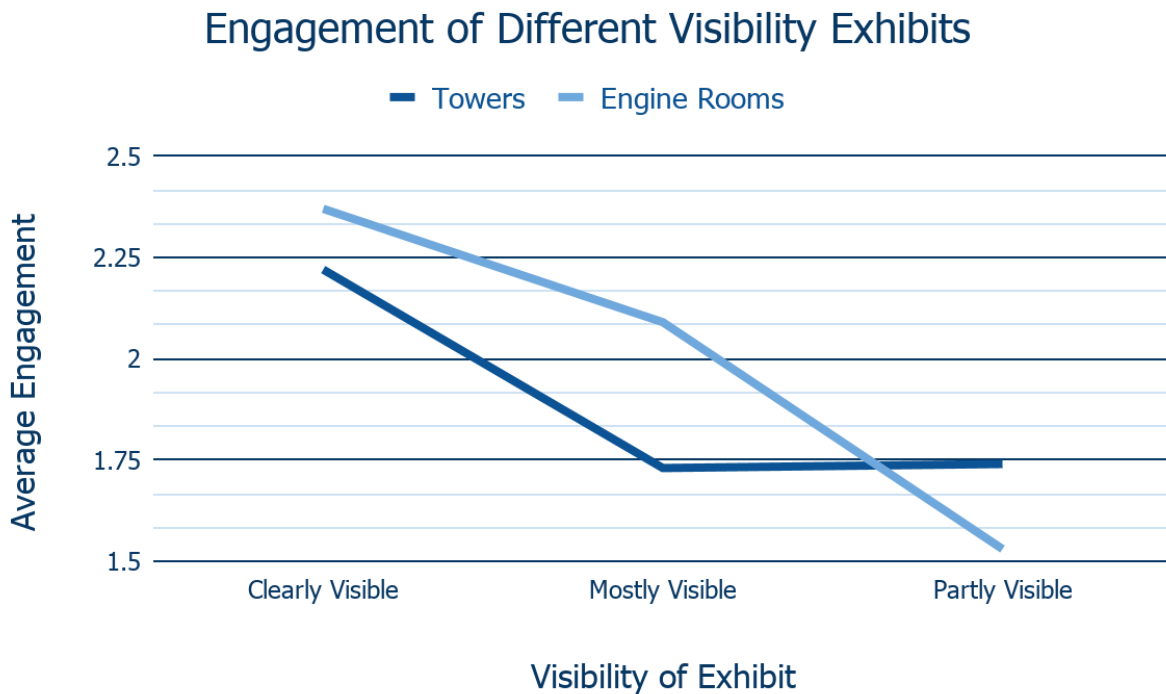


Figure 27. Engagement Scores of Different Exhibit Visibility

In the Engine Rooms, where there are no hosts to point out frequently missed exhibit elements, there was an even more severe drop between mostly visible and partly visible exhibit elements. However, in the Towers, where hosts will occasionally point out hard to spot exhibits to visitors, there was not much change between mostly visible and partly visible exhibit elements. Still, this figure illustrates the large effect exhibit element location has on engagement.

4.1.2 Welcome Hosts have Little Interaction, but Are Crucial for Engagement

Through engagement data, we found that nearly every element within an exhibit would have an improved engagement score if the Welcome Host interacted more with visitors. The complete data can be found in Table 11, but some key takeaways include improvements to North 4 exhibits and South 4 exhibits.

Exhibit Item	Raw score for exhibit				Score with host interaction				% Change
	1	2	3	Avg	1	2	3	Avg	
North 4 Film	80	146	223	2.31	4	10	66	2.78	+20%
Architects	296	110	42	1.41	0	4	42	1.91	+35%
South 4 Film	88	151	220	2.31	0	5	16	2.29	-1%
Rafters	287	33	136	1.66	2	12	51	2.75	+66%

Table 11. Engagement Score Changes with Host Interaction

In North 4, the **average interaction score with the film was a 2.31**; however, if the host directed attention toward the film, then the **score spiked to 2.78**. This can be seen in the architect pictures too. Without prompting, the visitor engagement score was 1.41 for architect pictures. But when guided to look at the banners by a host, the engagement score becomes 2.91, nearly a perfect score. Clearly, host engagement is crucial for optimal engagement.

A major problem could be seen then, as hosts rarely engaged with visitors. Of all 827 people observed within North 4 and South 4, only 154 of **them had any interaction with or guidance from the host**. This could be explained through our qualitative data, in which we observed most hosts standing silently within exhibit spaces. Only a few hosts throughout our observations regularly explained the exhibit content, resulting in both low interaction levels with the hosts, and consequently low engagement levels with the exhibit items.

In Table 11, the data reveals that although some visitors simply won't interact more with an exhibit due to narration by a Welcome Host, many are indeed **more engaged if a member of the exhibition staff is guiding them** through the information.

4.1.3 Engagement Patterns Reveal Type of Interaction with Exhibits

The results of our engagement analysis revealed four main groups that were of particular importance. First, **there are the exhibits that are clearly popular sights for visitors**. These can be spotted in the data based off of high engagement scores (3s), and lower concentrations of each lower score. These elements represent the parts of the exhibit that require little to no attention by Tower Bridge management, as they are already highly successful attractions. One such element are the original engines in the Engine Rooms. The distribution of the combined engagement scores of both engines can be observed in Figure 28.

Engines Engagement Distribution

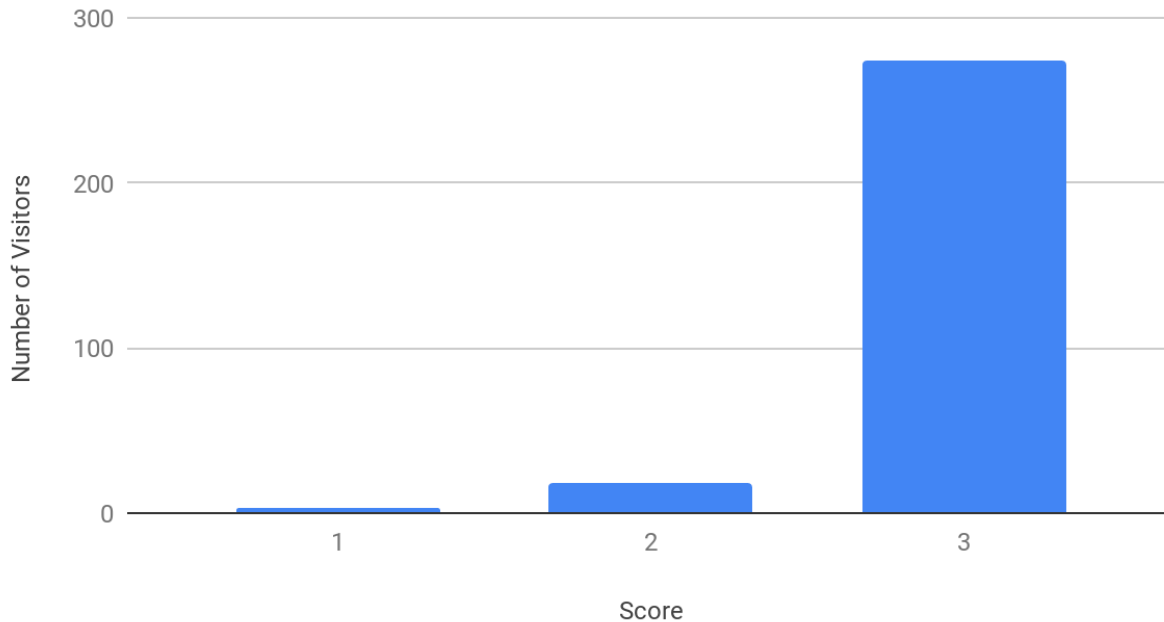


Figure 28: Distribution of Engagement Scores for the Engines

Other exhibits within this classification are the diving suit, display cases, and posters in North 4, boilers, and the hydraulic pumps.

The second group of consequence is those that were **very popular, but missed by a large percentage of the people visiting the museum**. These can be spotted in graphs such as Figure 29, where the data shows high concentrations of both no engagement (1) and full engagement (3) scores, with noticeably lower minimal engagement (2) scores. This demonstrates that while many people are unaware of the presence of that specific element, often due to placement, people that do notice the exhibit item enjoy it enough to engage with it fully. A key example of this sort of element is the Workers in the Rafters display of South 4. The distribution of this display's engagement scores can be seen in Figure 29.

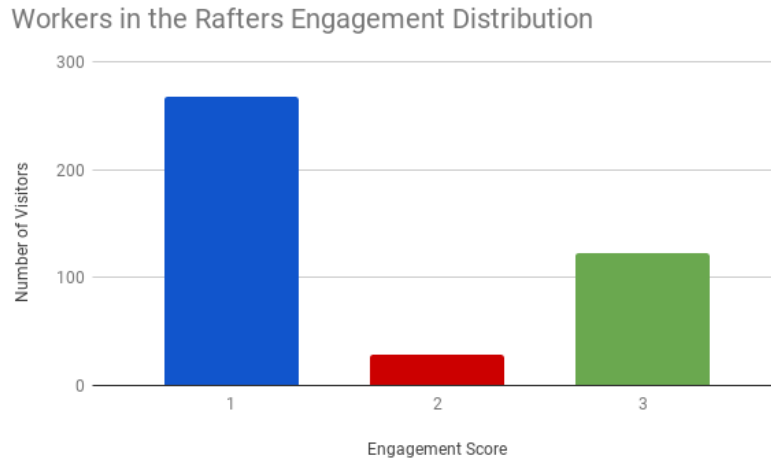


Figure 29. Distribution of Engagement Scores for the Workers in Rafters

Other missed but popular exhibits are the facts about the diving suit weights on the wall of North 2 and the historical book in the Engine Rooms. The facts in North 2 are printed up high on a wall while the book in the Engine Room is hidden in a corner, opposite the engines, which could explain the large numbers of visitors not noticing these elements.

Third, **several exhibits exist in Tower Bridge that are largely missed by visitors**. The data for these appear in graphs such as Figure 30 where there are almost exclusively no engagement (1) scores, since visitors simply were unaware of these exhibits during their visit. This reveals potential flaws in the placement of that element, and may be cause for moving that element to a more prominent area or using other methods to highlight its location. One such element is the images of workers along the back wall of North 4 (Figure 30). Often, unless the images were pointed out by Welcome Hosts, a large quantity of visitors did not even notice them. Other such exhibits are the North 4 architect images, the South 4 worker images, and the standing signs in the boiler room and at the flywheels of the Engine Rooms.

North 4 Worker Images Engagement Distribution

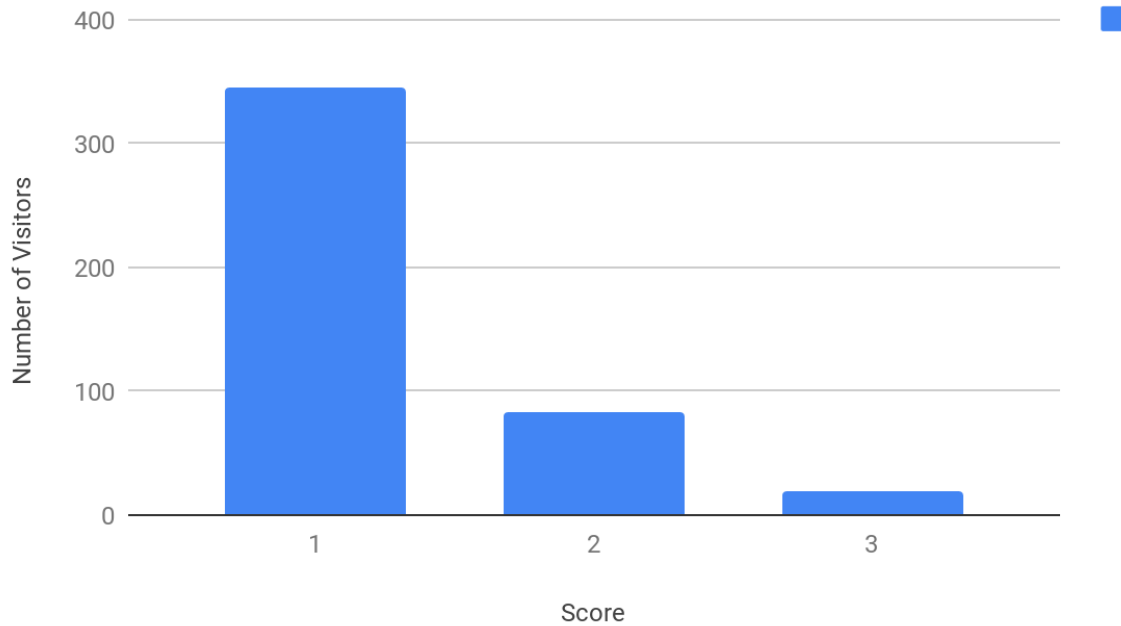


Figure 30: Engagement Scores of the North 4 Worker Images

Finally, the final exhibit type that causes concern are those elements that are noticed by visitors but still lack adequate engagement. These can be seen due to their large concentration of minimal engagement (2) scores relative to the no engagement (1) and full engagement (3) scores. This kind of pattern reveals that visitors have acknowledged that an element exists within the exhibit, but are not drawn in to engage with it. The exhibits that fall into this category are the North 4 props, South 2 schematics on the walls and floor, the C-Yard video, and the drive engine (Figure 31).

