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| **School of Applied Sciences** |

**Assessment Instrument Coversheet**

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Learning Outcomes 1 and 2

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The Tay Bridge Disaster

Throughout this report, the Tay bridge disaster will be discussed including what caused this disaster, the impact it had on people/society and what implications were made. The original bridge was completed in February 1878, using the design from Thomas Bouch with him also having the responsibility with the construction of the bridge. This bridge was known to be the longest in the world. This tragedy occurred on the 28th of December 1879 (BBC News, 1979) which led to the death and harm to people. Since this has happened, precautions and prevention measures have been put in place to ensure history doesn’t repeat itself.

A train heading from Edinburgh to Dundee was present on the Tay bridge as it suffered a catastrophic structural failure during a storm. The train left Wormit (Leisure and Culture Dundee), the town on the south shore of the Tay that lies opposite the city of Dundee, across the river on the north side of the bridge. The train left just as dangerous windspeeds present in the storm started to hit 80mph.

The bridge progressively became weaker due to the structure itself moving as a “vertical waveform” (Leisure and Culture Dundee), where the steel members of the bridge fixed for it to twist and turn, ultimately causing structural failure. Another theory suggests that a carriage that was part of the train was blown over and became derailed, hitting a buttress that sent a large shockwave knocking out some of the supporting pillars of the bridge.

The original theory established by the investigators was that lugs that held the main supporting girders had failed in the high wind thus resulting in fatal collapse when the top heave bridge blew over.

A summary of culpability is represented by the following diagram

**A close up of a map

Description automatically generated  
Figure 1**

Due to the poor design and structure along with the faults of the bridge’s engineering, it couldn’t withstand the extreme weather conditions. However, the bridge could have been closed for a short period of time due to this inconvenience especially knowing of the consequences this tragedy brought and is still known as one of the worst engineering disasters in the British Isles. The biggest consequence were the deaths stemmed from this calamity; it was reported that 75 people died including children (BBC News, 2011).Throughout the years more bodies have been found, unfortunately many families have not had the closure to move forward with the deaths of loved ones or proper burials. Another result of this disaster was another bridge was built, it took 3 years for its completion and some of the piers of the original bridge was used in the new structure (Open University, 2007). The designer of the Tay bridge, Thomas Bouch had to have all his work examined or rebuilt to take precaution and action. Lessons were learned in terms of improving the materials used in the new structure such as the use of undamaged girders that had been modified along with the stability being greater and increase in length. Rules were recommended regarding the construction of bridges and a maximum wind pressure in bridge design was put in place (BBC,1979).

Many people became involved in the investigation. A rail worker put himself at risk as he crawled across the bridge to establish what happened to the train (what culture 10 facts) Immediately afterwards the fate of the train had been discovered, a search and rescue were mounted and immediately hampered by the storm. The search quickly began to find bodies. The flaws in passenger records also became exposed when it was revealed tickets had been collected from 57 people on the train, however this didn’t count season tickets. It is also most likely incorrect, as a true number was never established.

Thomas Bouch would have designed the Forth bridge had the original Tay bridge not collapsed. When this occurred, investigators had to create a whole new science to understand what went wrong. Poor quality material had been used and a solution was found in better materials. Problem is, better tends to be more expensive. Therefore “adequate” materials were chosen, yet “adequate” is not the same as quality. To compound the problem, the bridge was also of poor construction and was known to have had various misaligned members. Some of these members had even been dropped into the Tay by accident during construction and were recovered and re-used (what culture 10 facts). There was no form of Victorian quality insurance available and it was doubtful if Bouch knew how many trains or years the bridge could withstand in its lifetime.

As we know from the above information about the causes, impacts and all about the factors that led to the Tay bridge disaster. In this paragraph we shall discuss the precautions taken by the authorities after the disaster to curb any future disasters of such kind.

