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Official Report

INFRASTRUCTURE AND CAPITAL INVESTMENT COMMITTEE

Wednesday 27 January 2016

Session 4

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INFRASTRUCTURE AND CAPITAL INVESTMENT COMMITTEE
4th Meeting 2016, Session 4

CONVENER

*Jim Eadie (Edinburgh Southern) (SNP)

DEPUTY CONVENER

*Adam Ingram (Carrick, Cumnock and Doon Valley) (SNP)

COMMITTEE MEMBERS

*Clare Adamson (Central Scotland) (SNP)
*Alex Johnstone (North East Scotland) (Con)
*Mike MacKenzie (Highlands and Islands) (SNP)
Siobhan McMahon (Central Scotland) (Lab)
*David Stewart (Highlands and Islands) (Lab)

*attended

THE FOLLOWING ALSO PARTICIPATED:

Councillor Ian Chisholm (Former Board Member, Forth Estuary Transport Authority)
Barry Colford (Former Chief Engineer and Bridgemaster, Forth Estuary Transport Authority)
Councillor Lesley Hinds (Former Convener, Forth Estuary Transport Authority)
Chris Tracey (Former Engineering Services Manager, Forth Estuary Transport Authority)
Phil Wheeler (Former Convener, Forth Estuary Transport Authority)

CLERK TO THE COMMITTEE

Steve Farrell

LOCATION

The Adam Smith Room (CR5)

Scottish Parliament

Infrastructure and Capital Investment Committee

Wednesday 27 January 2016

[The Convener opened the meeting at 10:00]

Forth Road Bridge Closure

The Convener (Jim Eadie): Good morning and welcome to the fourth meeting in 2016 of the Infrastructure and Capital Investment Committee. I remind everyone to switch off their mobile phones as they may affect the broadcasting system. As meeting papers are provided in digital format, you may see tablets being used during the meeting. We have received apologies from Siobhan McMahon.

Agenda item 1 is the continuation of the committee's inquiry into the circumstances surrounding the Forth road bridge closure. It gives me great pleasure to welcome, from the former Forth Estuary Transport Authority, Councillor Lesley Hinds, who is a councillor on City of Edinburgh Council and was the final convener of FETA, between 2013 and 2015; Phil Wheeler, who is a former City of Edinburgh councillor and was the convener of FETA between 2009 and 2011; and Councillor Ian Chisholm, who is a councillor on Fife Council and a was a board member of FETA between 2007 and 2015. I also welcome Barry Colford, who is the former chief engineer and bridgemaster at FETA. Mr Colford has gone to the trouble of travelling from Philadelphia in the United States to join us for this evidence session, for which I am grateful. It looks as though you have swapped one sort of inclement weather for another, Mr Colford. Finally, I welcome Chris Tracey, who is the former engineering services manager at FETA.

I invite Councillor Hinds to make an opening statement.

Councillor Lesley Hinds (Former Convener, Forth Estuary Transport Authority): Thank you for the opportunity to speak to the committee. I will take a few minutes to make a statement because it is very important for the reputations of the people who are sitting in front of you and the former FETA. I hope that the committee found that the written material that we sent was useful. As you know, all that material was available to the public, and FETA was a local democratic and publicly accountable organisation, which made decisions at local level. All meetings and papers were available to the public, press and Transport Scotland.

I mention Transport Scotland because after reading the *Official Report* of your meeting last week, I wanted to assure you that Transport Scotland was kept informed and was involved in all decisions that were taken by FETA. The draft papers for the board were sent to Transport Scotland, representatives of Transport Scotland attended board meetings, and regular meetings were held between the bridgemaster and Transport Scotland. I would not use the phrase "a light touch"—I think that that was what was said last week—to describe the relationship between FETA and Transport Scotland, particularly in the last couple of years of FETA's existence.

I would like to record my thanks to all the staff who worked for FETA for their dedication, hard work and commitment to keeping the Forth road bridge open over the years of the FETA board. I have chaired many organisations over my years as a councillor and rarely have I seen such dedication, knowledge and expertise as that of the FETA staff. Under their leadership and that of the FETA board, we kept the bridge open, apart from in severe weather conditions.

I will go over three decisions that other people took that were significant for FETA in terms of maintenance, management and governance. First, the bridge tolls were abolished in February 2008, which resulted in the loss of up to £12 million per annum. That money had been used to service the debt of building the Forth road bridge and for borrowing capital for bridge maintenance. FETA then had either to use reserves—which it did—or to apply for capital funding from Transport Scotland. The bridgemaster had regular discussions with Transport Scotland regarding capital funding and maintenance requirements, which would then be brought to FETA board meetings. Therefore, instead of FETA being able to plan for future investment, there was sometimes uncertainty over capital funding, as FETA had to rely on Transport Scotland for the majority of such funding.

Secondly, there was a spending review in September 2011 in which a 58 per cent cut was made to the indicative capital budget that FETA had set for 2012-13 onwards for future capital maintenance. Following that cut, a prioritisation exercise was undertaken on non-committed schemes. There were also committed schemes. The committee has a copy of appendix 3 of our submission. I was surprised that Transport Scotland did not recognise the 58 per cent cut, because in a paper from 16 December 2011—a copy of which Transport Scotland would have received—it is made very clear that there was a 58 per cut from the figure in the indicative capital plan that had been approved by the board. You will see from appendix 3 that there were priorities, although I will not go into details as we might

cover that issue later. As a result of the reduction in that funding the truss end links remedial works did not go ahead.

Thirdly, in December 2008 the Scottish Government announced its intention to build a new Forth road bridge, in April 2010 it set out the case for a single body to manage the two bridges and in February 2013 it decided to transfer that responsibility from FETA to Scottish ministers and to dissolve FETA. As I understand it, Transport Scotland did not recommend to ministers the option of keeping FETA and reviewing its governance and operation. The ministers agreed to FETA's abolition and to the transfer of responsibility for the management and maintenance of the two road bridges to a private company, and they agreed that staff would transfer from the public to the private sector. At the end of May 2015, FETA was abolished.

I also want to talk about the last two years of FETA, when I was its convener. Two issues that the board discussed and scrutinised at length gave them grave concerns. One was keeping the bridge open and having enough capital to ensure the on-going maintenance of the bridge and the work that we prioritised as the capital funding continued to reduce. At every board meeting in the last year, we were concerned about the level of capital expenditure and future investment in the bridge to ensure that it was kept open.

The second issue was keeping the senior management of the bridge until the handover, since they had the expertise and knowledge, and the trust of the staff and the board. The board was severely concerned about whether FETA could be sure of the continued good management of the bridge if the senior staff—especially the bridgemaster—left. The board was so concerned that it set up a subcommittee to discuss staffing issues and the actions that the board might take to keep the senior staff.

Because of the concerns about senior staff, the vice-convener Tony Martin and I met them individually, and they voiced deep concerns about the transfer to a private company and about their role in the new structure. FETA chief executive Sue Bruce, Tony and I then met a number of times with staff from Transport Scotland, including the head of Transport Scotland, to press our concerns about the present and future management of the existing bridge. We were given assurances. There can be no doubt that Transport Scotland was well aware of the FETA board's concerns regarding the loss of key staff and the effect that that would have on the management and maintenance of the bridge.

I and—I am sure—other people from FETA have been upset by the headlines regarding FETA. On one hand we have been blamed for not carrying out work on the truss end links five years ago, even though we did not make the cut in funding. On the other hand, the current failure has nothing to do with that work as that was

"not where the fault has occurred".

It cannot be both.

I apologise for my opening address being so long, but it is important that the facts are laid out about who made the decisions. I will not go into any engineering issues, as other people are far more expert on that than I am, although in the last two to three years I have become more of an expert on engineering.

The concern was voiced that it seemed that the bridge was being seen as just another road. The Forth road bridge is not just another road. As we can see, it is important to the thriving of the economy of Edinburgh, Fife and Scotland as a whole. We have seen that through the effect that the closure has had. We need to take into account that it is a structure—a complicated structure. It is a bridge, not a road. That attitude was one of our concerns as we handed it over.

The Convener: Thank you, Councillor Hinds. I think that we all agree with your closing comment about the importance of the bridge to the people and the economy of Scotland—that is why we are having this inquiry.

I will hand over to our vice-convener, Adam Ingram, to kick off with questions.

Adam Ingram (Carrick, Cumnock and Doon Valley) (SNP): Welcome, everyone. You will be aware from last week's evidence session that the cause of the failure of the truss end link was that the pin that connected the lower end of the link to the truss had seized. The resulting cyclical stresses caused fatigue failure.

Does it make sense that that was the cause of the failure? Were you surprised by the failure? Perhaps Mr Colford would be the appropriate person to ask first.

Barry Colford (Former Chief Engineer and Bridgemaster, Forth Estuary Transport Authority): I find it difficult to comment on engineering matters in which I have not been directly involved. Obviously I have been following the events since the closure, but it is difficult for me to comment on the actual method and mechanism of the failure, given that I have not been closely involved in the analysis of it.

Adam Ingram: Okay, but would it be a surprise to you that that particular element of the truss end link was the cause, if you like, of the failure?

Barry Colford: Again, it is difficult for me to comment because I do not know the mechanism. I understand from the comments at last week's

meeting that the early indications are that the pin seized, but until I see the engineering reports and make a decision on the matter, it is difficult for me to comment on that.

Adam Ingram: That is fair enough. Would anyone else like to make a comment on that issue?

Councillor Ian Chisholm (Former Board Member, Forth Estuary Transport Authority): Inspection of all the elements of this massive bridge is a complicated one. There are techniques that can be used to inspect the structure of the bridge—ultrasonics and X-rays and so on—but the machines are quite enormous and getting into the little nooks and crannies of the bridge would be very difficult.

I suspect that the way that the pin seized was invisible to a visual inspection, so the only alternative would have been for a machine inspection of every element of the bridge, which in my view would be impractical.