Drive Engine Engagement

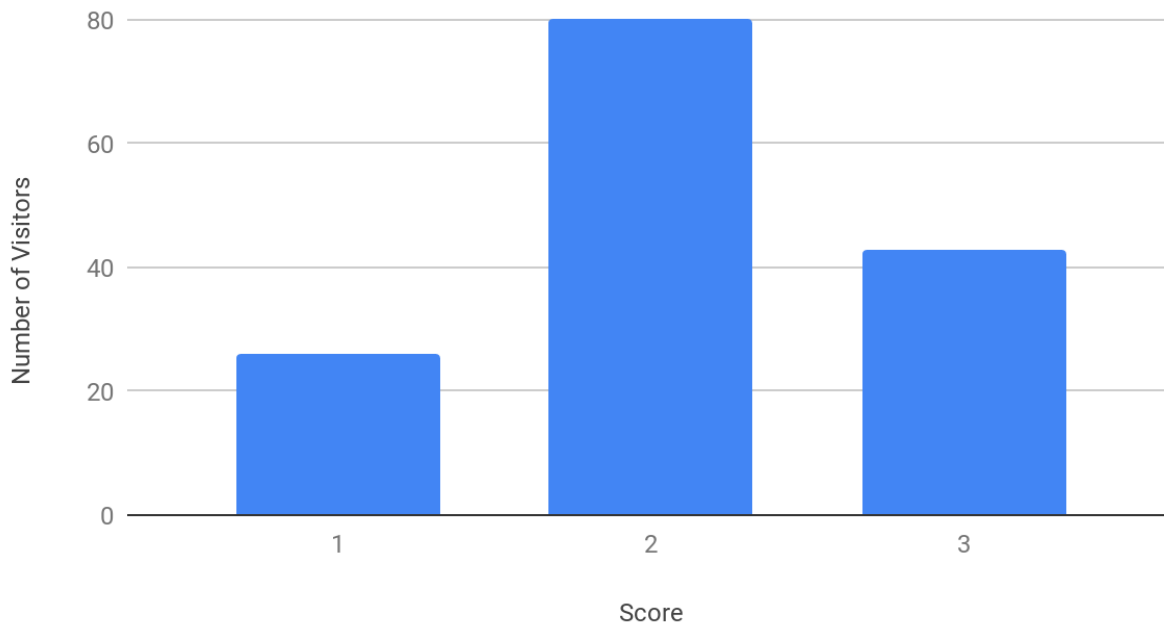


Figure 31: Distribution of Drive Engine Engagement

All remaining exhibits were found to have relatively uniform engagement distributions, indicating average performance.

4.1.4 Overall Engagement Analysis

This section presents data from our direct observation and shadowing to show compare visitor engagement across different sections of the exhibition. The following graph, Figure 32, shows the distribution of visitor dwell time gathered from shadowing. Outliers, such as a visitor missing an entire exhibit, were omitted. From this data, it can be seen that **visitors tend to spend more time per exhibit at the start of their visit, spending less time towards the end at the Engine Rooms**. However, many of the Engine Room exhibits, despite containing a similar number of elements to the rooms of the Towers, often were smaller in size. Therefore, this general downward trend is not sufficient enough evidence for us to claim that visitors experience any sort of engagement decrease due to fatigue or boredom.

Dwell Time Over Exhibition

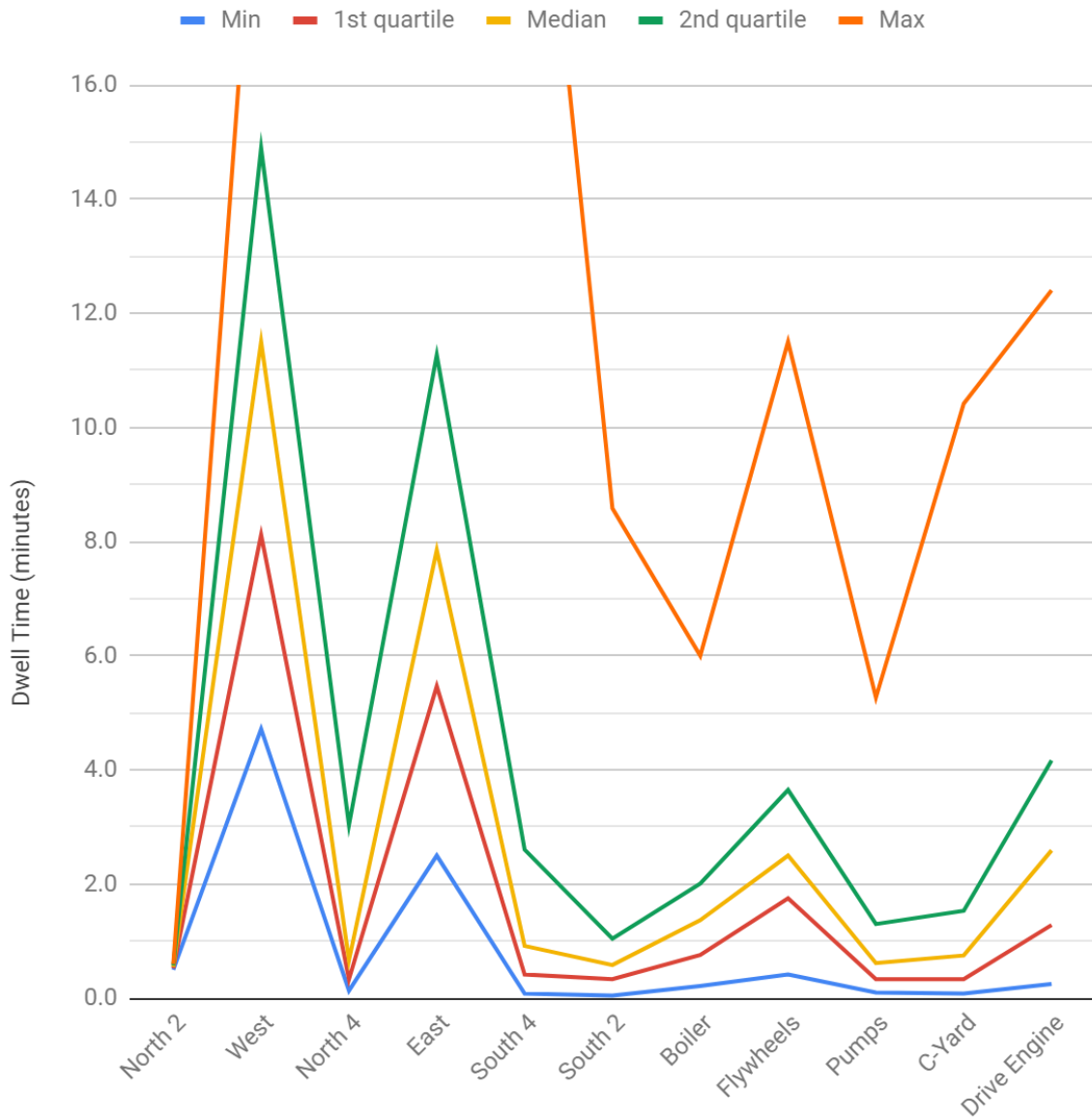


Figure 32: Dwell Time Distribution over Entire Exhibition

Instead, in order to see if there was any decrease in visitor engagement over time, we examined the average engagement level of each exhibition room in the order that most visitors progressed through them. These scores can be seen in Figure 33. From the data in this figure, we could see that **engagement did not decrease for later exhibits**, and was maintained in a fairly steady manner throughout.

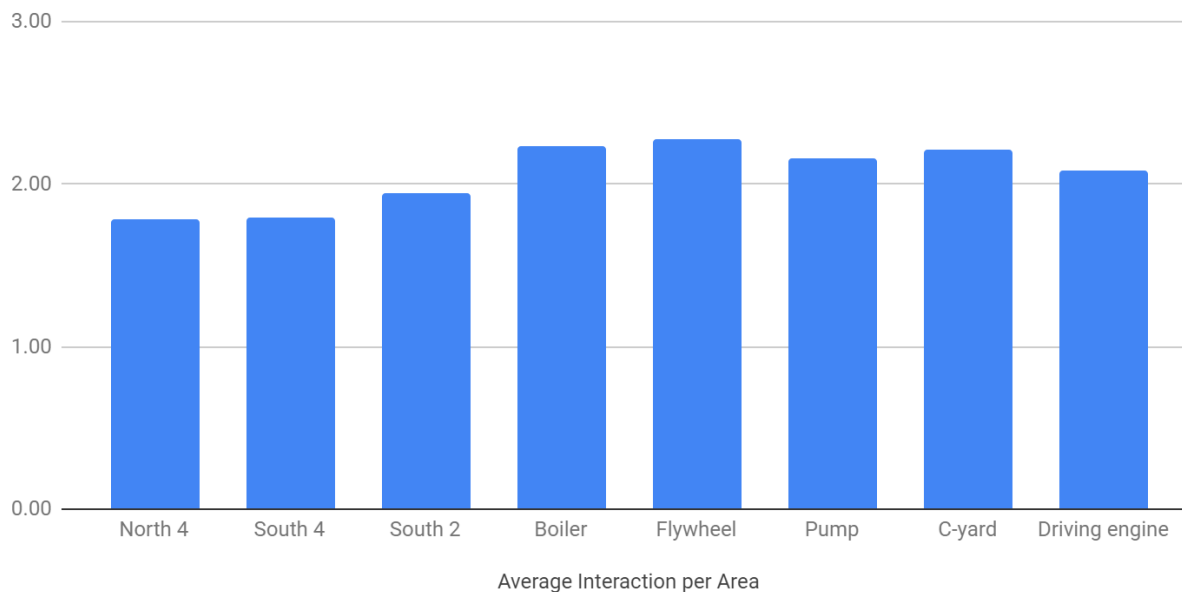


Figure 33. Engagement Scores in Regions of the Tower Bridge Exhibition

Overall, all of the exhibits could be improved to increase engagement. Ideally, all exhibit features would be fully engaged with by all visitors, for a score of 3. Some exhibits are more engaged with than others. In particular, North 2, the Boilers, the Flywheels, the Pumps, the C-yard, and the Driving Engine are all engaged with fairly well. South 2 has a fairly good level of engagement, with the average score under 2, and the engagement in North 4 and South 4 could use some improvement.

4.2 Demographic Profiles

Since the most important aspect of demographics was to confirm whether the previous demographic analyses still applied to the Tower Bridge visitor base, one of our focuses of this portion of the research was to acquire data regarding geographic information. More specifically, we wanted to analyze where people came from, and what languages are spoken by people visiting the attraction. This data was most important for the marketing department of the Tower Bridge Exhibition, because they want to understand who it is that actually visits, so that they can either reinforce existing marketing campaigns in those regions, or see where people are not visiting from, so that they can begin advertising in those regions to increase visitation.

