**ENGM263 Infrastructure Financing**
**Semester 1 (2020-21) Coursework**

**Student: Giacomo Butte 6615491**

## *Background information and assumptions.*

### Context

Hammersmith Bridge is a suspension bridge in London connecting the southern part of Hammersmith (Borough of Hammersmith and Fulham) and Barnes (Borough of Richmond upon Thames). Built in 1884, it is a Grade II listed since 2008. In the past decades the bridge had structural issues in several occasions (1973, 1984,1997) reaching a full closure in August 2019. Up to this moment, the bridge was used by 22,000 vehicles, 24,000 bus passengers and 16,000 pedestrians and cyclists each day travelling in both directions. This created problems to the surrounding residents in particular pedestrian and cyclists that need a long detour to get to their destinations. It is clear that the current situation cannot be considered as acceptable. (London Borough of Richmond Upon Thames, 2019). Citizens have started a petition to bring the matter to parliamentary debate (UK Government, 2020a).

The issues received a lot of attention in national and international media. A task force was established to address the issue with representatives from: TfL, London Borough of Hammersmith and Fulham, London Borough of Richmond upon Thames, Network Rail, the Greater London Authority and the Port of London Authority (UK Government, 2020b).

### The financial climate.

In the last years UK financial and political condition have been impacted by Brexit and in 2020 by the world pandemic caused by COVID.

The impact of Brexit represents a big uncertainty in the coming years. Its magnitude will depend on the type of deal reached at the end of negotiation. Some of the probable outcome may include: a reduction in GDP growth (up to 8% in a no-deal case (Bryant, 2017)), a depreciation of the Sterling Pound (as seen after the referendum) and a shrinkage of the UK financial sector due to relocation to the EU of some firms (Bisciari, 2019). In relation to this project, the main outcomes of interest are probable increase of import costs, a slower growth for the London area and perhaps a more conservative approach to long term investment due to the uncertainties generated by Brexit. Interest loan should remain low and peraphs even decrease as a consequence of the low interest rate by the Bank of England (0.1% end of 2020)[1]

The COVID pandemic is another significant area of uncertainty that has a decisive impact on local mobility. Up to November 2020, UK has experienced two waves of infection. Mitigation measures included the restriction or limitation of movement. The reduction of movement had an impact on Transport For London revenues to the point that government intervention with a £1.8bn was agreed (Transport for London, 2020). Current estimates predict the passenger demand for public transport to be at 65% of pre-pandemic period. It is very likely that at least for the coming 12 months disruption will still be present.

### London Transport

In the coming years transport in London will change. The vision for the city is to move to a multi-modal, more environmentally sustainable network (Greater London Authority, 2018). An increase in public transport and cycling is expected with a decrease in car transport. Bus demand expected to grow 30% by 2041 (TfL, 2017). The long-term solution for the bridge should align with this vision.

### Project aim

The solutions aimed at mitigating the disruption caused by the bridge closure are to be implemented on two timeframe. This approach is preferred in order to provide a quick solution while the bridge is refurbished/replaced. A short term solution (< 6 months) is required to offer the possibility of crossing to pedestrian, students, (some) cyclists and particularly tageting the most vulnerables. Cars and busses are excluded for this timeframe. The long term solution (1.5 years on) should provide at least the same level of service of the bridge before closure and possibly account for future changes in type and magnitude of traffic.

To evaluate the proposal a set of Key Performance Indicators (KPI) were identified as follows:

KPI 1: a short term solution is found to allow most vulnerables and in need (elderly, students, pedestrian, some cyclists) to cross the bridge.
KPI 2: short term solution can be dismantled when no more needed leaving minimal traces on the site
KPI 3: a long-term solution to allow the crossing of the river for a number of people and vehicles at least of the same magnitude of those prior of closure.
KPI 4: the historical dimension of Hammersmith bridge is partially or totally preserved.

### Assumptions used in the analysis

Economic assumptions: inflation was assumed, following Government intentions, at 2%. Debt was assumed in pounds and therefore no risk from currency exchange was considered. Future GDP changes was not assumed to create a significant impact on costs and traffic.

1 https://www.bankofengland.co.uk/monetary-policy/the-interest-rate-bank-rate

London transport: the analysis used projection on traffic published by TfL (2017). No major legislative changes were assumed. Different probable scenarios were explored in the Sensitivity Analysis.

***Q1: Consider whether there are other realistic technical solutions both for the stopgap and the longer-term investment, and if so, provide order of magnitude estimates for life cycle costs.***

## Long list appraisal

Given the diversity of needs, budget, time frame, management structure, the short term and long term solutions could be implemented as two separate projects.

Solutions for the two time frames are shown in Table 1. Considered options for the short term solution included: a boat service for pedestrian and cyclists (S1), a ferry for pedestrian, cyclists and cars (S2) and a temporary bridge for pedestrian and cyclists (S3), a double decker temporary bridge to be installed on the existing bridge (S4) and a do-nothing option (S5). For long term options a new bridge (L1), refurbishment of the old bridge for pedestrian and cyclists only (L2) and full refurbishment of the old bridge (L3). The long-term stabilisation of the existing bridge for option S4 was considered to be similar to L3.

The desired outcomes of the project were transformed into Critical Success Factors (CSF). In a very short term (< 6 months) it was considered important to provide the possibility of crossing for the most vulnerable such as elderly and students (CSF 01). The coverage of the Hammersmith Bridge carrying capacity was assessed with CSF 02. Value for money (CSF 03) was assessed using a Value of Travel Time Savings (VTTS) see Appendix A. Supplier (public, private, PPP) capacity of delivering the project was evaluated with CSF 04 . The ease of gathering financial resources for the project was evaluated with CSF 05 .The possibility for over-budget and delayed construction was assessed with CSF 06. Given the historical value of the bridge, a specific indicator was included (CSF 07).

Options were evaluated against CSFs (Table 2). For the short-term, options the chosen one were the boat for pedestrian and cyclists (S1) and the temporary bridge for pedestrian and cyclists (S3). Options S4 could be a valid competitor but uncertainties on delivery time and cost ruled this option out. For the long-term refurbishment for all vehicle transit of the old bridge (L3) and construction of a new bridge with the incorporation of some elements of the old one (L1).