Adam Ingram: We will perhaps come back to that point. We were informed that that area of the truss end links was previously inspected in May 2015. Can you explain how FETA assessed the need for inspections, how often that part of the structure was inspected and how it was inspected?

Barry Colford: Certainly. One of the requirements that were set out by the Department for Transport and adopted by the overseeing authorities in the United Kingdom is that highway structures, including bridges, should be inspected on a two-yearly and a six-yearly programme. There is a general inspection every two years, which is a fairly routine inspection, and a more exact inspection every six years, which involves a close visual inspection of every inspectable part of the structure. That is what is required of authorities in the UK when they inspect their highway structures.

Chris Tracey and I had been looking at that programme in regard to Forth for a long while. We felt that it was not particularly suitable for such a large structure, so we developed a risk-based inspection regime, which was based on how critical each component or family of components was and how vulnerable each of them was to failure. We felt that that was a better way of focusing resources and ensuring that the most critical and vulnerable elements were inspected.

We identified each component of the bridge or each family of components and determined how vulnerable they were to damage, whether accidental, deliberate or terrorist damage, and we looked at how critical each of those elements was to the structure. Combining those two pieces of information, we managed to come up with a risk-based inspection frequency whereby some elements would be inspected more frequently than others. That enabled us to use resources, which are always scarce, to inspect the most vital parts of the structure.

As a result, we inspected critical components such as the truss end links every six months. My recollection is that we did indeed carry out an inspection in May 2015 and that we had been carrying out regular inspections at that frequency on the truss end links. We did not detect any issues with the links during that inspection.

We carried out significant amounts of analysis and work on the links over the years. Obviously they were uppermost in our minds and therefore they were inspected. We knew that they were a critical component and, as it turned out, that was confirmed when we did our risk analysis. That was the basis of our approach. It is not too common—it is a fairly unique approach—but we felt that it was the way forward for such a large structure. That is not what is in the guidelines. The guidelines that are issued by DFT and followed by most of the overseeing departments in the UK are for two-yearly and six-yearly inspections, so our inspection regime was more onerous than that.

Adam Ingram: So you went over and above the guidance by identifying that the truss end links were a potentially important area that you needed to keep an eye on.

Barry Colford: Yes, and there were of course other areas that were equally important. We were doing something similar in regard to them.

Adam Ingram: Were you aware of the problems with the pins? Was any special method of inspection adopted to check whether the pins were rotating correctly?

10:15

Barry Colford: It is fair to say that we were always aware that the truss end link is a particularly different part of the structure from a normal member. It is a moving part. The pins were always a concern for not just me but my predecessors, and they were considered to be a critical component. We knew that there was no sign of excess wear on the pin, and there was no sign of the sort of movement that had been picked up in similar details on other bridges. We did not see excess wear on the bushes round the pin. There was nothing to say that the pin was not performing and the inspection did not show any outward signs of distress on the adjacent members.

There had been issues in the past when we erected scaffolding down at that part of the structure and the scaffolding had been destroyed

simply because of the movement of the deck. We were aware of the make-up of the pins and that it was not a particularly good detail. A detail that cannot easily be inspected and where a thing such as a pin cannot easily be lubricated is not considered to be a good detail. Those things were part of our thinking when we were looking to replace the whole element—the whole truss end links—back in 2010-11.

Adam Ingram: So at that time you did not regard the pin as a critical element in the overall profile of the issues that you were having with the truss end links.

Barry Colford: We carried out an analysis to determine where the most highly stressed part of the whole truss end link was. We focused on the weakest part, which was the connection to the tower. According to the analysis, that connection was severely overstressed. That was a major concern for us, as the analysis showed that the tower cantilever bracket might rip off the tower under fairly light traffic loading. The analysis did not show that there was an overstress down at the pin level.

Adam Ingram: Do the analytical techniques need to be better to improve the ability to assess what is happening with the pins?

Barry Colford: That is one of those difficult issues, because engineering is not science; it is a mixture of science and art, and it involves judgment. We have the most powerful analytical tools. Consulting engineers analysed the stresses in the members, and an independent checker also carried out an analysis. Those were the best firms in the UK, and the world, analysing and checking using the best tools, but it is engineering, and engineering is always about judgment. It is not an exact science.

Adam Ingram: Okay, but maybe you can draw on experience of bridges elsewhere. I understand that you are now based in America, where there are lots of suspension bridges. Has there been any evidence of problems with pins in those bridges?

Barry Colford: FETA was a member of the International Cable Supported Bridge Operators Association, or ICSBOA, which is quite an acronym, as we were keen to be part of the international community. The association has members from the Golden Gate bridge as well as members from Japan and China and other places in Europe. I was the European member of the organisation when I was with FETA.

Membership of that organisation brought experience from elsewhere. We were aware that the Humber bridge was suffering from an issue with its end connection. That end connection does the same job as our truss end links with the Humber deck, but it is a completely different structural form. The Humber bridge had a set of A-frames in which the wear in the pins was already apparent, so one could say that failure had already occurred, although the nature of that structure meant that it involved compression rather than tension. There was an early warning in that case, and the Humber bridge had its A-frames replaced. We were aware of that. The early warning was the wear and the noise that accompanied it, and there was no such indication on the Forth bridge.

Adam Ingram: We took evidence last week that suggested that the answer in future would be to have structural health monitoring in place. I understand that new technology can be used to check structural health. Was that technology available to you, and did you consider using it?

Barry Colford: We have structural health monitoring on parts of the bridge. There is acoustic monitoring to listen for wire breaks on the main cable, structural health monitoring on the dehumidification system, and global positioning system or global navigation satellite system technology on the bridge to look for movement of the deck. Structural health monitoring is developing on large bridges. It is being installed on the new Queensferry crossing, which has a significant number of sensors, and on Tsing Ma bridge in Hong Kong, among other bridges.

My main concern with such monitoring is overload of data. You really have to know what you are looking for. The problem is that, although monitoring is very useful and has been used a great deal on existing bridges where a problem has materialised and its progress needs to be tracked, it is not so good for detecting problems of which one is unaware.

Alex Johnstone (North East Scotland) (Con): I would like you to clarify a couple of small technical points to assist me in my understanding.

First, the joint that we are talking about was supposed to be moving, and the other joints were allowing some flexibility. At a very close-up point, how much movement was there in the pin? For example, if you were to make a chalk mark across it, would you see any movement in that when the bridge was flexing?

Barry Colford: Chris Tracey and I have been out on the bridge often and seen the end moving. It does move: you can see it physically moving.

Alex Johnstone: But can you see the pin rotating at all?

Barry Colford: That is probably not possible.

Alex Johnstone: What I am trying to get at is whether, on close inspection, there would be a tiny and almost imperceptible movement in the pin itself.

Barry Colford: No, the movement is not imperceptible, but it is difficult to determine how the pin is functioning just visually, by looking at it. It is difficult to get access in order to do that. You would probably have to stand back some distance and look at the end to see it moving.

Alex Johnstone: You also said that the joint was difficult to lubricate. I would like to know a little bit more about that joint. Was it operating steel on steel, or was there something between the two? Was there a soft metal ring or something like that?

Barry Colford: Yes, there is a bush between the pin and the cast lower part.

Alex Johnstone: What was that made of? Was it brass or something else?

Barry Colford: I think that it is cast, actually: cast iron. Such parts are usually made of phosphorus bronze or cast iron. They are supposed to wear down eventually, which is what happened on the Humber bridge, where there was a wear problem. From what I can see, that may not have happened on the Forth bridge, but I do not have the analysis. To determine that, you would have to take the pin out. Unfortunately, on the Forth road bridge, the pin is enclosed and you cannot get into it either to lubricate it effectively or to inspect it. It is not a great detail: if you were doing it again, you would not design it in that way.

Phil Wheeler (Former Convener, Forth Estuary Transport Authority): As a layman—although, like Lesley Hinds, I learned quite a bit about engineering in my time on the FETA board—I should say that we are talking about the bridge as both a historic monument and a living structure. It is moving all the time. I remember going out to the middle of the bridge once with Barry Colford to look at some element of it, and while we sat in the vehicle it appeared that West Lothian was going up and down quite markedly. The bridge is very much a live structure. That is the whole point of a suspension bridge: it takes a lot of the tension out of the whole structure.

We had Barry Colford's expertise and, as he said, he worked with his peer group all round the world. The emphasis during my time on the board was on dealing with problems with the cables—the wire breaks and so on—and it was pioneering work that Barry Colford and his team were doing on the bridge, which was then used elsewhere in the world by other bridge operators who said, "Oh dear, we'd better look at our cables." It was on the cables and the cable bolts that a lot of the budget had to go. That was the priority during that period, when, as Lesley Hinds said, we were dependent on Transport Scotland funding.

The Convener: We will come on to that. Is there anything else that you want to say at this stage about the technical aspects of the bridge and the structural health monitoring?

Phil Wheeler: We are very much in danger of applying too much hindsight to the engineering and design standards of the late 1950s and early 1960s, when the bridge was being designed and built. If it was built today, it would not be built in that way, and I know that lessons have been learned with the new bridge and with many other bridges. Each new bridge has learned from the previous one.

Councillor Chisholm: I agree with Phil Wheeler on that point. The early design of the bridge is an important issue. I remember Barry Colford speaking to one report and raising the issue of the design and the fact that the bridge was getting older, and saying that the issues around the truss end needed to be investigated at some point. However, as I recall, we were coming to the end of our term as FETA board members and I asked Barry Colford to ensure, if he could, that when the issue was handed over it was not lost in the transfer of responsibility to Amey. My worry was that that issue and other jobs might not be passed on clearly to the new—

The Convener: We will come on to the prioritisation of capital works in due course, but members have a range of questions that they want to ask, so I think that we should leave it there.

Councillor Chisholm: Okay.