Three main steps taken were:

* **To be a competent client:**

The reluctance of the client for the Tay Bridge to spend money is likely to have been a factor in the low level of supervision of the construction and maintenance work. The unsatisfactory relationship between the client and those working on the project had an important effect on the outcome. A better arrangement would have been to have adopted a ‘competent client’ approach so the client, via suitable representation, was an integral part of the project team seeking to control all risks. A competent client would understand cutting costs for site investigation, for design checks, for site supervision or for satiety in general, was inadvisable.

* **To adopt a safety culture:**

Investigations have shown that a main source of human error leading to aircraft crashes is rooted in the command structure in the cockpit when other members of the flight crew tended not challenge the actions of the captain. Crew are now trained to pass important information to the captain who is required to consider such information. Everyone is working together to improve safety.

We can be confident that such a situation did not exist for the design and construction of the Tay Rail Bridge. It is likely that many people recognized the manifest faults in design and construction but were disinclined to comment on these to Bouch because they expected that he would not be receptive to such information.

The client, designers, contractors and all staff should feel that it is their responsibility for the goals of the project to be met with safety requirements being paramount. The adoption of a safety culture is a developing feature in engineering projects, but it is not a new idea. It is likely that the failure of the Tay Bridge would not have occurred if a safety culture had been adopted for the project.

* **To use a reflective thinking approach:**

In a reflective approach one asks questions, one seeks answers to them, and one takes appropriate action. This is a main feature of a safety culture. We have seen how Bouch  
could have done this to advantage with Airy and with the site investigation contractor. Bouch should have been reflective about the detailing of the tie assembly but since he did not do that, the culture of the design team should have been such that the views of others were considered.

In the report we have seen a short summary of all the factors leading to the Tay Bridge disaster. We have discussed the causes, consequences, immediate impacts and preventive measures taken after the disaster.

The Tay Rail Bridge collapsed in 1879 and the event continues to hold fascination. While much has been written about the reasons for the collapse this report focuses on what can be learned from it. It is concluded that the designer of the bridge, Thomas Bouch, was negligent in relation to the design of the connections of the ties to the columns of the piers along with the safety measures that should have been priority, which ultimately was the biggest causative factor for this tragedy as when the bridge was being built many short cuts were taken. Many deaths were the consequence of this catastrophic failure along with a new structure being built with improvements made that were necessary. Strategies that may be used to avoid said tragedy are adopting a safety culture where everything had to be analyzed before construction for the client to be competent and most importantly, to use a reflective thinking approach.

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**Written By:**

Alisha Aslam, Arjun Bhatnagar, Peter Captain

**Unit 1 Personal Reflection Peter Captain**

I have learned in this group project that even a team with enough determination a small group can accomplish tasks intended for a much larger group.

Our group first met at the start of the term and I had a good feeling about everyone. We had all chosen this subject and therefore we should all be eager to get to work on it. Our group was much smaller than the group on our “groups” tool in our website suggested. I sent an email to everyone except Arjun and Alisha. Someone replied they were not in the module and another, Kieran, shown up to one practical and then left. Hence, I was left trying to co ordinate with a group of three people.

I learned this is a benefit. All of us were eager to get on with the group tasks and having less people meant that our coordination could be more easily split up between the three of us rather than 10 individual tasks, likewise, communicating with each other was now easier.

I seemed to be an impromptu team leader seeing as I had completed a similar task in the past as well as when it came to group discussions as to what to our report should be on it was my suggestion of the Tay Bridge that was adopted as our official strategy. I also decided how we could best split the workload.

At the start of the module, I did not know who my group members were. Alisha was eager to get going but seemed unsure of what to do, Arjun likewise wanted to get going but occasionally strayed off topic. Luckily, after a while we seemed to bond together as friends. We all complimented each other. Alisha would keep us on topic, Arjun would proof-read everything and I kept everyone glued together as a team.

However, the Quarantine inevitably had an impact when the university shut, I feel our group strengths were perhaps obscured a bit. Alisha seemed to panic we were going off topic, Arjun seemed unable to reply as he moved back home to India and I tried my best to listen to and answer questions despite me going to studying at home.

Nevertheless, we all ensured we were all completing the necessary tasks. Our good relationship as a team developed a mentality that enabled us to complete the given task.