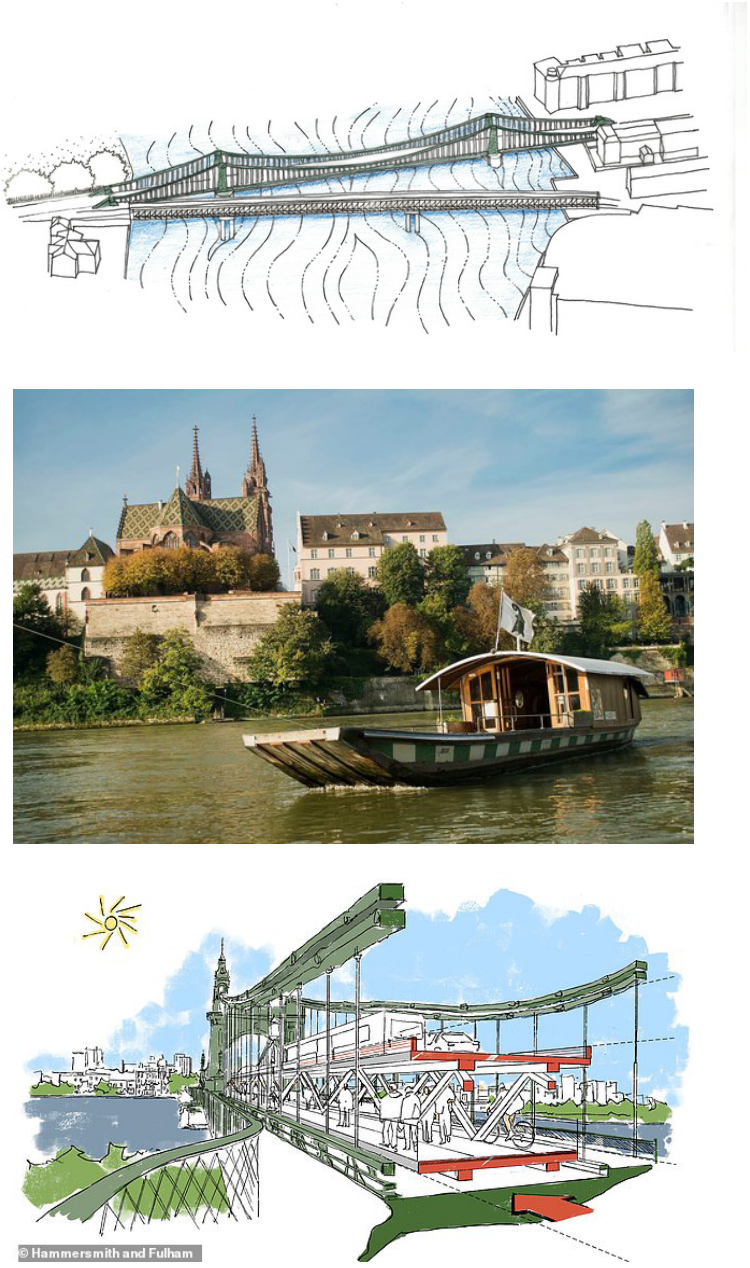


**Figure 1:different options proposed for temporary and long term solution.** Top: temporary pedestrian and cyclist bridge (option S3). Centre: a ferry for pedestrian and cyclist (option S1). Bottom: a double decker bridge on the existing structure (option S4).

**Table 1: long list of considered options for short and long term solution.**

| | Scope | Solution | Delivery | Implementation | Funding | Reference |
|---|---|---|---|---|---|---|
| | Users that will be able to cross the river | How the scope will be achieved | Organization consider for project delivery | | LCCA Estimated cost* | |
| Short-term solution | | | | | | |
| S1: ferry for pedestrian and cyclists | Pedestrians, cyclists. | Light ferry (10-15 people capacity) for pedestrian and cyclists. Demountable piers will need to be built | TfL and subcontractor | Implemented in one step, by early 2021. | £ 1-2M | Boat in Basel[1] |
| S2: ferry for cars | Pedestrian, cyclists, cars | Ferry that would allow for car transport | Direct public sector provision / Private sector provider | Implemented in one step, approx. 6-9 months. | £ 9-12M | Ferry at Cowes[2] |
| S3:temporary bridge for pedestrians and cyclists | Pedestrians, cyclists | Build a temporary floating bridge | Bidding for DBOD (design Build Operate Dismiss) | Implemented in one step 12 months. | £ 11-13M | Temporary bridge proposal[3] |
| S4: double decker on existhing bridge | Pedestrian, cyclist, vehicles (some?) | A double decked structure placed on the eixisting bridge to provide access while bridge is under stabilisation (see L3) | Bidding for DBOD (design Build Operate Dismiss) | Set up (6-12 months?) dismissal before origical bridge reopening | £15-25M | Foster + Partners and COWI proposal (Figure 1) |
| S5 : do nothing | none | - | - | - | - | |
| Long-term | | | | | | |
| L1 - new bridge | Pedestrian, cyclists, cars, busses. | Construction of a new bridge | PPP TfL with private investors | ~4.5 years | £ 100-120M | |
| L2 -"Light Refurbishment old bridge" | | Refurbishment of old bridge for pedestrians, cyclists. | Private provider | ~3 years | £ 90-110M | |
| L3 - Refurbishment old bridge for all uses | Pedestrain, cyclists, cars, busses. | Full refurbishment of existing bridge. | PPP, TfL, UK Gov, Private investors | ~5-6 years | £140-160M | |

* : LCCA includes planning, construction, operation only.

**Table 2: identification of most favourable option according to Key Critical Success Factors.**
**Legend: Green = preferred option, Amber = carry forward, Red = fails to meet CSF.**

| Critical Success Factors (CSF) | S1 | S2 | S3 | S4 | S5 | L1 | L2 | L3 |
|---|---|---|---|---|---|---|---|---|
| CSF 01 How well can the proposal provide short term (<6 months) mitigation for most vulnerables? | | | | | | n.a. | n.a. | n.a. |
| CSF 02 Capacity of crossing provided by the proposal. | | | | | | | | |
| CSF 03 Potential value for money | | | | | | | | |
| CSF 04 Supplier capacity and capability of carrying the project on time and budget | | | | | | | | |
| CSF 05 Potential affordability: how well can the option be financed | | | | | | | | |
| CSF 06 Potential achievability: how well is the option be likely to be delivered on cost and time. | | | | | | | | |
| CSF 07 Historical preservation | n.a. | n.a. | n.a. | n.a. | n.a | | | |
| Short-listed | yes | no | yes | no | no | yes | no | yes |

1 https://www.basel.com/en/Media/Attractions/Sightseeing/Ferries
2 https://www.countypress.co.uk/news/17205503.costs-floating-bridge-far-revealed/
3 https://tfl.gov.uk/travel-information/improvements-and-projects/hammersmith-bridge

***Q2: Prepare summary estimates of the Life Cycle Costs for the preferred stopgap and long-term solution for the Bridge, identify and determine the benefits and derive a Benefit-Cost Analysis.***

Short-listed options were further assessed against social, environmental and economic parameters. A Value of Travel Time Savings (VTTS) and a Willingness To Pay (WTP) for historical preservation were carried. Details in the Appendixes 1 and 2.

## Short-term option

The preferred options were assessed using a Social Cost Benefit Analysis (CBA) as shown in Table 3. Option S1 was taken as baseline and had lower performance on environmental aspects during operation, accessibility and safety. Higher performace was identified in minimal impact on landscape and historic environment, green house gas emission on life cycle.
A Cost-benefit Analysis was carried between the two options. The Net Present Social Value was calculated as sum of VTTS with Benefits from historical preservation and discounted at 8% per quarter given the urgency of the problem. Detailed calculations are shown in the Appendix and a visual summary in Figure 1. The analysis was limited to 2.5 years, the time-frame that should allow for the stabilization of Hammersmithe bridge for pedestrian and cyclist use.

**Table 3: social and environmental assessment for the two short-term preferred options. The colour highlights the better option.**

| Impacts | S1 (baseline) | S3 |
|---|---|---|
| Noise | some produced by engine | none |
| Air Quality | some emissions produced | none |
| Greenhouse gases | During operation, boat will produce some emission. Over the life cycle less emission than S3 | Life cycles emission were not quantified but the bridge is assumed to produce much more |
| Landscape | minimal impact | presence of the temporary bridge will have an impact |
| Townscape | minimal impact | presence of the temporary bridge will have an impact |
| Historic Environment | minimal impact | presence of the temporary bridge will have an impact |
| Biodiversity and water environment | disturbance from boat engine on an already stressed environment | construction will produce disturbance, once built minimal |
| Impact on commuting | Positive impact limited by boat capacity. | Solution able to provide service to all cyclists and pedestrians |
| COVID related concerns | proximity of travellers may be an hazard | negligible |
| Journey quality | waiting time and travelling on boat may impact the quality | good |
| Accidents | Safety is a concern. | Less likely |
| Access to services | with proper design access could be universal | no restriction |
| Affordability | fee | free for the final user |
| Cost to Broad Transport Budget | 0 | Yes, covered by TfL |
| Indirect Tax Revenues | Taxation may be present on the ticket (Revenue in the range or 40-60k £/yr) | no |

The coverage of the expected demand was also analysed (Figure 2). Proposal S1 could offer for the whole time-frame a partial coverage. S3 that offers no coverage for the first year and full coverage from 2022. S1 could be preferable since the continuous and partial coverage could target most vulnerable and in need such elderly, students.