Clare Adamson (Central Scotland) (SNP): I have a supplementary to Adam Ingram's question. FETA scoped the work for the truss end link replacement. Did the scope of that work include replacing the pins?

Barry Colford: Yes, we were looking at replacing the whole structure of the truss end link. We were even looking at the possibility of putting it above the deck; we had looked at other bridges that have a similar detail. Therefore, the answer is yes.

Clare Adamson: That is helpful. I would like to ask some questions about the indicative capital plan. Can you give us an indication of how the indicative capital plan was prepared each year and how the cost estimates were arrived at for each of the proposed capital plan projects?

Barry Colford: It is quite a challenging task because, on such structures, we are looking at doing things that are unique, and our comparators may be in New York, Hong Kong or San Francisco, where costs are completely different. Chris Tracey and I had the difficult task of trying to determine what we would spend on priority projects over the coming 20 years based on what we knew at the time.

That capital plan was brought to the board after we had put it together based on what we felt was needed for the Forth road bridge. It was a capital plan for what we felt needed to be carried out on the bridge over 20 years, and it was quite a challenge to determine what resurfacing would cost in 2018-19, but the prioritising was based on the needs of the structure as we could see them looking ahead.

10:30

Clare Adamson: Do any of the former board members want to comment?

Councillor Hinds: The experts would approach the board, and we have circulated a number of those reports—I have cited the one from 16 December 2011. At the penultimate board meeting of the authority before it was abolished, we presented the capital plan and reserves update, which goes through the truss end linkages, the suspended span, the underdeck gantries—

The Convener: Councillor Hinds, can you tell us what board minutes you are talking about? We just need the dates.

Councillor Hinds: Sorry. We have circulated the board minutes for 16 December 2011 as appendix 3 to our submission, and that goes through the priority ranking of non-committed schemes. Phil Wheeler may be able to talk about that, as he was there at that time. The normal process involved discussions with Transport Scotland because, after the abolition of the tolls, we had to go to Transport Scotland for grant funding. For example, we would say that we wanted to invest in the maintenance and upkeep of the bridge in the future and we would provide an indicative capital plan for that. However, the plan from 16 December 2011 went to the board because the plan that we had previously decided on could not be implemented following the 58 per cent cut.

The other report that I am talking about is item 5 in appendix 4 to our submission, which was the capital plan and reserves update. I was very clear—Ian Chisholm will back me up on this—that I wanted to ensure that we passed all the information from FETA to the new organisation, Amey, and to Transport Scotland. That report contains a detailed list of around £80 million—if I remember correctly—of works that we believed should be invested in on an on-going basis, including work on the truss end linkages and suspended span truss strengthening. It was about the on-going investment position, and the board would have taken the expert advice. As I said, the challenge over the last number of years was that our destiny was not in our own hands and we were not setting our own budget because we had to go to Transport Scotland for some of our funding.

The Convener: I have a specific question on appendix 4 to your submission, which refers to the truss end linkage work. It states:

"Strengthening the links will cost significantly less than full replacement which has an estimated cost of £15 million."

How definitive was that figure? Another FETA board paper, from 21 February 2014, said that full replacement

"has an estimated cost of £10 million to £15 million."

Are you confident that £15 million was what it would have cost to replace the entire truss end link assembly at eight locations?

Councillor Hinds: That goes back to 2011. Barry Colford or Phil Wheeler might be able to comment on that.

Phil Wheeler: That figure sounds familiar.

The Convener: I know that it is familiar; I am trying to establish whether it was a robust figure for what the works would have cost. Can you shed any light on that, Mr Colford?

Barry Colford: As I said earlier, we put indicative costs in our capital plans, and those were the indicative costs of likely spend over the coming 20 years. It is very difficult to determine the precise costs until you have the contractor's costs in your hand. We tried to find out what those things cost elsewhere, but there were not many places to look, so we made the best estimates that we could. Whether the cost would have been £12 million or £15 million, those were our best estimates at that point.

I remember that Chris Tracey and I produced the figure of £15 million, which we may then have reduced to between £10 million and £15 million. The precise cost would have depended on the contractor's programme, how much of the work could have been done overnight and the amount of possession time that would have been needed. With such work, the more disruption that is caused to bridge users by closing carriageways or lanes to allow the contractor access, the more the price goes down.

The Convener: Did you build any slack into that figure of £15 million?

Barry Colford: Yes, there would have been some allowance for contingencies in it. The basic premise of working on these live structures is that the more access the contractor is allowed, the cheaper the price becomes. Unfortunately, the more access that is allowed to the contractor, the more disruption there is for bridge users. It is a delicate balancing act.

The Convener: That is a very reasonable point.

Clare Adamson: Last week, when we had the technical experts before us, the indicative capital plan was described as the engineers' "wish list". What was the status of the indicative capital plan? Did you have one for every year of FETA's operation? I understand that the truss end links ended up at number 5 in the priorities that were identified in the most recent risk assessment. How far down the capital programme were you able to get in previous years?

Barry Colford: The capital programme, as I described it earlier, included what we considered needed to be done on the Forth road bridge. It was not a wish list or what we wanted to do; it included what we considered needed to be done. Obviously, finances come into that, and we were in a slightly anomalous position post tolling. FETA had the governance of the bridge, but the funding came from a third party. We had to deal with that, but the capital programme included what we felt needed to be carried out.

We were carrying out our capital programme prior to the spending review. Obviously, things changed after that, and we had to reprioritise capital spending. Engineering is about managing risks. When we looked at the schemes, Chris Tracey and I and the management team had to consider what schemes we could afford to carry out. We could not afford to carry out all the schemes in our capital plan simply because there was a spending review, and we had to accept that we needed to work within the moneys that we were granted. Therefore, we had to prioritise projects.

The important thing is the safety of users and the safety of staff. That is number 1. The second important thing is the bridge's long-term structural integrity; the third is the potential disruption to users. That was the ethos and philosophy that FETA used to manage and maintain the Forth road bridge.

We did as much as we could to minimise the disruption to users. Lots of the work was carried out overnight—sometimes at a higher financial cost—and at weekends simply because that minimised the disruption to users. The priorities were the safety of our users and our staff, and the long-term structural integrity of the bridge. Minimising disruption was also a priority, but the other two took precedence.

We looked at what projects we would prioritise on that basis. At that point, the main cable, the main cable anchorages and the cable band bolts were our priority—that was spoken about earlier. Such structures are very different from other bridges. Unfortunately, a lot of the key elements are above the heads of the people who use the bridge, so even carrying out an inspection of the main cable involves risk to the users. Our job was to minimise that risk. Unfortunately, we cannot eliminate the risk. Eliminating it would involve shutting the bridge completely while we carried out our work, and that is not possible.

Our whole ethos and what Chris Tracey and I and the staff did at all times was about minimising risk. We used that philosophy when we tried to prioritise projects post the spending review, and we brought that to the board. If a failure occurred in the main cable and the main cable anchorages, there would be a catastrophic failure of the bridge, so they became a priority. If the truss end link failed, there would be what we would term an operational failure. The risk of someone being killed or seriously injured would be lower than other risks but, unfortunately, a lot of disruption would be involved. When we risk assessed projects, the potential for structural damage, collapse or risk to life took priority. That is how we came up with the risks.

I am keen to emphasise the difference between operational risk and structural risk. Risk is a very difficult field, and we operate in that field all the time. Everyone who manages and maintains these large structures operates in that field. It is about recognising risk. Risk is not about probability of occurrence; it is about a combination of the probability that something will happen and the outcome of that event. That is the field that we worked in, and that is what we used to get the list of projects to move ahead with. We knew that there was an issue with a lot of the projects, but we had to prioritise them.

Clare Adamson: So the risk assessment that was done as part of the reprioritisation of projects would have considered public safety. Had the work in question been a safety-critical project that required to be funded, are you confident that you could have approached Transport Scotland to get the funding for it?

Barry Colford: We had good relations with Transport Scotland once it became responsible for our funding, and we had meetings with Transport Scotland staff. If I had gone to Transport Scotland and said that there was a problem, my professional integrity would have ensured that I pressed that case.

Clare Adamson: Are you confident that the decision not to go ahead with a full replacement of the truss end links and to put in place a trial of a temporary fix that would be carried forward by Transport Scotland was a reasonable decision? Did the carrying out of that test and the further implementation of the trialled repair address your concerns about what the risks were with the truss end links at that time?

Barry Colford: Following the prioritisation, we revisited the analysis on the truss end links. One of the difficulties with loadings on bridges such as the Forth road bridge is defining what traffic loading is, because traffic loading changes all the time. Unfortunately, traffic loading depends on the mix of cars and lorries or trucks and it can increase dramatically if there is a nose-to-tail line of 40-tonne trucks. That was the nightmare scenario.

We looked again at the risk of having three stationary 40-tonne lorries sitting nose to tail adjacent to the towers without cars between them to dilute the load. Because we have traffic control and we have staff at the bridge at all times, we thought that the probability of that happening was quite low. Therefore, we were able to look again at the stress levels in the truss end links, and that made me more comfortable about those stress levels.

In addition, the probability of that load occurring is dependent on time. Letting the situation run on for 50 years would have been a different prospect from letting it run on for five years. We knew that heavy traffic would be taken off the bridge and put on to the new crossing. All those thoughts were in our minds as we considered the reanalysis, and that gave us some comfort that the stress levels might reduce.

As engineers, we are always looking for something else. We knew that in the past, before the weakness in the truss end links was identified, abnormal loads of more than 200 tonnes had crossed the bridge. We had inspected the weak weld detail and there were no problems with it, so it had undergone a working trial and had withstood a test loading. In fact, at one time a 238-tonne transformer went across the bridge. We knew that those loads had gone over the bridge without any ill effects. That is the nature of engineering—the analysis told us one thing, but we knew that a larger load had crossed the bridge without causing the weld to rip off the tower.

Clare Adamson: That is fine. Councillor Hinds, do you have anything to say on that?