While basic geographical data is important, we also investigated visitors' **reasons for attending** Tower Bridge. This ranged from simply asking them to state their motivations for visitation, to learning about their interest in topics like history and engineering. We believed as though this information would provide us with valuable data to understand if people had interest

in the key concepts covered within Tower Bridge, and also further understand what parts of the exhibition Tower Bridge managers could emphasize in further ad campaigns.

4.2.1 Visitor Origins

Using our survey administered at the end of the exhibition, we gathered data that closely correlated with previous studies at Tower Bridge, confirming that the geographic distribution of visitors has **not changed significantly** in the past two years. In the interpretation plan studies, they found that 50% of all visitors were from Continental Europe, with 26% originating from the United Kingdom, and another 13% Visiting from North America. In the 2017 Engine Rooms study, similar demographics were reported. 50% of respondents originated from Continental Europe, 21% visiting from the United Kingdom, and 21% visiting from North America.

In our study, we found that current demographics are quite similar to these previous studies. The data shown in Figure 34 reveals that 43% of visitors were from Continental Europe, while 28% originated from the United Kingdom, and 19% originated from North America. The full breakdown of geographic origins can be seen in Figure 34. A fundamental issue with this, however, is that these demographics are reflective **only of those who took our survey**, and many visitors were unable to take the survey due to language barriers. Thus, it is likely that true demographics are less Anglocentric.

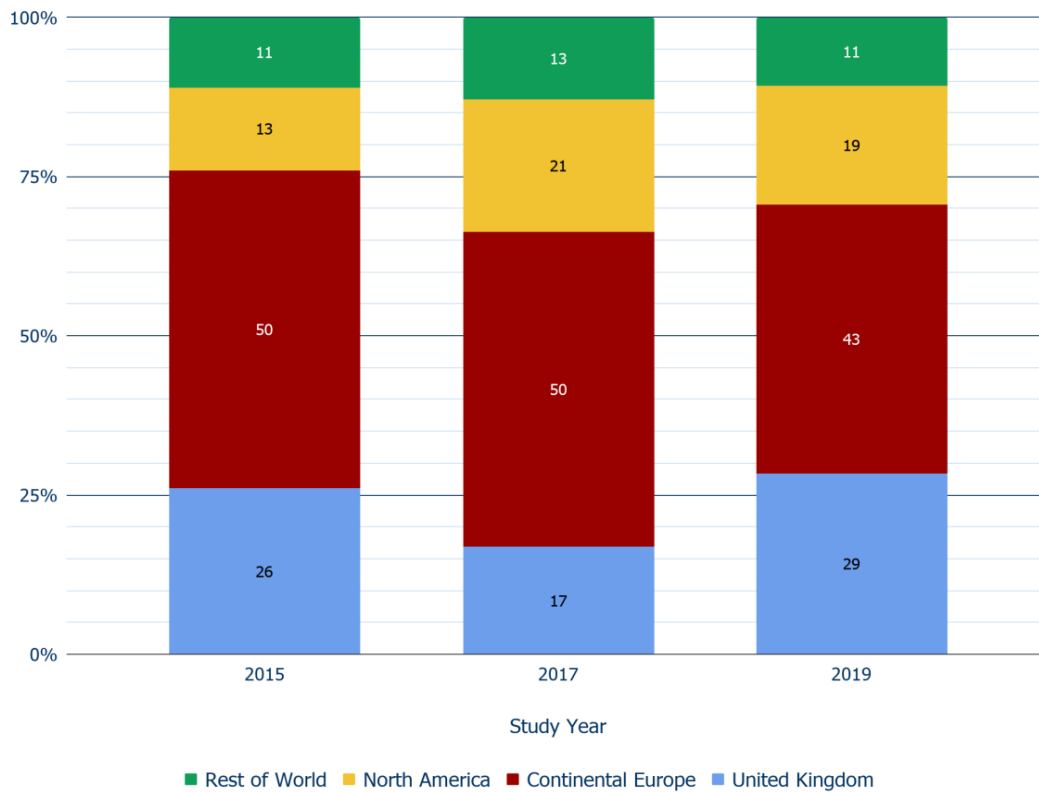


Figure 34. Geographic Distribution of Tower Bridge Survey Respondents

Figure 34 also shows a nearly constant profile, especially between 2015 and 2019. Variations that do exist can likely be attributed to the period of the year when the study was conducted. School vacations, holidays, and seasons can make a large impact on the geographic profile of an attraction of this distinction. Regardless, our study **confirms the geographic breakdown for visitors is unchanged** since 2017. Also of note, the map in Figure 35 shows that the largest number of respondents came from the United Kingdom, the United States, France, and Germany.

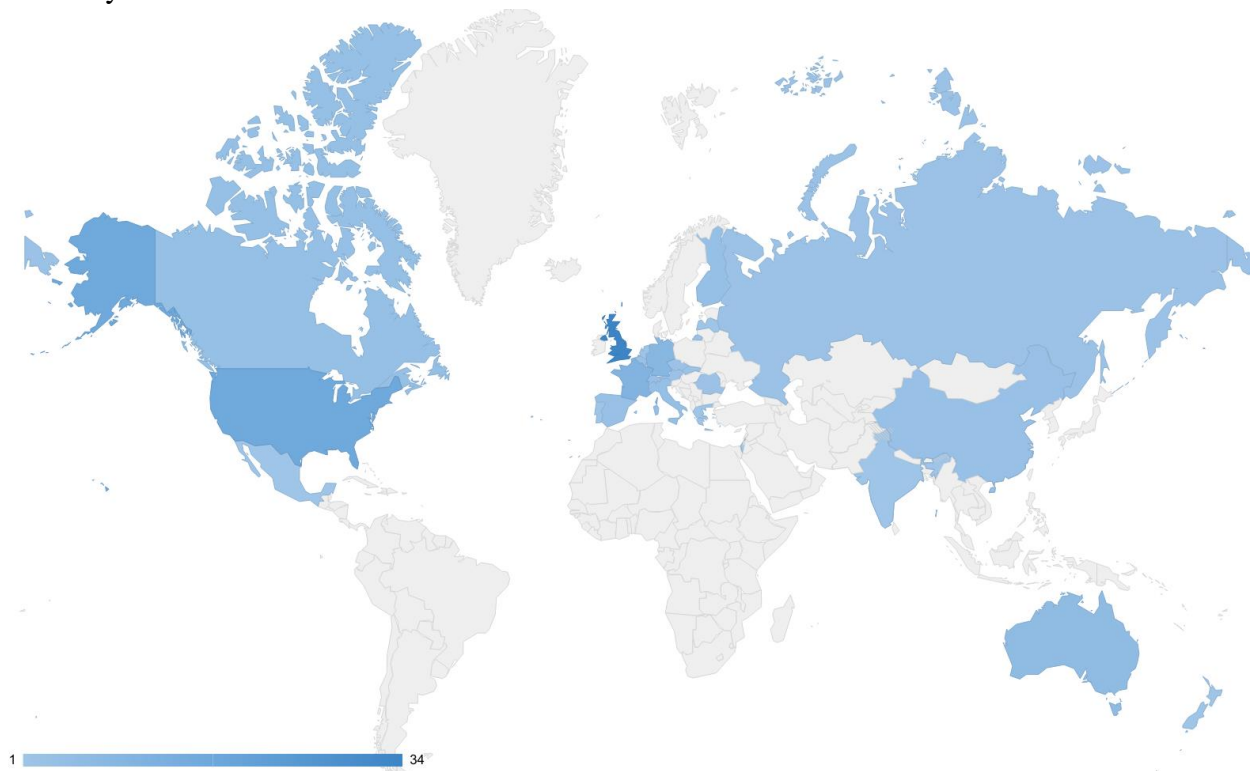


Figure 35. Geographic Distribution Map of Survey Respondents

The second aspect of pure demographic data was the group types visiting the Tower Bridge Exhibition. Our study found that 70% of survey respondents were visiting as a family, with 13% visiting as friend groups, and an additional 17% visiting as individual visitors. This data can be visualized in Figure 36. The data graphed in Figure 36 demonstrates that the majority of visitors attending the Tower Bridge Exhibition are still **mostly family groups**, with leisure groups such as friends visiting as well. However, this data excludes a considerable demographic, education groups, since they are quite frequent. Unfortunately, we did not include school groups in our survey responses, leaving this considerable demographic out of the data.

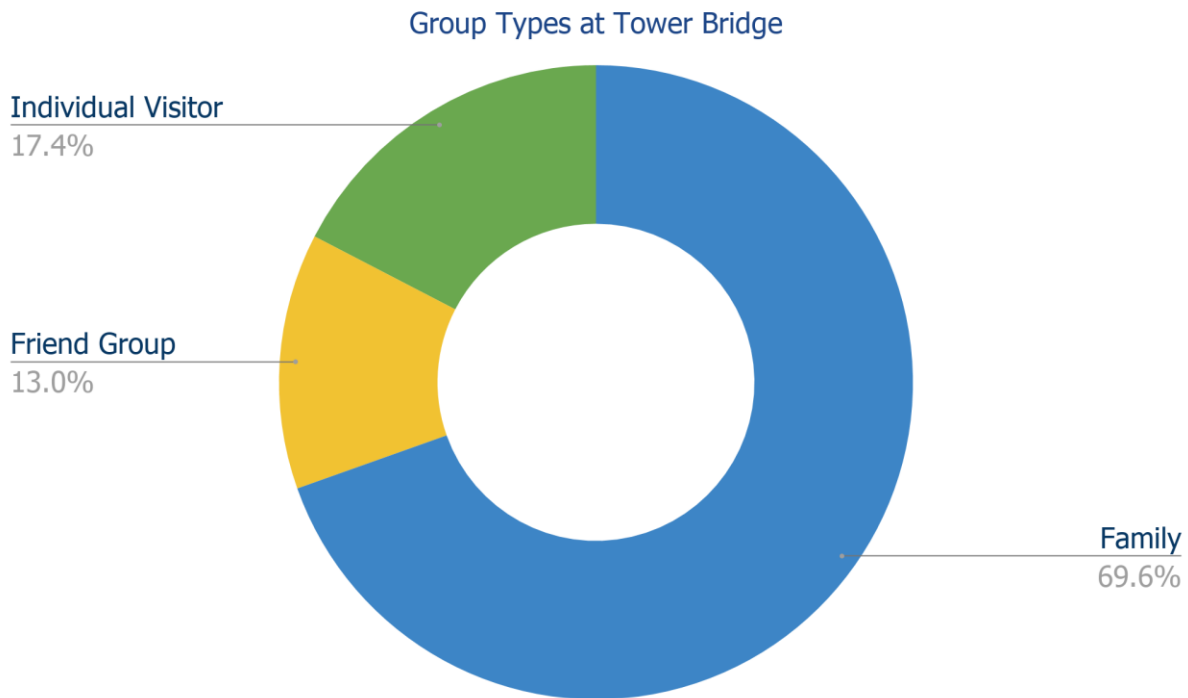


Figure 36. Groups that Visit Tower Bridge

Finally, a question addressed by our survey data delved into languages used to present exhibit information. We asked visitors if they were content with the current language accessibility found at the Bridge, or if they would prefer to see other languages in addition to English used to present information. Most of our respondents were happy with exhibits presented exclusively in International English, with 91% of respondents saying English was sufficient; however, the same issue as with geographic distribution arose when many people were unable to take the survey due to **language barriers**. If they were unable to take a survey due to language barriers, then it is likely they were also unsatisfied with the exclusive use of English within the exhibition.

4.2.2 Motivations for Visiting

We identified the motivations were for people to visit the Tower Bridge Exhibition, by both inquiring into interest in key topics addressed in Tower Bridge, as well as having visitors select from a list of possible reasons for visitation. The first thing addressed, interest in history and engineering, brought back very positive results. The data in Figure 37 revealed that respondents overwhelmingly demonstrated **high interest in history**, and **moderate interest in engineering**. Only 2.5% of respondents had a negative perspective of history, while 11.7% of visitors had disinterest in engineering.