Option S1 was preferred at the condition that security measures would need to be implemented by the operator. Due to the proximity of passengers, concerns related to

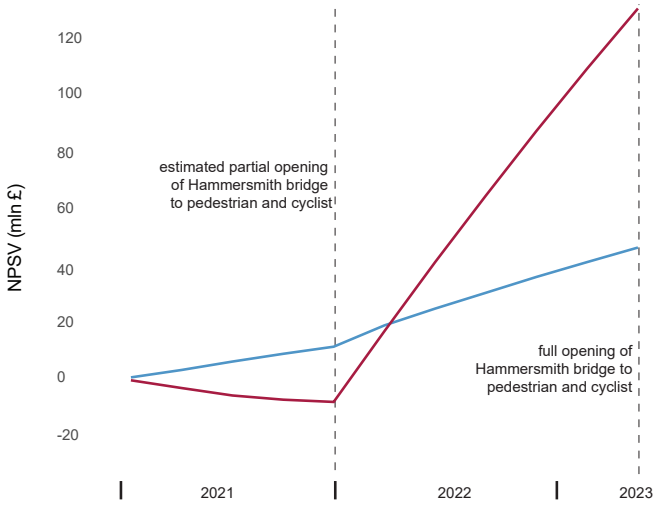


**Figure 2: comparison of estimated Net Present Social Value (NPSV) for the two preferred short-term options: S1- ferry boat and S3-temporary pedestrian and cyclist bridge.**

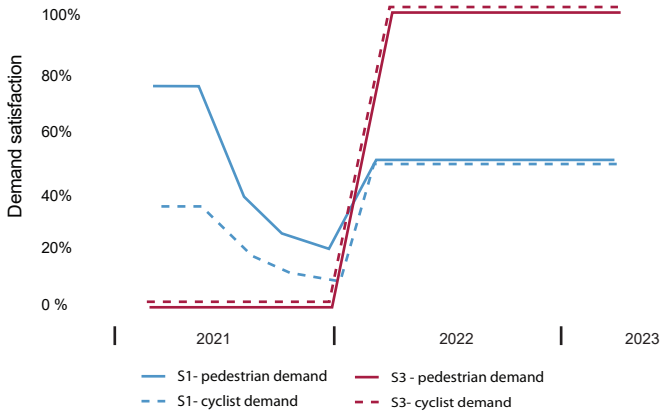


**Figure 3: comparison of coverage for estimated demand between the two short term options.** From Q1 of 2022 the partial opening of Hammersmith bridge is assumed.

COVID were taken into account but considered negligible with appropriate health and hygiene measures. This would include mandatory use of a mask and disinfection of hand-reachable surface at regular intervals.

Short-term options were not considered feasible for a PPP structure given their limited cost and time frame. Private providers and/or Transport For London (TfL) could be the most appropriate actors for implementation of the project.

A Business Case Summary was prepared in Table 4 highlighting the key information about the preferred option, alignment with the overall London Transport Strategy and indication of possible risks.

**Conclusion - short term option.**

The Social Cost Benefit Analysis showed that over a period of 2.5 years the construction of a temporary bridge would be more beneficial. Since during construction no mitigation would be offered a ferry boat is preferred.

This solution is not able to fully meet the demand but could at least cover the most needed.

**Table 5: short-term option business case summary**

| | |
|---|---|
| Project name | Boat crossing service |
| Contribution to London Transport Strategy | The proposal aims at temporarily mitigating the negative effects on urban circulation caused by the closure of Hammersmith Bridge. The proposed solution will provide within the next 4 months the possibility of crossing to the most vulnerable and in need sector of population. Due to its location, the solution is expected to proving significant time saving for pedestrians (45min) and cyclist (25 min). |
| Delivery | The proposed project organization include:<br>- the public sector (City of London, TfL, Government) in charge of setting up the piers and facilitating the acquisition of necessary legal permissions<br>- a private provider for the running and maintenance of the service<br>- a crossing fee for the passenger<br>- subsidies for vulnerable population may be included in the form of partial reinbursement for the crossing fee |
| Options considered | Other options considered included :<br>1. the construction of a temporary pedestrian and cyclist bridge<br>2. the institution of a ferry boat for pedestrians, cyclist, cars. |
| Benefits | 1. Provide river crossing in a short time-frame.<br>2. Address most vulnerable by not leaving them without crossing alternatives for the first year.<br>3. Estimated capacity during operation (12 months) ~400k pedestrian, 130k cyclists.<br>4. VTTS was estimated at £430k per month |
| Time scale | Until the first stabilization of the bridge is competed (12 months expected) that will allow for limited transit of the bridge. |
| Costs | Overall costs estimated between £4-6 ml. Public sector will provide the pier set-up while private sector will provide boat, operation and management. |
| Risk | A large part of the benefits for this solution are linked to the speed of setting up the boat service. Risks in this regard are linked with the pier construction and the acquisition of legal permission. Contract agreement with a private service provider could also create delays.<br><br>The feasibility of this option is also subjected to the implementation of security measures for the passengers. This would include standard river cruising measures but also COVID-related hygiene practices. Social distancing during operation is less of a concern due to the nature of the environment ( outdoor, well ventilated). |

## Long-term option

The initial screening done with CPIs ruled out option L2 (refurbishment only for pedestrian and cyclist). This decision was taken on the basis that vehicular transport, in particular public transport, covers the biggest share of traffic for the bridge. Therefore only option L1 and L3 were kept for further analysis.

The two short-listed options were assessed on social and environmental criteria (Tale 5). Performances were very alike on most criteria with the exception of Green House Gases emissions, impact on biodiversity and impact on historical environment and townscape.

A first important factor to valuate was the historical importance of the bridge. One proposal address this issue with a partial or full refurbishment (L3) while one (L1) does not. To be able to compare between the two a Willingness To Pay for the renovation of historical assets Provins et al., 2008) was quantified. Considering only nearby residents belonging to the two Boroughs, the WTP amounted at £4.3 mln per year. After 30 years the cumulative WTP is estimated at £130 mln. These value suggest that the additional costs for maintaining the old bridge are within an acceptable value. See Appendix for detail.

**Table 5: social and environmental assessment for the two long-term preferred options. Colour highlights the better option.**

| Impacts | L3 - refurbishment of old bridge | L1- new bridge |
|---|---|---|
| Noise | In both options, construction will produce noise. Usage would produce noise. | |
| Air Quality | Traffic will deteriorate air quality, not significant differences between options. | |
| Greenhouse gases | It was assumed that activities linked to refurbishment work would produce less emissions. | Life cycles emission were not quantified but the new bridge is assumed to produce more |
| Townscape | The current landscape would be preserved. | The loss/change of the iconic bridge will be the main impact. |
| Historic Environment | This option would preserve the historical value of the bridge. | In the case of a new bridge with elements of the old one, the impact will be mitigated but still present. |
| Biodiversity and water environment | Refurbishment will produce some disturbance. | Greater disturbance than L3 due to construction |
| Impact on commuting | Both solutions will allow for all types of vehicles. | |
| Accidents | No differences between two options. | |
| Access to services | with proper design access could be universal | No restriction |
| Affordability | Both options will include a fee either paid directly by commuters or by TfL | |
| Cost to Broad Transport Budget | Not possible to evaluate at this stage without a detailed financing structure in place. | |
| Indirect Tax Revenues | Not possible to evaluate at this stage without a detailed financing structure in place. | |

A second factor taken into consideration, was the Value of Travel Time Savings (VTTS). An estimation of time saving and economic benefit was carried for the different type of users (pedestrian, cyclists, car drivers and passengers, bus passengers). Future traffic projection were based on recent published documents on the Mayor's Transport Strategy (Greater London Authority, 2018; TfL, 2017).