Councillor Hinds: It is probably more suitable for Phil Wheeler to comment, because he was the convener of FETA in 2011.

Phil Wheeler: I certainly endorse what Barry Colford has told us. We had the guidance and the prioritisation programme that he produced for what was doable within the budget. The art of the possible is a basic aspect of politics, as members of the committee will know. We had to work within that constraint.

Ms Adamson mentioned the difference in the estimated cost of doing the work, which ranged from £10 million to £15 million. My recollection from conversations with Barry Colford about costings for different big contracts on the bridge is that only a very limited number of contractors had the skills to be let near the bridge. That meant that the tendering process was not all that competitive, given that only two or three firms had the ability to bid, which put pressure on the pricing.

10:45

From the time that the decision was taken to build the new bridge, I got the impression that there was always a pressure on FETA to carry out only the absolutely essential work to nurse the bridge through until the new crossing was available. The works that I touched on earlier—on the cables and bolts—were items 1 and 2 on the list and they were our priorities. We noted that there were a lot of other things that should be seen to, but they had to be pended for that time.

The Convener: Do you want to add anything, Councillor Chisholm?

Councillor Chisholm: My recollection about an issue cropping up regarding the safety of the bridge is that we were never refused any funding from Transport Scotland to go ahead with anything that was considered to be a vital safety issue. In the wider spectrum, one could see that eventually the whole bridge would have to be replaced piece by piece. Like the chap whose broom has had 10 broom handles and 15 brush heads, ultimately, we would not be left with the original bridge because whether now, or in 10 years' time, or in 50 years' time, most of the bridge components would have to be replaced.

As Councillor Wheeler said, with the advent of the new bridge, we had to be careful of priorities. I recall that Barry Colford was quizzed about the priorities on the truss end links and I got the impression that they were not an immediate priority and that the work probably related to a design issue from way back. I got the impression that we were talking about 10, perhaps 15 years in the future. That is why I was concerned that information should be passed on to Amey, so that it would be followed up and not lost in the transfer.

The Convener: Thank you, we may come back to that.

David Stewart (Highlands and Islands) (Lab): My initial question is for Mr Colford. You worked on the bridge for 19 years and the bridge is 52 years old, so you have exceptional experience and expertise on the bridge. I want to take you back to a couple of key issues. In 2010, FETA advertised for consultants for a contract to carry out the truss end links remedial works. Is that right?

Barry Colford: Yes, as far as I recollect.

David Stewart: Why was the decision taken in 2010 to advertise for those consultants to carry out that contract?

Barry Colford: At that time we were proposing to replace the truss end links. We had carried out a feasibility study. I remember that we had a workshop with a consulting engineer who was advising us at the time and with our staff. More often than not, the best ideas come from the guys who are working out there, so the staff were involved. We had a workshop on what would be the best way to replace the elements and on designing new ones bearing in mind any future maintenance, which was uppermost in our mind. We were some way down the road of putting together a feasibility study for replacing the truss end links.

Having got together the feasibility study, we knew that the engineering could be done, so the next stage was to advertise for an engineer to design the works. That is part of the procurement process. We have someone who helps us out with the initial feasibility and then we go to tender to bring in a consulting engineer to design the work. That is the stage that we were at.

David Stewart: Was it a unanimous decision of the FETA board to go ahead with that work?

Barry Colford: As far as I can remember, yes it was.

David Stewart: If the work had been carried out, might that have avoided last year's closure of the bridge? That is a key question.

Barry Colford: As an engineer I do not want to answer hypothetical questions. All that I can say is that at that point we had intended to replace the truss end links.

David Stewart: Can you explain again to the committee why the contract was cancelled? As I understand it, you had advertised in the press for consultants, although you had not appointed them. Is it correct to say that the contract was ceased between advertising and appointment?

Barry Colford: Yes.

David Stewart: Why did that happen? Was it 100 per cent FETA's decision or were other forces involved?

Barry Colford: FETA made the decision, but we make decisions based on funding availability.

David Stewart: What was the role of Transport Scotland and the Scottish Government over your decision making?

Barry Colford: As I said, FETA was in a position whereby we had the governance but not the funding, which is quite a difficult position for any organisation to be in. It was our responsibility to manage and maintain the Forth road bridge, but we had to rely on funding from the Scottish Government via Transport Scotland. However, our relations with Transport Scotland were good. We prepared the capital programme, the board approved the capital programme or plan and then we had to ensure that we got the money for that capital programme or plan. That involved negotiation and discussion with Transport Scotland.

David Stewart: Did Transport Scotland pull the plug on the funding for the project?

Barry Colford: The funding came from Transport Scotland and the Scottish Government, so I think that the answer to your question is self-evident.

David Stewart: It is that Transport Scotland did pull the plug.

Barry Colford: We did not have the funding. We had a spending review and we had to reprioritise our projects, so that was one of the decisions that we had to make. We made the decision, but it was made because of the spending review.

David Stewart: I am sure that you have read the *Official Report* of last week's committee meeting. Some of my colleagues have already used the quotes that I was going to use. It was said that Transport Scotland had a "light-touch" with you and, secondly, that your capital programme was a "wish list".

Barry Colford: I have tried to say that, from our point of view, Chris Tracey and I determined the capital plan and programme. We also used risk techniques in that process. It is quite complex: if you do one thing, how does that affect another element on the bridge? If you replace one part, how does it affect the future, access and spend? We used risk techniques to determine the priority of projects and the order in which we would do them, but it was a list of—it was not a list; it was a capital plan of what was needed on the Forth road bridge in our professional judgment.

I am sorry, but I have not answered your other question because I have forgotten what it was.

David Stewart: The other issue was about it being "light-touch".

The Convener: If you have not forgotten the question, perhaps you can repeat it.

David Stewart: I will do that, convener. The issue was that Transport Scotland had a light touch, the implication being that FETA made all the decisions and Transport Scotland was in the background.

Barry Colford: That sounds like a terribly political question. I can only tell you about my

experience of working with Transport Scotland. We had close relations with Transport Scotland. Engineers who had experience of bridges attended the meetings, so Transport Scotland understood the issues and the problems. On our side, we understood the funding issues, so there was a realistic relationship. Of course, Transport Scotland had funding pressures.

We were previously in a situation whereby moneys were ring fenced for funding the bridge. We were now in a different place and we had to be realistic about that. Our relationships were good. I do not recognise any of the terms, such as "light-touch" or whatever. All I recognise is that we had a job to do as engineers, we put forward what we felt was needed to be done and we had a discussion with Transport Scotland on the issue.

David Stewart: So it is perhaps fair to describe your environment as pre the abolition of tolls and post the abolition of tolls. Pre the abolition of tolls, the bulk of FETA's income—I think that Councillor Hinds said that it was £12 million—would by and large have gone towards maintenance, but in addition it could borrow. However, post the abolition of tolls, FETA was basically reliant on funding from Transport Scotland.

Barry Colford: FETA was formed in 2002, when we had tolls on the Forth road bridge, with a view to funding projects that might decrease congestion or increase public transport usage across the Forth. FETA spent about £17 million on other projects, such as making a contribution to the Ferry Toll park-and-ride scheme, roads in Rosyth, the approach to the Forth road bridge and the A8000. FETA spent some of the toll money on those projects.

Prior to 2002, all of the moneys were spent on the maintenance and operation of the bridge. Even post 2002, up to abolition, the majority of the toll money was spent on maintaining the bridge.

Post 2008, we were in a different era. The management and maintenance of the bridge obviously had to compete with other transportation projects, which were competing with other public-funded projects. It was a completely different era.

David Stewart: It was more difficult to control your destiny.

Barry Colford: I was not in control of the funding of my destiny after 2008 so, yes, it was more difficult.

David Stewart: Obviously, you did not go ahead with the project. Was there any prospect of FETA borrowing to carry out the project under its own steam?

Barry Colford: We considered borrowing. As far as I remember, FETA would have been able to borrow. However, speaking to our treasury people from the City of Edinburgh Council, who advised us, we ascertained that that was not a practical proposition, especially as FETA would be wound up when the new crossing opened.

Councillor Hinds: I spoke yesterday to the people at the council who were responsible for the finance in supporting FETA. They said that it could still borrow in the same way. However, as I understand it from the discussions that took place, Transport Scotland was not keen for that to happen. FETA could have borrowed the money to be able to invest. I had the conversation about it yesterday. Transport Scotland was not keen on the suggestion of FETA borrowing money.

Phil Wheeler: I doubt whether any lender would have been happy to lend to an organisation that did not have a revenue stream to fund the repayment.

Councillor Hinds: The revenue would have had to come from Transport Scotland. That was the reason.

David Stewart: So banks would have been a bit more concerned about the collateral position.

I will quote from page 7 of the FETA submission. Paragraph 3.10 states:

> "The Strengthening of the Truss End Links is vital to maintain the operational capacity of the bridge to carry heavy abnormal loads and for that reason I recommend that this work is also retained within the programme."

Do you recognise that quote, Mr Colford?

Barry Colford: Could you remind me what date that was?

David Stewart: That was from 26 October 2012.

Barry Colford: Yes. The key phrase is "operational capacity". As I said earlier, that came into our thinking when we were considering the prioritisation of projects post spending review September 2011. Yes, I do remember writing those words.

David Stewart: I asked this question about finance last week and Transport Scotland in effect denied that it was the case. Can you confirm that, at the September 2011 spending review, you had a 58 per cent cut to FETA's capital programme? Is that correct or incorrect?

Barry Colford: That was a figure that the treasury officials at the City of Edinburgh Council, Chris Tracey and I had sat down and discussed. I have seen a figure of 65 per cent quoted by Audit Scotland. I would have to bow to its superior knowledge—I am a mere engineer. We had calculated 58 per cent. That is what I had reported to the board as the figure for the reduction from our spending programme in February 2011 to

what we had after the spending review in September that year.