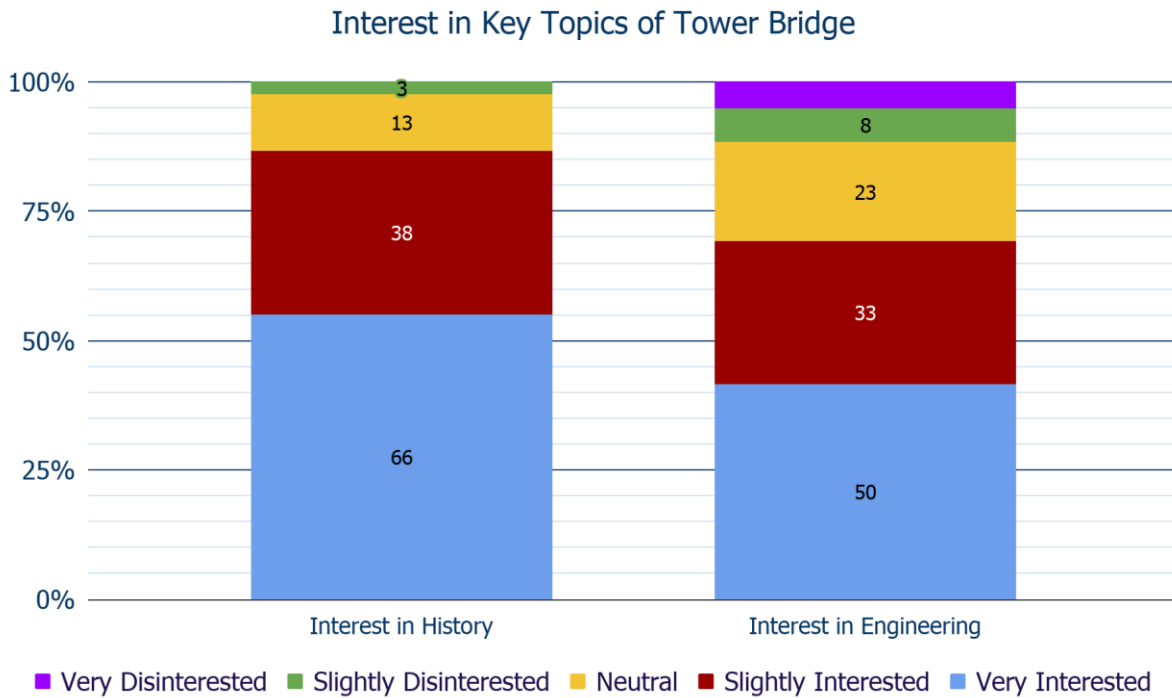


Figure 37. Interest in Key Topics Covered by Tower Bridge

Most visitors wanted to visit Tower Bridge because of its prominence as a **must-see landmark** in London. Additionally, many people visited due to **interest in history and engineering**, and simply because it was part of a **family trip**. Full results of this portion of the study can be referenced in Figure 38. So, while many people do in fact simply just visit Tower Bridge because it is a well known landmark, most visitors can enjoy the context and history of the exhibition.

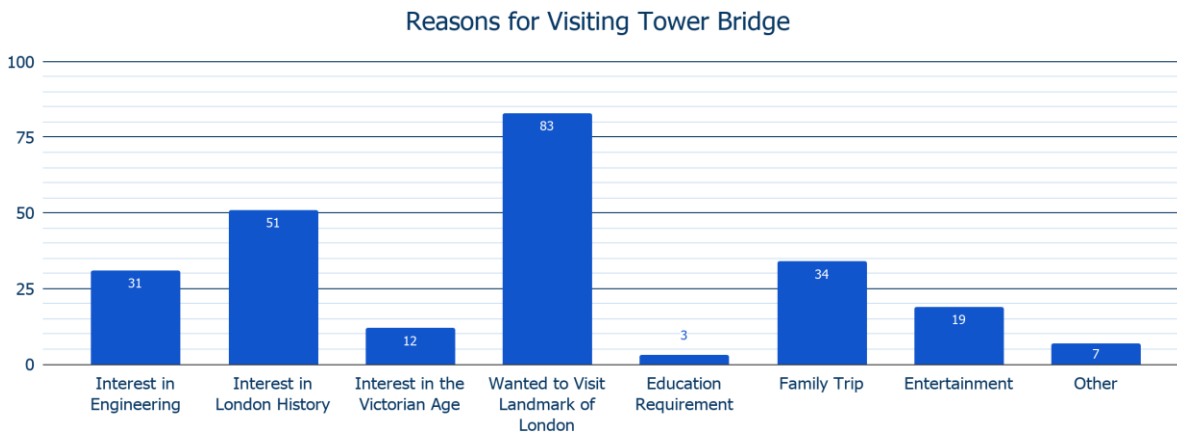


Figure 38. Visitation Motivations

4.3 Visitors are Satisfied with the Exhibition

A major role of our exit survey was to address the **satisfaction** of visitors to the Tower Bridge exhibition. Satisfaction with one's visit overall was evaluated, along with the satisfaction of any children brought to the exhibition. Satisfaction with more specific elements was also explored, with visitor feelings towards the Welcome Hosts being rated, and visitors asked to select their favorite exhibits.

Overall, **satisfaction was found to be very high**, indicating that the exhibition is performing well as an attraction in terms of its goal to be enjoyable to visit. 63.3% of visitors reported that they found their overall visit to be very enjoyable, with the remaining 36.7% describing the visit as enjoyable (Figure 39). No respondents described the visit as neutral, or unenjoyable to any degree.

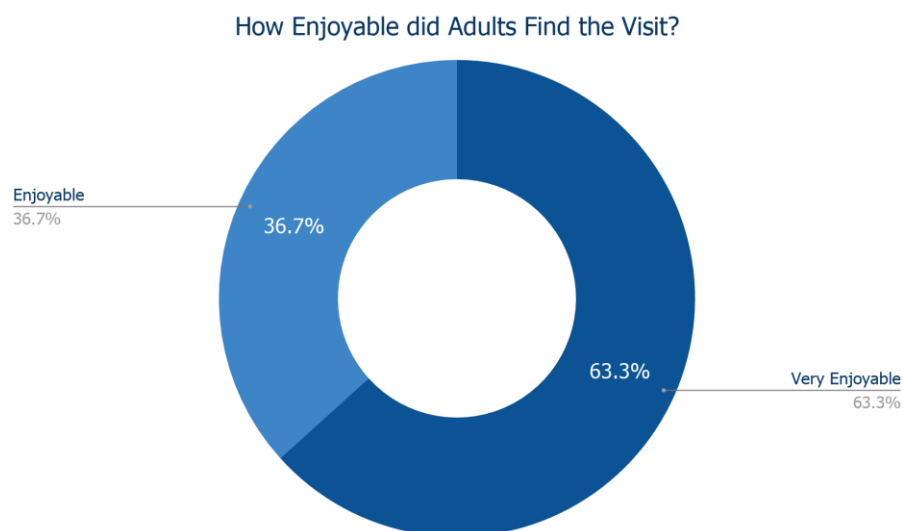


Figure 39. Enjoyment of the Overall Visit

Furthermore, while 69.4% of respondents did not bring children to the exhibition, of the visitors surveyed with children, the data in Figure 40 revealed that most children found the visit slightly or very interesting. Only 2.9% of the respondents with children reported that their children found the visit to be neither interesting nor uninteresting, with 30.4% of children finding the visit to be slightly interesting and 66.7% describing it as very interesting.

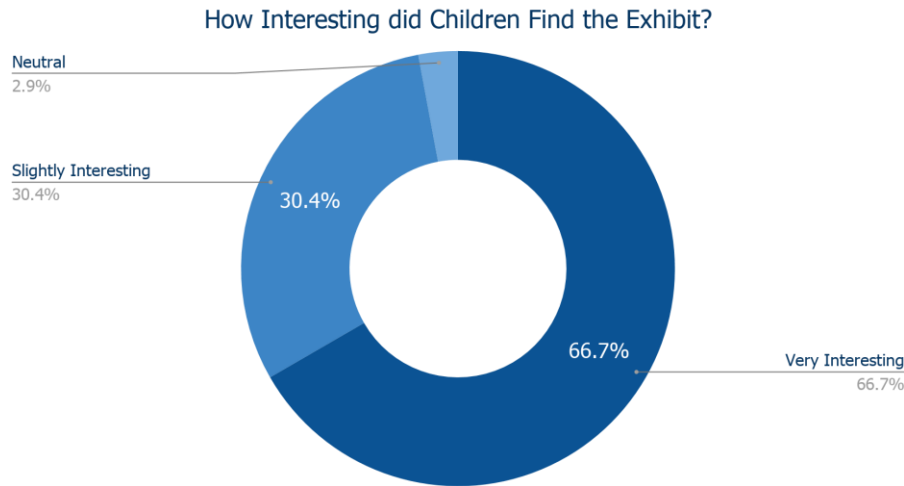


Figure 40. Children's Interest in Exhibition

4.3.1 Popular Exhibits

As a more specific question to explore visitor satisfaction, our survey presented participants with a list of major exhibits, along with images to ensure that it was clear what each one was. The results revealed that the top three most favored exhibits were the glass floors of the walkways (92.7%), the Engine Room machinery (89.1%), and the views of London from the walkways (81.8%). Disregarding the glass floors and views, since these components are in an area of the exhibition which is outside the scope of our in depth analysis, the most popular exhibits are the Engine Room machinery (89.1%), the Workers in the Rafters display (51.8%), and the interactive Engine Room process diagram (45.5%). This reveals that visitors tend to favor exhibits that are **highly visual**, as none of the most popular components feature a large amount of text, and instead are interacted with simply by looking at them. The popular exhibits also tend to be very **unique to Tower Bridge**, with the views of London and down through the glass floors being from a unique angle, the Engine Room machinery being unique to the Bridge, the Workers in the Rafters being thoroughly incorporated into the Bridge's structure, with the supports of the Bridge itself being just as vital to the display as the figures themselves, and the process diagram illustrated with the Bridge itself. Things that could be considered less unique to Tower Bridge seemed to be favored less, with the London in the 1800s film, for example, being described as a favorite by 36.4% of visitors. The percentage of visitors describing each exhibit as a favorite of theirs can be seen in Figure 41.

Visitor Favorite Exhibits

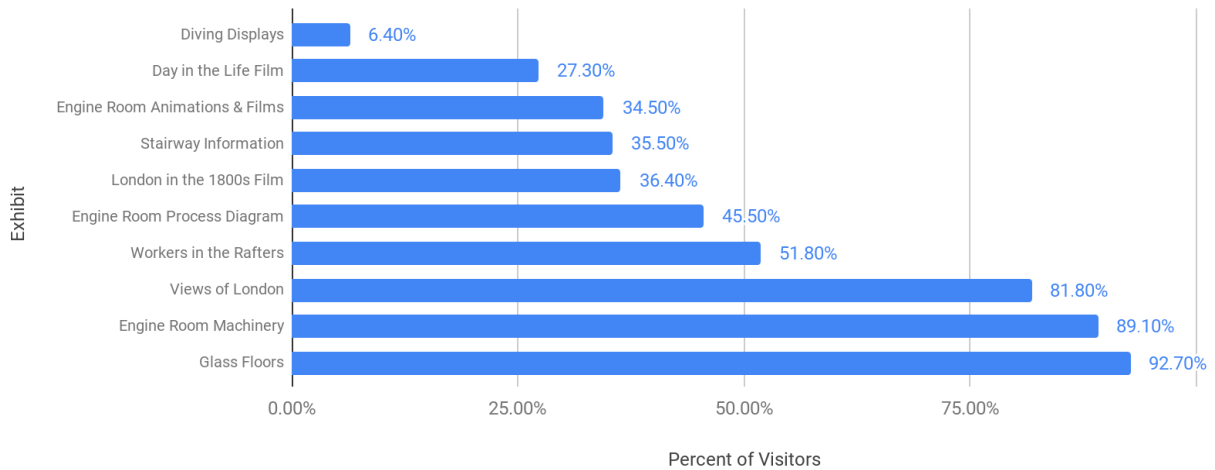


Figure 41. Favorite Exhibits of Visitors

A component of this data to note is the popularity of the **diving displays**. While only 6.4% of overall visitors reported this to be a favorite exhibit, of the visitors who took the stairs rather than the lift, therefore enabling them to see this exhibit, 70% described it as a favorite. This makes these displays **one of the most popular** exhibits among those who are able to visit North 2.