Net Present Social Value (NPSV) was calculated for both L1 and L3 (Figure 2). The calculation included construction costs, operation and management, VTTS and WTP for restoring the bridge. Values were discounted at 3.5% p.a. The result of the analysis are shown in Figure 4. The two option have a marginal difference (6%) on the cumulative NPSV over a 27-year period in favour of the new bridge. This difference is most likely to be absorbed by the uncertainty of the estimates. The two options are therefore considered without significant difference.

A Business Case Summary was prepared in Table 6 highlighting the key information about the preferred option, alignment with the overall London Transport Strategy and indication of possible risks.

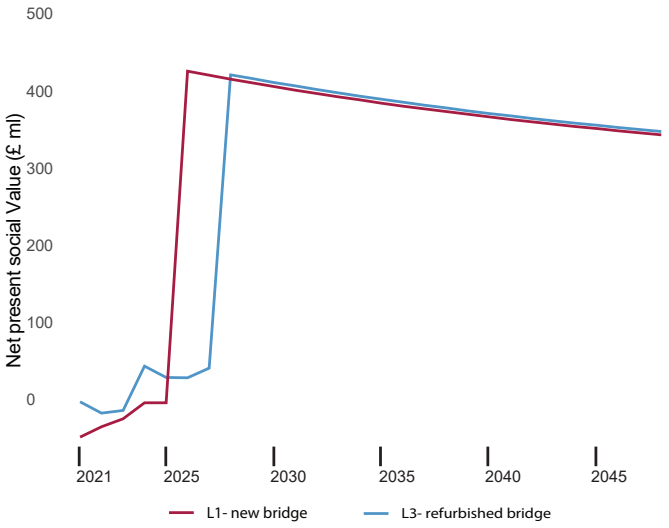


**Figure 4: Net Present Social Value of two options for long term solution.** The calculation includes construction and O&M costs, VTTS and WTP for historical benefit. Details of calculation in the Appendix.

**Conclusion - long term option.**
The construciton of a new bridge (L1) and refurbishment of the old one (L3) were compared using cost-benefit analysis over a period of 27 years. In terms of cost, option L3 would likely cost £40-60 mln more. Since the benefit are much larger, at the end of the considered period, no significant difference was found between the two options. Option L3 is therefore chosen as preferred one

| **Table 6: long-term option business case summary** | |
|---|---|
| Project name | Refurbishment of Hammersmith bridge. |
| Contribution to London Transport Strategy | The proposal aims at mitigating the negative effects on urban circulation caused by the closure of Hammersmith Bridge over the coming decades. The proposed solution will stabilise and reinforce the existing bridge for all purpose use to a capacity at least matching the one prior to closure. |
| Delivery | The proposed project structure is a PPP with the private sector taking design operation and management of the bridge for a defined period of time.<br>TfL (if needed with support from Government) will pay a yearly fee for the crossing of the bridge.<br>The London Borough of Fulham and Hammersmith will cover the operation costs. |
| Options considered | Other options considered included :<br>1. the construction of a new bridge.<br>2. the refurbishment of Hammersmith bridge only for pedestrian and cyclists.<br><br>This option was preferred since long term benefits were comparable with a new bridge with the advantage of maintaining the historical bridge. |
| Benefits | 1. Provide river crossing for pedestrian, cyclists, cars, buses.<br>2. Preserve the Grade II listed Hammersmith Bridge.<br>3. Estimated yearly capacity at full operation: 3.3ml pedestrian, 1.9ml cyclists, 7.2 ml cars, 7.9ml buses.<br>4. VTTS was estimated at 54k hours saved per day equivalent to £30ml per month. |
| Time scale | Partial opening for pedestrian and cyclists after emergency stabilisation: 12 months.<br>Full opening to pedestrian and cyclists after full stabilisation : 21 months.<br>Full opening to full traffic: 30 months. |
| Costs | Design and construction costs: £150-170 ml<br>Operation over 27 years: £ 25-35 ml |
| Risks | Construction costs are the most uncertain. The existing structure has been assessed but new issues may arise during the process. Stabilisation cost estimates may need to be revised.<br><br>Traffic prediction have a solid base given by the data collected prior to bridge closure. Estimates exists for London future traffic and have been included in the analysis.<br><br>An agreement on the financing, length and terms of the PP contract may cause delay to the project.<br><br>Construction cost and the financial climate may be negatively impacted by BREXIT and the post-COVID period.<br><br>Stabilisation work may be delayed by future lockdown due to COVID. |

***Q3: Prepare a Life-Cycle cash Flow Analysis for an Ownership variant that is based either entirely or substantially on a financing undertaken by the private sector, whether for the stop-gap or the long term solution, (or both, whether collectively or separately), identifying a realistic revenue regime and possible sources and costs of financing.***

## PPP structure

The proposed PPP structure is a Design-Rehabilitate- Finance- Operate -Maintain (DRFOM) with a duration of 30 years (Figure 5). The Public Party will pay an annual fee once the bridge is in full operation untill the end of the agreemetn.

The Private Party will therefore provide:
- Design for the bridge stabilisation for a three stage implementation: emergency stabilisation, stabilisation for pedestrian and cyclists and full stabilisation .
- Implementation of the required construction work in respect of current safety and environmental regulation.
- Acquisition of the necessary financial resources to cover for the costs up to bridge full re-opening.
- Operation and maintenance till the end of the agreement under supervision of TfL and LBHF.

The Public Party will:
- facilitate legal permit acquisition and compliance with environmental and safety regulation.
- guarantee a yearly fee (shadow toll) for the usage of the[5] bridge from the year of its full opening. The fee will be paid by TfL using a Government grant [1]. This is not a debt guarantee as previously done with Metronet.
- monitor on the performance of the Private Party

The LBHF will contribute to the operation and maintenance costs. Monitoring could be done using external engineering services to regularly check the quality of the maintenance work.
The participation of LBHF as a shareholder was considered since this could bring advantages in terms of transparency and control. The option was not considered feasible since the involvment of a public party in the the shareholder could discourage private investors. Additionally, risk would be retained by the Borough.
A support from the LB of Richmond (LBR) could be requested an the basis that LBR may be the in equal or superior need for the bridge rehabilitation. In terms of contribution, in the model a £1M per year + inflation adjustment was assumed. As a reference, the Council is currently spending £2.7 million a year for repairs[2].

The proposed solution would have the following impact on public sector budget: Central Government will not provide financial resources directly to the project but with grants in support of TfL. The LBHF will cover O&M costs.

The Life-Cycle Cash Analysis is shown in Table 8.
A summary of key indicators is presented in Table 7.

**Table 7: PPP Summary of key indicators**

| | |
|---|---|
| Public expenditure (NPV) | £254 M |
| Payback period* | 19 years |
| Equity / Debt | 17% / 83% |
| Loan | 20 years (5 years draw down) |
| IRR on equity | 14% |
| Project Rate of Return | 7% |
| Interest Cover Ratio (min) | 4.3 |
| ADSCR (min) | 1.12 |
| LLCR (min) | 1.8 |

* as Revenue - running costs = Construction and design costs

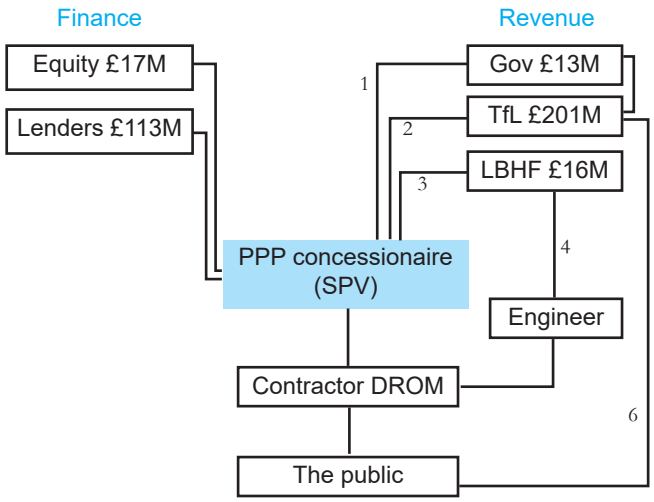


**Figure 5: diagram showing the PPP structure.**
1 Government contribution of ~10% of capital costs.
2 TfL will pay a shadow toll
3 LBHF will contribute to the toll. Its contribution is measured on maintenance costs.
4 LBHF will hire an external engineer for regular checks on the O&M of the bridge
5 Given TfL financial situation, an important contribution will be made by the Government. It should also be noted that TfL constribution will not start before the work completion.
6 The public will be paying for TfL network usage. No direct toll is proposed for the bridge.