David Stewart: I think the *Official Report* from last week will show that, when I asked the same question then, the witnesses did not recognise that figure. Whether it is 58 per cent or 65 per cent, it is still—

Councillor Hinds: But—

David Stewart: Councillor Hinds?

Councillor Hinds: I return to the report of 16 December 2011, the "Review of Capital Projects". Transport Scotland would receive the draft reports, and there would be a discussion. I am aware of that. Without giving away any secrets, I can say that there were times over the last year or two years when Transport Scotland was not particularly happy with some of the wording, and it would ask for some wording to be changed. I am aware that Transport Scotland was given draft reports. I was therefore quite surprised when I read that it was not aware of that figure. It is in the report. Normally, Transport Scotland would send someone to the board meeting.

At the back of the document from 16 December 2011, it says:

"The proposed three year capital grant to FETA has been reduced by 58% and, as a result, a review of the Authority's Capital Plan over this period has been carried out."

That followed the funding review. On the matter of Transport Scotland having some concern about that 58 per cent reduction or not being aware of it, I would say that it must have been aware of it. We would have thought that, if it had some concern about it, its representatives would have approached the convener or the bridgemaster at the meeting to say that they had concerns regarding the figure. It is in black and white, and it was considered by the board and by the finance people—the experts who dealt with the bridge day to day.

11:00

The Convener: Perhaps I can ask some questions. I will start with a simple one for Mr Colford, just for clarification. We discussed earlier the issue with the truss end link member and the pin joint, and it featured prominently in the evidence that we took last week. Do you believe that that issue could have been foreseen?

Barry Colford: I have obviously thought about that for quite some time, and my answer is no—I do not think that it could have been foreseen. We carried out our inspections, and the problem was not foreseeable. We spent a lot of time looking at the truss end links, and we had many consulting engineers assisting us in that. We did not foresee the issue with the pin sticking, if that is indeed what the mechanism for failure was.

The Convener: Thank you. I thought that it would be helpful to have that on the record.

Because of his extensive expertise—to which my colleague Kevin Stewart referred—I will direct most of my questions to Mr Colford, although I want to bring in other panel members, too.

I have a question for you as the former bridgemaster of the Forth road bridge. We learned last week from Mr Lees from Transport Scotland that FETA had been looking at works to replace the truss end assembly since 2006. In 2009 a preliminary preferred option was identified, which would have seen the entire truss end link assembly replaced at eight locations, at an estimated cost—as we discussed earlier—of between £10 million and £15 million. In 2011 FETA decided not to proceed with that option, for reasons that we have mentioned. It decided instead to proceed with a trial of the strengthening work at one of the towers, which commenced in May 2015.

I would like to know—I am sure that the public would be keen to know, too—why, when the need for maintenance work was identified in 2006, nine years passed before that work commenced. Can you explain the reasons for the delay and the consequences of the decision to delay that work?

Barry Colford: I can certainly go through the chronology. In 2006, we identified the scheme to replace the links. The links are part of the suspended span truss, which is a huge piece of engineering. We carried out an analysis of that suspended span truss and made an assessment. We had one firm of consulting engineers doing that work, as I said earlier, and another firm independently checking it. It was quite an undertaking. Both sets of engineers carried out analyses and ran their computer models—the finite element models—and, after putting a lot of data in, they came up with answers. We then spent time trying to get agreement between the answers. That took an awfully long time, but we finally did it. We identified that significant elements of the truss were overstressed, including the links and the connection to the site towers. Significant members within that truss were overstressed, but it took some time to get the final agreement between the two sets of consulting engineers, and to certify the analyses and the check.

In 2010-11 we identified that we needed to replace the truss end links, and that was put in the capital programme—

The Convener: I am sorry. What was the reason for the delay between 2011 and 2015? You had done all the preparatory work and you knew

what needed to be done, but there was a further delay.

Barry Colford: The spending review meant that we had to prioritise, as we said. We had a look at further detailed analyses of the truss end links to see whether there was anything else that we could do with live traffic loading to reduce the stresses within the members that we were most concerned about, which were part of the connection to the towers. Again, we had difficulties with the numbers and the analyses, and getting agreement between those, but we also had difficulties in deciding how we were going to strengthen the weak elements and whether there was anything that we could do to strengthen them without full replacement.

That was what concentrated our minds during that period. One of the—I guess—ironic issues that concerned us was that when we repaired the welding we would get burn-through in the paint on the towers. How would we repair that burn-through with the movement of the truss end links? How could we send our operatives down there when we knew that the scaffolding had been crushed and the truss end links were moving between the end of the truss and the tower? The matter of how to get people down there took a long time to determine.

The Convener: There were real practical and logistical issues.

Barry Colford: Yes. The access into the towers is very difficult. If we could overweld on the existing welding, how could we get welders in there? In addition, there was real concern about the quality of the steel within the towers. At that period, the steel in the towers had a number of laminations in it and slag, which is sometimes termed “dirty steel”. It is quite difficult to weld to that and we had real concerns about whether we would be able to overweld on that detail—we had to carry out trials to determine whether we could do it.

All that took a considerable amount of time and effort and had to be balanced with other things that were happening. Our main concerns at the time were the main cable, the main cable anchorages and the cable band bolts—our concerns were about the structural integrity of the bridge. We were not forgetting about the truss end links, but in prioritising works we knew that a failure there was an operational failure, whereas failure in a main cable or a main cable anchorage would affect the safety of the public and the long-term structural integrity of the bridge. If the main cable anchorages or the main cable of the Forth road bridge failed, there would be a risk to the lives of people using the bridge, an obvious risk to the future economy of the region and another risk that we sometimes thought about—that there might be a structure lying in the river that would affect what goes on at Rosyth and the port of Grangemouth. Those risks have to be thought about when determining funding for such structures.

The Convener: There was clearly a lengthy delay, whether that is taken to be the nine years since 2006 or the four after 2011, but you are saying that through your management of risk you were always prioritising any work that was safety-critical, even though all the work that you identified as needing to be done was work that a failure to undertake would threaten the long-term structural integrity of the bridge. Would that be a fair assessment?

Barry Colford: No. Only some of the risks threaten the structural integrity. Risks must be divided into operational and structural risks. However, the timeline can be divided into two parts—what happened prior to September 2011 and what happened after that.

The Convener: That is helpful. The distinction between operational and safety-critical—I will characterise it in that way—risk is helpful. We are trying to understand whether the repairs that should have been done were done in timescales that were appropriate in relation to public safety and reasonable in relation to what would be considered to be good practice within the industry. You would obviously argue that that was the approach that you took.

Barry Colford: Yes. Obviously, my view has to be somewhat coloured because I was directly involved. Looking back, I do not think that much more could have been done within that period.

As I said, before 2011 we were concerned with analysis of the truss and the results of that, but once we had established that there was significant overstress on the connections between the truss end link cantilever brackets and the tower we decided that we would put work to replace them in our capital plan. Subsequent to 2011, we had to make other decisions based on prioritisation of projects, and we were looking for a technical engineering solution by which we could possibly strengthen the links to help with that problem. That took quite a bit of effort and time because it is a unique problem for which unique engineering and technical responses had to be developed. You have to spend time considering the issues beforehand: you cannot just rush in and do something. You have to spend time looking at the engineering and at what is possible and what is not possible. The safety of the people who are doing the work is paramount, as well.

The Convener: You have talked about engineering being about managing risk and about the need to minimise the risk to the staff and the public. I will ask you a question that I asked

witnesses last week. In view of all that and with the benefit of hindsight, was the decision to postpone that larger piece of work—the replacement of the entire truss end link assembly at a cost of £10 million to £15 million—and to look at a more cost-effective trial reasonable?

We had a range of responses to that question last week. Transport Scotland witnesses felt that the decision was reasonable and appropriate. Amey suggested that

"FETA made the right decision"

and that the area

"was not overstressed"—[*Official Report, Infrastructure and Capital Investment Committee*, 20 January 2016; c 38.]

and Mr Hornby from Arup suggested that the "correct assessment" was made at that time. Does your view depart from any of those views? What is your assessment?

Barry Colford: All that I can say is that, at the time, FETA's view was that we should replace the whole assembly. We did not have the funding to do that so we had to look for an alternative. If we had strengthened it—as we thought was an option—it is likely that the failure would still have occurred because it was not at the point at which we were focusing our efforts to strengthen that assembly.

The Convener: Perhaps I can put the question in a slightly different way. This is also a question that I posed to Transport Scotland last week. From your assessment of the evidence, do you think that no safety-critical work was postponed or not undertaken because of the budgetary constraints that you were operating within?

Barry Colford: I am sorry, I do not mean not to answer the question directly, but "safety-critical" is not a term that I recognise. We have to look at risk and determine whether there is a risk to life, a risk to the long-term structural integrity of the bridge or an operational risk. We have to divide that risk—

The Convener: So, which type of risk was it?

Barry Colford: The risk of failure of the truss end links was an operational risk. The main risk would have been disruption to users. We knew that there was potential for a step to develop at the joint. That may have caused an accident for a user at the time, but the main risk was of disruption. There was not a threat to the structural integrity of the bridge and there was not a threat to the safety of the majority of users of the bridge. That is how we have to look at these things.

The Convener: That is very clear and helpful.

Barry Colford: I am not quite sure whether I have answered your question, though.

The Convener: I think that you have. Obviously the *Official Report* will reveal whether you have or not.

Phil Wheeler: Convener, you quoted from the evidence that you heard last week, when all the different experts said that it was the correct decision. That was also the guidance that the board received. We had no reason to overrule or change that guidance; we had to go along with what the experts and our bridgemaster told us. That is why the board made the decision, which I am pretty sure was unanimous. The board was normally pretty solid in its support of the management, but we asked a lot of critical questions from time to time—Ian Chisholm in particular, did so—and I am sure that we were satisfied with the technical answers that we were getting.