4.3.2 Welcome Host Satisfaction

Satisfaction with the hosts in the North and South Towers was also evaluated. While the hosts are officially titled “Welcome Hosts,” this may not be well-known among visitors, so the question simply used the general term of “guides.” 14% of visitors reported that they had no interaction with the Welcome Hosts, not having any of the information explained in additional detail by them or having any sort of conversation. 22.4% of visitors described the hosts as neither improving nor detracting from their experience, while the remaining 63.6% of visitors described the Welcome Hosts as having made their experience slightly or significantly **better** (Figure 42).

"How Did Guides Impact Your Experience?"

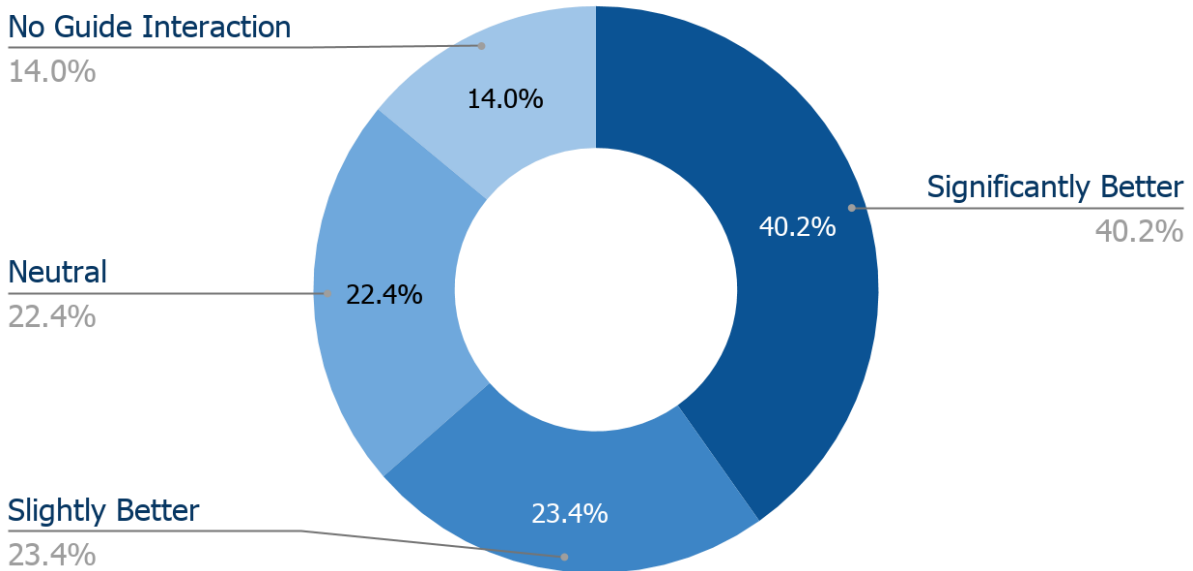


Figure 42. Perceived Welcome Host Impact on Visitor Experience

4.4 Visitors found Key Concepts Slightly Too Easy

In our exit surveys, we asked two main questions pertaining to their comprehension after going through the entire exhibition. First, we asked visitors how they felt about the **overall difficulty** of the exhibition in terms of quantity of information, amount of prior knowledge required, and difficulty of technical information. The possible responses were on a scale from “far too difficult” to “far too easy,” with “slightly” options and “neutral” available as well. The results of this question can be seen in Figure 43.

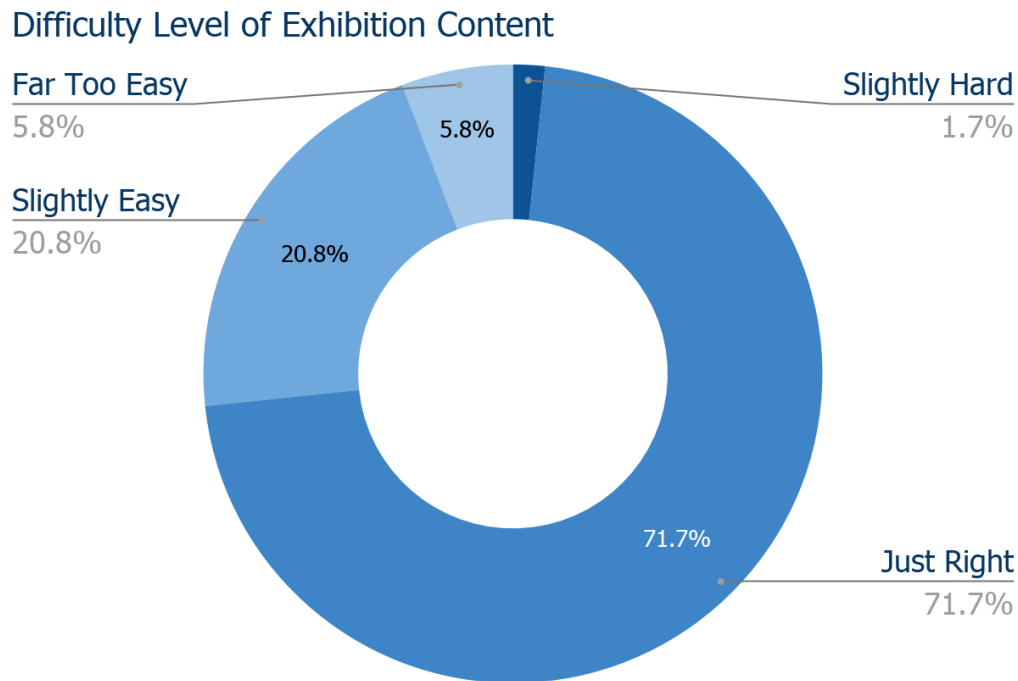


Figure 43. Difficulty Level of Exhibition Content

In the survey of 120 visitors/groups, only two people thought the content in the Tower Bridge was too complicated, or would have preferred simpler information. Most visitors were satisfied with the difficulty 86 visitors, or 72% of visitors we surveyed were fully satisfied with the difficulty of the exhibition content. A combined 27% of visitors surveyed thought the information was slightly easy or far too easy. While most visitors were satisfied with the difficulty of the exhibition, many more thought it was **too easy rather than difficult**. Luckily, we did not find any correlation between overall satisfaction due to perceived difficulty. A similar percentage of visitors found the exhibition very enjoyable regardless of whether they thought the difficulty was just right, slightly easy, or significantly too easy.

We then asked if visitors better understood **three core concepts** behind Tower Bridge, those being how the Bridge worked in the past, how the Bridge works today, and the history behind Tower Bridge's workers. As displayed in Figure 44, a majority of visitors felt that they now better understood how the Bridge used to work, with no visitors saying that they definitely did not now better understand.

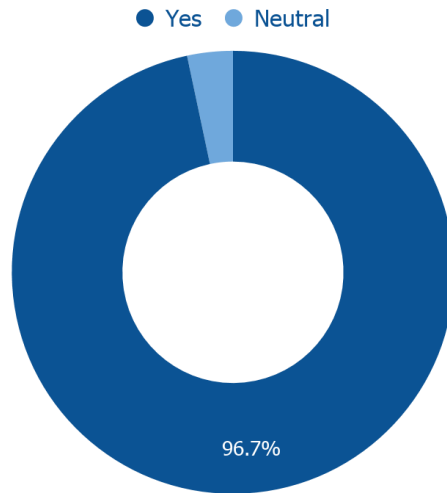


Figure 44. Understanding of Former Operation

Similar results were noted in regard to visitor understanding of the Bridge workers. While some visitors this time stated that they did not better understand the workers, over 90% of visitors responded that they did. The distribution of these results can be seen in Figure 45.

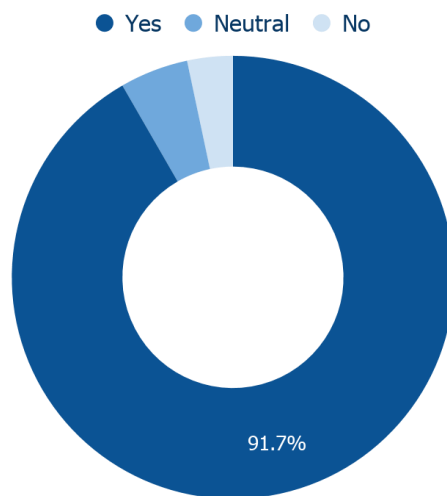


Figure 45. Understanding of Bridge Workers

While visitor understanding of the Bridge’s workers and how the structure used to work was well understood among visitors, a **less satisfactory** portion of visitors said that they better understood how the Bridge works today, with about 75% saying that they did and the remaining visitors saying that they did not feel that they learned about this concept or that they were neutral towards it (Figure 46). It is also worth noting that many visitors who answered that they did better understand how the Bridge works today answered this question more hesitantly than they did the

other two similar comprehension questions. Therefore, it is clear that more information on current Bridge mechanics would be beneficial to the visitor experience.

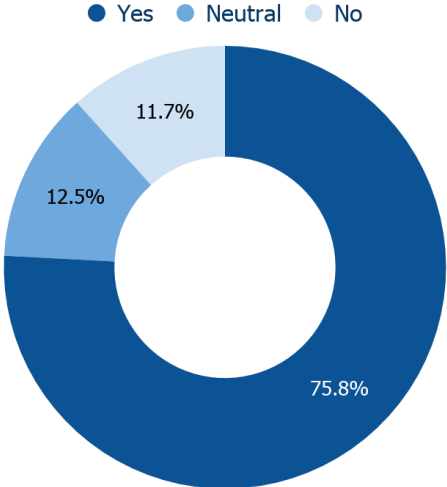


Figure 46. Understanding of Modern Operation

Overall, the visitors to Tower Bridge understand the concepts of how the Bridge used to work and the workers of Tower Bridge. Of the three primary concepts, a reasonable number of visitors do not have enough information about how the Bridge works today, or the information is not presented in the right way to them.

5. Recommendations

In this final chapter, we outline some changes and additions that Tower Bridge managers can make to improve visitor experience, both in engagement levels and overall satisfaction. The first section is composed of small, easily implementable changes that currently have minor impacts on overall experience. The sections 5.2 to 5.10 outline larger, likely more involved edits to the exhibition that would also likely result in larger improvements to visitor experience

5.1 Small and Quick Improvements

To improve overall cohesion and enjoyment of the exhibition, we propose a few small changes to the **North Tower**. First, since North 2 experiences high levels of engagement, indicating the popularity of the exhibit, it makes sense to increase access to this floor, especially in the off-peak season. This provides visitors with an essential part of the Bridge's narrative history, and the attraction is not busy to the point where this would hinder overall movement through the attraction. Next, in the Site Office exhibit pictured in Figure 47, within the North Stairway, the sign explaining the scene indicates that one of the characters can be identified by his top hat; however, none of the three characters are wearing a top hat. We recommend that this slight continuity error be fixed.