1 This approach already in use in 2020 with the Government £ 900 M bailout given to TfL that will be partially used for emergency stabilisation to Hammersmith bridge and establishment of a ferry service (UK Government, 2020a).
2 https://www.lbhf.gov.uk/transport-and-roads/hammersmith-bridge-all-you-need-know-and-latest-updates

**Table 8: Life-cycle Cash Flow Analysis for the proposed PPP**

| Timeframe | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Stabilization for pedestrian and cyclist | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Full stabilization | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Operation | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | **Total** | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **13** | **14** | **15** | **16** | **17** | **18** | **19** | **20** | **21** | **22** | **23** | **24** | **25** | **26** | **27** | **28** | **29** | **30** |
| **Revenue** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Government | | 13.602 | | 13.6 | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| TfL | | 364 | | | | | | | | 10.1 | 10.5 | 10.8 | 11.2 | 11.5 | 11.9 | 12.3 | 12.7 | 13.2 | 13.6 | 14.1 | 14.5 | 15.0 | 15.5 | 16.1 | 16.6 | 17.2 | 17.7 | 18.3 | 18.9 | 19.6 | 20.2 | 20.9 | 21.6 |
| Boroughs | | 30 | | | | | | | | 1.0 | 1.0 | 1.0 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.2 | 1.2 | 1.2 | 1.2 | 1.3 | 1.3 | 1.3 | 1.3 | 1.4 | 1.4 | 1.4 | 1.5 | 1.5 | 1.5 | 1.5 | 1.6 |
| Total Revenue (a+b+c) | | 408 | | 13.6 | | | | | | 11.1 | 11.5 | 11.8 | 12.2 | 12.6 | 13.0 | 13.5 | 13.9 | 14.3 | 14.8 | 15.3 | 15.8 | 16.3 | 16.8 | 17.4 | 17.9 | 18.5 | 19.1 | 19.8 | 20.4 | 21.1 | 21.7 | 22.5 | 23.2 |
| **Costs** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Consultancy, development | | -14 | -6.0 | -6.0 | -2.0 | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Construction costs* | | -136 | 0 | -14 | -17 | -17 | -32 | -33 | -23 | | | | | | | | | | | | | | | | | | | | | | | | |
| O&M* | | -30.4 | | | | | | | | -1.0 | -1.0 | -1.0 | -1.1 | -1.1 | -1.1 | -1.1 | -1.1 | -1.2 | -1.2 | -1.2 | -1.2 | -1.3 | -1.3 | -1.3 | -1.3 | -1.4 | -1.4 | -1.4 | -1.5 | -1.5 | -1.5 | -1.5 | -1.6 |
| **Operating Cash flow** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Operating cash flow (d+f+g+h) | | 227.8 | -6.0 | -6.7 | -18.6 | -17.0 | -32.5 | -33.1 | -22.5 | 10.1 | 10.5 | 10.8 | 11.2 | 11.5 | 11.9 | 12.3 | 12.7 | 13.2 | 13.6 | 14.1 | 14.5 | 15.0 | 15.5 | 16.1 | 16.6 | 17.2 | 17.7 | 18.3 | 18.9 | 19.6 | 20.2 | 20.9 | 21.6 |
| Post Tax Op. Cash Flow | | 364.2 | | | | | | | | 10.1 | 10.5 | 10.8 | 11.2 | 11.5 | 11.9 | 12.3 | 12.7 | 13.2 | 13.6 | 14.1 | 14.5 | 15.0 | 15.5 | 16.1 | 16.6 | 17.2 | 17.7 | 18.3 | 18.9 | 19.6 | 20.2 | 20.9 | 21.6 |
| **Financing** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Equity | 17% | 22.678 | 6.0 | 6.7 | 10.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | | | | | | | | | | | | | | | | | | | | | | |
| Debt (h+e) | 83% | 113.7 | 0.0 | 0.0 | 8.6 | 17.0 | 32.5 | 33.1 | 22.5 | | | | | | | | | | | | | | | | | | | | | | | | |
| Repayment | | 113.7 | | | | | | | | 6.5 | 7.0 | 7.0 | 8.1 | 8.1 | 8.1 | 8.1 | 8.1 | 8.6 | 8.6 | 8.6 | 8.6 | 9.1 | 9.1 | | | | | | | | | | |
| Interest paid | 2.0% | 17.8 | | | | | | | | 2.3 | 2.1 | 2.0 | 1.9 | 1.7 | 1.5 | 1.4 | 1.2 | 1.1 | 0.9 | 0.7 | 0.5 | 0.4 | 0.2 | | | | | | | | | | |
| Total Debt Service | | | | | | | | | | 8.8 | 9.1 | 9.0 | 10.0 | 9.8 | 9.7 | 9.5 | 9.3 | 9.7 | 9.5 | 9.3 | 9.1 | 9.5 | 9.3 | | | | | | | | | | |
| **Financial indicators** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Cash available for dividends | | 231.3 | | | | | | | | | 1.3 | 1.8 | 1.2 | 1.7 | 2.3 | 2.8 | 3.4 | 3.5 | 4.1 | 4.8 | 5.4 | 5.6 | 6.3 | 16.1 | 16.6 | 17.2 | 17.7 | 18.3 | 18.9 | 19.6 | 20.2 | 20.9 | 21.6 |
| Discounted dividends | 3.5% | | | | | | | | | | 1.0 | 1.3 | 0.8 | 1.2 | 1.5 | 1.8 | 2.1 | 2.1 | 2.4 | 2.7 | 2.9 | 2.9 | 3.1 | 7.8 | 7.8 | 7.8 | 7.8 | 7.8 | 7.7 | 7.7 | 7.7 | 7.7 | 7.7 |
| Interest Cover Ratio | min | 4.4 | | | | | | | | 4.4 | 4.9 | 5.4 | 6.0 | 6.8 | 7.7 | 9.0 | 10.5 | 12.5 | 15.5 | 19.9 | 27.1 | 41.2 | 85.2 | | | | | | | | | | |
| ADSCR | min | 1.12 | | | | | | | | 1.2 | 1.1 | 1.2 | 1.1 | 1.2 | 1.2 | 1.3 | 1.4 | 1.4 | 1.4 | 1.5 | 1.6 | 1.6 | 1.7 | | | | | | | | | | |
| Equity IRR | | 15% | -6.0 | -6.7 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.3 | 1.8 | 1.2 | 1.7 | 2.3 | 2.8 | 3.4 | 3.5 | 4.1 | 4.8 | 5.4 | 5.6 | 6.3 | 16.1 | 16.6 | 17.2 | 17.7 | 18.3 | 18.9 | 19.6 | 20.2 | 20.9 | 21.6 |
| LLCR | | 1.8 | | | | | | | | 1.8 | 1.8 | 1.8 | 1.9 | 2.0 | 2.2 | 2.3 | 2.5 | 2.8 | 3.3 | 4.1 | 5.5 | 10.2 | | | | | | | | | | | |
| Project Rate of Return | | 7% | -6.0 | -6.7 | -18.6 | -17.0 | -32.5 | -33.1 | -22.5 | 10.1 | 10.5 | 10.8 | 11.2 | 11.5 | 11.9 | 12.3 | 12.7 | 13.2 | 13.6 | 14.1 | 14.5 | 15.0 | 15.5 | 16.1 | 16.6 | 17.2 | 17.7 | 18.3 | 18.9 | 19.6 | 20.2 | 20.9 | 21.6 |

## Financial resources.

The private party will provide the financial resources for the design and build phase expected to be 6 years. An equity : debt contribution of 17% and 83% was assumed. A £113 M loan with a 6 years grant would be necessary. The repayment would be done over 14 years (total loan period 20 years). This would allow for acceptable debt service coverage ratio above 1.12. A 10% contribution from Government will be received ot the beginning of construction.