The Convener: Okay. Councillor Hinds already talked about the cut to the capital budget. Earlier, you said that it was in black and white that there had been a cut to the capital budget and that that cut had a direct bearing on the decisions that you took at the FETA board. Is that right?

Councillor Hinds: That is correct.

11:15

The Convener: Okay. FETA took the decision not to proceed with the larger piece of work, which was estimated to cost between £10 million and £15 million. If that maintenance work had been identified by the experts as being necessary, why did you and your predecessor convener not make a case to the FETA board and Transport Scotland for funds to be committed, so that the work could be undertaken?

Councillor Hinds: That was because there was a spending review. We—of course, Phil Wheeler was FETA convener at the time—had an indicative capital plan, which included replacement of the truss end links, which was the plan that FETA and the board wanted to carry out. If you are suggesting that we challenged the spending review, that might well be more for Phil than me, but—

The Convener: I am not suggesting anything. I am just asking the question.

Councillor Hinds: The bridgemaster would have been trying to put forward the argument for more resources in the indicative budget, which in his professional opinion were needed so that we could invest in maintaining the bridge, to ensure that we kept it open—

The Convener: That is helpful, I understand that—

Phil Wheeler: The essential thing was to keep the existing bridge going as best we could, with nothing going wrong, until the new bridge came on stream. Those were definitely the messages that we were getting.

Barry Colford: I should add that there were a lot of other operational risks on the capital plan that we could not address. For example, the surfacing of the bridge is only an inch and a quarter, or 38mm, thick. There is a risk of debonding of the surfacing, and if that happens we have to close a carriageway—we must close a lane. That is an operational risk; it does not threaten the structural integrity of the bridge or the safety of users, but it would cause massive disruption.

The truss end links were not the only capital project that had to be deferred because of the spending review; there were lots of other projects, in relation to which there was an operational risk but not a risk to the structural integrity of the bridge.

The Convener: Okay. Last week the committee heard from Mr Lees, from Transport Scotland. He said:

"FETA could have used its reserves or come to Transport Scotland and asked for help. I have found no evidence of that, so I consider that the risk was deemed to be manageable."—[*Official Report*, *Infrastructure and Capital Investment Committee*, 20 January 2016; c 12.]

Councillor Hinds, what is your response to that comment? Is that also your view? Is it a correct assessment of the situation that FETA faced at the time?

Councillor Hinds: No. We had reserves, which we needed. For example, one of the projects that came up as an emergency required £5 million, as I understand it, so we needed to use the reserves. There would be a discussion between Transport Scotland and the bridgemaster about what we would use from the reserves and what funding we would try to get from Transport Scotland.

The spending review was a decision by the Scottish Government and Transport Scotland about the money that the Government allocated to FETA. That was the money that we had. FETA also used its reserves, but—I got advice on this from the finance officers in the council yesterday—Transport Scotland would ask us to ensure that we kept reserves. The board was concerned about that in relation to the final year; our reserves went down and down. The only reason why we might pass over about £3 million or £4 million is a court case, which we are not allowed to discuss. We were, in the final year, getting down to a situation with our reserves that no local authority or public organisation would want to be in. Reserves are kept in case there is an emergency.

There was a discussion between the bridgemaster, Transport Scotland and FETA about using the reports that I have brought with me—the committee can look through them. We used our reserves when we thought that that was appropriate, and we tried to get as much funding as we could from Transport Scotland.

The Convener: I will put the same question to the former convener and the board member. How do you respond to what Mr Lees said last week about FETA being able to use its reserves or come to Transport Scotland for help?

Phil Wheeler: I am sure that that was theoretically possible, but we were told that as a result of the spending review we must make do with what we had unless there was a real emergency. That is my recollection of the situation at that time.

Councillor Chisholm: I do not think that the board would want to reduce its reserves to a dangerous level, and I do not think that Audit Scotland would be happy with our doing that, either. We were always determined to hand over the bridge to Amey in good condition and as safely as possible. That came up regularly in our meetings. We had taken pride—at least since 2007, when I joined the board—in the way in which we had run and maintained the bridge, despite many crises, which were down to the fact that the structure was ageing and was carrying loads that it was not designed to cope with. We felt that we had done a great job and we wanted to hand over a fully operational bridge to Amey.

It is worth noting that, during my period—from 2007 to the time that FETA was disbanded—we never closed the bridge completely, although lanes were closed at times. Therefore, it was disappointing when it was fully closed.

It is also worth pointing out the issue of operational risk, which Barry Colford pointed out—

The Convener: My question was about why FETA did not make the case to Transport Scotland for the work to be done, if it was deemed to be necessary.

Councillor Chisholm: In 2015, when we were nearing the end of our term, there was a proposal to conduct a pilot of welding as an alternative.

The Convener: I think that we will leave it there. Mr Colford wants to speak.

Barry Colford: It is fair to say that the value of the reserves would not have covered the work that needed to be done according to the capital plan. In my discussions with Transport Scotland, it was evident that both sides recognised the risks. Transport Scotland was well aware of and supported the risk-based approach that we were taking to the prioritisation of projects.

FETA officials and Transport Scotland officials recognised that the risk in relation to the truss end links was an operational one. Therefore, the prioritisation was put to the board and approved on the basis that there was an operational risk. If I had gone to Transport Scotland and said—

The Convener: So, to be clear, the postponement of this large piece of work, along with some other projects that had to be weighed in the balance, was an operational risk and an acceptable risk. Is that the case?

Barry Colford: It depends on whether you find an operational risk to be acceptable.

The Convener: I am asking you.

Barry Colford: It was a prioritised risk.

The Convener: I am asking for your view. You have the floor and can say what you think.

Barry Colford: Saying that it was a prioritised risk does not mean that any risk whatever is acceptable. An acceptance of risk is a subjective thing. All that we did was prioritise risk based on the philosophies of the safety of the public and the staff; the long-term integrity of the bridge; and disruption. In our priorities, disruption was lower than the first two aspects.

The Convener: So you would say that it was an operational risk but you would not go beyond that to say that it was an acceptable or reasonable risk.

Barry Colford: I reported to the board on these matters and the board might have taken a political view about whether the risks were acceptable. My job as an engineer is to present the risk and show where the priorities are. Whether a risk is acceptable is quite subjective.

Councillor Hinds: I repeat that the replacement of the truss end links and other projects were in the indicative capital plan. As far as the FETA board, the bridgemaster and the management team were concerned—leaving aside the issue of risks, whether high, medium or whatever—those projects were believed to be necessary in the interests of the bridge's integrity. However, a spending review came along and cut the funding, and judgments were made on the priorities, which were reported. We could have asked Transport Scotland for more money and I am sure that the answer would have been no. Therefore, replacing the truss end links was not seen as a priority. If you look at the list, you can see that the priorities included the main cable dehumidification—I can never say that word—and the main cable acoustic monitoring, which involved issues that were seen as posing a real risk of the closure of the bridge.

Phil Wheeler: To reiterate what I said, the board was guided by all the various experts that it was acceptable to postpone the work at that time. You heard that evidence last week and we endorse that today.

Councillor Chisholm: The truss end link work was never put off; it was a job that had to be done at some point. As I have said, we wanted to ensure as we came to the end of our term that that work was followed through. Given all the problems that we have in maintaining traffic flow between Edinburgh and Fife, we had to have a political eye to the closure or major closure of any part of the bridge. The route is very important to folk from Fife in getting home from their work and so on. I hope that, as well as talking about the safety and operational risks of the bridge, we can talk about the tolls and so on later in the context of the funding of the bridge, because that is an important issue, too.

The Convener: We will move on now.

Mike MacKenzie (Highlands and Islands) (SNP): I will be brief. I have just a couple of points for clarification. From reading briefings and so on, I understand that the part of the truss end link that was thought to be critical and most in danger of failing was the bracket to the main tower. Work was taken forward on that, and I think that the technical challenges that had to be addressed and how that was done have been explained. However, that resulted in it being four or five years before the work could eventually be done. Am I correct that it was the bracket rather than the pin and associated member that recently failed that was thought to be the problem?

Barry Colford: You are correct. The problem was the bracket and the weld—especially the weld of the bracket to the back of the tower. I have to say that it is not a particularly good detail. The bridge is a fantastic piece of engineering, but there are places on it where it is clear that not enough thought was given to what might happen in the future. That weld is a poor detail; an engineer can see that. We were particularly concerned about that weld, which was an intermittent weld.

What we were doing when we tried to strengthen the weld was really a trial, because we were not sure whether we could overweld on it and whether the steel underneath was good enough to take the overweld. As I understand it, the trial has been a success. It was continued by Amey, but Chris Tracey and I were involved heavily in it. Even to get people in there was difficult. It was difficult to get the welders, their equipment and the ventilation in there.

The problem was the bracket but more especially the weld detail to the end; it was in danger of ripping off the tower.

Mike MacKenzie: I suppose that it is just an irony that the weakest link did not fail but a stronger link failed.

Barry Colford: That could be described as ironic, but it did fail.

Mike MacKenzie: You have talked a wee bit about your method of risk assessment and evaluation. If my understanding is correct, that is a combination of the probability of failure and the severity of the consequences of failure, if it occurred. In your professional opinion, given all your experience and notwithstanding the fact that the technical challenges meant that it took a number of years to address the bracket welding, was all that reasonable in the circumstances? Is it the case that you were not so concerned about a few years' delay because your risk assessment indicated that the problem was not desperately urgent, so you could live with four or five years' delay? I am not suggesting anything otherwise; it seems that what you have said is that that was a reasonable position to take, given the consideration of probability and consequences in the risk assessment.

11:30

Barry Colford: As I said earlier, a couple of things gave us some comfort. One was that we knew that very large loads had crossed over the bridge in the past that, in theory, should have caused an overstress on those welds that was so significant that they should have failed, and they had not, because of the bridge's engineering. We knew that.