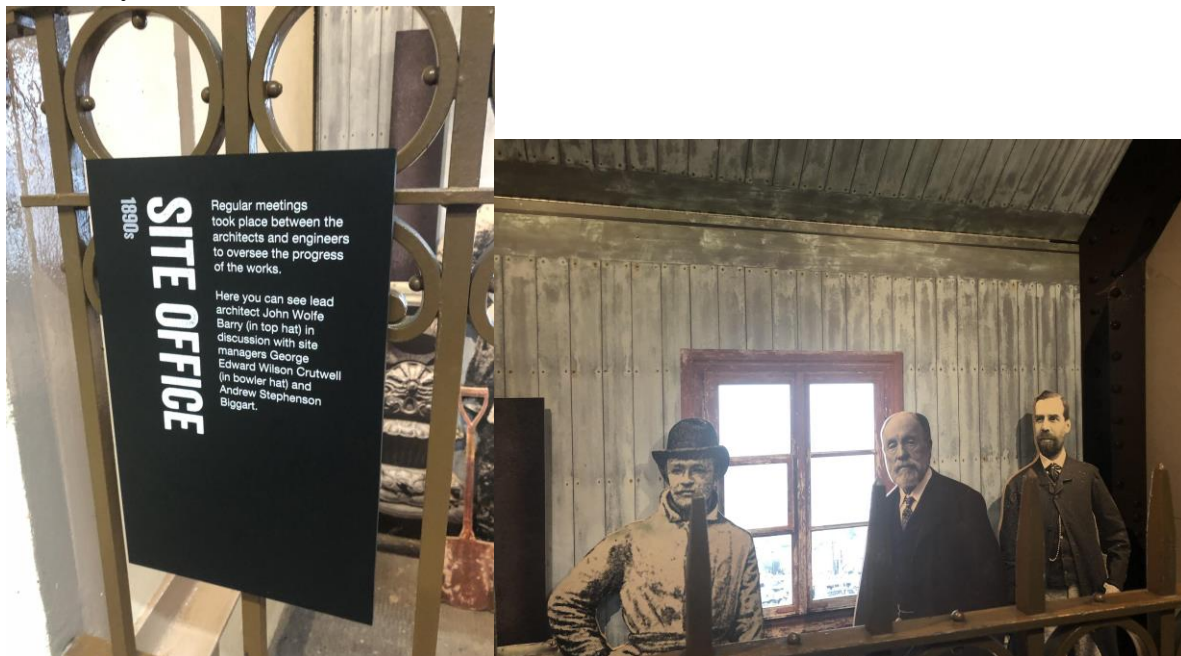


Figure 47. Content Error in North Stairway

In **both Towers**, the worker banners in North and South 4 are often non-visible due to direct light and shadows through the windows in the afternoon. This sub-optimal lighting is pictured in Figure 48. We suggest putting light diffusers in the windows behind these banners in order to allow light through without ruining the visibility of the banners.



Figure 48. South 4 Banner Lighting

In the **South Tower**, since the change back to the correct exhibit order, we noticed people missing the West Walkway all together, going down the stairs without noticing the additional exhibit. Since this section of the exhibition contains two of the three most popular exhibits, we believe a sign should be placed in the median between the two staircases reminding people to visit the West Walkway if they haven't yet. Next, some of the objects within the display case found on South 2 are hard to see due to the size and positioning of the case. From our understanding, Welcome Hosts are supposed to open this up and allow visitors to handle some of the items; however, no hosts during our time at Tower Bridge ever opened the case, so this may in fact not be the protocol for this exhibit. If it is the standard to open it up and show visitors, it would make sense to reinforce this practice. Otherwise, it would make sense to change this case to improve the visibility of otherwise difficult to see exhibit items. Finally, South 2 often becomes a bottleneck, especially during the time where school groups or tour groups come through. To mitigate this, the South 2 stairway could be opened more frequently, as this would alleviate this issue and provide visitors with more access to the exhibits found on this floor.

In the **Engine Rooms**, we found very few issues with any of the exhibits found within. However, we do recommend making the button on the process display more conspicuous. From the entrance of the exhibit, a beam that can be seen in Figure 49 blocks the button of the process display, so even though it does light up, people still frequently miss it, detracting from another popular exhibit.



Figure 49. Process Display as Seen From the Entrance of Engine Rooms

Additionally, the sign about the “unknown worker” in the first flywheel room is also frequently missed, since it requires visitors to nearly turn back the way they came to notice it. To alleviate this, we recommend moving this to the other side of the first flywheel in the empty space to the left of the passage to the second flywheel room. The location of this move can be found in Figure 50.



Figure 50. Current Location of Standing Sign and Proposed New Site

Finally, we recommend putting labels near the animations throughout the Engine Rooms (Figure 51) indicating that they are not touchscreens. Many people get quite aggressive with the

screens, trying to make the interface interact to their touch. This would increase the lifespan of the electronics as well as reduce visitor confusion.

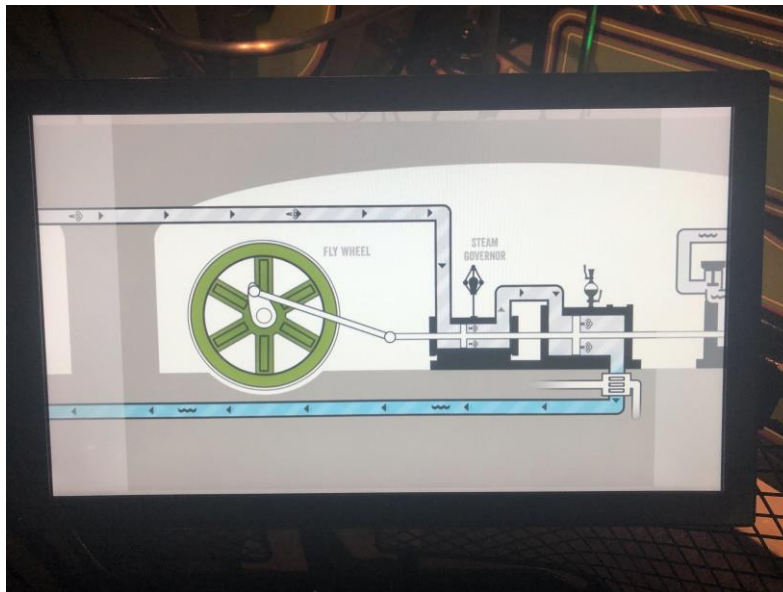


Figure 51. Engine Rooms Animation Monitor

In terms of the **entire exhibition**, we recommend a few more minor changes that would make an impact on the exhibit. First, prompting more Welcome Host interaction with visitors will drastically increase engagement with exhibits. As such, having all of the Welcome Hosts, not just some of them, narrate the videos in the main rooms and point out other exhibit features around the video could really improve the experience and understanding of visitors to Tower Bridge.

5.2 Introduce Signs that Explain Banners in the Tower Exhibits

While the aforementioned small changes would improve many aspects of the visitor experience, some larger, long term changes could be made for a **greater impact**. One such alteration could be the addition of signage for the image banners in North (Figure 52) and South 4, and the Workers in the Rafters. Often, these items are not noticed or engaged with, so the addition of some visible text nearby explaining and drawing attention to the banners and statues could increase engagement, while also educating visitors on the subject matter.



Figure 52. Worker Banners in North 4

It is likely that visitors could **better relate** to images such as those of the workers in the back of North 4 if there was some sort of explanation of who the people were, and what their roles were in the construction of the Bridge. It is also important to note that the size and location of these information plaques is crucial, since the existing signage for the architect pictures in North 4 is small to the point where only 2 out of 400 visitors noticed the information. We recommend putting signage explaining the worker banners along the railings surrounding the extra seating in North 4, the signage explaining the architect banners on either side of the “London in the 1800s” Video, and the worker banners in South 4 on the empty wall directly beneath the images.

5.3 Introduce Additional Worker Statue in South 4

An additional, more novel way to draw attention to the Workers in the Rafters is to produce one more worker statue, placing it somewhere highly visible on the ground. For example, at the bottom of the metal beam between the heat lamp and the lift could be a good location, as it is highly visible and also partially fenced in, so such a statue would not impede visitor movement through the room. As demonstrated in Figure 53, this worker statue could be pointing up at the other seven statues, or shouting up at them. This would **draw visitor attention** to the rest of the statues, without the need for Welcome Host interference or text-based signage, while also building on the existing scene.



Figure 53. Potential Location for Extra Statue

5.4 Consolidate and Increase Information About Modern Operation

As shown in our results, a quarter of the visitors we surveyed were unsure about or felt they **did not better understand** how the Bridge works in the modern day. A lot of the information that explains the differences between the old and new control systems can be found on the screen above the Bascule Driving Engine, and on a couple plaques in the West Walkway. These exhibit items are shown in Figure 54. We would suggest moving the information on the plaques to the Engine Rooms near the Bascule Driving Engine so all of the information about the modern operations of the Bridge are in one location. It would also be interesting to expand further on the **modern day operation** and the differences between that and the steam power. Further information could answer questions such as how long it took to change the machinery, how the Bridge operated during the transition, and why they decided to use a lower power hydraulic system, which would open the Bridge slower than the steam engines.



Figure 54. Locations of Information about the Modern Operation of the Bridge

5.5 Station a Welcome Host in the Engine Rooms

While we were surveying visitors in the Engine Rooms, we were frequently asked questions about the bascule driving engine, how the Bridge works today, and other technical questions. While we've already suggested providing some more technical information, especially on how the Bridge works in the modern day, we also recommend having a **Welcome Host positioned somewhere within the Engine Rooms**. There are currently no Welcome Hosts in the Engine Rooms and visitors have nowhere to direct their questions, meaning visitors will leave the exhibition less satisfied or having learned less than if they had their questions answered.

5.6 Shorten Animations in the Engine Rooms

Another improvement of the Engine Rooms would be to change the animations to be shorter. With all of the animations in the same style and appearing similar at a glance, it was observed that visitors tended to watch some of the first animations, but skip later ones, possibly assuming that they were all the same due to a similar styling pictured in Figure Y. The animations also seem to move slowly and have drawn out transitions, which resulted in few visitors watching them all completely through. Having these animations reduced to **only the relevant information** for each step of the bridge lifting process could increase visitor engagement with them, therefore increasing their educational impact.



Figure 55. Segment of Animation Seen in All Animations Through Engine Rooms

5.7 Fill Empty Space in South Tower with Additional Content

Many survey respondents explained that they wished there was **more exhibit content** in some of the spaces, especially within the South Tower. Additionally, many people wished to see more interactive or visual exhibits within the exhibition. As such, we recommend filling empty spaces, especially those nearby the video in South 4 and near the men's washroom in South 2, with more exhibit content. This will make these floors seem less empty and also give visitors more understanding of potentially under-covered topics. A quick example could be introducing some of the old machinery removed from one of the modern Bridge control rooms, and placing it in the corner of South 2 (Figure 56) in the same fashion as it was found. This gives visitors a look into how the Bridge used to operate, fulfills a frequently repeated request to see the Bridge Control Room, and introduces more relevant material to an exhibit. This could even be an interactive exhibit where people could pull levers and turn cranks.

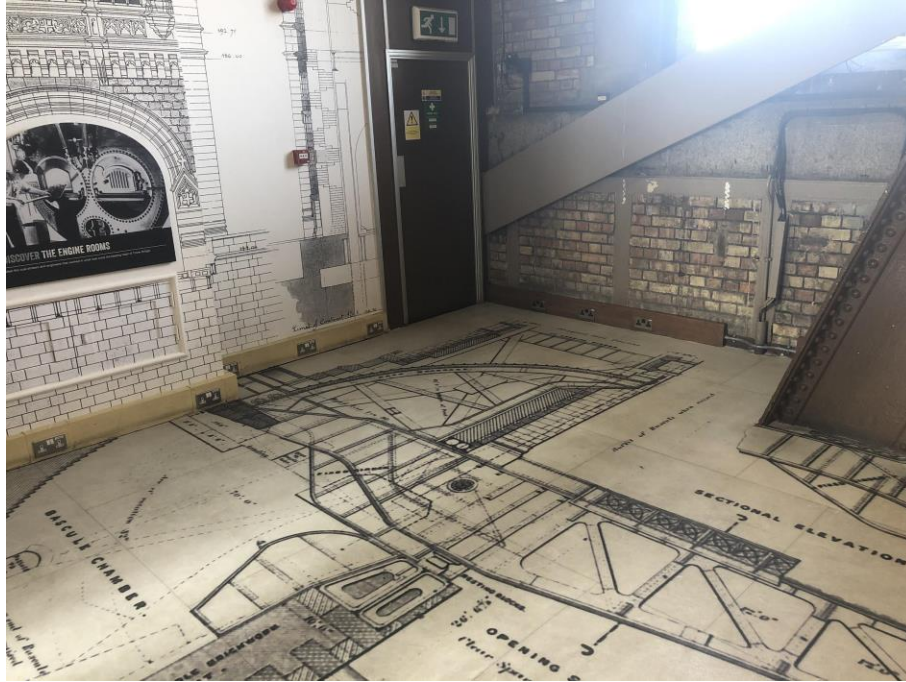


Figure 56. Empty Space in South 2

5.8 Replace South 4 Video

Through the results of our survey, it was revealed that the least popular exhibit was the “Day in the Life of Tower Bridge” film (Figure 57) in South 4, with 27.3% of visitors describing it as an aspect of the exhibition that they considered enjoyable or memorable. One survey respondent explained his dissatisfaction, stating that he “didn’t really care how they stocked the gift shop. [He] wanted to see more about the Bridge’s history.” Another respondent felt that this video looked like “a commercial for Tower Bridge.” An anonymous Welcome Host even approached one of us as we were waiting for a shadowing subject to return from the walkways, stating without solicitation that they preferred the video about the Bridge’s construction that used to be on display in South 4. They went on to say that they felt like the “Day in the Life” film was more of a “corporate advertisement that visitors don’t care about,” than a worthwhile component of the exhibition, and even described it as “the worst change made to the exhibition in at least the past ten years.” With little satisfaction expressed towards this film, an improvement to the exhibition could be to **remove** it and **replace** it with the previous film to provide visitors with more information on the Bridge’s construction or early operation. Alternatively, a new video about how Tower Bridge’s bascules function today could be produced and displayed in this area, as this is something that visitors expressed desire to learn more about.