## Revenue / fee.

Toll was initially considered as an option but was outlisted due to: the expected difficulties in public acceptance of the new toll, communication and implementation of the toll[3], the position of the bridge within an existing network that is not tolled in the immediate surrounding but that has an area subjected to congestion charge.

An inclusion in the congestion charge area was considered but dismissed due to the resistance that and expansion of the are would probably meet and to the concerns existed on the longevity of the charge considering that London mobility will (hopefully) move towards alternative means of transport.

The PPP assumes a fee in the form of a shadow toll for the DRFOM services to be paid on a yearly basis by the public sector. The fee shown in Table 8 is meant as a reference, the final amount could be auctioned by the Government at the beginning of the project.

The fee shown in Table 8 is based on a £1 per bus per day with inflation at 2% and projected increase of traffic. The fees would start at £10M on year 7 and end at £21M on year 30. This revenue stream would create a Project Rate of Return at 7% and Equity Rate of Return at 15%. These were considered acceptable values to attract Private investors. It should be noted that fee could also be calculated as annual fee independently from vehicular traffic or simplified in bands based on traffic. Another possibility would be the inclusion of Equity-IRR triggers to regulate the relation between public paid fees and private returns.

The LBHF is expected to contribute to the project as stated by the Transport Minister[4]. The proposed scheme assign to the Borough the payment of O&M fees. This would also leverage its position for monitoring of the service.

## Risks

An analysis of uncertainties and risks was carried (Table 10). In this structure, risks related to construction costs and timing are taken by the Private Party under the assurance of a fee. Since social costs due to a delay would be much higher than economic costs, the addition of a penalty for delayed delivery should be considered.

Operation and maintenance will still be under the Private Party responsibility for 23 years after completion. This should ensure that stabilisation works are done up to standards since poor quality work will likely reflect in additional maintenance costs.

The LBHF will be involved in O&M by providing finances and monitoring the service.This was decided upon the fact the Borough is the owner of the asset and therefore the one that would be most affected by poor O&M operation.

Commercial viability should not be an issue since there is a strong need for the project. An agreed yearly fee avoids the risk of excessive costs on the public as it has been the case in bridges with fees managed by the Private Party (Shaoul et al., 2011a). From the Private Party perspective, the yearly fee prevents the uncertainties generated by traffic variability.

## Sensitivity Analysis

The proposed PPP was evaluated under different scenarios to see how it would perform in comparison to the base Scenario (SA00). The first one (SA01) considered a construction over-budget of +25%, the second one (SA02) a two-year delay in construction and the third one (SA03) an inflation to 3% for the first 15 years on capital and operation costs, with bank loan interest set at 3.5%.

Results for key indicators are shown in Table 9. The results between different scenarios are rather similar due to the fact that the main flow of cash (shadow toll) is not changing significantly. To better understand the impact of each cash source it should be kept in mind that the NPV for construction is £132M, the guarantee paid by the Public Party (shadow toll) £254M, O&M costs £16M, interest paid for the loan £14.5M. Even in the risks of delays, the non received guarantee per year would be around £10M.

From the SA emerges that the main factor is the contribution of the Public Party. This flow is assumed not be effected from inflation, traffic fluctuation and therefore acts as buffer against possible risks. What could put this flow at risk? The answer probably deals with the a ability of TfL and the Government to find an agreement and the necessary financial support that could come also from TfL

3 The case of Mersey Gateway demonstrate the possible difficulties in toll implementation.

4 Hammersmith Bridge Taskforce Public Meeting https://www.youtube.com/watch?v=fEvjkH3Eu48&list=PLopFRtXDcnWgVA-_Nf-JK1Y-hGnXucKxt&index=3

**Table 10: risk matrix for the PPP indicating likelihood and risk allocation**

| Risk | Likelihood | Risk holder |
|---|---|---|
| Commercial viability | Very low. There is a strong need for the project. | Government, TfL, LBHF |
| Completion risk. | Moderate. Being a refurbishment of an existing historical structure, there is a level of uncertainty.A delay would produce much higher social costs than economic ones | Private provider for economic costs, society for social costs |
| Permits | Low. Permits acquisition should be facilitated by public counterpart. | Government, Borough |
| Operating risks | Low. The choice of the private provider will be crucial. | Private provider. LBFH |
| Revenue risks | Low. The infrastructure was existing with solid traffic flows that will increment in the future. Public Party will be ensuring the revenue flow. | TfL and Government |
| Input supply material | Moderate. Brexit may have an impact on material costs . | Private provider |
| Force majeure risks | Low. The impact of the COVID pandemic should terminate by end of 2021. Brexit impact is should be considered. | Private provider, TfL |
| Low financial attractivness | Low. The project would benefit from the assurance of a steady revenue flow. Private Party could bid on the required payment for the DRFOM services and therefore proposing an expected IRR. | |
| Required service specification | Moderate.If a bidding process is chosen, the standard specification for rehabilitation and maintenance has a crucial role. This may require careful preparation. | |
| Economic, financial | Low. Long term impact of COVID and Brexit needs to be fully understood. Bank of England has lowered interest rate in 2020. | Private provider |
| Default | Low with an accurate selection of private provider. | Government |
| Asset ownership | Low. The bridge, even after stabilisation will continue to degrade especially if proper management not in place. For this reason, the owner of the asset (Borough) will be in charge of supervising OM quality performed by private provider. | LBHF |

business. This leads to considerations on the overall UK economy in the coming years whose main uncertainties are Brexit and the post-COVID recovery.

It is worth noticing that in scenario SA02 (2 years delay) the financial costs are limited but the social costs would be ingent. To avoid this, a penalty / incentive for delivering the bridge on time should be considered.

**Table 9: sensitivity analysis for key indicator for different scenarios**

| Scenario | SA 00 | SA 01 | SA 02 | SA03 |
|---|---|---|---|---|
| Equity IIR | 15% | 12% | 14% | 12% |
| Public Expenditure NPV | £217M | £217M | £199M | £217M |

## *Q4: determine the implications of the private sector financing solution and impact on (a) the recurring budget of the public sector (whether LBHF, TfL or Central Government) and (b) the level of the public sector's outstanding debt stock.*

The involvement of the private sector in the project has several implications and will be evaluated comparing an hypothetical scenario of conventional public procurement (Scenario A) and the proposed PPP (Scenario B) (Figure 6).

In terms of risks, Scenario B allocates design, construction and implementation on the private sector. Risks of delays are absorbed by the fact that fees will be paid only after the full opening of the bridge while maintaining the length of the contract to 30 years.

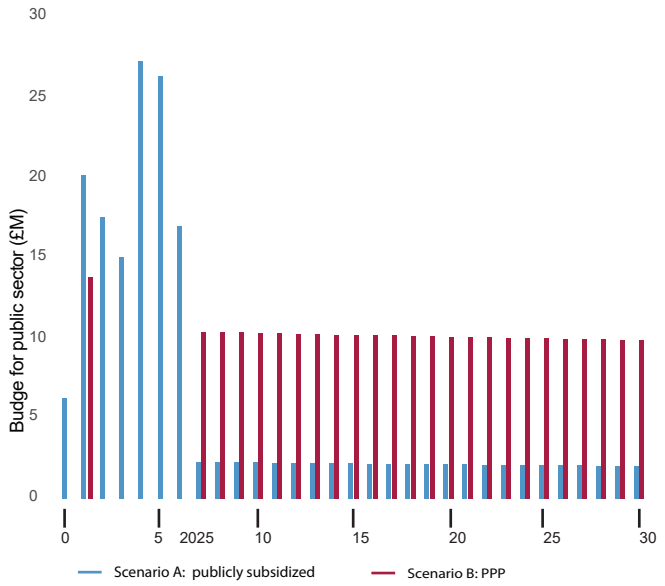


**Figure 6:** comparison of required yearly budget for a fully publicly run project (Scenario A) and the proposed PPP (Scenario B). Yearly values have been discounted at 3.5% p.a.