We also knew that the probability of the occurrence of the traffic loading pattern that would cause the failure was low. The outcome was high—the risk was high—but we could control the probability of occurrence. We had that comfort as well.

That helped us in that we had some time to do the work. It gave us the comfort of being able to find the right solution, which took some time, because there were a number of technical challenges in carrying out a modification to, or a trial on, the truss end link.

That is not to say that we were laggard or that we set the issue to the side. It was one of the constant worries on the bridge, along with the cable anchorages, the end of the truss, the truss members themselves, the main cable and the suspenders. It is a lively old structure that was designed to take half the traffic loading that it takes and it continually needs work and funding. Our whole job was to look at the issues but to manage them based on probability and risk.

Mike MacKenzie: You talked about the indicative capital programme and the difficulty of looking into the future and getting accurate costings. I accept that. Was the £15 million programme developed with the knowledge that the new bridge was going ahead, or was it developed without that knowledge?

Barry Colford: That is a good question. At the time that we were developing a capital programme, we put out feelers to ask questions about what would happen in the future. We did not know, basically. We did not know what traffic would use the new crossing and what traffic would use the existing crossing. Therefore, we had to plan on the basis of the traffic loading that was on the Forth road bridge and might be there in the future. That was the basis of the planning for the capital plan. That is what we had at the time and what we went forward with.

The Convener: You just alluded to the new Queensferry crossing. For the record, will you say what bearing, if any, the proposal to proceed with the new crossing had on the risk assessment exercise and the prioritisation of capital schemes following the reduction of the capital grant?

Barry Colford: It affected some of our thinking on programming. Post February 2011—I cannot say on which date—we knew that it was unlikely that heavy goods vehicles would be using the existing crossing. That allowed us to reduce the return period, as we call it, for loading.

The return period has to do with the probability of a convoy of heavy goods vehicles sitting adjacent to the tower and producing a maximum load that would cause the overstress. If you have been looking at the probability of that occurring during a hundred years, the probability changes if you have only five years. It does not change very much, actually—not much of a reduction is allowed—but it gives you something. That was something else that we could consider in our analysis of the truss end links.

The Convener: So the fact that the existing bridge had a limited lifespan at its current capacity was a factor in making the decisions about managing risk and prioritising.

Barry Colford: The bridge had a limited lifespan as far as the traffic loading was concerned. I would not like to use the words "limited lifespan" for the bridge, but I would say "a limited traffic loading".

Councillor Hinds: We had such discussions as well. There were quite a number of issues that were not sorted out—I do not know whether there still are—around what would be able to use the old bridge.

As the committee will know, before the new crossing was called the Queensferry crossing, there were proposals about how many lanes the old bridge would have, what traffic it would take and how it would be used. That was not very clear.

I remember the discussion and I remember that there was not a clear direction. There were issues about taxis and farm vehicles, for example. The position has only just been clarified, if it has been clarified—I have not kept up to date with that, because I am not responsible.

For quite a long time, we were not clear exactly what the existing bridge would be used for. That issue might have influenced us, but we did not know absolutely what would happen. I remember the discussion, and I remember that we were not exactly clear what the existing bridge would be used for once the new bridge was opened. It took some time to take those decisions.

Phil Wheeler: That conversation started back during my time on the board. Once it was decided to build the new bridge, there was a conversation about what the demarcation of traffic between the two bridges would be. That seemed to be crystallising but, as we have heard, it did not finally crystallise until fairly recently. However, the direction seemed to be that most traffic would go on the new bridge and only a limited amount of traffic would use the existing bridge, so the existing bridge would not need so much heavy or major work done to it, because it would be able to cope with that lighter load. As Barry Colford said, if there are no 40-tonne lorries going over the bridge, it will not take the same impact as before.

The Convener: Alex Johnstone has been waiting patiently to ask his questions.

Alex Johnstone: I have some finishing-off questions, but first I have a question on the issue that we have just been discussing. I hear what has been said, but there is still something that I do not understand about the funding loops. Transport Scotland believed that it was setting the budget to fit the priorities, and we have heard from the witnesses that you believed that you were setting the priorities to fit the budget. It is almost as if you were both sitting in the front seat of a car, each believing that the other was driving. Who was driving?

Councillor Hinds: On who was setting the budget, when the tolls were there, FETA was totally responsible for income, borrowing and setting the budget. Governance and decision making were our responsibility.

We have discussed this before, but it is worth repeating that an indicative capital budget was put forward for investment in the bridge and we set out the priorities of the FETA board and the bridgemaster. That is the way in which we believed we were working with Transport Scotland. A spending review then happened and there was a cut in what we expected the funding to be, and so we had to fit the priorities with the budget that we had.

Whether or not Transport Scotland believes that, that was the reality. It is set out in a report in black and white, and Transport Scotland was aware of that. We set out our priorities and the indicative budget that we wanted to invest in the bridge over the years from 2012-13 onwards, and we also had reserves that we could use.

However, the spending review happened and we got less money than we expected. We then had to set the priorities and we could not afford some of the projects, including replacing the truss end links, because we did not have the money. We could not borrow, because we did not have the tolls—well, we could borrow, but we could not pay back the funding because we would have to get money from Transport Scotland.

My understanding is that we set the priorities, taking all the risk into account, and the budget was set by Transport Scotland.

Alex Johnstone: So you are confident that you were not in control of the pace at which your priorities were addressed.

Councillor Hinds: Yes.

Phil Wheeler: Yes—I certainly agree. As soon as the tolls were removed, the bridge depended on Transport Scotland's cheque book.

Councillor Chisholm: To continue Alex Johnstone's analogy, it was like a car with dual controls—I am sorry, but that is the way that it was. It was complicated for us to work in that structure, but there were always going to be problems. The total funding could come from bridge tolls, but folk in Fife were getting increasingly upset about the possibility of the huge increases that were mooted. However, the funding had to come from somewhere. Given the ageing structure and the increasing loads on the bridge, the bill was always going to get higher and higher. If Transport Scotland and the Government had not been funding the bridge, motorists would have been looking at tolls of £5 or £10, which were not politically acceptable to the folk of Fife.

Alex Johnstone: That has maybe answered a question that I still had in my mind.

Councillor Hinds: To be fair, the Scottish Government took the decision about tolls, but perhaps the question of who would pay for long-term investment was not thought through. That is what I would ask: was it thought through? The tolls were taken off when there was a demand from the public. Income that could have been invested was no longer coming in, so the money had to come from somewhere. It had to come from the Scottish Government or Transport Scotland—or from some of our reserves, because that was the only alternative.

Councillor Chisholm: The removal of the tolls was widely supported in Fife.

Phil Wheeler: I will pick up on what Lesley Hinds said. The Government did not think through all the implications of taking the tolls off. We had to invite the then transport minister Stewart Stevenson to meet the FETA board to discuss the removal of tolls and all that that meant—he did not offer to come. When eventually he came, he did not have answers to a number of questions that we raised.

I recall raising the point that, if we no longer needed to collect tolls, we would no longer need people to collect the tolls. It was fair enough to say that some of those people could be redeployed, but a number of them would end up being made redundant. Who would fund the redundancy payments? The Government had not thought of that. The minister and his adviser beside him looked in horror when that question was raised, which indicates how much of a rush job it was.

The Government did not think through the implications of taking off the tolls. As it happened, the minister had to agree to stand behind the board and pick up the tab for the redundancies, which was an unquantifiable figure at that point. That is just one example that I can give of the lack of thought that went into the process.

Alex Johnstone: I said that I had some finishing-off questions. I will move on to them.

Clare Adamson: All car-related, are they? [*Laughter*.]

Alex Johnstone: We have spoken about how the problem could or could not have been foreseen. Should we be concerned about any other parts of the bridge, either because of their condition or because of the level of stress on them?

Councillor Hinds: Appendix 4 of the FETA submission has a list from FETA's second last meeting, which was on 20 February 2015. I was very clear in my opening remarks when I said that there were two staffing issues, which were to do with retention of staff and our expertise.

We ensured that we handed over the bridge with all the information. Appendix 4 has a list of projects, which totalled about £80 million, that were needed in order for the bridge to remain open, to be maintained and to be invested in. Amey and Transport Scotland had to consider them.

Barry Colford: It would be fair to ask that question of the people who are responsible: Amey and Transport Scotland. Pre-May 2015, we set down what we felt was required to carry out a capital programme on the Forth road bridge. Those requirements are in the public domain. The question would best be answered by the contractor and Transport Scotland.

Councillor Hinds: People always say, "With hindsight," but I remember clearly saying to the board that we had to make sure that we handed over all the information, because we did not want to get the blame and we did not want people to say that we had not handed over everything or done everything by the book. We wanted people to think that we had a good organisation that was run well and had handed over everything.

I hate to say this, but I had a feeling that something might happen. Six months after FETA was abolished, we have had that problem. I am so pleased that all the information that we handed over to Amey was there. What happened after that, in June, we do not know, because Amey is not a public body and its documents are not in the public domain.

Alex Johnstone: I presume that, as there would be with things such as the bridge, there would have been a list of issues that you were aware of and were planning for in the longer term.

Councillor Hinds: Yes.

Phil Wheeler: That would be an on-going thing all the time. We had a list of work in progress and work to be done. As you have heard, work was agreed to, allocated and done on the basis of risk, and that continued right up to the last day of FETA.

11:45

Alex Johnstone: At the committee's previous meeting, we were told that the new Queensferry crossing will be subject to continuous structural health monitoring and that such a system is being applied. Could and should that be considered for the Forth road bridge?

Barry Colford: Again, that is a decision for Amey and Transport Scotland. We installed a number of pieces of structural health monitoring on the bridge but, as I think I said earlier, such monitoring is useful mainly if there is an indication of a problem. It is like health monitoring in general. Would we put heart monitoring on the whole population hoping that we would spot those who might have a problem later on? That is the kind of issue that we were looking at with the Forth road bridge. There are thousands of individual members. Which one would we monitor?