Figure 57. "A Day in the Life of Tower Bridge" Video

5.9 Introduce Audio Tour for Language Accessibility

We found that many of the people asked for a survey were unable to take one due to a language barrier. It makes sense then, that these same people are largely unable to adequately understand some of the content found in the exhibit due to the same language barrier. A good workaround for this that is far less expensive than creating exhibit signage in several different languages is the introduction of an **audio tour** that can be presented in many languages. This solution has been employed to great success in many other museums around London, and is a logical next step for **accessibility** accommodations at Tower Bridge. More generally, our recommendation is to increase language accessibility for international visitors.

5.10 Add Additional Seating in the C-Yard

A final suggestion to improve the visitor experience is to add **additional seating** to the C-Yard, so that more visitors can sit at once to view the "Voices of Tower Bridge" film. With the film exceeding eight minutes in length and only one bench available for seating, many visitors stood to watch a short portion, but did not complete the film. The current seating setup is pictured in Figure 58. It was observed that visitors who were able to sit often viewed the film for longer, so additional seating could **improve engagement** with this film, especially in instances where multiple parties pass through the area at the same time.



Figure 58. C-Yard Seating Shortage

We hope that our recommendations can be used to make an already world-renowned exhibition one notch better. Since visitors already enjoy Tower Bridge, our recommendations would only improve an **already great experience**. We came to Tower Bridge this Spring to assist Tower Bridge Exhibition managers in determining the effectiveness of the reimagined exhibits in the exhibition. With our results and subsequent recommendations, we hope that our project deliverables can be used to make visitor experience even one bit **better**. We are confident that utilizing at least some of our recommendations would do just that.

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Appendices

Appendix A – The Interactive Qualifying Project

The interactive qualifying project (IQP) is a project that “lies at the intersection of science and society” (WPI, 2019). It is not strictly an academic research project, nor a technical one. The project focuses on real world problems, that will have an impact on people. Solving the problems of an IQP requires research beyond what is taught in any college course. The problems themselves may or may not be technical, but require creative solutions and a solid understanding of the problem. The problem, and the solution affect people whether they are from a sponsoring organization, a small community, or a collection of hundreds of thousands of people. Understanding and interacting with the stakeholders is a critical part of the IQP to help expand student’s problem-solving skills beyond technical aspects, while at the same helping students build respect and empathy for people from different walks of life.

Our project at Tower Bridge was a WPI IQP, and it satisfied the requirements of the IQP. The problem we solved was analyzing visitor satisfaction with the renovations on the North and South Towers and Engine Rooms Exhibits at the Tower Bridge Exhibition in London. We worked with our sponsor Dirk Bennett and the Tower Bridge Exhibition staff, to understand their goals and expectations for us. We also worked extensively with the exhibition visitors. The visitors were people from London and all over the world, of different ages and backgrounds. The interactions with museum visitors was the primary method to understand the problem fully so we could evaluate the exhibits and propose solutions. Our project was not very technical, and quite open ended, so it was necessary for us to research the problem more in depth, and then provide recommendations. Although some courses at WPI may have helped in this research such as one focusing on writing or data visualization, our project required additional research unique to the particular project specifications. Finally, our project at Tower Bridge made a difference in the world by helping a world-famous attraction understand the effect of their exhibits on visitors. As a result of our recommendations, Tower Bridge will be able to provide higher quality content, and a better experience for the hundreds of thousands of visitors every year.

Appendix B – Exit Questionnaire

Introduction

This survey aims to evaluate visitor demographics and feedback on the Tower Bridge Exhibition, particularly the North and South Towers. Your participation is entirely voluntary, and your responses will be kept anonymous and used for statistical purposes only. The results of this survey will be utilized to assess and improve the exhibition.

1: What region are you visiting from?

- United Kingdom
- Continental Europe
- North America
- South America
- Asia & Middle East
- Oceania
- Africa
- Other (Please specify: _____)

2: What country are you visiting from? (Fill in)

3: How would you classify the group you are visiting with?

- Individual visitor
- Family
- Leisure Group
- Educational Group

4: Please indicate how many adults and children are in your group.

- Adults _____
- Children 0-12 _____
- Children 13-18 _____

5: What inspired you to visit Tower Bridge? (Select as many as apply)

- Interest in Engineering
- Interest in London History
- Interest in the Victorian Age
- Wanted to visit a landmark of London
- Education requirement/field trip
- Family trip
- Entertainment
- Other (Please specify: _____)

6: Prior to this visit, had you ever visited the Tower Bridge exhibition?

Yes

No, but I had crossed Tower Bridge itself

No

7: How would you rate your interest in history?

Very disinterested

Slightly disinterested

Neutral

Slightly interested

Very interested

8: How would you rate your interest in engineering?

Very disinterested

Slightly disinterested

Neutral

Slightly interested

Very interested

9: Did you start your visit at the ticket office or engine room?

Ticket Office

Engine Room

Should the participant have started in the ticket office, they would progress to the following questions.

10: Did you take the lift or stairs from the ticket office up North Tower?

Lift

Stairs

11: Was information accessible to you in a language you are fluent in? If not, are there any other languages you would want the exhibits presented in?

Yes

No (Insert languages)

12: Were you satisfied with the difficulty level of the information presented?

Significantly too easy

Slightly too easy

Just right

Slightly too hard

Significantly too hard

13: If you brought children to the exhibit, how interesting did they find the visit?

Very uninteresting

Slightly uninteresting

Neutral

Slightly interesting

Very interesting

No children

14: Do you feel you now better understand ...

a) how the Bridge used to work? yes, no, neutral

b) how it works now? yes, no, neutral

c) who worked here? yes, no, neutral

15: How did the guides in the Towers impact your experience?

Significantly worse

Slightly worse

Neutral

Slightly better

Significantly better

16: How would you rate your overall enjoyment of the Tower Bridge Exhibition?

1 Very unenjoyable

2 Unenjoyable

3 Neutral

4 Enjoyable

5 Very enjoyable

17: Select your favorite parts of your visit (Select up to 5, images were supplied to remind participants of what the elements were)

Diving Displays

London in the 1800s Film

Views of London

Glass Floors

Workers in the Rafters

Tower Stairway Information

Engine Room Process Diagram

Engine Room Machinery

Engine Room Animations and Films

19: Was there anything you found particularly relevant to you, or particularly interesting?
(Open response)

20: Was there anything you had hoped to learn or see at Tower Bridge that was not displayed?

Thank you very much for your time and responses!

Should the visitor have not started at the ticket office and therefore only been to the Engine Rooms, the following questions would be asked.

10: Was information accessible to you in a language you are fluent in? If not, are there any other languages you would want the exhibits presented in?

Yes

No (Insert languages)

11: Were you satisfied with the difficulty level of the information presented?

Significantly too easy

Slightly too easy

Just right

Slightly too hard

Significantly too hard

12: If you brought children to the exhibit, how interesting did they find the visit?

Very uninteresting

Slightly uninteresting

Neutral

Slightly interesting

Very interesting

No children

13: Do you feel you now better understand ...

a) how the Bridge used to work? yes, no, neutral

b) how it works now? yes, no, neutral

c) who worked here? yes, no, neutral

14: How would you rate your overall enjoyment of the Engine Rooms?

1 Very unenjoyable

2 Unenjoyable

3 Neutral

4 Enjoyable

5 Very enjoyable

15: Please select up to 5 of your favorite parts of your visit.

Process Diagram

Machinery

Animations and Films

Hydraulic Pumps

Display Boxes

Accumulators

Boilers

Historic Book

Minecart

16: Was there anything you found particularly relevant to you, or particularly interesting?

(Open Response)

17: Was there anything you had hoped to learn or see at Tower Bridge that was not displayed?

(Open Response)

Thank you very much for your time and responses!

Appendix C – Towers Observation Sheet

The first questions included in every observation sheet were name of observer and room in which the observation was taking place. Additionally, every location had the following standard questions:

Host interaction (select all that apply)

Host directs visitors to interact with certain exhibit elements (depends on which exhibit)

Host narrates film (if applicable for room)

Host directs attention to frequently missed items

Host directs visitors to leave exhibit before visitors intended

Approximate Age:

Child (0-12)

Teen (13-18)

Young Adult (18-30)

Adult (30-65)

Senior (65+)

Other comments by observer (fill in the blank)

Dwell Time (minutes:seconds) rounded to nearest 5 seconds

The following subsections of this appendix included questions specific to that room as well as scales for engagement ratings

North Tower Level 2

Scale for engagement with exhibit items within the exhibit:

- Diving Suit: Found in the back right corner of the exhibit
 - 1. Visitor ignores or misses diving suit;
 - 2. Visitor looks at diving suit for only a few seconds;
 - 3. Visitor spends time engaging with diving suit.
- Display Case: Found next to diving suit in the back right corner of exhibit
 - 1. Visitor ignores or misses display case;
 - 2. Visitor looks briefly at display case contents;
 - 3. Visitor spends time engaging with or reading the contents of the display case.
- Posters: Found along dividing fence in the middle of the exhibit
 - 1. Visitor ignores or misses posters;
 - 2. Visitor looks at posters but not enough to engage material on it;

- 3. Visitor fully engages material on posters.
- Fun Facts: Found on the wall above the elevator to the right side of the exhibit
 - 1. Visitor ignores fun facts on the wall above elevator;
 - 2. Visitor glances at fun facts but without enough time to adequately read them;
 - 3. Visitor fully engage fun facts.