In terms of public sector debt, a fully publicly funded project would require less financial resources: £169M (with a 3.5% yearly discount) versus the £244M to be over 30 years as fees. It is assumed that in Scenario due to lack of incentives for cost efficiency and more fragmented procurement, capital costs will rise 15%. Timing for the required budget differ: in the first case the finance would be spent in the first 5 years with amounts ranging from £8M to £33M. The PPP options allows for a longer repayment with yearly fees at £11M (discounted).

In the proposed PPP, debt is acquired via commercial bank loan. This pathway will cause a higher financing cost due to a higher loan interest but would also provide benefits for the Public Party. The disbursment of Public capital is spread over more years and with less fluctuation and therefore could have less impact on budge (Figure 6). Additionally, the yearly guarantee could be used as a motivation for the Private Party in keeping the delivery of the service.

Limiting the analysis to the implementation timeframe of 6 years, shows that Scenario A would require the Public Sector to cover design and rehabilitation work plus any extra costs derived from delays and changes. Scenario B would require only a small contribution on the overall costs (in this case estimated at 10%).

An agreed yearly fee, as in the PPP, would also protect from possible fluctuation in inflation, GDP, traffic.

Most uncertainties (construction, impact of Brexit) will be faced in the first 6 years of the project. After this moment a refinancing could be discussed between the Project Company, Government and Banks.

***Q5: evaluate and summarise succinctly the advantages and disadvantages of alternative ownership structures, responsibilities for the operation and maintenance of the Bridge and financing arrangements. This should include an assessment of the implications for the time required to achieve availability.***

A comparison between conventional public procurement (CPP) and PPP was done along different aspects of the project. The observations made are based on generalization done upon what could be considered a "ideal PPP" or "ideal/typical public procurement" (Decorla-Souza et al., 2013).

In reality, an analysis should be contextualized and re-evaluated on a case by case basis. Numerous factors contribute to the success of failure of projects. It has been observed that the composition of the PPP consortium (ex. majority of it made by construction firms) could change the behaviour and performance of the project, turning a PPP into almost a standard procurement (Lee and Kim, 2019).

### What is suitable?

Not all types of projects are suitable for private financing. PPP are more beneficial where specifications are clear, a better quality of infrstructure may reduce costs and in situation with stable demand (Iossa and Martimort, 2015).

### Project overall costs

CPP usually have issues in terms of delivering projects on time and on budget (Lords 2010, par. 9 ). PPP usually deliver projects in a timely and more efficient way. Costs in CPP are usually due in earlier years and therefore result higher than later payments once discounted.

Bidding processes are generally more complex and longer in project involving private parties. Prices usually would change during this period. EU has tried to regulate this step by creating a procedure called Competitive Dialogue.

Optimism bias may be present in PPP estimates but in CPP as well. Government guidelines suggest to refer to sector studies and experience.

The accounting of PPP in public budget has been a matter of discussion since according to UK GAAP (Generally Accepted Accounting Practice) if the balance of risk was within the private sector it could be excluded from balance sheet. This practice is now changing to guarantee more clarity (Lords, 2010, par. 54-61).

In PPP project the involvement of a Private Party with technical expertise should generate a lower overall costs compared to a CPP. On the other hand, monitoring costs for the Public Party in a PPP may be higher.

### Cost of financing

Cost for financing would be generally lower in CPP due to the access to public credit. PPP would depend on interest rates, the share of equity and debt, risk premium required by investors and discount rate. Better value for money could be achieved through cost saving in the management or through better quality. The higher cost of debt reflects the additional risks undertaken by the private sector. Private debt finance constitute an incentive for due diligence.

One of the effect of Brexit will be the inability to access credit from the European Infrastructure Bank. This situation will support the already proposed idea of creating a UK National Infrastructure Bank.

## Bundling and unbundling functions

In PPP, the possibility of bundling services and maintenance is often seen as an advantage. This is even more visible in project, as Hammersmith bridge, where maintenance is a significant component. Choicestaken during the rehabilitation stage will therefore consider the consequences over maintenance in the coming decades.

## Retained and transferred risks

One of the main reasons for PPP projects is the possibility of transferring risks to the Private Party. This situation has two main advantages ever the CCP: Public Party is sheltered from (certain) risks. If the PPP is well designed, main risks could be transferred to the Private Party. Secondly, risk can be allocated to the entity that is more capable of dealing with them. In the case of the PPP proposed for Hammersmith bridge, design and construction costs were allocate to the Private Party. Risks related to traffic to the Public Party (TfL) that is already managing the network surrounding the asset.

***Next, consider and evaluate whether a generic or collective approach to the ownership and responsibility for the operation and maintenance regime of all or some of other London river crossings could deliver better and more cost effective outcomes, or solutions that minimise, or shield public sector budgets and levels of outstanding public sector debt.***

## Current situation

The issue of bridges maintenance is present at the national scale: the cost of clearing workload on bridge maintenance has been estimated at £6.7 billion for the whole Great Britain (RAC Foundations, 2019).

The current situation of Hammersmith bridge is the result of many factors that include the age of the building, the chance of traffic type and volume, being a target of terrorist attack, and perhaps a maintenance not up to standards in last decades. One of the key weaknesses of the current ownership situation is caused by the Local Government Act 1985 that transferred non trunk-bridges to Boroughs. This brought a decaying asset (as assessed by the Comprehensive Structural Integrity Review in 2014) that could costs over £100M in repairs into the hands of a fairly small administrative institution with annual expenditure in the range of £400-500M[5].

TfL would be the main actor due to its management of the whole transport network. Due to COVID and recent failure in expansion projects, it is not able to provide enough financial support on its own. A recent grant from government was received to balance the loss due to passenger decrease. Perhaps a more diversified portfolio could be beneficial. On this line the example of New York / New Jersey Port Authority could be useful. The Joint venture operates several assets including bridges, tunnels, ports, airport but also own prime real estate sites (World Trade Center).

From a risk allocation perspective, the current set up has some shortcomings: Boroughs probably do not have the internal expertises to monitor complex structure as historical bridges, the costs of probable major rehabilitation are beyond their financial capacity. Boroughs have also suffered from shrinking budget in latest years[6]. Additionally, there seems to be a lack of clarity of the duties and responsibility of the Borough, TfL and government[7].

## Towards a different ownership

The magnitude of the demand for maintenance and repair opposed to the limited funds and capacity available to the owners (the Boroughs) could support the consideration of a collective approach to the problem. A consortium made of private investors, firms with technical experties and a public party could take the overall management of the bridges. This set up could provide several advantages:

- Responsibilities over maintenance and repair would be clearly allocated to the consortium

-Risk would be transferred (mostly) to Private Party.

- The length of the contract would ensure that solutions below standards are discouraged since consequences would still be managed by the same party.

- Specific know-how, equipment could be gathered in one single group/firm. to address similar issues across the different bridges.

- The Private Party could reach a better efficiency over procedures, management and methods used over the maintenance and repair operation.