To date, monitoring has been done mainly where there are issues or problems on existing structures. If there is a problem, we put on a monitor, and we monitor it for a limited time until we see the progress of the problem. Monitoring the whole of big structures over a significant time has not been done that often. The Queensferry

crossing is one example of where that has been done, and the Tsing Ma bridge is another.

There have been issues with data collection and questions about whether we are collecting the right amount of information. If we spend money on structural health monitoring, the money comes from other things, because we all have limited pots of money. We have to look at the matter on the basis of prioritisation. Structural health monitoring certainly has a place in the industry, but it is still developing.

The Convener: Adam Ingram has a brief supplementary question.

Adam Ingram: That begs a question, Mr Colford. If you were recommending replacement of the truss end links at a significant cost of £15 million, surely that points to a need for structural health monitoring of the truss end links. Why did you not consider that?

Barry Colford: Because the weakest parts that we had identified were the welds within the truss end links and we were carrying out close inspection of those. There are components of the bridge that need to be replaced before the life of the structure comes to an end, and the truss end links are part of that family of components. They were reaching the age of 50 years, so we felt that they had to be replaced.

Adam Ingram: You also pointed out that it was extremely difficult to inspect the pins.

Barry Colford: Yes.

Adam Ingram: Would that not also indicate a need for structural health monitoring of the pins?

Barry Colford: At the time, we did not feel that there were any issues with the pins.

Adam Ingram: Yes, but you pointed out in answer to an earlier question from me that there were issues with the pins in the Humber bridge.

Barry Colford: There were.

Adam Ingram: I assume that there are also issues with the pins in other suspension bridges around the world. Surely that should have flagged up that there was perhaps a need to investigate the issue.

Barry Colford: The pins at Humber displayed signs of wear and signs of distress, so they were replaced. I am not sure that much permanent monitoring was done at Humber.

We were aware that we could not inspect the pin and we could not grease it, but we carried out an inspection of the areas adjacent to the pin. As I understand it, the pin itself has not failed.

Adam Ingram: It has seized.

Barry Colford: As I understand it, it is the members adjacent to it that have failed, although, as I said, I have not been involved in the analysis.

Adam Ingram: I come back to the point about—

The Convener: This is supposed to be a brief supplementary question.

Adam Ingram: Sorry, convener. It is on the point about structural health monitoring. Clearly, you cannot do that on every part of the bridge, but surely it should be done on the parts of the bridge that you have concerns about and which might alter your prioritisation for capital programmes. Why was that not done?

Barry Colford: You have to consider the risk, what is involved in it and whether you should spend money, time and resource examining a particular member or another one. The risk priority was members that might cause structural collapse and the one that we are talking about was not one of those. The failure of that member would have caused an operational issue, not collapse.

Adam Ingram: In hindsight, would it have helped to determine the possibility of something being done sooner if structural health monitoring had been in place to identify the problem?

Barry Colford: With the benefit of hindsight would I—I am sorry, but what was the second part of your question?

Adam Ingram: If structural health monitoring had been in place, would it have flagged up the fact that there was an issue with the pin that needed to be addressed?

Barry Colford: Yes, possibly.

The Convener: Is it fair to say that that would not have been a cheap option?

Barry Colford: It would have been difficult to do and I assume that it would have been expensive.

Councillor Hinds: You might consider monitoring, but one of the reasons why we wanted the bridgemaster and the senior team to remain in place was their experience. They knew the bridge like the backs of their hands, and that level of expertise is one of the reasons why the FETA board was keen to keep them in place. We wanted to ensure that, when we handed the bridge over, that expertise, knowledge and experience of the bridge would be in place. That is crucial as well.

Alex Johnstone: I have a question about the antithesis of structural health monitoring, which is the way it has aye been done. Early in the process, the minister, who had been advised by his engineers, told me that, if the truss end links work had been done, the problem would have been avoided but that would have been a by-product—it would have been a bit of a lucky break

that the work had been done without the issue having been discovered. Is that not, to an extent, fundamentally to misunderstand the nature of maintenance of old machinery, in that, when you take things apart and put them back together again, you invariably discover things that you did not know were there and you replace parts as you go along? Is failure to deal with the issues not also a risk factor for being caught out, as we were?

Barry Colford: That is difficult to answer.

Alex Johnstone: It was not meant to be an easy question.

Barry Colford: I am not actually sure what the question was. It sounded like more of a statement than a question.

We had identified a need to replace the truss end links. We felt that it was a serious issue when we first discovered the overstress in the welding, but we considered it from an engineering point of view. The links were getting on for 50 years old. They were one element of the bridge that we considered for replacement and put in our capital programme for replacement. The decision to do that was made in 2010 or 2011, but it was one of a number of issues on the bridge that had to be dealt with. Our focus at the time was on the main cable anchorages and the main cable. Five years on, it is difficult to remember how intense that period was for dealing with the main cable and main cable anchorages. We had real concerns about those at the time.

Councillor Chisholm: I will add a wee bit from my own life experience. Preventive maintenance often causes more problems than it purports to solve. If you take your car into the garage, many times it comes back with more problems than it went in with.

Alex Johnstone: It depends on your mechanic.

Councillor Chisholm: It does. It is a difference in philosophy. Many people say that you should just not to go into preventive maintenance.

I do not know of any sensor that would monitor the seizing up of that bearing on the truss end links. How could that be done? It might show up under visual inspection, but it is difficult. As I said right at the beginning, you could do it using ultrasonics or X-ray technology, but permanent monitoring of those components would be difficult in practice. As Barry Colford said, which component on such a complex structure do you decide to monitor? I might add that the structure is more like a ship than a road bridge. It is in a marine environment and so has all the problems of marine environments, such as salt water ingress. They all have an impact and were probably a factor in the bearing seizing up.

The bridge is not easy to look after, but we have kept it going. She is getting to be an elderly lady. Funding will have to be supplied for the next 50 to 100 years because, as far as I know, the bridge is a listed building. Somebody has got to commit to funding the bridge in future despite it having a much lower loading. It will still need to be looked after because of the environment that it lives in.

The Convener: Thank you. Do members have any final questions?

Clare Adamson: Mr Colford, earlier you said that, had the truss end link project gone ahead—I appreciate that it was not scoped and the full technical specification had not been done—it would have resulted in considerable disruption. What would that disruption have been and how long would it have lasted?

Barry Colford: At the time, we knew that we had an engineering solution and we could do the work. We had got to the point at which we knew that it could be done. The next stage would have been to advertise for a consulting engineer to design it. The consulting engineer would have put together a design and we would have got a contractor on board to carry out the work. That is when the determination of disruption would have been done.

We knew at that point that there was likely to be some disruption to users. As we know, closing a lane of the Forth road bridge for four hours causes significant disruption to users. At that point during the feasibility study, it would have been difficult to say that there would be no disruption to users. That would have been possible only when we got the contractor on board and knew its method of working and where the balance would be between carriageway closures and cost of the works. The cheapest way of doing it would have been to shut the bridge and allow the contractor to get on with it. That is one extreme, and we could not have done that. The other way would have been to minimise the number of closures, which is what we would have done, but the cost would then have gone up because the contractor would have had to work difficult hours.

It is difficult to say what the disruption would have been, because we did not reach that stage; it would have come quite a bit later. However, we would have been telling people to expect disruption. In my experience on the bridge, when we resurfaced a carriageway during weekends, we would carry out a huge publicity campaign to tell people to stay away, but it did not work as well as we would liked. Human nature being what it is, people still came and expected that their neighbour would not go so they would be okay.

It is difficult to do all that and there is a balance to be struck. If we had carried out the works

ourselves, there would likely have been major disruption. The work would have been planned and advertised, but my experience has shown me that there would still have been disruption.

The Convener: As there are no further questions, I ask the witnesses whether they have any final comments. I am conscious that you have not contributed, Mr Tracey.

Chris Tracey (Former Engineering Services Manager, Forth Estuary Transport Authority): I am consciously keeping quiet. [*Laughter*.]

Councillor Hinds: It is okay; he used to do that at board meetings as well.

Chris Tracey: Barry Colford has covered most of the issues as far as I am concerned, although I might reiterate a couple of things. The capital plan was based on our programme of inspections, on structural assessments and on operational needs. That was how we established the plan in the first place. Bridge managers, or asset managers in general, use asset management and work prioritisation every day throughout the UK, and around the world, for that matter. Following assessment and inspections, we go through and prioritise schemes. We have to prioritise them because there is not an infinite budget available for us to carry out all the work on all the assets throughout the country. The process that we went through was no different from what happens on a daily basis throughout the country.

12:00

The Convener: I knew that it would be worth having you here. Do witnesses have any final comments to place on the record?

Councillor Hinds: The discussion has been interesting and the questions have been very detailed and have helped me to focus—flattery will get you everywhere. In my opening statement, I talked about the three significant decisions that were taken outwith FETA and the board and about the professionalism that was shown. FETA's reputation is really important to me and I hope that the evidence that we have given today as a board has proved that.

The only time that the board had a vote when I was convener was when we were asked to put a certain flag on the bridge.

The Convener: It was not the skull and crossbones, was it?

Councillor Hinds: I think that you know what the flag was.

Councillor Chisholm: You probably know which way the vote went, too.

Councillor Hinds: We will not go there.

The Convener: We try to operate the committee on the basis of consensus.

Councillor Hinds: Exactly. I hope that the answers that we have given to your questions have proved that the FETA board and the professional body left the bridge in a good condition.

The Convener: Thank you. It only remains for me to thank all our witnesses for their attendance this morning and for their openness and willingness to engage with the committee in such a constructive way. We also appreciate the detailed documentation that you sent to the committee. It was invaluable for our deliberations. Thank you, once again.

Thank you to Mr Colford; we recognise that your commute today was slightly longer than that for the rest of us.

12:02

Meeting continued in private until 12:23.

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