Scale	1	2	3
Diving Suit			
Display Case			
Posters			
Fun Facts			

North Tower Level 4

Scale for engagement with exhibit items within the exhibit:

- London in the 1800s Film: Found in the center of the exhibit
 - 1. Visitor ignores or misses film;
 - 2. Visitor watches brief segment of film;
 - 3. Visitor either sits or stops walking to watch majority or entirety of film
- Architect Pictures: found behind the video screen on the center wall of the exhibit
 - 1. Visitor ignores or misses pictures;
 - 2. Visitor looks at pictures briefly either on own or when prompted;
 - 3. Visitor reads plaques or photographs or spends several seconds time observing architect pictures
- Worker Pictures: Found behind vaulted seating at rear of exhibit on back wall of exhibit
 - Same as architect pictures
- Various Props: Found in front of video screen at center of exhibit
 - 1. Visitor ignores or misses props;
 - 2. Visitor looks at props in passing;
 - 3. Visitor either interacts with, photographs, points out to other group members, or shows emotion regarding props
- Welcome Host:
 - 1. Visitor ignores or does not interact with host;
 - 2. Visitor listens to a portion of the host's discussion, if applicable;
 - 3. Visitor actively engages with the host either through questions or listening to entire narration or discussion, if applicable

Scale	1	2	3
London in the 1800s			
Architect Pictures			
Worker Pictures			
Various Props			
Welcome Host			

Pathway through exhibit upon leaving stairs or elevator:

West walkway first

East walkway first

Remains in North Tower Level 4

South Tower Level 4

Scale for engagement with exhibit items within the exhibit:

- A Day in the Life of Tower Bridge Film: Found on the center wall of the exhibit
 - 1. Visitor ignores or misses film;
 - 2. Visitor glances at or watches a brief portion of film;
 - 3. Visitor either sits or stops moving to watch either large portion or entirety of film
- Workers in the Rafters: Found above the walking space in the exhibit in the ceiling
 - 1. Visitor ignores or misses workers;
 - 2. Visitor glances at workers briefly;
 - 3. Visitor spends time looking at, photographing or pointing out workers to others in their group
- Worker Pictures: Found above stairway at back of exhibit
 - 1. Visitor ignores or misses worker pictures;
 - 2. Visitor glances briefly at pictures;
 - 3. Visitor photographs or spends significant time engaging with pictures
- Welcome Host:
 - 1. Visitor ignores or does not interact with host;
 - 2. Visitor listens to a portion of the host's discussion, if applicable;
 - 3. Actively engages with the host either through questions or listening to entire narration or discussion, if applicable;

Scale	1	2	3

Film			
Workers in Rafters			
Worker Pictures			
Welcome Host			

South Tower Level 2

Scale for engagement with exhibit items within the exhibit:

- Wall Schematics: Found on the walls and floor of the exhibit
 - 1. Visitor ignores or misses wall schematics;
 - 2. Visitor glances at wall schematics for no more than a few seconds;
 - 3. Visitor looks at schematics or schematic information panels for an extended period of time
- Display Cases: Found in the center of the front wall of the exhibit
 - 1. Visitor ignores or misses display case content;
 - 2. Visitor only spends a few seconds glancing at the contents of displays;
 - 3. Visitor studies or reads at least a portion of the display boxes within the case

Appendix D – Engine Rooms Observation Sheet

The first questions included in every observation sheet are name of observer and room in which the observation is taking place. Additionally every location had the following standard questions:

Approximate Age:

Child (0-12)

Teen (13-18)

Young Adult (18-30)

Adult (30-65)

Senior (65+)

Other comments by observer (fill in the blank)

Dwell Time (minutes:seconds) rounded to nearest 5 seconds

The following subsections of this appendix included questions specific to that room as well as scales for engagement ratings

Boiler and Cart Rooms

Scale for engagement with exhibit items within the exhibit:

- Process Display: Found on right side of boiler room exhibit
 - 1. Visitor ignores or misses the display;
 - 2. Visitor glances at display but either does not turn it on, or does not watch more than a small portion of process;
 - 3. Visitor either turns on display or watches entire process animation
- Boilers: Found on left side of boiler room exhibit
 - 1. Visitor ignores or misses the boilers;
 - 2. Visitor glances at boilers in passing
 - 3. Visitor either looks within open boiler or engages with boilers in depth
- Boiler Animation: Found between boilers on the left side of exhibit
 - 1. Visitor ignores or misses the animation
 - 2. Visitor glances briefly at animation but not long enough for full viewing of animation
 - 3. Visitor watches entire animation
- Boiler Room Standing Signs: Found on both left and right sides of boiler room exhibit at exit of room
 - 1. Visitor ignores or misses standing signs
 - 2. Visitor looks at standing signs but not long enough to adequately read information included

- 3. Visitor reads contents on standing signs
- Coal Carts: Found on right side of cart room slightly above eye level
 - 1. Visitor ignores or misses carts
 - 2. Visitor briefly glances at carts when passing through the room
 - 3. Visitor either stops to look at carts or points them out to group members in passing

Scale	1	2	3
Process Display			
Boilers			
Boiler Animation			
Standing Signs			
Coal Carts			

Steam Engines

Scale for engagement with exhibit items within the exhibit:

- Flywheel 1: Found in center of first steam engine room
 - 1. Visitor ignores or does not interact with flywheel
 - 2. Visitor briefly glances at flywheel but does not stop moving to examine
 - 3. Visitor stops moving to engage with flywheel
- Flywheel Animation: Found in front of both flywheels and behind flywheel 1
 - 1. Visitor ignores or misses the animation
 - 2. Visitor glances briefly at animation but not long enough for full duration
 - 3. Visitor watches entire animation
- Standing Sign: Found on wall directly to the left of entrance of first steam engine room
 - 1. Visitor ignores or misses standing signs
 - 2. Visitor looks at standing signs but not long enough to adequately read information included
 - 3. Visitor reads contents on standing signs
- Flywheel 2: Found in center of second steam engine room
 - same engagement scale at flywheel 1
- Historical Book: Found directly to the right of the entrance to second steam engine room
 - 1. Visitor ignores or misses the book
 - 2. Visitor notices book but spends very little time engaging
 - 3. Visitor engages with book for significant time period

- Peripheral Machinery: Found on right side of first steam engine room and along the right wall of the second steam engine room
 - 1. Visitor ignores or misses machinery
 - 2. Visitor glances at machinery but does not engage with it or does not stop moving
 - 3. Visitor either stops to observe machinery or engages with while walking past

Scale	1	2	3
Flywheel 1			
Animation			
Standing Sign			
Flywheel 2			
Historical Book			
Peripheral Machinery			

Hydraulic Pumps

Scale for engagement with exhibit items within the exhibit:

- Hydraulic Pumps: Found in center of both steam Engine Rooms
 - 1. Visitor ignores or misses pumps
 - 2. Visitor glances at pumps but does not stop moving to engage with them
 - 3. Visitor stops to engage fully with pump
- Pump Animation: Found on backside of first pump and on both sides of second pump
 - 1. Visitor ignores or misses animation
 - 2. Visitor glances briefly at animation but not long enough for full duration
 - 3. Visitor watches entire animation
- Standing Sign: Found on wall to the left of the exit of the second steam engine room
 - 1. Visitor ignores or misses standing signs
 - 2. Visitor looks at standing signs but not long enough to adequately read information included
 - 3. Visitor reads contents on standing signs
- Peripheral Machinery: Found along right side of both steam Engine Rooms
 - 1. Visitor ignores or misses machinery
 - 2. Visitor glances at machinery but does not engage with it or does not stop moving
 - 3. Visitor either stops to observe machinery or engages with while walking past

Scale	1	2	3
Pumps			
Animation			
Standing Sign			
Peripheral Machinery			

C-Yard

Scale for engagement with exhibit items within the exhibit:

- Display Boxes: Found along rear wall of the C-Yard room
 - 1. Visitor ignores or misses displays
 - 2. Visitor glances briefly at boxes but not long enough to adequately engage with contents
 - 3. Visitor spends significant time looking at and reading the contents of display
- Character Displays: Found on both left and right sides of the C-Yard room
 - 1. Visitor ignores or misses displays
 - 2. Visitor glances briefly at one or more displays but not long enough to read contents
 - 3. Visitor spends enough time to adequately read one or more of the displays
- Character Video: Found on the front wall of the C-Yard room
 - 1. Visitor ignores or misses video
 - 2. Visitor watches small portion of video or glances at it while walking past
 - 3. Visitor takes time to watch most or all of the video or stops moving to watch

Scale	1	2	3
Display Boxes			
Character Images			
Character Video			

Bascule Driving Engines

Scale for engagement with exhibit items within the exhibit:

- Accumulators: Found in adjoining room on left side of driving engine room

- 1. Visitor ignores or misses accumulator room
- 2. Visitor glances briefly up room while walking past
- 3. Visitor stops and steps into the room to look up at accumulators
- Bascule Operation Game: Found on the right side of driving engine room
 - 1. Visitor ignores or misses game
 - 2. Visitor briefly interacts with game
 - 3. Visitor attempts to complete entire 2 minute game
- Fun Facts and Images: Found around the games on the right side of the exhibit
 - 1. Visitor ignores or misses images and facts
 - 2. Visitor glances at images and facts but not long enough to properly read data
 - 3. Visitor takes enough time to read at least some of the material presented
- Drive Engine: Found at the rear of the exhibit in the space past the exit of the exhibit
 - 1. Visitor ignores or misses engine
 - 2. Visitor glances at engine either while watching video, sitting, or leaving the exhibit
 - 3. Visitor stops to examine engine for extended period of time
- Drive Engine Animation: Found on the wall next to accumulators and in front of drive engine
 - 1. Visitor ignores or misses animation
 - 2. Visitor glances briefly at animation but not long enough for full duration
 - 3. Visitor watches entire animation
- Video: Found on a monitor above the drive engine
 - 1. Visitor ignores or misses video
 - 2. Visitor watches small portion of video or glances at it while walking past
 - 3. Visitor takes time to watch most or all of the video or stops moving to watch

Scale	1	2	3
Accumulators			
Bascule Game			
Fun Facts			
Drive Engine			
Animation			
Video			

Appendix E – Dwell Time Determination

Location	Dwell Time Determination
North Tower Level Two	Start when visitors cross from the stairs to the room, stop when visitors enter the staircase to the next level
North Tower Level Four	Start when visitors return from the West Walkway, stop when visitors enter the East Walkway
South Tower Level Four	Start when visitors enter from the East Walkway, stop when visitors progress down the staircase to South Tower Level Two. However, if a visitor is walking down the stairs and still watching the video, stop when they are done engaging with the exhibit
South Tower Level Two	Start when visitors reach the landing of the stairs before the exhibit, stop when visitors stop engaging with the exhibit. This can be when they physically leave, or when they are waiting for the lift and no longer examining anything.
Boiler Rooms and Minecart Room	Start when visitors enter the boiler room, stop when visitors enter the first steam engine room or when they go to the bathroom or if they sit on the bench outside the bathroom and stop engaging with the exhibit.
Flywheel Rooms	Start when visitors enter the first steam engine room, stop when visitors exit the second steam engine room.
Hydraulic Pump	Start when visitors begin engaging with either the pump side of the second steam engine, the pump animation, or when they exit the second steam engine room. Stop when they exit the first engine room.
C-Yard C-Yard (continued)	Start when visitors enter the C-Yard, stop when visitors both cross out of the C-Yard (denoted by change in flooring) and stop engaging with the film.

Bascules Driving Engine Room	Start when someone crosses from the C-Yard into the Driving Engine Room and/or begins engaging with elements closer to the boundary between the C-Yard and Driving Engine Room. Stop when visitor exits exhibition.
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Appendix F – Shadowing Sheet

This document was utilized to analyze a single visitor’s engagement through the entire exhibition. Every exhibit element contained here contains the same parameters as that stated in Appendices C and D. The sheet was filled in utilizing Google Forms.

North Stairs to North 2

Dwell Time: _____

North 2

Exhibit	1	2	3
Diving Suit			
Diving Display			
Posters			
Fun Facts			

Dwell Time: _____

North Stairs to North 4

Dwell Time: _____

West Walkway

This section was not part of our study, and as such, we only factored in dwell time within this region as a parameter of study.

Dwell Time: _____

North 4

Exhibit	1	2	3
Film			
Architect Pictures			

Worker Pictures			
Various Props			
Welcome Host			

Dwell Time: _____

East Walkway

As with the West Walkway, only dwell time was considered

Dwell Time: _____

South 4

Exhibit	1	2	3
Film			
Workers in Rafters			
Worker Pictures			
Welcome Host			

Dwell Time: _____

South Stairs to South 2

Dwell Time: _____

South 2

Exhibit	1	2	3
Wall Schematics			

Display Case			
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Dwell Time: _____

Walk to Engine Rooms

Dwell Time: _____

Boilers and Cart Rooms

Exhibit	1	2	3
Process Display			
Boilers			
Animation			
Standing Signs			
Coal Cart			

Dwell Time: _____

Steam Engines

Exhibit	1	2	3
Flywheel 1			
Animation			
Standing Sign			
Flywheel 2			
Historical Book			
Peripheral Machinery			

Dwell Time: _____

Hydraulic pumps

Exhibit	1	2	3
Hydraulic Pumps			
Animation			
Standing Sign			
Peripheral Machinery			

Dwell Time: _____

C-Yard

Exhibit	1	2	3
Display Boxes			
Character Signs			
Video			

Dwell Time: _____

Bascule Driving Engine

Exhibit	1	2	3
Accumulators			
Game			
Fun Facts			
Drive Engine			
Animation			
Video			

Dwell Time: _____

Overall Information

Total Dwell Time: _____

Comments: _____

Did the visitor take the survey (Y/N)

Survey Number: ____