- Aggregating different bridges in London could produce

5 https://www.lbhf.gov.uk/council-tax/how-your-council-tax-spent

6 Letter to Baroness Vere of Norbiton from Cllr Stephen Cowan (28 October 2020) https://www.lbhf.gov.uk/transport-and-roads/hammersmith-bridge-all-you-need-know-and-latest-updates

7 Hammersmith Bridge repair works delayed amid funding gap https://www.bbc.com/news/uk-england-london-38134617

benefit by creating an "economy of scale". The benefits could be seen in management, procurement, equipment purchase/renting, negotiating with sub-contractors.

Barriers to this arrangement could come from:

- Uncertainty over the projection of extraordinary repairs in the coming decades, considering that the assets are not newly built and the Private Party would have limited or no knowledge of prior maintenance.

- The need for the Public Party to monitor the quality of the service delivered over technical issues.

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## Appendix 1: Willingness To Pay for renovation of historical elements.

Due to the paucity of data on evaluation of historical bridges, willingness to pay was estimated using a study by Adamowicz (1995) on the preservation of inland waterways. The study found a mean WTP per person per year of £6.8 and £8.9 for users, and £5.6 per non users. Values refer to 1993. The inflation adjustment from 1993 to 2019 was done using the Bank of England calculator (Bank of England, 2020). The WTP for 2019 was estimated as £18.3 per person per year (pppy) for users and nearby residents and £11.5 pppy for non users but still within the nearby area.
Estimated affected population were divided into two 2 groups: the first group composed by users of the bridge and nearby residents (calculated as half of Richmond and Hammersmith and Fulham Boroughs) and the second group as non-users but still living in the proximity of the bridge (the other half of the population of the two Boroughs). Present value after 30 years with a 3.5% (HM Treasury, 2018) discount rate was calculated.

**Table A1: Willingness to Pay for renovation of Hammersmith bridge in Sterling Pound per person per year.**

| User | WTP (£ pppy) | Pop. | Per year | Rate | After 30 yrs (discounted) |
|---|---|---|---|---|---|
| Users and nearby residents | 18.3 | 221,500 | £4,045,698 | 3.5% | £74,408,652 |
| Non users | 11.5 | 191,500 | £2,199,569 | 3.5% | £41,943,285 |
| | | | £6,245,267 | | £116,351,937 |

**Table A2: Present value of benefit from restoring Hammersmith bridge. (WTP expressed in £ perperson per year, Present value calculated after 30 years at 3.5% discount rate)**

| Relation | WTP (£ pppy) | Pop. | Per year | Present value |
|---|---|---|---|---|
| Users and nearby residents | £18.3 | 221,500 | £4,045,697 | £74,408,652 |
| Non users | £11.5 | 191,500 | £2,199,569 | £41,943,285 |
| | | | | £116,351,937 |

## Appendix 2: Value of Travel Time Saving

A quantification for time saved was carried for type of vehicles and type of options (boat, temporary bridge, renovated bridge) as shown in Table A3:

**Table A3: traffic and expected time saved for the options considered**

| **Option** | **S1** | **S2** | **S3** | **S4** | **L1, L3, L4** | **L2** |
|---|---|---|---|---|---|---|
| | | | **Crossings per day** | | | |
| Pedestrians | 1500 | 2880 | 8000 | 8000 | 10000 | 10000 |
| Cyclists | 420 | 720 | 4800 | 4800 | 6000 | 6000 |
| Car driver | 0 | 360 | 0 | 13200 | 22000 | 0 |
| Car passenger (0.3/car) | 0 | 108 | 0 | 3960 | 6600 | 0 |
| PSV driver | | | | 1200 | 2000 | 0 |
| PSV passenger | | | | 14400 | 24000 | 0 |
| | | | **Time saved (hr)** | | | |
| Pedestrians | 0.75 | 0.6 | 1 | 1 | 1 | 1 |
| Cyclists | 0.4 | 0.4 | 0.75 | 0.75 | 0.75 | 0.75 |
| Car driver | 0 | 0.2 | 0 | 0.5 | 0.5 | 0 |
| PSV driver | 0 | 0 | 0 | 0 | 0 | 0 |
| PSV passenger | 0 | 0 | 0 | 0.2 | 0.2 | 0 |

Business user travel time savings where based on the TAG Data Book (Ministry of Transport, 2020): pedestrians (13.37£/hr), cyclists (13.37£/hr),
car driver (23.59 £/hr), car passenger (23.59 £/hr)
bus passenger (23.59 £/hr). Calculation for each option are shown in Table A4

**Table A4: Value of Travel Time Saving**

| Option | S1 | S2 | S3 | S4 | L1, L3 | L2 |
|---|---|---|---|---|---|---|
| Monthly money saved | | | | | | |
| Pedestrians (13.37£/hr) | £376,031 | £577,584 | £2,674,000 | £2,674,000 | £3,342,500 | £3,342,500 |
| Cyclists (13.37£/hr) | £56,154 | £96,264 | £1,203,300 | £1,203,300 | £1,504,125 | £1,504,125 |
| Car driver (23.59 £/hr) | £0 | £42,462 | £0 | £3,892,350 | £6,487,250 | £0 |
| Car passenger (23.59 £/hr) | £0 | £12,739 | £0 | £1,167,705 | £1,946,175 | £0 |
| PSV driver | | | | £0 | £0 | £0 |
| PSV passenger | | | | £10,190,880 | £16,984,800 | £0 |
| Monthly money saved | £432,185 | £729,049 | £3,877,300 | £19,128,235 | £30,264,850 | £4,846,625 |
| Yearly money saved | | | | £229,538,820 | £363,178,200 | £58,159,500 |

**Table A5: projected traffic change over Hammersmith bridge in reference to year 0**

| Traffic | Cars | Pedestrian | Cyclists | Busses |
|---|---|---|---|---|
| | 28 | 10 | 6 | 24 |
| 0 | 1 | 1 | 1 | 1 |
| 1 | 1.0 | 1.0 | 1.0 | 1.0 |
| 2 | 1.0 | 1.0 | 1.0 | 1.1 |
| 3 | 1.0 | 1.0 | 1.0 | 1.1 |
| 4 | 1.0 | 1.0 | 1.1 | 1.1 |
| 5 | 0.9 | 1.1 | 1.1 | 1.2 |
| 6 | 0.9 | 1.1 | 1.1 | 1.2 |
| 7 | 0.9 | 1.1 | 1.1 | 1.3 |
| 8 | 0.9 | 1.1 | 1.1 | 1.3 |
| 9 | 0.9 | 1.1 | 1.2 | 1.3 |
| 10 | 0.9 | 1.1 | 1.2 | 1.4 |
| 11 | 0.9 | 1.1 | 1.2 | 1.4 |
| 12 | 0.9 | 1.1 | 1.2 | 1.5 |
| 13 | 0.9 | 1.2 | 1.2 | 1.5 |
| 14 | 0.9 | 1.2 | 1.3 | 1.6 |
| 15 | 0.9 | 1.2 | 1.3 | 1.6 |
| 16 | 0.8 | 1.2 | 1.3 | 1.7 |
| 17 | 0.8 | 1.2 | 1.3 | 1.8 |
| 18 | 0.8 | 1.2 | 1.3 | 1.8 |
| 19 | 0.8 | 1.2 | 1.4 | 1.9 |
| 20 | 0.8 | 1.2 | 1.4 | 1.9 |
| 21 | 0.8 | 1.3 | 1.4 | 2.0 |
| 22 | 0.8 | 1.3 | 1.4 | 2.1 |
| 23 | 0.8 | 1.3 | 1.4 | 2.1 |
| 24 | 0.8 | 1.3 | 1.5 | 2.2 |
| 25 | 0.8 | 1.3 | 1.5 | 2.3 |
| 26 | 0.8 | 1.3 | 1.5 | 2.4 |
| 27 | 0.8 | 1.3 | 1.5 | 2.4 |
| 28 | 0.7 | 1.4 | 1.6 | 2.5 |
| 29 | 0.7 | 1.4 | 1.6 | 2.6 |
| 30 | 0.7 | 1.4 | 1.6 | 2.7 |